Lectures on the science of human life / by Sylvester Graham.

Contributors

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LECTURES

ON THE

SCIENCE OF HUMAN LIFE,

BY

SYLVESTER GRAHAM, M.D.

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AND

A Biographical Sketch of the Author.

"KNOW THYSELF."

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LIFE OF SYLVESTER GRAHAM.

SYLVESTER GRAHAM was descended from a family of some distinction and in the reign of George I. one branch of the family was promoted to the title of Duke of Montrose. It was in 1718 that the Rev. John Graham, after being graduated at Oxford, arrived at Boston, Mass. Of one of his children, Sylvester Graham was the seventeenth child. He was born in 1794, the son of his father's old age, who died soon after. His mother was so overwhelmed with grief and care, that she was the subject of a melancholy derangement. Under these circumstances, the youth of Sylvester Graham was much neglected, and his native genius, which subsequent events prove that he inherited, allowed to run wild. It may be doubted, however, whether this very circumstance did not preserve his life, for had he early in life been allowed to study, it is scarcely possible his highly nervous system would have survived the effects of being overwrought.

Sylvester Graham was left to the care of an uncle, and was thought to be dying. He recovered, however, and one of his brothers acted like a father to him, and placed him under the charge and guardianship of a brother-in-law, who was a farmer. With this person he lived for some years, and did all the drudgery of the farm, being treated like a laborer, and having many hardships and buffetings to undergo, feeling all the time ambitious and restless, for, as he says, "I had heard of noble deeds, and longed to follow to the field of fame." Though without cultivation, he was naturally clever, and asserted and maintained a superiority among his playmates; and in whatever society he was thrown into, his powers of description, his imagination, his active and stirring spirit, always made him a center of attraction. But as distinction always brings envy, he made both friends and enemies, and had much to suffer from persecution. In his twelfth year he went to New York, to be educated in a school recommended by his brother. He was, however, soon tired of a town life, and requested his brother to allow him to return. At fourteen he was residing with his mother at the family mansion; and though he had more opportunities of learning, and quickly made himself master of that which he applied himself to, he was still untutored, and occupied his time in all social amusements. But while to the world he appeared a thoughtless, rattle-headed, crazy boy, cheerful, wild, and extravagant, he has left records of an early liking for deep meditations and philosophic reflections far beyond his years. At this time he entered into a paper-mill at his mother's earnest solicitation to learn some trade; but though he tried to fancy that some day he might rise to distinction by making paper,

the drudgery was too great for him to endure, and he only staid four weeks. After this he entered into an arrangement with a farmer, but was very restless and discontented. He soon left, and traveled with a horse-dealer, which was much to his taste. In 1810 he was clerk in a country store, but did not remain long there; and in the same year went to New York, and was clerk to a merchant for a few months; this was in his sixteenth year. Symptoms of consumption appeared at this time, and Sylvester was again sent into the country. He went to a sister's at Middlebury, Vermont, and though employed in occupations of the house and hand labor, his talents attracted the attention of some of the students and principals of the college, who noticed him with partiality. A talent for drawing exhibited itself at this time, and he drew several good likenesses, and some of his patrons thought he might become a great painter. Though only sixteen, a love affair here interfered with his happiness. Peculiarly sensitive, and full of ardor and expression, his youth was checkered by many such adventures, which on his part were acted out with purity of sentiment and feeling, but which were perhaps imprudent, and not adapted to the cool and unfeeling world, by whom he was much censured. He often poured forth his feelings in poetry, some of which has been preserved. In his nineteenth year he began in earnest to set about educating his mind, and entered with ardor into studies under a very judicious tutor; and after four months' tuition his master recommended him to become teacher. In this capacity, Sylvester exhibited all the fire and energy of a reformer; and such was the influence that he gained over his pupils, that he produced an impression on their minds, and carried them on in the career of improvement so rapidly, as to get his name extolled in the neighborhood. Here again illness seized him, and he was obliged to give up his school. He was kindly treated in the family of a Mr. Wyckoff, and, when recovering, had entered with his usual amiability and sociability into friendly and intimate intercourse with all members of the family. There was among the rest a daughter, and evil spirits took the opportunity of sowing the seeds of suspicion, which no protestations of the parties could remove, and he left the house. He began his occupation of teaching in another school, but his health failed, and he gave it up. He was at a loss what profession to choose, and his friends seemed to think that whatever he took up he would succeed in, so that he did not obtain from them any decided impulse.

A religious feeling penetrated his heart at this time, when overcome with physical weakness and melancholy forebodings, and he joined in prayer-meetings, where he eloquently poured forth his sentiments, and much affected his audience. His love for Miss Wyckoff preyed upon him, it was returned by the object of his affection, but the parents forbade communication. They met clandestinely, and bid each other adieu, vowing constant love. Sylvester went to Albany with his sister; but he was weak, emaciated, miserable, and with the hope of dissipating the gloom and benefiting his health, he went by steamer to New Brunswick, in New Jersey. In this journey Graham made several valuable acquaintances and friends.

In 1823 he resolved to study at Amherst College, to qualify himself for the ministry. He labored under the most dreary feelings and dark

despondency, and became much emaciated; but he continued his exertions; and having previously often exhibited his powers of elocution, in which he excelled in moving his audience, at the time throwing his whole soul into his orations, he felt here the stings of envy, for the pupils being used to a much more cold and finished elocution, had no appreciation for the true feeling which Graham exhibited. Though for the time he carried all with him, they afterward persecuted him as a stage-player, a mad enthusiast; he met, however, with a few spirits who appreciated him and consoled him. His social qualities and truly sensitive character led him into much society in Amherst, and particularly he was in request among the ladies. He drew good likenesses, wrote poetry, and was ever the most active in parties, balls, or theatricals. His studies were not pursued very closely, as his health was bad, and he suffered from nervous headache. Whatever he did was done with great enthusiasm; he had no trouble in keeping up with his class, and when called upon for any production of the pen, he astonished both students and professors by the depth of his thoughts and the power of his reasoning. He defended his friends with warmth, and though they were few they were earnest. His enemies were so malignant in their opposition that they succeeded, at last, in establishing a case against him, in which there was no foundation at all, of an assault upon a lady, to whom he had merely spoken. All the counsel in the town being engaged against him, and he himself being very ill, the case was carried against him, and he was consequently forbid the college. During his illness he was attended by two ladies (Miss Earls), one of whom he very soon afterward married, and had never reason to repent the match. This was in 1826. After his marriage he became a preacher in the Presbyterian Church. He was popular as a preacher, but he soon took up the Temperance cause, and thence studied anatomy and physiology. In 1830 he was engaged by the Pennsylvanian Temperance Society. In 1832 he made himself conspicuous as the advocate of those principles he has since printed in his Lectures. He first put them forward as a preventive of cholera, and thousands followed his advice with beneficial results. He continued lecturing with great success, and was always well received and very impressive. In his desire to do good, he acted contrary to all advice, and brought himself more than once to death's door. He himself believed that had he not adopted the principles he recommended, he must have died. It was unfortunate, however, that so conspicuous a teacher was himself so much an invalid; and of course there were many to take advantage of this circumstance to decry the principle. Graham, therefore, published "An Apology," in which he stated his own previous state of health, and pointed out how he had sacrificed his chance of improvement to benefit the public. The multitude could not appreciate so exalted a philanthropy, but many were benefited and acknowledged his worth.

Sylvester Graham lived during the latter part of his life at Northampton, Massachusetts. He had four children, two of whom are now living, as also his widow. In 1849 his health was evidently such that he could not long survive. In those times physicians trusted, even more generally than now, to stimulants, and Graham occasionally submitted to a treatment which was contrary to his judgment. He was,

however, worn out, his mind had always been too active for his feeble frame, and on the 6th day of September, 1851, in his 58th year, his spirit escaped from its mortal tenement, where it had been so long struggling to work out the happiness of the human race.

PHRENOLOGICAL DESCRIPTION.

It is no matter of surprise to us that such an extraordinary work as "The Science of Human Life" should have issued from the mind of Sylvester Graham, as the first glance will be sufficient to convince the student in Phrenology that the amount of brain-power is very considerable; and the head is so formed as to give an evidence that the truth would be greatly loved, and knowledge pursued with an unrelaxing energy. It is clear from the volume of brain in the coronal, reflective, and perceptive regions, that if the propensities had been large, they would ever have been under the strong, healthy, and restraining influences of the moral sentiments, as it will be seen that this part of the head greatly preponderates. The coronal region is strongly indicative of a great love for that which is just and true. Mere intellectual truths would not satisfy such a mind; and hence we find a moral vein running through all his writings, which render them perfectly safe in the hands of the young and confiding; and while he gives clear statements in reference to the organism of the human body, his well-developed organ of Veneration ever prompts him to recognize the hand and the wisdom of the Divine Being. It will also be seen that the organ of Ideality is rather large. Sylvester Graham would not have been inferior as a writer of good poetry. Ever and anon we meet in his works with some very refined and beautiful passages. The organ of Language was large; his diction is always pure and effective. Acquisitiveness, Veneration, Hope, Firmness, are all large. Eventuality, Constructiveness, Alimentiveness, and the perceptive powers in general, are well developed. There was a fine ear for music, and a love for the elegant and artistic. He was thoughtful and deliberate, amusing and pleasant; in conversation solemn, hopeful, and thoughtful; as a father and husband, loving and affectionate; and as a citizen, noble-minded and independent. Sometimes a little nervous, though generally the intellectual power was great; the subjects studied required severe application; the whole framework of man was before him; comparative anatomy was completely investigated, and as far as possible all the complex and wonderful laws of the human system were studied and explained. He then had the moral daring to dive into the deep and intricate subjects of mental and moral philosophy; and in these departments of knowledge he has evinced a profound acquaintance with ethical and intellectual phenomena. Before his lamented departure from this world, a few numbers were issued; but since his decease a handsome volume has appeared, called "The Philosophy of Sacred History," which will doubtless stand as a lasting memorial by the side of "The Science of Human Life;" one to show man his best interests in this world, the other to unfold the proper reading of Scripture in relation to the neglected truths of physiology.

REVIEW OF "THE SCIENCE OF HUMAN LIFE."

The Life of Sylvester Graham will be interesting to posterity from his being the author of a work on the "Science of Human Life," which has been published in England and America. The followers of his system of diet were for some time called Grahamites, and there were Graham hotels and Graham bread. The distinguishing character of his system was to maintain the advantage of a well-selected diet from the vegetable products in maintaining health and securing long life. The character of this work will be best presented in a review, published in Philadelphia soon after the appearance of the "Science of Human Life." This periodical, *Bell's Select Library and Eclectic Journal of Medical Science*, was the best in America, and therefore its opinion will be taken as of some weight and importance. We give it entire.

Speaking of the work published by Sylvester Graham, the writer says:

"We have met with few treatises on the Science of Human Life, especially among those addressed to the general reader, of equal merit with the one before us. The author, instead of following in the ordinary route pursued by popular writers on the principles of hygeine, has endeavored, from an examination into the nature of human organism, of the vital laws with which it is endowed, and the effects produced upon it by external agents, to deduce the means best adapted to prolong its health and vigor to the latest possible period—in other words, to establish a correct system of hygiene upon the basis of physiology. The subject is treated in all its details with uncommon ability. Untrammeled by the opinions of those who have preceded him in a similar investigation, the lecturer has examined for himself every point connected with it, and has, in more than one instance, been led to the adoption of views altogether different from those generally entertained.

"Whatever may be the estimate formed by different individuals of some of the doctrines advanced in these Lectures, there is no one, we are persuaded, who will not derive gratification and instruction from an attentive perusal of them. The physiological views they contain, are, in general, correct, and expressed with perfect clearness. Even those particulars in which the opinions of the author differ from those of our leading physiologists, present very forcible claims to our attention from the ingenious manner in which they are defended and enforced; while the hygiene precepts peculiar to Mr. Graham, false and ridiculous as they may appear to those who have not given sufficient attention to the subject, have this important recommendation, that in every instance in which they may be followed out in practice, even to their fullest extent, they can not fail of being productive of an increased vigor of the moral and physical powers of the constitution.

"The very ultraism of the lecturer on certain particulars, is, we conceive, better calculated to produce a beneficial reformation in those particular practices that are adverse to the health and well-being of man, than the awkward attempts which have been made by a few modern writers on hygiene to accommodate its rules to the requirement of fashion, the cravings of a vitiated appetite, or the suggestions of pride or of interest. The bold originality of thought which pervades the Lectures before us, and their perfect freedom from those errors into

which most writers who treat on the same subject have fallen by following too implicitly the dogmas of their predecessors, constitute one of their chief recommendations.

"The first eight Lectures are devoted to a general consideration of the organization of the human body, and of its relations to the external world. The author's remarks on all the leading particulars connected with this portion of the subject are highly interesting, and, generally speaking, sufficiently accurate.

"The ninth and tenth Lectures treat of intellectual and moral philosophy, and contain many original views in relation to the mental powers of man, in their healthy and diseased conditions. We regret our inability to lay before our readers the views of Mr. Graham contained in these two Lectures, as well as in the succeeding one, which treats of the general law of relation between the instincts and voluntary powers and the intellectual faculties, and of the moral powers of man, inasmuch as they are marked by great depth of thought, and present a very happy exposition of some of the most intricate points connected with intellectual and moral philosophy. This portion of the work will be found equally interesting to the scientific as to the general reader.

"Lecture eleventh is devoted to the consideration of the question—How long can man live? It is discussed with the author's usual acuteness. The remarks on this important subject are pertinent, and in strict accordance with a correct physiology. Those who may feel inclined to deny the truth of the general conclusions at which the author arrives, will find it no easy matter to overthrow the arguments upon which these conclusions are based.

"The several subjects treated of in the twelfth Lecture are all important, in reference to their bearing upon the rules of hygiene. Some interesting remarks are made upon the substances employed for food; the principles to which they refer, though susceptible of very ready proof, are often overlooked by medical men, and almost invariably by the unprofessional.

"In the ensuing eleven Lectures we are presented with a full exposition of the peculiar views of the author in relation to the proper food of man. They who will attentively and candidly study the facts and arguments adduced by our author on the subject of diet, can not but be struck by their force, and will be little inclined to treat his opinions as absurd hypotheses, even though they may not be willing to admit, in every instance, their entire accuracy.

"In Lecture fourteenth our author enters upon the evidence of the natural dietetic character of man, as derived from comparative anatomy and physiology. His observations on this head are marked by uncommon acuteness. They prove conclusively that the distinctive characteristics of carnivorous, granivorous, and omnivorous animals adopted by naturalists, are by no means so well established or strongly marked as many suppose.

"In confirmation of his general proposition, that man is naturally frugivorous, the lecturer adduced the testimony of Linnæus, Sir Everard Home, Cuvier, Lawrence, and Thomas Bell, all of whom infer, from the consideration of the anatomical structure of the alimentary organs of man, that, in the words of Baron Cuvier, 'the natural food

of man appears to consist of fruit, roots, and other succulent parts of vegetables.'

"Lecture fifteenth is replete with reflections which recommend themselves most forcibly to the serious consideration of every individual desirous of promoting his own happiness and well-being, as well as that of his offspring. In this Lecture will be found a curious and interesting inquiry into the causes which have produced and perpetuated the varieties of the human family. Toward the close of the Lecture, the author, with great truth, remarks that, in attempting to test physiological principles by the apparent facts of human experience and history, a great variety of modifying causes must be taken into consideration; some of which are detected with great difficulty, while it is even more difficult to estimate their true force with exactness and certainty.

"The sixteenth Lecture is devoted to an examination of the effects of vegetable and animal food on the human body, with reference to suppleness, activity, agility, vigor, ability to endure protracted efforts, etc. The physiological views advanced in relation to this subject are illustrated by a large mass of interesting facts. In the ensuing Lecture, the comparative effects of animal and vegetable food in enabling the human system to resist the action of morbific causes, and to recover from disease, is very fully discussed. Some, if not all, of the author's opinions in relation to the dietetic treatment of disease are peculiarly striking and correct. The Lecture concludes with an examination of the comparative effects of vegetable and animal food with reference to longevity, prolificness, and the ability to endure cold.

"The subject of the eighteenth Lecture is the comparative effects of vegetable and animal food on the sensorial power of the nervous system, particularly on the special senses, and the intellectual and moral faculties. On this point the author has collected a large amount of facts.

"In the nineteenth Lecture the comparative effects of vegetable and animal food on the animal propensities and moral sentiments are examined and illustrated. In the twentieth Lecture the author endeavors to show that the experience in favor of a mixed diet does not militate against the physiological principles he has advanced; that health may be maintained at the expense of life—intensive and extensive life being incompatible; that health is not always a proof of good habits, etc.

"In the next Lecture we are presented with the general physiological laws in regard to preparing food, and the use of artificial means as aids to the vital powers; the general principles which should govern the artificial preparation of food in relation to mastication, insalivation, deglutition, temperature, concentration, combination, quantity, etc., with the practical application of these principles; and many full and interesting details on the subject of bread—the best materials for its formation, the manner of preparing, baking, and preservation.

"The subjects discussed in the remaining three Lectures are the physiological principles in regard to time of eating; the physiology of hunger, the causes by which it is made to recur at shorter or longer intervals, and is augmented and diminished in intensity; the importance of great regularity at the times of eating, the quantity of food

necessary to sustain the human body; the effects of excessive alimentation; drinks, why required—the proper kind; thirst—natural and morbid. Stimulants—their effects on the system, and the general delusion concerning them. Sleep—the physiological necessity for it, its effects, causes which prevent and disturb it, the proper period and duration of sleep. Bathing, air, clothing, and exercise—all these subjects are treated in a masterly manner. The remarks of the author in relation to these possess, often, much originality, and are, with very few exceptions, founded upon strictly physiological principles.

"We have deviated somewhat from our usual practice in presenting so extended a notice of a work professedly addressed to the general reader; but from its very great superiority over the popular treatises on the Science of Human Life, we felt desirous of directing to it the attention of our readers. These Lectures will afford the unprofessional reader a fund of curious and useful information in relation to the organization of his frame, the laws by which it is governed, and the several causes which tend to derange the regularity of its functions, which he would find it difficult to obtain from any other source."

With such a reception among the highest medical authorities of the country, one would have expected the Graham Lectures would have been adopted by the medical profession as a text-book for the guidance of their patients in their dietetic habits. These Lectures occupy an entirely new field. They do not usurp the position usually taken by the profession of medicine. Medical science may go on in its routine of drugs, leeches, and mercury; and if the people will have the moral courage and resolution to adopt a rational and healthful system of diet, such as Graham prescribes, they would well-nigh declare their independence of the ordinary medical treatment. Such, in fact, has been the case in almost every instance where it has been rationally and systematically adopted. Our own experience, and that of hundreds of our friends on this and on the other side of the Atlantic, are confirmatory of this; and as to extend the benefits of such an independence it only requires an extension of the practice inculcated, we have deemed it important that the facts of Graham's Life should be published.

LECTURE I.

Man's relations to the world—True mode of studying the philosophy of man—Man's ignorance on the subject of life, health, and disease—In regard to every thing else he will acknowledge first principles, fixed laws—He contends that every thing concerning life, health, and disease is uncertain and contingent—This ignorance of the laws of life, etc., accounted for—Disease leads to the study of remedies rather than causes—The essence of life unknown—How its laws are ascertained—Extensiveness and comprehensiveness of the science—Requires the most serious and persevering application of the mind.

1. MAN is the soul of the world—the intellectual and moral sensorium of nature.

He is not, indeed, the creating *cause* of things, nor is he the efficient *energy* by which the various operations of nature are carried on. He does not sustain the sun in his bright sphere, nor cause the light and heat to come down upon us as an all-pervading spirit. He does not wheel the planets in their eternal rounds, nor roll the earth upon her axis, nor urge the moon along her silent way. Nor does he heave the ocean's tides, nor pour the streams and rivers from their fountains, nor direct their currents in their winding paths. He does not clothe the earth with vegetation, nor embellish it with verdure, and the various hues and tints and forms of beauty, nor fill it with rich fragrance and delicious fruits. Nor does he quicken this magnificent theatre of being with the numberless forms and modes of animal existence. Yet, but for man, to what great intellectual and moral end would all these things exist?

2. The grazing ox might crop the grass, and, for all the purposes of his nature, instinctively discriminate the odors of the earth, and slake his thirst in the clear stream; and, when the summer's heat became oppressive to him, he might seek the cool shade of the forest; and, in his ruminating moments, he might raise his head, and on his unenquiring eye the sun or moon, or the far distant star, might pour its light: but neither the herbage, nor the fragrance, nor the varied hues of the vegetable kingdom, nor the beautiful freshness of the morning, nor the noontide splendor, nor the soothing silence of the summer twilight, nor the magnificence of the nocturnal firmament, nor aught of creation's loveliness or sublimity, would awaken in him the deep musing of philosophic thought, or moral feeling, or reflection.

3. Not so with man! He opens his percipient faculties on the surrounding world, and light with its variety of hues and visual properties of external things, and the various odors of the earth, and all harmonious and discordant sounds, and the qualities of taste and touch, rush in and make their impressions upon his intellectual and moral sensibilities, and awaken there the elements and energies of mind and moral feelings. And thus all substances and qualities and things surrounding man become to him the great alphabet of knowledge. The numerous properties which inform his senses, seem to come in as with intelligence to inspire his intellectual operations, and to constitute a part of his own mind; and he throws out his thoughts and feelings

over all things, and associates and sympathizes with them, till he becomes, as it were, a part of them, and they of him, and until he learns to arrange these various elements into systems, and elaborates from them the profound truths and principles of science!

4. The beautiful, the harmonious, the sublime, associated with external things, are but the inward sentiments of his own soul, awakened by those things and breathed out upon them, till they become, to his imagination and his feelings, invested as with an intelligent and sympathizing spirit, which holds communion with him in his various moods of mirth and melancholy and poetic musing and solemn meditation.

5. The mountains and the valleys and the streams, the deep forests and the spreading lawns, the ocean's foaming beach, the craggy cliff, the thundering cataract, and all other things in nature, are endowed by him with their peculiar genii, and become, as it were, the talismanic keys which awaken their appropriate tones and melodies and strains within his breast. And thus he grows in knowledge and wisdom, and in moral character, and erects an immortality of thought; and makes all material substances and forms and qualities inservient to mind.

6. He lifts his eye to the heavens, and beholds the sun and moon and myriads of stars, whose light descends upon him like an informing spirit; and he diligently contemplates them till he learns to weigh them in his balance, and measure their dimensions and their far-sweeping orbits; and ascertains their laws and their relations; and finds the universe to be a vast fraternity of material forms, and *feels* himself to be the percipient and intelligent centre of material things, gathering their influences and converting them to mind, which he exerts upon them, and by which he investigates their nature, qualities, laws, relations, purposes, and ultimate designs.

7. Thus man becomes a part of the vast world in which he lives, and every thing becomes a part of him; and hence it may with propriety be said that man is the soul of the world. Nor is he only thus intellectually and morally associated with material things: his wonderfully constructed body, the organic tenement and engine of his mind, partakes in its elements of their common nature, and is subject to those common laws of matter which bind all forms together in inseparable relations.

8. Whatever, therefore, may be the interest connected with material things, man is the centre of that interest; and consequently man, in his nature and faculties, and capabilities and condition, and in his relations to the world in which he exists, is one of the most interesting and important subjects which the human mind has power and compass to investigate.

9. But it is a profound and complicated subject. An attempt to study living man either as a subject of intellectual, moral, religious, political, physiological, or pathological science, singly, without a just regard to his peculiar nature and constitution and condition, the laws of relation under which he exists, the reciprocities and mutual dependencies of mind and body, and the various influences which act upon him, as a material, organic, animal, intellectual, and moral being, would almost necessarily result in error. And for this very reason the world has ever been filled with controversies and disputes concern-

ing man as a subject of intellectual, moral, religious, and political philosophy. Volumes without number have been written on these topics, of a strange mixture of truth and error, mainly because the investigations and discussions have been conducted on partial and improper grounds. Nor have they who have studied man as a subject of natural history or of physiology and pathology, wholly avoided the same sources of error and absurdity.

10. If we would know the true philosophy of the human mind, it is not enough that we, as metaphysicians, study man's intellectual faculties and capacities and laws; but we must ascertain how far the mind is connected with the body, to what extent it is affected by the conditions of the body; and then, again, on what depends those conditions of the body which affect the mind. In order to this, the body itself must be understood in its animal and organic nature, and its physical and vital properties and laws, in its physiological actions and pathological affections. And this investigation will disclose to us a multitude of relations between human organic life, and the animal, vegetable, and inorganic world around us; relations which not only greatly affect the body, but, in the present state of being, modify mind and morals and religion to an extent which cannot safely be disregarded.

11. So likewise, if we would correctly understand the science of physiology or pathology, we must take into view, and thoroughly investigate, the whole nature and condition and relations of man. He who treats of the functions of the human organs, and the diseases of the human body, without fully and accurately considering the modifying influences of the mind, and of the various physical and moral circumstances acting on the healthy and on the morbid sensibilities and sympathies of the system, may indeed form a theory which will have its day of popular acceptance; but fortunate without a parallel will it be, if it does not, sooner or later, prove to possess sufficient errors to sink it into utter disrepute, if not into total oblivion.

12. There is probably no subject which the mind of man has ever contemplated, concerning which more extensive and enormous error prevails, than in regard to human life and health and disease; and yet nearly every person seems to think that there is a kind of intuitive knowledge possessed by all, which enables each one to understand his own constitution and what is good for him, better than another can teach him.

In relation to almost every thing else in nature, mankind are willing to acknowledge that there are fixed principles and permanent laws, and established order and system.

13. If we speak of the science of astronomy, and assert that God has constructed the planetary system upon fixed principles, and arranged the several bodies according to precise laws,—that the relative size, weight, distance, velocity, and every thing else in regard to the whole planetary system, are regulated and governed by the most exact and permanent laws,—every enlightened Christian and theist will readily admit the truth of the assertion.

Or if we affirm that, in the creation of our globe, God ordained all things according to fixed principles, and that he has established unchanging laws which govern it in every respect, our affirmation will

be promptly acceded to. Or if we speak of the science of chemistry, and declare that all the molecular combinations and arrangements of matter are according to fixed laws, and that these laws always govern every chemical action and result with the utmost precision, here again the truth of our declaration will be acknowledged. If also we assert that God has constructed every mineral according to fixed principles—that the formation of every crystal is governed by established laws, this too will be admitted. If we proceed yet farther, and affirm that, in the vegetable kingdom, from the smallest thing that has an individual existence, to the largest tree, all are constituted according to fixed laws;—that the life, growth, health, and every thing belonging to the nature and properties and powers of the vegetable, are governed by the permanent laws which the Creator has established and continually sustains,—the truth of what we affirm will still be unhesitatingly allowed. And finally, if ascending in the scale of creation, we advance to the animal kingdom, and assert that God has created every animal, and estabished all its properties and powers upon fixed prinlciples; that even in the formation of the bones and muscles and nerves, and all the organs of the human body, with their mysterious and wonderful endowments—law and order and adaptation to special purposes and ends prevail and govern every thing,—even here the truth of what we predicate will be admitted.

14. Thus, from the nice adjustments and balancing of revolving worlds, to the structure and operation of the organs of the smallest insect, and the simplest vegetable, and even to the arrangement of the particles of matter in the formation of minerals; and all the combinations of the elements of nature by which the various forms and properties of matter are produced. Throughout the whole immensity of created things, mankind will readily admit that an intelligent, and wise, and benevolent Creator has established laws; and that by virtue of the laws which he has established and continues to sustain, the forms and properties and powers of all material things are what they are. All, except the atheist, will frankly acknowledge that it is befitting a God of infinite intelligence and wisdom and goodness; that all the works of his hands should be established in order and harmonious system, and governed by precise and unchanging laws. And even he who denies the existence of a God, is forward to confess that eternal and unvarying laws reign in and over every thing; and that, by the energy of those laws of nature, all the forms and conditions of nature are produced, and are preserved. Yet, strange to tell! when all these acknowledgments are made concerning the laws which govern the material universe and all material forms, if we turn to the higher order of God's works, in which he has associated with organized matter, in human nature, organic vitality and animal consciousness, and sensibility and voluntary motion, and intellectual and moral powers, and affirm that human life and health and thought and feeling are governed by laws as precise and fixed and immutable as those which hold the planets in their orbits, and cause all portions of each globe to press towards its centre, and point the trembling needle to the pole, and govern all the molecular aggregations and combinations and arrangements of matter in the inorganic and organic world, mankind will, almost universally, without a pause for thought, deny the truth of the

affirmation, and contend that human life and health and disease are matters of entire uncertainty, governed by no laws, and subject only to the arbitrary control of God, or the blind necessity of fate, or the utter contingency of accident. They do not believe that there are any fixed laws of life, by the proper observance of which, man can, with any certainty, avoid disease and preserve health, and prolong his bodily existence: and they are confident that the experience of the human family in all ages has fully and conclusively demonstrated the correctness of their views.

15. In the same circumstances and habits of life, they affirm, one enjoys good health, and another is frequently or continually diseased; one dies early, and another reaches an advanced period of life; while people of very different, and even opposite circumstances and habits, experience the same uncertainties and share the same fate; some enjoying health, and others being afflicted with disease; some finding an early grave, and some attaining to old age; and in all circumstances and habits, the vigorous and robust often die suddenly in the opening of manhood or the very prime of life, while the feeble and the sickly frequently drag out a protracted and miserable existence. Survey, say they, the extended map of the earth, and we find the inhabitants of one portion feeding on the putrescent carcasses of dead animals, others on noisome vermin and reptiles, others on a mixture of animal and vegetable substance, others on vegetables exclusively, and others allaying their hunger, and to some extent supplying the alimentary wants of their nature, with unctuous earths. Some indulging freely in the use of tobacco, others in opium, others in arrack, others in rum, or some of the numerous forms of alcoholic liquor; and yet, with these differences of dietetic habits, and all the difference of climate from the equator to the poles, we find, it is said, among all the different tribes and portions of the human family, about an equal share of health and disease, premature death and extended life. And, while the Esquimaux feasts with gustatory satisfaction and delight on his carrion flesh, and derives from it the most healthful and invigorating sustenance to his body, the Hindoo, with equal gustatory enjoyment and health, makes his repast on his dish of rice; yet, if the diet of these two be exchanged, and the Esquimaux be fed on the rice and the Hindoo on the flesh, both will be disgusted and both will be made sick.

16. Thus, we are told, it is completely demonstrated by the experience of all nations and all ages, that human life and health and disease are matters either of absolute fatality or perfect contingency; and that, in regard to them, there is no fixed philosophical relation between cause and effect; and therefore, the life, health, disease, and diet of man cannot be governed by fixed laws, nor made matters of systematic science.

17. This reasoning, at first view, appears forcible and conclusive; but when thoroughly examined, it proves to be entirely fallacious: and the more deeply and extensively we push our investigations on this subject, the more fully are we convinced that human life, health, disease, diet, and general regimen are matters of as pure and nearly as exact science as mathematics. Indeed, human physiology, in the full sense of the term, is far the most profound and important science that has ever occupied the attention of man; and in order to the most perfect

understanding of it, a knowledge of all other sciences is requisite. In act, it may almost be said that this science consists of the sum of all other sciences systematized into one; and the only reasons why the notions of mankind are so vague and erroneous on this subject are that they never study it as a science; and most or all of their opinions are the results of *feeling*, or what they miscal experience, rather than of deep reasoning and philosophical investigation. Nor is it surprising that it should be so, when the nature of man as a rational animal, and the circumstances in which he is placed, and the influences which act on his natural and moral susceptibilities, are accurately considered.

18. In the rude state of nature, the wants of man are few and simple. If hungry, he plucks the fruit from the bough of the tree, or gathers some nutritious substance from the earth, and satisfies his want. If thirsty, he stoops to the clear fountain or stream, or with his hand, or with a folded vegetable leaf, lifts the pure beverage of nature to his lips, and answers the instinctive demand; or perhaps, more naturally, he satisfies this want with the juices of succulent fruits. If cold, he wraps his body in the skins of beasts; if oppressed with heat, he retires to the cool shade of trees. When the sun sinks below the western horizon, and the curtain of night gathers over him, he throws himself upon the bosom of the earth, or on some rudely prepared couch, and sleeps till the returning light rouses him, fresh and vigorous, from his slumbers: or if he inhabits a portion of the globe where darkness prevails for months, he sleeps and wakes according to the instinctive demands of his nature. The apparent revolutions of the sun, the waxing and the waning of the moon, and the changes of the seasons, constitute his only chronometer.

19. In all this, it is manifest, that the *rational powers* of man are little employed in investigating the adaptation of his diet and habits to the laws of organic vitality. Possessed of the instincts common to all animals, he *feels* his wants, and by the *feeling*, is prompted like other animals to satisfy them; and, in doing this, he is governed by those instinctive powers of smell and taste, which enable him with utmost accuracy to discriminate between esculent and poisonous substances. And, if reasoning powers of a higher order than those which are exercised by other animals are employed by him, it is in devising the means by which his supplies are procured, rather than in ascertaining the fitness of those supplies to the real constitutional wants of his nature.

20. As man gradually becomes removed from the simplest state of nature, by the artificial habits and circumstances of society, he finds it first *convenient* and then *necessary* to possess those rude utensils—the earliest specimens of human art—with which he prepares his food, and dips his water from the brook, and fits his clothing for his body. No sooner are these things considered *necessary*, than the supply of them becomes of nearly as much importance as food and drink and clothing. This, in time, leads individuals to devote themselves wholly to the manufacture of such articles as the wants of society demand: and *this* leads to an increase of skill and knowledge in the manufacturing art, and a consequent improvement of the things manufactured: and this reacts upon society, and accelerates its progress towards what

are called the refinements of civil life: and this, again, while it continually multiplies the artificial wants of man, increases the necessity for the supply of those wants: and the final result is, that the artificial wants of man become so numerous and so imperious, that a large portion of the time and powers of every member of society are employed in supplying them: and, in the progress of the development of this state of things, the several arts and sciences of civil life are originated and matured.

21. Thus, from the simple instinct of thirst, or natural want of water, has grown the invention or discovery and manufacture of the numerous beverages or kinds of liquor drank by man, and of the boundless variety of cups, glasses and vessels of every description employed in containing water, tea, coffee, wine, and all other kinds of alcoholic and other liquors used as human drink. And out of the simple instinct of hunger has grown all the devices and arts concerned in producing, procuring and preparing food, and the invention and manufacture of all culinary utensils; and all the dishes, tables and other articles used in cooking, holding and serving up the aliments of man. And out of the want of clothing, which was at first supplied by a light tissue of leaves or by the skins of beasts, has grown the manufacture of the interminable variety of articles made of wool, flax, silk, cotton, fur, etc., etc.

22. In the progress of these arts and operations, one want has created another, and caused a continual demand for the closest and most constant application of the mental powers of man to the investigation of the physical, mechanical and chemical properties of things, and with reference to forces, motions, numbers, quantities, time, distance, etc., etc., till mathematics, astronomy, chemistry, and all other human sciences have been slowly developed and matured, and become themselves some of the most important wants of society.

23. But it is obvious that, in this general progress of things, by which new wants are continually and rapidly generated and multiplied, there is little to lead the mind of man to study the laws of human life, or to examine the dietetic and other habits of civil life with reference to health and disease.

24. The artizan who manufactured the first rude cup or goblet, probably never gave a thought to the question whether water or some other liquid is best adapted to the natural wants of man; and since him, the thousands who have been employed in the same line of art have seldom, if ever, been led by their occupation to enquire whether wine, tea, coffee, and other alcoholic and narcotic beverages are adapted to the real wants of the human body, or are consistent with the laws of life and health. On the contrary, the very employment and circumstances of every artizan require the constant application of his mental powers to the principles and operations of his art, in order to his immediate success as an artizan, and to his ultimate pecuniary success as a member of society. The wants of civil life are so numerous, and constitute so important a part of the very texture of social and domestic life, that every man finds nearly his whole time and attention taken up in supplying them.

25. It is true, that disease multiplies in society in proportion as man removes from a pure state of nature, and becomes more and more an

artificial being in his habits and circumstances:* and this leads to the study of the healing art, and ultimately to the study of anatomy and physiology, But, even here, the general tendency of things is far less favorable to the accurate and profound study of the science of human life than is generally supposed.

26. Disease always precedes the physician; and the sick are only concerned to know how they can obtain the most speedy relief from their sufferings. The question with them, and with their friends, is not, how they came by their sickness, or by what violations of the laws of life it has been induced, but by what remedies they can remove the disease and restore health.

27. The domestic therapeutics of the earliest stages of society is generally extremely simple; and is perhaps governed at first by the morbid cravings of the patient, by accident, and finally, by experience. If by any means the disease is removed, the remedies and measures employed are carefully remembered, and used again, when similar cases occur; and in this manner every tribe, and almost every family soon acquire their system of pharmacy, and their theory and practice of medicine.

28. As society advances and diseases become more numerous and frequent, it follows as a necessary result, from the consequent order of things, that individuals become devoted to the study of remedies, and to the care of the sick; and thus, physicians originate. The office is, perhaps, more frequently, at first, confined to the priesthood, who employ with their simple remedies, an abundance of superstitious juggling, and incantation and exorcism. In time, however, some master spirit like Hippocrates, rises up, and digests the chaos of crude elements, into something like order and system. But it is obvious that, from the first rude origin of these elements to their systematic arrangement, every thing is done simply with a view to *cure* the disease, and without any regard to its cause: and, indeed, the disease itself is generally considered as the direct and vindictive infliction of some benevolent or malevolent supernatural being or beings; and therefore, in all the progress of the healing art thus far, not a step is taken towards investigating the laws of life and health, and the philosophy of disease.

29. Nor, after medicine had received a more systematic form from the plastic hand of Hippocrates, did it lead its votaries to those researches which were most essential to its success, and which its great importance to society demanded; but like religion and everything else in the hands of man, it became blended with the grossest superstitions, errors, and absurdities. Hence, from the earliest traditions of Egypt, until comparatively modern times, the history of medicine, with very limited exceptions, is a tissue of ignorance and folly, error and absurdity; and only serves to demonstrate the absence of that knowledge upon which alone an enlightened and successful system of

* By 'a pure state of nature,' let it be understood, once for all, that I never mean the savage state; for I consider the savage state, in many respects, very far from the truly natural state of man, and therefore, I distinguish between the rude state of nature (18) and the pure state of nature. By the latter, I always mean that state in which the condition, circumstances and habits of man are in strict and full accordance with the constitutional laws of his nature.

medicine can be founded; and to show to what extent a noble, and I might perhaps with propriety say *divine* art, can be degraded and perverted from its high capabilities of good, to almost unmixed evil, by the gross ignorance and sensuality and superstition and cupidity of man.

30. In ascertaining and defining the symptoms of disease, with reference to the application of remedies, some of the ancients certainly did much for the healing art; and they undoubtedly made considerable attainments in the knowledge of anatomy and surgery. But we ought to know that all this may be done, with almost entire ignorance of the laws of life, and the true philosophy of disease. Still, however, it must be admitted that, with all the disadvantages under which he labored in regard to physiological knowledge, the therapeutic views of Hippocrates were such as justly entitled him to be called 'the Father of Medicine.'

31. In modern times, anatomy and surgery have been carried perhaps nearly to the top of perfection, and very great attainments have been made in physiology. The science of human life has been studied with intense interest and remarkable success: but this has been confined to the devoted few; while, even in our day, and in the medical profession itself, the general and powerful tendency of things, is adverse to the increase and diffusion of scientific knowledge, in regard to human life, health and disease.

32. Intent as all men are on present enjoyment, they are little inclined to practise present self-denial for the sake of a future good which they consider in any possible degree contingent; and will only consent to bear the cross when compelled by necessity, or when they find it the only means of shunning imminent destruction, or of escaping from intolerable evils. Hence, so long as mankind are favored with even a moderate degree of health, they rush into the eagerly desired excitements of their various pursuits and pleasures and indulgences: and nothing seems to them more visionary and ridiculous, than precepts and regulations and admonitions concerning the preservation of health. While they possess health, they will not believe that they are in any danger of losing it: or if they are, nothing in their habits or practices can have any effect, either in destroying or preserving it: nor can they be convinced of the universal delusion that, if they enjoy health, they have within themselves the constant demonstration that their habits and practices are conformable to the laws of health, at least in their own constitutions. They will not, therefore, consent to be benefited, contrarily to what they regard as necessary to their present enjoyment, either by the experience or by the learning of others.

33. The consequence is—as a general fact—that, while in health, mankind prodigally waste the resources of their constitution, as if the energies of life were inexhaustible; and when, by the violence or by the continuance of their excesses, they have brought on acute or chronic disease, which interrupts their pursuits and destroys their comforts, they fly to the physician, not to learn from him by what violation of the laws of life and health they have drawn the evil upon themselves, and by what means they can in future avoid the same and similar difficulties; but, considering themselves as unfortunate beings, visited with afflictions which they have in no manner been

concerned in causing, they require the exercise of the physician's skill in the application of remedies, by which their sufferings may be alleviated and their disease removed. And in doing this, the more the practice of the physician conforms to the appetites of the patient, the greater is his popularity, and the more cheerfully and generously is he rewarded.

34. Every thing, therefore, in the structure and operations of society tends to confine the practising physician to the department of therapeutics, and make him a mere curer of disease; and the consequence is that, excepting the few who are particularly favored by their situation as public teachers, the medical fraternity, even of the present day, have little inducement, or opportunity, to apply themselves to the study of the science of human life, with that devotedness and zeal and perseverance which the profoundness and intricacy of the subject require; while, on the other hand, almost every thing by which men can be corrupted, is continually presented, to induce them to become the mere panders of human ignorance, and depravity, and lust: and if they do not sink their noble profession to the level of the vilest empyricism, it is owing to their own moral sensibilty, and philanthropy, and love of virtue and magnanimity, rather than to the discriminating encouragement which they receive from society, to pursue an elevated, scientific professional career.

35. Thus, we see that both the natural and acquired appetites, propensities, and habits of man, and all the circumstances of life which act on his natural and moral sensibilities, concur to divert his attention from the study of the science of human life, and fix it on present self-enjoyment, and on the pursuit of the means of supplying his natural and artificial wants. And hence, he is left to *feel* his way to, or gather from what he calls *experience*, most or all the conclusions which he embraces, in regard to the laws of life, health, and disease.

36. This source of knowledge is as utterly fallacious as it is delusively specious: and the more deeply and extensively mankind are betrayed by it, the more totally blinded do they become to its treachery, and the more zealously and confidently do they contend for its validity.

37. Every one *knows* from his own *feelings* and *experience* precisely what kind of constitution he has; and what agrees and what disagrees with it;—and every body knows exactly what agrees and what disagrees with his own stomach; and is taught by his own experience what is best for his constitution, and his health, and strength, and comfort. And surely, if a lady has the headache, she knows her own feelings better than any body else does; and if she drinks a good strong cup of tea, and the pain leaves her head, nobody ought to be guilty of so gross an insult to her understanding, as to attempt to convince her that tea is a poison, and that her use of it is a principal cause of her headache; for she knows that she always feels better after drinking tea; and from fifteen or twenty years' experience, she knows that there is no better remedy for headache than a good strong cup of tea; for she has been subject to the headache for nearly twenty years, and the frequency and violence of the turns has gradually increased upon her from the first, till she is now obliged to give up all business, or pleasures, and take to her bed for the whole day, whenever she has a turn, which is certainly as often as once a week, and sometimes more

frequent; and she has always found that tea is "the sovereignest remedy in the world" for headache! Who can reason against such facts as these? or have the temerity to advance a theory which contradicts the universal experience of the human race? It must be confessed that the enterprise is an arduous and a daring one; and is cheered by no encouraging prospect, except the possibility that mankind can be undeceived in regard to the validity of their feelings and their experience, as rules of life.

38. I do not, however, wish to convince my fellow-creatures that they have no *feelings*; nor that they do not know when, and how much they feel: but I wish to convince them that the kind and degree of their feelings, by no means teach them what causes it, nor the principles upon which its existence depends. I am willing to concede to the lady, that she knows best how her own headache *feels;* and that she knows it is relieved by a cup of tea. But does she know either the remote or immediate cause of her headache? Does she know the vital properties and powers and functional relations of the organs of her body? and does she accurately understand the healthy and the diseased affections and sympathies of those organs? Does she know the qualities of the tea in relation to the vital properties and functional powers of her system? Does she know the direct and the ultimate effects of the tea on her system? How it produces the pleasurable feelings, how it removes the pain of her head? And does she know whether the very effects of the tea, by which the paroxysms of her headache are relieved, are not the principal source of her headache, and the main cause of the frequency and violence of the paroxysms? If not, what are her feeling and experience worth, to herself or others, as rules of life, by which she, or any one can judge of the fitness of her habits to the laws of life and health? I answer, not a farthing. Nay, indeed! they are worse than nothing! mere delusions by which we are decoyed from step to step along the specious labyrinths of sensuality and suffering. And such, with rarely an individual exception, is the universal experience of mankind! I acknowledge that they *feel;* and that they know whether their feelings are pleasurable or painful. But do they know physiologically *how* or *why* they feel; and understand the relation of their feelings to the powers and laws of vitality; and to the condition and functions of the living organs? I acknowledge that, by virtue of a vigorous constitution, many may live years, and some even to what we call old age, in the enjoyment of ordinary health, in spite of habitual violations of the laws of life and health. But does this constitute an experience which proves the correctness of their habits? or at least, that those habits are not unfavorable to life and health, in certain constitutions? Most evidently it does not!

39. It has been justly observed by a distinguished philosopher, that men in their inductive reasonings deceive themselves continually, and think that they are reasoning from facts and experience, when, in reality, they are only reasoning from a mixture of truth and falsehood. The only end answered by facts so incorrectly apprehended, is that of making error more incorrigible. Nothing, indeed, is so hostile to the interests of truth, as facts incorrectly observed.' And

on no subject are men so liable to misapprehend facts, and to mistake the relation between cause and effect, as on that of human life, health, and disease. Without the most profound physiological and pathological knowledge and discrimination, it is not possible for them to avoid self-deception. They constantly mistake the *causes* of their feelings, and misunderstand the physiological and pathological character of the feelings themselves. And, judging of the qualities of things by the feelings which they produce, and without considering that even the most baneful substances may be made the causes of pleasurable stimulation to depraved organs, they inevitably confound good and evil. their facts become falsehoods, their inductions erroneous, and their experience a tissue of error and absurdity, which serves only to mislead and betray them.

40. Nothing is more certain, therefore, than that the only way by which mankind can attain to correct notions concerning human life, health, disease, regimen, etc., is to apply their intellectual powers assiduously to the study of the subject as a science; and this will lead them, not as mere animals possessed of sensibility and consciousness, and the voluntary power of sensual indulgence, but as rational beings, over a most extensive and interesting field of research and investigation.

41. Could we seize upon vitality itself, and ascertain its essence, we might, perhaps, be able to reason from its intrinsic properties and powers, to all conclusions necessary for our use, with a more limited extent of argument, and much less help from other sciences than we now find requisite. But we know nothing of the essence of life, and therefore we can only know its peculiar properties, and powers, and laws, by accurately ascertaining the character of its manifestations and effects in relation to the ordinary laws and properties of inorganic matter.

42. We perceive, therefore, that the science of Human Nature is most comprehensive as well as complicated and profound: that it extends, not only over the whole man, embracing all his moral, intellectual, animal and organic properties, and reaching even to the vital forces and affinities, from the action of which result the several arrangements, structures, tissues and organs of the body, but, in order to come at the truth on all these points, and ascertain how far the matter of the living body is subject to the common physical laws of the organic world, how far and in what manner the living body resists and overcomes those laws, and to what extent the vital economy is affected, and life modified by the presence of chemical agents, the force of chemical affinities, and the power of physical laws, it necessarily goes still farther, and investigates the properties and laws common to all matter; and endeavors, in its analytical progress, to arrive as nearly as possible at the primordial form and essential nature of matter itself; and thus prepares the way to ascertain the differences and distinctions between inorganic and organic matter, and to find out the properties and laws peculiar to all organized matter, or all living vegetable and animal bodies; and the differences and distinctions between vegetable and animal bodies, and the properties and laws peculiar to the latter; and in this way, finally brings us to the study of the particular anatomy and physiology and psychology of man.

43. The subject is immense! yet it is, in all its details, replete with

interest to every human being. Man finds himself upon the theatre of life, full of susceptibilities, surrounded by innumerable influences, and acted on at every point; and he is continually conscious, not only of his existence and the action of surrounding influences, but of an unceasing desire for happiness. Has God implanted this desire as a fundamental principle of action in our nature, merely to tantalize us in the vain pursuit of what has no reality? or is the desire itself a living proof that our benevolent Creator has fitted us for happiness, not only in a future state, but here—in soul and body? and adapted every thing within us and around us, to answer this desire, in the fulfilment of those laws of life and health and happiness which he, in wisdom and in goodness, has established in the constitutional nature of things?

44. Surely our heavenly Father cannot but prefer our happiness at every instant of our lives; and if we are not happy it cannot be because he has not endowed us with the capability of being so, and adapted earth and all terrestrial things to all that he has made us capable of being.

45. Our disquietudes, and diseases, and ultimately death, must therefore spring, not from the fulfilment, but from the infraction of the laws of God; and it becomes us humbly, yet diligently, to endeavor to ascertain those laws, and to obey them and be happy; and thus fulfil the benevolent purposes of God, and glorify him in our spirits and our bodies, which are his.

46. It is impossible to attain to a full understanding of these things without a determined and persevering application of the mind; and for the sake of knowledge so important, we must be willing to submit even to the drudgery of that application which at first is made only with the hope of being rewarded when the task is mastered, and hidden things are brought to light by penetrating diligence.

LECTURE II.

The variety of material forms—Their origin—apparent difference between organic and inorganic matter—Great variety of organic forms—Systematized into a few classes—Order and design in every thing—Organic and inorganic bodies resolved to the same elements—All things in the material world resolved to a few simple substances—Wonderful powers of vital chemistry in vegetable and animal bodies—All kinds of aliment converted into the same organized substances—The various forms of matter composed of minute primordial atoms, the same in organic and inorganic bodies—differently arranged—Intimate relations between all material forms—What is matter?—Moses' account of the creation!—St. Paul's explanation—A single element of matter—Opinions of Braconnot, Sir Humphrey Davy, Dr. Herschel, Dr. Arnot, Sir J. F. W. Herschel, Dr. Prout, and others—Original formation of things—The agency of an intelligent and omnipotent Creator necessary—The intrinsic properties of matter could not produce the results of nature—No law nor property of matter known to be essential to it—We know no more of matter than of spirit—Original forms and primitive combinations of matter—Number of chemical elements—Water, how formed—Rocks—Earth, &c.—The Neptunian and Plutonian theories of Geology—Natural elements few, or one—Essentially the same matter in all forms—Inorganic affinities could not produce organized bodies and life—Opposition of organic and inorganic affinities—Life not the result of organized matter, but the contrary—The inorganic world left to itself must have remained eternally so, without a blade of grass—The necessity for an intelligent and omnipotent Creator.

47. If, in our imagination, we assume some elevated stand, and contemplate the surface of our globe, we behold mountains and valleys, hills and plains, bounded by oceans, and intersected by rivers and streams, and clothed with vegetation, and swarming with a vast variety of animals. Pleased with the interesting view, we are naturally led to enquire, whence all this beautiful variety of things? Do they constitute but a part of an eternal succession of material and living forms? Or is this globe, with 'all that inhabits it,' but the wreck or fragment of something more magnificent and vast? Or are these things the blind result of chance? Or, far retired behind these mighty works, is there a mightier Architect, whose power and wisdom and design, for some great purpose of benevolence, created and constructed every thing? But in vain we question nature in this general manner! No distinct and definite answer is afforded us. If, with the spirit of philosophical inquiry, we descend from our elevated situation and general view, and approach to a nearer and more intimate inspection of the several parts of the great scene before us, we behold the mineral and vegetable and animal kingdoms displayed around us in splendor and luxuriance and beauty and enjoyment. Profusion and variety and disorder seem, at first glance, to prevail throughout the whole. Between inorganic and vegetable and animal matter, there appears to be not only a distinction of forms, but an essential difference even in the ultimate elements.

48. Turning our more particular attention to the organic world, it appears, at first view, as if nature had spontaneously thrown out an interminable variety of forms, without regard to order or design. But when we come to a more close and careful examination, we discover that the most perfect order pervades the whole, and that interminable as the variety at first appeared, all may be arranged into a few classes, each of which embraces but a limited number of species;

and the more rigorously we scrutinize the individual forms of things in order to ascertain their peculiar structure and properties, and constitutional principles and laws, the more clearly we perceive order and design in every part, and perfect fitness and harmony reigning through all. At each advancing step, we discern more and more distinctly on every part, the deep and indelible handwriting of Creative Intelligence, and Design and Goodness! In every animal—in every vegetable form, God has stereotyped a living alphabet, by which we can spell out his power and wisdom and benevolence!

49. Not satisfied with these discoveries, we begin more boldly to demand of Nature the disclosure of her secret things, and in the crucible, and by other modes of analysis, compel her to divulge her most hidden principles. All living bodies, and the atmosphere and ocean, and the earth, even to her inmost entrails, are explored. The solid forms of matter melt beneath the fiery inquisition! The earths shrink into metallic bases! and these again, if still pursued with sufficient intensity of heat, vanish into thin vapour—apparent nothingness! And we are astonished to perceive that, essentially different as we suppose the animal and vegetable and inorganic substances which we subjected to our analytical ordeal, yet the results exhibited the same ultimate elements in all, or only differing in their proximate conditions.

50. Encouraged by our success, we eagerly urge onward our experiments, till we seem about to step upon the threshold of ultimate analysis; and arrive at the full conviction that every fluid and every solid substance in the world—even the hardest minerals, may, with sufficient heat, be converted into thin air or gas! and we learn that all things composing and inhabiting this globe of ours—organic and inorganic, may by chemical analysis even in the hands of man, be resolved into a few forms or substances, which in the present state of science we find convenient to call elements.

51. But the vital alchemy of the organic laboratory leaves the chemist's crucible, and the more simple operations of inorganic nature, far behind in its energy of analysis and in its creative aggregations and arrangements; and seems to possess the power not only of decomposing most, if not all, of those substances which are called elements, but also, of actually transmuting them into each other.

52. 'The seeds of various plants,' says a distinguished chemist, 'may be placed in pure sea-sand, or even leaden shot, and nourished with nothing but pure distilled water, and the common atmosphere, and the sun's light and heat, and the seeds will sprout and the plants grow and thrive, and attain to maturity, elaborating for themselves, out of the distilled water and the atmosphere, all their own nutriment, and properly arranging and composing the several vegetable structures and substances, and producing the several vegetable properties. And if this vegetable matter thus produced be carefully preserved and accurately analyzed, the various earths, the alkalies, acids, metals, carbon, sulphur, phosphorus, nitrogen, etc., may be obtained the same, or nearly the same, as if the plants had grown in their natural soil.'

53. 'It is well known,' says Dr. Turner, in his Elements of Chemistry, 'that many plants grow when merely suspended in the air. In the hot-houses of the botanical garden of Edinburgh, for example,

there are two plants, species of the fig-tree, the *Ficus australis* and the *Ficus elastica*, the latter of which, as Dr. Graham informs me, has been suspended for four, and the former for nearly ten years, during which time they have continued to send out shoots and leaves.'

54. 'The Aerial Epidendrum, a beautiful plant of Java and of the East Indies beyond the Ganges,' says an eminent physiologist, 'has no roots nor any apparent organs of nutrition, but lives alone on air and the vapor of the atmosphere. It is said to be no uncommon thing for the inhabitants to pluck it up on account of the elegance of its leaves and the beauty of its flower, and the exquisite odor which it diffuses, and to suspend it by a silken cord from the ceiling of their rooms, where from year to year, it continues to put forth new leaves, new blossoms and new fragrance, excited to new life and action only by light and heat and the surrounding atmosphere.'

55. Here then, the atmosphere, with the assistance of light and heat, is converted by the vital forces of the vegetable organic economy, into fluid and solid vegetable substance, color and fragrance; and if this vegetable matter be carefully analyzed, it will afford many of those substances, or forms of matter, which chemists now call elements, and which no analysis that they are capable of making, has, as yet, been able to detect in the substances by which the plants were nourished.

56. If, therefore, earths and alkalies and acids and metals and sulphur and phosphorus, and other equally simple substances, may be elaborated by the vital power of the vegetable economy from the oxygen and nitrogen and hydrogen and carbon of the common atmosphere, with what propriety can they be considered elements, or primordial forms of matter?

57. 'The cerealia produce pure silex or flint, though not a particle of it is to be found in the soil in which they grow, nor in the fluid by which they are nourished. Plant in the same soil, the sugar-cane, the aloe and the nightshade; water them with distilled water, and let them grow side by side, warmed and invigorated by the same heat and light and atmosphere, and the juice of the one will afford nutritious sugar; of another, the medicinal, intensely bitter aloes; and of the third, a substance with but little taste, but a deadly poison. From the sap of the peach-tree, are produced the woody structure, the verdant foliage, the blossom with its beautiful tints and delightful fragrance, and the delicious fruit; while in the leaves and kernel is formed a pungent bitter, and the prussic acid, which, in its concentrated state, is one of the most deadly poisons known. The mayapple or mandrake, which grows wild in our woods, bears a fruit which is esculent and fine flavored when ripe, while its root is a purgative of about the same power as jalap, and the leaf is actively poisonous.'

58. 'Thus, from the common sap,' says Dr. Good, 'which may itself be elaborated entirely from pure water and the atmosphere, with the help of light and heat, are secreted a variety of substances of different, and frequently of opposite powers and qualities: substances nutritive medical, or destructive; and often in the same individual plant, some of its organs secrete a wholesome aliment, while others secrete a deadly poison.'

59. Nor is the vital economy of the animal system less wonderful in its analytical and synthetic powers. From all the varieties of aliment

with which it is supplied, whatever may be the chemical properties of the food, it constantly and with utmost integrity, during health, produces chyme, chyle and blood of very nearly the same chemical character: and whatever may be the kind of nourishment received into the stomach, in a healthy state of the system, the blood elaborated from it regularly affords the appropriate supply of materials to every structure and substance of the body, whether the particular properties or substances derived from an analysis of the several structures be found in the aliment or not.

60. Neither in the chyle nor in the blood is any gelatine ever found, and yet the most extensive structure of the whole body is principally composed of this substance; and the quantity of carbon eliminated by the human body seems very greatly to exceed the quantity received into it in any appreciable manner.

61. Moreover, the vital economy seems to possess the power of varying the quantity of particular qualities and substances produced by it, according to the condition and demands of the system, periodically supplying from the common and ordinary current of blood, without any known variation in the food from which it is elaborated, a very large increase of appropriate nourishment, for particular structures, and at the same time, regularly sustaining the general function of nutrition, in every part and substance of the system.

62. Whatever may be the kind or quality of the food from which it is elaborated, the blood of man will always afford, by chemical analysis, a considerable quantity of iron. Several other metals and other substances are also procured in the same manner, from the animal system, which it would be difficult, if not impossible, to account for in any other satisfactory way, than by admitting the power of the vital economy to produce, from a nearly homogeneous chyle, various substances which in chemistry are considered not only opposite in their qualities, but of essentially different elements.

63. In the same animal, from the same vital current which nourishes the flesh, that would be perfectly safe and nutritious for human aliment, is secreted the most deadly poison. The flesh of the rattlesnake is eaten by many people, as a great luxury: and even its blood may be received into the human stomach, or put upon a fresh wound with perfect safety; and yet, from the same blood, is secreted a poison, which if mingled with the blood of our system, will, with almost irremediable certainty, prove fatal in a very short time.

64. Besides these natural and ordinary operations of the vital economy of the animal system, it is no uncommon thing for protracted irritations and diseased action to produce results totally different from those of the normal or healthy and regular functions of the organs; and the blood, which in the healthy condition and action of the parts, regularly supplies appropriate nourishment for the soft solids, is made to yield the materials for the structure of bone; and thus, ossification has taken place in the heart and other important organs, to an extent which has often proved fatal to life.

65. All the beautiful variety of things, therefore, which we, at first, supposed essentially different, may be resolved by the keen scrutiny of analytical science, to a very few substances, which are called elements, because they have hitherto withstood the utmost powers of analysis in

the hands of man; and yet, such have been the astonishing results of human investigations, that men of high and wonderful attainments in science begin to tell us that 'it is scarcely possible to say what substances are not compound bodies;' and still, as we have seen, the nicer alchemy of the organic laboratory, penetrates far beyond the reach of human science, and seems to have the power to decompose and combine and generate with almost a creative energy. And the sacred Scriptures affirm that 'the time shall come when all these things shall be *dissolved*, and the *elements* shall melt with fervent heat.'

66. If now we interrogate Nature in another mode, new revelations of her secret things astonish and delight us: and from her disclosures and her intimations, we are led to the conjecture, and feel ourselves urged to the conclusion, that the various forms of matter are composed of almost infinitely minute atoms (78, 79); and that these little molecules are precisely the same, whether in animal, vegetable, or inorganic structure; precisely the same, whether composing the animated flesh of man, the beautiful and fragrant flower, or delicious fruit of the vegetable, or the hardest mineral, or the most subtile and elastic air: and that it is only the different arrangements or aggregations of these atoms, that constitute the different material substances and qualities and forms, organic and inorganic. Nor is it probable that, in the various transformations of matter, which are continually going on, the analysis that takes place in the processes of Nature, often approaches near to the primordial atoms: but molecules composed of myriads of those atoms, may be the ultimate forms in most of the ordinary changes of composition and decomposition in nature.

67. Thus, of those forms of matter which in chemistry are at present considered elements, different aggregations of the same molecules, make substances not only of entirely different natures, but of properties as different as those of aquafortis and the balmy air which we breathe; of sugar and vinegar; of charcoal and diamond. And thus again, by differently arranging the same molecules of matter, red, orange, yellow, green, blue, and other colors and tints are produced; and in like manner, are formed the most fragrant and most offensive odor; and the different qualities of sweet and sour and bitter, etc. And there are reasons for believing that light and heat, and electricity and magnetism, instead of being essentially different substances, are but the results of particular aggregations or arrangements and conditions of the same primary atoms of matter.

68. If these things be so, they reveal to us most intimate relations between all material forms and substances, which hitherto we have little thought of; and we learn from them our natural fellowship with earth and ocean and the atmosphere and every thing around us.

69. What, then, is matter? and what was its primordial form? and what are its essential properties?

Moses instructs us that, 'In the beginning God created the heaven and the earth!' And having made this general predication of his subject, he commences a brief history of the creation, in detail; and declares that, previous to the creation of the earth, it was '*emptiness* and *nothing*,' or had no perceptible existence; for such is the radical and primitive sense of the Hebrew words in the original text; and such is the sense which the apostle Paul, who was a learned Hebrew scholar,

gives them, when speaking of the same subject, in his epistle to the Hebrews. 'Through faith,' says he, 'we understand that the worlds were formed by the word of God; so that the things which are seen were not made of things which do appear.' The writer of the book of Job and the prophet Isaiah also use the same Hebrew words in this sense

70. There is nothing in the Hebrew text, therefore, to justify the notion that our globe was formed out of a chaotic mass of matter, which might have been the wreck of some other planet, or of a comet, or fragment of the sun: but the true sense of the passage is nothing more nor less than that before God created our globe, this material world of ours had no perceptible existence; it was 'emptiness and nothing.'

71. The interesting question therefore still recurs: What is matter? which we see displayed around us, in such multitudinous forms of magnificence and beauty and life and activity and sensibility and passion and enjoyment?

72. From the many interesting facts and considerations which have now been presented, and a multitude of others which may be observed by the philosophic inquirer, on every hand, are we not urged to the conclusion that all these material forms and substances and qualities and things, which now compose our palpable universe, are but the different modifications, or arrangements, of the same primordial atoms which constitute the SINGLE *element* or ESSENCE *of all matter?*

73. It is true that the demonstrations of human science have not yet arrived at this grand conclusion, and it is possible that they never will: but it is equally true that the glorious march of scientific discovery, seems continually approaching toward this great point; and that every advancing step of analytical demonstration, while it multiplies the proximate forms, draws apparently still nearer to the single element of matter. And it is an interesting fact, that many of the greatest minds which, in modern times, have been devoted to the pursuits of natural science, appear almost simultaneously, as if inspired by Nature's great Spirit of Truth, to perceive indications of such a final consummation of analysis, and to intimate their conjectures of a single element; or, at most, a very few.

74. 'Oxygen and hydrogen, with the assistance of solar light,' says Braconnot, 'appear to be the only elementary substances employed in the constitution of the whole universe: and Nature, in her simple progress, works the most infinitely diversified effects, by the slightest modifications, in the means she employs.'

75. 'A very few elementary bodies indeed,' says Sir Humphrey Davy, 'and which may themselves be only the different forms of some *one and the same primary material*, constitute the sum total of our tangible universe of things. And that distinguished philosopher, Dr. Herschel, has advanced the opinion, that 'light is the source of all substances and the basis of all worlds.'

76. 'Whether those substances which, in the present state of science, are considered elements,' says Dr. Arnot, 'are in truth originally and essentially different, or are only the *one simple primordial matter*, modified by circumstances, as yet unknown to us, we cannot at present positively determine.'

77. In a truly able and exceedingly interesting preliminary discourse

on the study of Natural Philosophy, by J. F. W. Herschel, Esq., the same important idea is fully advanced. 'Philosophical chemistry,' says Mr. Herschel, 'no more aims at determining the *one essential element, out of which all matter is formed—the one ultimate principle of the universe*, than astronomy at discovering the origin of the planetary movements, in the application of a determinate projectile force in a determinate direction; or geology at ascending to the creation of the earth. THERE MAY BE SUCH AN ELEMENT. Some singular relations which have been pointed out, in the atomic weights of bodies, seem to suggest to minds fond of speculation, *that there is*. But philosophical chemistry is content to wait for some striking fact, which may either occur unexpectedly, or be led to by the slow progress of enlarged views, to disclose to us its existence.'

78. 'The discoveries of modern chemistry have gone far to establish the truth of an opinion entertained by some of the ancients, that the universe consists of distinct, separate, indivisible atoms (66), or individual beings, so minute as to escape our senses, except where united by millions, and by those aggregations making up bodies of the smallest visible bulk.'

79. 'What is proved concerning the atomic theory,' (66) says Mr. Whewell, in his admirable treatise on Astronomy and general Physics, 'is that chemical and other effects take place as if they were the aggregate of the effects of certain particles of elements, the *proportions* of which particles are fixed and definite.' And Dr. Prout, in his profoundly scientific treatise on Chemistry and Meteorology, says, 'by element is here meant a principle that is not made up of others, and which consequently possesses an absolute and independent existence. Whether ONE or more such elements exists, is not now our object to inquire. The astonishing discoveries of modern chemistry have shown that many of those substances, formerly considered as elements, are in fact compounds; and as the science of chemistry is still progressive, it is probable that with the enlargement of its boundaries, there will still be a further diminution of the number of those substances which are, as yet, held to be simple.' Indeed the general train of reasoning throughout the whole of this very learned and exceedingly interesting treatise, embraces the supposition of only *one essential form of matter*.

80. If, therefore, any importance may justly be allowed to the opinions of those who are devoted to the pursuits of science, and who occupy eminent stations in the scientific world, we are here, by high authority, decidedly corroborated in the conclusion that the minute atoms of a single element constitute the primordial forms of matter, by the various combinations, arrangements, and aggregations of which all the diversified and interesting forms of things in our material world are produced.

81. Having pursued our analytical inquiry concerning the nature and original form of matter, through the various researches of human science, and the still more discriminating and wonderful process of the organic vital economy, till we have arrived, with the support of demonstration, apparently near to a single ultimate principle, with many known truths and manifest analogies leading to and justifying the hypothesis of a single essence or original element; it now becomes necessary for us to travel down the deeply interesting course of synthe-

tical arrangement and conformation, till we have again returned to the present existing forms and conditions of things, in order that, by such investigations, we may as clearly and as fully as possible ascertain the laws of constitution and relation appertaining to the various forms of matter and modes of being; and particularly such as are connected with the existence and affect the condition of the human race.

82. Here we are met, however, at the very outset of our career, by the exceedingly important question: How could such various forms and qualities of matter be produced from the atoms of a single element by the action of any intrinsic physical properties or powers? This interesting interrogation brings us at once to the great point at issue between Materialists and Theists. And it must frankly be confessed that it is not easy to conceive of the possibility, that the present variety of material forms and modes of existence, could have resulted from different aggregations of the atoms of a single element, nor of fifty elements, by the exclusive action of any intrinsic affinities or properties of the elementary atoms, or forms of matter.

83. If there ever was a time when the atoms of a single element or of fifty elements, lay in a quiescent state, with undisturbed affinities, then that state must have remained for ever, if some disturbing cause had not been introduced to excite the action of those affinities, and produce combinations and new forms of matter: and when those affinities thus excited, had all exhausted their activity in such combinations, there they must eternally have continued, bound by the laws of primitive conjugation, unless some new disturbing cause had again been introduced; and so on, *ad infinitum*, matter would expend its chemical activity, in every action that took place, and be totally destitute of the ability to take on new action and to change its form, without the agency of some new paramount disturbing cause, which should relax or overcome the law of its previous affinities, and superinduce another law of aggregation.

84. To illustrate this point, let us suppose that the two kinds of air called oxygen and hydrogen gases, are original elements of nature; and that the atoms of which they are composed possess an intrinsic appetency or affinity, which being excited to action by the combustion of the two gases together, in certain proportions, will result in the production of a third and entirely different form of matter which we call water. Suppose this room to be filled with those gases, in the proportion of two volumes of hydrogen to one of oxygen, and that they are completely secluded from the action and influence of all other causes: here they would remain for ever, without entering into that combination which forms water, unless some new cause is introduced to bring their latent affinities into the necessary action; and if such a material cause were introduced, it must necessarily act upon the whole, and every atom of matter composing the two gases would enter into the formation of water; and here the active power would be expended, and matter would eternally remain in the form of water; unless again some new cause were introduced, which would overcome those affinities, the action of which resulted in the formation of water, and bring into play other affinities, whose action would produce other forms of matter; and here again would be the end of action from any intrinsic affinity or power of matter.

85. But perhaps it would be asserted that, with fifty elements, we

can form a countless number of proximate elements, and, with these, by the various possible combinations, and in the various possible proportions with the original elements, we can produce an infinite variety of substances and forms, which, acting upon each other as disturbing causes, can keep in eternal activity the affinities of matter, and thus cause an endless transformation of material things.

86 This, it is acknowledged, is true to a considerable extent, if all that is assumed concerning the properties of elementary matter be admitted; and yet, there is a limit far more circumscribed to the action of all these possible affinities and combinations and propositions, than is compatible with the reasoning and hypotheses of atheistical philosophy; a limit beyond which intrinsic atomic affinity and activity could not go; and yet, beyond which matter has been carried to a wonderful extent by laws of arrangement which counteract and suspend its more primitive affinities, and erect magnificent superstructures on the ruins of all previous forms and qualities. It will be seen in the progress of our investigations, that there are forms and modes of material existence, resulting from the action of powers and qualities and affinities, which are so entirely different from, and in fact opposite to, all that can be considered the more primitive atomic properties, that it is not possible they ever could have been, or ever can be produced by any intrinsic appetency or power of matter, even though we admit the existence of a thousand elements.

87. But, although modern chemistry has distributed matter into more than fifty elements or simple substances, yet is it not evident from what has been advanced on the present occasion, that the elements of nature must consist of a much smaller number? and do there not appear to be many and strong reasons for believing that there is but a single original element, or essence of all matter? How extremely subtile and refined and sublimated that material essence in itself may be, or what may be its distinction from, or proximity to, spiritual substance, it is not possible for us to form a clear conception, nor even for our imagination to shadow forth an indistinct idea!

88. Moreover, it is an interesting and important truth, that there is not a single known property or law of matter of which human science can with certainty affirm that it is essential to the nature of matter. Even gravitation, the most universal and all-pervading property or law of matter known to man, may only appertain to certain forms and conditions of matter, and not be in any degree an intrinsic property of its essence. And this is true of magnetism, and electricity, and molecular affinity, and every other known property. Indeed we know no more of the *nature* of matter, and of what are its essential properties, than we do of spirit. To some extent, we can appreciate its forms, and ascertain the properties connected with those forms, and the laws which govern their motions and changes, but beyond this our knowledge does not extend.

89. Starting then, in our synthetical career, with the primordial atoms either of a single element, or of several elements, we are compelled to acknowledge the agency and intelligence and design of a creating and controlling Cause, who gave existence to those atoms, and impressed upon them those virgin affinities or first laws of action, in obedience to which they entered into those primal combinations which

constituted the proximate elements of nature; and these, again, received new laws of aggregation, which resulted in other forms and qualities of matter. And thus, from step to step in the great architectural work, the delineating and directing finger of Omnipotence inscribed the constitutional laws of every form, and by those laws imparted to each form its own peculiar nature and properties and powers, and defined the modes of conduct to all material action. But how far these rudimental combinations and arrangements travelled down from the deep bosom of eternity, before they reached the present visible and tangible state of things, it is impossible for us to ascertain, without a knowledge of the first-made forms of matter. Nor is it of much importance to my present purpose that we should know, since our ignorance in this respect does not obscure the great principle of my reasoning. Those substances which we now call elements, are probably the results of many combinations of the primordial atoms (66), and although most of them have hitherto resisted the powers of analysis in the hands of man, it is almost certain that they are decomposed by the vital energies of organic forms (51), and perhaps also, in many of the operations of inorganic nature.

90. There is, however, the greatest probability that the pure gaseous form, or form of vapor, is that which matter in its progressive combinations first assumed within the bounds which lie between the known and the unknown of things; and there does not appear to be any just ground of doubt that the first palpable form of matter was limpid water. 'The form of our globe and of the moon, and all the planets and celestial bodies,' says Dr. Arnot, 'demonstrates their original fluidity.' The laws of constitutional relation between water and the vegetable and animal forms of matter—indeed the whole economy of nature strongly indicates, if it does not prove, that water was the first *visible* and *tangible* form of this material world. And Moses in his brief history of creation, tells us that before the heaven and the earth were formed, 'darkness was upon the face of the deep (or the abyss), and the spirit of God moved upon the face of the waters.'

91. Water was regarded by the ancients as one of the elements of nature, and some, indeed, considered it the single original element, out of which all other material things were formed. Nor was it till the close of the last century that its compound nature was fully ascertained, and it was found to be formed by the chemical combination of two kinds of air or gas.

92. I have already stated (87), that modern chemistry has distributed matter into more than fifty substances, which in the present state of science are called elements. Among these are two, which are denominated oxygen and hydrogen gases. Oxygen gas or air, in its separate and pure state, is a little heavier than the common atmosphere, of which it is a component part, and is the supporter of animal respiration, and the principal supporter of combustion. Remove it entirely from the atmosphere, and we could not breathe, and our lamps and fires would be immediately extinguished, and many other evils would result, which there will be occasion to notice in the progress of my subject. Hydrogen gas is about fourteen times lighter or less dense than the atmosphere, and is one of the most combustible substances known. If a quantity of oxygen gas be enclosed in one vessel, and a

quantity of hydrogen in another, with a tube leading from each vessel and uniting in a common mouth, and if the gases be permitted to pass out in certain proportions, and be fired at the mouth where they meet and mix together, a bright flame will flash up, and at the same time a heat will be produced, of sufficient intensity to burn iron like dry wood, with a brilliancy of light which the eye can hardly endure, and to melt down many minerals and other hard substances which the heat of a common fire will scarcely affect at all: the product of the combustion of these two gases is water.

93. Thus, from two invisible aeriform substances which burn with such intensity of heat and brilliancy of light, water is formed by their chemical combination in the act of combustion, and when thus produced, is one of the greatest extinguishers of combustion known in nature, and is many hundred times heavier than the same volume of the gases from which it was formed!

94. Nor is it necessary to suppose, that the water first formed was in a turbid state, holding, in a semifluid solution, a chaotic mass of crude and undigested matter, which gradually settled into solid forms, and thus produced the rocks and finally the earthy mould which covers them.

95. It is only the opinion that those different forms of matter which we call simple substances are, in their peculiar natures and properties, essentially and primordially different and distinct, which causes us to cling to the vague notion of a primitive chaos of partly fluid and partly solid matter, mixed together in a kind of semifluid paste or pudding, because, with our limited views of things, we cannot easily conceive how rocks and other solid substances could be formed, without different original, and appropriate kinds of matter, adapted to the structure of such substances.

96. But if we keep in view the principles which we have been contemplating, and the truth of which may be considered as more than probable—that all the different forms and substances and qualities of matter are but the results of different arrangements and aggregations of the same primordial atoms—we shall find no difficulty in understanding how rocks and other solid substances could be formed from pure transparent water. Besides, it is a matter of continual fact, that the various crystalline substances are so formed; and certainly we cannot consider it more incredible that such solid substances should be formed from a limpid fluid, than that they should be formed immediately from thin and invisible air, which is a fact of frequent occurrence in nature and in art.

97. The transformation of fluids into solids, which seems to possess no properties in common with the fluids from which they were formed, is a very common process in the laboratories of chemists, and by no means an unfrequent one in the great operations of nature.

98. It is not, therefore, in any degree necessary for us to suppose that matter, in its first visible and tangible state, consisted of a chaos of all the rudimentary substances mingled together in confusion, but still possessing each its distinct existence and peculiar character. Pure limpid water alone, with the surrounding atmosphere, and light and heat and electricity, contains amply sufficient material for all the purposes of nature in the magnificent architecture of our world of things.

99 Those substances which we call oxygen and nitrogen gases, being more primitive forms of matter than water, of course existed before it, and therefore the atmosphere, such or nearly such as now surrounds the globe, existed before the formation of the world of waters.

100. When the intimate connection between light and heat and electricity and magnetism is considered, and when we take into view the important parts which these agents probably performed in the progressive work of the original construction of the various forms of matter, we are philosophically led to suppose that they were the next productions in the order of creation. And according to the Mosaic record, after water was formed, light was commanded to be, and there was light; and it is now pretty fully ascertained, that if light is not simply a peculiar arrangement and condition of the primary atoms common to all matter; if light and common matter are not convertible into each other, as suggested by Sir Isaac Newton, it does not emanate from the sun, according to the doctrine of that distinguished philosopher, but is a substance so far independent of the sun as to be capable of existing without it

101. In intimate connection with light, came heat and electricity and magnetism. These new agents being brought into operation upon fixed constitutional principles, by the almighty and creative Energy, began to act upon the atmosphere and water, according to laws of constitution and relation prescribed by infinite intelligence and benevolent design.

102. Evaporation began to take place, and the waters ascended up silently in the invisible state of vapor; 'and the waters were divided from the waters,' and the firmament was established. At the same time new laws of aggregation were brought into action in 'the mighty deep,' and the limped water began to arrange itself in the beautiful and solid crystals of mineral structure. For even here, in this inorganic aggregation, intelligence and design preside, ordaining and exerting rigorous law; and every particle of matter, as by a kind of instinct, takes its constitutional place, with an order and precision and integrity inflexible as necessity and irresistible as omnipotence! observing with the exactness of geometry the lines and angles of the structure into which it enters, as if each particular atom were directed one by one, by the designing finger of the Almighty. And thus the fluctuating waters were composed into the 'everlasting rocks,' varying in nice peculiarities, according to the delicate variations of the constitutional laws of aggregation. And thus the foundations of the earth were laid and built up, and lifted their heads from out the bosom of the 'vasty deep,' 'and the waters under the heaven were gathered together into one place, and the dry land appeared.' *

103. Heat and frost and moisture, and various other agents acting upon the rocks which rose above the face of the water, caused a dis-

* Those geologists who oppose the idea that water was the first perceptible form of the matter of our globe, contend that the crystals of what are supposed to be the primitive rocks, are much more like those which we know to be the result of fusion, than those resulting from solution. But the idea which I have advanced in the text, is that primitive crystallization resulted from electricity or galvanic action on pure aqueous matter; in which case the crystals would more resemble those which result from fusion than those from solution, but as a general fact, would be much more regular and perfect than either.

integration of their surfaces, and by this means a body of gravelly earth was formed as a mitrix for vegetable seeds and roots. Thus was the inorganic world completed. Nice varieties of gaseous and fluid and solid formations continued to be produced by the ceaseless operations of nature. And deep in the bosom of the globe fires were spontaneously kindled, by which vast portions of the solid rocks were melted, and brought again into a fluid state, and earthquakes and volcanoes were produced: and by such means, the immense beds of unstratified rocks were formed, and the superincumbent layers thrown into disorder, and hills and mountains were erected, and molten rocks poured out upon the surface of the earth.

104. Such is the general hypothesis which one class of geologists have assumed concerning the formation of the globe. While another class, with equal confidence, and with numerous facts which favor their positions, have embraced the hypothesis that the matter of our globe was originally in a state of thin vapor, produced by intense heat, and that, as this body of vapor gradually cooled down, it became more dense, and in due time the surface became so cool that the matter began to consolidate and form a crust of rocks, which slowly increased in thickness inwardly, while heat and moisture and frost and other agents acting on the external surface, caused a disintegration of the rocks as already stated; and when some thousands of years had passed away, and numerous layers of stratified rocks had been superimposed upon the original crust, by the precipitation or deposition of matter held in aqueous solution, and derived from the disintegration of the primitive rocks, then the pent fires in the centre of the globe became impatient of their confinement, and rose up in their wrath, and burst through their prison walls, now strengthened by the continual accumulations of hundreds of centuries; and thus, not only hills and mountains were formed, but islands and continents were lifted from the bottom of the ocean, and made dry land, and portions of the unstratified rocks or original crusts were thrust up through the superincumbent layers, and thrown out upon the surface of the earth.

105. I say there are many facts which greatly favor this Plutonian hypothesis so much in vogue among geologists at the present day: and yet I cannot feel convinced that the objections against it are not more powerful than the facts in favor of it. Besides, I conceive that every fact which the advocates for this hypothesis adduce in its support, is perfectly compatible with the aqueous origin of the globe. But after all, it is of little importance to the argument which I have in view, whether the Plutonian or the Neptunian hypothesis is the true one; since, in either case, the general positions which I have advanced concerning the original forms and primitive combinations of matter are equally sustained Nor, indeed, is it of much importance to my argument, that any geological theory should be established.

106. The great points I wish to prove are, first, that the natural elements of matter are very few in number, and probably a single one; secondly, that essentially the same matter is common to all material forms both of the inorganic and organic world; and therefore the essential difference between inorganic and organic forms of matter, is not in the matter itself, of which they are composed, but exclusively in the constitutional laws of aggregation and arrangement; and thirdly,

that all the affinities, properties, and laws of matter, established and brought into action during the formation, and up to the completion of the inorganic world, necessarily ended in inorganic aggregations and forms, and beyond which it was not possible for them to go.

107. The first of these points I have shown to be exceedingly probable; the second is unquestionably true; and the third admits not the shadow of a doubt. To suppose that the action of inorganic affinities could terminate in organic arrangement, is to assume that it is possible for the same thing to be and not to be at the same time; and to say that organic affinities could grow out of any inorganic properties of matter, is equally contradictory and absurd. If inorganic affinities or properties are exerted, inorganic results necessarily take place; and no combination of inorganic material causes can possibly produce an organic effect. For it is only by counteracting and overcoming and suspending the inorganic affinities, and destroying the inorganic aggregations, that matter can be brought into organic aggregation, and established in the organic constitution. Hence it is always and to all extent necessarily true, that the inorganic affinities are directly opposed to the organic affinities; and therefore the latter could, in no possible way, spring from the former, nor from any results of the former.

108. The atheistical notions concerning the origin of organic forms of matter, and of mind, are therefore utterly unphilosophical, and entirely destitute of any foundation in scientific truth, and all attempts to account for vitality upon any principles appertaining to the physical or chemical properties of matter must necessarily end in error and absurdity. To say that life is the result of peculiar organization of matter, is obviously and egregiously absurd; because we *know* that organization is always and necessarily the result of vital action; and therefore, excepting the first act of creation, vitality has always produced organization, and propagated and perpetuated itself in and through organized matter; but has never been, and cannot, in the nature of things, ever be produced by organized matter not possessing life. And the notion that the organized matter of our world belongs to a state of things which has eternally existed, is entirely contradictory to all that we know of the nature of things.

109. The inorganic world left to itself, with all its properties and powers in continual activity and perpetual operation, would necessarily have remained for ever within the precincts of inorganic law and structure. The solitary ocean would have rolled on in its eternal flow and ebb of tides,--evaporation and clouds and rain,—lightnings and thunders and tempestuous winds, and raging hurricanes, and wintry storms,—and spring and summer skies, and balmy airs, and bright and glorious sunshine, and sultry heat,—and congealing frost,—and night and day, would have succeeded in endless and unfertilizing rounds; while on the surface of the solid and the liquid globe, and in its bosom, and deep within its bowels, the busy chemistry of inorganic nature would have carried on its unceasing processes, transmuting substances, and multiplying the varieties of forms and properties, and kindling subterraneous fires to burst into volcanoes, and to rend the globe with tremendous earthquakes, and heave the regularly concentric strata of its rocks into wild irregularity and disorder; dis-

turbing thus the smooth rotundity of its surface, and producing lofty mountains and deep valleys, and ploughing channels for the streams and rivers, and scooping out new dwelling-places for the ocean: but not a tree nor plant nor blade of grass, nor any other organic form of matter, could possibly have been produced by any or all of the affinities and properties and powers of that lonely and lifeless world!

110. Men, in the gloomy or the sensual darkness of their minds, and in the temerity of indomitable pride, may speculate as they will, but sound philosophy and the truth of science pause on the confines of the inorganic world, and are compelled to acknowledge the necessity of an intelligent and designing Omnipotence, to superinduce new laws of action and arrangement, and establish new constitutions, by which matter shall be set free from the dominion of its more primitive affinities, and lifted up above its former state of being, and *forced* into arrangements and structures and tissues and organs and systems, entirely different from any of its previous forms, by the action of affinities which cannot co-operate nor efficiently co-exist in the least possible measure, with any of the inorganic affinities: nay, indeed, which cannot act, but to resist and subdue the inorganic affinities; which cannot erect their own peculiar superstructures, according to their own specific economy, without overcoming and demolishing at every step the affinities and structures of inorganic matter (86).

111. How, then, could any primitive condition of inorganic matter ever have produced, by any of its intrinsic properties or powers, a single blade of grass, or the simplest form of vegetable existence? It is not possible! and such an opinion cannot be embraced without a credulity which shuts its eyes against the light of science, and far exceeds the darkest superstitions of the human race.

LECTURE III.

All forms of matter composed of the same elements—Water the principal material from which vegetables are formed—The different vegetable substances produced from the same materials—Each, its fixed laws of constitution and relation—Animal bodies not produced by inorganic or vegetable affinities—Essentially different—The constitutional economy of nature permanent—If man were cut off, matter could not reproduce him—Animal substances, how formed—The composition and properties of inorganic bodies—Organized bodies derive their existence from pre-existing organized bodies—Organic elements, how formed and arranged—Organic bodies consist of both solids and fluids—They take the type of the bodies that produce them—Life a forced state—Vitality resists gravitation—Resists the law of temperature—Organic bodies return to inorganic forms of matter when life ceases—Hibernating animals, how preserved—Transmutation of substances—Life terminates in death—Mutability of organic forms—Properties common to all organized bodies—Difference between animal and vegetable bodies—Properties peculiar to animals—The use of chemistry to physiology—Vitality decomposes chemical elements—The nature of things depends not on their matter but their constitution—Constitutional nature and relations of each and every thing.

112. It is, then, as already stated (106), by different aggregations of the same elementary atoms of which air and water, rocks and earths, are formed, that vegetable substances and forms are produced. Water is the principal material which enters into the vegetable structure. The atmosphere also affords a portion of the nutriment of vegetables; and light and heat are concerned in the activity of vegetable life, and in vegetable growth, and qualities and forms. But all these substances, or forms of matter, on entering into the vegetable organic structure, forego their inorganic forms and characters and qualities, and become vegetable organic matter. The oxygen and hydrogen and carbon of inorganic chemistry, by virtue of new laws, new actions and new arrangements, become vegetable sap, and this, by various new arrangements resulting from vital action, becomes solid wood and bark and leaf and blossom, and color and odor, and fruit and resin and gum, etc., etc. But while these compose the vegetable structure, and while vegetable life exerts its controlling energy, it cannot, with strictest propriety, be said, that there is any such substance as oxygen, or hydrogen, or carbon within the vital domain: these substances can only be detected as such, when they have been set free from the vegetable structure and arrangement, and have returned again to the inorganic state.

113. Yet, notwithstanding vegetable substances have their fixed and peculiar laws of constitution essentially different from those of inorganic arrangement, there is, nevertheless, such an exact adaptation of the constitutions of these different structures to each other, that the most determinate and fixed and important laws of relation exist between them.

114. Here, again, if the vegetable and inorganic world be left to itself, it is not possible for any, nor for all of its material properties and powers, separately or combined, to produce animal life and structure and organization, and its self-nourishing and self-propagating economy. If inorganic affinities predominate, inorganic structure necessarily results. If vegetable organic affinities predominate, vegetable structure necessarily results. They cannot possibly co-operate,

because they directly counteract each other: and if it were possible for them to be simultaneously co-efficient, they could not go together in the production of a third substance, differing from inorganic, and from vegetable organic structure, and of a higher order of nature than either; but of necessity from the nature of things, they would arrest each other and remain in belligerent equilibrio. Besides, if it were possible for laws of action and constitution to arise from any condition of inorganic and vegetable matter, by which animal life and structure and organization could be produced, such laws, in order to accomplish such systematic results, must necessarily arise from the nature of things, and therefore, of necessity, must be as permanent in their existence and activity as the nature of things from which they spring. But such are the constitutional laws and relations of things, that they cannot essentially alter their natures without ceasing to exist: *for the nature of things depends not on the matter of which they are formed, but on the laws of constitution by which the matter is arranged* (106). Hence, therefore, if it were possible for laws of action and constitution to arise from any condition of inorganic and vegetable matter, by which animal structure and organization and function could be produced, then of necessity, in the nature of things, such laws would still continue to exist and to produce their results; and living animal bodies would not depend on the vital power and economy for their successive origination, but on the physical laws by which they are first produced. Yet we know that these things are not so: and who with a sane mind can believe, that if every human being were, at this moment, destroyed from the face of the earth, matter, with all its inorganic and vegetable and animal properties and powers, could, in millions of years, or even an eternity of time, reproduce the human species, or raise a hair's breadth above the order of being which now exists next on the scale to man?

115. If animal matter were, in its ultimate elements, essentially different from vegetable and inorganic matter, then might we suppose that obeying laws peculiar to its nature, it entered into an arrangement peculiar to itself, without opposing or in any manner interfering with the inorganic and vegetable affinities: but when we know that animal matter resolved even to the experimental elements of chemistry, is in reality nothing but inorganic matter, common to all material forms and substances, we see that it is *not in any possible degree the nature of the matter, but the constitutional laws of arrangement, on which all the forms and properties and peculiarities of material substances depend.* Hence, therefore, of necessity, the laws of arrangement from which animal structure results, are not only opposed to the laws of inorganic and vegetable arrangement, but altogether of a higher order; superinduced by a Power extrinsic from matter, by an Intelligence adequate to the great designs of nature, and by a power competent for the fulfilment of its designs.

116. A truly philosophic and scientific mind cannot indeed ask for a more complete demonstration of the existence of an intelligent, omnipotent, and benevolent First Cause, than is afforded by an accurate knowledge of the laws of the various material structures and forms, and modes of existence.

117. By the controlling power of peculiar laws of action which

overcome and suspend the inorganic affinities, and which also demolish the vegetable structure, matter is set free, or rather forced from its previous forms of aggregation, and compelled to take on the arrangement, and enter into the structure, and compose the organs of living animal bodies; where it remains in reluctant vassalage, till, having fulfilled the purpose of the system, the subservience to the vital economy, it is regularly discharged from the vital domain—or until the vital power is wholly worn out or overcome and destroyed, when it returns again to the more primitive dominion of inorganic affinities and aggregations, there to continue in the simpler and more permanent forms of inorganic matter, or be subject to its various changes, until perhaps it is again forced into the comparatively brief endurance of vegetable or animal organic laws of life; and so on, in the perpetual round of inorganic and vegetable and animal structure, matter takes its course, obedient to the various laws which comprise the several constitutions of those forms.

118. Thus, from the same primordial atoms of which all vegetable and mineral substances are made, the living animal blood is also formed, simply by a different arrangement resulting from laws of action which neither existed in any of the previous forms, nor sprung from any of the previous conditions or properties of matter, but were instituted and established in a permanent economy by a supreme Intelligent and designing Power. By a different arrangement of the matter composing this same living blood, the cellular substance of the animal is formed. By a still different arrangement, the animal muscle is formed from the same blood; and by a still different arrangement of the matter of the same blood, it formed the living animal nerve, which is the most remarkable for its peculiar properties and powers, of any known material structure. And thus every solid and every secreted fluid of the body is formed from the blood, by the peculiar arrangement of the atoms of matter; and this is purely a result of vital power, acting and accomplishing its ends in direct opposition to the chemical affinities of inorganic matter, and differing essentially in its nature and effects from the vegetable organic economy.

119. Notwithstanding, therefore, all material bodies and substances are formed from essentially the same matter, by different arrangements of its primordial atoms, yet, by virtue of their different laws of constitution, organic and inorganic bodies and substances differ essentially from each other in their natures and properties.

120. Inorganic bodies, resulting from the more primitive affinities and simple aggregations of matter (100), may, according to the statements of chemistry, consists of a single one of those substances which are called elements; or of a combination of two of them; or of four of them, in double binary compounds; or of six of them, in triple binary compounds. They may also exist in the solid or liquid or gaseous forms; yet every organic body consists wholly, either of the solid or liquid or gaseous form of matter; and all its parts are alike in structure and properties, and may exist as well when separated into portions or broken into fragments, as when united in a single volume or mass. But whether solid, liquid, or gaseous; whether composed of one or more of the chemical elements, the aggregations and arrangements of the atoms of matter in every substance take place according to fixed

constitutional laws, and in a regular and determinate manner; so that the intimate structure of each form of matter is always true to its own nature. Still, however, the constitutional laws of aggregation in inorganic bodies do not define the shape nor determine the size of the general mass, and therefore, while their molecular arrangement is always strictly determinate and true to their nature, their general mass is either regular or irregular in shape, and large or small in size, according to circumstances, and the action of accidental causes, and without in the least degree affecting their nature or properties: and they are increased or diminished in size, or changed in shape, not by any internal economy of growth or decrement, but by the simple accretion of matter to, or attrition of, it from the surface.

121. Organized bodies, as we have seen (106), do not result from the action of the more primitive affinities of matter, but are produced by a permanently established constitutional economy, the intrinsic forces of which counteract and overcome those affinities, and bring the elementary atoms of matter into arrangements wholly different from those of inorganic substances (107); and the forces of this economy do not act, as it were, unembodied and at large on the natural elements of matter, but their operations are always confined to living bodies, consisting of a system of organs, in and by which they produce their peculiar effects, and transmute inorganic substances into the substances and structures and organs of living, vegetable, and animal bodies. All organized bodies, therefore, are, of necessity, produced only by the controlling power and action of the vital forces of living organized bodies; or in other words, all organized bodies necessarily derive their existence from preexisting organized bodies.

122. In the peculiar processes by which the vital economy transforms the common matter of the inorganic world into the organized matter of living bodies, those simple forms of organic matter are produced which are called the organic elements, and which, according to chemical analysis of dead vegetable and animal matter, are composed (generally speaking) in the vegetable of three, and in the animal of four, of those substances called the inorganic elements. But as the peculiar combinations and arrangements by which the organic elements are formed, can only be effected by the vital forces and actions of the living organs, so it is impossible by any other means or in any other manner to produce the organic elements.

123. When the living body has elaborated its own elements from the various, and even very different materials on which its assimilating forces act, it distributes them to every part of the system by an internal economy peculiar to organized bodies, and in the most regular and determinate manner arranges them in its several structures and organs, and thus incorporates and identifies them with itself.

124. These interesting processes and results require that organized bodies should be composed of both solids and fluids; of solids different in character and properties arranged into organs, and these endowed with peculiar functional powers, and so associated as to form of the whole a single system; and of fluids contained in those organs, and holding such constitutional relation to the solids as that the existence, the nature, and the properties of both, mutually and necessarily depend on each other.

125. As the vital forces by which organized substances are produced, always and of necessity act in and by the organs of living bodies (121), as intrinsic constitutional properties or powers, so the operations and results of the vital economy are governed and determined by the organic constitution of the body in which it acts; and hence, all organized bodies not only derive their existence from pre-existing organized bodies, but necessarily also take on the type of the bodies from which they spring, and are of the same internal and external structure and form; and when no disturbing causes modify the result of the general organic economy, they naturally come to the same size. And consequently, all organized bodies have, within a certain range, their specific proportions and shape and size; by which, as a general fact, they are not only distinguished from inorganic bodies, but specifically from each other.

126. Not only the intimate structure, but the general conformation of parts, and the adjustment of properties in organized bodies, therefore, depend on the action of the vital forces and the general control of the vital economy; and life maintains its dominion over the organized mass, and preserves in all its parts an integrity of structure and of function, not only by counteracting and overcoming the inorganic affinities, in its process of assimilation and organization, but by resisting the action of foreign powers and influences. For, while the chemical affinities of inorganic matter are more completely overcome and subdued by vitality within its own organic domain, chemical agents and the physical laws of nature are continually exerting their influence on living bodies, causing an expenditure of vital power, and tending to the destruction of the vital constitution, and the decomposition of the organized matter.

127. From the commencement to the termination of the vital existence of organized bodies, therefore, life maintains a continual conflict with opposing forces: and hence it has with beauty and propriety been said, that 'life is a forced state,'—'a temporary victory over the causes which induce death.'

128. The common law of matter, which in our world causes all bodies to tend to the centre of the earth, acts equally on inorganic and organic bodies, and, therefore, it is in direct opposition to this law, that vegetable vitality raises up the sap, and constructs the vegetable form; and almost every function and action of animal bodies, is performed in opposition to the law of gravity. The ascending fluids; the act of standing, and walking, and raising the hand, etc., etc., are all vital performances, in opposition to the law of gravitation.

129. Again, it is a common law in physics, that heat always seeks an equilibrium of temperature in contiguous bodies; that is, the hotter body always imparts its heat to the colder one in contact, until they are both of the same temperature: and this law appertains to all forms of matter, inorganic and organic. Living bodies give off their heat to colder bodies in contact, the same as inorganic bodies, and but for their peculiar powers, would soon become of the same temperature of contiguous bodies or the surrounding medium. By virtue of vitality, however, they are enabled to maintain a temperature peculiar to themselves—not by suspending or counteracting the common law of heat, but by generating heat, according to the wants of

the system; or by disposing of its excess in the formation of vapor. Even the lowest order of vegetable life, when in a state of activity, preserves a temperature peculiar to itself; and this is more remarkably the case with animal life, and especially in the higher orders of animal existence. The temperature of the human blood, for instance, is, in a healthy robust man, about ninetyeight degrees; and it hardly varies two degrees from this point, whether the temperature of the surrounding atmosphere be twenty degrees below zero, or two hundred and sixty degrees above it: but destroy vitality, and very soon the blood will be of the same temperature of the surrounding air.

130. When heat acts on inorganic bodies, it raises their temperature by directly communicating itself, or its quality or condition, to them; but living animal bodies mostly or entirely resist the action of extrinsic heat, and their temperature is very little, if at all, elevated by its direct communication to them as *heat*. When extrinsic heat, therefore, serves to elevate in any degree the temperature of the living animal body, it does it in a twofold manner: positively and negatively. Positively, by acting as a stimulus on the nervous system, and through that, on the organs and vessels generally, and thus increasing vital and functional activity; and negatively, by elevating the temperature of the surrounding medium, and thus preventing the radiation of intrinsic heat. Hence, the more healthfully vigorous the vital power is, in animal bodies, the better are they enabled to sustain the extremes of cold and heat.

131. Organic arrangement of matter, being as we have seen (106) the result of vital forces which counteract and suspend the more primitive affinities of inorganic matter, depends entirely for its permanence, on the controlling power of vitality: hence, when organic arrangement is destroyed, it is always by the mastery of the inorganic affinities, asserting their prior claim to the organized matter; and consequently, organic bodies when they cease to live, begin immediately to decay; or, in other words, their matter begins to return to the dominion of inorganic affinities and laws, and to enter into inorganic aggregations and forms. But while vitality maintains its predominance, it resists the action of the principles of decay, and preserves the matter within its precincts, in its living organic nature and condition and powers. Thus vegetable and animal bodies being deprived of their vitality (unless artificially preserved) soon decay and pass into inorganic arrangements and forms of matter: yet vegetable seeds and roots have been preserved by their vitality for thousands of years, with all their properties and powers so perfect, that even after a lapse of centuries, on being placed in a genial soil, they have vegetated, and grown like the productions of the preceding year. And, in like manner, some of the animal creation, such as toads and frogs, have been preserved by their organic vitality, in a state of suspended animation, for hundreds and thousands of years; and on being set free from their incarceration in the bosom of solid rocks, far beneath the surface of the earth, having awakened again from their living death, and exerted their powers of locomotion. But if the vitality of those bodies be extinct when they are first surrounded by the matter of the rock, and when that matter is in a fluid state, or if they be surrounded when not in a state of hibernation or of suspended animation, and their vitality be

destroyed, the fluid enters into the cavities of the bodies, and by its peculiar qualities so acts upon the organized matter, that it foregoes its organic arrangement, and takes on the aggregation of the rock in which it is entombed, retaining only the general outlines of its animal form; and thus becomes an animal petrifaction. Vegetable substances are also frequently petrified or transmuted in the same manner. 'I have often seen amidst quantities of mineral ore brought into this city for manufacturing purposes,' says Mr. John Far, an extensive practical chemist of Philadelphia, 'pieces of wood, which at one end were partly carbonated, in the middle completely carbonated, and at the other end changed into sulphuret of iron, hard enough to strike fire with a flint.'

132. Thus in every case, so long as vitality maintains its dominion over the matter which is forced into its organic structure, it preserves that matter from the power of inorganic affinities, but when that conservative principle is destroyed, matter returns, as by a more deeply written instinct, to its more primitive and inorganic forms.

133. Vitality, as I have already stated (108), is not in the least possible degree the result of peculiar arrangements of matter, but the peculiar arrangements of matter composing organic bodies are always the results of vital action, and depend on vital power and vital action for their continuance; and hence, living bodies not only derive their origin from pre-existing beings like themselves (125), but also, in a perfect state, always possess faculties and powers by which vitality perpetuates itself, in connexion with organization, in the successive propagation of organized bodies. And hence also (126), when that peculiar condition of organized bodies on which the operations of the vital economy depend, is either violently destroyed or gradually worn out, the vital actions cease, and life becomes extinct; and the individual existence of the body terminates in death, and the matter composing it yields to the action of inorganic affinities, and dissolution and decay succeed. As a general law, therefore, organic bodies, from their very nature and condition, are less permanent in their modes of existence than inorganic bodies are.

134. See, in yonder peaceful and silent retirement, that gray, moss-covered rock, rendered hoary and venerable by the lapse of centuries, and deeply wrinkled in its ancient brow by the waveless and noiseless, but swiftly gliding current of time. Beside it stands, in full development and early vigor, a noble oak whose large and powerful branches stretch abroad, in bold defiance of the storms of heaven. In the shadow of that stately tree, and under the covert of that venerable rock, a little boy, full of health and buoyancy, and vivacity of youth, is happy in the enjoyment of his childish play. To one who did not know the history of man, or understand his nature, it would seem as if that human form, in its health and activity and power, might be as permanent in its existence as that tree and rock.

135. Years pass away, and lo! beside that rock, and in the shadow of that tree, leaning upon the handle of his scythe, in the full stature and sturdiness of manhood, he that *was* that boy, again appears. Health and athletic vigor; energy of mind, and peacefulness of heart; bright prospects, and sustaining hopes, in all the fulness of life's prime, are his. He looks far abroad over his fertile fields, and in the dreamy sunshine of his soul contemplates the prosperity and happiness of

coming years. But in that bright prospective vista of his thoughts, there comes no intimation to his mind, that in those future years so full of present hope, old age, with all its paralyzing and withering influences, will come upon him, to take away his strength and elasticity, and impair his senses, and, to him, throw over every thing in nature, the twilight mistiness, if not the melancholy, of declining life. But years pass on, and there remains that rock, unaltered in its aspect and its form, save where, perhaps, the violence of man hath made a fracture on its insensible front, and it may be, the inclemencies of heaven—humidity and frost, and the eternal unebbing flow of time—have worn more deeply the wrinkles of its brow: and there that oak, in its full power and stateliness and verdant health, continues still beside that ancient rock; no marks of time's destructiveness are on it; save here and there, on the extremity of some long branch, a leafless and dry twig appears. But, lo, where but as yesterday that boy was seen, in the spring-tide and joyfulness of youth, now stands an aged man, bowing in palsied feebleness upon his staff, and thinking how like a hurried dream his life has been. He looks upon that rock and on that tree as the associates of his childhood; and they remind him of his youthful days, and bring back upon his chilled and aged heart something of the warmer spirit of those years of childish cheerfulness and hope: and it hardly seems reality to him, that such a change has passed upon him in the brief lapse of intervening time, which has stolen from him, even as the oblivion of a single night! The rock, the tree, and all the face of nature, seem the same as when in infancy he first beheld them; but he is changed! He *feels* that he is changed! The bounding pulse—the elastic step—the buoyant spirit—they have passed away, and left him in the tottering feebleness of hoary-headed age! A few more years pass on, and that old man is gathered to the dead, and his organic tenement returns to inorganic and insensible forms of matter; and other generations come to make acquaintance with that rock and tree, and pass through life with all its hopes and fears, and joys and griefs, from childhood to old age, and die and moulder back to former dust! Thus, in succession, generations rise and fall: till by and by, the years are numbered even of that tree; and death begins to manifest itself in the leafless and dry branches of its top; and soon its verdure and its foliage wholly disappear, and the dead trunk and limbs stand hoary as the aged man; and in a few more years that tree is prostrate on its native earth, and silently decays beside that solitary rock, which still remains but little changed in form and size and aspect, from what it was, even centuries before the tree first sprang from earth within the precincts of its shadow.

136. Thus organic bodies begin their existence, and gradually grow up to maturity; and then decline and die, and decay, and pass into other forms of matter, in comparatively brief periods of time; while inorganic bodies more permanently exist, exempt from death, and from those internal changes and effects which impair and finally destroy the constitutional power of organic structure and arrangement.

137. The properties already stated as peculiar to living organized bodies, are common to all vegetables and animals. All living material beings, vegetable and animal, derive their origin from pre-existing bodies of the same kind; and possess the faculties of nutrition and

reproduction, and alike terminate their peculiar modes of existence by death. Yet the animal kingdom is as distinct from the vegetable, as the latter is from the mineral kingdom : and although animals partake of several physiological properties and powers and conditions, in common with vegetables, nevertheless the constitutional laws of arrangement in animal matter, differ as essentially from those of vegetable, as the latter do from those of inorganic aggregation. Hence, animal structure is of an entirely different nature from that of vegetables, and possesses properties and powers peculiar to itself.

138. The great fundamental endowments distinguishing animals from vegetables, are, sensibility, consciousness of being, volition, and voluntary action or motion, out of which grow a number of important and interesting faculties and peculiarities.

139. According to the technical language of chemistry, vegetable matter, as a general statement, is formed by a peculiar combination of carbon, oxygen, and hydrogen ; while animal matter is formed by a peculiar combination of nitrogen, oxygen, hydrogen, and carbon. Several other simple substances are also said to enter into the composition of vegetable and animal bodies. But these statements are assumed rather for the convenience of theory than as being exact expressions of what is strictly true in the nature of things The great fondness of modern chemists to account for all the phenomena and results of vitality upon chemical principles, has too frequently led them to trespass on the prerogatives of life, and thus retard the progress of physiological science, by preventing that investigation of the vital forces and actions, which is necessary to a full ascertainment of the laws of life. It should be ever remembered, that no organic substance can be separated from the vital control, and subjected to chemical experiment, without so essentially altering the character of the substance, as to render it impossible for the chemist to affirm, from the results of his experiments, with any degree of certainty, what is true or not true of the peculiar processes of the living organic system. It is therefore much more safe and philosophically accurate for chemists to say what inorganic forms or kinds of matter result from a chemical analysis of organic substances, than it is for them to state that organic substances are composed of such and such chemical elements or kinds of matter. We know, it is true, that all material bodies are composed of that common matter of the world, which modern chemistry has distributed into more than fifty elements; and we know that in manufacturing its various organic substances out of that common matter, the vital economy employs more of some of those elements than of others. We also know that some of those elements or forms of matter are much better adapted to the purposes of the living body than others; but we have no right to assume that the vital forces possess no higher energies of analysis than are exerted by the chemical agents of the inorganic world; nor that their principles of combination in any respect resemble those of inorganic chemistry: on the contrary, we have reason to believe that vitality decomposes all those substances used in its economy, which chemists call elements; and that in arranging its various organic substances and structures, its synthetical operations are very different from those of inorganic chemistry. It is therefore purely hypothetical to assert that oxygen, and carbon, and hydrogen, and

azote, and other chemical elements, as such, combine in the vital processes, to form the various substances and structures of the organic system. Nevertheless, it remains equally true, that the only essential differences between the various organic and inorganic forms of matter, consist in, and spring from, the constitutional laws of arrangement which govern their component particles and *constitute the peculiar nature of each form.*

140. The most interesting and important principles, therefore, which are presented to our consideration by these investigations, and which should make the deepest impression on every mind, are these:---THE NATURE OF THINGS DEPENDS IN NO DEGREE ON THE MATTER OF WHICH THEY ARE FORMED, BUT ENTIRELY ON THE CONSTITUTIONAL LAWS OF ARRANGEMENT AND STRUCTURE, FROM WHICH THE PECULIAR FORMS AND PROPERTIES OF THINGS RESULT; and, consequently, it is necessarily true, not only that each particular form of matter has its specific laws of constitution, but also that the constitution of each particular form is so exactly adapted to the constitution of other forms of matter, in relation to which it exists, that the most definite, and fixed, and inseparable laws of relation are established between all material forms; binding the universe together in one great and intimate community of interests, on principles as fixed and permanent and as unalterable as the nature of things.

141. Thus, the proximate elements of nature were constituted with definite relations to each other; and so on, as matter travelled down from its unimaginably subtile, and almost spiritual essence (87), combining (it may be, its essence and its proximate elements in a thousand modes before it reached those forms which human science regards as simple substances), each peculiar form of matter, throughout all the range, was constituted with fixed and permanent relations to all other forms; and, continuing on in the progressive work of conformation, the same principle pervaded all material existence.

142. Thus, water has not only its fixed and necessary laws of constitution, but also its constitutional laws of relation to the gases of which it is formed, and to every thing in the mineral kingdom formed from it; and thus, the vegetable sap has its own peculiar laws of constitution, and its fixed and precise constitutional laws of relation to water and the atmosphere, etc.; and the woody matter, and bark and leaf, and blossom and color and fragrance and fruit, etc., of vegetables, have all their particular laws of constitution, and their definite laws of relation to each other, and to the sap and to the atmosphere, and to heat, and light, etc.: and thus, again, the animal blood has its fixed laws of constitution, and its equally fixed and necessary laws of relation, to the aliment from which it is formed, and to water, and the atmosphere, etc.; and the bone, and cartilage, and muscle, and nerve, and all other forms of matter in the animal system, have their fixed and necessary laws of constitution, and their necessary laws of relation to each other, and to the blood from which they are formed.

143. There are also many interesting laws of relation existing between the inorganic and vegetable and animal kingdoms, of a more general and obvious character, which spring from the constitutional nature of things. Thus the vegetable economy has its relations to the

nature and qualities of the soil, and atmosphere—to climate and seasons —to day and night—to heat and gravitation, etc., etc.; and the vegetable economy, to a great extent, elaborates from inorganic matter, the substances on which animals subsist; and in return vegetables receive a portion of their nutriment from animal excretions. Carbonic acid gas, which is thrown off in such immense quantities by animal respiration and perspiration, is, when received into the lungs without a mixture of atmospheric air, almost instantaneously destructive to animal life; or, in other words, it is wholly unfitted to sustain animal respiration: but the vegetable economy, at least during the day, decomposes this gas, and retains its carbon as vegetable nourishment, and sets free the oxygen, which is the peculiar property or constituent principle of the atmosphere that supports animal respiration.

144. But these important and interesting relations are too numerous, and in many instances too intricate to admit of a full exhibition at this time. I shall, however, have occasion to speak of some of them which are most important to my subject, when I come to consider those particular points to which they more immediately belong. Suffice it now to say, that throughout the universe of created things, the laws of constitution and relation (146) compose the great permanent net-work in whose sustaining meshes all material forms and beings subsist. And, therefore, every thing in nature is bound to its general condition, by laws innumerable, which cannot be violated with impunity. And man, whether he will acknowledge it or not, is, in his constitution and relations, such that he cannot move nor breathe nor exercise volition without obeying or violating penal laws!

LECTURE IV.

All solids formed from fluids, in the mineral, vegetable, and animal kingdom—Chemical analysis and physiology—Phosphorate of lime in bones—Laws of vital combination unknown—From chyle and blood, solids formed—The department of the physiologist, what?—of the anatomist, what?—of the chemist, what?—How far chemistry can aid physiology—Chyle, its character—all the body formed from it—its properties nearly the same, whatever the food—The blood—all the substances of the body formed from it—Three general kinds of solids—Cellular, muscular, and nervous tissues—Globular form of the elementary filaments—The nature and properties of the three general tissues—These form all the organs—Their distribution and arrangement in the system—Natural order of development—Internal organs—External frame—Great divisions of the body—Arrangement of the serous membrane—its character—The bones—their number and arrangement—Cartilages, their station, and uses—General skeleton—Original state of the bones—The structure and character of cartilages and ligaments—Properties of the muscle—distribution and functions—Voluntary and involuntary muscles—Tendons—Number of muscles—Arrangement of voluntary and involuntary muscles—Muscles not reproduced.

145. It is an interesting fact, that so far as human knowledge extends, all solid bodies are formed from fluids. In the mineral kingdom, the internal structure and general form of some solid masses indicate a previous state of fusion, or fluidity, produced by heat or electricity; while others strongly indicate, if they do not prove, a state of previous solution, or aqueous fluidity of their matter.

146. In the vegetable kingdom we know that all the solid, as well as other substances in the plant or tree, are formed from the sap, which

in the radicles that absorb it from the earth, is apparently little else than pure water, and which is gradually changed into the vegetable nature, and determinately arranged in the vegetable structures, by the peculiar powers of the vegetable economy. And in the animal kingdom also, we know that all the solid, as well as other substances composing the living body, are formed from the thin watery fluid called chyle, which is elaborated from the digested food of the alimentary canal, and gradually converted into living blood, and diffused throughout the system, and arranged into solids and secreted into other fluids, by the peculiar energies of animal vitality.

147. When the chyle and blood, and bone and muscle, and the various other solids and fluids of the system, have been elaborated by the vital economy, chemists take these several substances and subject them to chemical experiment and analysis, and when they have resolved them to the simplest forms peculiar to the decomposition of animal matter, they denominate the substances thus obtained the organic elements; and these again are resolved to the ultimate chemical elements, or purely inorganic forms of matter. And thus we are furnished with a chemical nomenclature of the elements that compose the living animal body. And learned physiologists, taking these results of the chemical analysis of dead animal matter, gravely attempt to account for most or all of the operations and effects of the living organic economy, on the principles of inorganic chemistry; and to teach us what chemical elements combine, and in what proportions, to form the several substances of the organic system. But it must be perfectly obvious that most of their reasoning is purely hypothetical, for it assumes that the experimental elements of chemistry are the real elements of nature; or, at any rate, the vital forces cannot decompose them; and, therefore, that the chemical decomposition of *dead* animal matter, demonstrates the vital composition of *living* animal matter. But, if any given number or proportions of the chemical elements, as such, combine to form any one animal substance, why is it not possible for the manufacturing powers of human science, with the same elements, to make any approach to the results of the vital processes (51)?

148. The atheistical philosopher sneeringly tells us that the human bone was not made by a God, as the ignorant superstitiously believe, but that it is composed of gelatin, phosphorate of lime, etc., and that these are formed by peculiar combinations of oxygen, hydrogen, carbon, azote, phosphorus, etc. But can such philosophers take these elements and compose the human bone? Or do they seriously believe that there is any power or means in the material universe by which the human bone can be composed, except the vital power and economy of the living animal system? Whether phosphoric acid and lime, *as such*, enter into the vital composition of the animal bone or not, it is not possible for the atheistical philosopher to prove that they do; and science affords him less evidence of the fact, than it does that the peculiar economy by which alone in nature the animal bone is formed, was originated and established by an intelligent Creator. Nor would it be an easier matter for the chemical physiologists to demonstrate that the gelatin which so largely abounds in animal bodies is formed from the albumen of the blood by a chemical process which abstracts

from it a portion of its carbon, *as such*; nor, indeed, can it be proved that oxygen, or carbon, or any other chemical element, *as such*, passes through the vital operations into the living results, retaining its peculiar nature and properties, or without entirely foregoing the nature and qualities which it possessed as an inorganic substance.

149. All we know with certainty is, that when proper substances are received into the appropriate living and healthy organs of the animal system, they are, by powers and processes peculiar to that system, converted into chyme, chyle, and blood, and from the blood into several distinctly different solids and fluids, possessing each its peculiar nature and properties; the solids being so arranged as to form the several organs of the system, and the fluids being contained in those organs in such state and conditions as the welfare of the vital domain requires.

150. To ascertain as fully and as accurately as possible the properties and powers of the living solids, separately, and the functional powers and performances of the several organs formed by particular arrangements of their solids, and the nature and purposes of the fluids, and the general and particular laws and conditions which govern and affect the vital economy; in short, to ascertain as far as possible all the properties and powers and operations and effects of the living body, is the appropriate business of the physiologist. When the body is dead, the dissection and description of its several parts, organs, tissues, etc., is the appropriate business of the anatomist; and the analysis of the dead animal matter into proximate or ultimate elements, is appropriately and only the business of the chemist.

151. Chemistry, therefore, can tell us what forms of inorganic matter result from a chemical analysis of dead animal matter; but she cannot tell us what forms combine to compose the living organ. She cannot inform us *a priori* whether mineral or vegetable or animal substances are best adapted to the alimentary wants of man; nor can she with any certainty direct us in the selection of even those substances which experience has proved to be nourishing to the human body. She can decompose the atmosphere, but she cannot tell us which of its elements qualify it to support animal respiration. If, by reason of impaired functional power in the human stomach, foreign acids should be generated in that organ by the action of inorganic affinities, chemistry can inform us what will neutralize these acids, but she cannot tell us whether the alkalies which she prescribes will not do more mischief to the living tissues of the organ than the acids she seeks to neutralize, and, therefore, she cannot tell us whether her very remedy will not be a powerful means of perpetuating the evil she seeks to remove: in short, she can in no respect, from her knowledge of the chemical elements, or their laws of combination in the living body, tell us what is salutary or baneful to the vital weal. All this we learn only from the living body.

152. While, therefore, all due honor is paid to the highly interesting and important science of chemistry, the sciences of physiology and of therapeutics should be exceedingly cautious how they invoke her aid. So far as chemistry can assist the physiologist in ascertaining and defining the external relations of the living body, she is useful to him; but more than this she cannot do, with that certainty which should inspire his confidence.

153. The most simple form of the animalized matter composing the living body is the chyle, which is elaborated from the digested food in the alimentary canal. This, when it first enters the radicles of those capillary tubes which conduct it onward towards the blood-vessels, is a very thin pearl-colored fluid, apparently homogeneous, and, by chemical analysis, is almost wholly resolved into water. And so far as *chemical* scrutiny has been able to discover, this fluid is almost precisely the same, whether elaborated from vegetable or animal food.* As it proceeds along the vitalizing tubes, it gradually becomes more and more albumenous and fibrinous; and with scarcely any appreciable difference in regard to these properties, whether the food be vegetable or animal; but in regard to vital properties and effects, differing very considerably, as we shall see hereafter (466).

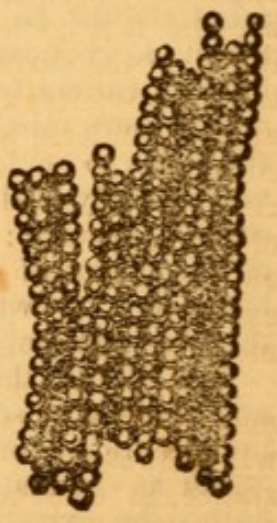
154. When the chyle enters the blood-vessels, it approaches very nearly in character to the blood, which is itself *apparently* a very simple, homogeneous fluid, the chief constituents of which are essentially albumenous; and of which, four-fifths may be resolved to water by chemical decomposition.

155. From the blood, the vital economy elaborates all the substances and forms of matter composing the animal body, constructing, with marvellous skill and wisdom (with reference to final causes), the blood-vessels and the alimentary tube, with the assemblage of organs associated with it for the purposes of nutrition, and the outer walls of the body with its limbs and organs of external relation.

156. The solid forms of organized matter thus inexplicably and wonderfully elaborated by the vital economy from the fluid blood, consisting of membranes, and nerves and muscles and tendons and ligaments and cartilages and bones, may all be reduced to three general kinds of substances—the gelatinous, the fibrinous, and the albumenous; which, in the simplest language of modern physiology, are denominated the CELLULAR, the MUSCULAR, and the NERVOUS TISSUES.

157. Some eminent physiologists assure us that the elementary structure of the animal tissues is a delicate arrangement of minute globules; and that this is alike true of the cellular, muscular, and nervous tissues (Fig. 1). Indeed, it is said that the fluid as well as the solid parts, both of animals and plants, abound in these minute globules. In regard to the size of these globules, there is considerable difference of opinion. It has been asserted by some, that a globe of about the eight thousandth part of an inch in diameter, is the elementary organic molecule of which every solid of every animal body is formed. Others contend that the size of the molecules differs in the different tissues, and even in different parts of the nervous system --being, it is said, largest in the brain proper, somewhat smaller in the little brain, still smaller in the medulla oblongata, smaller still in the spinal marrow, and smallest and most opaque of all in the nerves. These views may be correct; but in the present state of our knowledge on this

Fig. 1



* See Note to 465.

subject, we cannot rely with entire confidence on the results of microscopic investigation.

158. The gelatinous substance, in its various forms of proper cellular tissue, membranes, tendons, ligaments, cartilages, etc., is the most simple of all the animal solids, and the lowest in the scale of vitality and vital endowment. Its properties are cohesion, flexibility, elasticity; and in some of its forms, extensibility. These properties are, none of them, peculiar to organized matter; yet the elasticity of the cellular tissue, which is a very important power in the vital functions, is probably, to a very considerable extent, a vital endowment; as it is much greater in the living body than it is after life is extinct.

159. The muscular tissue, composed of the fibrinous substance, is of a higher order of animalization and vital endowment than the cellular tissue. It possesses the two important vital properties of excitability and contractility. The former renders it capable of being acted on by stimulants, and the latter of contracting or shortening its length, under the action of stimulants.

160. It is impossible to say how far we can subject the animal tissues to our analytical investigations, without effecting an *essential* change in their nature; and therefore we cannot with entire certainty affirm that the organized substance which we examine and on which we experiment, is precisely the same as when constituting a healthy portion of the living body. It is under this disadvantage and incertitude that we always necessarily labor when we attempt to ascertain the elementary character of any of the animal solids; or even of any of the results of vital action; and it is to a considerable degree under this disadvantage that physiologists affirm that the nervous tissue is essentially albumenous. But, as I have already stated, it is of comparatively little importance to the physiologist to know the chemical composition of the animal solids. It mainly concerns him to know the vital powers and properties and functions of those solids when composed and arranged into organs: and in regard to these, there is little necessity for ignorance or uncertainty on any important point.

161. The nervous tissue is the highest order of organized matter, and is endowed with the most peculiar and wonderful vital properties. In the descriptions of anatomy, it is said to consist of two apparently distinct substances. The one is sometimes called cineritious, because it is generally the color of ashes; sometimes cortical, because it lies on the surface of the brain like the bark of a tree; and sometimes, from its apparent consistency, it is called pulpy. It is said to appear, under a powerful microscope, to be principally composed of a congeries of blood-vessels. But the truth is, the real structure and character of this substance is little understood. Some consider it a kind of matrix or ganglion by which the real nervous substance is produced and re-enforced; while others believe it to be the more refined and exalted part of the nervous substance, in which the sensorial power more especially resides. All this, however, is nothing but conjecture.

162. The other substance, from its resemblance to marrow, is called medullary, or in contradistinction to the cineritious, it is called the white substance, and more recently it has been called the fibrous substance, in contradistinction to the pulpy. It is of firmer consistence than the pulpy, and the matter of which it is composed has, in our

own day, been ascertained to be arranged in the form of minute and delicate fibres.

163. In every portion of the nervous system, which constitutes a distinct nervous apparatus, the pulpy subtance is found associated with the medullary or fibrous, in some of its parts. Sometimes investing the surface, as in the case of the brain; and sometimes situated more internally, as in the spinal marrow.

164. The peculiar vital powers of the nervous tissue are two, the nervous and the sensorial.

To the nervous belong the vital properties concerned in the functions of digestion, absorption, respiration, circulation, secretion, organization or the processes of structure, and the production of animal heat. The transmission of external impressions to the centre of perception, and of the stimulus of volition to the voluntary muscles, have also been classed among the nervous properties, but it is questionable whether the former of these two powers or functions does not more strictly belong to the sensorial power of the nervous system.

165. To the sensorial power belong consciousness, sensation, the perception of external impressions and internal affections, reflection, volition, and other faculties called intellectual.

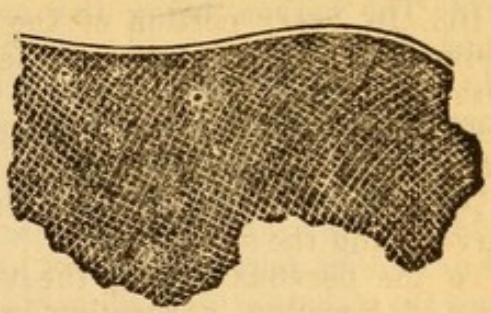
166. Sensibility is generally considered the fundamental sensorial power; yet the brain, which is regarded as the more special seat and centre of the sensorial power, is, in its own proper substance, entirely destitute of sensibility or the power of sensation, in the ordinary meaning of the word. Animal sensibility, in the physiological signification of the term, is the power of sensation in the living nervous tissue, and sensation is an affection of the living tissue, of which the centre of perception is not only conscious, but always refers it to some particular locality. Animal sensation, therefore, not only makes the mind conscious of a body, but of particular parts of the body. This is not necessarily true of the sensorial power. We may gaze on an interesting and absorbing scene, or sink into a deep reverie, and lose all consciousness of a body, and be only conscious of a mental existence. We *think*, it is true; and we are conscious of our thoughts; but we are not conscious of the organic machinery of our thoughts, and still less do we refer our thoughts as sensations to any particular part, or organ of the brain. At such times we are not even conscious of a brain, nor of a head, nor any thing of a corporeal nature. To say, therefore, that sensibility is the fundamental sensorial power, is to give the term sensation a very broad signification, and to confound things, between which, in the common understanding, there are very important differences.

167. These three general tissues the cellular, muscular, and nervous, together with the more solid matter of the bones, compose all the organs and parts of the animal system; and, in entering into the texture of the several organs, each tissue carries with it, and retains during life and health, its own peculiar vital properties, and these together, become the fundamental principles of functional power in the organs.

168. The cellular tissue constitutes a kind of reticulated frame-work to the whole body (fig. 2); giving shape and proportion to each particular organ, and connexion to all; and entering so intimately and extensively into every part, that if the other substances were entirely ab-

stracted, the cellular tissue would perfectly preserve, not only the general outlines of the body, but the definition and proportions of each particular organ and part.

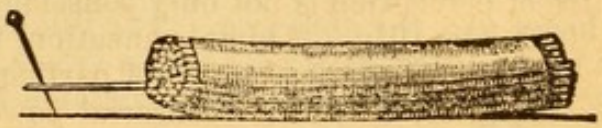
Fig. 2.



169. Every bone partakes largely of this substance in a spongy or cellular arrangement, the interstices of which are filled with a fluid, separated from the blood, which becomes hard, and gives the peculiar solidity to the texture. Some of the bones are united by this substance in the form of elastic cartilage, or fibro-cartilage, as the vertebræ of the back, the ribs to the sternum, etc., and the articulating surfaces of the bones are also sheathed with cartilage : and the joints are strongly secured, and different bones bound together by another form of the same substance, called ligament. This last form is likewise expanded into a fibrous membrane, which surrounds every bone in the osseous system, and also surrounds the cartilages and forms sheaths for the tendons.

170. Besides this distribution to the bones, cartilages, and tendons, the cellular tissue forms sheaths for every muscle and for every fibre of which each muscle consists, and principally composes the tendons and tendonous expansions which connect the muscles with the bones. Every fibre, and fasciculus, and cord of the nervous system, is also separately enveloped in a delicate sheath of cellular tissue (fig. 3); and the brain and spinal marrow are wrapped in a membranous texture of the same substance.

Fig. 3.



171. The different tissues, in their arrangement in the texture of the several vessels and viscera of the body, are connected together by the cellular tissue; and, in fact, this substance principally composes the solid part of all the vessels and viscera of the system: and finally, each individual organ is enveloped, and every internal surface is lined, and the external surface of the body is covered with membranes composed of this substance.

172. With very limited exception, if any, the vital contractility of the muscular tissue is the only element of positive motion in the living animal body. All voluntary motion, and most, if not all, involuntary motion, depends on this vital property of the muscle. Hence the muscular tissue is distributed where motion is required. The bones are incapable of motion within themselves, and consequently no muscular tissue enters into their texture. But they serve as levers of voluntary motion, and therefore the muscles of voluntary motion are connected with them, and attached to them, in such a manner as that the contraction of the several different muscles produces the various motions required. The windpipe, meat-pipe, stomach, and intestines are also furnished with muscular tissue. The heart is principally muscular, and the diaphragm is mostly composed of muscular tissue. Several other internal organs are supplied with this tissue. The

arteries and veins are said, by some anatomists, to be destitute of it, and yet it is very certain that they possess the power of contractility.

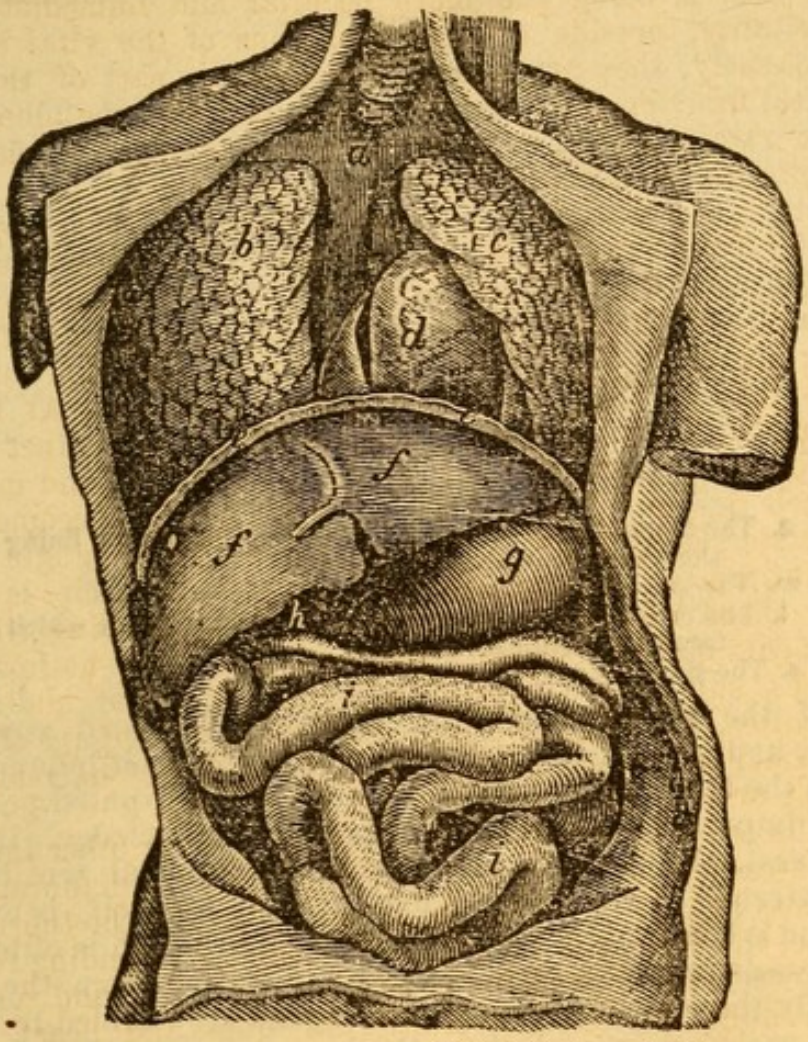
173. The nerves, being the more peculiar and immediate instruments of vitality, preside over the functions of the vital economy; and, consequently, they are distributed to every part of the system where a vital function is performed, accompanying the blood-vessels in all their ramifications, and being most intimately associated with every muscular fibre and filament.

174. In the order of nature, the blood-vessels with their appropriate and presiding nerves, are first produced, and these immediately commence the structure of the alimentary tube with its accompanying organs, furnishing each with its due supply of cellular, muscular, and nervous tissue, according to its particular office in the system, and the powers required for the performance of its special function. At first, the several internal organs are, in a measure, so many distinct and independent formations or systems, which become more and more connected as their development advances, and finally they become so intimately associated as to form of the whole assemblage a single system. In the meantime, a wonderfully constructed tabernacle is in preparation for them. The spinal column, and the arching ribs, with their investments of muscle and membrane, form the hollow trunk, which encloses, supports, and protects them. The head, and then the upper extremities, and the lower extremities, and the organs of special sense, and the external skin with its appendages of hair and nails follow in their order.

175. For the better protection of the organs, and for other important purposes, the cavity of the body is divided by the diaphragm into two apartments (Fig. 4). The upper one is called the thorax, and the lower one, the abdomen. The thoracic cavity, extending from the neck to the lower extremity of the breast-bone in front, and somewhat lower at the sides and back, contains the lungs and heart, and a portion of the large blood-vessels, and the meat-pipe. The abdominal cavity contains the liver, stomach, intestinal canal, pancreas, spleen, kidneys, etc. (Figs. 4 and 31.)

176. For the still farther security of the several parts, and the general well-being of the whole, a peculiar texture of the cellular substance, called the serous membrane, completely lines both cavities of the body, and then facing back upon itself, it is extended and folded in such a manner as to envelope each organ separately, and, in a measure, to insulate and confine it to its proper place. Thus, in the thorax or chest, the serous membrane, here called the pleura, besides lining the cavity throughout, including the upper surface of the diaphragm, faces back upon itself, and surrounds each lung, and passes double across the chest from the breast-bone to the back-bone, forming a septum or double partition between the lungs, called the mediastinum, and thereby completely encloses each lung in a sack by itself, the one on the right and the other on the left side of the thorax. The two laminæ or sheets of membrane which form the middle partition are separated at the lower part of the chest, to receive the heart between them. This organ is also surrounded by its own peculiar membrane called the pericardium. The serous membrane which lines the inner surface of the abdomen, and envelops each organ of that

Fig. 4.



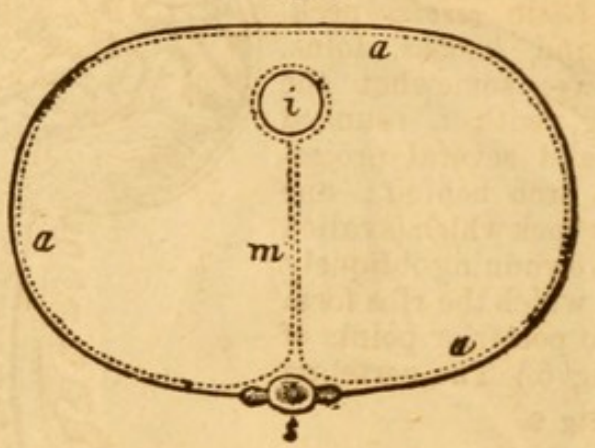
a. Large blood-vessels.
b. Right lung.
c. Left lung.
d. Heart.
e. e. Diaphragm.
f. f. Liver, turned up.
g. Stomach
h. Large blood-vessel in the abdomen.
i. i. Intestines.

cavity, has the general name of peritoneum; but its particular parts are designated by terms significant of the organs invested. Thus, the part which embraces the intestinal tube, and holds its convolutions in their relative position, is called the mesentery, mesocolon, etc. (Fig. 5. See also fig. 35).

177. In regard to the particular anatomy and physiology of the serous membrane there is much difference of opinion. Some describe it as being abundantly supplied with nerves and vessels, both being colorless, and the latter containing a colorless fluid, and performing the office of exhalants and absorbents; and this they consider fully proved by the fact that the serous membrane is capable of a high degree of inflammation and morbid sensibility; as in pleurisy, peritonitis, etc. On the other hand, it is asserted with equal confidence, that this membrane is entirely destitute of both vessels and nerves, and that fluids pass through it by infiltration or imbibition. Those who entertain this opinion, of course deny that this membrane can be the seat of inflammation and morbid sensibility. They contend that the

inflammatory diseases attributed to the serous membrane, have their seat in the subjacent tissue, and that such is the thinness and trans-

Fig. 5.



a. The dotted line representing the serous membrane lining the walls of the abdominal cavity
m. The mesentery.
i. The intestine surrounded by the serous membrane which forms its peritoneal coat.
s. The spine.

parency of the serous membrane, that the inflamed aspect is seen through it, and gives it the appearance of being itself inflamed.

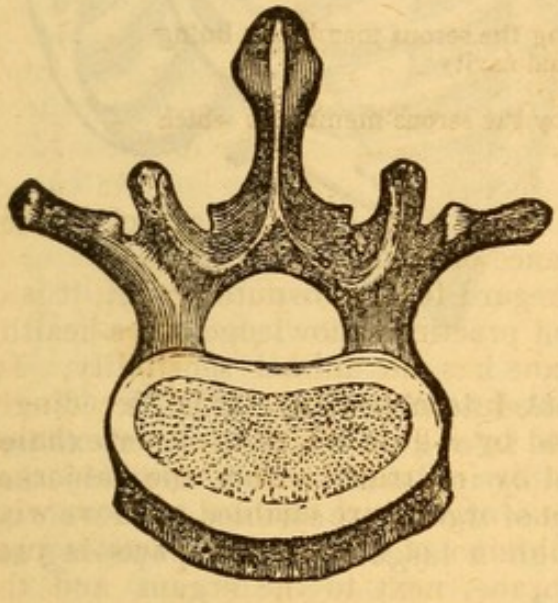
178. Be the truth as it may in regard to this disputed point, it is of very little importance as a matter of practical knowledge. In a healthy state, at least, the serous membrane has no animal sensibility. Its surface, external to the organs, but internal to itself, is exceedingly smooth, and is continually lubricated by a fluid which is either exhaled from its vessels or passes through it by infiltration from the subjacent vessels. By these means, contiguous organs are enabled to move with ease upon each other, and the adhesion of contracting parts is prevented. On the side of the membrane, next to the organs and the parts which it lines, it is everywhere surrounded or covered with a spongy cellular substance, which contains more or less of adipose or fatter matter, according to the condition of the body. In fleshy people, large quantities of fat accumulate in many parts of this tissue (508.)

179. The bones which compose the solid frame-work of the body, and serve to give it shape and firmness, and to form its cavities and its organs of prehension and locomotion, are of various forms and sizes. Some of them are hollow, and their cavities are lined by a cellular membrane, which contains an unctuous substance called marrow, the use of which is not certainly known. The whole number of bones in the body is two hundred and fifty-six; of which fifty-six belong to the trunk, sixty-six to the head, sixty-eight to the upper and sixty-six to the lower extremities.

180. Of the bones of the trunk, twenty-nine, and in some instances thirty, are employed in the construction of the spinal column or back-bone. Twenty-four of these are called the true vertebræ, and the other five are called the false vertebræ, or the sacrum and coccygis; these last being concerned also with the hip-bones in the formation of the pelvis or basin at the bottom of the trunk, and constitute the base on which the vertebral column rests. Of the true vertebræ, seven belong

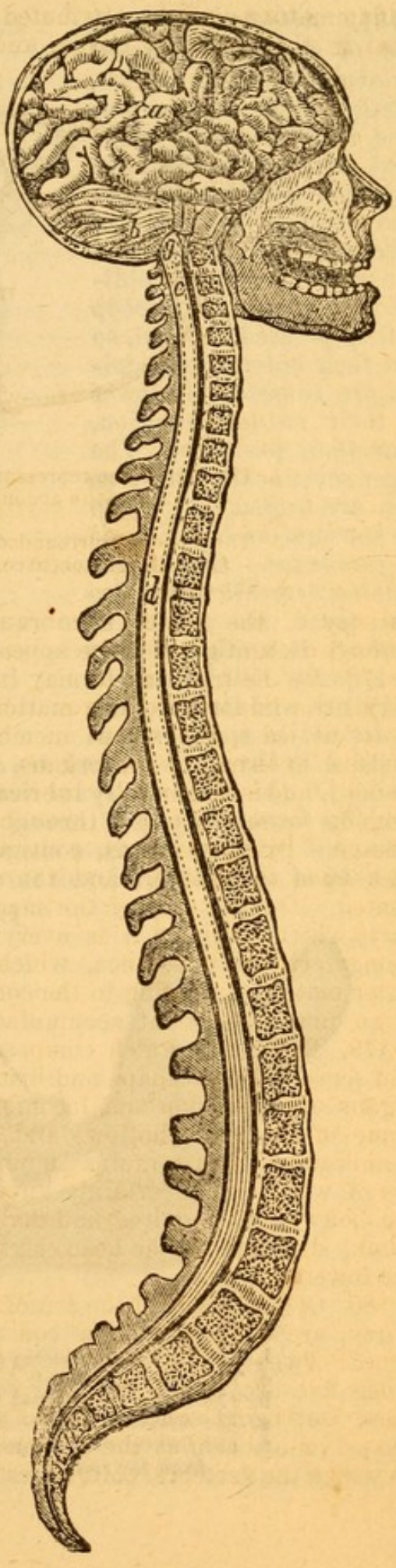
to the neck, twelve to the back, and five to the loins; and are accordingly distinguished by the terms cervical, dorsal, and lumbar vertebræ, from the Latin *cervix*, neck, *dorsum*, back, and *lumbus*, loins. These bones have somewhat the shape of a ring, with a rounded body in front, and several projections from the arch behind; one running directly back which is called the spine, and two running obliquely backward, with which the ribs form one of their two posterior points of attachment. (Fig. 6.) The vertebræ

Fig. 6.



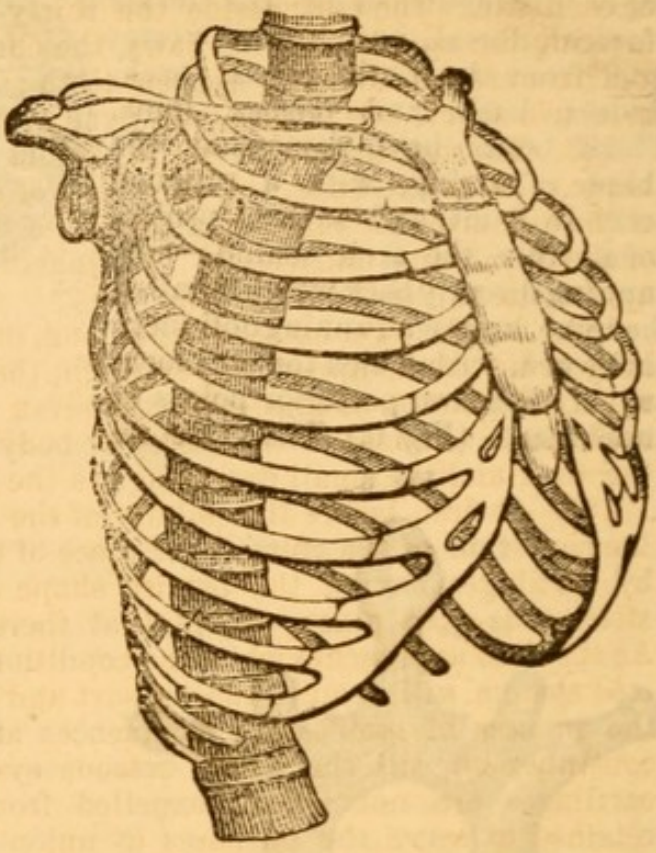
are therefore so constructed, that when arranged in their proper order, they form both a column of support to the body, and a canal for the spinal marrow. Between all of these bones is interposed an elastic fibro-cartilaginous substance, which, with surrounding ligaments, unites and binds them to each other in such a manner as to give the column considerable flexibility and elasticity, and at the same time secure to it all the supporting power of a solid bone. In the most natural, easy, and graceful position of the body, the spinal column is not erect, but waved or curved; and such is its elasticity, caused by the intervertebral cartilages, that an individual is sometimes an inch taller when he rises in the morning than when he retires at night. (Fig. 7.)

Fig. 7.



Bones of the head and spinal column, divided on the middle line so as to show—a, the brain; b, the little brain; c, d, the medulla oblongata; e, the spinal marrow.

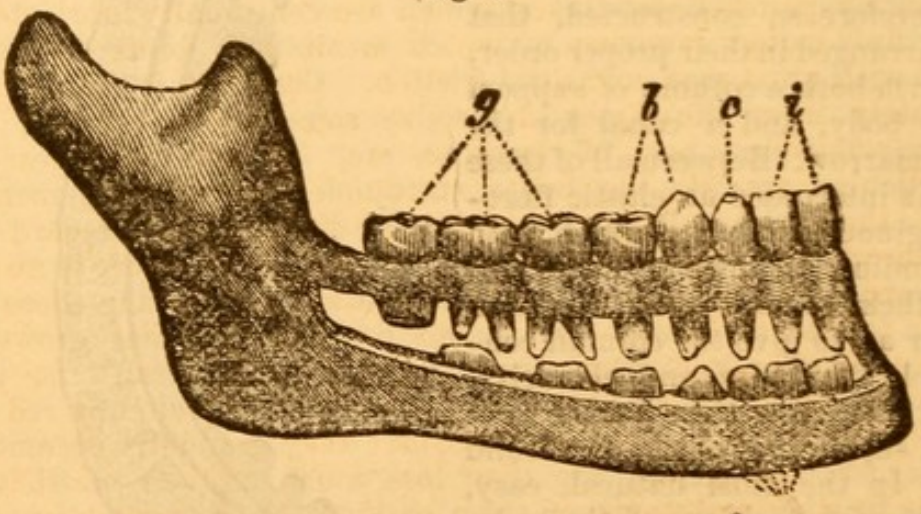
Fig. 8.



181. Attached to each side of the twelve dorsal vertebæ are twelve which, together with the breast-bone, form the cavity of the chest. Most of the ribs have a double attachment behind; one to the body of vertebræ, and one to the transverse process or oblique projection. They droop as they proceed forward, so that their anterior extremities are considerably lower in their natural position, than their posterior. The upper seven, called the true ribs, are united directly to the sternum or breast-bone by cartilages. Of the remaining five, called the false ribs, three are joined in front to each other and to the superior ribs by curved cartilages, and the two lowest are not in any way connected with the sternum, and are called floating ribs. (Fig. 8)

182. Of the sixty-six bones which belong to the head, seven enter into the formation of the strong globe or skull which contains the brain, and which rests upon the top of the spinal column and receives the head of the spinal marrow through a large foramen or opening at

Fig. 9.



a

i, The incisors, or cutting teeth.
c, The cuspid, or corner tooth.
b, The bicuspids, or small cheek teeth.
c, The molar, or large cheek teeth.
a, The rudiments of the permanent teeth before they emerge from the jaw

its base. Four small bones constitute a part of the auditory apparatus of each ear. The rest, beside the thirty-two teeth, are employed in forming the upper and lower jaws, the cheeks, the nose, the palate, etc.

There are in each jaw sixteen teeth; of which there are on each side two front, one corner, and five cheek teeth. (Fig. 9.)

183. To the upper extremities belong, on each side, the shoulder-blade, the collar-bone, the long bone of the upper arm, the two bones of the fore arm, the eight small bones of the wrist, the five of the body of the hand, the fourteen of the fingers and thumb, and the small appendage to the thumb-joint.

184. To the lower extremities belong, on each side, the hip-bone, the long bone of the upper leg, or thigh, the two bones of the lower leg, with the patella, or knee-pan, the seven small bones of the ankle and heel, the five bones of the instep or body of the foot, the fourteen of the toes, and the small appendage to the great-toe-joint.

185. At first, before the solidity of the bony structure is required by the condition of the animal, the place of the bones is entirely occupied by cartilages having the precise shape of the bones to which they afterwards give place, except that there are none of them hollow. As the time approaches when the condition and functions of the organized system will require the support and protection of the solid bone, the process of ossification commences at many different points, and continues on, till the whole osseous system is completed. But the cartilages are not wholly expelled from the system. Enough are retained to serve the purposes of union and general and particular elasticity. As life advances, the bones gradually become more dry and hard, and in old age, and in some kinds of disease, they become vitreous and very brittle. In every instance, where two bones are united, cartilages are interposed between them, and forms the union: in some cases firmly, as in the sutures of the skull, in other cases admitting flexion, as in the back-bone and ribs. In all the moveable joints the articulating surfaces of the bone are covered with dense and highly-polished cartilages, which are continually lubricated by a glairy fluid called synovia; by which means the joints are enabled to act with great ease and little friction. Cartilage is also employed separately from the bones in forming some of the cavities, as the larynx, wind-pipe, part of the nose, etc. All the cartilages, except the articular, are, like the bones, surrounded by a fibrous membrane called the perichondrium. Anatomists differ much in regard to the vascular and nervous endowments of the cartilages. There is no reason to believe, however, that they have any other nerves than those which belong to the texture of the vessels concerned in their growth and nutrition (230): and, accordingly, they have in health no animal sensibility (294), nor in health do their vessels contain any red blood. In early life the cartilages are very soft: they gradually become drier and harder: and in old age they lose much of their elasticity and become brittle; and some of them ossified, or converted into bone, especially those of the fixed joints, as the sutures of the skull.

186. By this interposition of cartilaginous substance between the bones, many advantages are gained. Besides the flexibility of the spinal column and the yielding of the ribs and other bones, friction is prevented in the joints, and a general elasticity is imparted to the

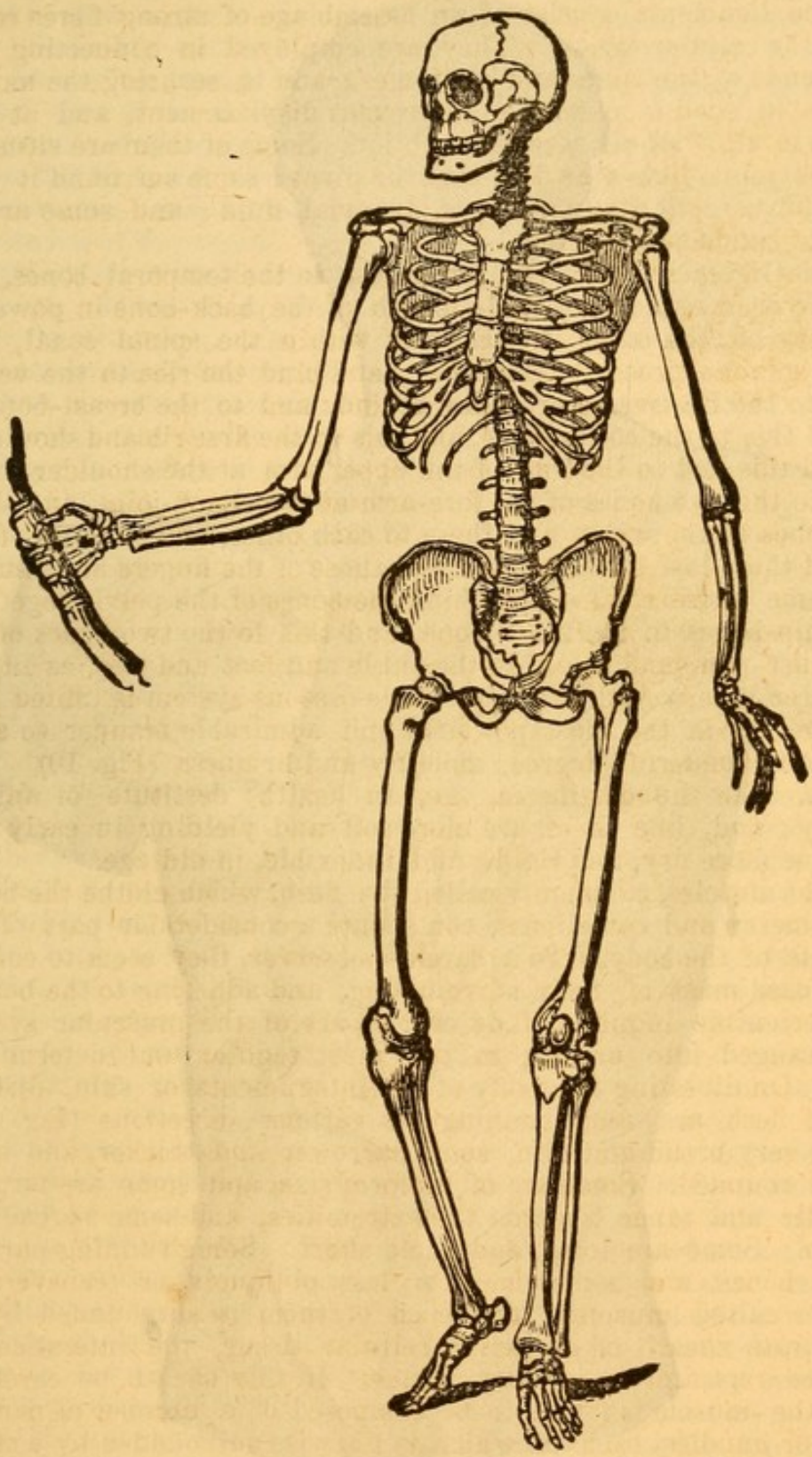
frame; greatly assisting in running and jumping, etc., and to a very considerable extent protecting us from injury by breaking the force of blows, falls, etc.

187. The ligaments consist of an assemblage of strong fibres composed of the cellular tissue. They are employed in connecting the articular ends of the bones and cartilages; and in securing the moveable joints in such a manner as to prevent displacement, and at the same time to allow of all necessary motion. Some of them are situated within the joint, like a central cord or pivot; some surround it like a hood, and contain the lubricating, synovial fluid; and some are in the form of bands at the side.

188. The ligaments bind the lower jaw to the temporal bones, the head to the neck, extend the whole length of the back-bone in powerful bands, both on the outer surface, and within the spinal canal, and from one spinous process to another; and bind the ribs to the vertebræ, and to the transverse processes behind, and to the breast-bone in front, and this to the collar-bone, and this to the first rib and shoulder-blade, and this last to the bone of the upper arm at the shoulder-joint, and this to the two bones of the fore-arm at the elbow-joint, and these to the bones of the wrist, and these to each other, and to those of the hand, and these last to each other, and those of the fingers and thumb. In the same manner, also, they bind the bones of the pelvis together, and the hip-bones to the thigh-bone, and this to the two bones of the leg and knee-pan, and so on, to the ankle and foot and toes, as in the upper extremities. And thus the whole osseous system is united and bound together in the most powerful and admirable manner so as to possess, in a wonderful degree, mobility and firmness (Fig. 10). The ligaments, like the cartilages, are, in health, destitute of animal sensibility; and, like them, are more soft and yielding in early life, and become more dry, and rigid, and inflexible, in old age.

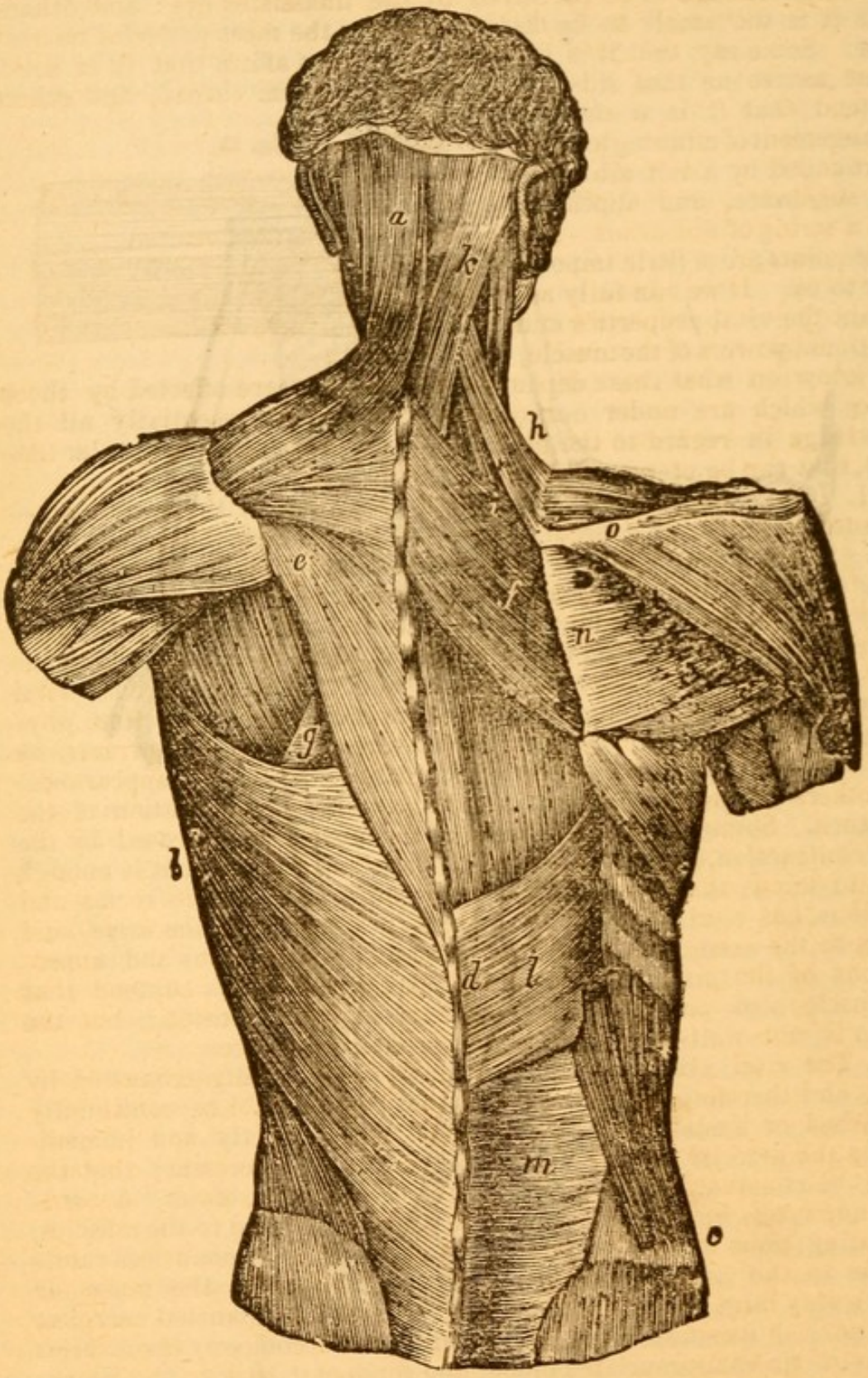
189. The muscles, commonly called the flesh, which clothe the bones with symmetry and comeliness, constitute a considerable part of the whole bulk of the body. To a careless observer, they seem to consist of a confused mass of flesh, surrounding, and adhering to the bones; but the scientific inquirer finds every part of the muscular system to be arranged into organs, in the most regular and determinate manner. On divesting the body of its integuments or skin, distinct masses of flesh are seen running in various directions (Fig. 11). Some are very broad and thin, some narrower and thicker, and some are more rounded. Some are of uniform size, and some are large in the middle and taper towards the extremities, and some spread out like a fan. Some are long, and some short. Some running parallel with the bones, and some more or less obliquely or transversely. These are called muscles; and each of them is surrounded by its own separate sheath of gauzelike cellular tissue, the interstices of which are repositories of fatty matter. If this sheath be carefully opened, the muscle is found to be composed of a number of parallel fasciculi or bundles, each of which is likewise surrounded by a cellular sheath. If, again, one of these be opened, a number of parallel fibres appear, which are also separately enveloped in cellular sheaths: and each of these fibres is composed of a number of minute parallel filaments (Fig. 12).

Fig. 10.



The Skeleton.

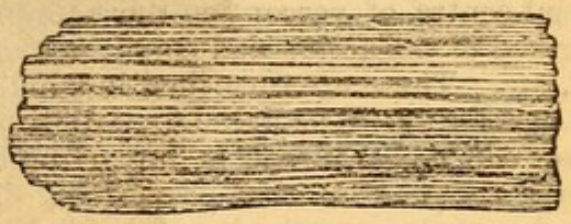
Fig. 11.



The Trunk divested of the skin, showing the muscles, a, b, c, etc.

190. There is the utmost discrepancy of opinion among anatomists, in regard to the elementary muscular filament. Some asserting that it is large enough to be perceived by the unassisted eye: and others, that it is too small to be discerned under the most powerful microscope. Some say that it is hollow, and others affirm that it is solid. Some assure us that it is a continuous, uniform thread, and others contend that it is a delicate arrangement of minute globules, surrounded by a soft albumenous substance, and appearing like a string of fine beads. But these points are of little importance to us. If we can fully ascertain the vital properties and functional powers of the muscle, and know on what these depend, and how they are affected by those causes which are under our control, we possess essentially all the knowledge in regard to the nature and structure of the muscular filament, that can be of practical utility to the world.

Fig. 12.



191. I have said (159) that the vital properties of the muscle are—1st, susceptibility, or a peculiar kind of *organic* sensibility to stimulants; 2nd, contractility, or the power to shorten its length under stimulation. These are generally regarded as a *single* property, or power, and denominated muscular irritability. But they are obviously different powers. The one is a power to *receive* an impression, and the other a power to *act* under that impression, and they are both vital endowments of the muscle. In regard to muscular contraction, physiologists do not agree. Some say that, when the muscle contracts, its fibres are bent in a waved direction, and have a knotted appearance: and others assert that there is a longitudinal condensation of the substance. Some think the volume of the muscle is increased by the act of contraction, and some assure us that it is not. But it is enough for us to know, that the living healthy muscle, in all its forms and situations, has vital contractility, which is essentially the same, and subject to the same laws, in all the parts and distributions and appropriations of the muscular system. Some physiologists contend that the muscle also possesses the power of active extension; but the opinion is not well supported, and is probable incorrect.

192. The vital properties of the muscle are rapidly exhausted by action, and therefore it is requisite that they should be continually replenished or sustained. This depends most directly and immediately on the arterial blood; and consequently it is necessary that the muscle be constantly and freely supplied with that fluid. Accordingly, numerous and capacious arteries are distributed to the muscles, penetrating them in every direction, and extending in countless ramifications to the smallest filaments, and conveying to the muscular system a very large supply of blood, to replenish its exhausted energies, and to nourish its substance. Veins everywhere accompany the arteries to receive their unappropriated blood, and conduct it back to the heart; and thus, a continual stream of fresh arterial blood is poured through all the muscular tissue.

193. The nerves which are distributed to the muscles of voluntary

motion, are of three kinds. 1. Those that accompany, and belong to, the blood-vessels, and preside over their functions. These are only concerned in maintaining those conditions and in producing those changes in the blood which are necessary to the welfare of the muscle. 2. Those that convey to the muscle the stimulus of the WILL. These are supplied in great numbers, and they divide and subdivide till they are too small to be detected. These only act to stimulate and exhaust the muscle. 3. The nerves of animal sensibility, that convey to the animal centre of perception those impressions by which the mind is informed of the action and conditions of the muscles, and of external tact, etc. These are furnished in small numbers, and hence the muscles possess but little animal sensibility. None of these three kinds of nerves can be concerned in imparting directly and immediately to the muscle its peculiar vital properties. Those properties, therefore, belong to the intrinsic vitality of the muscle: and this vitality can only be maintained by constant supplies of arterial blood, in an appropriate condition; and this, as a permanent fact, requires the presence and integrity of all the nerves described. A degree of muscular contractility, however, remains, sometimes a full hour after the extinction of animal life.

Fig. 13.

A biceps muscle, or muscle having two tendons at one end and one at the other.

194. The muscles of the body are divided into two classes, in the descriptions of anatomy. Those of voluntary motion, and those of involuntary motion. The former are also called the muscles of animal life, and the latter the muscles of vegetative or organic life. The muscles of voluntary motion, or of animal life, generally invest the bones, and are mostly on the outer parts of the body, and greatly abound in the limbs. The muscles of involuntary motion belong to the vascular system, and the digestive and respiratory apparatus. Some of the muscles of voluntary motion attach themselves immediately to the bones, but most of them terminate their two extremities in a fibrous arrangement of cellular tissue, called tendon, and by these tendons, or tendenous expansions, are attached to the bones (Fig, 13.) Some anatomists suppose the tendons are formed by the continuation and condensation of the cellular sheaths which surround the muscular fibres (170).

195. In their texture and properties, the tendons differ very little from the ligaments. They are composed of small white fibres closely united to each other, and are surrounded by sheaths, lined by a membrane which secretes for them a lubricating fluid. They possess little elasticity or extensibility, have no animal sensibility, and but few vessels, and these not discernible in an ordinary state. Like the cartilage and ligaments, they are more soft and elastic in early life than at a later period, and become dry and rigid in old age.

196. The tendons being attached to the muscles at one end, adhere at the other to the periostium, or membrane which surrounds the bones, and which unites them to the bones; and thus they become the media

through which the muscles act on the bones. Some of them are very long, and extend to parts considerably removed from the muscles, as in the upper and lower extremities. This arrangement secures many mechanical advantages to the system, and very greatly contributes to the symmetry and beauty of the body, by accumulating muscles into large masses in some places, and withdrawing them from others, and thereby giving the beautifully curved outlines of the trunk, limbs, small ankles, wrists, etc. The tendons are usually found only at the extremities of the muscles, but they are sometimes inserted in the middle, dividing the body of the muscle into two or more parts, as in the under jaw, the neck, diaphragm, etc. The end of the muscle which is attached to the most fixed point is called its head or origin, the fleshy mass is the body, and the end attached to the moveable point, is its termination. Some of the muscles are only attached to the bones at one extremity; and some being circular, have no direct attachment to the bones. Both of those last-named kinds are found in the face, surrounding the mouth, etc.

197. As the muscles have only the power to produce motion by their contraction, they are so arranged as to act as antagonists to each other, some *dis*placing a part, and some *re*placing it: some flexing or bending a limb, and some extending it: and, therefore, they are termed the abductor and adductor—the flexor and extensor muscles. The flexor muscles are considered to be generally more powerful than the extensors, and hence, when the WILL ceases to act, as in sound sleep and death, the body and limbs are partially fixed or bent.

198. According to Meckel, 'there are in the normal or proper state of the body, two hundred and thirty-eight different muscles, six of which are composed of two parts, which unite on the median line, and two hundred and thirty-two are in pairs; so that the whole number of the voluntary muscles are four hundred and seventy.' These are so arranged and adjusted, as to position and connexion, that by the contraction of the different pairs or individual muscles all the voluntary motions of the lower limbs are performed. The function of respiration, which, to a certain extent, is both voluntary and involuntary, also employs some of these muscles.

199. The muscles of involuntary motion are much more simple in their external form than those of animal life; and except in the heart, they have no appearance of tendons. Their fasciculi, fibres, and filaments are not distinct and parallel to each other, but continually interlace, and consequently are much shorter than the fibres of the voluntary muscles. Their fibres are arranged in several superimposed layers, and these layers are most generally transverse or oblique; and form rings round the cavities which they circumscribe. The circular fibres or rings are nearest each other at the orifices of the cavities, and are stronger than the longitudinal or oblique fibres. The involuntary muscles do not antagonize or act in opposition to each other; but they either act in concert, or so as not to counteract each other; as their office is to diminish the cavities in length and caliber; both of which may be done simultaneously. Some of the muscles or fibres, however, act alternately or successively, as in the heart and intestines. The involuntary muscles are even more abundantly supplied with vessels than those of animal life.

200. The muscles of the body, like the cartilages, ligaments, tendons, and other forms of the cellular tissue, are at first very soft, and gradually become more consistent and powerful; and, in old age, they gradually become more and more dry and rigid.

201. The muscular substance when once destroyed is never reproduced; but when the muscles are wounded with or without a loss of their substance, the breach is healed, and the parts united by a peculiar arrangement of cellular tissue, which is wholly insensible to the action of stimulants.

LECTURE V.

The nervous system the most important portion of the body—The more immediate organism of vitality—Through the nerves vitality acts on all the other tissues and substances of the body—Nervous system, subject of great interest—Difficult to study—Physiological properties common to all living bodies—Vegetables and animals—Different degrees of consciousness and voluntary motion in different orders of animals—Organs of sensation and locomotion—of internal and external relation—their functions—Animal bodies have two classes of functions—of nutrition—of voluntary motion—How far are they dependent on a nervous system?—Have vegetables nerves?—Brain and spinal marrow, etc., supposed to be the nervous system of man—errors of the opinion—Natural law and order of development—Human bodies without a brain and spinal marrow—Errors from experiments on living animals—Brain and spinal marrow passive in the development of the body—Must be some other system of nerves—Nerves of organic life, their development, distributions, arrangements, and functions—General order of the development of the several parts of the body—Nerves of organic life preside over all the function of development, and nutrition, etc.—Composition of the ganglions—Cerebro-spinal system—its order of development—distribution—arrangement and functions.

202. The nervous system is, in many respects, the most interesting and important portion of the human body. It is the more immediate organism of vitality, and the vital operations, and the intellectual manifestations: and hence it has been said, that the nervous system constitutes the man; and, that the bones and muscles, and the whole assemblage of internal organs, with their various functions, are only intended to sustain and serve the nervous system.

203. Vitality, however, is by no means peculiar to the nerves; but, in various degrees, it pervades all the tissues of the living body; and the blood is a living fluid: and the chyle also, especially in its more advanced stage of assimilation, possesses a measure of vitality. Nevertheless, the nerves are more highly endowed with vital properties and powers, than any other substance of the body: and they are, in the animal kingdom at least, most evidently and immediately the instruments of vitality, in all the operations of its wonderful economy.

204. By the vital powers of the nerves, the properties of the other tissues are called into exercise, and the functions of all the organs are performed. The food is digested into chyme, and thence into chyle, and thence into blood; and the blood is transformed into the various solids and fluids of the system, and, at the same time, the temperature of the body is regulated (173).

205. By virtue of the vital endowments of the nerves, we perceive our internal wants, and external conditions, and relations; and act

upon the muscles, and through them upon the bones, in our voluntary motions. And by virtue of the peculiar and mysterious endowments of the nervous substances, we think, and reason, and feel, and act, as intellectual and moral beings (530).

206. It is not surprising, therefore, that the nervous system of man has ever been the subject of peculiar interest to the anatomist and physiologist; nor, when all the difficulties of the subject are considered, is it wonderful that a great diversity of opinion and theory has always obtained in regard to it. Among those difficulties, the almost impossibility of carrying our enquiries within the vital domain, without disturbing the vital economy to such an extent as to throw the utmost uncertainty over the results of our investigation, is by no means the least. Yet it is to be apprehended that this difficulty has been too much disregarded by those who have boldly, and even rudely, invaded the precincts of life. Had those physiologists who have experimented so freely and extensively on living animals, always duly appreciated the force of sympathies in those bodies while under their experiments, they would probably have been saved from many erroneous conclusions; or, at least, would have asserted them with less confidence.

207. I have said that all living bodies possess those faculties by which their nourishment and growth are effected, their temperature regulated, etc. (137). The vegetable seed, by virtue of its own vitality, excited to action by a genial soil and other appropriate circumstances, puts forth its little roots into the earth, and absorbs foreign matter, and converts it into the substances and textures of its own organism; and thus an economy is established, by which the trunk, and branches, and twigs, and leaves, of the giant oak, are gradually and fully developed, and all the vital operations of the tree maintained, until the condition on which the continuance of the vital action depends is worn out, or destroyed, and then death ensues.

208. Drawing its nourishment from the earth, into which its roots penetrate, and from the atmosphere which surrounds it, and, in none of its final causes requiring a voluntary change of place, nor the performance of any other voluntary function, the tree, by nature, is fixed to the spot from which it springs, unconscious of its being, and without any organs of external perception and of voluntary motion. And, so far as those vital operations are considered by which chyme, and chyle, and blood are produced, and the blood circulated throughout the system, and the body, in all its parts nourished, and growth and development effected, and the temperature regulated, and all the other functions of organic life sustained, the animal differs but little from the vegetable: and, in health, is equally destitute of animal consciousness.

209. In the lowest order of animal existence, the Zoophytes approach so near, in all respects, to vegetables, that naturalists long doubted whether they belong to the animal or vegetable kingdom. They are but dimly conscious of their being: and are nourished by means which scarcely demand faculties superior to those with which the vegetable is endowed. But the higher order of animals, being nourished by substances which are not only external, but separated from them, require both a perception of the internal wants of the system, and the faculties by which they can perceive, and approach to, and seize, the external

substances by which those wants are supplied. Hence, organs of sensation, and locomotion, and prehension, subject to voluntary control, are necessary as organs of external relation; the primary office of which, is to perceive and procure the materials by which the body is nourished, and place them within the reach of those organs of nutrition, by which the whole system is built up and sustained in all its powers and operations; and, also, to perceive and avoid, or withdraw from those causes or means, by which the vital interests and the comfort of the body may be disturbed and destroyed: and, having fulfilled these duties, the organs of external relation have no other immediate concern with the internal organic functions, except so far as their own welfare and integrity depend on the general welfare and integrity of the whole system. And this is true of all the higher, as well as of the lower classes of animals.

210. There are, therefore, in organized bodies, two general classes of functions, and a corresponding organization. The primary class, consists of all those functions which are concerned in the nourishment, growth, temperature, and general sustenance of the body, as an organized being. The secondary class, consists of those functions which minister to the wants of the primary class, and are established with reference to the relations between those internal wants and the external supplies, and to the general external relations of the body. The functions of the primary class, I have said, are common to all organized bodies, both animal and vegetable; but those of the secondary class are peculiar to animals.

211. The important question then is; do the functions which are common to all organized bodies depend on a system of nerves, or are they performed independently of any nervous system?

212. It is a disputed point among physiologists, whether there is a system of nerves in vegetables or not. Some have asserted that they have been able clearly to discover a simple system of nerves in vegetable bodies; while others declare that there is nothing in vegetables which approaches to the nature and character of a nerve. That there is nothing in vegetable bodies which approaches to the nature and character of an *animal* nerve, cannot be doubted: for the whole molecular arrangement of organization, and all the vital operations and results of the vegetable, differ essentially from those of the animal; and therefore it is impossible that the organic structure and properties of any of the vegetable tissues should be the same as those of the animal. Nevertheless, it may be, and probably is true, that there is a tissue in vegetable bodies which in functional character corresponds with the nervous tissue of animals, as nearly as the functions of vegetables and animals correspond in their processes and results. Be this as it may, however, it is entirely certain, that as the vegetable derives its nourishment from the earth, into which its roots penetrate, and has none of those external relations which require voluntary motion; so it has none of those organs of external relation, which are concerned in perception, locomotion, and prehension; and has nothing which, in structure, or properties, or functional character, corresponds with the cerebro-spinal system of nerves in animals.

213. The nervous system of the human body has generally been considered as consisting of the brain and spinal marrow, with their numer-

ous cords, branches, and twigs, dispersed over the whole organized system: and these have been supposed to preside over all the varied operations and manifestations of life.

214. Some anatomists and physiologists have contended that the brain is the original point of nervous development, from which spring as from a grand root, the spinal trunk and all the branches and twigs of the nervous system: and these have considered the brain as the great centre of nervous, as well as sensorial power; or as a kind of vital galvanic battery, which continually generates nervous energy, and distributes it through nervous conductors to the several organs of the body, according to their functional necessities; presiding in this manner, alike, over all the vital functions of the system. The opinion which has been more generally entertained, however, is, that the spinal marrow is the grand original centre or axis of the nervous system, and that the brain and all the nervous cords, branches, and twigs of the body, spring from, and in a measure depend upon it. But if either of these opinions were correct, then it would necessarily be true, that in the original development of the body, the brain or spinal marrow would be the first-formed portion of the system, and come earliest to maturity, form, size, and consistency, and of functional character and power. For it is a law of nature, in the development of organized bodies, that those parts are first produced and brought forward to a functional capacity, which are most essential to the earliest operations of the vital economy. But we know that, in the establishment of an economy, by which an animal body is to be developed, the first thing necessary is a presiding centre: the next thing is the blood-vessels, over the functions of which that centre presides, and by which the development of all the other parts of the system is effected. If, therefore, the brain or spinal marrow were the presiding centre of vital operations, in the formative processes of the body, then it would necessarily follow, that all the branches belonging to this centre would issue from it, and go out with the blood-vessels, to preside over their functions, in the formation of other parts, and to enter into the texture of parts thus constructed. But this is not true. So far is the brain or spinal marrow from being the first-formed portion of the system, that all the other parts of the body are formed, and considerably developed, while the brain and spinal marrow are yet in a fluid state, not more consistent than the white of an egg, and utterly incapable of exercising any functional power; and so far are the nervous branches, which have been supposed to issue from the spinal marrow, from investing the blood-vessels and presiding over their functions, that they are almost totally distributed to the voluntary muscles and to the outer surface of the body.

215. But nature has not left us in the dark on any of these points. Where her normal operations have failed to instruct us, her abnormal exploits have afforded complete demonstration. Children have been born without a vestige of a brain or spinal marrow; and I have known one instance, in which all the parts of the body were regularly and healthfully developed, except that there was no brain, nor spinal marrow, nor even a trace of a spinal canal; the vertebræ being entirely solid. Such children, of course, cannot live after respiration becomes necessary; because respiration, though strictly speaking, an involun-

tary function, is yet, for important reasons which will be hereafter stated, immediately connected with the nerves and muscles of animal life; or of voluntary motion.

216. Some distinguished physiologists, because they could not tear the brain and spinal marrow from the living animal, without arresting the functions of organic life, have insisted that those organs preside over these functions. But such physiologists might have been saved from their error, had they considered that the assemblage of organs constituting the animal system, is more of a republic, or a confederation, than an absolute monarchy; and that the powers of that system are so delicately adjusted and so nicely balanced, that any considerable violence done to a particular part—and especially an important part—it is necessarily felt as a disturbing cause, over the whole system; and often to such a degree as to destroy the balance of power, and arrest all the functions of life, without, by any means, proving that the injured part is the centre of life, or that it is the organ which presides over the vital functions of the system. Ten thousand such experiments, therefore, are of no weight against the single fact that nature has produced a body in all other respects perfect, but destitute of a brain and spinal marrow; and yet evincing, by every appearance, that its organic life had continued till respiration became necessary.

217. It follows of necessity, then, that the brain and spinal marrow, with their nervous appendages, stand rather in the relation of an effect than of a cause, to the formative and conservative operations and economy of the animal system: and we must therefore conclude, either that this economy in animals, as in vegetables, has no apparent nervous system which presides over its functions; or that, in animals there is an apparatus, or system of nerves, which, so far as the internal interests of the economy are concerned, is independent of, and in the order of nature prior to, the brain and spinal marrow.

NERVES OF ORGANIC LIFE.

218. In the human body, such a system is readily found. In the very midst of those parts which are known to be the first produced in the natural order of development (174), is a mass of nervous matter, which, in composition, very nearly resembles the brain. This mass, which may with propriety be considered as a species of brain, is undoubtedly the very first-formed portion of the human body, and is the grand centre which presides over all the functions concerned in the development and growth of the body, and the general function of nutrition during life.

219. In close connexion with this central mass, and scarcely second to it in order of time, is produced the rudiment of a heart, with a few of its principal blood-vessels, which gradually extend and enlarge and become more complex. Into all of these, as a part of their texture, enter branches from the central mass, which thenceforward through life, presides in a general manner over all the functions of the sanguiferous system. Accompanying the blood-vessels, numerous other branches of nerves go out from the central brain, in different directions and form other, smaller, and subordinate brains, which become the more special centres of development, and of perception and action, to

individual organs, or particular apparatuses of organs. These subordinate brains or special centres, in their turn, give off numerous branches, some of which enter into the texture of the blood-vessels formed for, and appropriated to their services in the construction of their particular organs; others are distributed to the contractile tissue or muscles of those organs, as the conductors of the stimulus of involuntary motion; others also are distributed to the organs as the nerves of organic sensibility, or the conductors of impressions made upon the organs, to their special centres; and finally, in order to establish a more intimate connexion between the different special centres, and bring them all into a more direct relation to each other, and to the common centre, large cords run directly from one centre to another; and numerous branches go from each centre, to interlace and unite and form plexuses with branches coming from several other special centres, and from the great common centre.

220. The alimentary canal and the other organs associated with it in the general function of nutrition, being earlier in the order of development than the other parts of the body (174), the special centres concerned in their development, and which are the more special centres of perception and action to them during life, are the first of the subordinate brains which the formative economy produces. At an early stage of the central development, however, numerous fibres rise on each side of the general mass, which form a pair of large cords, called the trisplanchnic nerves, that pass upwards, the one on the right and the other on the left side of the middle line, and give rise to an elongated mass or an uninterrupted series of small brains, which gradually separate in a longitudinal direction, and draw farther and farther apart, keeping up their connexion with each other by intermediate branches, till they form a connected range of about fifteen little brains, on each side, extending, in a fully developed body, along the spinal column from the bottom of the thoracic cavity to the top of the neck. In the progress of these developments, the trisplanchnic nerves become divided in their upper portions into from three to seven or more branches, which terminate in as many of the little brains in the two ranges. Eight or nine more of these little brains are arranged in a similar manner, on each side in the abdominal cavity, so as to form, in the completely developed body, a continued series, on each side of the back bone, from the base of the cranium to the inferior extremity of the spinal column. Each of these little brains in the two ranges, sends out numerous branches, some of which serve, as I have said, to unite the several little centres successively to each other: others plunge into the muscles: and others form connexions with the nerves and muscles of animal life, of which I shall speak hereafter. But the largest number of branches, from each of these little brains in the two ranges, go to interlace and form numerous plexuses with branches from others of the same, and of the opposite side, and from those more deeply seated among the viscera, and from the great central mass itself. From these plexuses, again, numerous branches are given off to the different organs, entering intimately into their texture. And all the branches and twigs of this system of nerves as they proceed along their course to their destination, cross and unite and divide and interlace, so as to form of the whole system, one extended net, the meshes of which become smaller and smaller, as the nerves be-

come more and more attenuated and approach to their inconceivably minute termination in the organs.

221. The two ranges of little brains, with their connecting cords and other branches which I have just described, are generally supposed by physiologists to be designed to bring all the parts associated in the functions of organic life, into a closer union, and to establish between them the most intimate and powerful sympathy: and, therefore, they are commonly called the great sympathetic nerves. Some writers, however, include under this denomination, all the nerves of organic life. But I apprehend there has been much error of opinion on this point. Whatever may be the anatomical knowledge concerning these nerves, which they have derived from written descriptions, or from dissections, most writers on anatomy and physiology still speak of the brain or spinal marrow as the grand centre of nervous power, which presides, in a general manner, over all the functions of organic life, as well as those of animal or phrenic life; and, therefore, they do not seem to perceive any other use for the nerves of organic life, than merely to serve the purposes of sympathetic association.

222. That the two series of little brains, with their connecting cords, etc., do serve to bring all the organs with which they are connected into a closer union as a single system, and to establish between them a more powerful bond of sympathy, is, I think, undoubtedly true, and I consider it equally certain that they perform other and very important offices.

223. Considering this whole system of nerves as that which presides over all the vital functions in the development and sustenance of the body, and the other special centres already described, as being more immediately concerned in the development of the organs employed in the general function of nutrition, does it not legitimately follow from physiological analogy, as well as from anatomical arrangement, that the two series which extend the whole length of the spinal column, are more immediately concerned in the development of the spinal nerves, and of the cerebro-spinal system generally, and perhaps also of all the other parts pertaining to the trunk and extremities?

224. It seems to be a general law of the vital economy, in the development of organized bodies, that, where any new subordinate centre of action is established for the construction of any particular organ or apparatus, a subordinate brain or nervous ganglion is produced. Every anatomist knows that one of these ganglions is found on each spinal nerve, near its connection with the spinal marrow, and several of them are found in the brain; and, according to some, the spinal marrow itself is but a continued series of them. Now then, if the spinal nerves are not developed from and by the spinal marrow, as the original centre of action in the formative process of the vital economy, but are developed independently of it, by functions over which the nerves of organic life preside (223), where does the development of these nerves commence, if not at the ganglions near the spinal marrow?—and is this not rendered still more probable by the fact, that each of these ganglions is directly connected by large cords, with one of the little brains of organic life, which from the extended series along the two anterior sides of the spine, and one of which lies very near to each of the ganglions of the spinal nerves, with which it is connected? There may

be insuperable objections to this view of the subject, but if there are, I confess I have not been able to discern them.

225. In brief review of this whole system of nerves, we perceive then, that, by means of cords which unite the several little brains to the great central mass, and those which unite the little brains to each other, and the numerous branches from the different centres, which interweave and form plexuses in every part of the two great cavities of the body, all of these centres are brought into the most intimate and powerful union, as a single nervous system; and then, by means of the numerous branches distributed from each of these centres to its particular organ or organs, and the numerous branches which pass from the several plexuses to different organs, the whole assemblage of organs concerned in the functions of organic life, is, as it were, woven into one grand web of nervous tissue, and brought into a general and powerful communion of sympathy.

226. I have said (218) that in composition the central mass nearly resembles the proper animal brain. This is also true of all the special centres or subordinate brains. Like the proper animal brain, they are all composed of the white and the gray nervous substance, surrounded by a vascular membrane, analogous to the piamater of that organ (272), and an external envelope of dense cellular tissue. They have the closest resemblance to, and indeed seem to be but repetitions of, the brain of some of the lower animals; and they undoubtedly perform many of the functions of a brain, acting as centres to all necessary extent in their appropriate spheres, both in receiving impressions from, and in dispensing nervous powers to, their special domains. In the nomenclature of anatomy, however, these bodies are termed ganglions or knots The great central mass which is situated at the roots of the diaphragm, in the upper and back part of the abdominal cavity, or nearly back of the pit of the stomach, consists of several parts. 1. Two semicircular bodies about an inch long and half an inch broad, lying one on the right, and the other on the left side of the backbone. These are called the SEMILUNAR GANGLIONS. They are, probably, at first, united in a single mass, and afterwards partially separated to accommodate themselves to the duplicate arrangement of the human body (281). They, however, remain closely connected by many large branches, which pass from one to the other, and form what is called the SOLAR PLEXUS. These two semilunar ganglions, united by the solar plexus, constitute the grand centre of all the ganglions and plexuses of organic life. Surrounding this great centre, as I have said (219), and united to it by cords and plexuses, are the numerous special centres which subordinately preside over particular functions. These, and the ganglions that range along the two sides of the back bone, are much smaller than the semilunar ganglions, and are of an irregular ovate form.

227. The ganglions of organic life are, in the descriptions of anatomy, divided into two orders, called the central and the peripheral or limiting ganglions. The central are those which are more deeply seated among the viscera, and which are supposed to preside generally, and specially, over the functions concerned in nourishing and sustaining the body: the peripheral or limiting are those which form the two ranges on the sides of the spinal column, and have been supposed to be more particularly appropriated to the general sympa-

thies of the internal system, and are accordingly called the sympathetic nerves (221).

228. This general system of nerves, consisting of a common centre, and many special and subordinate centres, with their numerous cords, branches, plexuses, etc. (225), is sometimes called the ganglionic system. And, because these nerves preside over all the functions common to animals and vegetables (208), and, in health, without the consciousness of the animal, they are also called the nerves of vegetative life; but they are most commonly denominated THE NERVES OF ORGANIC LIFE, in contra-distinction to the brain, and spinal marrow with their branches, etc., which are called the NERVES OF ANIMAL LIFE.

229. There seems, however, to be little propriety in calling these latter the nerves of animal life, for they have no independent *life* peculiar to themselves, nor are they directly and immediately concerned in maintaining the common life of the body. Their functions may be entirely suspended for a considerable time, and still the common vitality of the body be preserved. Andrew Wallace, a surviving revolutionary veteran, now over a hundred years old,* and remarkably vigorous and active, was struck down by lightning while tending a cannon on the fourth of July, soon after the close of the American Revolution, and lay seventeen days in a state of suspended consciousness or animation: and a youth now living in Philadelphia once lay twenty-eight days in this condition But a single moment's entire suspension of the functions of the nerves of organic life, would be a death from which there can be no resuscitation. The brain and spinal marrow with their nervous appendages are also sometimes called the phrentic nerves, as being the more immediate and exclusive organs and instruments of the mind; but they are perhaps most commonly and most properly called THE CEREBRO-SPINAL SYSTEM OF NERVES.

230. Of the nerves of organic life, there are three orders (219). First, according to nature, those that enter into the texture of the blood-vessels, and other portions of the vascular system, and go with them in all their ramifications, to their most minute terminations in the different tissues, and preside over all their functions of absorption, circulation, secretion, structure, etc.; second, those that go to the contractile tissue, or muscles of involuntary motion in the texture of the organs, and convey to them the stimulus of motion; third, those that are distributed to the organs, as the nerves of organic sensation, and which convey to the special centres, and, if necessary, to the common centre (226), the impressions made upon the organs. The cords which serve to connect the special centres to the common centre, and to each other, are probably composed of filaments of all these three orders.

231. In this distribution of the nerves of organic life, each organ is supplied according to the nature of its function, and its relative importance in the system. The heart, which in its rudimental state, lies near the great ganglionic centre (219), and which, with its vessels, is first employed in constructing the alimentary canal and the organs associated with it in the general function of nutrition (220), is gradually removed farther and farther from the centre, as the several parts of the system become developed and enlarged Composed of tis-

* Wallace has since died, at the age of 105 years.

sues peculiarly susceptible to the action of their appropriate stimuli, and simply employed under vital control, as a mechanical power, to circulate the blood, without effecting any changes in it, the heart seems to require and to possess but few nerves. All this is likewise true of the large blood-vessels. But in the capillary system, or minute extremities of the vessels, where all the important changes take place, the nerves much more largely abound. But as I shall have occasion to speak of the tissues of the several organs, when I come to treat of their functions, it is not necessary to enter into particular details here. I will, therefore, at present, only observe that, of all the organs of the body, the stomach is the most remarkable for its nervous endowment, and for its functional and sympathetic relations. Lying near the great ganglionic centre, it receives a large supply of nerves directly from that source, and is thereby brought into the closest sympathetic union with the common centre of organic life, and through it with all the organs and parts in its domain. By the arrangement and distributions of plexuses also, the stomach is brought into very direct relations with the heart, liver, lungs, and all the other organs.

THE CEREBRO-SPINAL NERVES.

232. I have already stated (214) that it has been a prevailing opinion among physiologists, that the spinal marrow is the grand nervous axis of original centre, from which spring all the other parts of the whole nervous system belonging to the human body, and that it, in a general manner, presides over all the formative processes in the organic development, and all the functions of the vital economy, during life. But we have seen (215) that these opinions cannot be true, because the brain and spinal marrow are among the last-formed portions of the body, and every other part of the body may be, and actually has been, completely developed without them.

233. The cerebro-spinal nerves, therefore, together with the muscles of voluntary motion, and the bones of the head, and upper and lower extremities, are purely and exclusively organs of external relation, and are, to no extent, directly and effectively concerned in the original formation and development of the body, nor in its permanent economy of nutrition and general sustenance; nor are they in any manner or degree essential to the life of the body, until respiration and deglutition become necessary. The introduction of proper external substances into the lungs and stomach, and the voluntary evacuations of excrementitious matter, are the only immediate duties which they have to perform, and the only direct agency which they have to exercise, in all the complicated processes of the general function of nutrition.

234. The nerves of organic life then, presiding wholly and exclusively over all the formative processes of organic development, and the cerebro-spinal system being as purely and entirely passive in those processes as the cartilages and ligaments, it necessarily follows that the organic system is not developed either from the brain or spinal marrow, as the original centre of development and point of unity to the formative economy, but the several parts may be, and in fact are, originally formed in a measure independently of each other, having at first no other connexion than that which is formed by the nerves of organic life (230), and by the common system of blood-vessels by which they are

all constructed. As the development of the separate parts progresses, they become more and more nearly associated, and finally become closely and permanently connected, forming of the whole assemblage a single system of organs, and establishing by their combined functions, a single vital economy, by which the individual is sustained and the species perpetuated.

235. The cerebro-spinal nerves, therefore, instead of springing from the brain, or spinal marrow, or any other common centre, originate with the parts to which they belong, and in the progress of the general development, become permanently connected with the spinal and cerebral centres. Some modern physiologists indeed, contend that the nerves of organic life, as well as those of the cerebro-spinal system, originate in the extremities of the parts of which they belong, and terminate in the centre, and that the formative process by which organic bodies are developed, are, both in vegetables and animals, effected by a species of vital force, which does not depend on any nervous system; and consequently that the several parts of the body with all their tissues may be, and probably are, originally formed without any connexion with each other, as so many distinct individual beings; and, in the progress of development, become united in a single system. But this is both contrary to fact and to every sound physiological principle and analogy. Whether vegetables have nerves or not, we know that the economy by which they are developed has a *punctum saliens*, a single starting point; and that, in all its processes, this is the grand point of unity, the general centre of action: and we know with equal certainty that this is also true, in the development of animal bodies. A grand centre of unity and of action is first established, and this is maintained with strictest integrity throughout the whole progress of development. This centre, I have said (226), is the central brain of the nerves of organic life, consisting, in the fully developed body, of the semilunar ganglions and solar plexus; and from this common centre, all the subordinate centres with their connecting cords, branches, etc., are developed, by the blood-vessels over which these nerves preside (219), and which in all stages of the general development, have also a common centre or heart, from which they all receive their blood. There must, of necessity, therefore, be an entire unity in the formative economy by which animal bodies are developed, so far as the nerves of organic life and the blood-vessels are considered. But different portions of these, acting by special centres, in a subordinate manner, as I have already described (219), may, and in fact do, commence at different points, the structure of different parts, in a measure independent of each other (174), just as ossification commences simultaneously at many different points, which have no immediate connection with, nor dependence upon, each other, while at the same time they all depend upon a single economy, acting from a common centre. In this manner, the cerebro spinal nerves, instead of being developed in unity from a common centre, originate in several parts, and by subsequent connexion, constitute a single system. Hence, as we have seen (215), the spinal nerves may be developed without a spinal marrow, and, as is frequently the case, the spinal nerves and marrow may be developed without a brain; and we are told that there have been instances in which the brain has been developed without a spinal marrow.

236. The natural order of development in the cerebro-spinal system of nerves, in the human body, is probably as follows: 1. The spinal nerves, or those which are commonly described as arising from the spinal marrow. The development of these, as I have said (224), probably commences at the ganglions near the spine (Fig. 14, *d*.). 2. The spinal marrow itself. 3. Those ganglions of the brain, which are common to the lower orders of the vertebrated animals, and which are essential to the functions of taste, smell, hearing, and sight, together with the special nerves by which these functions are performed. 4. The ganglions which more particularly belong to those portions of the brain which constitute the more immediate and special organism of the mental and moral faculties; and 5. The cerebral hemispheres themselves. I do not mean to be understood, however, that each preceding part is fully developed before the succeeding one is commenced; but that the natural order in which the development of these several parts commences, is such as I have described.

237. Having thus pointed out the natural order of development, I shall now proceed to a more particular description of the several parts of the cerebro-spinal system of nerves; not in the order in which they are developed, but as they present themselves to the eye of the anatomist in the dissection of the dead body; because this is the usual manner of describing them, and therefore will probably be more readily understood.

238. The spinal marrow is that soft substance which lies in the hollow of the back bone (180, 182). To a careless observer, it appears to be a common mass of marrow; but when carefully and properly examined, it is found to be composed of the white and the gray nervous substances (161); the gray being situated internally, somewhat like a series of ganglions, and surrounded by the white. It is naturally divided, longitudinally, into a right and left half: each of which consists of a front and back column, so that the whole marrow is composed of four columns, or rather of two corresponding pairs; as the two front portions correspond with each other in form and character; and the two back portions correspond with each other in like manner; thus constituting a double spinal marrow, as if the two halves of the body had a distinct and independent existence; which, indeed, so far as the spinal marrow and its nerves are concerned, is really the case. For, as we shall see, the whole of one side may be paralyzed, while the other remains in the full possession of its powers.

239. The spinal marrow is enveloped in three different membranes. The first, which everywhere closely adheres to it, is full of blood-vessels that are supposed to nourish it, and hence the membrane is called the *pia mater*, or natural mother. The second, called the arachnoid, or spider's-web membrane, is extremely thin, and is continually moistened by its own serous exhalation. The third, or external one, which may properly be considered the lining membrane of the bony cavity or canal, is a strong fibrous membrane, like that which everywhere surrounds the bones: and some anatomists think this a continuation of the periostrum. It is here, however, called the *dura-mater*, or hard mother. These membranes are all three composed of the cellular tissue (169).

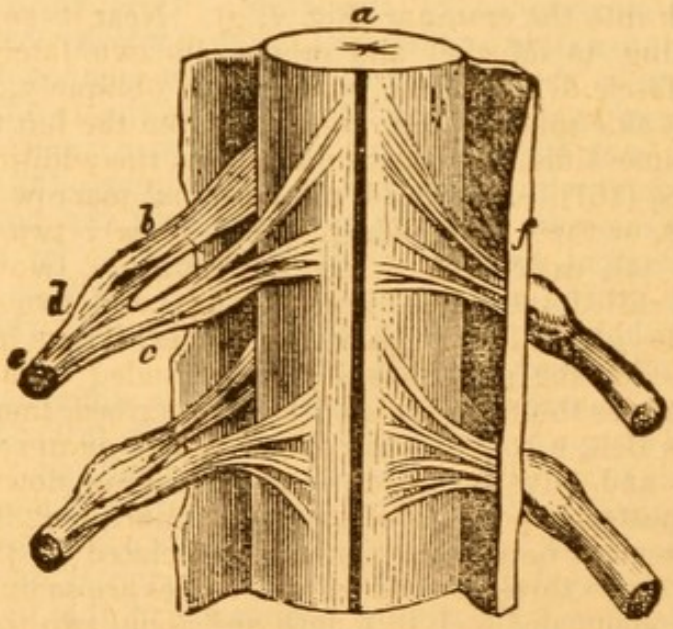
240. Connected with the spinal marrow, through small interverte-

bral openings formed for the purpose, on each side of the spinal canal, are thirty pairs of nerves, which are called the spinal nerves. Each of the nerves consists of numerous filaments, surrounded by the *pia-mater*, and an external envelope of strong cellular membrane, resembling the *dura-mater*, and which some anatomists consider a continuation of the dura-mater; but others are of a different opinion.

241. As the cerebro-spinal nerves on each side of the middle line, or in each half of the body, are precisely alike, it is most convenient to describe them on one side only. I shall therefore adopt this method, and I wish it to be understood that when I speak of a single nerve, it is one of a pair, the corresponding one being on the opposite side.

242. According to Sir Charles Bell, Magendie and others, a part of the filaments which compose each spinal nerve, rise from [or terminate in] the back portion, and a part from the front portion of the spinal marrow (Fig. 14). Those which rise from the back portion (*b*), almost immediately run into a ganglion (*d*), and proceeding from this, they unite with those that come from the front portion (*c*), and form the cord (*e*) which goes out to be dispersed over the body. But in entering into the formation of the cord, the filaments retain their filamentary form and original character, and are again, ultimately, separated. The filaments which rise from [or terminate in] the back portion of the spinal marrow, are the nerves of animal sensation. Some few of those are distributed to the muscles of voluntary motion, and endow those organs with a small degree of animal sensibility, by which the mind is informed of the action of the muscles in obedience to the will, and enabled to regulate the extent of

Fig. 14.



A section of the spinal marrow, showing the connexion between it and the spinal nerves by double roots.

a, spinal marrow.
b, root of spinal nerve from back portion.
c, root from front portion.
d, ganglion on the posterior part.
e, the two parts united in one cord.

the action. The rest of the posterior filaments proceed to the outer skin of the body, and by endowing it with a high degree of animal sensibility, constitute it a general organ of touch, which is the fundamental animal faculty of external relation. They however abound more in some parts than in others, making particular portions of the body the more special organs of touch. In man, the ends of the fingers are pre-eminently qualified for this function.

243. The filaments which arise from [or terminate in] the front portion of the spinal marrow, are the nerves of motion. They are all distributed to the muscles of voluntary motion (194), ramifying in great numbers over the whole of this part of the muscular system, and penetrating to the smallest muscular filaments. These convey the stimulus or influence of the WILL to the voluntary muscles, causing them to contract in obedience to the WILL, in the performance of voluntary motions. If, therefore, the filaments from the back portion of the spinal marrow be separated from that centre, the animal sensibility of the parts to which they are distributed is immediately destroyed, or in other words, the animal centre of perception has no longer cognizance of any sensations or affections in those parts; yet the power of voluntary motion will remain. But if the filaments from the front portion of the spinal marrow be separated from that centre, the power of voluntary motion of the parts to which they are distributed will be lost, while the sensibility will remain.

THE MEDULLA OBLONGATA.

244. The same column of nervous matter which, in the hollow of the backbone, is called the spinal marrow, continues upward, and passing through a large foramen or opening in the base of the skull, extends about an inch into the cranium (Fig. 7, g). Near its entrance into the skull, according to Meckel and others, its two lateral parts divide into several fasciculi or cords, which cross obliquely, so that those from the right side take the left, and those from the left take the right: and, at the same time, they are enlarged by the addition of masses of gray substance (161). The head of the spinal marrow is now divided into six parts, or three pairs of bodies (Fig. 15, *m*): two corresponding ones in front (*h*), called the PYRAMIDAL BODIES; two corresponding ones behind, called the RESTIFORM BODIES: and two corresponding ones at the sides (*i*), called the OLIVARY BODIES. These last are principally composed of the gray substance, surrounded by a thin layer of the white Besides the parts which I have described, there is, according to Sir Charles Bell, a convex strip of medullary matter lying between the restiform and olivary bodies, and extending down between the anterior and posterior portions of the spinal marrow (238), which gives origin to the several nerves particularly associated in the function of respiration. These three or four pairs of bodies are so united as to form a single bulb, about one inch in length and about two thirds of an inch in diameter, and commonly called the Medulla Oblongata (Fig. 15, *m*).

245. From the sides of this bulb, rise several pairs of nerves, and from its top all the other parts within the cranium which I will briefly describe in order from below upwards.

In the region of the neck, a number of branches and filaments from several different nerves. unite to form a nerve which descends to the

diaphragm, and is concerned in the function of respiration. In its course from its origin to its termination, it gives off twigs which go to different parts, and unite with twigs from the ganglionic nerves of the neck, with branches from the solar plexus, and with other important nerves. This nerve belongs to that portion of the respiratory apparatus, which ordinarily acts without the agency of the WILL, but which the WILL can act directly upon, and, to a limited extent, control. The next nerve above, called the spinal accessory, has an extended origin. Some of its roots arise from the lower part of the marrow of the neck, others from the middle, and others from the upper part of the same region. These all enter the skull with the spinal marrow, and after receiving three or four roots from the medulla oblongata, unite to form a cord which passes out at a small opening at the base of the skull, and is distributed to the muscles of the neck concerned in moving the breast and collar bones and shoulder blade, and in drawing back the head and shoulders. This is one of Sir Charles Bell's respiratory nerves; and according to that distinguished anatomist, both this and the diaphragmatic nerve spring from the middle strip of medullary matter, which I have named. Of those nerves which have their origin entirely within the skull, the lowest is called the hypoglossal. It arises by a series of roots, from the groove between the pyramidal and olivary bodies, and passes out at another small aperture in the base of the skull, and after giving off twigs in several directions, and receiving twigs from other nerves, it divides into many branches which are distributed to the muscles of the tongue, imparting to them the power of voluntary motion in mastication, swallowing, speaking, singing, etc. The nerve next in order above, is called the pneumo-gastric, or the lungs-and-stomach nerve. It arises by numerous roots very near the top of the medulla oblongata, and according to Sir Charles Bell, from the respiratory strip between the restiform and olivary bodies. It issues from the skull with the spinal accessory: and by numerous branches and twigs, forms connexions and plexuses with almost every nerve in the region of the throat and neck and thoracic cavity, to such an extent, that it has been called the middle sympathetic. It sends branches to the pharynx, or top of the meat-pipe, and to the meat-pipe itself, to the larynx or organ of voice at the top of the windpipe, and to the windpipe in all its branches and whole extent. It also sends branches which unite with others from the cervical ganglions of the sympathetic, to form what is called the cardiac plexus, and at the bottom of the neck it sends back a recurrent branch to the larynx and windpipe and other adjacent parts: and these different branches interweave and unite in every direction, so as to bring the organs of the throat and neck into very direct and important relations. Several branches of this nerve also enter into the formation of plexuses for the lungs: and some twigs extend to the solar plexus, to the plexus of the liver, spleen, etc.; but the main body of this nerve descends to the stomach, and is distributed over that organ, interweaving and uniting extensively with the nerves which come from the solar plexus, the great centre of organic life.

246. This nerve has been the subject of more speculation and experiment and discussion and controversy among physiologists, than perhaps any other portion of the human system. Some, as I have stated, have

considered it the middle sympathetic nerve, the office of which is to maintain a direct sympathy between all the parts to which it belongs, and especially between the brain and the stomach. Some have supposed that it is simply the medium by which the want of air in the lungs and of food in the stomach is communicated to the animal centre of perception and action; others, that it conveys to the lungs and stomach the nervous energy by which those organs are enabled to digest the inspired air and the ingested food. Some have considered it an animal nerve, and others a vegetative nerve. Some have thought it wholly a nerve of sensation, and others that it is both a nerve of sensation and motion; and others again contend that it is exclusively a nerve of motion. It has been tied and cut and experimented on in various ways, and with various results in the minds of the experimenters, according to their particular theories. Some assert that if it be cut or tied, digestion, respiration, and the action of the heart are entirely arrested: while others contend that digestion is only temporarily interrupted, and respiration is arrested only by the closing of the top of the windpipe, and that the action of the heart may be restored by artificial respiration. But in all these experiments the sympathies of the system seem to have been wholly overlooked (206, 216). Sir Charles Bell tells us that it is exclusively a respiratory nerve, and that it immediately or remotely associates all the parts to which it is distributed in the function of respiration.

247. Amidst such a wilderness of discrepant opinions and statements, it is impossible to decide from their authority where the truth lies; but there are several important considerations which should ever be kept in view, when we attempt to arrive at a conclusion on this vexed question. In the first place, this is a large nerve issuing from the very top of the medulla oblongata, a point towards which all other parts in the body, below and in the skull above, seem to converge. In the second place, it not only anastomoses, or forms connexions, by numerous branches, with several other nerves, issuing from the cranium, but also anastomoses freely, and even from plexuses, with the nerves of organic life, from the cervicle and thoracic ganglions of the sympathetic. In the third place, the main body of the nerve proceeds very directly to, and expends itself upon, the stomach, as if that organ were its grand point of destination, and all its other distributions secondary or of less importance. It is said to send some branches to the heart, but all those branches are first merged in plexuses with nerves of organic life, and few if any of them reach the heart, even in a modified form. Those branches which go to the substance of the lungs are also much involved in anastomoses and plexuses, and perhaps considerably modified by other nerves, before they reach their destination. In the fourth place, some filaments of this nerve extend to the great centre of organic life, or solar plexus (226), and the plexuses immediately formed from it and surrounding it. Would this be the case if it were simply a motor nerve? In the fifth place, it is pretty certain that those branches of this nerve which are distributed to the pharynx and larynx and the muscular portion of the windpipe, are nerves of voluntary motion; and that the section or paralysis of them destroys the vocal power and the power of deglutition or swallowing: and it is entirely certain that the WILL has no direct control over that large portion of this nerve which is dis-

tributed to the stomach; nor is there the least reason to suppose it has over those branches which reach the substance of the lungs. Moreover, it is very certain that in the stomach the pneumogastric is not a nerve of common animal sensibility of feeling, while it branches in the lining membrane of the larynx and windpipe appear to be highly sensible. Finally, the special sense of hunger and of thirst, and the well-known direct and powerful sympathy that exists between the brain and the stomach, seem to require the agency which has long been attributed to this nerve. Indeed, it appears to occupy a middle ground between the nerves of organic and animal life; and, if such a thing may be, I am inclined to think that, in its origin, it is an animal nerve of sensation and motion, and after forming its great plexus, and becoming intimately associated with the nerves of organic life, it becomes an animo-organic nerve of the same powers, giving motion perhaps to the bronchæ and certain motions to the stomach, which take place in vomiting, etc., and constituting the medium by which the centre of animal perception has cognizance of those wants of the organic domain which are indicated by hunger, thirst, and the desire for air; and by which, also, the brain and the stomach, and other parts associated by this nerve, are brought into more direct and powerful sympathy with each other. Something very analogous to this is found in the trifacial nerve, if it be true that that nerve endows the tongue with gustatory power. But whatever the pneumogastric nerve may have to do with the motions, sensibilities, and sympathies of the stomach and lungs, the general law of physiological analogy teaches us that it is not directly and immediately concerned in the important changes which take place in them, these depending entirely on the vital properties and functional powers of the nerves of organic life, connected with the capillary vessels of those organs (230).

248. The next nerve in order is called the glosopharangeal, or tongue-and-pharynx nerve. It rises by numerous filaments from the groove between the restiform and olivary bodies, immediately above or before the pneumogastric, and passes out of the cranium with the latter nerve. Indeed, some anatomists think it actually forms a part of the pneumogastric. Sir Charles Bell classes it among his respiratory nerves. On its exit from the skull, it gives off several branches, which unite with other nerves, and supply many parts in the region of the throat; but it is mainly distributed to the pharynx and tongue. According to Sir Charles, it gives motion to the muscles of the tongue and pharynx, and more especially those necessary for the articulation of the voice. Spurzheim, on the contrary, says: 'This nerve appears to be destined to general sensation or feeling.' Another nerve rises immediately above and on the same line with the one just described, which is called the facial nerve. It passes out at an opening near the ear, and is principally distributed to the muscles of the face; being dispersed over the chin, lips, angles of the mouth, cheeks, nostrils, eyelids, eyebrows, forehead, ears, neck, etc., and uniting in its ramifications with the branches and twigs of several other nerves. This is another of Sir Charles Bell's respiratory nerves; and, according to him, it is the principal muscular or motor nerve of the face, and orders all those actions which are, in any degree, connected with the acts of respiration; and on it the expressions of the face depend. The next nerve is

called the abductor, or the external muscular nerve of the eye. It rises from the top of the pyramidal body, and passes out at an opening in the back part of the cavity formed for the eyeball, and goes to the muscles which turn the eye outward. This nerve is entirely appropriated to voluntary motion (Fig. 15, No. 6.) There are six other pair of nerves, including those of special sense, which originate within the cranium, and all of which actually rise, either directly or indirectly, from the top of the medulla oblongata; but their roots are so covered by other parts, or they originate in a manner so diffuse and indistinct, that they have the appearance of springing from parts removed from that point.

249. In describing the remaining nerves, I shall deviate from the usual order, and proceed in a method of my own, for the sake of placing important points in the strongest light with reference to physiological relations. The nerve which next presents itself as we proceed forwards, is the auditory (Fig. 15, No. 8), and the next is the trifacial (Fig. 15, No. 5), both of which I shall leave for the present, and pass to the two remaining muscular nerves of the eye. The internal motor nerve of the eye is the smallest that originates within the cranium (Fig. 15, No. 4). It is the highest of Sir Charles Bell's respiratory nerves, and, according to that gentleman, it rises from the very top of the medullary strip which gives origin to all the nerves of the respiratory apparatus (244), and which terminates upwards and forwards, just under the masses called the corpora quadrigemini. This nerve passes out of the skull, with the nerve last described, and goes to the superior oblique muscle of the eye, which rolls the eye, and turns the pupil downward and outward, and gives the pathetic expression to the eye, and hence this nerve is called the pathetic. The common motor nerve of the eye (Fig. 15, No. 3), rises by numerous filaments, which may be traced back nearly to the top of the medulla oblongata, and are then lost in parts coming from that point. The filaments soon unite, and form the nerve, which passes out at the same opening with the two last described nerves, and is distributed to the greater number of the muscles of the eye, which serve to direct the pupil towards the object of vision.

250. The nerves which remain to be described are those of special sense, and the trifacial. All these have their origin at or near the focal point, at the head of the medulla oblongata, from which all the parts within the cranium rise and diverge. This, it must be remembered, however, is according to the usual mode of anatomical description, rather than according to the natural order of development. It is highly probable, if not certain, as I have said (236), that the parts within the skull do not actually spring from the medulla oblongata, but that the cerebral ganglions, such as the quadrigeminal, the ophthalmic, and the striated bodies, are first formed or commenced in regular order of succession, and in due time united with the medulla oblongata and with each other by medullary fibres, and that from these are developed the parts more particularly connected with them. The quadrigeminal bodies are four small ganglions lying at the top of the medulla oblongata. A little removed from these are the two largest ganglions of the brain, called by the old anatomists the optic thalami, being supposed to give rise to the optic nerves; and still a little removed from these last are two smaller ganglions, called the

siriated bodies. All of these bodies are principally composed of the gray substance (161), surrounded and traversed by the white or medullary fibres; and all lie near the centre and base of the brain, and occupy but a small portion of the cranial cavity.

251. Anatomists have attempted to demonstrate the precise points at which the olfactory, optic, and auditory nerves rise from these bodies; but no one has yet been so successful as to place the matter entirely beyond dispute. As these nerves are traced backward and inward towards their origin, they become less and less distinct, and more and more indefinite, till they fade into the substance of the parts from which they rise, and evade pursuit; and this is particularly the case with the optic and olfactory nerves. Indeed, all these nerves appear to have a general relation to all the parts arising from, or terminating in, the common centre of animal perception and voluntary action, at the top of the medullary oblongata.

252. The auditory nerves (Fig. 15, No. 8), are endowed with the power of receiving those impressions which we call sounds, and are distributed to the inner cavities of the ear as the special nerves of hearing. The olfactory nerves are endowed with the power of receiving those impressions which we call smell. They proceed forwards, and before they make their exit from the skull, they are considerably enlarged by a quantity of the gray substance (Fig. 15, No. 1). They then pass out through a number of small apertures, and are distributed over the cavities of the nose, forming the external organ of smell. The optic nerves proceed forwards a short distance from their origin, and then come together and form a junction, and again immediately separate, and continue forwards, and make their exit from the skull through the optic foramen; and having passed through the outer coats of the eye-balls, they finally terminate in a delicate expansion, called the retina, which surrounds the humors of the eye (Fig. 15, No. 2). The nature of the union which these nerves form at their junction, is yet a matter of uncertainty. Anatomists and physiologists not only disagree on the subject, but in their arguments and in their statements of facts, directly contradict each other. Some assert that the two nerves cross each other entirely, so that the nerve which rises on the right side goes to the left eye, and that which rises on the left side goes to the right eye. These support their opinion by an array of pathological and other facts and reasonings, which are very convincing and conclusive. But others assert that there is only a junction and no crossing of the nerves, and that even the function is not essential to their functional powers. These again, by facts and reasonings, make out their case as clearly and as conclusively as those of the former opinion; while yet others contend that there is a partial decussation, and establish their position most conclusively by facts and reasonings; and still others, with equal force of facts and arguments, prove that there is no decussation, but an intimate and essential union of the substance of the nerves. From such contradictory statements, it is impossible to know what is true: but we have the satisfaction of knowing that whatever be true in the case, it is of little importance to physiology. The optic nerve is endowed with the power of receiving those impressions which we call sight. It is the special nerve of vision, and is always present where the faculty of vision exists

253. The peculiar endowments of the nerves of special sense are generally considered as modifications of common animal sensibility; but there is some reason to doubt the correctness of this opinion. It is certain that these nerves, at least in a healthy state, have no tactile sensibility. The optic nerve is no more sensible to a puncture or laceration than a dead tree, but it is most delicately sensible to light, which we can in no other possible manner appreciate nor perceive. Nor is there the least foundation for the notion which some have advanced, that other nerves may in some degree vicariously perform the functions of these nerves, in their absence. Indeed, the sense of touch is in all respects as truly a special sense as that of sight, hearing, smell, or taste. It is much more extensive in its special organism than any other sense, only because the relations of the animal to the tangible properties of things require that it should be so; but the extensiveness of its organism does not in any measure render the sense less specific. If the optic nerve instead of being expanded into the retina of the eyeball, were expanded like the skin over the whole external surface of the body, so that the animal could see, as he can feel, at every point, the optic sense would be no less a special sense than it now is; because the speciality of a sense does not consist in the limitedness of its peculiar organism, but in the *specificness* of its power The sense of sight is a special sense, not because we can see only with the eye, but because we can only perceive special properties of external things by it, which we call the visual properties of things; and so of all the other senses called special. But the sense of touch is as specific in its power as either of the other senses, for by it we can only perceive the tangible properties of things, and therefore it is the special sense of touch, notwithstanding the faculty pervades the whole body.

254. I now return to the trifacial nerve, or the fifth of the old anatomists. This is the largest nerve within the cranium, and in many respects corresponds with the spinal nerves. Like them it rises by two roots, has a ganglion, and is both a nerve of sensation and motion (Fig. 15, No 5). In birds and other animals which have no annular protuberance, this nerve is plainly seen rising from the pyramidal and restiform bodies of the medulla oblongata; but in man and other bodies which have a large annular protuberance, the origin of the nerve is not so easily perceived. The posterior root of this nerve, coming from the restiform body, is much the larger, and is composed of thirty or forty fasciculi of different sizes, containing in all about a hundred filaments, which interlace freely as they proceed forward to form the semicircular prominence or enlargement called the gasserian ganglion. This portion of the nerve is endowed with animal sensibility. The anterior portion which arises from the pyramidal body does not enter the ganglion. This is the motor portion of the nerve, and is ultimately distributed to those muscles of the face, concerned in mastication, etc. From the gasserian ganglion the nerve proceeds in three large branches, called the ophthalmic, the superior maxillary, and the inferior maxillary. The ophthalmic is principally distributed to the eye, giving sensibility to the surface of the ball and the parts that surround it, sending some twigs to the nose, etc The superior maxillary is distributed to the upper part of the face, upper jaw, roof of the mouth, superior salivary glands, gum, lip, etc., sending a twig to each root

of each tooth (Fig. 20), and ramifying generally over all the parts connected with the upper jaw; some twigs extending to the cavities of the nose, and interlacing with twigs of the olfactory. The inferior maxillary is distributed to the lower parts of the face, mouth, and region of the ear, supplying the teeth, jaw, gum, inferior salivary glands, tongue, lips, chin, etc.; and some of its twigs extend to the internal auditory apparatus of the ear. The inferior maxillary also gives rise to the branch which, after peculiar modifications, is endowed with the power of receiving those impressions which we call taste, and is distributed by minute filaments to the mucous membrane of the mouth and throat, and particularly upon the edges and tip of the tongue, and thus forming the special organ of taste.* In short, the trifacial nerve is distributed to every part of the face, forehead, eyelids, nose, lips, jaws, and ears: and, in its extensive ramifications, it anastomoses or unites freely with the facial nerve, with several other nerves of the head, and with a great number of twigs from the sympathetic of organic life. It communicates with the organs of all the five senses, and of voluntary motion, and brings these and all other parts to which it is distributed into general relationship; and it also brings all these parts into a more direct and powerful relation with the stomach and the whole domain of organic life. This is the universal nerve of sensation to the head and face, to the skin, to the surface of the eye, to the cavities of the nose, mouth, tongue, etc.

255. The trifacial nerve has been the subject of much physiological research, experiment, and speculation. It has, by some, been called the sympathetic of the head; and there certainly are many interesting analogies between this nerve, the pneumogastric, and the sympathetic of organic life (227). Tiedemann, however, conceives that this last nerve is sufficient to answer all the sympathetic purposes of the body; and as a medium of general sympathy it undoubtedly is. Yet both the trifacial and the pneumogastric may act in their spheres as special sympathetics, bringing into more special and immediate relationship particular parts, which are collectively embraced by the great sympathetic, without at all interfering with the functions of this last nerve. In a state of extended inflammation, or a high degree of morbid sensibility, the trifacial nerve is certainly the medium of morbid sympathy between different parts to which it is distributed. The protracted irritation of the nerve of a decayed tooth, often gives rise to ear-ache, head-ache, etc.; and sometimes these sympathetic symptoms continue constantly for years, or until the tooth is extracted. And we know, too, that those parts to which the trifacial is distributed as the principal nerve, sympathise very powerfully with the stomach, especially in a diseased state; as the eyes, ears, teeth, etc. In that distressing complaint called sick head-ache, it is probable that both the trifacial and the pneumogastric nerves are much concerned.

256. Such is the importance of this nerve to those of special sense, that some physiologists have supposed it immediately essential to their

* There is some question whether the inferior maxillary branch of the trifacial does actually furnish the gustatory nerve. Many experiments have been made on living animals, to settle this point: but the parts are so complicated, and different nerves are so closely associated, that nothing perfectly satisfactory and conclusive has yet been ascertained

functional powers; and some have even asserted that the functions of sight and smell are performed in certain animals by the branches of this nerve, in the absence of the optic and olfactory. But, most unquestionably, these opinions are erroneous. Yet it is entirely certain that the division of those branches which go to the eye and nose, will instantly destroy the sensibility of the parts, and soon cause a total abolition of sight and smell: and all injury done to these branches commensurately impairs the functional powers of the optic and olfactory nerves; so intimately connected and reciprocally dependent are the several parts which compose a single organ and a whole system.

257. There is one other view presented by some physiologists, of the trifacial nerve, which is exceedingly interesting and plausible. It is, that this nerve is peculiarly the cerebral organ of animal instinct. It is said that in the vertebrated animals, the development of instinct appears to be in a direct ratio with the trifacial, and that in those articulated animals whose brain corresponds with the gasserian ganglion of the trifacial nerve, the instinctive powers are more developed than in the members of other classes.

258. The originators and advocates of this opinion affirm that the brain and trifacial nerve are always developed in an inverse ratio, and that the development of the trifacial and the instinctive faculties always bear a precise relation to each other. 'Man,' say they, 'is governed by reason, and not by instinct; and in him the trifacial nerve, in comparison with the other parts of the nervous system, is reduced to its minimum of existence. The monkey, the dog the elephant, and most of the higher mammalia, though immeasurably below man, appear to be directed by a kind of brute reason. In these animals, also, the trifacial bears but an inconsiderable proportion to the general nervous mass; the instinctive faculties are indeed manifest, but not carried to the extent they are met with in many of the lower orders. In the seal and beaver, among the mammalia, these faculties are at their highest pitch of development, and seem rather to be the effect of an unerring reasoning power, than the result of the organization of instinct. In these animals the brain is reduced to a state of atrophy, whilst the trifacial is carried to an enormous extent of development. In the wasp, the bee, and the spider, and especially in the bee, instinct is carried to its highest perfection. And here the brain is wholly wanting; the gasserian ganglion being the predominating part of the nervous system in all the invertebrata, and in the bee, this organ is carried to its highest point of complexity and organization.'

259. All the parts of the nervous system which I have described may be developed, and all the functions immediately essential to animal and organic life may be performed, without the brain. 'Many instances are on record of human beings, which were entirely destitute of the proper brain, and in which the two gasserian ganglions approached each other and became confounded in one general mass; and with this, the olfactory, optic, auditory, and other nerves of the head, were connected, and during the life of the individuals the functions of smell, vision, hearing, and taste were perfect.' But these are monstrosities of nature, and fortunately are of rare occurrence. They, however, serve to demonstrate the relations and dependencies of parts; and

sometimes teach us important physiological truths, which it would be difficult, if possible, for us to ascertain in any other way.

260. We see, therefore, that the spinal marrow and the spinal nerves, together with the medulla oblongata and the several pairs of nerves within the cranium, are all purely and exclusively the agents of animal sensation, perception, and voluntary motion; and that the brain itself, instead of being a galvanic apparatus employed in generating the nervous power or vital stimulus of the whole system, is appropriated entirely to the intellectual and moral powers and manifestations, and has little more to do with the rest of the body than to depend on its general organic economy for its own sustenance, and to constitute the special organism through which the mind is acted on by the body, and in turn acts on the body—directly in the exercises of the WILL, and indirectly in all mental excitements and motions.

LECTURE VI.

The brain—the order of its development and the relations of its parts—Gall's views—Spurzheim's views—Tiedemann's views—Number of cerebral organs described by Gall—Number added by Spurzheim—Common centre of the cerebro-spinal system—Duplicate and symmetrical form of the system—Not so in the nerves of organic life—Connexion between the nerves of organic life and the cerebro-spinal system—Skin and mucous membrane, their structure and general functions as media of nervous connexion and sympathy—Organic and animal sensibility described—Centre of animal life, no perception of, nor control over, the functions of organic life—Nerves of organic life no animal sensibility—External senses and their relations—Touch, taste, smell, hearing, sight—Special senses of organic life—Sympathetic relations between the different parts in organic and animal life—The powerful sympathetic relations between the stomach, brain and all other parts—Sympathies, sources of happiness and of misery—Organic sympathies excited by poison—Morbid sensibility in nerves of organic life—Sympathetic relations between the nerves of organic life and the mind—Influence of the mind on the body—Of the body on the mind—Hereditary predispositions, etc.—Nerves larger and more pulpy in early life—smaller and drier in old age.

261. THE parts within the cranium remaining to be described, are the cerebrum or brain, and the cerebellum or little brain. The latter occupies the lower portion of the back part of the skull, and the former occupies the whole of the upper and front portion. In common language, however, all the parts within the cranium are collectively called the brain, and in the technical language of anatomy and physiology, the encephalon, from two Greek words meaning 'in the head.'

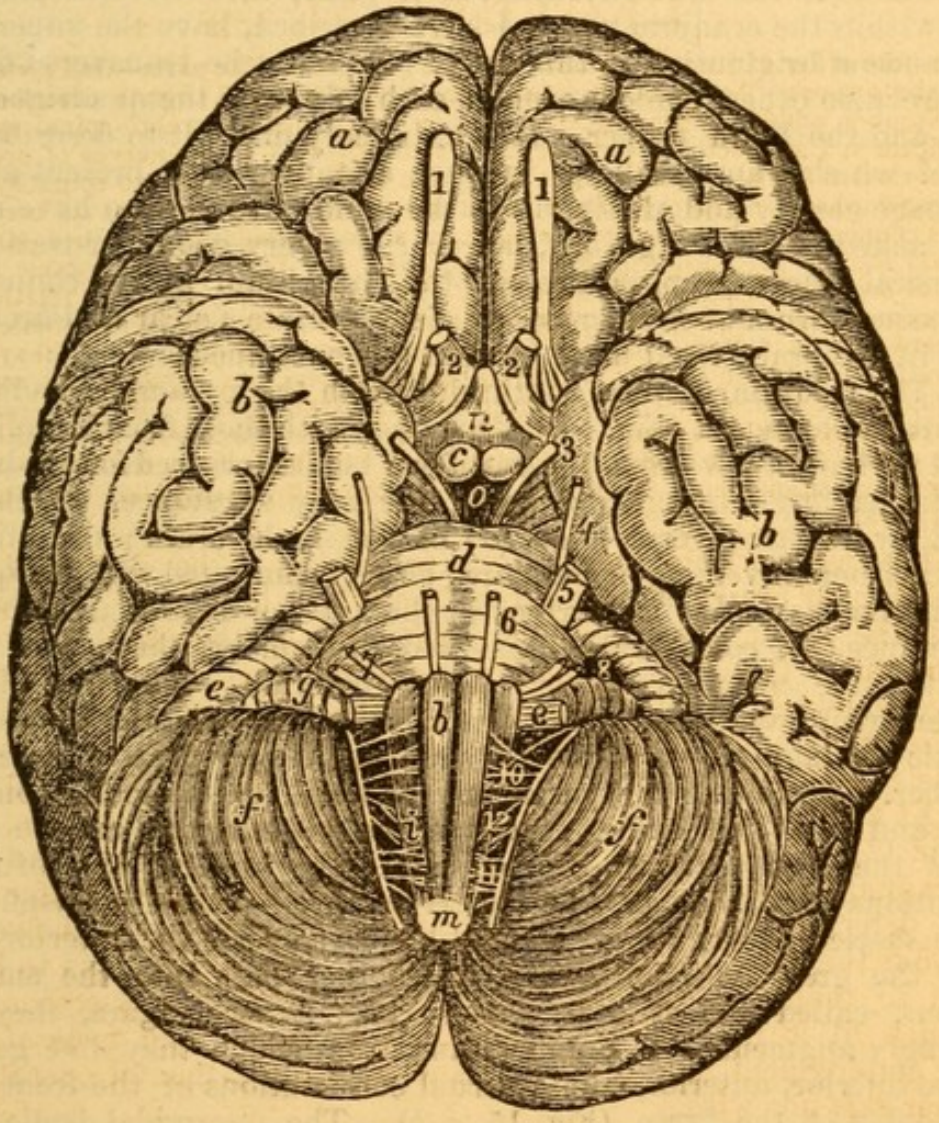
262. At first, the contents of the cranium and spinal canal are, as I have said (214), exceedingly soft, somewhat like the white of an egg. They gradually become more and more consistent, and assume the form of determinate structure and arrangement. It is not, however, until about the seventh year of life that the brain is supposed to have attained to that completeness of development and degree of consistency which fit it for vigorous functional exercise; and even at this age, the employment of it in severe and continued mental operations is neither safe nor wise.

263. I have already so fully described the natural order of the original development of the cerebro-spinal system (250), that I trust I shall not be misunderstood if I now proceed to describe the brain as it presents itself to the eye of the anatomist, in the dissection of the

completely developed body, and speak of parts as rising from others, which probably originated separately, and in the progress of development became united.

264. The medulla oblongata, or that portion of the spinal marrow which is within the skull, I have said (244), consists of three pairs of bodies united in a single bulb (Fig. 15, *m*)—viz., the two pyramidal bodies (*h*) which are continuations up of the two front portions of the spinal marrow (238), the two restiform bodies which are continuations up of the two back portions of the spinal marrow, and the two olivary bodies (Fig. 15. *i*) lying between the other two pairs, and partly at the sides, which are composed of gray matter thinly surrounded by white fibres, and by some anatomists are considered enforcing ganglions. The bulb thus composed leans forward in the cranium, and rests in anterior surface in a fossa or groove formed for it in the

Fig. 15.



The base of the brain, exhibiting—a, the anterior lobes; b, the middle lobes; k, the posterior lobes, projecting over f, the little brain; m, the medulla oblongata; h, the pyramidal bodies; i, the olivary bodies; d, the pons varolii; and 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, the different cerebral nerves described in the text.

basilar bone. This brings the front portion, or the two pyramidal bodies, partially under the others, so that the restiform bodies, or the continuations of the back portions of the spinal marrow, are placed somewhat above. Medullary fibres (250), continuing from these last named bodies, pass through masses of the gray substance, by which they are greatly augmented in number, and are reflected backwards in nearly a horizontal line, and expanded into something like a fibrous membrane which by its peculiar foldings forms the little brain. The diverging fibres from each restiform body form a distinct lobe, so that the little brain consists of two lobes, the one on the right and the other on the left of the middle line. Some of the fibres of each of these lobes proceed forwards, and, taking a transverse direction, meet and unite on the middle line at the top of the medulla oblongata, forming the principal commissure or uniting portion of the little brain. This portion is sometimes called the pons or bridge, going from one lobe to the other; sometimes it is called the annular protuberance and sometimes the transverse fibres (Fig. 15, *d*). Several pairs of nerves within the cranium which I have described, have the superficial appearance of originating in this body. Besides the transverse fibres, there are also others which connect each lobe with the quadrigeminal bodies and the brain proper. It is extremely difficult to describe the parts of which I am speaking, in such a manner as to present a correct image clearly and distinctly to the mind of those who have never seen a naked brain. Fig. 15, *f*, however is a very good illustration of the general external appearance of the little brain in its connexion with the cerebrum or brain proper. Yet to obtain a clear and accurate idea of it, the brain itself must be seen and examined.

265. The medullary fibres continuing from the pyramidal bodies of the medulla oblongata (Fig. 15, *h*), together with those from the olivary (*i*), and perhaps a few from the restiform bodies, proceed forwards and upwards, passing through masses of the gray substance, which are covered by the transverse fibres (*d*) of the little brain; the olivary fasciculi either traversing or becoming closely connected with the quadrigeminal bodies. Having arrived at the anterior edge of the annular protuberance (*d*), considerably increased in number, they form what are called the *crura cerebri*, or legs of the brain. They now plunge into the great ganglions of the brain, called by the old anatomists the optic thalami (250), where they are again very greatly increased in number. According to Spurzheim, the fibres or fasciculi, from the olivary and restiform bodies, traverse the posterior and middle portions of the great ganglions, from which they diverge and form the convolutions of the upper and posterior parts of the hemispheres; and the fasciculi from the pyramidal bodies traverse the anterior portion of the great ganglions, from which they pass into the smaller ganglions, called the striated bodies (250), where, again, they are exceedingly augmented in number, and from which they diverge and form the inferior, anterior, and external convolutions of the front and middle lobes of the brain (Fig. 15, *a*, *b*). The pyramidal bodies (*h*) of the medullary oblongata he considers the rudiments of such parts of the brain as belong to the intellectual operations, and, in man, the olivary (*i*) and part of the restiform bodies, as the roots of those parts that pertain to the affective manifestations. And in accordance with

this view, he says that in the animals below man, that portion of the legs of the brain which is formed by the olivary fasciculi, is much more voluminous than that portion which is formed by the pyramidal fasciculi; and as we descend in the scale of being, its relative proportion increases continually; while in man, that portion which is formed by the pyramidal fasciculi constitutes two-thirds of each cerebral leg.

266. In regard to the arrangement of the medullary fibres in the formation of the convolutions and commissures of the brain, there is a wide difference of opinion between the most eminent anatomists. 'The convolutions internally consist,' says Spurzheim, 'of white fibres, which are covered on their extremities with cineritious substance. These fibres, which terminate the nervous bundles of the cerebral crura, are not all of the same length. Many, especially of those which are situated on the outer side of the convolutions, terminate immediately beyond the exterior walls of the cavities; the others extend to distances progressively greater as they run more centrally; those of the interior extending the farthest of all. It is in consequence of this peculiar structure that prolongations and depressions are formed on the surface of the hemispheres. The cineritious or gray substance follows all the forms composed by the white fibres, and covers every elevation and depression with a layer.

267. Concerning the commissures of the brain, or those parts which unite the two hemispheres, he says—'They are formed by the *converging fibres*. Nothing' he continues, 'can be easier than by dissection to prove the two orders of cerebral fibres the diverging and converging, and to show that the mass or bundle called the corpus callosum belongs to the converging order.' Yet Tiedemann, whose authority on this subject is perhaps equal, if not superior, to that of any other man, declares that those converging fibres have only an imaginary existence, that they are not to be found in the brain, and that the corpus callosum is formed before the convolutions (which according to Spurzheim give rise to converging fibres) begin to appear.

268. I confess that my own inquiries and investigations, which have been somewhat diligent and protracted, have resulted in impressions much more in accordance with the views of Tiedemann than with those of Gall and Spurzheim, in regard to the converging fibres, and the formation of the commissures and convolutions of the brain. If nothing can be easier than by dissection to prove the two orders of cerebral fibres, it is very remarkable that so few have ever succeeded in satisfying themselves by actual dissection, of the existence of the converging fibres. I have conversed with many able anatomists who had dissected many brains, and who believed and taught the doctrine of Gall and Spurzheim concerning these fibres; but I never yet saw the man who by actual dissection had demonstrated their existence.

269. According to Tiedemann, the medullary fibres that issue from the cerebral ganglions which I have already described (265), at first form a thin fibrous membrane on each side of the head. These membranes, in the progress of development, curve their superior edges in towards the middle line, and these edges gradually meet and unite, and thus form the corpus callosum, or great cerebral commissure; and by so doing, at the same time, form the two hemispheres of the

brain; which as yet are in a membranous state, like two bladders, without any appearance of convolutions: but the membrane is considerably thickened by the additions of new medullary matter on the exterior surface. In this state of the brain the fibres are to be traced from the medulla oblongata to the corpus callosum, and it is evident that the fibres which terminate in and form this commissure, are the same that come from the legs of the brain; and were the skull sufficiently capacious for an entire development of the cerebral hemisphere in this form, the human brain might come to full maturity of organization and of functional power without a single convolution. In cases of hydrocephalus, where the hemispheres are completely expanded, they are merely brought back into that membranous state in which they were at first. And this, we know, takes place without any perceptible disturbance of the cerebral function.

270. 'Were the diverging fibres of the great cerebral ganglions prolonged directly into the corpus callosum,' says Spurzheim, 'it would be extremely difficult to understand how they could be elongated to the degree occasionally observed in hydrocephalus. But the difficulty here contemplated is purely imaginary. It is not claimed that in the normal state of a fully developed brain the fibres proceed *directly* from the ganglions to the commissure, but that the membrane formed by these fibres is so folded in and out upon itself, as to form what are called the convolutions of the brain, and so as to bring the greater extent of surface within the capacity of the skull. It is therefore very easy to understand how water, slowly accumulating in the cavities of the brain, gradually raises up the corpus callosum, and enlarges the capacity of the skull, and unfolds the hemispheres into their expanded membranous form without lacerating any of the cerebral texture, or disturbing any cerebral function. It is before the convolutions are formed, and those cases of hydrocephalus in which all the convolutions are unfolded, and the hemispheres completely expanded into their original membranous state, that the fibres proceed directly, or rather in a curved line, from the ganglions to the corpus callosum. I have not found it very difficult to unfold the hemispheres of a recent brain in this manner, and spread it out into an extended membrane with no other laceration of the parts than was necessary at the edges, in order to bring a natural hemisphere into a plane; and when thus unfolded, it is very easy to see the blood-vessels ramifying over the whole internal surface, and to perceive the medullary fibres radiating like the sticks of a open fan, from the medulla oblongata to the ganglions, and from the ganglions to the great commissure.

271. According to Tiedemann and to my own convictions, then, when the cerebral hemispheres are as fully developed in the extended membranous, or bladder-like form, as the normal capacity of the skull will allow, the membrane, not consisting of the fibrous arrangements of the white substance, with a thin covering of gray substance on the external surface, begins to gather into folds, so as to continue the enlargement of its surface, and still accommodate itself to the capacity of the skull. In this manner the development of the hemispheres proceeds, till a nervous membrane is folded up in the cranial cavity, the area of whose surface is several times greater than that of the inner surface of the skull; and until that thin membranous arrange-

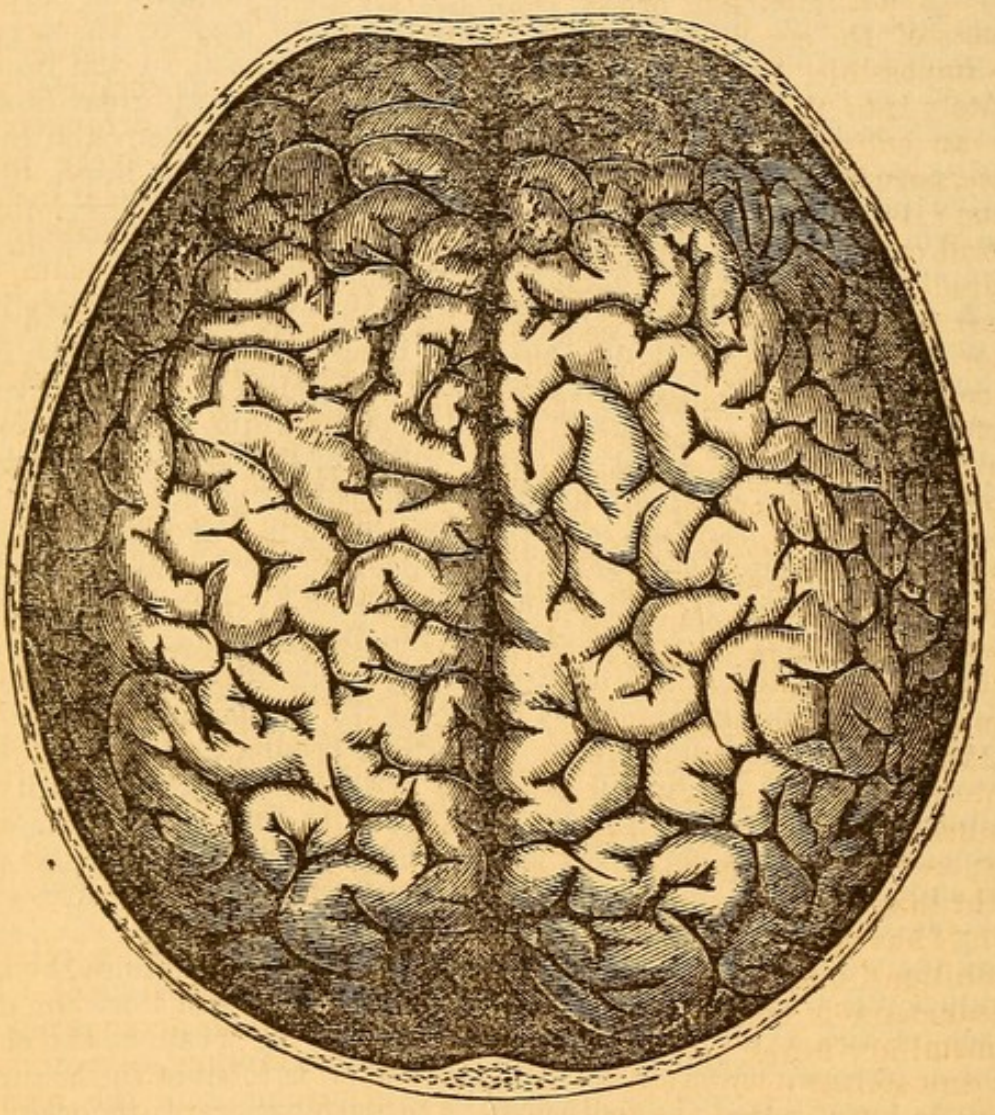
ment, which at first was expanded and smooth, is so closely folded upon itself, and by the general curving of the mass to adapt itself to the capacity and shape of the skull, the internal parts are so closely pressed together and compacted as to give to the external surface of the hemispheres those elevations and depressions which are called the convolutions, and to the medullary matter the appearance of a thick solid wall or mass. By the general curving of this wall, also, in order to come into the spherical shape of the skull, the corpus callosum or great commissure is brought down on the middle line near to the base of the brain, and thus are formed, by the same disposition of parts, the great external fissure extending from the forehead to the occupit, between the two halves of the brain (Fig. 16), and the great internal ventricles or cavities of the hemispheres. Other smaller cavities are likewise formed, at and near the centre and base of the brain, by the relative position of different parts. But as the minute description of them would serve in no degree to illustrate any known physiological principles, I shall say nothing more concerning them.

272. Each hemisphere of the brain thus developed is subdivided, in the descriptions of anatomy, into three lobes: an anterior lobe lying in the forehead (Fig. 15, *a*), a posterior lobe lying in the back part of the head and over the little brain (*k*), and a middle lobe lying in the region of the ear (*b*). Each of these lobes, again, is composed superficially of a number of apparent convolutions of the cerebral substances, so that the whole external surface of the brain is a succession of irregular elevations and depressions; and this irregular or uneven surface, it will be remembered, is everywhere covered by a thin layer of the gray substance (Fig. 16). The vascular membrane called the *pia mater*, which surrounds the spinal marrow (239), comes up and expands over the little brain and brain proper, adhering in all parts closely to the surface, and dipping into every depression, fissure, and cavity. Over this is spread the arachnoid or spider's-web membrane, which also continues up from the spinal marrow, and is everywhere constantly moistened with a serous fluid; and which, beside covering the cerebrum and cerebellum, forms a sheath or envelope for all the nerves and all the vessels which enter or issue from the skull; and finally, enveloping the whole, the strong fibrous membrane called the *dura-mater*, continues up from the spinal canal, and expands and lines the inner surface of the skull throughout. dips down, by what is called the faciform process, between the hemispheres of the brain to the corpus callosum, forms a partition between the posterior lobes of the brain and the little brain called the tentorium, and also separates the two lobes of the little brain.

273. The two hemispheres of the brain are united, as I have said, on the middle line by the great commissure or corpus callosum which lies near the base. There are also smaller commissures in the anterior and posterior parts. But the principal bond of union, and that on which the unity of the brain and of its functions, as a single organ, or as a single system of organs, mainly depends, is established at the focal point, at or near the top of the medulla oblongata, from which the fibres composing the legs of the brain rise and diverge. 'The corpus callosum,' says Spurzheim, 'may be split through its entire length, without destroying the unity of function of the two hemispheres.'

274. The fibrous arrangement of the medullary substance of the brain (162), and the disposition of the fibres in the texture and general conformation of the cerebral hemispheres, have, of late years, been rendered matters of very considerable interest by the views, originally advanced by Dr. Gall, and since advocated by Spurzheim and others, concerning the relation existing between particular parts of the brain and particular intellectual and moral powers and manifestations

Fig. 16.



Top of the brain, showing the convolutions, and the fissure between the two hemispheres.

275 According to these views as first advanced by Gall, a certain number of medullary fibres radiating from the cerebral ganglions in each hemisphere, form a fasciculus or bundle, which proceeds to the surface of the brain, and constitutes a special organ, the single and exclusive function of which is the manifestation of a specific propensity, sentiment, or intellectual power. Of these special organs, Gall described and located twenty-seven pairs, including the two lobes of the cerebellum as a single pair; the organs of one hemisphere corresponding precisely with those of the other, as one eye or ear does with the other.

276 Spurzheim, who was a pupil of Gall's, embraced the views of his master with great confidence and zeal, and from that hour devoted his whole life with untiring industry to those researches and investigations by which he hoped to erect the theory into a complete and well-established science; and if he did not live to accomplish all that he desired, he certainly succeeded in producing a powerful impression on the intellectual world, and in convincing thousands of the correctness of his doctrines He was probably more successful in unfolding the brain, and did more to introduce a correct mode of dissecting and studying that important organ, than any other man. But such is the softness of the cerebral substance, and the delicacy of its tissue, that it is impossible, by any artificial means, to push our enquiries very minutely into the details of its intimate structure and arrangement, with an entire certainty of ascertaining the truth on every point. Hence, notwithstanding the confidence with which Spurzheim insisted on the existence of an order of converging fibres which originate in the cerebral convolutions and terminate mainly in the corpus collosum, and declared that 'nothing is more easy than to prove this by dissection,' yet all his followers have been obliged to receive this purely as a matter of faith, for no one, I believe. has been able to demonstrate the truth of the statement. The course pursued by Tiedemann is, therefore, a far more correct and sure way of coming at the truth, in regard to the intimate texture of the brain. He carefully watched the cerebral development in all its stages, from the first appearance of any of its parts to its full maturity. He saw the several parts in their rudiments, saw them in their more advanced state, saw the thin membrane of the hemispheres before they were united to the corpus callosum, saw them when partially and when completely united, saw the two hemispheres when thus united, expanded and smooth like two distended bladders lying side by side, saw them when they first began to gather into folds, and saw them when closely folded in the full-formed brain. Yet even in this mode of investigation it was possible for him to be deceived in regard to the origin and disposition of some of the parts; but the probability of error in this mode is incomparably less than in that pursued by Spurzheim.

277. I have already presented Spurzheim's description of the cerebral convolutions, and of the manner in which they are formed (266). But if Tiedemann is correct in regard to the membranous arrangement of the medullary fibres, and of the folding of that membrane, so as to form what are called the convolutions of the hemispheres in the manner I have described (271); and that he is correct, I must still insist, is fully proved by the complete unfolding of the brain into its membranous form, in some cases of hydrocephalus,—then Spurzheim was in error, not only in regard to the existence of an order of converging fibres, but also in regard to that arrangement of the diverging fibres which he describes in speaking of the formation of the convolutions.

278. But if it were fully demonstrated that Spurzheim was in error on both these points, it would not necessarily follow that his theory concerning the relation between certain parts of the brain and certain powers of the mind is incorrect. The truth of this theory is not to be demonstrated by cerebral anatomy, but by cerebral physiology; and it is equally possible for such physiological powers to be possessed by

the brain whether its organization is according to the descriptions of Spurzheim or those of Tiedemann.

279. I have said that Gall described and located twenty-seven pairs of cerebral organs. To these Spurzheim added eight pairs, which he described and located; and conjectured two pairs more, the location of which he only suggested. So that, according to Spurzheim, we have thirty-five, and perhaps thirty-seven, or more pairs of cerebral organs appropriated to the propensities, sentiments, and intellect. The two pairs conjectured by Spurzheim have with more confidence been described and located by some of his followers; and, indeed, some of the more bold and zealous phrenologists multiply and locate organs *ad libitum*, to suit their convenience, to meet their exigencies, or according to their convictions from observation. The character and location of these organs I shall describe according to the views of Gall and Spurzheim, when I come to treat of the physiology of the brain (534). It may be well, however, in this place, to say that phrenologists, so far as I am informed, are not decided in opinion whether the thinking power of the brain belongs more especially and intimately to the gray substance of the surface, or to the white medullary fibres which form the convolutions (161, 162).

280. From the view which I have presented of the cerebro-spinal system, it will be perceived that all the nerves of the trunk and extremities appear to converge, as it were, toward the head of the medulla oblongata (251), and all the nerves and medullary fibres within the cranium converge towards the same point. All the parts above this point may be destroyed by slow disease, without destroying the power of animal sensation and of voluntary motion; and all the parts below the medulla oblongata may be paralyzed by disease, without immediately abolishing the intellectual powers. It may, therefore, be asserted with great confidence, that the grand centre of animal life is at or near the top of the medulla oblongata. I do not, however, intend to imply that vitality peculiarly resides at this point, but that here seems to be such a focal point of the whole nervous machinery of the cerebro-spinal system, that we can at this place put our finger on the whole at once, and instantaneously arrest all the functions of this system of nerves. It is therefore the centre of animal perception and of voluntary action; the point to which all animal sensations are directly conveyed, or by which they are perceived, and from which all the mandates of volition are transmitted directly to the muscles of voluntary motion.

281. I have already more than once alluded to the duplicate form of all those parts in the human body which belong to animal life (238). If the body be divided on the middle line, it will be found to consist of two precisely corresponding halves: the bones, the muscles, and the nerves of one side correspond almost exactly with those of the other. The parts uniting on the middle line are composed of two corresponding halves, as the tongue, the nose, the mouth, etc.; while those removed from the middle line are in corresponding pairs, as the eyes, the ears, the upper and lower extremities, etc. The nerves of the two halves of the cerebro-spinal system are very exact and symmetrical in their resemblance to each other. The right and left half of the brain and spinal marrow and all the nerves connected with them, are almost

precisely alike. Yet it is an interesting fact that this symmetry is less perfect in man than in the animals below them. 'Considered either in regard to symmetry or structure,' says Meckel, 'the nervous system of man is less regular than that of other animals, even those which are nearest to him. In fact, the halves of the nervous system correspond more perfectly in the mammalia, and the deviations from the normal state in those animals are rarer than in man.' This difference is very certainly not an aboriginal one, but is most unquestionably a degeneracy in the human species, and without doubt has resulted from the voluntary habits of man.

282. In the domain of organic life, though there is some approach to the duplicate form, yet there is no regularity or symmetrical correspondence. The two lungs do not exactly correspond, nor do the two halves of the heart. Indeed there is an evident oneness of system and economy in the domain of organic life.

283. We have seen that this system of nerves presides over all the vital functions by which the body is formed and sustainad (218—231), and that the nerves of animal life, with their muscles, bones, etc., are purely organs of external relation, whose office it is to perceive those external wants, the supply of which requires their exercise, and to perceive and procure those external materials by which the internal wants are supplied (233). These important functional relations make it necessary for the two systems of nerves to be so connected that the requisite media of communication shall be established between them; and the mutual dependencies of the two systems also require them to be intimately reciprocal in sympathy. I shall therefore now proceed to speak of these CONNEXIONS AND SYMPATHIES.

284. It will be recollected that, when treating of the nerves of organic life, I spoke of a range of ganglions lying on each side of the backbone (220), connected by intermediate cords, and extending from the base of the skull to the lower extremity of the spinal column; and that these ranges are connected with the great centre of organic life, by numerous cords radiating from that centre and terminating in many of these peripheral or limiting ganglions. Of these ganglions there are usually on each side three in the neck, twelve in the region of the back, five in the region of the loins, and three or four in the sacral regions. These ganglions lie near where the spinal nerves of animal life are connected with the spinal marrow; and as the spinal nerves pass by the ganglions, each ganglion gives off two branches, which proceed outward a short distance, and join the corresponding spinal nerve. One of these branches is usually larger and more pulpy than the other, and sends some twigs to the muscles between the ribs. This is supposed to be more especially the medium of communication from the ganglion to the spinal nerve: and the other, which is smaller, whiter, and gives off no twigs, is supposed to be the medium of communication from the spinal nerve to the ganglion. All the ganglions in the two ranges also give off filaments which go with the nerves of animal life to the muscles of voluntary motion; and more especially to those voluntary muscles which are concerned in the function of respiration. The highest ganglion of the range on each side lies at the base of the skull, and sends a branch upwards, which, dividing into twigs, forms a kind of plexus around the main artery of the brain, and passing with

it into the cranium, unites with two or three cerebral nerves, and particularly the trifacial, which is so important a nerve of the head. This last nerve also, it will be remembered, after passing out of the cranium, unites in its various ramifications extensively with the nerves of organic life (254). Such are the connexions between the limiting ganglions of organic life and the nerves of animal life.

285. The upper central connexions are mainly established by the pneumogastric. This nerve, it will be remembered, issues from or near the grand centre of perception and action of the nerves of animal life (245), and by its branches forms connexions with almost every nerve, both animal and organic, in the region of the throat and neck, and also forms extensive connexions with the nerves of organic life in the thoracic cavity, and unites freely in the stomach with the nerves coming directly from the great centre of organic life, and finally sends some twigs directly to that centre itself (247).

286. Another and more extensive and general connexion is formed between the two systems of nerves, by that arrangement on which the body in all its parts and tissues depends for sustenance. The nerves of organic life appropriated to the vascular system, and which preside over all its varied functions, penetrate with the vessels to which they belong into every structure of the body. Even the brain and spinal marrow, and all the nerves of the body, are nourished by blood-vessels over whose functions the nerves of organic life preside. By this universal presence and functional relation, the nerves of organic life are brought into important connexions with those of the cerebro-spinal system. This species of connexion is largely formed in the extended membrane which constitutes the covering of the body; and, therefore, for the sake of showing still farther the anatomical connexions and functional and sympathetic relations between the domains of organic and animal life, I shall introduce in this place a general description of the skin, reserving the more minute details till I come to speak of its particular functions.

287. In the vegetable kingdom there are some species which may be torn up by the roots and inverted, placing their tops downwards in the earth, and their roots in the place of their boughs, and the order of their vegetation will change, and their tops will become roots, and their roots boughs with their twigs, leaves, etc. So in the animal kingdom there are some species which may be turned inside out, and they will live on, apparently as well as before; the membrane which was internal performing all the necessary functions of the external, and that which was external performing all the necessary functions of the internal skin. This correspondence of anatomical structure and functional capability between the inner and outer skin, is continued to a considerable extent through the whole animal kingdom, up to the human species. In man, a peculiar membranous texture of cellular tissue covers the whole external surface of the body like a sack: continuing over the lips and up the nostrils, the same membrane lines the cavities of the mouth and nose, covering the tongue, etc., and still continuing backward and downward, it covers and lines all the parts of the throat, lines the windpipe, and extends through all its innumerable branches in the lungs, lining all the air-passages and cells, and presenting to the air in the lungs an extent of surface equal to the whole external skin of the

body; and some think much greater. The same membrane also continues down the meatpipe, lining it and the stomach and the whole intestinal canal and the ducts which open into it This membrane, throughout its whole extent, is a delicate net-work, with an almost infinite number of extremely small meshes. Through these meshes penetrate in countless numbers the almost inconceivably minute terminations of capillary vessels of the sanguiferous and lymphatic systems, with their accompanying and presiding nerves. Besides these, innumerable filamentary extremities of the nerves of sensation pass through the meshes of the membrane in the same manner. These vessels and nerves are so minute, so numerous, and so intimately associated, that it is not possible to puncture the skin in any place, with the point of the finest needle, without wounding both a nerve and a blood-vessel. According to some anatomists, this vasculo-nervous web is so constructed as to form a kind of nap on the exterior face of the membrane, somewhat like the pile upon velvet. This nap, however, and particularly that portion of it which consists of the nerves of sensation, is longer and thicker in some parts than in others (242); as on the ends of the fingers, etc., externally, and in the stomach and small intestines internally. To lubricate these exquisitely delicate little organs, and preserve them in a condition proper for the performance of their functions, they are everywhere surrounded by or imbedded in a thin body of mucus. This, on the external surface, is called the rete mucosum, and contains the substance which gives the color to the skin; being black in the negro, copper-colored in the Indian, white in white people, etc. Still farther to protect these delicate little organs from the rude and improper contact and influence of external things, the whole external surface is covered with a thin transparent horny substance called the epidermis or cuticle. This, however, becomes very thick and hard on parts subjected to much friction, as the bottoms of the feet, the palms of the hands, and insides of the fingers of laboring men, etc. On the lips, nostrils, etc., where the external skin fades into the internal, the cuticle is extremely thin. In some animals a very delicate epidermis or cuticle continues inward, lining the mouth, meatpipe, and stomach; and some anatomists have supposed this to be the case in man. *

288. We see, then, that the external surface of the body, and the cavities of the mouth, nostrils, windpipe, air-passages, and cells of the lungs, meatpipe, stomach, intestinal tube, etc., constitute the confines of the incorporated living system, through which it communicates with the external world; and all these surfaces are covered by the same continuous, delicate, net-like membrane, through which must pass every thing that enters into or issues from the living system. And for the purpose of introducing into the system all materials necessary to sustain the vital economy, and of conducting from it all that the vital economy has no further use for, or that would clog or oppress or disturb or destroy the operations of the economy, the innumerable vessels which I have just named pass through the meshes of the membrane, and form a vascular web upon its exterior face; and with

* Doctor Hernet, of Philadelphia, has recently demonstrated the existence of an epidermis throughout the whole length of the alimentary canal, of which I shall speak more particularly when I come to describe the particular anatomy of the parts.

these, also, the myriads of most exquisitely delicate feelers, whose office is with strictest integrity to give their respective centres of perception and action all necessary information concerning the presence and qualities of external things, with reference to the interests of the vital economy.

289. In regard to the substance conveyed into the living system, the little vessels differ in function in the different parts of the internal and external surface, as we shall see hereafter; and this is also true concerning the substances conveyed out of the system. Still, however, there is, to some extent, a general correspondence of function throughout the whole confines of the living system; and especially the eliminating functions, or those which convey substances from the body. The external skin, and that of the lungs and alimentary canal, in many respects very nearly resemble each other, in regard to the substances which they throw off from the system; and they are, to a considerable extent, reciprocal or vicarious in their offices, the excess of one corresponding with the suppression of another. The internal skin which lines the mouth, nostrils, windpipe, meatpipe, stomach, intestinal tube, etc., is, in the descriptions of anatomy and physiology, called the mucous membrane.

290. The myriads of little *feelers* or filamentary extremities of the nerves of sensation in the external skin, are nerves of animal life, and are connected with the back portion of the spinal marrow (242), and through it with the top of the medulla oblongata and brain. Those of the internal skin or mucous membrane, are nerves of organic life (230), and are connected with their special centres of perception and action, and through them with the grand centre of organic life (226). The nerves of animal sensibility also extend to all portions of the mucous membrane which line or cover parts subject to the control of the WILL, or which perform voluntary functions, as the mouth, throat, etc.

291. Thus we see that the skin, as a whole, constitutes a very extensive medium of connexion and functional relation between the nerves of organic and those of animal life; and the sympathetic relations and reciprocities are equally direct and powerful. The mucous membrane of the alimentary canal and lungs sympathizes directly and powerfully in all the irritations and affections of the external skin; and the whole external skin, in turn, sympathizes in all the irritations and affections of the mucous membrane: this is particularly the case in all morbid affections of the external and internal skin.

ORGANIC AND ANIMAL SENSIBILITY.

292. I have often spoken of organic and animal sensibility. It is very important that the meaning of these terms should be fully understood. Strictly speaking, there are several species of sensibility in the human body. That vital property of the muscles which renders them susceptible of the action of their appropriate and other stimuli, may be considered a species of organic sensibility, but it is generally called irritability; and the term sensibility is only applied to the nerves. To make this deeply interesting subject as plain as possible, it is necessary that I should recapitulate for a moment. I have said that the large nervous mass lying at the back of the pit of the stomach is the great, primary, and common centre of organic life and that the numerous

smaller masses, or subordinate brains, are the specia centres of particular organs or apparatuses of organs; and that the top of the head of the spinal marrow is the centre of the nerves of animal life, or the centre of the nerves of external relation.

293. Now let us understand the centre of the functional powers of these several centres.

In the first place, the special centres of organic life (219) preside over the functions of their particular organs; and so far as each particular function is isolated from the functions of other organs, the centre which presides over it is an independent and sovereign centre of perception and action; but so far as it is immediately associated with the function or functions of other organs, the confiding centre is confederated with other special centres; and so far as each function is related to the great common centre as a constituent part of the common whole of organic life, each special centre is subordinate to the great common centre; and so far as the COMMON WHOLE of organic life requires the exercise of the organs of external relation, it is in a manner subordinate to the centre of animal life. The functional powers of this last centre, then, are, first, the perception of the wants of the internal system as a whole, such as the want of air, food, drink, etc.; second, the perception of the external materials and means by which the internal wants can be satisfied; and third, the exertion of that influence by which the voluntary muscles are contracted, and the motions are performed, necessary for supplying the internal wants.

294. We see, then, that when there is a general state of health throughout the body, and all things in the vital domain are as they should be, and every function properly performed, the special centres only have perception of what is taking place in their own appropriate spheres, while the great common centre has perception of the general condition of each particular organ, and presides in a general manner over the whole domain of organic life. The centre of animal life, therefore, has no perception of, nor control over, the particular functions of organic life. It only has cognizance of those general wants of the internal system which, though referred to particular organs, are still the common wants of the whole system. The functions of the stomach, intestinal canal, liver, pancreas, and all the other organs within the exclusive domain of organic life, are, in a state of perfect health and good order, no more perceived by the centre of animal life, than they would be if they belonged to another distinct individual animal (228). Hence we say that the nerves of organic life have no animal sensibility. They may in a state of health be touched, cut, or lacerated, and the animal will suffer no pain, because the centre of animal perception has no consciousness of the act. But the performance of the functions of external relation, over which the centre of animal life presides, requires that this centre should have an extensive perception of external things with all their qualities and conditions. The qualities of density or resistance, heat, cold, etc., must be *felt* by the animal. Hence a part of the nerves of animal life (242), are endowed with the vital power of conveying to the centre of animal perception the impressions of touch, heat, cold, etc.; and as the things and qualities in relation to which this sense exists, may annoy and injure the body in every part, the sense is universal in the domain of animal life. The whole exter-

nal skin is largely supplied with nerves which constitute it a general organ of touch. The limits of the internal skin, and the muscles or flesh generally, also receive a measured supply of these nerves. That property or power of the nerves of animal life, then, which enables us to feel heat and cold, and to know when any thing wounds or touches us, and to perceive the qualities of hard, soft, rough, smooth, etc., is what is usually called common animal sensibility; and the exercise of this power, or the pleasurable and painful feeling excited in these nerves by contract or otherwise we call animal sensation. This, I have said (242), is the fundamental faculty of external relation, and in some degree is always present when animal life exists. It is a specific power which gives the centre of animal life the perception of certain qualities of external things, and is as truly a special sense as any in the body (253). But there are other qualities of external things which exist in relation to organic life, that are not perceived by this sense or power. For the perception of these, therefore, the animal is endowed with other special senses or faculties of external relation. The first of these, and that which comes nearest to the sense of touch, and is perhaps most intimately associated in organization with it, is the sense of taste (254), by which the animal perceives certain qualities of external things which relate to the alimentary wants of organic life, such as sweet, sour, bitter, etc. The next, in the order of its functional character, is the sense of smell (252), by which the animal perceives certain other qualities of external things which relate to the respiratory and alimentary wants of organic life; such as the various agreeable and disagreeable, salutary and baneful odors. The sense of hearing and the sense of sight are faculties established not only in relation to the wants of organic life, but to the general interests and welfare of the body as a whole; and, in man, these two faculties are more extensively and eminently the instruments of the soul, in the performance of its higher functions.

295. Now let it be distinctly remembered that each of these senses or faculties of external relation is a power by which the centre of animal life perceives certain qualities of external things; and that the peculiar vital endowments of each organ of special sense precisely fit it for the perception of those particular qualities, in relation to which it is established; and therefore these faculties are never vicarious in their functions (253). The eye never hears, the ear never sees, etc. The eye is only fitted to appreciate the properties of light, the ear of sound, the nose of odors, the tongue of taste, and the fingers and external skin universally the tangible properties.

296. With these explanations of animal sensibility, or the powers of external perception, let us return to the domain of organic life; and there, though we find no animal sensibility, yet we shall find the rudimental prototypes of all the external senses, each organ possessing an organic sensibility as exquisitely delicate as the special sensibility of the nose or ear or eye, and as perfectly fitted to perceive and appreciate the qualities of things in relation to which it was constituted by a wise and benevolent God, as either of those special organs. Organic sensibility, then, as a general property, is the power of the appropriate nerves of organic life to receive and convey to their special or general centres, the impressions made upon them by the substances contained

in the organs to which they are distributed; but this sensibility has nice and important shades of difference in the different organs, adapted to the constitutional purposes of each particular organ. Thus, the organic sensibility of the stomach is adapted to the properties of the food designed for the nourishment of the body, and the organic sensibility of the intestinal tube is adapted to the properties of the chyme, etc., that of the lacteals to the chyle, that of the arteries, etc., to the blood, that of the biliary vessels to the bile, etc. But this very adaptation of the nerves of organic sensibility to the properties of appropriate substances, unfits them for the presence of improper substances; and consequently when such substances are introduced into the stomach and other organs, they are the causes of irritation, disorder, and disease; and in a natural and healthy state, always in proportion as they are unadapted to the peculiar sensibility of the organ, and unfitted for the supply of the vital wants, or are of a character unfriendly to the vital interests

297. In regard to the sympathetic relations of parts, there is a very considerable difference between the nerves of organic and the nerves of animal life. The organs of animal life, so far as their sympathetic connection depends on the cerebro-spinal nerves, are comparatively isolated. A hand or a foot, an ear or an eye, or even a lobe or hemisphere of the brain, may be diseased and destroyed, and the corresponding and other organs of animal life will suffer very little direct sympathy. But in the domain of organic life, all parts sympathize with each, and each with all. If the stomach, in a healthy state of itself and of the whole system, receives a portion of food which is perfectly adapted to its peculiar sensibility and to the real wants of the vital economy, it is healthfully excited, and its general condition is agreeable, and all the other organs sympathize directly in the general condition of the stomach, rejoicing with it, and performing their own functions with a livelier and more gladsome energy; and, on the other hand, if, by the ingestion of an improper substance, or any other cause, the stomach is irritated or disturbed to an extent which affects its general condition, all the other organs sympathize in that condition, and their functions are commensurately disturbed, being either accelerated or retarded in an unhealthy and injurious manner.

298. In the same manner, also, all the other organs sympathize with the intestinal canal, with the liver, kidneys, etc. But the degree of sympathetic influence which each organ has on the others, is always proportionate to the functional importance of the organ in the system, and the nearness of its nervous relation to the great centre of organic life. Hence the stomach holds an immensely important station in the assemblage of vital organs. Supplied as it largely is with nerves directly from the great centre of organic life (231), and with the pneumogastric, from the centre of animal life (245, 285), and associated by plexuses with all the surrounding organs, it sympathizes more directly and powerfully with every other internal organ, and with every part of the living body, than does any other organ; and, in turn, every other internal organ, and every part of the living body, sympathize more directly and powerfully with the stomach than with any other organ

299. But notwithstanding the organs of animal life have very little

direct sympathy with each other yet inasmuch as they depend on the nerves of organic life which belong to the blood-vessels that enter them for their continual sustenance and healthy condition, they sympathize very directly, and, in a diseased state, very powerfully, with the internal organs, and particularly with the stomach. If the eyes, ears, hands, feet, or any other part belonging to animal life, be diseased, every disturbance, irritation, or oppression of the stomach, aggravates that disease; and chronic indigestion always impairs the tone and functional power of the whole external skin, and indeed of the whole living system. Few things it is well known, will more speedily and completely prostrate the muscular powers of even the strongest men, than high irritation in the alimentary canal. On the other hand, the internal organs sympathize very directly with those of animal life. The continued action of excessive cold upon the external skin, retards all the internal functions; and so, also, the continued action of excessive heat on the external skin debilitates the stomach and other internal organs, and always tends to cause indigestion, pulmonary disease, etc. In short, every external affection has some sympathetic influence on the internal organs, and especially the stomach and alimentary canal generally; the liver, lungs, kidneys, etc., are also intimately involved in this sympathy. But of these reciprocal sympathies between the organs of organic and of animal life, perhaps the most powerful at all times is that which exists between the stomach and the brain. A severe blow upon the head will cause nausea and vomiting, and all degrees of irritation in the brain proportionably affect the stomach; and, on the other hand, certain irritations of the stomach will cause vertigo of the brain, or a derangement of the functions of the brain, or even a total suspension of its functional powers; and all degrees of irritation in the stomach, which affect its general condition, proportionably affect the brain. And let it be remembered also, that in all the sympathetic as well as idiopathic or original irritations of the stomach, the liver, intestinal tube, and other internal organs sympathize.

300. This wonderful economy of sympathy, which, in a well-regulated state of the living system, is admirably adapted to the purposes of vitality, and is exceedingly conducive to the enjoyment of the animal, may, by long abuses of the system, be converted into the source of the most intolerable suffering. In a healthy state of the system, if any improper substance be brought within the precincts of vital action, the part with which the substance comes in contact, perceiving by its organic sensibility (296), the deleterious character of the substance, gives alarm to its centre of perception and action, and that centre takes immediate measures, by increased secretion, etc., to shield its special domain from the pernicious effects of the substance. And if the quality and quantity of the substance be such as to endanger seriously the vital interests of the whole system, the special centre gives alarm to the great common centre of organic life, and thence it is spread throughout the whole domain, and all parts sympathize with the suffering organ, and, by a general consentaneousness of action, strive together to remove the offending cause; and when the emergency is great, and the danger imminent, the agonizing energy of organic life is poured upon those muscles of animal life concerned in respiration, and violent vomitings, etc., ensue. In all these operations the organic instinct acts determi-

nately, and, as it were, rationally, with reference to a final cause of good, viz., the removal of the offending cause. But if the disturbing cause be too long continued, or too frequently repeated, the organic sensibility of the part becomes diseased, and excessive irritability is induced; and if the part be an important one, such as the stomach or intestinal canal, the diseased irritability is soon propagated throughout the whole domain, and a highly morbid sympathy is universally established. In such a state of things, the organic instincts when agonizing with irritating causes, frequently acts with most fearful insanity, pouring its misdirected energy on parts whose action cannot afford relief, and terrible spasms and general convulsions are produced. These effects are generally attributed to the irritations of the brain. But I am convinced that this is a capital pathological error, and that it has been the source of immense error and evil in therapeutics. The brain undoubtedly *may be* the primary seat of those irritations which cause spasms and convulsions, but this is not necessarily the case. Epileptic and other convulsive fits, and spasmodic affections, almost universally result from irritations in the domain of organic life; and the alimentary canal is most generally the primary seat of those irritations. When the irritations and convulsions are long continued, the brain becomes sympathetically involved, and often suffers most ruinously, even to the entire derangement or total abolition of its functions, and decay of its substance. Yet how often do we see the most terrible spasms and convulsions where there is not the slightest symptom of cerebral irritation! proving that the morbid irritations of the nerves of organic life can be transmitted directly to the muscles of animal life, without the agency of the cerebro-spinal centre. The numerous branches which the ganglions, and particularly the limiting ganglions on each side of the back-bone, send to the muscles of animal life (284), are probably the media through which the irritations are transmitted.

301. The nerves of organic life, I have said (294), are, in a state of health, entirely destitute of animal sensibility, but as we have seen (296), they are endowed with an exquisite organic sensibility, which qualifies them most perfectly for the performance of their constitutional functions in the living system; and the complete integrity of those functions essentially depends on the healthy properties of the nerves. But the organic sensibility of these nerves may, by continued or repeated irritation, become exceedingly morbid or diseased, and a preternatural irritability and diseased sympathy may be induced and permanently established. In this state of things, all the functions of organic life are necessarily impaired, and to an extent always proportionate to the degree of diseased irritability and sympathy of the nerves. The food is less perfectly digested in the stomach, the chyle is less perfectly elaborated, the blood necessarily becomes deteriorated, and the whole system, in every part and tissue, consequently suffers. By excessive and continued irritation, also, inflammation may be induced, and the most painful sensibility developed in the nerves of organic life, so that the centre of animal life will not only be conscious of the pain, but refer it to the part diseased; the same as it does impressions or affections of its own domain. This state of things is not only distressing, but is always injurious to the living system, and often imminently hazardous to life. When, therefore, we are *conscious* that we have a

stomach or a liver, from any *feeling* in those organs, we may be certain that something is wrong. For, as I have already remarked, in a perfectly healthy state of the system we have no consciousness of individual organs within us, and no other consciousness of the domain of organic life as a whole, than such as appertains to the general wants of the vital economy, which require the exercise of the voluntary powers in supplying food, drink, and air, and in the voluntary eliminations of the body. When the food is procured and masticated and swallowed, it has passed beyond the cognizance of animal life, and is given up to the operations and processes of the vegetable organs, to be converted into chyme; from which is elaborated the chyle, the blood, the bone, the muscle, the nerve, etc., and all without the care or consciousness of the animal.

302. Let us now, for a few minutes, contemplate the sympathetic relations between the nerves of organic life and the mind. We have seen (218), that the great centre of organic life presides in a general manner over all the functions concerned in nourishing and sustaining the body; and consequently these functions are removed from the control of the WILL. The stomach, the liver, the heart, and all the other internal organs, regularly perform their functions without the agency, and beyond the direct control of the WILL. Because it is the business of the voluntary powers to fulfil external relations, and to prevent the ingress of improper substances to the lungs and stomach, a wise and benevolent Creator has made the WILL, as it were, a warden to those important organs. Should we find ourselves surrounded by an offensive atmosphere, or submerged in water, the WILL, by a direct control, can suspend respiration for a very short time; and for similar reasons, it can exert its power directly on the apparatus of respiratory muscles, to accelerate their action. By a voluntary control of the respiratory apparatus to a necessary extent, we are also enabled to speak, sing, etc. Yet the function of respiration is properly an involuntary one, and is performed independently of the WILL. So in regard to the stomach; the WILL must control the functions of chewing and swallowing the food, but the instant the act of swallowing is performed, the food is beyond the direct control of the WILL.

303. Properly speaking, therefore, the mind cannot exert the power of the WILL directly on any organ strictly within the domain of organic life. The ordinary, calm, and gentle operations of the mind, have little if any effect upon the nerves of organic life. But when the exercises of the mind are intense and protracted, the whole domain of organic life sympathizes with the brain; and when these exercises are of an excited and impassioned kind, the sympathetic influence is poured with considerable energy upon the nerves of organic life, and all the functions of that domain are more or less disturbed; while, at the same time, a strong emotion or sensation of a peculiar kind is produced in the epigastric centre, usually referred to the heart; but the stomach, more than any other organ, is the true seat of it. Hence the function of this organ is more affected by mental influence than that of any other; and, indeed, it is in a considerable measure through the stomach that the other organs are affected by mental influence. In all violent passions, however, the whole domain of organic life seems to be, as it were, inundated by the lava of the mental volcano, and the actions of the several organs are convulsively accelerated or retarded to a most fearful

and dangerous extent; and in some instances, all the functions of life are suddenly arrested as by a lightning stroke, and death is instantaneously induced.

304. All mental excitements, therefore, are causes of some degree of disturbance to the nerves of organic life; and when violent, and frequently repeated, they necessarily induce, and permanently establish, a morbid irritability and sympathy throughout the whole domain, generally involving also the brain and spinal marrow, and especially the brain. Functional aberration and derangement necessarily result from this state of things, leading to disease and change of structure in the organs.

305. On the other hand, the mind sympathizes in the most delicate and powerful manner with the nerves of organic life, in all their general affections and conditions. When this system of nerves is in perfect health, and under the influence of appropriate stimuli—such as proper air in the lungs, proper food in the stomach, proper chyle in the lacteals, proper blood in the arteries, etc.,—the instinctive wants of the system are satisfied, every organ performs its function with tone and alacrity, and a delightful communion of sympathy pervades the whole domain. In all this there is no *local feeling*, no animal perception of a distinct sensation *in any particular part;* nay, indeed, there is not the least animal consciousness of any internal organ. Without being conscious whence it comes, or on what it depends, the animal is simply conscious of a general, and, as it were, *spiritual* joy.

> And in this consciousness the playful lamb
> Skips with delight and gambols round its dam,
> The calf and colt, from their confinement freed,
> Stretch their young limbs and bound along the mead;
> The noble horse, with wildly flowing mane
> And wide-stretched nostrils, gallops o'er the plain;
> Lifts high his head, as of his freedom proud,
> Snuffs the pure breeze, and snorts his joy aloud.
> And, in this consciousness, with infant glee,
> The tottering child plays round the mother's knee
> The older sister, though oft chid as rude,
> Yields to the spirit of her romping mood;
> With her loved brother seeks the open air,
> And they like lambs, run, leap, and frolic there.
> E'en full-grown man, though crippled, blighted, cursed,
> By evil habits long and fondly nursed,
> In healthier moments still doth often feel
> Something of this pure spirit o'er his bosom steal!

The mind, in all its faculties and operations, feels the bland exhilaration, but it is not conscious of its nature, nor of its source. The thoughts flow with greater ease and increased energy, the imagination becomes more vivid and vigorous, and the memory more clear and active. But the mind is not at all conscious that this state of things is in any degree connected with the condition of the body; on the contrary, it thinks that the exhilaration is aboriginally and purely mental, and that the pleasurable feeling results entirely from its own felicitous exercises. This delightful sympathy between the nervous system of organic life and the mind may be preserved through life; and were all the laws of constitution and relation which our benevolent Creator has established in our nature, properly obeyed, it would be so. While the nerves of organic life are preserved in a perfectly healthy

state, the mind is habitually serene and cheerful, as in healthy childhood. Moral causes may give it pain, but as soon as the direct action of those causes ceases, it springs elastic from the oppression, like that of a little child which turns from the chidings or chastisements of a parent, to forget its sorrows, and to break into the smiles of its revived enjoyment, before the tears are dried from its cheek. But when, by the continued irritations of the stomach and other organs, the organic sensibility of the nerves becomes diseased, and a morbid irritability and sympathy are gradually induced and permanently established, the mind, sympathizing with the nerves, and yet without the consciousness of that sympathy, gradually loses its habitual serenity, and by degrees becomes shrouded, first, in the occasional and then the more constant pensiveness of early youth, and this is followed by the darker shades of youthful discontent; a deep, continual restlessness! We are unhappy, yet we know not why. We long for relief, but we know not what. We would go, but we know not where! We would cease to be what we are, yet we know not what we would be. This sickly sentimentality tends always to a more confirmed and painful melancholy, from which we only find occasional relief in the intoxications of a misguided world; and too frequently the very means of our relief, serve to aggravate our disease, till we become completely wrapped in the black and cheerless pall of unutterable despondency. And even they who seek relief in the faith which looks forward to a better world, too often have little other enjoyment of their existence than that which arises from the hope of what they shall be beyond the grave; and this is often torn from them by morbid doubts and fears. In all these painful sympathies, as in the pleasurable ones, the mind has no consciousness that it sympathizes with the body, but fully believes that all its sufferings are purely of a mental and moral nature; and it seeks and fixes on some object which it believes to be the cause of all its misery. The dread of becoming poor, of losing friends or reputation, or some other imaginary evil, haunts the mind thus laboring under the influence of a diseased body, perhaps to utter madness; and too frequently the miserable victim rushes from the world in the anguish of insupportable despair.

306. Such are the direct relations between the mind and the nerves of organic life. The indirect relations are numerous and important, many of which I shall explain hereafter. All those predispositions and peculiarities which we call hereditary, are transmitted from parent to child through the medium of this system of nerves, such as temperament, predisposition to consumption, dyspepsy, and all other diseases of the body; and also the mental and moral predispositions: for I shall show hereafter, that, admitting all that Gall and Spurzheim claim concerning the organization of the brain and its relations to the mind, still the nerves of organic life are the media through which all cerebral peculiarities are transmitted from parent to child.

307. Like the other solids which I have described, all the nerves of the body are much more soft and pulpy in early life than at a later period. In advanced age they usually become much drier, smaller, and harder. Ordinarily, in civic life, the internal ganglions with their cords begin to diminish in size, and to become paler, drier, and harder, about the fortieth year; but the period is greatly varied by the habits of the individual.

LECTURE VII.

The cellular, muscular, and nervous tissues, and their vital properties, compose the organs, and endow them with functional power—Definition of tissue, organ, vessels, viscera, vascular system, capillary system, function, vital economy, etc.—Change of matter in organized bodies—They are organized and endowed accordingly—Vegetable bodies, how nourished and organized—Animal bodies, how nourished and organized—Grand function of the alimentary cavity—Masticatory organs, jaws, teeth, tongue, etc.; their development, character, and functions—The fibrous, serous, and mucous membranes; their situation and office—The anatomy, disposition and functions of the skin and mucous membrane particularly described—Simple absorbents and exhalants—mucous follicles and glands—Mucous membrane forming the œsophagus, stomach, and intestines—Salivary glands, liver, pancreas, kidneys, etc.—Muscles of the alimentary canal; their arrangement, etc.—The peritoneal coat—Nerves of alimentary canal, etc.—Respiratory apparatus—the structure and functional purposes of the several parts—larynx, windpipe, lungs, diaphragm, ribs, etc.—Organs of circulation—heart, arteries, veins, capillaries; their distribution, etc.—The portal system and the spleen—The lymphatics; their structure, situation, and office—The lacteals—Circulating forces—Propelling power of the heart, etc.—General law of vital action and expenditure, and flow of arterial blood—Local increase of circulation—Organs of taste, smell, hearing, and sight—Hair and nails.

308. Having given a general description of the cellular, muscular, and nervous tissues, in their separate forms, and having described their vital properties, and presented a general view of the disposition of these three elementary tissues in the formation of the living animal body, I now proceed, after a very brief recapitulation, to the consideration of the structure of the particular organs.

309. The cellular tissue, I have said (158), is the lowest order of animal structure. It pervades every part of the body, constitutes the general frame of every organ, connects all the tissues, and binds all parts together (168—171). Its property, which is called vital, because it is much greater in the living than in the dead body, is elasticity.

310. The muscular tissue (159) is a higher order of animal structure than the cellular. Its most important property in the vital economy is contractility. This is the element of all voluntary motion, and of most, if not all, positive involuntary motion, in the living body. The muscles are divided into those of voluntary and those of involuntary motion (194), or those of animal and those of organic life. The former being mostly attached to the bones, and lying principally on the outside of the frame, and around the bones of the upper and lower limbs (189); and the latter being situated in the hollow organs composing the respiratory, digestive, and circulatory apparatuses.

311. The nervous tissue, with its important properties, relations, and sympathies, I have described at large in my last two lectures (160—165, and 202—307).

312. These three general tissues, I have said (167), together with the more solid matter of the bones, compose all the organs and parts of the animal system, and in entering into the texture of the several organs, each tissue carries with it, and retains during life and health, its own peculiar vital properties; and these properties, viz., *cellular elasticity, muscular susceptibility and contractility, and nervous and sensorial power, together with the vital affinities, which are under the control of the nervous power, constitute the vital forces of the organic economy, and the functional powers of the organs.*

313. Though these three general kinds of animal structure are, in the language of modern physiology, called *tissues*, yet, strictly speaking, a *tissue* is a particular arrangement of fibres or filaments, in the formation of an organ. 'An *organ* is a compound body, consisting of a specific arrangement of different tissues.' The internal organs are, in the descriptions of anatomy and physiology, divided into *vessels* and *viscera*. The vessels, such as the arteries, veins, lymphatics, etc., are called the *vascular system;* and the minute extremities of the arteries and veins, which, together with the lymphatics, compose a large proportion of the bulk of the whole body, are called the *capillary system*. The stomach, liver, pancreas, spleen, intestinal tube, etc., are collectively called the *viscera*, or singly a *viscus*. A *function* is the office which an organ performs. And the VITAL ECONOMY consists of the general co-operation of the whole assemblage of living organs, in the performance of their several functions, to one grand result, viz., the sustenance of the body in all its organization and in all its functional powers and operations. With these recapitulations and explanations, we are now prepared to enter upon the consideration of the structure of particular organs.

314. We have seen that all living bodies are formed from the common inorganic matter of the world (49, 112, 118); that the matter composing organized bodies is brought into the organic arrangement and structure, by vital forces acting in and by living organs, which overcome and subdue the inorganic affinities (121), and hold the organized matter, as it were, in reluctant obedience to vital power; and hence the matter composing living bodies has always a tendency to yield to the affinities, and to return to the more simple and primitive forms of inorganic matter. Hence, also, as a general fact, matter is less permanent in organic than in inorganic forms (133). It does not remain permanently in organized structure during the life of the body, but, particle by particle, is continually giving place to new matter, so that, in the course of a few years, all the matter in the human body undergoes a change. The two great processes of composition and decomposition, of incorporation and elimination, are therefore continually going on in the living body. Foreign matter, on the one hand, is continually assimilated and incorporated; and organized matter, on the other hand, is continually decomposed and eliminated. All living bodies are, therefore, adapted in their organization to this condition. They have organs which act on foreign matter, and assimilate it to their own nature, and organs which distribute the assimilated matter to every part of the organic system, and organs which convert this matter into the various structures and substances of the body, and organs which decompose these structures and substances, and organs which convey the worn out and excrementitious matter from the vital domain.

315. The particular organization of the different species of living bodies, corresponds with the character and condition of the foreign matter on which they subsist.

316. Vegetable bodies are nourished entirely by aqueous and gaseous forms of matter. The former, as a general fact, they derive from the bosom of the earth, the latter from the atmosphere (208). Hence they require no masticatory organs, and no internal cavity to contain their food and to reduce it to the fluid state, but they send their roots into

the earth, to imbibe its moisture, and extend their trunk and branches, and spread out their leaves in the atmosphere, to inspire its gases; and remain through life fixed to the spot from which they spring, elaborating all the varieties of vegetable substances from inorganic matter, and thus preparing food for a higher order of living bodies. But animal bodies, being diminished by substances whose character and condition render voluntary powers and locomotion necessary (293), require an internal cavity or sack to contain and digest their food, and prepare it for the action of those organs which correspond with the roots of plants. And hence, every animal, from the zoophyte to man, has an internal cavity for the reception and digestion of its food; and this is one of the grand peculiarities which distinguish animals from plants.

ALIMENTARY ORGANS.

317. But though all animals are alike in possessing an internal cavity for the reception and digestion of their food, yet they differ most widely in the construction, capacity, and general arrangement of their alimentary apparatus; each species being adapted in its organization to its appropriate kind of aliment.

318. In some, the alimentary organization consists of a simple sack, with a single aperture, through which every thing it receives and evacuates has its ingress and egress. In others, it consists of a tube or canal, of nearly equal size in all its parts, extending directly from the mouth to the posterior end of the trunk, and having an aperture for the reception of food, and one for the evacuation of excrementitious matter. In others, again, the alimentary tube is convolved or folded, so that its length is several times that of the body, and portions of it are greatly enlarged, so as to form what are called the stomach, the colon, etc.

319. In those animals that subsist on food which is rapidly digested, and which requires a quick passage, the stomach is simple, and the alimentary tube comparatively short, and its general capacity is comparatively small; while in those that feed on substances which contain little nutriment, and are slowly digested, the canal is comparatively much longer, and either has several capacious enlargements, or the stomach and colon are so constructed as to retain their contents a considerable time. In a third general class of animals, which subsist on a more nutritious aliment, such as the farinaceous seeds, grains, roots, etc., and various fruits, the alimentary tube, as a general rule, is comparatively longer than that of the first class just described, and shorter than that of the second; but its general calibre or capacity is paratively large, and the stomach and colon are fitted for a slow passage of their contents.

320. But whether the alimentary cavity be a simple sack, or a straight tube, or a convolved canal with one or more enlargements, its grand function is always the same, viz., *converting the food into that partially assimilated substance which is called chyme, and presenting the chyme to those organs which elaborate the chyle from it, and conveying the fecal matter from the body.*

321. In regard to other portions of the alimentary apparatus, animals differ as widely as they do in respect to the internal cavity. Some

simply imbibe a liquid aliment; some swallow substances of more consistency, which readily dissolve in the cavity, without any mechanical trituration or breaking down; others swallow harder substances, which are triturated or mashed by an internal apparatus; and others have organs in the oral cavity or mouth, with which they masticate their food. In respect to the masticatory organs, animals differ again very considerably. Some are fitted to tear and cut flesh into small masses, others to crop the grass and grind the woody fibre, and others to cut and mash the bulbous roots or fruits or other substances which constitute the appropriate aliment of the species.

322. The alimentary apparatus of man consists of masticatory organs, a meatpipe, a stomach, an alimentary tube several times the length of the body, together with various glands, vessels, etc

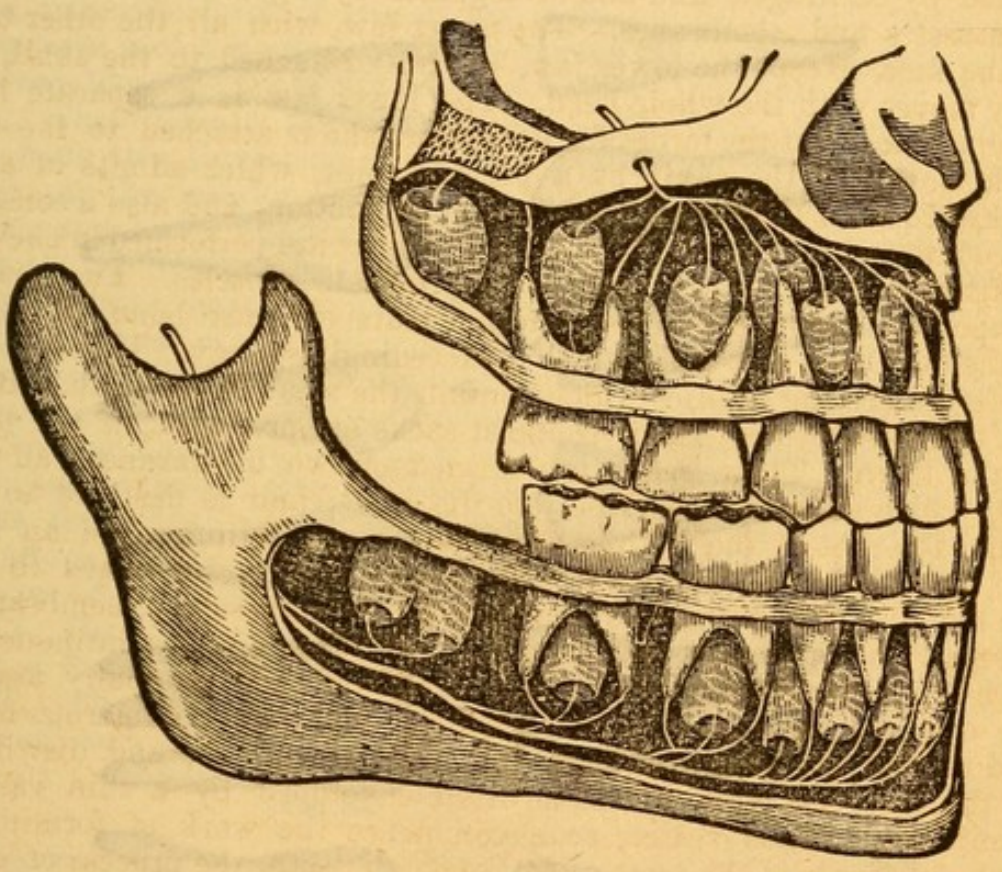
MASTICATORY ORGANS.

323. The oral cavity is formed by the bones of the head and face, united by cartilages, and bound together by ligaments, and invested by muscles and membranes. The upper jaw, with all the other bones of the face, except the lower jaw, is firmly attached to the skull, and only moves with the whole head. The lower jaw is a separate bone, having somewhat the form of a horseshoe, and is attached to the temporal bones of the skull by a peculiar joint, which admits of a free backwards and forwards, or up and down motion, and also a considerable extent of lateral motion. These motions are performed in chewing, talking, etc., by several pairs of appropriate muscles. Each jaw is composed of an external and internal plate of dense bone, and an intermediate bony substance which is exceedingly spongy. In this spongy structure are the cavities which contain the roots of the teeth. Before the teeth are formed, small rounded sacks are produced, in the places of the teeth. These sacks are formed of two membranes: an outer one, which adheres very closely to the gums, and is destined to surround the root of the teeth as a permament periostium; and an inner one, on which are dispersed the vessels and nerves destined to form the tooth, and to supply its texture. Between these two membranes is a small quantity of serous fluid. In due time a soft gelatinous pulp rises from the base of the internal membrane, and gradually assumes the exact shape of the tooth; and, at the same time, numerous nerves and vessels are given off from the inner membrane, and distributed to the pulp or germ, which is itself enveloped by a thin vascular membrane. These vessels soon commence the work of forming the bony substance of the tooth. In the single teeth, the process of ossification begins in a single point at the top. In the double teeth, it begins simultaneously at the several corners or elevations at the top. A thin shell is first formed on the outside, and then layer after layer is added inwardly, gradually diminishing the cavity, and reducing the size of the pulp. When the crown of the tooth is considerably advanced, the pulp throws one, two, or three branches downwards, according to the number of roots which the tooth has, and the root or roots are formed in the same manner as the crown is. In the meantime, the vascular membrane, which envelopes the germ, and which surrounds the crown of the tooth, commences the secretion of a fluid, which gradually hardens into the enamel. When it becomes necessary for the

tooth to emerge from the gum, a set of vessels called absorbents, which I shall soon describe (385), begin their operations, and remove before the rising tooth all the superincumbent substance. The tooth, at length, lifts its body above the gum, which is a dense substance composed of the cellular tissue, and which surrounds the neck of each tooth, and covers the edges of the jaw-bones, affording a firm support to the teeth.

324. The two inner front teeth in the lower jaw are generally the first that make their appearance, about the seventh month after birth. These are soon followed by the two corresponding ones in the upper jaw; and to these succeed the two outer front teeth of each jaw; and then follow the first molar or double teeth of the under and upper jaws; and then the eye or corner teeth; and lastly the second or posterior double teeth appear. So that, in the course of three years the whole twenty deciduous or temporary teeth make their appearance (Fig. 17)

Fig. 17



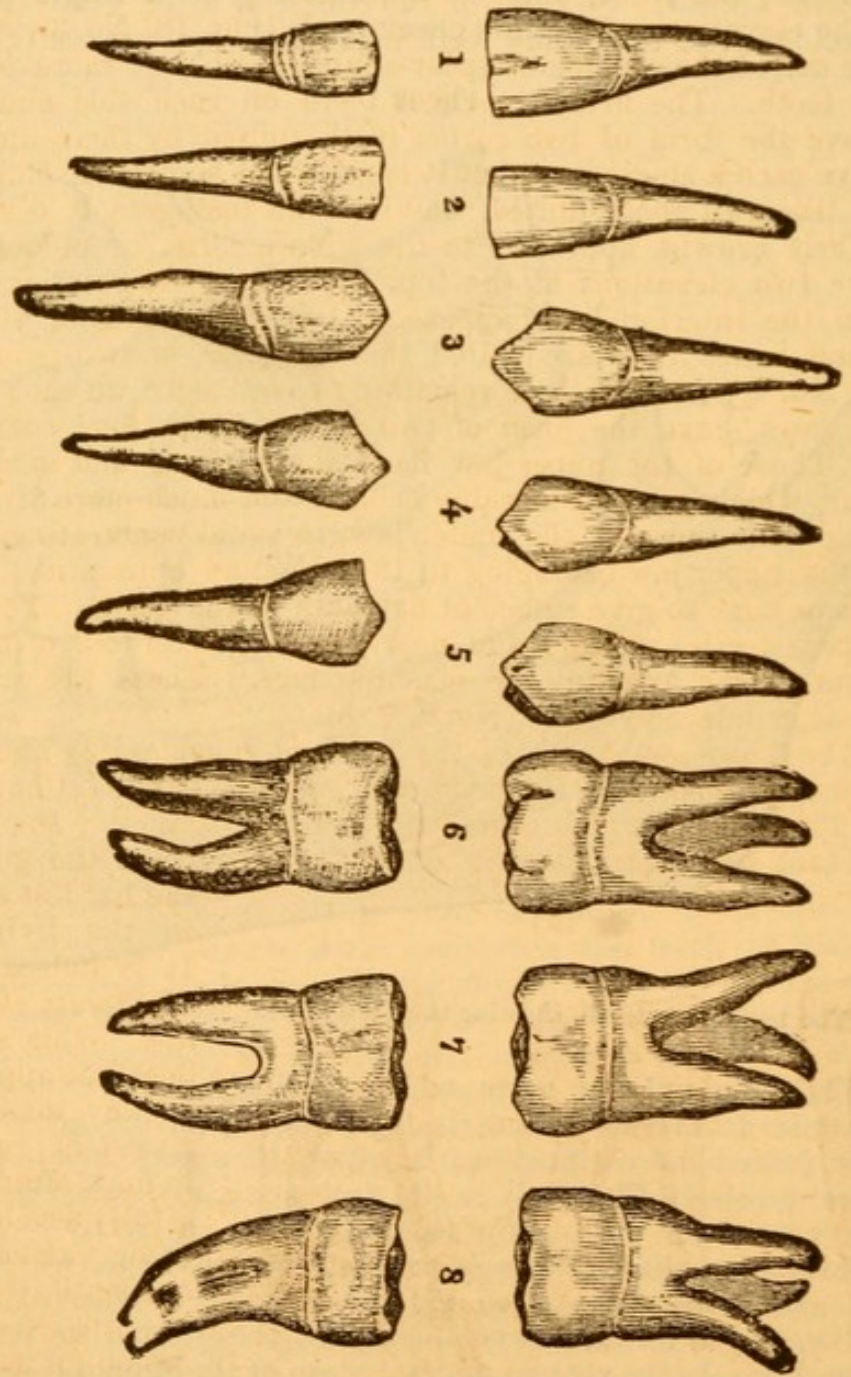
The temporary teeth, showing the germs of the permanent teeth.

325. When the pulp or germ which produces the temporary teeth in the manner I have described, is fully developed, and about to commence its process of ossification, it gives off a very small germ or sac, formed precisely like itself in its first state, and adhering to it by a minute branch or cord. For this new germ, a cavity is prepared by the absorbents, in the spongy part of the jaw-bone, where it lies carefully and securely deposited till the jaws are sufficiently lengthened and enlarged for the development of the second or permanent teeth (Fig. 17). In the present general state of the human constitution,

the process of second dentition ordinarily commences about the sixth or seventh year of life. The permanent teeth are developed in precisely the same manner, and appear in nearly the same order, as the first teeth; and as they advance in development, the roots of the first teeth in a perfectly normal and healthy state of the system are gradually absorbed and carried away, till nothing is left but the part above the gums, which becomes very loose, and is easily removed. Sometimes, however, in the present physiological condition of man, it becomes necessary to remove a temporary tooth by violence, before its root is absorbed away.

326. The last of the permanent teeth do not usually appear till about

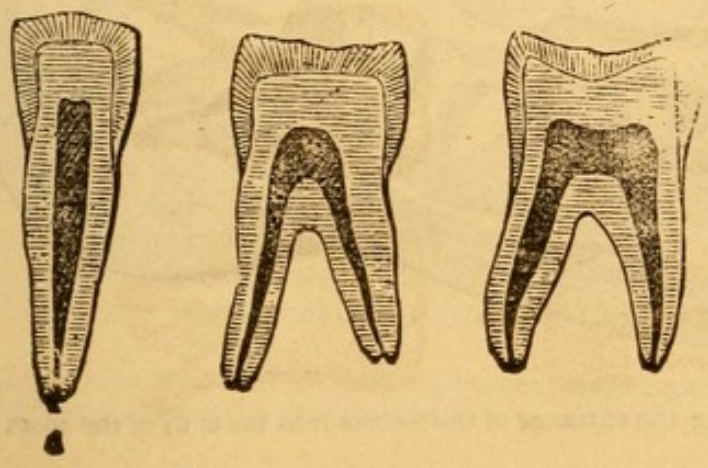
Fig. 18.



the twentieth year of life, and they are therefore called the wisdom teeth. These are double teeth, and are situated in the back part of the jaws. When all the permanent teeth are developed, there are two front, one corner, and five cheek teeth, in each half of both jaws, making in the whole thirty-two. The four front teeth in each jaw have single roots, and chisel-shaped crowns for cutting, and are called the incisors (Fig. 18, No. 1, 2). The corner teeth, between the front and cheek teeth, are the first step of transition from the chisel-shaped cutters to the square crowned mashers. They, therefore, of necessity, take more of the rounded and pointed shape than the front teeth. They have each but one root, which is however longer than those of the front and cheek teeth. Their crowns, as it were, combine the forms of the front teeth and the first of the cheek teeth, being somewhat flattened like the front, and yet approaching to a single point like one of the elevations of the first cheek teeth (Fig. 18, No. 3). They are therefore called the cuspids or spear-shaped teeth, but more commonly the eye teeth. The first two cheek teeth on each side and in both jaws, have the form of two corner teeth united by their inner faces. They have each a single root, but it is generally somewhat flattened and grooved like two roots united, and in some instances it divides into two. Their crowns approach to the square form, or oblong square, and have two elevations at the top, the one on the exterior, and the other on the interior face, appearing like the points of the corner teeth; and hence they are called the bicuspids, or two-pointed teeth (Fig. 18, No. 4, 5). The three remaining cheek teeth, on each side, and in both jaws, have the form of two bicuspids, or four corner teeth united. Those of the upper jaw have three roots, and in some rare cases four, which are considerably shorter and much more divergent or spreading than those of the under jaw, to avoid penetrating the cavities in the upper jaw belonging to the olfactory apparatus (399), and at the same time to give sufficient firmness to the teeth. The crowns of all these teeth are large and nearly square, with four or five slight elevations on the grinding or mashing face. These are called the molares or grinders (Fig. 18, No. 6, 7, 8).

327. The bony substance of the teeth is considerably harder than that of the other bones of the body, and contains less gelatinous matter (169). The enamel which covers the bony substance of the crown or body of each tooth, and extends down to the edge of the gum, is far the hardest substance in the living body. It is indeed a species of *organic chrystalization*. This substance does not appear to be in any manner nourished or reproduced in man, after the tooth is fully developed; but, being extremely hard or dense, it sustains the friction of mastication for many years

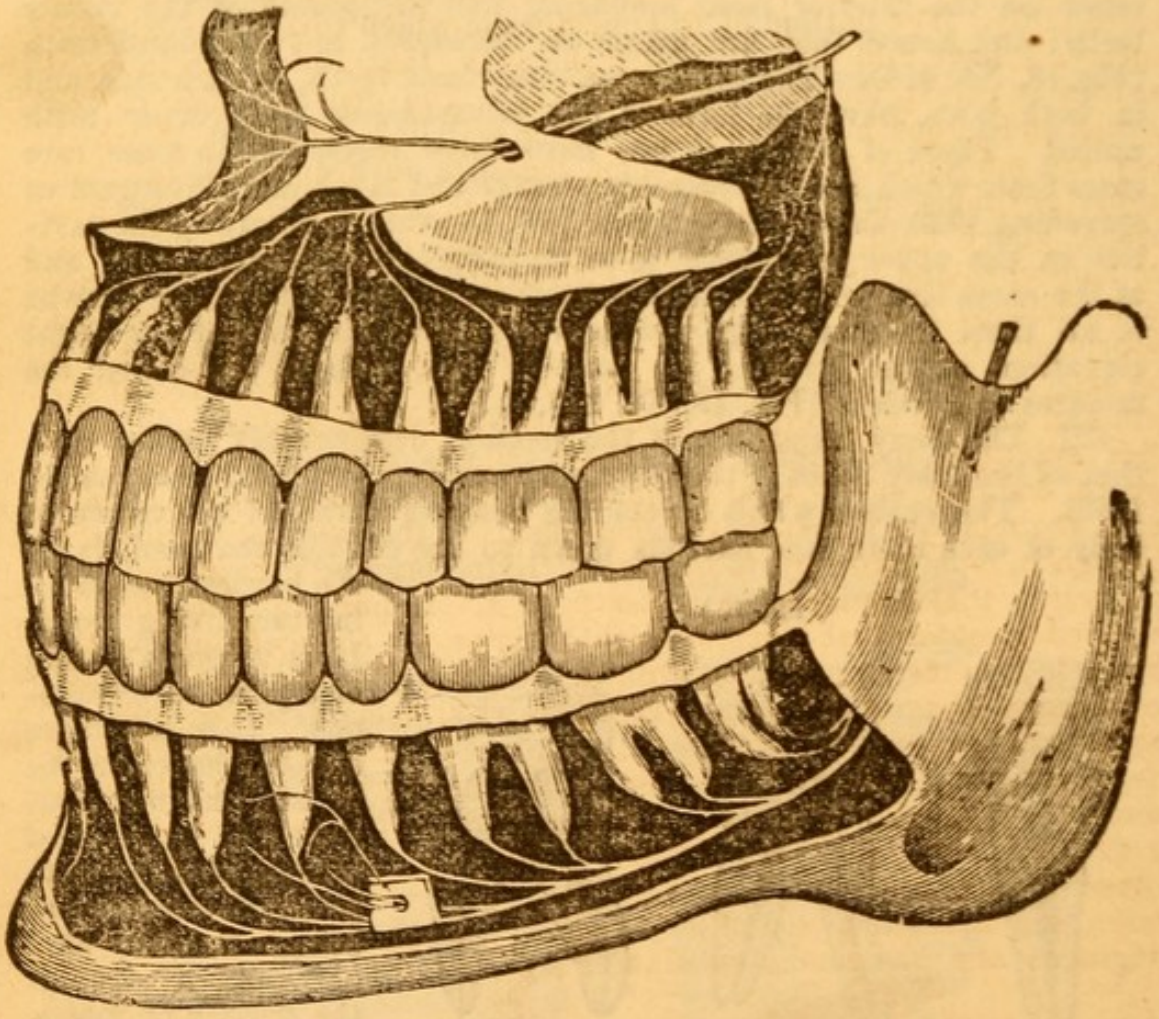
Fig. 19.)



without being worn through. The internal cavity of the teeth occupied by the pulp is never wholly filled up, but it is considerably smaller in advanced life than it is in youth (Fig. 19). It continues by small canals through each root; and at these canals the vessels and nerves of the teeth enter (254); and after ramifying upon the membrane that lines the cavity (323), they are distributed to the bony substance, penetrating to the enamel; but they do not enter this last named substance (Fig. 20). These vessels and nerves are largest, and pervade the bony substance of the tooth most extensively in early life. They gradually diminish in size, and become obliterated in their extremities, as life advances, and recede from the surface inwardly towards the central cavity. When the habits of life are not in strict accordance with the physiological laws of the body, the canals in the roots of the teeth often entirely close in old age, and the teeth are wholly cut off from vital sustenance, and then they soon become loose, and drop out of the jaws, or their roots are removed by the absorbents.

328. In the human head, the front teeth are intended to cut the food into small masses, convenient for the action of the cheek teeth, which are designed to mash or grind it finely, before it is swallowed. This process is called mastication; and while it is going on, other

Fig. 20.



The permanent teeth, showing the entrance of the nerves into the ends of the roots

organs co-operate to prepare the food for deglutition, and to commence the process of assimilation.

329. The tongue I hardly need describe. It is composed of many different pairs of muscles, which render it capable of acting in every direction, and in almost every manner; and is covered by the mucous membrane, which lines the mouth (287). It assists in masticating the food, by continually throwing it between the grinders of the upper and lower jaws. It also assists in the act of swallowing it, in a manner I shall describe when I come to speak more particularly of the functions of these parts.

SKIN AND MUCOUS MEMBRANE.

330. I have already described three general kinds of membranes. 1. The fibrous (169), which everywhere surrounds the bones, cartilages, and tendons; lines the spinal canal, the cavity of the skull, etc. 2. The serous (176), which lines the closed cavities, such as the thorax and abdomen, and surrounds all the organs of those cavities (Fig. 32). 3. The membrane which covers the whole external surface of the body like a sac, and passing over the lips and up the nostrils, lines the mouth, nasal cavities, throat, windpipe, lungs, meatpipe, stomach, alimentary tube, and every other internal cavity which has an opening outward, or which by a mouth or canal communicates with the external world (287). The portion of this membrane which covers the external surface, I have said (289), is called the SKIN, that lining the internal cavities is called the MUCOUS MEMBRANE. The general office of the fibrous and serous membranes is to cover and line the parts to which they are appropriated, and in some measure to keep them in their proper positions, and to furnish the cavities which they line with a serous, glairy fluid, by which the parts that move upon each other are moistened and lubricated; and also to absorb whatever fluids may be introduced into these cavities.* For this kind of exhalation and absorption, they require nothing more than the minute extremities of the arteries and veins, and the lymphatics. But the general office of the skin and mucous membrane is much more diversified and complicated. This extended membrane, as I have stated (288) constitutes the general confines of the vital domain, and is constructed with reference to all the relations which that domain holds to the external world; and through it, must pass, by the action of living organs, everything that enters into that domain, or egresses from it. If pure aqueous fluid is required to enter that domain with little or no change, appropriate organs in this membrane must absorb and convey it thither. If there be an excess of aqueous matter within the vital domain, this membrane must furnise organs to exhale or eliminate it from the system. If nutrient matter is to enter the domain of life, appropriate organs in this membrane must elaborate it from the contents of the alimentary cavity, by an assimilating process peculiar to themselves, and, as it were, hand it over to other functionaries of the system, to be subjected to other processes, and finally disposed of for the general good of the body. If mucilaginous and oleaginous substances are to be secreted from the vital

* It is not a settled point, whether the fibrous membrane in any situation performs these functions of secretion and absorption.

domain, to lubricate the exterior surface of this membrane, and protect its myriads of delicate little organs, and preserve them in proper conditions to perform their functions, or to oil the external surface of the body, to preserve the skin from the injurious action of various external agents, other appropriate organs in this membrane must secrete those substances. And if substances of a yet more exalted or complicated character, such as the saliva, the pancreatic fluid, the bile, etc., are to be secreted either for the purposes of the vital economy in carrying on its assimilating processes, or for the sake of separating excrementitious matter from the fluids of the system, and eliminating it from the vital domain, this membrane must furnish the organs for the performance of these various and wonderful functions.

ABSORBING, EXHALING, AND SECRETING ORGANS.

331. In giving a general description of the skin and mucous membrane (287), I said that countless numbers of the almost inconceivably minute terminations of capillary vessels of the sanguiferous and lymphatic systems, pass through the meshes of this membrane, and form a close web or plexus upon its exterior surface. Some of these minute vessels thus situated, are employed in their simple form in absorbing such aqueous and other substances as are at any time permitted to pass into the vital domain with little or no assimilating change. These pervade the whole external and internal membrane, but mostly abound in the mucous membrane of the alimentary and respiratory cavities, and especially in the stomach and alimentary tube. Others, again, are employed in their simple form, in throwing off or eliminating like substances from the system in the state of vapor and of sensible fluids, etc. These also pervade the whole membrane, but mostly abound in the lungs and external skin. Another set of these vessels are employed in their simple form in secreting the nutrient matter by which the system is sustained.* These innumerably abound in the alimentary cavity, and especially in the small intestines. It is contended also by some physiologists, that organs capable of performing this office exist in the lungs and external skin; and various experiments have been made, and anecdotes told, that hunger may be appeased, and nutrition to some extent sustained, by the absorption of these surfaces; but nothing conclusive or satisfactory has been accomplished; and the utmost that can be affirmed is the possibility of a vicarious function of this kind, to some extent; but this is not a normal function of the parts.

332. In regard to the solvent fluid of the stomach, it is not yet ascertained whether it is secreted by some of these little vessels, in their simple form, or in their more complicated glandular arrangements. It is common for writers on physiology to speak of the *glands* which secrete the gastric juice, but the existence of these glands has never been demonstrated.

FOLLICLES AND GLANDS.

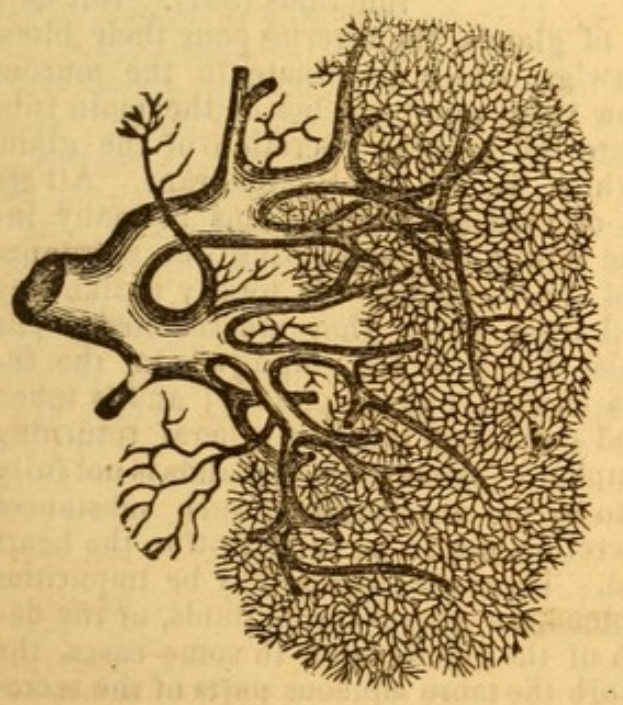
338. The remaining functions belonging to, or immedfately connected with, the great enveloping and limiting membrane, appear to be per-

* This process is by all writers on physiology called 'absorbing,' but with utter impropriety. The lacteals no more absorb the chyle than the liver absorbs the bile, as will be shown hereafter (455).

formed by more complicated organs; and yet, when thoroughly analyzed, they are found to be scarcely less simple than those described. The glandular follicles are the simplest kind of these organs. These are little bottle-shaped sacs imbedded in the substance of the membrane, with their mouths opening on its surface. The membrane continues into these mouths, and lines the internal cavities of the sacs; or, in other words, the sacs are formed by the membrane itself, and supplied with numerous nerves and blood-vessels, and appear to possess a contractile tissue, by which they are enabled, at any time, to expel their contents. These abound in every part of the membrane, but cluster more numerously in some parts than in others, as the wants of the organic economy demand. Though apparently similar in their anatomical structure, they differ very considerably in the character of their functions. Some of them secrete the mucus which everywhere lubricates the membrane, and imbeds and protects its delicate nerves and vessels (287). Others, situated on the external surface of the body, secrete the unctuous matter which oils the skin; of these sebaceous follicles there are said to be not less than a hundred and twenty millions: others, situated in the exterior cavities of the ears, secrete the *cerumen* or wax of those cavities. Whether the coloring matter of the skin is a distinct secretion, by a special set of organs, or whether it is an effect of the action of light and heat and perhaps the oxygen of the atmosphere upon the mucous coat, is yet an unsettled point.

334. The next form of a gland is still more complicated and much more extensive. Instead of the little sacs which I have just described, the membrane forms a tube like the barrel of a small quill, and this tube, like the main stem of a shrub, gives off many branches, and each of these branches divides into a very great number of twigs, and these are all hollow and formed by the same continuous mucous membrane; so that all the minute hollow twigs open into the hollow branches, and all the hollow branches open into the hollow stem or main tube, and this opens upon the face of the great membrane. This ramified tube or duct is more or less extensive according to the size of the gland, and the particular character of its function. But whether more or less extensive, it only differs from the little sacs in shape and extensiveness. To complete the structure and functional capacity of the gland, an artery advances to the main tube, and suddenly divides into a great number of branches, and each of its branches into an immense number of twigs (Fig. 21), and these minute

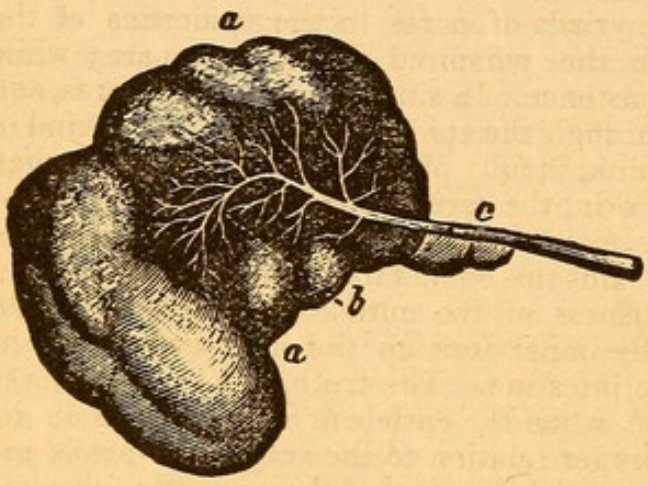
Fig. 21.



An artery of a gland dissected out.

twigs terminate in the membrane which forms the hollow twigs and branches of the tube or duct; and where these arterial twigs terminate, an equal number of venous twigs arise, which run together and form branches, and these run together and form the venous trunk or trunks of the gland, corresponding in ramification with the artery, but generally somewhat greater in capacity, and passing from the gland by the side of the artery. With these vessels, which almost form a dense plexus, are also associated a great number of lymphatic vessels; and all these capillary arteries, veins, and lymphatics, are largely supplied with nerves of organic life (231), and intimately woven together into a single organ, by a delicate cellular tissue; and, finally, the whole are enveloped in a serous membrane, and thus the gland is completed (Fig. 22). Some of the glands are provided with a membranous sac, which is also lined with the mucous membrane, and in which the secreted fluid or substance is deposited for a time.

Fig. 22.



A gland, a, a, with its excretory duct, c, and branches, b.

335. This is a general description of what are called the conglomerate glands, such as the salivary glands, the pancreas, the liver, etc. In one important respect, however, the structure of the liver differs from that of other glands. This peculiarity I shall notice when I come to speak of its particular functions (381). But as a general statement of this class of glands, the arteries pour their blood into their myriads of minute twigs, which terminate in the mucous membrane that forms the hollow twigs and branches of the main tube or duct of the gland, and there the peculiar secretion of the gland takes place, in a manner of which we are totally ignorant. All we can say is, that it is an effect of vitality, which seems in many instances actually to possess the power of transmuting one substance into another (51): for many of the secretions are totally unlike any thing to be found in the blood from which they are secreted. The blood thrown into these vessels, which is not employed in the secretion, becomes changed in its character by the process; and is taken up by the venous capillaries, and carried off into the general returning circulation. The office of the lymphatic vessels in these glands is not fully ascertained, but it is supposed to be the absorption of such substances as ought not to pass into the secretion, nor to be carried off to the heart unchanged, in the venous blood. These substances may be impurities brought into the gland in the blood, or extravasated fluids, or the decomposed matter, or the lymph of the gland; and, in some cases, the lymphatics are supposed to absorb the more aqueous parts of the secretion itself. These glands are situated in different parts of the body,

according to the wants of the vital economy. A considerable number of them, however, appertain to the alimentary cavity, and constitute a portion of the alimentary apparatus. It may, therefore, almost be said, that the great enveloping and limiting membrane which covers the external surface of the body, and lines all the open cavities, is one extended and complicated organ of secretion and excretion, of absorption and of depuration.

336. The external skin, I have said, is covered everywhere by a thin membranous form of horny matter, called the cuticle or epidermis (287); and some anatomists say that this epidermis extends over the whole mucous membrane. Dr. Horner, of Philadelphia, assures us that he has fully demonstrated its existence in the small intestine, and he therefore concludes that it pervades the whole alimentary cavity.* How the substances which enter or pass from the vital domain, get through the epidermis where it does exist, is a question much disputed. Some physiologists say that there are myriads of pores in the epidermis of the external skin, through which the perspired fluids, etc., pass; while others confidently deny the existence of a single one of these pores, and affirm that whatever passes through the epidermis, does so by a kind of infiltration; and this, they think, is fully proved by the fact, that when a blister is raised upon the skin, the serum which accumulates under the epidermis does not escape, as it would if there were numerous pores through which it could pass. But this seems to prove too much; for it equally proves the imperviousness of the cuticle by infiltration. Dr. Horner says he found it wholly impervious to the air, with which he inflated it, in a section of the intestine. The truth, however, seems to me to be most probably this: when the cuticle or epidermis is in its proper place, and holds its proper relation to the subjacent vessels and tissues, it presents openings to the mouths of those vessels, through which they pour out, or drink in, such substances as they give or take; but when it is raised up, and separated from its proper place and connexion, either by a serous fluid or by air, those openings, from the peculiar construction of the parts by which they are formed, become perfectly closed, and render the cuticle wholly impervious. The nerves of animal and of organic sensibility, intimately associated with the minute vessels of the skin and mucous membrane, I have sufficiently described (29[illegible]).

337. I have been thus minute and particular in describing the great limiting membrane which constitutes the confines of the vital domain, because it is the seat of many of the most important functions of the organic economy, and, as I have said (330), is constructed with reference to all the relations which the vital domain holds to the external world; and hence, it is impossible for any one to have a clear and full understanding of the laws of constitution and relation under which man exists, without knowing the organization and physiological endowments of those important parts.

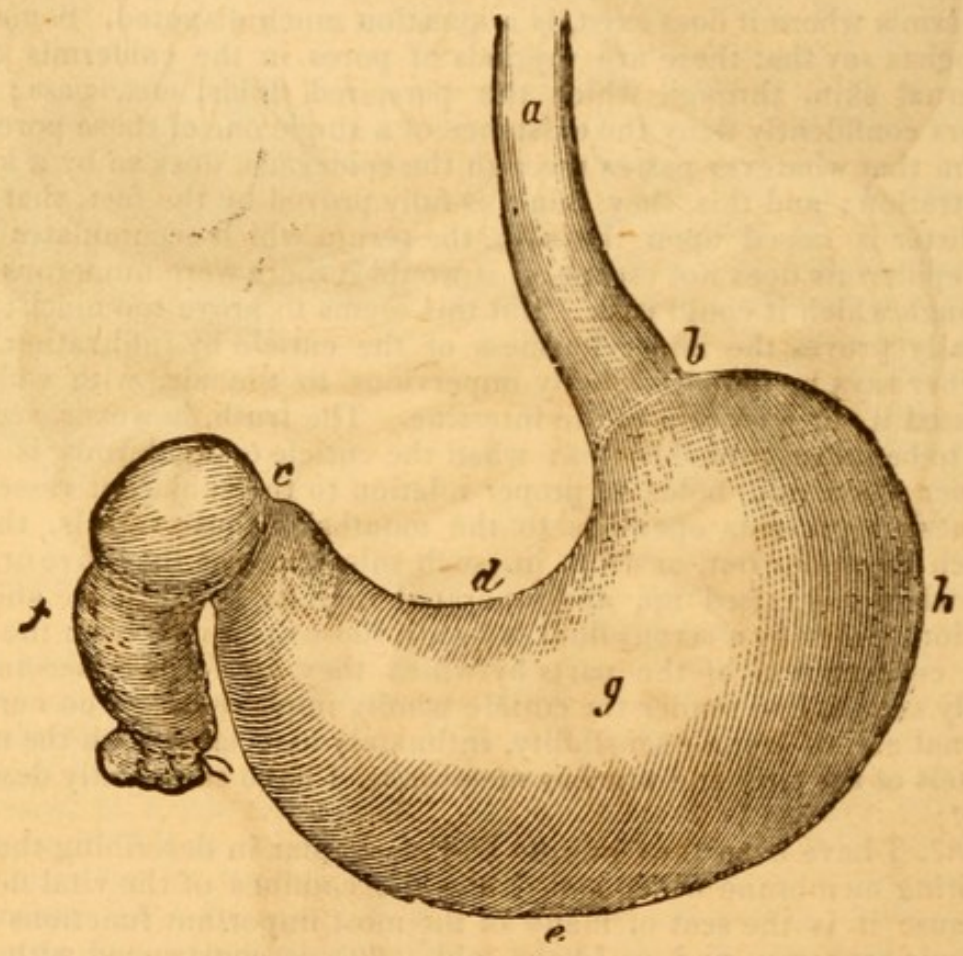
THE DIGESTIVE ORGANS.

338. The mucous membrane, then, we perceive, is the grand seat of all the primary processes of alimentation, of the various functions

* See Appendix, Note A.

of secretion and excretion, of respiration, etc.; and hence it is so arranged as to constitute the most important portion of all the organs by which these functions are performed. Having lined the mouth and nasal cavities, it passes back, and unites in the fauces or throat, and thence descending, forms a funnel-shaped cavity called the pharynx, which tapers downward and gathers into a tube. This tube, called the œsophagus or meatpipe, continues downward some twelve or fifteen inches, and having entered through a small opening of the midriff or diaphragm (Fig. 37), into the abdominal cavity, it suddenly expands into a large sac, which is called the stomach. This sac has somewhat the shape of a pear (Fig. 23), and lies across the upper part of the abdominal cavity

Fig. 23.

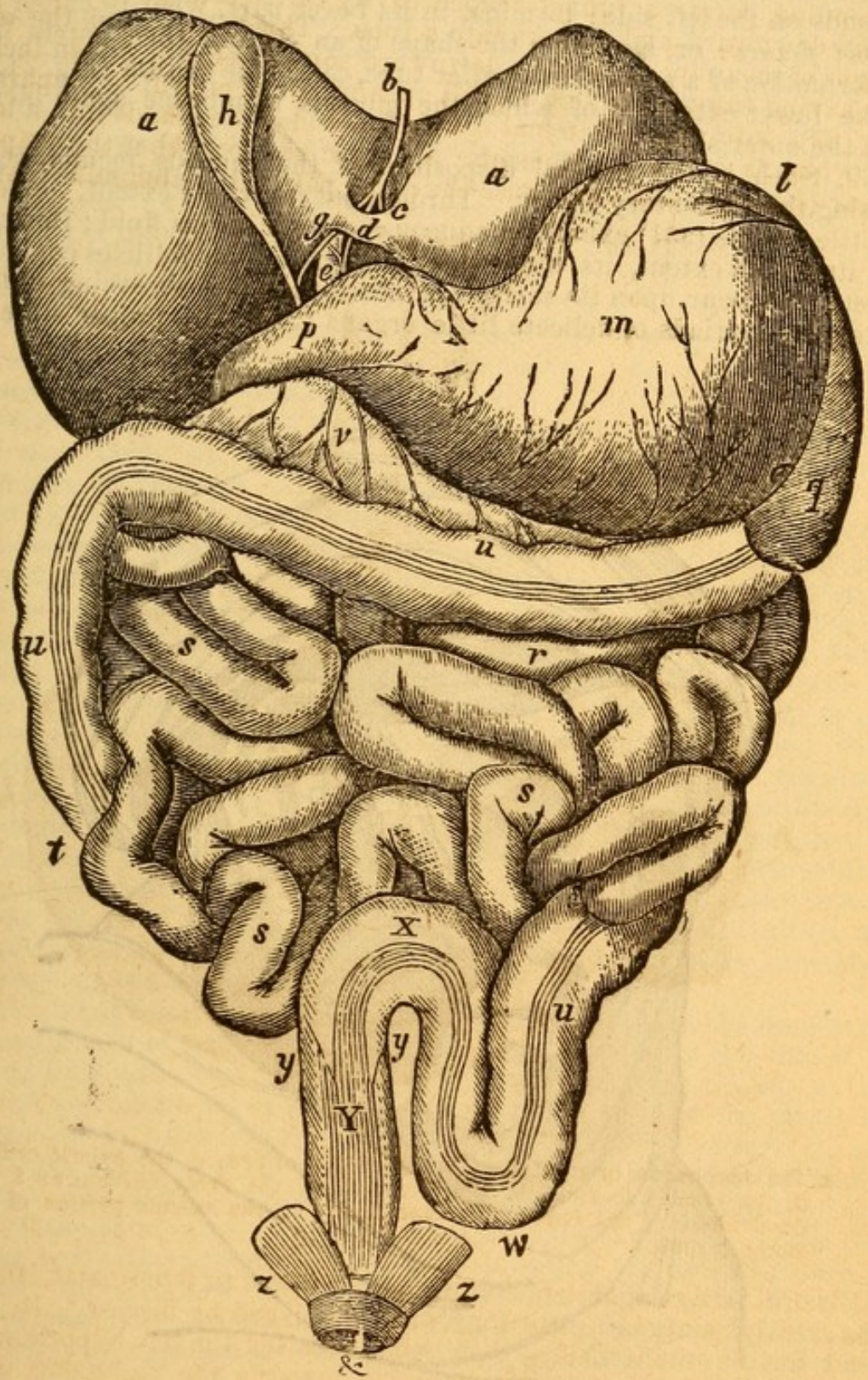


a, the œsophagus, or meatpipe; b, the cardiac orifice; c, the pyloric orifice, d, the small curvature of the stomach; e, the great curvature; f, the duodenum; g, the centre of the stomach; h, the splenic portion of the stomach (382).

It is ordinarily capable of containing from one to two quarts, but may be greatly enlarged by gluttony, and diminished by disease. Its largest end lies on the left side, or in what is called the left hypochondrium. It diminishes in size as it proceeds towards the right side, where it rather suddenly contracts into a tube, which is considerably larger than the meatpipe or œsophagus (Fig. 23, *f*.) This tube is prolonged to six or eight times the length of the body, and is nicely convolved or folded,

so as to be brought into a small compass (Fig. 24, *s*). In the descriptions of anatomy and physiology it is artificially divided into three parts, called the *duodenum*, the *jejunum*, and the *ileum*. It is more properly, as a

Fig. 24.



a, the under side of the liver; b, c, d, g, the biliary ducts; h, the gall-bladder; m, the stomach; p, the pylorus; r, s, small intestine, terminating at t in the large intestine u, w, X, Y.

whole, called the small intestine, or the small portion of the alimentary canal or tube. This tube, at its lower extremity, suddenly expands into what is called the colon, which is much more capacious than the small intestine (Fig. 24 *u*). The colon ascends to the stomach on the right side, arches over the whole volume of the small intestine, and descends on the left side; forming, in its lower part, what is called the *sigmoid flexure:* or, assuming the shape of an S; and then enters into the formation of a somewhat smaller tube, called the rectum (Fig. 24, *v*), at the lower extremity of which the mucous membrane again blends with the outer skin.

339. Such is the general disposition of the mucous membrane, in forming the alimentary cavity. Throughout its whole extent, some of its little vessels (331) exhale an aqueous vapor or serous fluid; throughout its whole extent, its numerous little glandular follicles copiously secrete, and pour upon its surface, a lubricating and sheathing mucus, to keep its myriads of delicate little organs (287) in a proper state for

Fig 25.

a, the salivary gland in the cheek; b, the duct leading to the mouth; c, the gland under the edge of the under jaw

the performance of their functions, and to protect them from the injurious action of whatever substances may be introduced into the cavity.

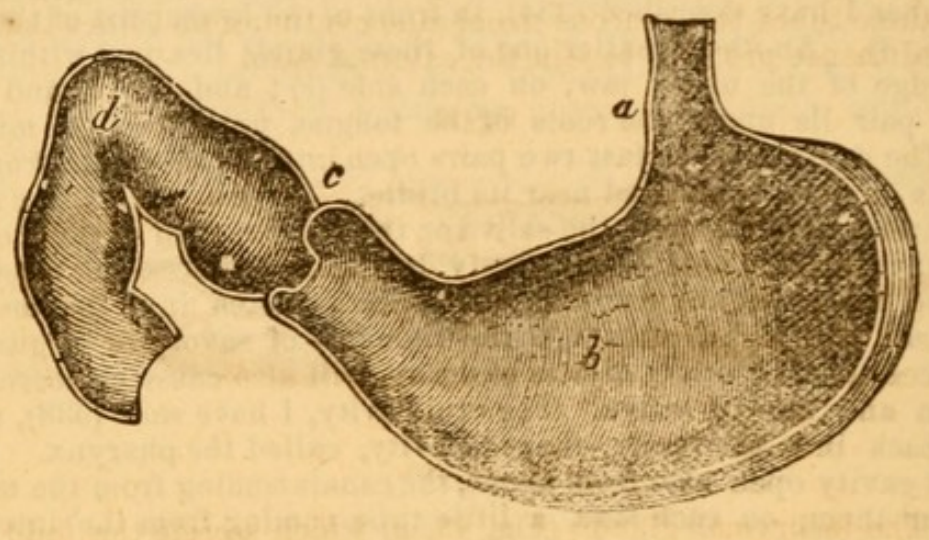
340. In the oral cavity, on each side, near the second double tooth in the upper jaw, the mucous membrane forms a little tube (Fig. 25, *b*), which ascends along the cheek, and branches out and forms a gland in the manner I have described (334), in front of the lower part of the ear (Fig. 25, *a*). Another smaller one of these glands lies just within the lower edge of the under jaw, on each side (*c*); and a third and still smaller pair lie under the roots of the tongue, uniting on the middle line. The ducts of these last two pairs open into the mouth in front of the roots of the tongue and near its bridle. These are called the salivary glands. They secrete the saliva or the solvent fluid of the mouth, and pour it into the oral cavity freely during the process of mastication, and whenever any exciting substance is taken into the mouth. The smell, and sight, and even the thoughts of savory or disgusting substances, and of other objects of desire, will also cause an increased secretion and flow of saliva. The oral cavity, I have said (338), continues back into the funnel-shaped cavity, called the pharynx. Into this last cavity open also from above, the canals coming from the nose; and near them, on each side, a little tube coming from the internal chambers of the ear, called the Eustacian tubes. These tubes are lined by the mucous membrane, and are so essential to hearing, that if they become closed up, deafness is caused. Just in front of these is the soft pendulous body commonly called the palate; but in the descriptions of anatomy, the vail of the palate. This, in the act of swallowing, is pressed back, and closes the nasal canals and the Eustacian tubes, so that nothing can pass into them. A little lower down, near the roots of the tongue, in the front part of the pharynx, opens the *larynx*, or the mouth of the windpipe. This is so situated that every thing which is so swallowed must pass directly over it. To prevent any of the food or drink from entering the windpipe, a small oval-shaped cartilaginous valve is placed over the orifice. But as respiration requires that the mouth of the windpipe should only be momentarily closed, this little valve called the *epi-glottis* is always raised, except during the act of swallowing, when it shuts down over the orifice, and completely closes it for an instant, while the food or other substances are passing, and then immediately opens. *

341. Descending again to the stomach, we find that the œsophagus or meatpipe does not enter this cavity at its end, or in the line of its longitudinal axis, but, as it were, at its upper side (Fig. 26, *a*), so that the inferior mouth (*c*) of the stomach, which opens into the small intestine (*d*), is little lower than that at which the food enters (*a*), and which on account of its proximity to the heart is called the cardiac orifice. The inferior mouth of the stomach (*c*), which lies in the right side of the abdominal cavity, is called the pyloric orifice. About four inches below this orifice, in the small intestine (*d*), is the mouth of another tube, formed or lined by the mucous membrane. This tube ascends and branches out in the manner I have described (334); and, together with appropriate vessels, nerves, etc., forms the largest gland

* The fact that the glottis can close itself in the absence of the epi-glottis does not in the least degree prove that the epi-glottis is not designed to act exclusively as a valve to close the glottis in the act of deglutition.

in the body, called the liver (Fig. 24, *a a a*). This gland is situated at the top of the abdominal cavity, and lies immediately under the

Fig. 26



a, the cardiac orifice of the stomach; b, the interior of the stomach; c, the pylorus; d, the interior of the duodenum.

diaphragm, and mostly on the right side. It is divided into a large lobe, and two small ones. On the lower surface of the large lobe, which lies on the right side, is formed a membranous reservoir, called the gall-bladder, which is also lined by the mucous membrane (Fig. 24, *b*). The common biliary duct, after proceeding a short distance from the small intestine, gives off a tube called the cistic duct, which goes to the gall-bladder. The remaining portion of the main duct, which now takes the name of the hepatic duct, continues a little farther, and then divides into two tubes, one of which goes to the right and the other to the left lobe of the liver. The nerves of the liver, which are very numerous, are principally from the hepatic plexus, which is formed by a multitude of the branches of the nerves of organic life, and into which some of the filaments of the pneumogastric penetrate (245, 285). By this plexus, also, the liver is brought into very immediate and powerful anatomical and sympathetic relations with the stomach (231).

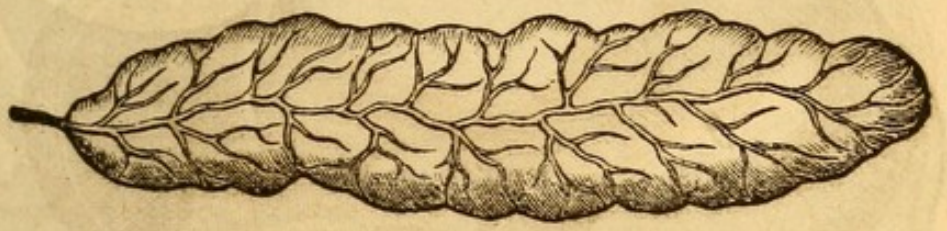
342. The pancreas, which very closely resembles the salivary glands in its structure and in the character of its secretion (Fig. 27), is situated behind the stomach, and lies crosswise of the body (Fig. 28, *p p*). It is about six inches long and one thick, and weighs from four to six ounces. Its duct generally enters the small intestine, at the same point, and in a common mouth with the biliary duct. These excretory ducts, and those of other glands, though formed essentially of the mucous membrane, as I have said, have also an exterior tunic or dense cellular substance.

343. These are the glands which immediately pertain to the mucous membrane of the alimentary cavity, and are more or less concerned in the performance of its general function of assimilation.

344. The kidneys, which are situated in the region of the loins (Fig. 28, *k*), though they, like the glands just described, are founded

founded upon the mucous membrane, are not immediately connected with the alimentary canal. The mucous membrane, which lines all their ducts and cavities, continues from each kidney, and forms or lines a long tube about the size of a writing quill, one of which descends from the kidney on each side, and opens into the bladder (Fig. 28, *u u*). From these tubes the mucous membrane continues and lines the bladder, and thence proceeds to join the external skin.

Fig. 27



The Pancreas.

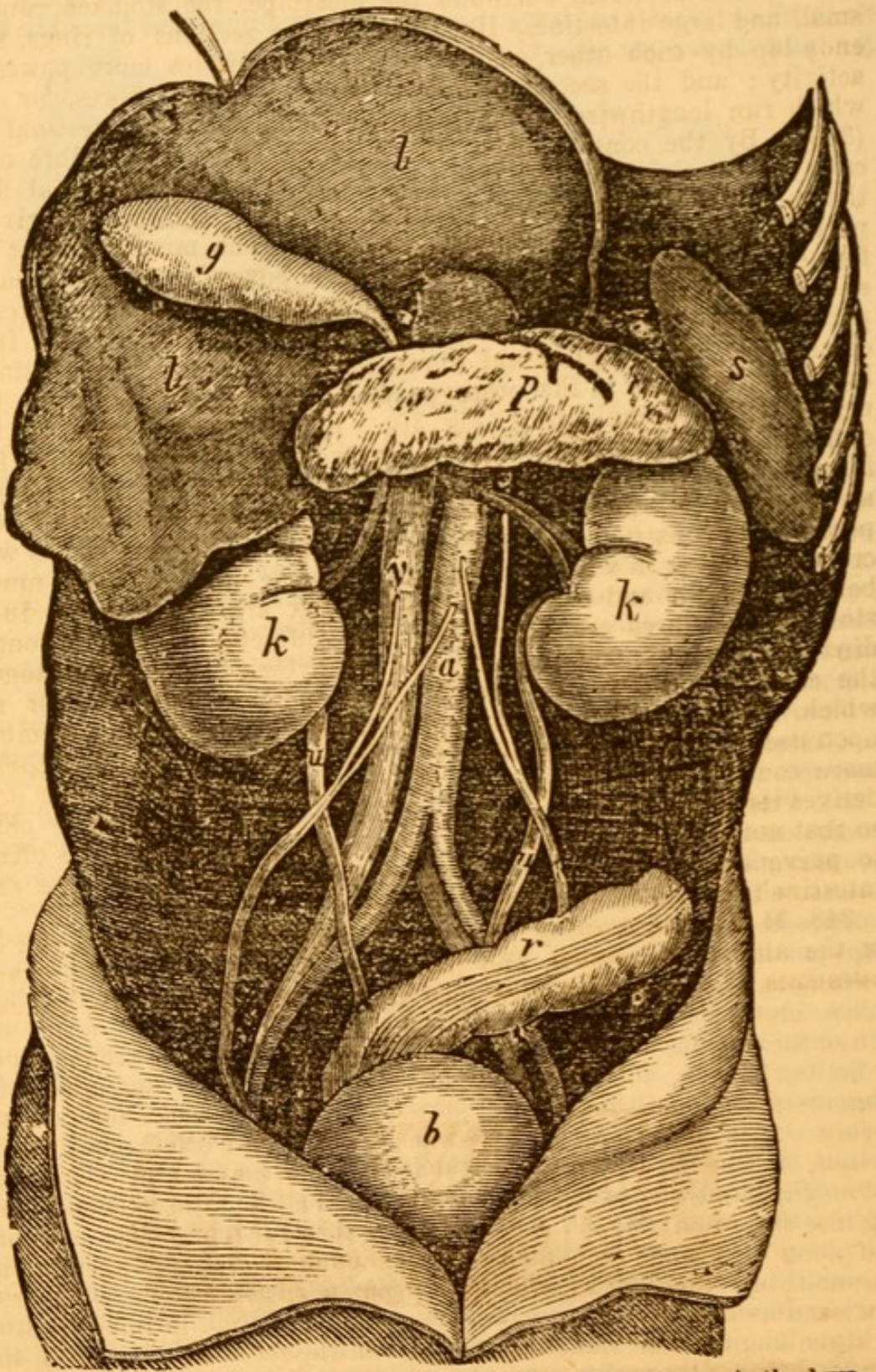
345. The lachrymal glands (Fig. 49, *a*) which secrete the fluid that moistens the eyeball and composes the tears, and the other glands of the body, not particularly described, are all constructed upon the same general principles, having the mucous membrane for the grand foundation of their structure. But in all these glands this membrane is, as it were, isolated, and at a greater or less remove from the great sheets of the alimentary and respiratory cavities. Yet when it is remembered that the main difference between the external skin and the mucous membrane (287, 289) is in *situation*, which affects function more than structure, we see that the one may readily pass into the other, in any part, according to the general and particular wants of the organic economy.

346. Passing downward from the mouth of the biliary and pancreatic ducts (341, 342) along the small intestine, we find the organ abounding in small semilunar folds (Fig. 29) called the *valvulæ conniventes*, which greatly increase the extent of its surface, and cause its contents to descend more slowly. This intestine does not pass into the large portion of the canal, in the line of its longitudinal axis, as a continuous tube, but enters in at a right angle (Fig. 30 *h*) about four inches above its inferior extremity (*a*), and terminates in a circular fold of the mucous membrane, called the *ileo-cæcal valve*, which extends, by its free border, into the cavity of the large intestine, and suffers the contents of the small intestine to pass freely into the large, but does not permit those of the large intestine to pass into the small. The portion of the large intestine which extends below the ileo-cœcal valve (Fig. 30, *a*), is called the cœcum. It has the form of a sac opening into the colon (Fig. 30, *b c d*), and is three or four inches in depth, and about the same in diameter. The colon is not cylindrical like the small intestine, but is gathered into partial circular folds, which give it a saculated form and appearance, and is secured in this condition by three longitudinal bands (Fig. 30). In the rectum (Fig. 30, *f*), this saculated form disappears, and the canal again becomes more uniform and cylindrical.

MUSCULAR TISSUE OF THE ALIMENTARY CANAL.

347. Motion, as well as innervation and secretion, being necessary for the performance of the general functions of the alimentary cavity,

Fig. 28.

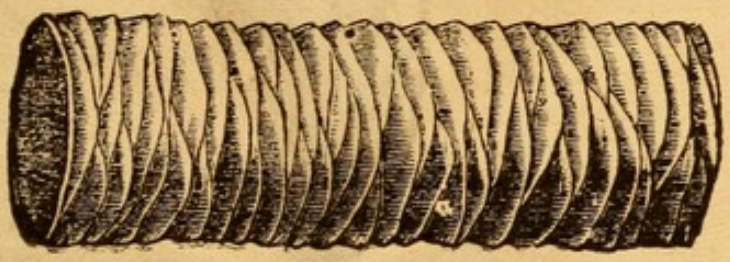


a, the aorta; b, the bladder; g, the gall-bladder; k, the kidneys, l, the liver turned up, showing the under side; p, the pancreas; r, the rectum; s, the spleen; u, the uretures; v the vena cava.

muscular fibres are therefore everywhere attached to the back of the mucous membrane forming that cavity. These fibres are arranged in different parts according to the motion required. Throughout the whole extent of the canal, however, the arrangement is very similar (199). In general, it consists of two layers; the first composed of circular fibres, which surround the meatpipe, the stomach, and the small and large intestines, like rings, or like sections of rings, whose ends lap by each other, so as to give the muscles more power and activity; and the second composed of longitudinal fibres, or those which run lengthwise of the meatpipe, stomach, and intestinal tube (338). By the contraction of the circular fibres, the calibre of the cavity is diminished. By the contraction of the longitudinal fibres, the parts are shortened, and by their combined action, they give the parts a vermicular or undulating motion. The muscular coat thus formed is considerably thicker and more powerful in the meatpipe and stomach, than in the small intestine; and in the large intestine, particularly the colon, it is still thinner than in the small. In the colon, also, the longitudinal fibres, instead of forming a continuous layer or sheet, as in the other parts, are gathered (346) into three separate longitudinal bands (Fig. 30). In the rectum, again, the muscular coat becomes thicker and stronger, and the longitudinal fibres form a continuous layer around the tube. In the pharynx (338) the arrangement is somewhat different: here the muscular coat is composed of six constrictor muscles, the fibres of which form sheets which cross each other in various directions. By the action of these muscles both the length and calibre of the pharynx are diminished. In the stomach the fibres are disposed in three different directions: longitudinally, circularly, and obliquely. At the pyloric orifice of the stomach, the circular fibres gather into a thick and powerful band or ring, which, together with a thickening or folding of the mucous membrane upon itself, forms what is called the *valve of the pylorus* (Fig. 26, *c*), or more commonly the pylorus or 'gate keeper,' from which the orifice derives its name. When this ring is contracted, the orifice is closed, so that nothing can escape from the stomach downwards. Its office is to prevent the contents of the stomach from passing into the small intestine in a crude and undigested state.

348. It is an interesting physiological fact, that the muscular coat of the alimentary organs, and particularly of the stomach and small intestines, is more or less developed and powerful and active, according

Fig. 29.

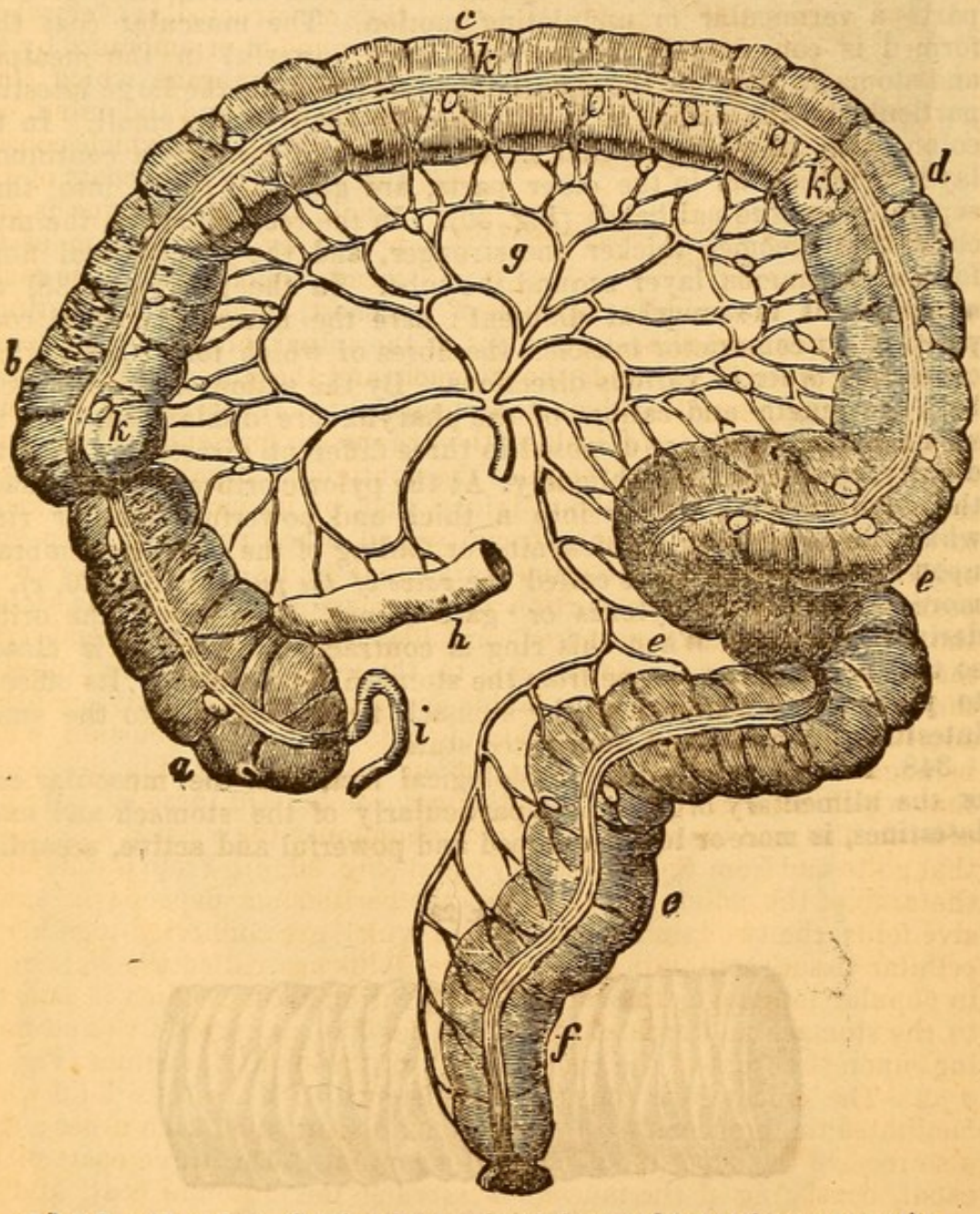


Section of the small intestine, turned inside out, to show the folds of the mucous membrane.

to the character and condition of the food on which the individual habitually subsists. Those kinds and conditions of food which require considerable muscular action and power in the alimentary organs, conduce to the development, vigor, and activity of the fibres which form their muscular coat; while the opposite kinds and conditions of food conduce to the emaciation and feebleness and inactivity of those fibres, and in some instances the atrophy or wasting of the muscular coat of the stomach proceeds to such a degree as to render its action exceedingly sluggish and feeble.

349. Such is the general contractile tendency of the muscular coat of the alimentary canal, that when its several parts are not distended

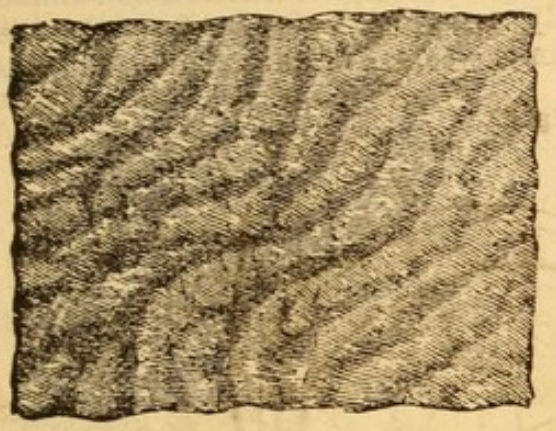
Fig. 30.



a b c d e, the colon, showing its saculated form and general arrangement; e, the sigmoid flexture; f, the rectum; h, the small intestine terminating in the colon, and forming the ileo-cæcal valve; g, the vessels crossing the mesocolon.

with food, their cavities are very considerably diminished; and by this means, the mucous membrane is gathered into numerous wrinkles or folds. In the meatpipe, these are nearly longitudinal. In the stomach the wrinkles run in every direction, and the folds are exceedingly numerous (Fig. 31); but in both of these organs they wholly disappear when the parts are completely distended. In the small intestine the folds (Fig. 29) are even more numerous than in the stomach, and many of them are also more permanent (346).

Fig. 31

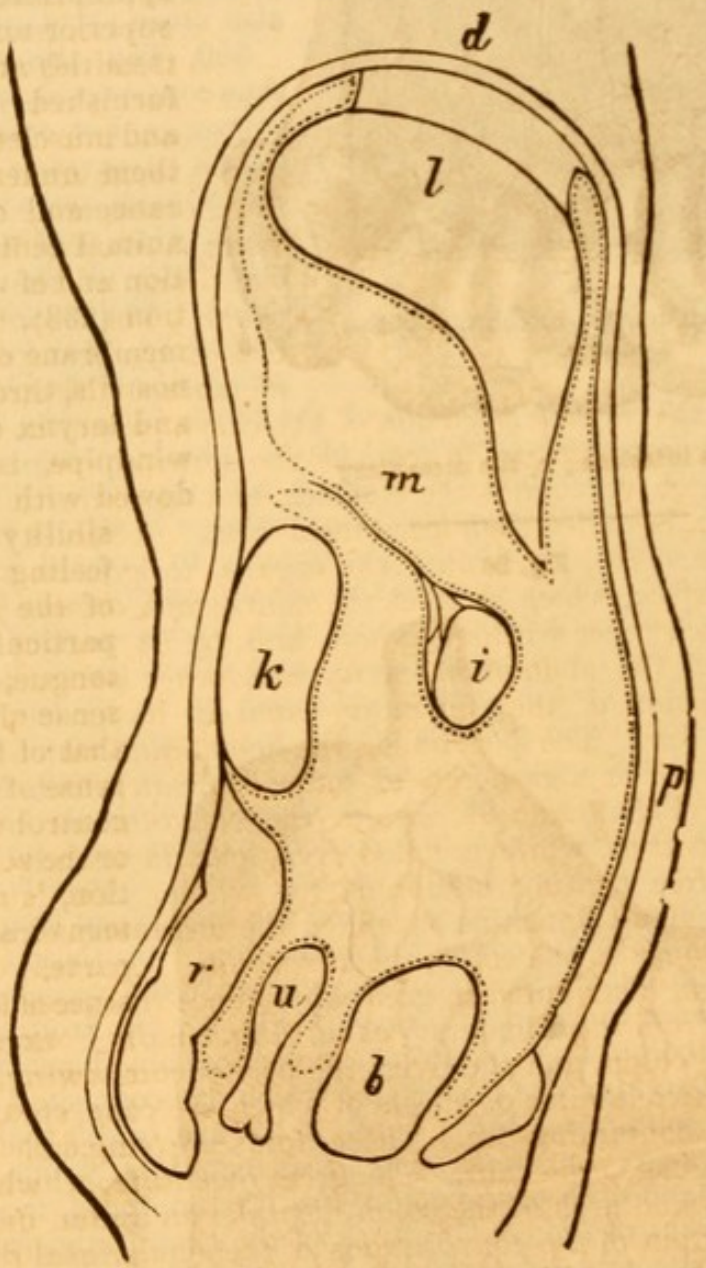


The folds in the mucous membrane of the stomach.

350. The alimentary canal, thus constructed, is everywhere surrounded or embraced by the serous membrane which lines the thoracic and abdominal cavities (176), and which constitutes one of the coats of the canal. The œsophagus is embraced by that portion of the membrane of the thoracic cavity which forms the middle partition of the chest, called the mediastinum (176), and lies immediately in front of the spinal column. The serous membrane which surrounds the stomach and the intestines, excepting the duodenum, is called their peritoneal coat. It serves in a measure, as I have said (176), to isolate the organs, to present a smooth and lubricated surface, which enables the contiguous organs and parts to move upon each other without injury, and, by its various attachments to the walls of the abdominal cavity and other parts, to keep each organ and portion of the alimentary canal in its proper and relative position (Fig. 32). The portion of the membrane which thus secures the intestines, forms a gathered or folded curtain which extends from the back-bone (Figs. 5 and 32, *m*), to the convolutions and arches of the canal; and thus, while it holds every part in its relative position, admits of a free floating motion of the whole. The curtain which belongs to the small intestine is called the mesentery (Fig. 33, *c*), and that which belongs to the colon, the mesocolon. On these curtains also are ramified and distributed in great abundance the vessels and nerves that go to and from the alimentary canal (Fig. 30, *g*). From the stomach, the arch of the colon, and the liver, the peritoneum depends in extensive folds, the two laminæ or sheets of which are connected together by cellular tissue containing fat. These folds are called the omenta, or in popular language, the caul. The great omentum, which is attached to the stomach and arch of the colon, lies like an apron, free and floating upon the front of the convolutions of the small intestines (Fig. 34, *g g*). The omenta are constantly moistened with a serous fluid which facilitates the movements of contiguous organs upon each other; they also receive the superfluous depositions of fat. The three coats of the canal, consisting of the mucous membrane, the muscular coat, and the peritoneal coat, or the serous membrane, are closely knit together by a delicate cellular tissue. The nerves distributed to the alimentary

canal, and which preside over its functions, we have seen (220), are from the ganglionic system of organic life. These are exceedingly abundant in every part of the canal, imparting the stimulus of involuntary motion to its muscular tissue (219), giving the functional power of absorption, secretion, excretion, exhalation, etc., to its myriads of minute vessels (230); and organic sensibility, common and special (296), to its whole extent of mucous membrane (290). The stomach we have seen (231), is very largely supplied, not only from the great centre of organic life, but also from the centre of animal life (245), and

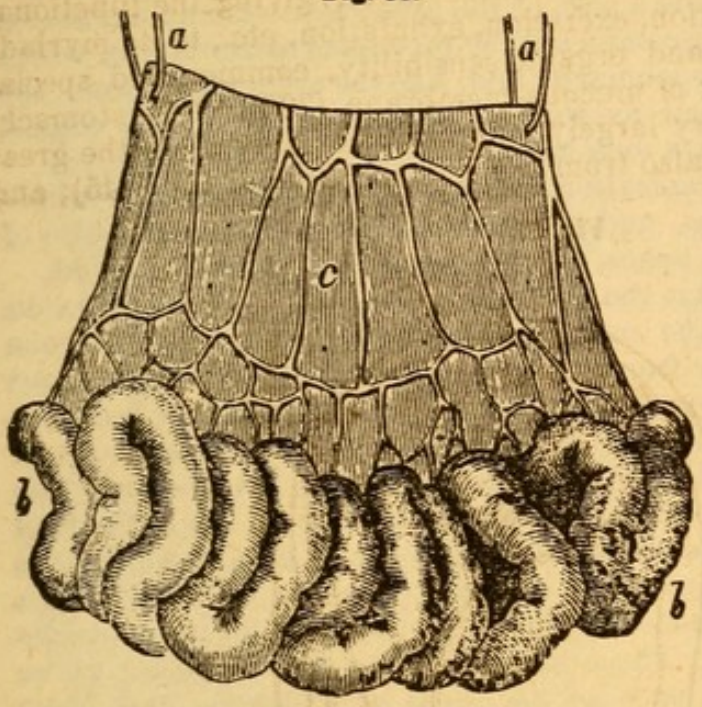
Fig. 32.



The dotted line shows the arrangement of the serous membrane in the abdominal cavity (176); lining p, the front wall of the abdomen, partially surrounding b u r, the organs of the pelvis, and k, the kidney; going down around i, the intestine, and returning and forming m, the mesentery; ascending to d, the arch of the diaphragm, and surrounding l, the liver, etc.

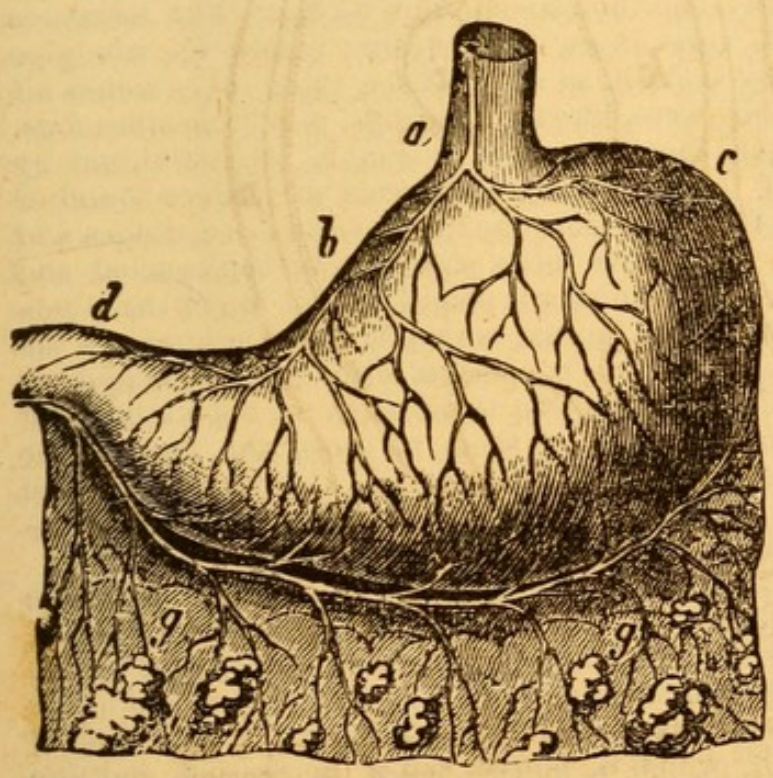
is thereby brought into the most immediate, powerful, and important relations and sympathies with each and every part of the system (297, 298). The alimentary canal, however, being a general organ of external as well as internal relation, designed to receive foreign substances for the nourishment of the body, and to expel the unappropriated portions, its superior and inferior extremities are accordingly furnished with nerves and muscles which bring them under the cognizance and control of the animal centre of perception and of voluntary action (233). The mucous membrane of the mouth, nostrils, throat, pharynx, and larynx or top of the windpipe, is highly endowed with animal sensibility of touch or feeling (294); that of the mouth, and particularly of the tongue, has also the sense of taste, and that of the nose the sense of smell. The control of the WILL, or the voluntary action, is nearly commensurate, in these parts, with the sense of feeling, and is exercised in chewing, swallowing, speaking, singing, etc. The nerves from which these parts derive their animal sensibilities and power of voluntary action, I have fully described (245—256).

Fig. 33.



b b, the intestine; c, the mesentery

Fig. 34



a b c, the stomach; g g, the great omentum or caul

RESPIRATORY AND VOCAL ORGANS.

351. The respiratory organs are closely associated with the alimentary. Indeed they constitute a part of the great assimilating apparatus of the system, for in them is completed the process of assimilation, which commences in the mouth or stomach; and, like the alimentary canal, the lungs are organs of external as well as internal relation, and consist fundamentally of the mucous membrane.

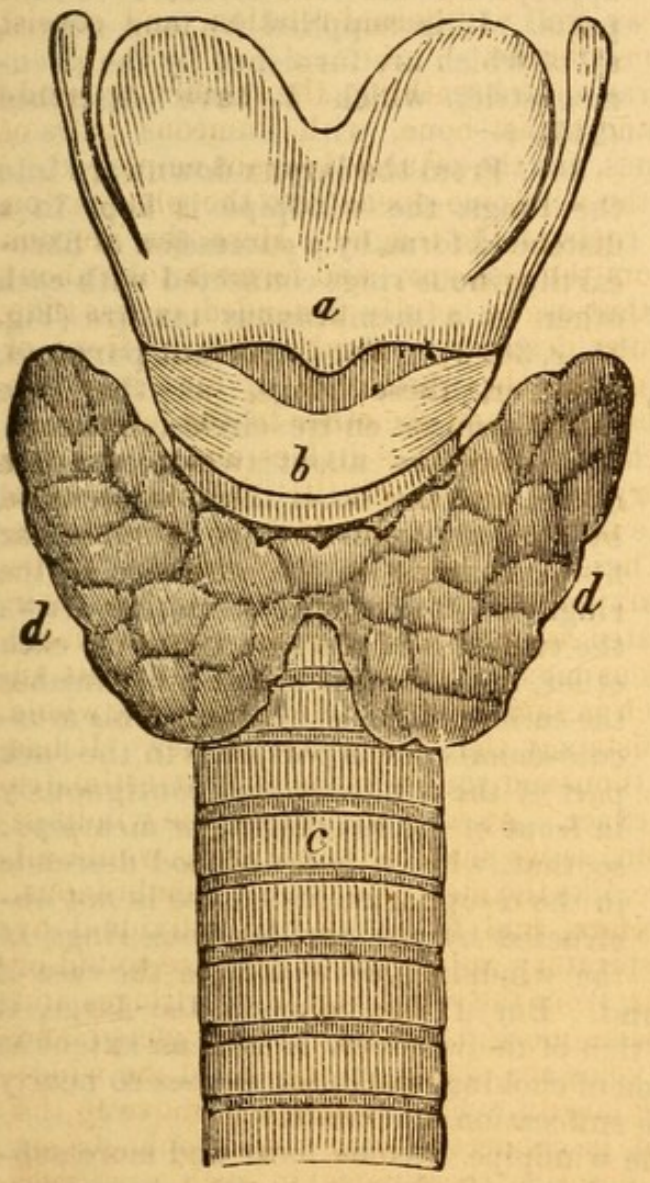
352. In the function of respiration or breathing, the trachea or windpipe, lungs, diaphragm, ribs, and breast-bone, with numeous pairs of muscles which move these bones, are the principal organs employed.

353. I have said (340) that the windpipe opens into the pharynx on the front side, just below the roots of the tongue. Here the mucous membrane continues down from the pharynx, and forms a tube about the size of the meatpipe when that organ is fully distended, or less than an inch in diameter. This tube descends several inches in front of the meat-pipe to the cavity of the chest, where it divides into two branches, the one going to the right, and the other to the left side of the thoracic cavity. Here each of the branches divides and subdivides in every direction, like an artery of a gland (Fig. 21), till they form a thick brush or broom of minute hollow twigs, and each of these twigs terminates in a little cell. These little air cells are supposed to be about the one-thousandth part of an inch in diameter, and their number in both lungs is estimated at more than one hundred millions. By this arrangement the mucous membrane of the lungs presents an extent of surface to the air which is said to be equal to that of the whole external skin, and some anatomists say that it is much greater. It has been estimated at twenty-one thousand square inches. But estimates of this kind cannot be very exact. As the air enters the windpipe and lungs principally by suction, as we shall see, these tubes would all collapse or close up, if they were, like the meatpipe, purely membranous. To keep them distended, therefore, and to enable the individual by the voluntary control of the respiratory apparatus to produce sound or voice in the emission of the air from the lungs, various cartilages and muscles are supplied. The parts more particularly constructed and arranged for the production of voice are placed at the top of the windpipe, and collectively called the larynx, which is attached above to the bone of the tongue, and behind is connected with the œsophagus or meatpipe. It is impossible to describe these parts in such a manner as to give a clear and accurate idea of them to those who have never seen them, without extensive visible illustrations, and as their minute anatomy will not serve to elucidate any important physiological principle, I shall only give a general description of them.

354. The larynx is composed of five cartilages, which are moveable one upon another by the action of several muscles. 1. The *thyroid*, or shield-like cartilage (Figs. 35, 36, *a*), which is the largest of the five, and forms the upper and anterior part, and produces at the upper part of the neck the prominence called *Adam's apple*. 2. The *cricoid* or ring-like cartilage (*b*), which is placed below the thyroid, and like that can readily be felt in the fore part of the neck. It is narrow in front, and thick, broad, and strong behind. Its upper edge has its front part fixed to the thyroid cartilage; its lower edge is connected

to the whole circumference of the commencement of the trachea. 3 and 4. The two *arytenoid*, or small pyramid-shaped cartilages (Fig. 36, *c*), which are situated at the upper and back part of the larynx, above the cricoid cartilage, to which they are attached by a strong ligament (Fig. 36, *e*), and upon which they have a sliding motion in every direction. 5. The *epiglottis*, a soft fibro-cartilage of an ovoid form, situated at the upper part of the larynx under the roots of the tongue, and placed obliquely over the glottis or mouth of the windpipe, which opens into the pharynx, forming a valve by which the glottis is closed in the act of deglutition (340). 'On the inside of the larynx there are two ligaments, formed of elastic and parallel fibres, and extending forward from the anterior part of each arytenoid cartilage to the thyroid cartilage, where they meet. These are called the *chordæ vocales*, or the vocal ligaments (Fig. 36, *f*). The opening between them is the entrance into the windpipe, and is called the glottis. This narrow chink is capable of being enlarged, contracted, or wholly closed. Immediately above these two ligaments are two small pouches, termed the ventricles of the larynx; and above the ventricles are situated two other ligaments formed of a mucous membrane, and extending between the arytenoid and thyroid cartilages, above the *chordæ vocales*; so that the ventricles of the larynx are situated between these ligaments and the vocal chords.

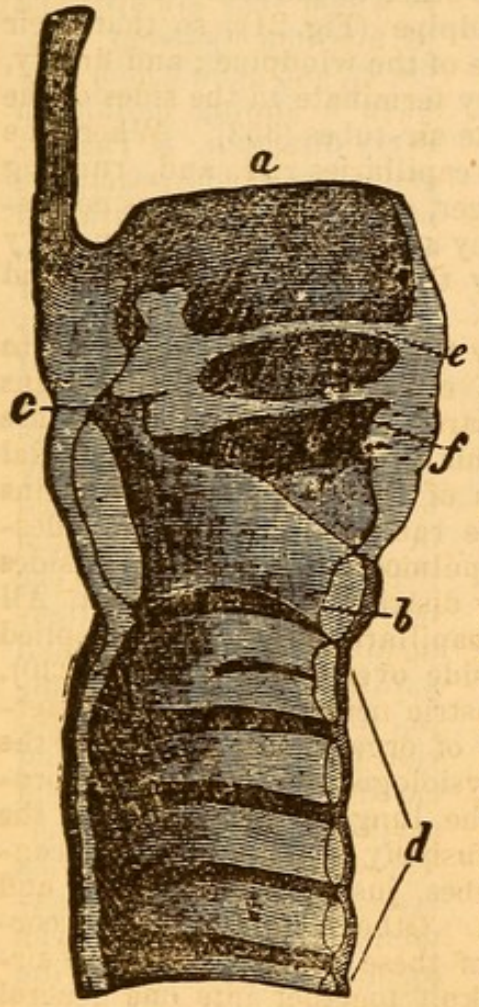
Fig. 35.



355. 'All the modifications of the voice are produced by the air passing out of the lungs through the larynx. The sound is occasioned by the vibration of the vocal ligaments. According to Magendie, the gravity or acuteness of the sound depends on the greater or less approximation of the arytenoid cartilages towards each other. But Mayo remarks that the pitch of the voice has no reference to the size of the aperture between the vocal chords, nor to any alteration of their

length, but depends solely on their *tension*, and, consequently, on the frequency of their vibrations.' *

Fig. 36.



356. The whole larynx may be elevated towards the chin, or depressed towards the sternum, by the action of appropriate muscles situated in the parts. It is supplied by four nerves, all of which are furnished by the pneumogastric, which I have described (245). †

357. From the larynx downward into the lungs, the windpipe is kept in a distended form, by a succession of fibro-cartilaginous rings connected with each other by a membranous texture (Fig. 35, *c*, 36, *d*). For important purposes, however, these rings, as they are called, are not entire circles, but each ring describes about two-thirds of a circle, and the other third is occupied by a membranous texture of muscular fibres running in the direction of the rings: so that their contraction draws the two ends of the ring nearer to each other, and thus considerably diminishes the calibre of the windpipe. This musculo-membranous portion is in the back part of the windpipe, and contiguously in front of the œsophagus or meatpipe: so that, when a bolus of food descends in the œsophagus, its course is not obstructed by the cartilaginous rings of the windpipe, as would be the case if they continued entirely around. But if the bolus is too large, it presses in the membranous portion of the windpipe to such an extent as to cause the distressing sensation of choking, and in some cases so nearly closes the windpipe as to cause suffocation and death.

358. As the branches of the windpipe become more and more subdivided in the substance of the lungs, the rings become less and less cartilaginous, and gradually soften down and fade away, and finally disappear entirely, leaving nothing but the membranous form of the small air-tubes. It is however asserted by some anatomists, that the transverse muscular fibres, by the contraction of which the calibre of these tubes is diminished, are continued down to the smallest subdivisions, and that they are employed in the act of expiration, in expelling the air from the lungs; and that it is to this contractile tissue

* Oliver's First Lines of Physiology, p. 453.

† In front, and somewhat below the larynx, is situated a soft, spongy body called the thyroid gland, the use of which is not known. It consists of two lobes, one on each side, which are united in the middle (Fig. 35, d) It receives blood from four arteries, but has no excretory duct. It is usually larger in females than in males, and larger in early life than in more advanced age.

that the pulmonary branches of the pneumogastric nerve are mainly distributed (245).

359. A large pulmonary artery, rising from the heart (Fig. 40, *k*), divides like the windpipe (353) into two branches, one of which goes to the right branch of the windpipe, and the other to the left. These now ramify in the same manner as the windpipe (Fig. 21), so that their branches and twigs correspond with those of the windpipe; and finally, the extremely minute twigs of the artery terminate in the sides of the air-cells at the extremities of the minute air-tubes (353). Where the arterial capillaries terminate, the venous capillaries rise, and, running into each other, the vessels become larger, and form branches corresponding with those of the artery, till they swell into large pulmonary veins, which emerge from the lungs by the side of the arteries and proceed to the heart (Fig. 40, *m m*).

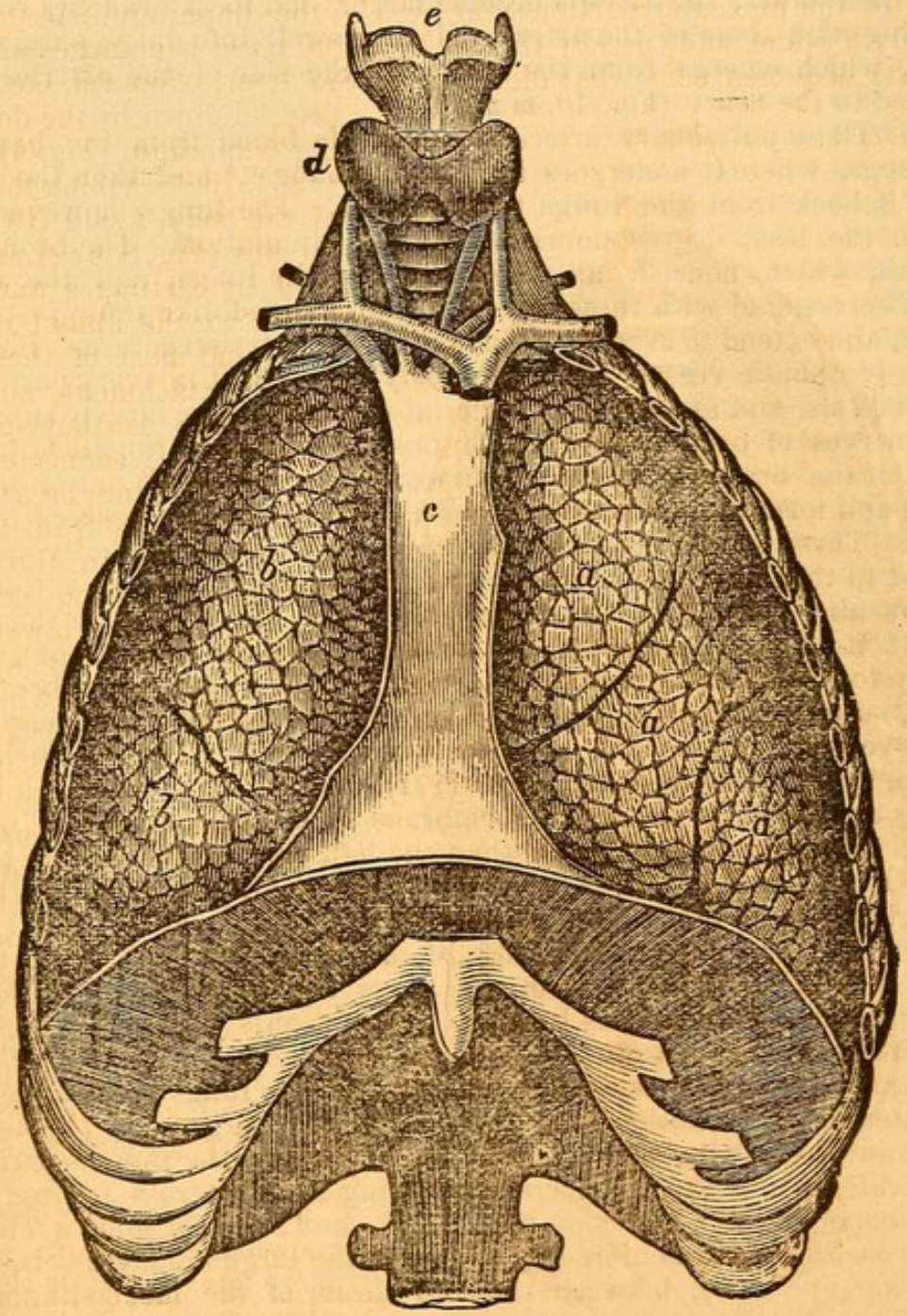
360. These pulmonary arteries convey the blood from the heart to the lungs, where it undergoes important changes, and then the veins carry it back from the lungs to the heart. The lungs, however, are not in the least degree nourished by this circulation. The bronchial arteries, which nourish all the tissues of the lungs, and the veins which correspond with these arteries, are ramified like those just described, and extend to every portion of the pulmonary structure. Besides these, lymphatic vessels are numerously distributed in every part. All these vessels, and especially the arterial capillaries, are largely supplied with nerves of organic life, which preside over their functions (230). Some of the branches of the pneumogastric nerve (245), after interlacing and forming plexuses with nerves of organic life, proceed to the lungs. These are supposed by some physiologists to be wholly appropriated to that peculiar sensibility of the lungs by which we feel the want of air: others think they are exclusively distributed to the contractile tissue or muscles of the air-tubes, just described (358), and convey to them the stimulus of motion. Others, perhaps more correctly, suppose that they perform both of these offices. All these air-tubes, vessels, and nerves, are closely knit together into one general texture by a delicate cellular tissue (171), and the whole mass, on each side, is enveloped in the serous membrane as an external coat (176).

361. The right lung is larger than the left, and is divided into three lobes (Fig. 37, *a a a*). The left has two lobes (*b b*), and is smaller than the right lung, to make room for the heart (171), which lies partly on the left side (Fig. 4, *h*). The lungs of men are in general larger than those of women. Each lobe of the lungs is divided, in its internal arrangement, into numerous lobules. The air-cells (353) of each lobule communicate with each other, but the cells of one lobule have no direct communication with those of another. The two lungs are completely separated from each other, and from all the other organs, by the serous membrane, here called the pleura (176), which lines the thoracic cavity, and divides it into two chambers, by passing double across it from the breast-bone to the back-bone (Fig 37, *c*), and thus forming a closed sac for each lung, and embracing the heart, the large blood-vessels, and the meat-pipe (350), between the two sheets of the mediastinum or middle partition

362. By this arrangement, every part is kept in its proper place and condition, and an admirable provision is made against evils which

might otherwise arise from injuries of the chest and lungs. If instead of being completely separated as they are, the two lungs occupied one cavity, then any perforation of the walls of that cavity, by disease or otherwise, so that the external air could rush into it, would at once arrest the function of respiration, and immediate death would result. But now, if by any means one lung is disabled, it can lie still while the other continues faithfully to perform its function; and thus life is preserved,

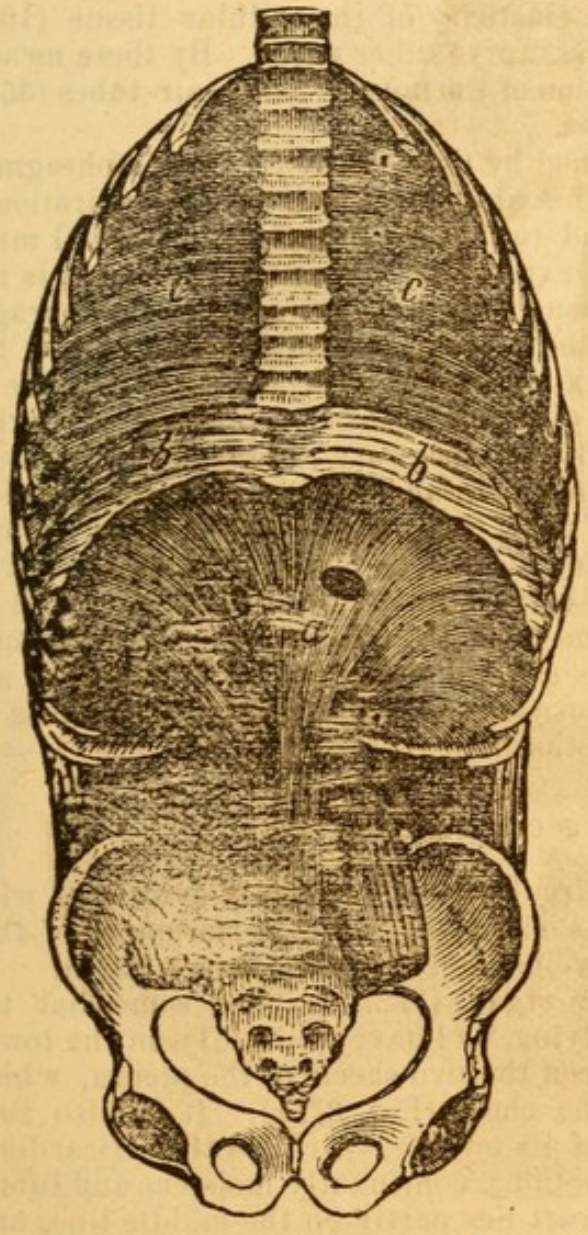
Fig. 37.



the right lung; b b, the left lung; c, the mediastinum; d e, the top of the windpipe.

363. The diaphragm (175) is a musculo-tendinous membrane, which is attached by its two legs to the two upper vertebræ of the loins (Fig. 38, *a*), and proceeds diagonally upwards and forwards arching up into the chest like a bridge or dome (Fig. 4, and 32, *d*), and, being attached by its peripheral edge to the walls of the body, all around (Fig. 38, *b b*), so as completely to divide the trunk into the two large cavities (175) called the thoracic and abdominal (Fig. 38, *c a*). The meatpipe, the large blood-vessels, etc., pass through this partition near the spinal column. The legs and centre of the diaphragm are principally tendonous, and its wings are muscular. By the contraction of the muscular portions, the arch of the diaphragm is reduced to nearly a plane, and thereby the cavity of the chest is enlarged and that of the abdomen somewhat diminished, the liver, stomach, etc., being pressed down by the descending diaphragm (Fig. 4).

Fig. 38.



The diaphragm during expiration; a, its tendonous centre; b b, its fleshy sides; c c, the lateral cavities of the chest in which the lungs lie.

364. In describing the bones of the body, I said (181) that the ribs (Fig. 8, *c c c*) are fastened by cartilages and ligaments to the spinal column (*b b*), and most of them by a double attachment, and that they droop as they proceed forward to be connected with the sternum or breast-bone (*a*); so that the front ends of the ribs, when in their most natural or resting position, are considerably lower than the back ends (Fig. 8). By this arrangement, when the various muscles concerned in elevating the breast-bone and the ribs are contracted, the breast-bone and the front ends of the ribs are raised up so as to bring the ribs nearly to a horizontal position; and this also considerably enlarges the cavity of the chest. When, therefore, the diaphragm is drawn down, and the breast-bone and ribs are elevated, the cavity of the chest is much enlarged.

365. It is a matter of general knowledge, that the atmosphere has weight, or that like other ponderable substances, it gravitates towards the centre of the earth; and that it presses on the surface of the

earth and things on the earth, at or near the water's level, at the rate of about fifteen pounds to every square inch of surface. This pressure being the same on every part of our bodies, we do not feel it. But if the air could be entirely expelled from the lungs, and the mouth and nose completely closed, and the thoracic cavity enlarged, as in a full inspiration of breath, there would be a pressure of many hundred pounds upon the external surface of the chest. But the nose being open, the air rushes into the windpipe, air-passages, and cells of the lungs, and distends these organs, so that they at all times just fill the cavities allotted to them, and no vacuum is produced, and consequently no pressure is felt. In ordinary breathing, therefore, the muscles which elevate the breast-bone and ribs slightly contract, and the arch of the diaphragm (Fig. 32, *d*) is simultaneously drawn down, and thereby the cavity of the chest is enlarged, and at the same time the air rushes in and inflates the lungs; and then all the muscles employed in producing these motions instantaneously relax, and the ribs and diaphragm return to their natural position, by the elasticity of the cellular tissue (169), the force of gravity, and the pressure of other parts. By these means, and perhaps also by the contraction of the muscles of the air-tubes (358), the air is expelled from the lungs.

366. When the ribs are confined by tight clothing, the diaphragm is compelled to carry on the function alone, but in this case respiration is much restrained. In violent and rapid breathing, the abdominal muscles probably assist in the act of expiration. We see then that it is not by a direct action of the WILL upon the lungs, but upon the diaphragm and the muscles which elevate the breast-bone and ribs, and upon the parts which compose the Larynx or organs of voice, that we have to some extent, a voluntay control over the acts of inspiration and expiration: and this we have seen (302) is necessary in order to the protection of the lungs from offensive air, etc., and to the production of voice, speech, etc.; but when neither of these final causes demands the immediate exercise of the WILL, the function of respiration is wholly given up to organic instinct, and is carried on without our care, and in health generally without our consciousness. All the muscles of animal life, therefore, concerned in the general functions of respiration, are associated in the regular performance of this function with those of organic life or of involuntary motion.

ORGANS OF CIRCULATION.

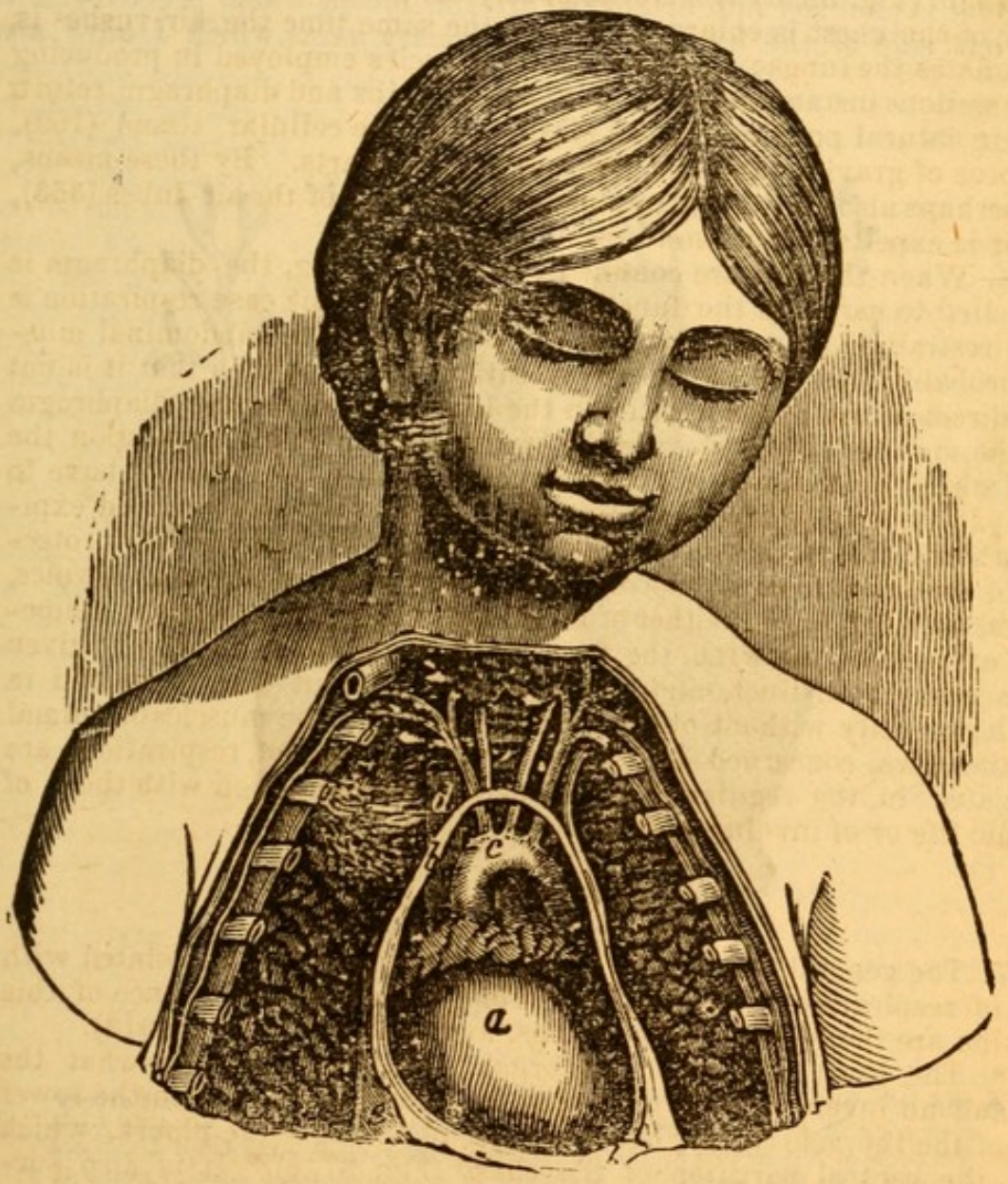
367. The general function of circulation is intimately associated with that of respiration. The organs employed in the performance of this function are the heart, arteries, veins, and capillary vessels (313).

368. The heart is a muscular organ (172), having somewhat the shape of an inverted cone, and lying, as I have said (361), in the lower part of the thoracic cavity, between the two sheets of the pleura, which form the central partition of the chest (Fig. 37, *c*). It is also surrounded by a membranous sac of its own (176), called the pericardium (Fig. 39, *b b*), which, by its exhalations, continually moistens and lubricates its enclosed organ. The heart lies partly on the middle line, and partly on the left side of the chest (Fig. 39, *a*). Strictly speaking, it is a double organ, composed of two corresponding halves, each half having

an upper and a lower chamber or cavity. The upper chambers are called auricles, and the lower ones ventricles (Fig. 40. *a b n*).

369. Before birth, there is an opening between the auricles, through which a portion of the blood passes from the right auricle to the left; but after respiration commences, there is no direct communication between the two halves of the heart. The auricle on each side, however, communicates freely with its corresponding ventricle. The cavities of the right side of the heart are somewhat more in front than those of the left. The right auricle receives the dark blood that returns in the veins from all parts of the body, and, contracting upon it, sends it into

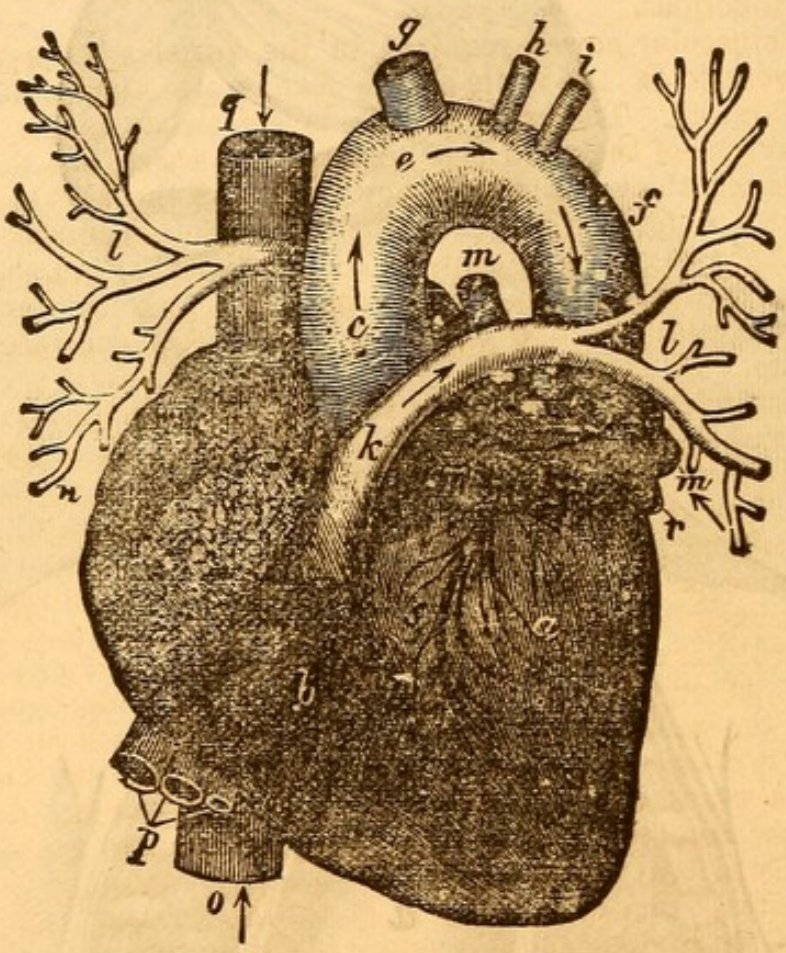
Fig. 39.



The cavity of the chest laid open, to show the heart and lungs.—a, the heart; b b, the pericardium cut open; c, the aorta, the great artery of the left side, that distributes the blood to all parts of the body; d, the great vein, called the descending vena cava, which, with the ascending, brings the blood to the right auricle; e, the pleura or membrane that covers the lungs.

the right ventricles through an orifice which is furnished with membranous folds, so arranged as to form a *triplex* valve, called the *tricuspid valve;* which, being pressed back, closes the orifice, and prevents the blood from returning to the auricle. The pulmonary artery, which I have already described (359), rises from the right ventricle (Fig. 40, *k*), and soon divides into two branches, called the right and left pulmonary arteries, which are ramified (Fig. 40, *l l*) with the branches of the windpipe, in the formation of the lungs. The orifice of the pulmonary artery is furnished, internally, with three membranous folds, called the *semilunar valves.* These suffer the blood to pass freely from the heart into the artery, but prevent its returning from the artery to the heart. Through this artery the right ventricle sends its dark blood to the lungs, where it is changed into bright red arterial blood, which is conveyed to the left side of the heart by the pulmonary veins which I have also

Fig. 40.



a, the left ventricle; b, the right ventricle; c e f, the aorta, the great artery that goes off from the left ventricle; g h i, the arteries that are sent from the arch of the aorta; k, the pulmonary artery, that goes from the right ventricle to the lungs; l l, branches of the pulmonary artery, going to the two sides of the lungs; m m, the pulmonary veins, which bring the blood back from the lungs to the left side of the heart; n, the right auricle; o, the ascending vena cava; q, the descending: these two meet, and by their union form the right auricle; p, the veins from the liver, spleen, and bowels; s, the left coronary artery, one of the arteries which nourish the heart.

described (359). These veins, advancing from the lungs in two trunks on each side, open into the left auricle (Fig. 40, *m m*). From this auricle the blood passes into the left ventricle, through an orifice like that on the right side, which is furnished with a fold of membrane called the *mitral valve*, which prevents the blood from returning to the auricle. From the left ventricle opens the mouth of the great arterial trunk called the *aorta*, through which passes all the blood that nourishes the body. This orifice is furnished with three semi-lunar valves similar to those at the entrance of the pulmonery artery, and which like them suffer the blood to pass from the ventricle into the artery, but prevent its returning from the artery to the ventricle.

370. It is probable that, at first, the heart consists only of the left ventricle (219), and that the other parts are added as the general development of the system progresses. It is not, however, until respiration, and with it the pulmonary circulation, commences, that all the cavities of the heart come into the regular performance of their appropriate functions.

371. The muscular power required in the auricles being much less than in the ventricles, the walls of the former are much thinner than those of the latter. The right auricle is somewhat larger than the left. The cavities of the ventricles are nearly of a size, but the walls of the left are much thicker and more powerful than those of the right.

372. In the actions of the heart, the two auricles contract simultaneously, and the two ventricles contract simultaneously; but the auricles and ventricles contract alternately; so that as the two auricles contract, the two ventricles dilate, and as the two ventricles contract, the two auricles dilate.

373. The muscles of the heart are supposed by some physiologists to possess a peculiar irritability (231), which causes them to contract from the stimulus of the blood in the cavities; but it is more probable that the heart has cognizance of the blood in its cavities, by means of its nerves of organic sensibility (230). Some also suppose that a positive distending muscular force is employed in the dilatation of the cavities. But this appears to be both impracticable and unnecessary. The elasticity of the cellular tissue is probably sufficient for that effect (158, 312).

The nerves of organic life, I have said (219), preside over all the functions of the sanguiferous system. The heart, which in its rudimental state is closely connected with the central brain of that system (219, 231), is gradually removed as the several parts are developed, till it becomes established in the thoracic cavity; and the ganglionic masses, from which its nerves principally issue, are situated in the neck and upper part of the chest. Some of the branches of the pneumogastric, it will be recollected (247), enter also into the cardiac plexuses, but few if any of them reach the heart. At any rate, they neither bring it in any degree under the control of the WILL, nor render it cognizable to the centre of animal perception (302). The heart, therefore, is entirely independent of the WILL, yet its action is more or less accelerated or retarded by every emotion of the mind. This, however, principally depends on its organic sympathy with the stomach, and with the great centre of organic life, and through them with the brain (303). For the heart is in no degree the seat of these emotions or feelings which are, in common language, referred to it.

374. From the left ventricle of the heart, as we have seen (369), rises the great arterial trunk, called the *aorta*, or *air-keeper* (so named by the ancients, because they supposed all the arteries were air-tubes, they being generally found empty after death). This trunk ascends a short distance towards the head, and then forms the arch (Fig. 40, *c e f*), and descends behind the heart, in front of the spinal column, passing through the diaphragm, and dividing in the lower part of the abdominal cavity, to proceed to the two lower limbs (Fig. 28, *a*.) Almost immediately after leaving the heart, it gives off two branches which go to nourish that organ; for neither the heart nor any of the blood-vessels receives nourishment directly from the blood which flows in it: but they are all, even to the smallest vessels, nourished by arteries distributed to their tissues for the special purpose. At the top of the arch, the aorta gives off three large branches (Fig. 40, *g h i*), which are divided into the internal and external arteries of the head, arteries of the face and neck, arteries of the arms, etc. As the aorta descends, it gives off branches, all along its course, which go to the internal organs, to the walls of the body, etc. All these different branches, as they proceed towards their destination, divide and subdivide and inosculate or run into each other in every direction, like a net (Fig. 30, *g*), till they become extremely minute twigs, which are lost in the tissues of the parts to which they are distributed, penetrating to the smallest muscular and nervous filaments, and being dispersed so universally and so numerously over the whole body, that it is scarcely possible to puncture any part with a fine needle, without wounding some of these little vessels. These are called capillary or hair-sized vessels, and collectively with those of the veins, constitute the capillary system (313), in and by which all the important changes in the blood are effected.

375. The number of these capillary vessels has been estimated at more than one thousand to every square inch. Some physiologists have conjectured that there is another set of almost infinitely minute vessels connected with the capillary extremities, and immediately concerned in nourishing the several tissues, etc., which they call the exhalents; but this is mere conjecture.

376. It is a general law of the animal organic economy, that all vital action is attended with an expenditure of vital power and a waste of organized substance (192), and these are replenished by the arterial blood. In the distribution of arterial vessels to the different parts, therefore, each organ is supplied according to the nature of its function and its relative importance to the system; and such is the general and particular arrangement, that every part, and especially every important part, is so furnished that if its blood be obstructed in some of its vessels, it freely flows on in others.

377. The arterial vessels of the brain are very numerous and capacious; and the voluntary muscles, as we have seen (192), are largely supplied with them. As a general fact, however, the arteries distributed to the organs of organic life, and particularly those in which there is much vital action, and those in and by which important vital changes are effected, are larger and more numerous than those distributed to the organs of animal life (199). The vessels of the heart, which is constantly in action, are proportionally very large; those of the stomach are also large and exceedingly numerous; and those of

the small intestines are little less so. Moreover, the arteries are capable of being both enlarged and diminished, to a considerable extent, without actual disease. In a limb which is habitually and vigorously exercised, the arteries become much larger, and the muscles more fully developed, than in the corresponding limb which is little employed; and, on the other hand, if the same limb be suffered to remain inactive for a considerable time, the size of the arteries will be much diminished. In case of an injury, which renders it necessary to tie the principal artery of a part, the smaller arteries of the same part immediately begin to increase in size, and in a short time they become sufficiently capacious to supply the part with nearly or quite as much blood as it received before the injury.

378. Either continuing from, or originating very near, the extremities of the arterial capillaries, those of the veins rise in equal or greater number; and, running into each other, become larger and larger, till they form numerous branches, which unite to form a large venous trunk called the *vena cava*, or returning hollow. The veins from the lower and middle parts of the body, and lower limbs, form the *ascending vena cava;* which goes up by the side of the great arterial trunk (Fig. 28, *v v*), and opens into the right auricle of the heart (Fig. 40, *o*). The veins from the upper part of the body, the upper extremities, and the head, form the *descending vena cava*, which opens into the same cavity, near the mouth of the ascending venous trunk (Fig. 40, *q*).

379. The veins anastomose, or run into each other in a net-like manner, even more frequently than the arteries; and for the same important purpose, viz., if the flow of the blood be obstructed in some of the veins, it readily turns aside into others, and goes on its way. The number of branches and twigs, compared with that of the trunks, is much greater in the venous than in the arterial system; so that, as a whole, the venous system is much more capacious than the arterial.

380. Myriads of arterial and venous capillaries, as we have seen (287), pass through the meshes of the great limiting membrane, and assist in forming the vasculo-nervous web upon its exterior surface. In this web, however, the venous capillaries seem to be much more abundant than the arterial, both in the mucous membrane and in the skin. In the mucous membrane of the alimentary canal according to Dr. Horner,* 'The superficial layer of vessels composing this web or plexus appears to consist almost entirely of a cribriform texture of veins. The aborescence of the arteries is confined to the level beneath the venous intertexture, and is there developed to an extreme degree of minuteness, being intermixed with corresponding venous ramuscles, generally larger and more numerous than the arteries themselves.' 'The external surface of the *cutis vera*, or true skin, presents as it were an outline of the same arrangement; the venous, reticular intertexture appearing broader, not quite so perfect, and more shallow, and forming the papillæ.'

THE PORTAL SYSTEM.

381. I have said (378), that the veins arising from the venous capil-

* See Appendix, Note A.

laries in all parts of the body, run into each other like a net, gradually increasing in size till they finally unite to form the great ascending and descending venous trunks which open into the right auricle of the heart. But there is a remarkable peculiarity in the arrangement of the veins arising from the abdominal viscera. All the veins arising from the venous capillaries of the stomach, the spleen, the pancreas, the omentum, the small intestine, and the ascending and transverse colon, run together in the manner already described (378), and form the three large veins called the coronary vein of the stomach, the splenic, and the mesenteric veins. These, instead of advancing directly to the vena cava, unite and form a large venous trunk, which proceeds obliquely upward to the right, and plunges into the liver, where it suddenly divides into branches, which are ramified in the manner of an artery (Fig. 21), and where in fact it takes the place of an artery, being distributed in the same manner, and holding the same relations to the secreting surface, or the mucous membrane of the ducts, that the principal artery does in other glands. This peculiar arrangement of veins constitutes what is called the system of the VENA PORTÆ, or the PORTAL SYSTEM; and where these veins terminate in the ramifications of the biliary duct, other venous capillaries arise, which, running into each other, form the hepatic veins; and these, receiving the blood from the portal veins, and from the hepatic artery, convey it to the vena cava (Fig. 28, *v*).

382. The portal system has an appendage which has hitherto exceedingly perplexed physiologists, and been the subject of a great diversity of experiment and speculation. It is called the *spleen*, and is situated in the upper and back part of the abdominal cavity, on the left side between the diaphragm and the left kidney (Fig. 28, *s*). It is attached to the diaphragm, the stomach, and the ascending colon, in a loose manner, by folds of the peritoneum, and by a great number of vessels; and hence the left extremity or large end of the stomach, is called the splenic portion. The spleen is extremely spongy or vascular, being formed almost entirely of blood-vessels, lymphatics, and cells, woven together by cellular tissue, and surrounded by a very firm serofibrous membrane. Its artery ramifies in a peculiar manner, and abruptly expends itself on the tissues of the organ. Its veins, *which are proportionally larger than in any other part of the body*, arise from the cells, and empty into the vena portæ; or, rather, they constitute, as we have seen (381), a part of the roots of the portal trunk. Its lympathics are very numerous. Its nerves come from the splenic plexus of the nerves of organic life, and are very small. The form of the spleen is elliptical or oval. Its size varies much, not only in different individuals, but also in the same individual at different periods, and inconstantly. As a general statement, however, it is, in an adult, about four inches long, three broad, and a little less than one thick. Its weight varies as much as its size, but on an average is about eight ounces. It would be a tedious and unprofitable task to recite the various opinions which have been advanced concerning the use of this organ. The conclusions to which I have arrived, after a careful examination of them all, will be presented when I come to speak of the functions of the liver and the vena portæ (450).

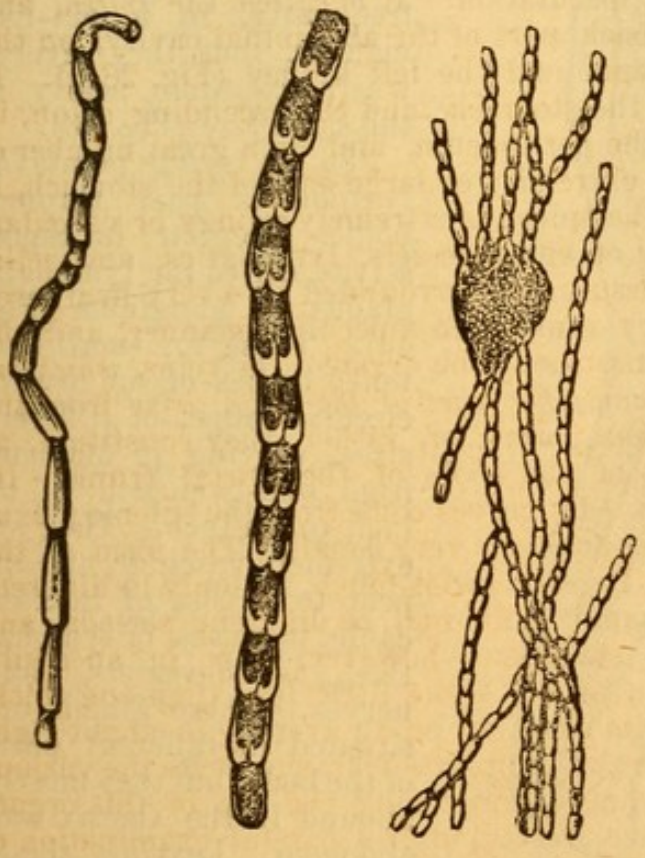
383. The arteries are composed of three coats. The exterior one is a

dense cellular tunic. The middle one, called the muscular coat, consists of transverse circular fibres of a yellowish color, which, though they differ in appearance from the ordinary muscular tissue are contractile like the muscular fibre. The inner coat is a very smooth, thin, transparent membrane, which has no appearance of fibres, and is continuous with that which lines the cavities of the heart. The veins, according to some anatomists, have but two coats. Others, perhaps more correctly, say three. Of these, the outer one is a dense cellular coat, and is very strong. The middle one is composed of longitudinal fibres resembling the circular fibres of the arteries. The inner coat is exceedingly thin and smooth, and is very similar to that which lines the arteries and heart. Some anatomists think it is a continuation of the same. This coat, in most or all the veins in which the blood ascends against gravity, is frequently folded so as to form a species of valves, which favor the course of the blood towards the heart, but obstruct its course in a contrary direction.

384. The nerves which enter into the structure of the blood-vessels, and preside over their functions, we have seen (219, 231), are from the ganglionic system (228). They much more largely abound in the capillary vessels, in and by which all the important vital changes are effected in the blood, than in the larger trunks and branches (231).

LYMPHATIC SYSTEM.

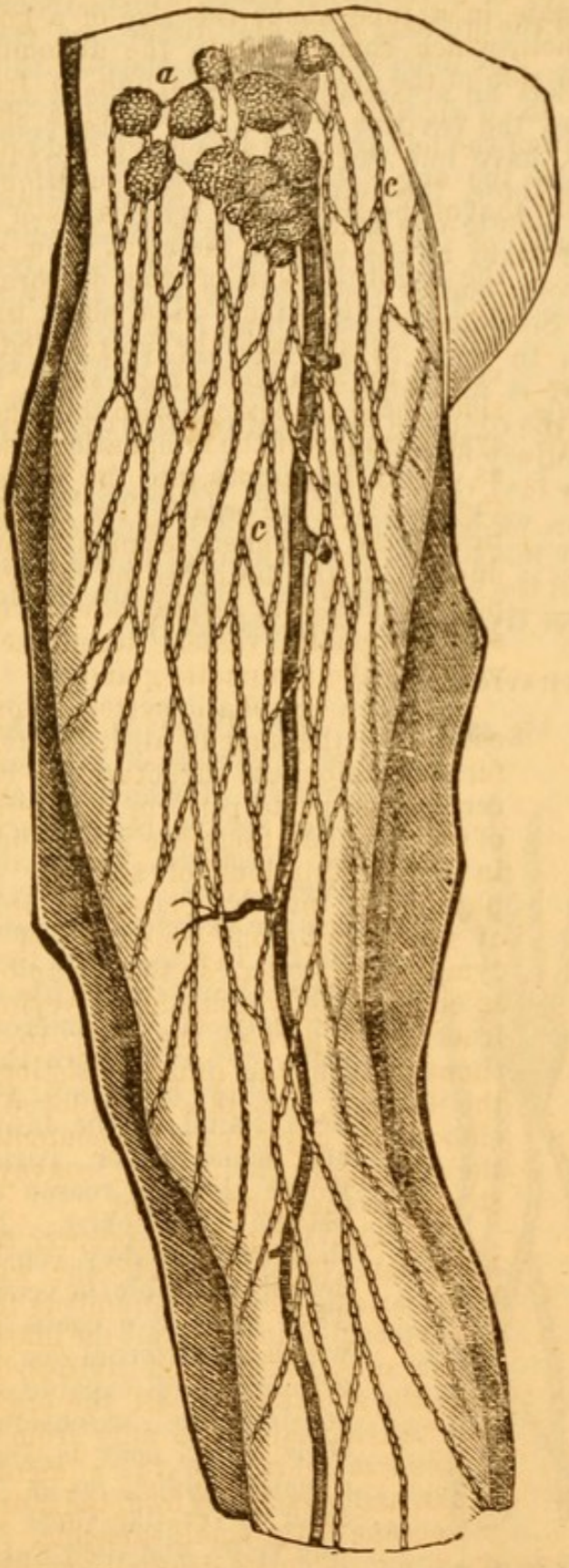
Fig. 41. Fig. 42. Fig. 43.



The lymphatic vessels greatly enlarged, showing their jointed appearance. 42 shows the interior valves; 43 shows the vessels running into each other and their passage through a gland.

385. There is another set or system of capillary vessels, of which I have often spoken, remaining to be described, called the LYMPHATICS. These vessels are extremely minute, so that in many parts they cannot be detected without the help of the microscope, and even with this help they have not yet been found in the brain and some other parts, where there is reason to believe they exist. In their texture they considerably resemble the veins. They have two coats, of which the external one is cellular, and capable of considerable extension; their inner coat is frequently folded, so as to form valves like those in the veins, and their walls are so thin that these folds give them the appearance of being jointed (Figs 41,

Fig. 44.



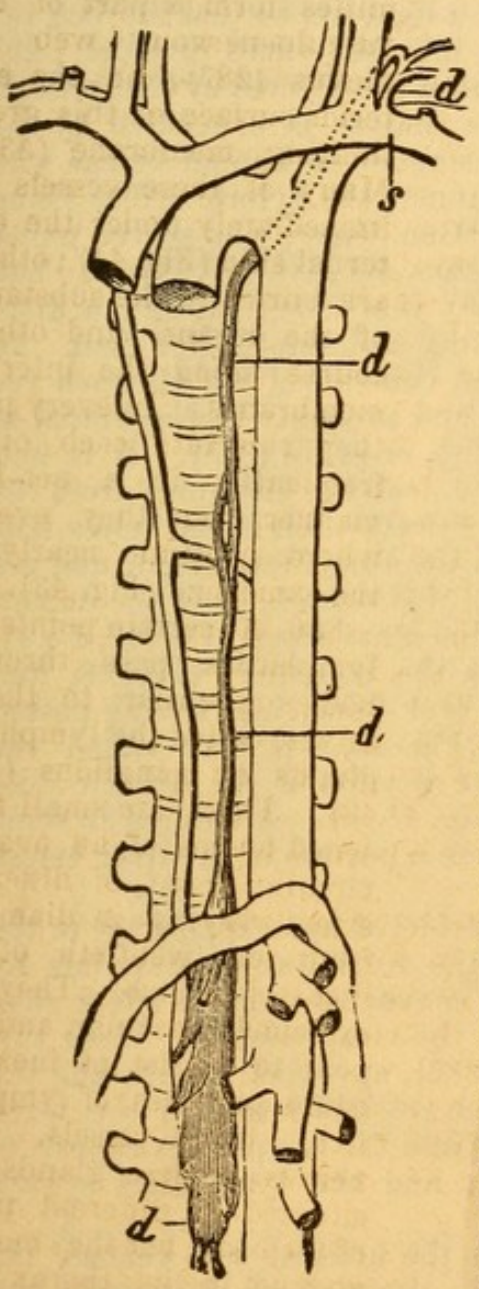
Shows the lymphatics, c, of the thigh, lying under the skin; with their glands or ganglions, a, at the groin.

42, 43). These vessels rise in immense numbers from almost every internal and external surface and substance of the human body, so that there is scarcely a particle of matter in the whole incorporated system which cannot be reached by them. Myriads of them rise from the skin and mucous membrane, and their extremities form a part of the vasculo-nervous web or plexus (287), on the exterior surface of this great limiting membrane (337). Many of these vessels lie immediately under the external skin (Fig. 44); others are buried in the substance of the organs, and others course along the internal membranes. In every part they run into each other frequently, in a net-like manner, but they everywhere continue nearly of the same size (Fig. 43).

386. At certain points the lymphatics pass through bodies peculiar to themselves, called the lymphatic glands or ganglions (Fig. 43). These are small flattened bodies of an oval or circular shape, of different sizes, varying in diameter from one-twentieth of an inch to an inch. They are extremely vascular, and appear to consist of inextricable plexuses, of lymphatics, blood-vessels, and nerves. These glands are situated in different parts of the body, but they mostly abound in the thorax and abdomen. Leaving these, the lymphatics proceed in a direction towards the heart, and, as it were, *converge* from

all parts of the body so as to pour their contents into tubes, which open into large veins leading to the heart, near the bottom of the neck. Most of them terminate in a tube about the size of a goose quill, called the thoracic duct, which commences in the abdominal cavity, and passes up by the side of the great arterial trunk, in front of the spinal column (Fig. 45, *d d*), and, having ascended a short distance above the large vein of the left arm, it turns down and opens into that vein (Fig. 45, *s*), at the angle formed by the junction of the large vein of the head with that of the arm. The lymphatics of the right side of the head and neck, of the right arm, the right lung, and the right portion of the diaphragm and liver, terminate in a short tube, which opens into the corresponding vein of the arm on the right side. Besides these connexions with the venous system, many of the lymphatic vessels, as capillaries, empty into the veins in the tissues of the organs; the lymphatics of the abdomen terminate abundantly in the branches of the vena portæ, and also in several other veins; and lymphatic vessels terminate in veins in the lymphatic glands.

Fig. 45.



Shows the spinal column, with d d, the thoracic duct, ascending in front of it, and entering the subclavian vein at s.

387. The lymphatic system, though essentially the same in all its parts, so far as anatomical structure is concerned, seems to perform a diversity of function, and therefore it is divided, in the descriptions of anatomy and physiology, into two classes or orders of vessels: the one consisting of the lymphatics proper, or those employed in elaborating lymph, and conveying it from every part of the body to the thoracic duct; the other consisting of the lacteals, or those employed in elaborating chyle from the contents of the alimentary cavity, and conveying it also to the thoracic duct.

388. The lymphatics proper, as I have said (385), pervade the whole body, arising in great numbers from the external skin, from all the internal membranes, vessels, and cavities, and from the substance of all the organs. But the lacteals arise only from the mucous membrane of the alimentary canal, and principally from the mucous membrane of the small intestine. Indeed, physiologists generally speak of them as arising wholly from this section of the canal, and as being much

more numerous in the upper than in the lower portion of it. But it must be remembered that there is no appreciable difference in structure between a lacteal and a lymphatic vessel, and that all which distinguishes the one from the other is, that the one, in the regular performance of its office, elaborates and conveys chyle, and the other lymph, which in many respects nearly resembles chyle. As a general statement, they are all assimilating organs; and wherever they may be situated, if they elaborate chyle from alimentary substances, and convey it to the thoracic duct, they are in fact lacteals. And it is very certain that chyle may be, and there is reason to believe that it regularly is, elaborated by some of these vessels from the alimentary contents of the stomach. Experiments on animals have proved that they can be sustained for months at least with the pyloric orifice of the stomach (341) completely closed by a ligature, so that the food received into the gastric cavity cannot pass into the small intestine; but the process of chymification and chylification are effected by the stomach and its lacteals, and the excrementitious matter is evacuated by the mouth (471). There have also been instances of human beings who have been sustained for years in this manner, the pyloric orifice being entirely closed by disease of the parts. 'Gen. Grose, who served under the Duke of Cumberland, in Flanders,' says Sir Everard Home, 'had no passage through the bowels for thirty years; yet he had a good appetite, and ate heartily, and was a healthy and able-bodied man. In two hours after eating, he threw up the contents of his stomach remaining undisposed of.' Chyle may be, and probably is, elaborated to some extent also from the large intestine, or colon (338). It is not, therefore, strictly correct to say that the lacteals arise only from the small intestine. For important reasons, however, it is nevertheless true that they mostly abound in this section of the alimentary canal, and are most numerous in the upper two thirds of this section, or in the duodenum and jejunum (338). Leaving the alimentary canal (Fig 46, *a a a*), the lacteals (Fig. 46, *b b*) proceed across the mesentery (Fig. 33, and 46, *c c*) (350), converging towards the back-bone, and having passed through a number of their ganglions (Fig. 46, *d e*) here called the mesenteric glands, they terminate in the portion of the thoracic duct (386) called the receptacle of the chyle (Fig. 45, *f*). According to some anatomists, most or all the lacteals traverse a portion of the liver before they reach the thoracic duct.

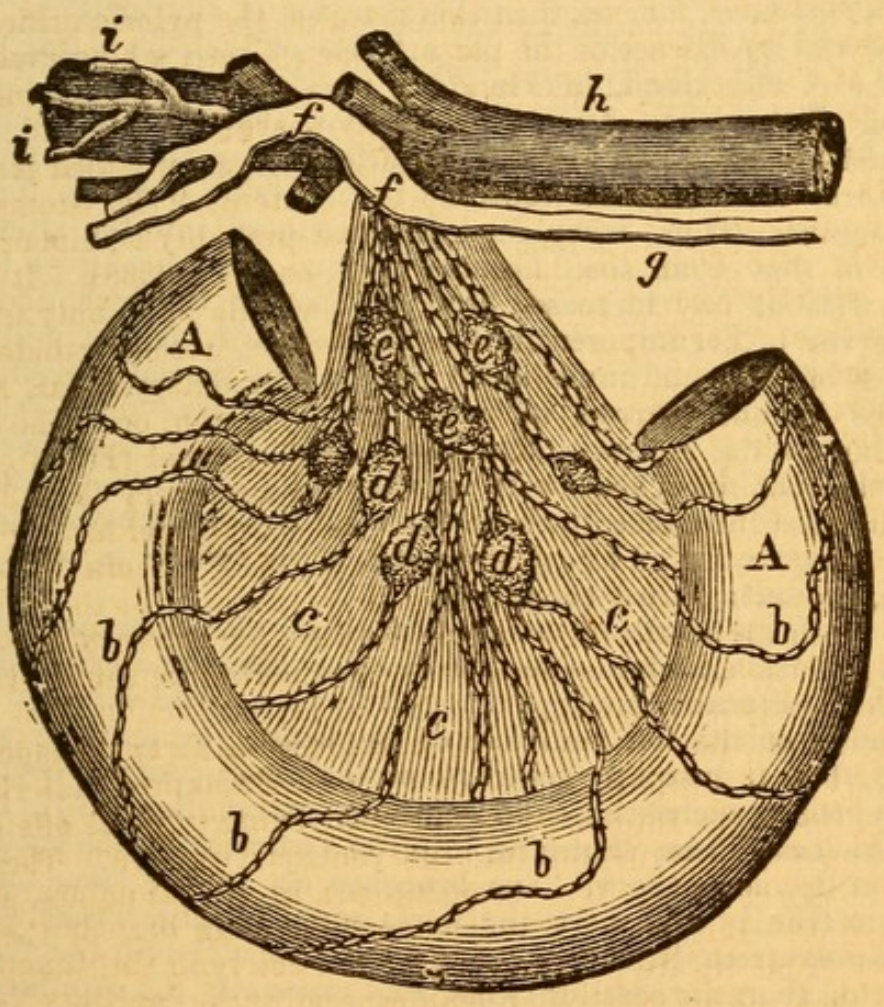
389. The lymphatic system may be considered as an appendage to the venous system, furnishing it with all the assimilating materials by which the body is nourished, as well as conveying to it the effete substances which are to be eliminated from the vital domain. These two systems are connected as we have seen (386), at several points, and the structure of the lymphatic vessels much resembles that of the veins (385). Moreover the venous capillaries and the lymphatics appear, to some extent, to reciprocate in function, and the lymphatics always empty their contents into the veins.

390. In the lymphatic systems, as in the arterial and venous, the nerves of organic life supply the nervous tissue of all the vessels, and preside over all their functions (230); and in these vessels, as we shall see, some of the most important vital changes take place.

THE CIRCULATING FORCES.

891. Concerning the agencies and forces employed in the circulation of the blood, and other fluids in the vessels just described, physiologists have differed widely in opinion. Some have asserted that the heart alone exerts all the force by which the blood is circulated, and that the arteries and veins have no other agency in the general function than as elastic, conducting tubes, to adapt their capacity to the volume of blood which they contain; and accordingly the advocates of this theory have denied all contractility to the arteries, and estimated the contractile power of the heart as equal to many hundred pounds. On the other hand, it is contended by others, that the heart simply injects the blood into the arteries with a very small force, and the arteries, by their active and vigorous contraction, carry on the circulation as in those animals which have no heart. Others, again, with more correctness, take the middle ground between the two extremes.

Fig. 4



A A is a piece of small intestine; b b b b are the superficial lacteals; c e c is the mesentery, a delicate but firm membrane, consisting of two layers, by which the intestines are connected with the spine, and within the folds of which the deep-seated lacteals pass; d d d and e e e, the two sets of absorbent glands; f f, the receptacles of the chyle; g, the thoracic duct; i i, the lymphatics, coming from different parts of the body; h, the aorta, the great artery.

392 According to the best experiments and estimates which have been made on this point, the left ventricle of the heart acts with a force of six pounds on the square inch. This ventricle, when distended, has about ten square inches of internal surface, and consequently the whole force exerted by it in throwing the blood into the aorta, is about sixty pounds. That the arteries are very elastic, and that they have the power of adapting their capacity to the quantity of blood in them, is I believe admitted on all hands; and it is generally acknowledged that when animals bleed to death, and also after the heart has ceased to act in what is called natural death, the arteries continue to diminish their capacity till all the blood is pressed out of them.

393. We have seen (376) that it is a general law of the organic economy, that all vital action is attended with an expenditure of vital power and waste of organized substance, and that these are replenished by arterial blood. It is also a general law of the organic economy, that all increased action of a part is attended with an increased flow of blood to the part. But this local increase of blood does not depend on the action of the heart, nor on the general action of the arteries. It is the effect of the special action of the arteries of the part acting under the influence of the special centre (219) which presides over the organic function of the part. It is very evident, that in particular organs, the blood-vessels, and especially the arteries, are to some extent under the control of the special centres which preside over the functions of those organs. Thus, when food is introduced into the stomach, the vessels of that organ soon become injected, sometimes even to turgescence, without any increased general action of the heart and arteries. The nerves of organic sensibility (230), perceiving the presence and qualities of the food, immediately inform the special presiding centre, and this instantly throws its stimulating influence upon the arteries belonging to the stomach, and causes them to fill themselves, and to inject the secreting vessels with an increasing quantity of blood; and if the substance introduced into the stomach be of a highly offensive character, the quantity of blood pressed into the vessels is often very excessive, producing great congestion.

394. Both the heart and the arteries, therefore, are actively concerned in the general circulation of the blood, while the special increase of blood in particular parts depends entirely on arterial action. At every contraction of the left ventricle of the heart, the aorta is somewhat dilated; but it instantly contracts on the blood, and presses it onward through the branches into the capillary extremities (374), the blood being prevented from returning into the ventricle by the valves at the mouth of the aorta (369). The branches act in the same manner as the main trunk. But both the aorta and the large branches issuing immediately from it, are probably much less active in the function of circulation than the smaller twigs, and especially the capillary vessels.

395. In regard to the venous circulation, some physiologists have thought that the force exerted by the heart is sufficient to effect the motion of the blood in the veins. Others have supposed that the propelling action of the capillary vessels, the throbbing of the arteries against the veins, the suction of the heart by the dilatation of its auricles, and atmospheric pressure connected with respiration (365), are all concerned as moving forces in the venous circulation. But

the texture and construction of the veins (383), and the physiological analogy of the whole vital economy, show that the veins as well as the capillary vessels possess the power of propelling the fluids which circulate in them.

ORGANS OF SPECIAL SENSE.

396. The parts which remain to be described, and which in the order of development (174) appear later than the internal organs, are the apparatuses to which the nerves of special sense are distributed, and the hair and nails. The organs of touch I have already described (242, 253, 287). It is extended over the whole external surface of the body, and in fact may be said to pervade the whole body, because at every point we are exposed to the action of those tangible properties of things which may prove injurious and destructive to life. In man, however, the ends of the fingers are more particularly appropriated to the voluntary function of touch or feeling, and here most thickly cluster those little tufts or velvety eminences formed principally of the minute extremities of the nerves of sense, called the papillæ (287). The sense of touch or feeling is the primary animal sense, and exists in a greater or less degree in every living animal (294). It is determinately established upon the constitutional laws of relation existing between the living body and external substances and things, and with strictest reference to the physiological interest of the body.

ORGAN OF TASTE.

397. The nerves of taste, or the gustatory nerves, I have said (254), are distributed to the mouth and throat; but the papillæ in which their extremities terminate most largely abound in the mucous membrane which covers the end of the tongue. This sense is founded on the alimentary wants of the vital economy, and determinately established on the constitutional laws of relation between the physiological interests of the body and its appropriate alimentary substances.

ORGAN OF SMELL.

398. The sense of smell (294) is nearly allied to that of taste, in the character and extent of its functional relations and responsibilities. It is founded on the respiratory and alimentary wants of the vital economy, and determinately established on the constitutional laws of relation between the physiological interests of the body and the qualities of external things which may affect those interests through the functions of respiration and alimentation, or through the medium of the lungs and stomach.

399. The olfactory nerves, or the nerves of smell, I have described (251, 252). They proceed from the centre of animal perception (280), and terminate in the vasculo-nervous web (287), on the exterior surface of the mucous membrane which lines the nostrils and the cavities connected with it. There are four principal cavities, two of which are situated in the upper jaw (one on each side of the face), and two in the prominent part of the frontal bone, directly above the eyes; and all of these communicate with the nostrils. Whether the sense of smell is as extensive as the mucous membrane which lines these various cavi-

ties and passages, or is limited to the superior part of the nasal fossæ is a question on which physiologists are not agreed. Some experiments and pathological facts seem to prove that the olfactory sense is limited to the superior part of the nasal canals where the olfactory nerve is mostly distributed, while comparative anatomy and physiology favor the contrary opinion, the cavities being most largely developed in those animals which are most remarkable for their power of smell.

400. It is essential to the integrity of the faculties of taste and smell, that the parts to which these senses belong should be continually moistened. If by disease or otherwise the mucous membrane of the mouth and nose becomes perfectly dry, the senses of taste and of smell are for the time entirely abolished. Hence, in a healthy state and condition of these parts, the mucous membrane is at *all times* moistened and lubricated by its own exhalation and secretion (339). But this is not peculiar to these parts. Throughout the whole extent of the mucous membrane and external skin, the same condition is essential to the functional integrity of the nerves and vessels which form the vasculo-nervous web on the exterior surface (287). The situation of the mucous membrane in the nasal cavities, however, renders it peculiarly liable to become dry, and hence there seems to be a necessity for a very copious supply of lubricating fluid; and it may therefore be true, as has been suggested by some physiologists, that the office of the cavities associated with the nasal canals is to secrete mucous for those canals.

ORGANS OF HEARING AND SIGHT.

401. The sense of hearing and the sense of sight are founded on the general wants of the organic system, with whatever powers and capacities it may possess, and with regard to the most extensive relations (294). They minister not only to those wants which arise from the operations and conditions of the vital economy, but also to the mental and moral wants, whether more or less comprehensive and diversified. They are therefore of a higher order of functional character, and are not susceptible of being sensualized and depraved like taste and smell.

402. The organism specially appropriated to these senses is exceedingly complicated and difficult to be described in an intelligible manner. The apparatus which constitutes the organ of hearing is perhaps the most intricate and complicated piece of organic mechanism in the human body. It has been the subject of an immense amount of observation, investigation, and experiment. Its anatomy has been studied and described with great minuteness and accuracy, and yet at the present moment very little is known of its physiology, except the bare fact that it is the organ of hearing. I shall therefore only give a very brief and general description of this organ, and refer the curious reader to the minute anatomists for further information respecting it.

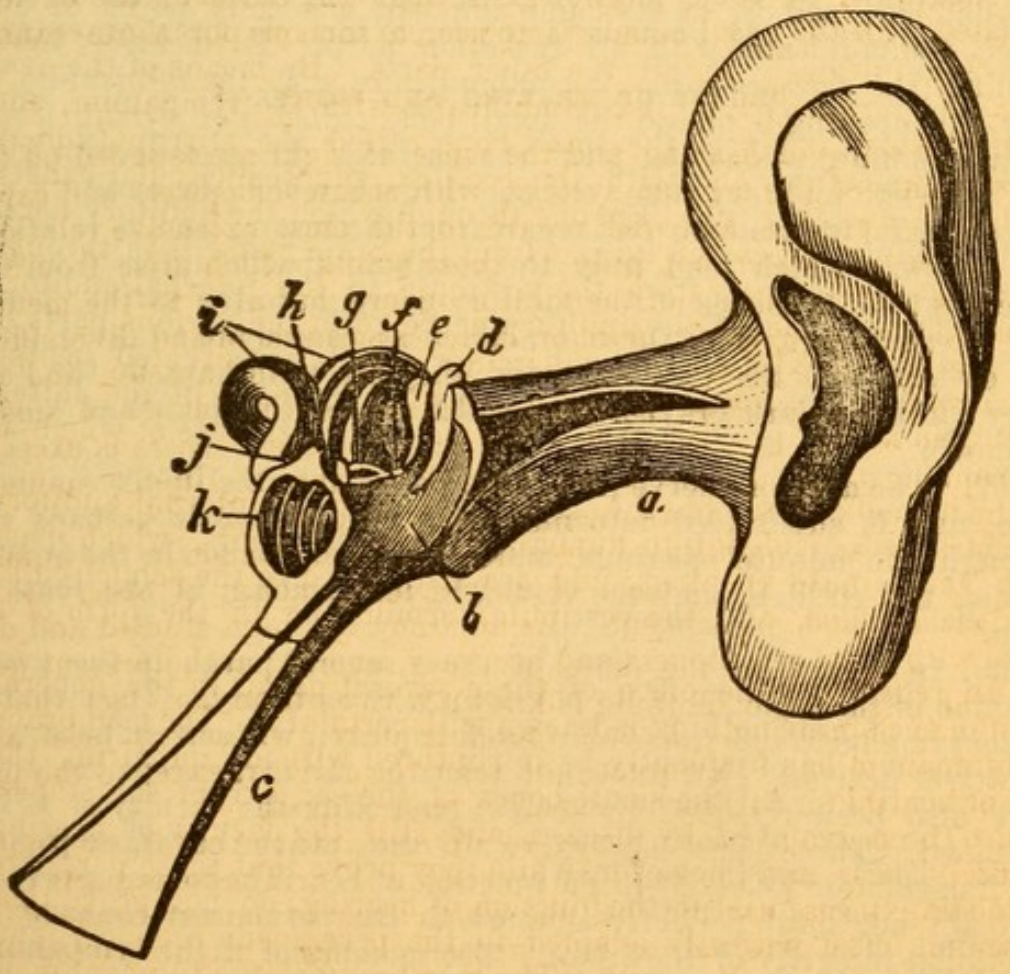
403. The organ of hearing may be divided into the outer, the inner, and middle parts, and the auditory nerve (Fig. 47). The outer parts consists of the external ear and the tube which leads to the membrane of the tympanum. The external ear is composed chiefly of cartilage, covered with a delicate skin, and supplied with nerves and blood-vessels. When well formed, it inclines a little forwards, and is admirably adapted to collect sound, which it transmits through the tube that leads to the

membrane of the tympanum (Fig. 47, *a*). This tube is nearly an inch in length, and is formed in part of cartilage, and in part of bone. It has a number of small glands or follicles which secrete the wax (333), and its entrance is guarded by stiff hairs, to prevent insects and other foreign bodies from entering. When it is recollected, however, that the membrane of the tympanum has no opening, it must be apparent that the apprehension which is so often expressed lest insects should penetrate into the head, is wholly groundless.

404. 'The middle part of the organ of hearing embraces the tympanum and its membrane, the small bones of the ear, and the Eustachian tube (340). The membrane of the tympanum is situated at the bottom of the external passage or tube (Fig. 47, *b*), and is covered on its exterior by a thin delicate skin, the same that lines the tube. Its inner surface is covered by a mucous membrane, and a nerve called the chord of the tympanum passes over it. To this inner surface also is attached one of the small bones of the ear. This membrane is placed obliquely, inclining downwards and inwards, and is terse, thin, and transparent.

405. 'The tympanum is a cavity situated between the external and internal ear. It is of an irregular cylindrical form, with several open-

Fig 47



A map of the ear. a, the external auditory tube; b, the membrane of the tympanum; c, the Eustachian tube; d, the hammer; e, the anvil; f, the round bone; g, the stirrup; h, the oval opening; i, the semicircular canals; j, the vestibule; k, the cochlea.

ings, some communicating with the internal ear, and one which is the termination of the Eustachian tube. It also contains the four little bones of the ear, called the hammer (Fig. 47, *d*), the anvil (*e*), the round bone (*f*), and the stirrup (*g*). These bones are all connected together; the end of the hammer is attached to the membrane of the tympanum, and the stirrup is placed over an opening which leads to the internal ear. Muscles of very small size are inserted into these bones, and move them in various directions. The Eustachian tube (*c*) leads from the cavity of the tympanum to the back part of the throat (340). It is about two inches in length, partly bone and partly cartilaginous, and is lined by a mucous membrane. Its two extremities are not of the same size, the one opening into the throat being somewhat larger than the other.

406. 'The internal ear is situated in a part of the temporal bone, near the base of the skull, which, from its stony hardness, is called the petrous portion. It is composed of three parts; the cochlea (Fig, 47, *k*), the vestibule (*j*), and the semicircular canal (*i*). The cochlea is so called from its resemblance to the shell of a snail. It is situated near the entrance of the Eustachian tube, and is the most anterior part of the internal ear. It communicates with the cavity of the tympanum and the vestibule. The vestibule is situated in the central part of the internal ear, and is, as its name imports, a sort of porch or entry, which communicates with all the other parts. By means of the oval opening (the *foramen ovale*) it communicates with the tympanum, and over this opening is placed the small bone called the stirrup (*stapes*). It has communications also with the cochlea, the semicircular canals, and internal auditory tube, the one through which the auditory nerve passes to the internal ear on its exit from the brain; and it is through the openings which lead from the vestibule to the internal auditory tube, that the branches of the auditory nerve go to the various parts of the internal ear. The three semicircular canals are situated behind the cochlea and the vestibule, and they all terminate in the latter. They contain a dark grayish semi-fluid substance, the use of which is unknown.

407. 'The auditory nerve (251, 252) passes into the internal auditory tube, and is subdivided into numerous small filaments, which pass through the minute openings, and are distributed to the semicircular canals, the cochlea, and the vestibule, terminating in the form of a pulp.'

408. In regard to the office of these several parts, in the general function of the organ, nothing is known with certainty. The membrane of the tympanum has frequently been ruptured without impairing the faculty of hearing. All the small bones of the ear, except the stapes, have also been removed by disease, and still the faculty of hearing remained. These facts, however, while they prove that those parts are not immediately essential to the function of hearing, do not prove that they are not most perfectly adapted to the permanent economy and functional integrity of the organ. The membrane of the tympanum is probably designed mainly to shut out foreign substances from the inner chambers of the ear, and thus keep the auditory nerve, which is

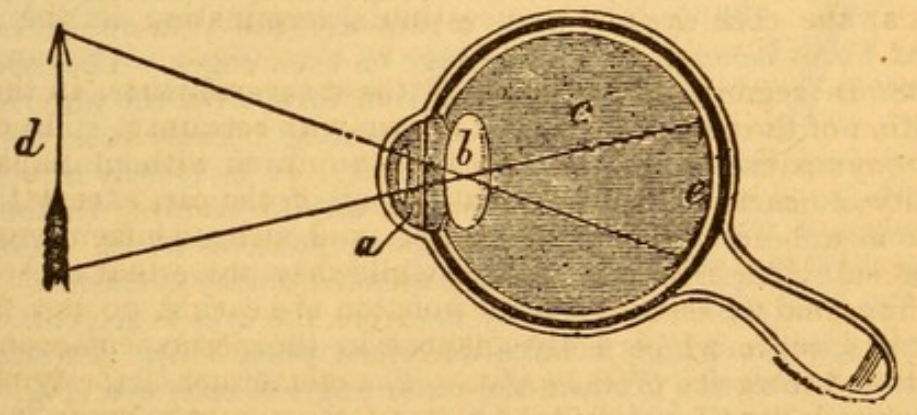
expanded into those chambers, in the most delicate and susceptible condition, and at the same time it is most perfectly fitted to transmit vibrations to that nerve.

Concerning the function of the auditory and other organs of sense I shall speak more fully when treating on the intellectual and moral powers, and on the organs of relation.

ORGAN OF SIGHT.

409. 'The apparatus which constitutes the organ of vision is somewhat less complicated than that of hearing, and the uses of its various parts are much better understood. The eye is an optical instrument of the most perfect construction. It is of a globular form, composed of a number of humors, so called, which are covered by membranes, and enclosed in several coats (Fig. 48). These humors are called the vitreous (*c*), the crystalline (*b*), and the aqueous (*a*). The vitreous, which takes its name from its resemblance to melted glass, is situated in the back part of the eye, and constitutes the greater portion of the globe. It is of the consistence of the white of an egg, and is contained in numerous small cells, formed in a membrane of great delicacy, which also covers it. On its anterior surface there is a slight depression, and in this is situated the crystalline humor or lens (Fig. 48, *b*). This is a body of considerable thickness and strength, and has the form of a double convex lens; the convexity of the two sides, however, is not the same. It is placed in a perpendicular direction immediately behind the pupil, and is kept in its situation by a membrane which is called its capsule. In front of the crystalline lens, and occupying the whole of the anterior part of the eye, is the aqueous humor (*a*), the only one of the three which is properly called a humor. It is composed principally of water, with a few saline particles, and a very small portion of albumen. A curtain with an opening in its centre floats in the aqueous humor, but is attached to one of the coats of the eye at its circumference. This curtain is called the iris, and the opening in it is the pupil. It derives its name from the various colors it has in different individuals; and it is the color of the iris that determines the color of

Fig. 48.



A section of the human eye. a, the aqueous humor; b, the crystalline lens; c, the vitreous humor; d, is an object from which the rays of light go off, and as they enter the eye, they are refracted by the different humors, and form an inverted image, e, on the retina.

the eye. Some have thought the iris to be a mere continuation of one of the coats of the eye; others have supposed it to be a peculiar texture; and others again are of opinion that it is formed in part from one of the coverings of the eye, and that it has also a layer peculiar to itself. The back part of the iris is called the uvea. The iris divides the space between the crystalline lens and the front of the eye into two parts, called the anterior and posterior chambers, the former of which is much larger than the latter. All the light admitted to the eye passes through the pupil, which is dilated and contracted by the radiating and circular muscular fibres of the iris, according to the intensity of light, the power of the eye, etc.

410. 'The eye has three coats or coverings. The outer, which is called the sclerotic, is a firm fibrous membrane (169), which serves to defend the eye from injury, and into which the muscles that move it in various directions are inserted. It extends over the whole of the eye, except the fore part, which is covered by a transparent membrane. It is the sclerotic coat which is commonly called the white of the eye. Within the sclerotic coat is situated the choroid coat. It is a thin delicate membrane, composed mostly of blood-vessels and nerves. It is loosely attached to the sclerotic coat, which it covers, and is of the same form and extent. On the inner surface of the choroid coat is found a dark substance called the black pigment, which is of great importance in the function of vision.

411. 'The inner coat of the eye, if it be not an expansion of the optic nerve, is composed of nervous filaments, and is called the retina (252). It is of the same extent as the other coats, surrounding the whole globe of the eye, except the circular opening in front, to the edge of which the circumference of the iris is attached by a band called the ciliary ligament, and over which is placed the convex transparent membrane, which, from its resemblance to horn, is called the cornea.'

412. The optic nerves have been fully described (251, 252). 'They do not enter the eyeballs in the centre, but a short distance from it towards the nose. The balls are situated in deep bony sockets, with prominences above, on which are placed the eyebrows. They are furnished with lids, which can shut so closely as to exclude not only foreign bodies, but even light. There is also an apparatus by which the external surface of the balls is moistened, and foreign particles washed away. The eyelids have a thin delicate skin on the outside, muscular fibres beneath, and a cartilage on their edges. They are lined by a mucous membrane which passes from them over the anterior part of the eye, and is called the tunica conjunctiva, because it is the tunic which connects the eyeballs with the lids. It is loosely attached to the eyelids, so as to allow free motion in all directions. In the edges of the lids are numerous small glands or follicles which secrete an unctuous substance that is probably expended on the eyelashes.'

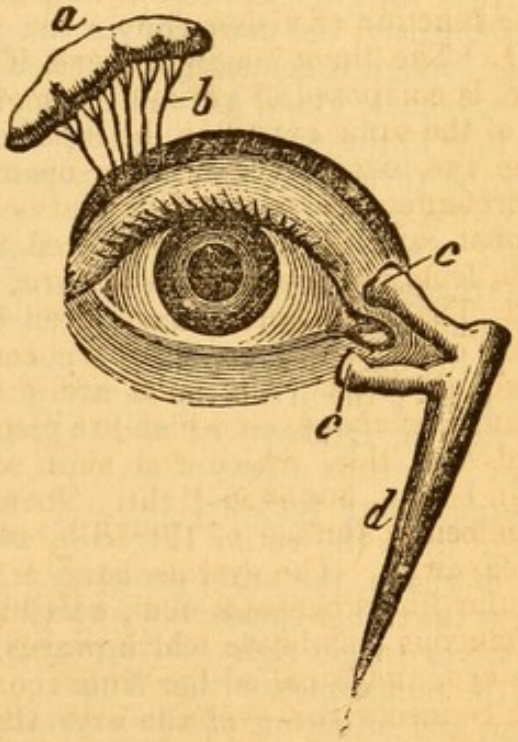
413. The fluid which continually moistens the eyes is secreted by the lachrymal glands, which I have described (334, 345). These glands are situated within the orbit, at the outer angle of each eye (Fig. 49. *a*), and constantly supply the eyes with moisture, not only when they are open and in action, but also when closed and quiet in sleep. The fluid

thus secreted having performed its office, passes from each eye through two small openings (one in each lid), called the puncta lachrimalia (Fig. 49, *c c*), and is thence conveyed into the nose by a canal on each side, called the nasal duct (Fig. 49, *d e*), which is lined by a mucous membrane. These canals, from inflammation and other causes, frequently become obstructed, and then the moisture accumulates in the eyes till it flows over the under lid. When the lachrymal glands are much excited by irritations of the eyes or nose, or by strong emotions of the mind, or morbid sensibilities, they pour their fluid into the eyes, far more rapidly than the nasal ducts can convey it to the nose, and consequently it overflows the under eyelids, and runs down upon the cheeks, and is called tears.

414. Each eye has six muscles, which are attached to the outer coat, and which turn it in every direction. These muscles are among the most curious parts of the visual apparatus. The nerves which convey the stimulus of voluntary motion to these muscles have been described (248, 249). Those which impart the sense of touch or feeling to the eyes, ears, nose, and mouth, are from the trifacial or the fifth pair of the old anatomists, and have also been fully described (254).

415. So far as the eye is considered as a mere optical instrument, the philosophy of vision is easily understood and explained; but when considered as a living animal organ of visual perception, the philosophy of its function is much more intricate, and has hitherto greatly perplexed the learned, and given rise to many ingenious speculations and theories; none of which, however, have been free from insuperable objections. It is not consistent with my general plan that I should enter extensively into an explanation of the mechanical or physical philosophy of vision. The properties and laws of light and other principles belonging to the science of optics must be studied elsewhere; but the physiological and psychological philosophy of vision I shall endeavour to explain fully when I come to treat on the functions of the intellectual and moral faculties.

Fig. 49.



a, the lachrymal gland; b, its several ducts, to convey the tears to the eye; c c, the puncta; d e, the nasal duct.

416. It is a matter of common knowledge, that light is the medium of vision. If any one will take one of the glasses of a pair of spectacles of considerable magnifying power, and cut a hole in a window-shutter, just large enough to receive the glass, then close the shutter, and exclude all light from the room, except what passes through the spectacle glass, if the sun is shining brightly, the rays of light will be seen in the

darkened room, passing from the glass, and converging or drawing together, till they all meet in a point or focus, and then diverging or spreading out beyond this point, the diverging rays forming exactly the same angle at the focal point that the converging rays do. At this focal point all the rays coming through the glass cross each other, so that the top rays at the glass are the bottom ones beyond the point, and the bottom rays at the glass the top ones beyond the point; and, in the same manner, all the rays cross at the point. Now if a sheet of white paper be placed a little beyond the focal point, a beautiful miniature image will appear upon it, of the trees, animals, or whatever else the rays of light may come from, which pass through the glass; and this image will have all the colors and hues of the objects from which the rays of light are reflected. But the image upon the paper will be upside down, and turned side for side, and this will be caused by the crossing of the rays of light at the focal point; and the rays of light are made to cross each other by passing through the glass in the shutter, which is thicker in the centre than at the circumference, and, being a more dense or solid substance than the atmosphere, bends the rays towards each other as they pass through it. The rays will be bent towards each other more or less in passing through the glass, according as the glass is more or less convex, or in proportion as the centre of the glass is thicker than its edge at the circumference; and, consequently, the more convex the glass, the sooner will the rays which pass through it come to a point and cross each other. And if instead of a spectacle glass, a small glass globe filled with water be placed in the hole in the window-shutter, the rays will cross and diverge before they get through it, and the image will be thrown upon the back part of the globe.

417. This is a brief description of what is called a *camera obscura*, or darkened chamber, which is considered the best illustration of the eye, and of the physical philosophy of vision. The interior of the eye is the darkened room; the cornea is the perfectly transparent window glass; the iris is the shutter; the pupil is the hole through which the rays of light enter; and the aqueous, crystalline, and vitreous humors constitute a lens of so great a convexity, that the rays cross and diverge before they get through the globe, and throw their inverted image upon the retina (Fig. 48), where, according to the received theory of vision, the mind perceives it, not as the image of external things but as the things themselves, which the judgment, somehow or other, contrives to get right end upwards. But of this more hereafter.

418. Sometimes, either from the shape of the eye-ball, or from the shape and situation of the crystalline lens, the rays of light cross too near the cornea (411), and the image upon the retina is confused and indistinct. This is the case with near-sighted people. When the eye becomes enfeebled by old age, or disease, either from the falling back of the crystalline lens, or the flattening of the ball, the focal point is formed too near the retina, and by this means also the image is rendered imperfect and confused. In the former case, spectacles with concave, and in the latter with convex glasses, assist the eye in forming its focus at the proper distance from the retina; the concave glasses, by spreading out the rays before they enter the pupil, and thus preventing their crossing so soon after they have entered; and the convex

glasses, by bringing the rays nearer together before they enter the eye, and thus causing them to cross sooner after they have entered. In the eye, however, as in every other part of the vital organism, *the physiological powers are always impaired by a dependence on artificial means;* and though it may sometimes be convenient, and even necessary, to have recourse to the use of glasses, to regulate the focal distance of the eye, yet it is certain that thousands of eyes are permanently injured, where one is benefited, by such means.

419. The eye, in a healthy and vigorous state, undoubtedly has the power of adjusting its own focal distance, either by the movement of its crystalline lens, or in some other manner; and if man were always obedient to the laws of his nature, he would never need artificial means to improve his vision, though his life were prolonged to a thousand years. But it must ever be remembered that neither the eye, nor any other part of the living body, can be diseased or cured independently of the common vital economy of the whole organized system; and that the physiological interests of each particular part are inseparably connected with those of every other part; so that the organs of sight, of hearing, of smell, of taste, and of touch, and all the other constituent parts of the living whole, are dependent for their individual welfare on the common weal of the general assemblage.

HAIR AND NAILS.

420. The hair and nails are generally spoken of as appendages of the skin, but they are as dependent on an appropriate organism, consisting of vessels, nerves, etc., for their production and sustenance, as any other part of the living body. Every hair has its root, which is situated immediately under the skin, and consists of a small oval pulp, invested by a sheath or capsule, and supplied with vesseis and nerves. The shaft which rises above the surface of the skin consists mostly of a horny substance resembling that of the epidermis (287). In its origin it is tubular, the inner part being occupied by the pulp; but the pulp extends only to that portion of the hair which is in a state of growth, and never rises above the surface of the skin. As the shaft is prolonged from the surface, therefore, its cavity is either gradually obliterated, or is filled with a dry pith or spongy substance, which is supposed to contain air.

421. The health and vigor of the hair depends entirely on the health and vigor of the root; and this, as a living organ, is a constituent member of the general system, and its vital interests are inseparably connected with the general welfare of the body. Every injury done to the digestive organs, every instance of gluttony or intemperance, or sensual excess of any kind, and every violent excitement or emotion of the mind, such as anger, fear, grief, etc., immediately and powerfully affect the roots of the hair, and through them the health of the hair itself. Violent grief has covered many a head with gray hairs, in a very short time; and violent paroxysms of fear have produced the same effect in a few hours; and so has excessive sensuality. But the abuses of the stomach, or dietetic errors, are probably the most general causes of the unhealthiness of the hair, and of baldness, in civic life. When the health of the roots of the hair begins to decline, the bulb diminishes in size, the vessels lose their power of supplying nourish-

ment, the coloring matter ceases to be deposited, and the hair soon becomes gray or white. The hair, therefore, though its stem or shaft above the surface of the skin is destitute of vessels and nerves, and has no sensibility, ought nevertheless to be regarded and treated as a living part of the living body; and its health should be cherished, and its disease avoided or remedied, only upon principles and by means which are in perfect accordance with the general laws of life and health, and favorable to the well-being of the whole system. All external applications, except in so far as they contribute to the health and vigor of the roots by the cleanliness and exercise of the skin, are entirely useless, and in most cases decidedly injurious. In a healthy state of the hair and its appropriate organs it is always supplied with an oily secretion or halitus, with which it is anointed; and it can never be benefited, but is generally injured, by the application of any other unction. A proper regard to all the physiological laws of the body is the only genuine prophylactic for the hair, and the only ground on which any one can reasonably hope to restore the natural covering to a bald head.

THE NAILS.

422. The nails, like the hair, though composed of an insensible horny substance, destitute of nerves and vessels, have their appropriate organs or roots, by which they are produced and sustained, and by which also they are physiologically associated with all the living organs and parts of the body, and brought under their common laws of life and health. They do not however appear to sympathize so directly and powerfully in the particular affections of the body and mind as the hair; but they are always involved in the general and permanent physiological conditions of the system; being more or less moist and pliable, or dry and brittle, according to the general state of health, and in some instances they are entirely destroyed by a general disease of the body, or what is probably more correct, by the medicinal substances employed to cure the disease.

423. The truth is, that every part of the living body, even the cuticle or epidermis (287), is either a living substance, or so closely connected with living organs, and so immediately dependent on vital functions and conditions, that it is brought under the general laws of the vital domain, and kept in its best condition by the health and integrity of all the organs of the system; and therefore ought always to be treated with reference to health and disease, as a constituent portion of the living body, which cannot be either benefited or injured without in some measure correspondently affecting the whole vital economy.

LECTURE VIII.

Exercise of the voluntary powers in procuring food—Mastication and deglutition—Gastric digestion—Beaumont's experiments—Saliva and gastric juice, solvent fluids—True chymification only effected by the living organs—Function of the pylorus—Importance of the stomach—Character of the chyme—Indigestible substances, how disposed of by the stomach—Not all the properties of the food digested—Time employed in digestion—How fluids are disposed of—Absorption, by what vessels performed—Fluids rarely descend into the small intestines unless strongly offensive to the absorbents, etc., as alcoholic liquors when first used, etc.—Function of digestion, on what its integrity depends—Chyme, how presented to the lacteals—Chyle, where formed and by what vessels—None in the alimentary cavity—Use of the pancreatic fluid—Use of the bile, and functional character of the liver—Portal system—Communication between the liver, kidneys, lungs, skin, etc.—Alcoholic liquors, why not at first admitted into the general circulation—Foreign substances found in the portal blood—Use of the spleen—Oily matter and acids in the food require bile—Chyle secreted—its nature—Process of chylification mysterious—Chyle the same whatever the food—Function of the mesenteric glands—Globules of the chyle invested with tunics—Passage of the chyle to the lungs—Function of respiration—Blood circulated for the nourishment of the body—Quantity of blood in the body, frequency of pulse, etc.—Vitality of the blood, character of its globules, etc.—Saline property of the serum—Foreign properties in the blood—Animal heat—Nutrition—Secretion—Adipose matter, its use—Size of the body determinate—Decomposition—Depuration—Wear, expenditure, and disease.

424. HAVING taken a general survey of the materials and construction of the human body, and attended to the minute anatomy of its several organs, as fully as is necessary in order to a clear and correct understanding of the physiology of the system, we are prepared to enter upon the more interesting and pleasing study of vital function, or the offices performed by the several parts of the body as living organs in the wonderful economy of the vital domain.

425. Let us then contemplate the living human being, rising from the Creator's hand, and awakening to the consciousness of his existence and of his wants, and to a perception of the external world. He soon feels that special sensation which we call hunger, or the instinctive desire for food. This sensation physiologists have attempted to explain in various ways, and most of them with much more fancy than truth. My own views in regard to it will be presented when I come to speak of the proper times of eating. Prompted by this instinctive impulse, man exercises his voluntary powers for the supply of the want. He looks abroad, and beholds the fruit hanging upon the drooping bough of the tree, and by a voluntary control of his lower limbs he moves forward to the object of his vision. The specific odor of the fruit freighting the air which he breathes, is brought into contact with his olfactory nerves (399), and he instinctively perceives by the special sense of smell, that it is good for food. By a voluntary control of his upper limbs, or organs of prehension, he puts forth his hand and seizes the fruit, and places it between his teeth, with which, by a voluntary exercise of the various appropriate muscles attached to his under jaw, he cuts and mashes it into minute particles. The instant this process is commenced, the special sense of taste (397) perceives another specific quality of the food, and corroborates the testimony of the sense of smell. And while the process of mastication is going on, the mucous membrane of the mouth secretes its glairy and lubricating fluid (333, 339), to shield its delicate little organs (287) from too rude

a touch, and to facilitate the movements of the food upon its surface, and its passage into the stomach. At the same time, also, the salivary glands (340) secrete from the arterial blood, and pour into the oral cavity, a copious supply of a bland tasteless fluid called the saliva, to be thoroughly mixed with the aliment by the action of the teeth.

MASTICATION, INSALIVATION, AND DEGLUTITION.

426. The functions of the oral cavity are generally regarded as merely preparatory for deglutition or swallowing, and the salivary fluid is considered as simply intended for this purpose. But this is incorrect. The mucous secretions and serous exhalations of the mouth and fauces and œsophagus (339) are abundantly sufficient for all the purposes of lubrication and dilution necessary to prepare the food for deglutition. The saliva is truly *a solvent fluid*, and designed to act as such upon the alimentary contents of the oral cavity; and always, when the function of mastication is properly and thoroughly performed, the process of assimilation or digestion commences in the mouth; the change effected there being greater or less according to the perfectness of mastication, the length of time the food is detained in the mouth, and the healthiness and purity of the salivary fluid. And it is certain that the change *can be* carried so far as to afford nutrient matter to the lymphatics (385, 387) of the parts. By hasty and imperfect mastication, therefore, a fourfold injury is done to the stomach. 1. It compels that organ to receive the food more rapidly than is consistent with the welfare of its own physiological economy (429). 2. It compels the stomach to secrete a larger quantity of solvent fluid than would be necessary if the functions of the mouth had been properly performed. 3. It compels the stomach, at great inconvenience, to reduce by maceration those masses which ought to have been broken down and finely comminuted by the teeth; and 4, by increasing the duration and difficulty of gastric digestion, it increases the expenditure of the functional powers of the stomach, and thus causes a greater degree of vital exhaustion in that organ, tending to debility and disease.

427. When the food is prepared for deglutition, it is gathered back upon the arch of the tongue, whence it is suddenly launched into the pharynx (338, 340), and passes into the œsophagus or meatpipe, by which it is conveyed into the stomach. In its transition from the arch of the tongue to the meatpipe, the food, it will be remembered, passes by several orifices, and directly over the mouth of the windpipe (340). But it must not be permitted to enter any of these orifices, nor cause any considerable interruption to respiration; and, therefore, the orifices are closed during its transition, and its passage is very rapid; and hence, the function of deglutition or swallowing is somewhat complicated, and requires the perfect co-operation of all the parts concerned. At the instant the food is launched from the arch of the tongue, the muscles of the pharynx (347) contract, shortening that organ, and raising up the larynx (356); at the same instant the veil of the palate is pressed back, and closes the nasal canals and the tubes coming from the ears (349); the epiglottis (340, 354) shuts down and closes the glottis, or mouth of the windpipe, and the pharynx darts up, as it were, and seizes the descending mass, and suddenly dropping down, presses it into the meatpipe. If in this process there is any want of consent, or co-

operation of the parts; if the food or drink is accidently thrown into the pharynx, without the determinate action of the WILL, or if the WILL attempts to arrest the action of swallowing when the food has passed a little too far to be recovered; or if there happens to be a spasm or paralysis of any of the parts at the moment, a derangement of the function takes place, and a portion of the food or drink passes into the exceedingly sensitive mouth of the windpipe (247), which instantly gives alarm to its presiding centre (219), and a convulsive expulsion of air from the lungs drives the intruding substance violently back through the mouth and nose, and in some instances through the ears. But the irritation produced in the mouth of the windpipe does not immediately cease when the irritating substance is expelled, and hence an unpleasant sensation, and perhaps violent coughing, continues for some seconds, or even minutes, after the expulsion takes place.

428. As soon as the œsophagus receives the food, its muscular coat (338, 347) contracts upon it from above downward, and presses it onward into the stomach; and at the same time the mucous follicles (333) situated in this narrow passage, pour out their lubricating fluid, to shield the nerves and vessels of the lining membrane (387), and to facilitate the movement of the descending mass. The œsophagus does not cease to act, however, when the food has passed from it into the stomach, but continues, and especially its lower portion, to contract vigorously from above, downward, to the cardiac orifice (341), to prevent a regurgitation of the food during the action of the stomach.

GASTRIC DIGESTION.

429. When the food reaches the stomach, it is instantly perceived by the delicate little *feelers* (230, 287, 290) which largely abound in the vasculo-nervous web of the mucous membrane, lining the gastric cavity, and these at once inform the presiding centre (220), which throws its stimulus on the several tissues of the organ (313); the muscular fibres (347) are called into a rapid and vigorous action; an increased quantity of arterial blood is injected into the vessels (393); the nervous power (164) is exalted, and the temperature is somewhat elevated. By the contraction of the different layers of muscular fibres, the whole stomach is thrown into a gentle commotion, by which the food is carried around the gastric cavity, and everywhere pressed against the internal surface. This excites the little vessels, or, as some say, glands (332) that secrete a thin transparent fluid, which very soon begins, like sensible perspiration, to exude from the mucous membrane, in small drops, and mingle with the food. This fluid is called the *gastric juice*; from *gaster*, the ancient Greek name of the stomach. After the first portion of food has been carried about the gastric cavity, and freely mixed with this fluid, if the stomach be not crowded and embarrassed by a too rapid ingestion or swallowing, its muscles relax in some degree, and the organ is prepared for another portion, which, when received, undergoes the same process as the first. These operations are continued, till the stomach is distended with food, and the meal is finished; when the muscular action becomes less rapid, and a gentle, undulating, or vermicular motion succeeds, and is kept up, till the function of the stomach is completed, and its contents are emptied into the small intestine.

430. The process of digestion was formerly supposed not to commence till some time after the food is received into the stomach; but this notion is now known to be incorrect. When the functions of the oral cavity are thoroughly performed, the process commences there (426). The passage of the food from the mouth to the stomach is too rapid to admit of any assimilating change during the transition. But no sooner is the properly masticated food introduced into the stomach, than the process of gastric digestion commences.

431. Concerning the nature of this process, and the means by which it is effected, the human mind has been busy with its speculations from the time of Hippocrates to the present, and perhaps from a much earlier period; and, until a comparatively recent date, the results were little more than fanciful and erroneous theories. Some supposed it to be a process of putrifaction, others a process of concoction, others of fermentation, and others of trituration. Indeed, a century has scarcely elapsed since any thing like a correct notion began to be entertained on this subject; and even yet there is no little discrepancy of opinion in relation to it among physiologists. Dr. Beaumont, of the United States army, from his peculiar advantages, and by his patient perseverance in experiments and observations, has perhaps done more than any other man to settle the disputed points; but even he has evidently been misled in some repects by false theories, and has left broad ground for controversy. *

It is, however, well ascertained that the gastric juice is the principal agent under vital control of the change which the food undergoes in the stomach. This fluid, as well as that secreted by the salivary glands and the pancreas, has frequently been analyzed by the chemists, but without the most remote advantage to physiology or medicine. As a matter of chemical science, we know what substances are obtained by a chemical analysis of the fluid taken from the stomach; but not the least ray of light is thereby thrown upon the physiology of the stomach. We know no better than we did before it was analyzed, what are the peculiar properties of this fluid in the living stomach, by which it produces its specific effects as an agent in the vital process of digestion; and should we attempt to assist the stomach by throwing into it any of those substances which result from a chemical analysis of the gastric juice, we should be more likely to injure than to benefit the organ. Indeed, it is well known that both the chemical and phy-

* Dr. Beaumont published, in the close of the year 1833, his 'Experiments and Observations on the Gastric Juice and the Physiology of Digestion.' These experiments 'were commenced in 1825, and continued, with various interruptions, till 1833.' The subject of them was Alexis St. Martin, a Canadian of French descent, who, in 1822, when about eighteen years of age, with a good constitution and robust health, was accidentally wounded by the discharge of a musket, the contents of which were received in his left side, and carried away the parts, so as to wound the lungs and stomach very seriously. Under the care of Dr. Beaumont, St. Martin recovered his health; but in the healing of the parts, the lacerated coats of the stomach attached themselves to the lips of the external wound, and formed an artificial aperture to the stomach; so that the gastric cavity could be examined, and substances put into it or taken from it at any time, by pushing in a valve which the stomach had formed to close the aperture, so as to prevent its contents from escaping thereat. Dr. Beaumont's advantages for gastric experiments and observations were therefore probably better than have ever been enjoyed by any other man, and they were diligently and faithfully improved.

siological character of the gastric juice is very considerably affected by the dietetic habits, by the general state of the health, by the affections of the mind, and by the conditions of the stomach; and this is also true of the salivary and pancreatic fluids, and in fact of all the fluids of the body. All physiological and medical and dietetic theories and practices, therefore, founded on chemical knowledge in regard to the secretions and assimilating changes which are produced by the organic economy, are established in utter darkness, and are more frequently the source of evil than of good to mankind.

432. We are told, it is true, that the gastric juice can be taken from the living stomach, and put upon cooked and masticated food in a glass vessel, and that if it be kept at the temperature of the stomach (434), it will, in the course of several hours, digest the food; and some of the chemical physiologists assert that they can prepare an artificial gastric juice which will do the same. And without doubt they can prepare an artificial gastric juice which will digest the food as well as will the fluid taken from the stomach. But the truth is, that neither the artificial nor real gastric juice can effect the changes in an inorganic vase, which are produced in the living stomach. They may *macerate* or dissolve the substances on which they act, and reduce them to the *consistency* and *appearance* of the digested contents of the stomach, but they cannot produce genuine chyme, from which the appropriate organs of the living body can elaborate chyle.

433. The gastric fluid, therefore, is, in truth, a vital solvent; for although it undoubtedly possesses, in some degree, from its intrinsic character, a solvent and an antiseptic power, especially if be kept at a high temperature, yet it is only when acting under the vital control of the living organ that it can be in any measure the agent of that vital change which is essential to genuine chymification; and even in the living stomach, when the process of digestion is healthfully going on, if by any means the nervous power of that organ be considerably diminished (164), the process will be retarded, and perhaps wholly arrested, and inorganic affinities will become active, and inorganic combinations result, in direct hostility to the vital welfare. For not only disintegration and decomposition, but new and peculiar combinations take place in the vital changes, which are effected by the digestive organs; and these combinations, as we have seen (117), are the results of affinities or forces which act in opposition to the inorganic affinities of matter; and the inorganic affinities are subdued, and the vital affinities superinduced, only by the immediate and controlling influence of the living organ (121).

434. During the early stages of gastric digestion, the pyloric orifice of the stomach (341) is completely closed by the contraction of the muscular fibres of the pylorus (347), so that the contents of the gastric cavity cannot be pressed into the small intestine by the muscular action of the stomach, and the alimentary mass is kept in constant motion, and becomes thoroughly permeated by the gastric juice. The temperature of the stomach is somewhat elevated by the concentration of vital power in the tissues of the organ, to enable it to perform its function. In a healthy and vigorous body, it varies from a hundred to a hundred and four degrees *Fahrenh.* When the digestive organs have been impaired, and chronic debility and preternatural irritability induced

in them, this concentration of vital energy during the process of digestion is often attended with a disagreeable feeling of chilliness of the external surface of the body, and many of the symptoms of an internal fever, and more especially if the dietetic habits are objectionable.

435. By the solvent power of the gastric juice, the food is gradually reduced to a soft pultaceous mass, and brought into a proximate state of chymification. The portions of the mass which come in contact with the mucous membrane of the stomach are then still further acted on by the vital powers of the organ, and, in a peculiar and inexplicable manner, the nutritious properties of the aliment are converted into a substance very different from anything in the food when it was received into the stomach. This substance is real chyme; and in the language of physiology, it is said to be homogeneous; and so far as chemical tests can determine, it is nearly identical in character, whatever be the kind or kinds of food from which it is formed. But in regard to its physiological qualities, and its nice relations to the vital economy, its character varies with the food, as we shall see hereafter (456).

436. When the portion of aliment which comes in contact with the mucous membrane of the stomach is converted into chyme, it is carried forward by the muscular action of the stomach, slowly, towards the small extremity, and, as it advances, the chymifying change is more and more perfected, till it reaches the pylorus or gate-keeper (347), which, by a nice organic instinct, perceives its character and condition, and immediately opens and suffers it to pass into the portion of the small intestine called the duodenum (338). When the pylorus is in a perfectly healthy state, if a crude mass of undigested food attempts to pass into the duodenum with the chyme, it instantly closes, and the intruder is carried back, to be subjected still further to the operations of the stomach. If it be of an indigestible nature, it is finally either permitted to pass into the intestinal tube, or is suddenly and convulsively ejected from the stomach, through the meatpipe and mouth. But when the stomach is greatly debilitated, and its organic sensibilities become unhealthy (296), the integrity of the pylorus is impaired, and crude substances are frequently permitted to pass into the intestines, where they become the causes of irritation, and produce many uncomfortable disturbances, and in some instances fatal disorders.

437. When one portion of the contents of the gastric cavity is chymified and removed into the duodenum, another portion comes in contact with the inner surface of the stomach, and is operated on in the same manner, till the whole mass is chymified and carried into the small intestine. But if, by a paralysis of the muscles of the stomach, or any other means, the chymified portion in contact with the inner surface of the organ is not removed, the process of chymification is entirely arrested. It is therefore essential to genuine chymification, that every portion of the alimentary matter should come in contact with the living organ; and in order to this, each successive portion, as it is chymified, must be removed; and hence muscular action, though not immediately concerned in the vital change which takes place in the portion of the food in contact with the mucous membrane, is nevertheless as essential to the general function of the stomach as nervous power.

438. Not only the unlearned reader, but even physiologists themselves, are often betrayed into error by the indefiniteness of the language used in physiological works. When it is said that the alimentary matter received into the stomach is, by the process of digestion, converted into a *homogeneous* substance called chyme, it should be understood that this is a general statement, which in fact is not strictly true. All the alimentary substances in nature suitable for human food, consist of certain proportions of nutritious and innutritious matter, and the alimentary organs of man are constituted to receive and act upon such substances. In the process of digestion, therefore, it is only the nutritious portion of the alimentary matter on which we subsist that undergoes the assimilating change, and is converted into real chyme. The innutritious portion is simply separated from the nutritious, and reduced to such a state and condition as fit it to pass long the alimentary tube as fæcal or excrementitious matter. Nor is it strictly true that all the nutritious properties of our food are perfectly chymified in the stomach, as is generally supposed. This error has grown out of the notion that the stomach is peculiarly and exclusively the organ of chymification; but this process, as we have seen (320), is common to the whole alimentary cavity The stomach receives the food from the mouth, more or less changed, according as the functions of the oral cavity have been more or less perfectly performed (426). In the gastric cavity, a general solution of the alimentary matter is effected, and, in the nutritious portion, the assimilating change is very far advanced; and, in some parts of it, the process of chymification is perfected, and the matter is prepared for the action of the organs which elaborate the chyle; and undoubtedly this matter is acted on to some extent by those organs, before it leaves the stomach (388). In other portions of the nutritious matter the chymifying change is not perfeced in the gastric cavity, and therefore the process remains to be completed in other sections of the alimentary canal.

439. Some kinds of food pass through the stomach much more slowly than other kinds; and the stomach of one individual differs from that of another, in regard to the time employed in the process of digestion; and even the same stomach varies in this respect very considerably with the varying circumstances and conditions of the individual; but as a general statement, the food received at an ordinary meal undergoes the process of gastric digestion, and passes from the stomach into the duodenum, in from two to five hours.

440. When water is received into the stomach, it does not appear to undergo any change in the gastric cavity, but is all removed by absorption in a very few minutes, if the stomach is healthy and vigorous, and still more rapidly in some forms of disease, when the mucous membrane of the stomach (338) is inflamed, and the system is laboring under general symptoms of fever, attended with great thirst. In chronic diseases of a dyspeptic character, on the other hand, absorption often takes place very slowly, and the water which is drank will sometimes remain in the gastric cavity for hours, retarding digestion, and causing acidity, flatulence, and eructations; and finally, perhaps, the greater part of it will be regurgitated or thrown up, with portions of undigested food. When liquid food, or water holding in solution any kind of nutritious animal or vegetable matter, such as flesh or vegetable

broth or soup, is taken into the stomach, the aqueous part is all absorbed before the process of digestion commences. Milk also is managed in a similar manner. The gastric juice separates the curd from the aqueous portion, and the latter is absorbed, and the curd is then digested. But when indigestible substances are received into the stomach in aqueous solution, they are absorbed with the water, and pass into the vital domain with no apparent change.

ABSORPTION.

441. In what manner, and by what particular agents, this absorption of unchanged matter is effected, are questions about which there has been a vast amount of controversy; to settle which, very numerous and diversified experiments have been made on living animals and dead substances, and with very different and inconclusive results. We have seen that the skin and mucous membrane constitute the great enveloping and limiting membrane of the vital domain (288, 330), through which every thing passes that enters into or egresses from that domain, and that there is on every part of the exterior surface of this limiting membrane a vasculo-nervous web or plexus formed by the minute extremities of arteries, veins, lymphatics, and nerves (287). Of these three kinds of vessels entering into this web, the veins appear to be much the more numerous, and especially in the alimentary canal, where, according to Dr. Horner, who is probably correct, the venous capillaries of themselves form a superficial plexus (380, Note). Now, the grand question is, whether the lymphatics absorb both assimilated and unassimilated substances? or whether they absorb only assimilated, and the veins only unassimilated substances? Some physiologists have embraced one of these views, and some the other, and both have perhaps been equally confirmed by experiments on living animals. These experiments, however, have been wholly inconclusive, and from the nature of things, they ever must be. The actions of any part of the living body under the anguish and agonies of such experiments, cannot afford conclusive evidence of the normal and regular functions of those parts (216). Undoubtedly, under such circumstances both the venous capillaries and the lymphatics can be made to absorb foreign and unassimilated substances; and the fact settles no principle in physiology. The question is not, what are the abnormal possibilities of the organic system? but but what are the regular and appropriate functions of the parts in the normal condition and operation of the vital economy? Here there seems to be less ground for dispute; for there is little reason to doubt that, in the regular and undisturbed performance of their appropriate functions, the lymphatics, including the lacteals (387), are principally confined to assimilated and assimilable substances; and foreign and unassimilated substances are mostly absorbed by the venous capillaries. It is, however, probable that in some instances foreign substances find their way into the lymphatic extremities which inosculate with the venous capillaries, and which transfer those substances to the veins in the lymphatic glands, in the portal system, and at other points of connexion (386).

442. The venous capillaries, then, which form the superficial venous plexus of the mucous membrane of the stomach and intestines (380), are undoubtedly the vessels which absorb the water and other sub-

stances that pass unchanged from the alimentary cavity into the vital domain; and these capillaries we know to be the radicles of the great venous trunk of the portal system (381), through which, as a general fact, all unassimilated substances that enter the general circulation, find their way to the vena cava (378).

443. The pyloric orifice of the stomach being nearly on a level with the cardiac orifice (341), or that at which the food enters (Fig. 23, *b c*), the contents of the gastric cavity do not descend into the intestines by the force of gravity, but are, as it were, lifted up and pressed through the pyloric orifice by the contraction of the muscular fibres of the stomach (347). But there is comparatively little of this action when pure water is received into the gastric cavity, and consequently very little of this fluid ordinarily passes into the small intestine, but is mostly taken up by the absorbents of the stomach. When irritating and deleterious substances are mingled with the water, however, the absorbents of the stomach receive it much more reluctantly; and, as the stomach will not long retain it, a considerable portion of it is expelled from the gastric cavity into the small intestine. Hence, when ardent spirit is introduced into the stomach of animals, and they are shortly after killed and examined, the mucous membrane, not only of the stomach, but also of the small intestine, is always found highly inflamed.

444. The healthfulness and integrity of the digestive function of the stomach, then, depend principally on three things:—1, healthy and vigorous nervous power (164); 2, healthy secretion (429); and 3, healthy and vigorous muscular action (347); and neither of these can be impaired without injuring the others. The nervous power always suffers from all inordinate mental action and excitement, and especially from the depressing passions, such as fear, grief, painful anxiety, etc. (304). Narcotic substances, of every kind, and in fact all purely stimulating substances, also impair the nervous power. Improper kinds and conditions of food, gluttony, lewdness, sensuality of every kind, in short, every thing that tends to impair the general health of the body, serves to diminish the nervous power of the stomach; and all these causes injuriously affect the secretions and the muscular power and action of that organ, and consequently impair the healthfulness and integrity of its function.

CHYLIFICATION.

445. As the chyme passes from the gastric cavity into the duodenum, or upper portion of the small intestine (338), it is instantly perceived by the innumerable little feelers or nerves of organic sensibility, in the vasculo-nervous plexus of the mucous membrane (287, 290), and they, like those of the stomach (429), immediately inform their presiding centre or centres (220), by which the muscles of the part are excited to action, causing a vermicular or worm-like motion, by the successive contraction of the fibres (347) from above downwards. By this motion the chyme is slowly carried along the intestinal tube, its course being considerably retarded by the semilunar folds of the mucous membrane (346, Fig. 29); and at the same time a solvent fluid, nearly resembling the gastric juice, exudes from the vessels of the membrane (339).

446. As soon as the chyme enters the small intestine, the lacteals,

which, as we have seen (388), very numerously abound in this section of the alimentary canal, begin to act on the most perfectly assimilated portion of it, and to elaborate from it their peculiar fluid, alled the chyle (153). And as the chyme moves slowly along the living tube, presenting its most perfectly assimilated portions to the lacteals of the successive parts, the digestive or chymifying process is at the same time carried on by the vital energies and secretions of the tube; so that, while the lacteals in one part of the intestine are acting on the most perfectly assimilated portion of the chyme, the less perfectly assimilated portions are preparing for the lacteals of the succeeding part. In this manner the two assimilating processes are carried on through the whole length of the small intestine, or until all or nearly all of the nutritious matter of the food is converted into chyme and chyle. Some physiologists suppose these processes are continued in the large intestine, and that the cœcum (346) acts as a kind of second stomach, to complete the digestion of the nutritious matter which may be received from the small intestine; and it is undoubtedly true that nutrition may, to some extent, be effected through the large intestine (388), and that, when nutritious matter reaches this section of the alimentary canal, both chymification and chylification to some extent take place in it. The principal office of the large intestine, however, is to receive and dispose of the fecal or excrementitious matter of the food. But whether the process of chymification is ordinarily continued into the large intestine or not, it is very certain that the most perfect performance of the functions of the small intestine, including both chymificatiou and chylification, requires that the stomach should not be employed at the same time; and hence, the reception of food or other substances into the gastric cavity at improper times, and in fact all dietetic irregularities, always in some measure disturb the functions of the small intestine.

447. It has generally been supposed that the chyle is formed in the small intestine, by the mixture of the pancreatic juice and bile with the chyme, and that it is merely absorbed or sucked up, and conveyed to the thoracic duct, by the lacteals (383). This notion, however, is entirely erroneous, and will probably soon become obsolete. There is not a particle of chyle formed in the alimentary cavity. The only assimilating change effected in that cavity, is, as we have seen (320), that of chymification; and, therefore, all the secretions, both of the alimentary canal and of its glandular appendages (343) which are in any manner immediately concerned in the great process of assimilation, are employed in the production of chyme. The pancreas (342), in structure and appearance, is almost precisely like the salivary glands, and there is no essential difference between the pure salivary, gastric, and pancreatic fluids, the different degrees of acid and other qualities found in one or the other of these fluids being wholly accidental, and owing to the physiological condition of the system, or to the peculiar state of particular organs. The pancreatic fluid, therefore, is employed in perfecting the process of chymification in the small intestine; and accordingly the pancreas, as well as the salivary glands, is proportionably largest in those animals which subsist on food that requires the greatest quantity of solvent fluid for its chymification.

448. In order to a clear and correct understanding of the use of the

bile in the economy of the alimentary cavity, it is necessary that we should take a comprehensive survey of most of the parts contained in the abdomen. 1. The alimentary canal presents a surface of about thirteen square feet of mucous membrane; and this surface is everywhere covered by a close plexus of minute vessels and nerves, which are employed in the performance of greatly diversified and most important functions (331); and of these vessels, the venous capillaries are by far the most numerous. 2. All the venous capillaries of this extended surface, together with those of the spleen (381), of the pancreas, of the mesenteric glands, etc. (386), run into veins, which unite to form the great venous trunk of the portal system (381). 3. The portal trunk, instead of proceeding to the heart or vena cava (378), plunges into the liver (335, 341), where it is ramified in precisely the manner of an artery, and holds the same relation to the biliary ducts that the artery, does to the excretory ducts of other glands (334) and forms by far the greatest part of the vascular substance of the organ; while the hepatic artery is evidently designed for the nourishment of the tissues of the liver, for it is distributed on other vessels, giving rise there to a very complex net-work. The finest ramifications, however, enter the vena porta; and the hepatic veins, the twigs of which are fewer and larger than those of the vena porta, and the hepatic artery, receive their blood, not from the artery, but from the vena porta. 4. According to the general law of the organic economy (393), that as the degree of vital action in a part, so is the supply of arterial blood to that part, a great quantity of arterial blood is sent to the stomach and intestines during the performance of their general function of digestion; and a large proportion of the volume of this blood, remaining after the tissues of the organs are nourished and their vital powers replenished (376), and the secretions, exhalations, etc., are accomplished, is by these processes converted into venous blood, and must be returned to the heart and lungs for renovation. 5. Not only the water which is received into the stomach as drink, but the aqueous portions of the food, and many other substances, some of which, if permitted to pass into the general circulation, would prove exceedingly deleterious to the system, are absorbed, unchanged, and mingled with the venous blood just spoken of; and hence this blood, so freighted with impurities, instead of being permitted to return to the heart and lungs in the ordinary manner of the venous blood from the other parts of the body, is furnished with the peculiar apparatus of vessels which constitute the portal system (381), and by which it is poured into the largest gland, and almost the largest organ of the whole body; and thus all the venous blood from the tissues of the alimentary canal, with all its foreign substances and impurities, is filtered through the liver before it reaches the heart, and returns to the pulmonary and general circulation; and it is entirely certain that the liver, in its normal state, and in the regular performance of its function, secretes the bile from the blood thus furnished by the portal veins, and not from the arterial blood; the latter being necessary only to nourish the tissues of the organ, and sustain their functional powers, and supply the biliary ducts with mucus; yet, after having done all this, and become venous blood, it enters with the portal blood into the venous plexus where the bile is secreted; and, therefore, in the absence of supplies from the vena porta, bile

can be secreted, to some extent, from the blood which enters the liver into the hepatic artery. Again, we know that when foreign substances are absorbed from the alimentary canal, if, by any means, they can be detected in the blood, they are readily found in the spleen, in the portal veins, and the liver, even when no trace of them appears in the thoracic duct (386) nor in the general circulation. Indeed it is nearly certain that, in the general health and perfect integrity of the system, there is a way by the intercommunication of the veins and lymphatics (386), through which foreign and unassimilated substances, absorbed from the alimentary cavity, are carried off to the kidneys, lungs, skin, and other organs, and expelled from the vital domain, without being permitted to enter into the general circulation. But when deleterious substances are habitually received into the alimentary cavity, and taken up by the absorbents, the nicely discriminating organic sensibility of the organs (296) is gradually depraved, and their functional integrity impaired, till they finally suffer those substances to pass freely into the general circulation, and throughout the whole system. And hence it is that when ardent spirit is only occasionally drunk, it can very rarely, if ever, be detected in the general circulation, even while it is strongly exhaled from the lungs; but when an individual becomes an habitual drunkard, and continues his inebriation for several days in succession, the blood taken from the vein of the arm is found strongly charged with alcohol.

449. Still further, in regard to the liver and its secretion, it is now well ascertained that the bile is not in any manner directly concerned in the formation of chyle, nor is it indirectly subservient to that end, any further than it may assist in the process of solution, preparatory to chymification: for both chyme and chyle are regularly produced without any agency of the bile (388). Moreover, it is well known that the liver is largely developed, and performs its secretory function to some extent, before chymification and chylification take place in the system. Besides, if the liver had been designed to secrete a fluid essential to the assimilating processes of the alimentary cavity, and primarily intended for that use, it would be furnished with no sack or reservoir to receive and retain its secretion, but would, like the salivary glands, secrete its fluid only when the wants of the vital economy required it, and pour it directly into the cavity, where it was needed. But the secretion of the liver is continually going on; and because the bile cannot be continually poured into the alimentary cavity, consistently with the general and particular regulations of the vital economy, the liver is furnished with a reservoir (341), which receives its secretion, and retains it until an opportunity is afforded for its discharge into the alimentary cavity.

450. Now, then, in view of all these facts, is it not fully evident that the liver is a great filtering gland, designed to separate the impurities from the venous blood of the portal system coming from the tissues of the alimentary canal? But we have seen that there is a large quantity of this blood, and that the whole of it must filtrate, as it were, through the liver (448), before it reaches the heart; and furthermore, the quantity of blood in the portal system is not always the same. The arterial supply to the alimentary organs being greatly increased during their performance of the function of digestion (393), there is

consequently, and somewhat suddenly, a commensurate increase of the quantity of venous blood returning from those organs. At the same time, also, considerable quantities of aqueous fluid are, or may be, absorbed from the alimentary cavity (440), and mingled with this blood in the portal veins, greatly and suddenly increasing its volume. It follows, therefore, of necessity, either that this heterogenous fluid is at times driven through the liver with excessive rapidity, or that the veins of the portal system are at times suddenly and excessively distended, or that there is connected with the portal system a vascular appendage, which serves as a reservoir to receive a portion of this fluid, when its volume is increased, and retain it till the liver, in the regular performance of its function, is prepared to act upon it. Precisely such a vascular appendage is found in the SPLEEN (382). The structure of that organ, its connexion with the portal system, the regular increase of its volume with the increase of venous blood returning from the tissues of the alimentary canal, its somewhat sudden enlargement when fluids are absorbed from the stomach, and the fact that foreign substances absorbed from the stomach are invariably to be found in its blood, if they are such as can be detected at all within the vital domain; and the fact also that it can be extirpated from the body without destroying life, and apparently without detriment to health, all concur to prove most conclusively, that the spleen is nothing more nor less than such an appendage or reservoir to the portal system. And the whole organization, arrangement, and economy of the parts, clearly prove that the portal system, the spleen, and the liver, constitute an apparatus of organs designed to receive the venous blood from the tissues of the alimentary canal, mingled with whatever foreign substances may be absorbed from the alimentary cavity, and so far to purify that blood, as to prepare it to return to the heart and lungs, with safety to the vital domain. And this purification evidently does not consist exclusively in the secretion of bile, but it is nearly certain that this apparatus has a vascular communication with the kidneys and lungs, and perhaps also with other organs, through which it disposes of foreign and unassimilated substances without suffering them to pass into the general circulation (448).

451. The grand function of the liver, in the vital economy of the general system, therefore, is evidently that of a depurating or cleansing organ; and consequently the bile is *primarily* an excrementitious substance, thrown into the alimentary cavity, to be carried off with the fecal matter of the food; and hence, as a normal fact, it enters freely into the small intestine only when that tube is distended with alimentary matter, and then always mixes most intimately with the fecal portions of that matter. It is nevertheless true, however, that though the bile is secreted for the primary purpose of purifying the blood, and is therefore an excrementitious substance, yet by a wise provision it is in some respects made subservient to the chymifying or digestive process of the alimentary cavity. How far our benevolent Creator prospectively adapted the range of capabilities in this portion of the organic economy, to the artificial and depraved habits of man, it is impossible to say; but it is certain that those habits do extensively call

into requisition the biliary secretion for purposes which are by no means compatible with the best interests of the body.

452. Not only the animal, but nearly all the vegetable substances on which man subsists, contain more or less of fatty or oily matter; and it is now fully ascertained, that when this matter is introduced into the alimentary canal, the gastric juice has little or no effect on it, until it is in some measure changed by other means. When only the lean part of flesh meat, or such vegetable substances as are best adapted to the alimentary wants of man, are received into the human stomach, the oily matter is in so small a proportion, and so diffused in particles through the general mass, that the food is sufficiently digested in the gastric cavity to afford portions of perfect chyme for the action of the lacteals, and to fit it to enter the duodenum, with little or no change in the oily matter. Soon after it is received into this section of the alimentary canal, the bile is mixed with it (341), and acts on the oily matter as an alkali, and converts into a sopaneous substance, which is immediately acted on by the solvent fluid from the pancreas (447), and other chymifying agents of the small intestine (445), and with difficulty converted into chyme. But when a considerable proportion of the food consists of animal or vegetable fat or oil, it cannot be so far chymified in the stomach, by the secretions and actions of that organ, as to fit it to enter the small intestine safely, and without disturbance. In this emergency, the stomach is irritated by the presence of the unmanageable substance, and the biliary apparatus sympathizing (297, 341) with the stomach in its irritations, pours the bile freely into the duodenum, where, instead of descending in the usual manner along the alimentary canal (341), it is carried up and admitted through the pyloric orifice, into the gastric cavity, to assist the stomach in the digestion of its contents, by converting the oily matter into a kind of soap, and thus rendering it soluble by the gastric juice. But the introduction of the bile into the stomach, though rendered necessary by such exigencies, is nevertheless utterly incompatible with the best physiological condition and most perfect functional integrity of that organ.

453. Besides the oily matter of our aliment, there is frequently more acid in some kinds of food than is consistent with the welfare of the intestines; and this acid is, in some measure, neutralized by the alkaline properties of the bile, soon after the chyme enters the duodenum.

454. To act as an alkali on the oily matter and the acids of the alimentary contents of the intestines, is therefore the *secondary*, and often very important, use of the bile, and in no other respect or manner is it concerned in the production of chyle.

455. The chyle, I have said (447), has generally been supposed to be formed in the small intestine, and to be merely sucked up by the lacteals; and hence, in all works on physiology, these vessels are said to *absorb* the chyle. But as there is not a particle of chyle formed in the alimentary cavity, the function of the lacteals is rather that of *secretion* than of absorption; for, instead of simply sucking up a substance already formed, they elaborate, as it were, an entirely new substance from the most perfectly chymified portions of the food; and in this process, it is evident that there is a further decomposition of the chymified matter, and new combinations and arrangements of its

particles, so that the chyle possesses a different constitutional nature from the chyme, and is essentially a different substance (140). Indeed, this is a vital function of a mysterious and most wonderful character, which has completely foiled the ingenuity and beggared the calculations of the chemical physiologists, who, taking the results of the chemical analysis of dead animal matter for their data (147), have endeavored to reason out the elementary laws of vital action and organic combination. In vain have they attempted to regulate the diet of man on chemical principles (151), and insisted on the necessity for certain chemical properties in human aliment, to sustain the vital economy. That economy has shown them that it can triumph over the chemical affinities and ordinary laws of inorganic matter, and bend them to its purposes of pleasure; generating and transmuting from one form to another, with utmost ease, the substances which human science calls elements (51); and while the living organs retain their functional power and integrity, elaborating from every kind of aliment on which an animal can subsist, a chyle so nearly identical in its *physical* and *chemical* character, that the most accurate analytical chemists can scarcely detect the least appreciable difference. *

456. The lacteals seem to possess the transmuting power of vitality in an eminent degree. The chyle which is found nearest to the secreting radicals or mouths, is of an entirely different nature from the chyme in the alimentary cavity (153). It is a thin aqueous fluid, of a milky or pearly appearance, and is slightly albumenous, and when examined under the microscope, is found to contain the globules (157) peculiar to animalized matter, and which are supposed to be the elementary nuclei of all the solid forms of matter in the living body. The color of this fluid varies somewhat with the quality of the aliment, being always more white in proportion as fatty or oily matter abounds in the food. As the chyle flows along the lacteals, and passes through the mesenteric glands (386) (Figs. 43, and 46, *d e*), it is more and more assimilated to the blood; and, before it mingles with this latter fluid, it is apparently like it in all respects, excepting color (154). The proportion of its fibrin, or more correctly speaking, of its globules, to its other properties, even in a carnivorous animal accustomed to a mixed diet, is so nearly the same, when the food is exclusively vegetable, and when exclusively animal, that the difference is scarcely appreciable. But the chyle elaborated from purely vegetable food differs in one respect, most remarkably, from that formed from purely animal food. When taken from its living organs, the chyle elaborated from animal food putrefies in three or four days at longest, while that from the vegetable food may be kept for several weeks without becoming putrid. This is an exceedingly important physiological fact, which does not seem to have been sufficiently appreciated by physiologists (914).

* The scientific world has been greatly misled on this subject by the inaccuracies of the chemists. We have been told by some, that chyle formed from vegetable food contains much more carbon and less nitrogen than that formed from animal food; but it is now ascertained that all such statements are incorrect, and that if there be perfect health and functional integrity of the assimilating organs and the system generally, the chyle formed from vegetable and that from animal matter are so nearly identical in chemical composition, that no appreciable difference can be detected by the most careful and accurate analysis.

457. In regard to the effect which the mesenteric glands have upon the chyle in its passage through them, there has been some diversity of opinion among physiologists; and yet, when the structure and office of these glands are contemplated in connexion with the general and particular economy of the system, there appears to be little ground of doubt concerning them. They are, as we have seen (386), little more than intricate plexuses of minute vessels and nerves, having none of the peculiar characteristics of secreting organs, and are therefore more properly called vascular ganglions, than glands. The vessels of these ganglions consist mostly of lacteals or lymphatics; and with these are associated numerous veins, which arise from the ganglions, and which in the ganglions communicate with the lacteals or lymphatics, by opening the one into the other. It can hardly be doubted, therefore, that these ganglions are formed for the sake of establishing such communications between the lacteals or lymphatics and the veins, as will enable the former to expel into the latter such foreign or other substances as they may contain, which cannot safely or consistently with the greatest good of the system be permitted to pass into the thoracic duct. The chyle, in passing through these ganglions, therefore, is probably no further affected than to be in some measure purified by the removal of the foreign substances or crudities which it may contain. This opinion appears to be supported, not only by the anatomical structure of these ganglions and the general physiological analogies of the vital economy, but also by all the physiological phenomena pertaining to them both in their healthy and in their morbid state.

458. If the opinion of some anatomists, that most or all the lacteals traverse a portion of the liver (388) before they reach the thoracic duct, be correct, it is probable that they do so for the purpose of still further communicating with venous capillaries, into which they may discharge any remaining crudities or unassimilated substances contained in the chyle.

459. When the chyle reaches the thoracic duct (386), into which it is converted by the lacteals (Fig. 46, *b f g*), it is in a very advanced state of assimilation to the blood, being possessed of a considerable share of intrinsic vitality (203), and largely abounding in elementary animal molecules (456). Before leaving the thoracic duct, each of these minute animalized molecules becomes invested or surrounded by a thin pellicle or tunic, and being thus invested they are prepared to enter into the great highway of the returning circulation, and after having undergone the process of the lungs, to become the globules of the blood. Sometimes also the chyle is found to be slightly pink-colored before it leaves the thoracic duct. Being in all respects prepared for a passage to the lungs, in company with whatever impurities it may meet with in the venous blood (448), the chyle is carried up by the thoracic duct (Fig. 45, *d d*), and emptied into the subclavian or large vein coming from the left arm, at the point and in a manner which I have described (386). Here it mingles with the venous blood, with which it flows into the right auricle of the heart (368, 369), and thence passes into the ventricle, by which it is sent through the pulmonary arteries (359, 369) into the capillaries of the lungs, where the grand process of digestion is completed, which commences in the mouth (426), and continues

all along the living, alimentary, and lacteal canals and tubes, till the chyle is poured into the veins; and then no further change takes place till it reaches the lungs.

460. The precise change which is effected in the chyle, while in the lungs, is not known, as it always goes to the lungs mingled with a large quantity of venous blood. It appears pretty certain, however, that the chyle which goes to the lungs nearly colorless, there becomes red, and is more perfectly animalized, and more highly endowed with vitality. I say more highly endowed with vitality, because it is evident that the chyle is in some measure a vital fluid before it reaches the blood-vessels (459). As the chyle and venous blood, however, are mingled together, and are operated upon by the lungs at the same time, I shall embrace the two at once, in my descriptions of the physiology of respiration and circulation.

461. The blood, which is diffused throughout the body by the heart and arteries, for the nourishment of the whole system, is not all taken up and appropriated in its first distribution, but a considerable proportion of it is returned through the veins and large venous trunk to the right auricle of the heart (368, 369). In consequence, however, both of the absence of properties which have been abstracted by the arterial capillaries, in the general function of nutrition, and of the presence of other properties which have been accumulated in the course of the circulation, the venous blood returns to the heart, dark and full of impurities, and wholly unfitted in its condition to supply the wants of the system. Should it be forced, unchanged, into the general arterial circulation, the action of the circulating organs would immediately become extremely feeble and interrupted, nutrition would cease, animal sensibility and consciousness would be instantaneously abolished, all the functions of organic life would falter, and death would soon ensue. The venous blood, therefore, must either be wholly thrown out of the system as excrementious matter, or it must, by some renovating vital process of the organic economy, be restored to its original character as arterial blood. Should it be eliminated as excrementitious matter, the demand for alimentary supplies in the digestive organs would be vastly increased. The benevolent Creator has therefore established a special economy, by which the venous blood is purified and renovated, and perfectly restored to its original character, and fitted for supplying the wants of the system, equally as well as new-made blood; and in doing this, He has, in a truly wonderful manner, combined vital function with physical and mechanical advantage and convenience.

462. As soon as the returning blood of the veins is poured from the large venous trunks (378) into the right auricle of the heart, the walls of that cavity contract upon it, and press it down into the right ventricle (369), from which the tricuspid valve prevents its returning. No sooner does it enter this ventricle than its walls also contract upon it, and send it through the pulmonary artery and its branches, into the capillary vessels of the lungs, which are ramified upon the air-cells as I have described (359). While passing through these minute vessels, the chyle and venous blood undergo those important changes by which they both become arterial blood. In regard to these changes, physiologists have indulged in extensive speculations, some of which are exceedingly ingenious and interesting. But it would not be

a profitable employment of time to review them on this occasion; and therefore I shall only present the conclusions to which I have arrived, after a careful examination of the whole subject, merely observing, by the way, as a general remark, that with respect to respiration, as well as all the other vital functions of the body, many physiologists appear to have erred by attempting to explain vital phenomena on the principles of inorganic chemistry.

RESPIRATION, OR THE FUNCTION OF THE LUNGS.

463. It is, doubtless, a matter of general knowledge, that, according to modern chemistry, the atmosphere is composed of several gases or kinds of air, and a considerable quantity of water in a state of vapor. Pure air, however, according to the statements of chemistry, consists of twenty parts of oxygen gas, and eighty parts of nitrogen or azote (99). But by means of the chemical changes of composition and decomposition which are continually going on in nature, various gases are evolved, and become more or less diffused throughout the atmosphere; some of which are too subtil to be detected by the closest scrutiny of the chemist, and others are so volatile and light that they ascend to the upper regions of the atmosphere, where they probably undergo new changes and enter into new forms. Some, however, enter into combinations near the earth's surface, and are of sufficient specific gravity or weight to remain in the lower region of the atmosphere. Of these, about one per cent. of carbonic acid gas, formed by a chemical combination of certain proportions of oxygen and carbon, is always and universally present.

464. The oxygen and azote of the atmosphere are not chemically combined as in nitric acid, but intimately mixed together; so that, when a portion of the oxygen of a given volume of air is consumed, the remaining oxygen diffuses itself equally throughout the whole volume, as fast as the consumption takes place. This law of nature, established by a wise and benevolent Creator, is of immense importance to all living bodies, both animal and vegetable.

465. Now, in regard to the changes which take place in the lungs, there are certain phenomena or facts attending respiration, on which physiologists have built their theories of the function. In the first place, the venous blood goes from the heart to the lungs, with a dark purple color, and unfitted for the purposes of nutrition in the system, and returns from the lungs to the heart with a bright red color, and possessed of all the properties requisite for supplying the general wants of the vital economy. In the next place, the air goes into the lungs composed of about seventy-nine or eighty parts of azote, nineteen or twenty parts of oxygen, and one per cent. of carbonic acid gas; and returns from the lungs with about the same proportion of azote, five or six parts of oxygen, and thirteen or fourteen parts of carbonic acid gas. In some way or other, therefore, the oxygen of the inspired air suffers a great diminution of volume in the lungs, and a volume of carbonic acid gas is produced equal, or nearly equal, to the loss of oxygen. These facts led the chemists to conclude that the venous blood, and perhaps the chyle also, give off a quantity of carbon in the lungs, and that a part of the oxygen of the inspired

air combines with the carbon, and forms the carbonic acid gas. And as it is a law in organic chemistry, that when oxygen combines with carbon in the formation of carbonic acid gas, heat is always produced, a most ingenious and beautiful theory of animal heat has been built upon this view of the function of the lungs.

466. Mr. Crawford, who principally matured this theory, reasons thus: When the venous blood gives off its carbon in the lungs, its capacity for caloric, or the substance of heat, is increased; the carbon thus set free instantly combines with a portion of the oxygen of the inspired air, and forms carbonic acid gas, by the process of which combination heat is evolved, and that heat is instantly taken up by the increased capacity of the now arterial blood; and as this blood is diffused into every part of the system, and becomes changed into venous blood again, its capacity for caloric is diminished and the heat is given off.

467. This was making the changes effected on the blood and chyle in the lungs, and the production of animal heat, purely processes of inorganic chemistry. And perhaps never was an erroneous theory more ingeniously constructed or more plausibly supported. But it has been fully ascertained, by numerous experiments and extensive investigation, that the oxygen of the inspired air does not combine with the carbon of the blood in the lungs to form the carbonic acid gas of the expired air; for this gas continues to be expired from the lungs, when nothing but pure hydrogen is inhaled: neither does the oxygen enter in a free state into the blood, to combine with carbon and form carbonic acid gas, and evolve heat, in the course of the circulation, as some have suggested. The whole chemical theory, therefore, in regard to respiration and the production of animal heat, is without the support of any well established facts requiring such an explanation; and it is certainly contrary to all correct notions of the vital operations, and the general physiological economy of the living body.

468. The function of the lungs may be considered as twofold. As depurating or cleansing organs, they eliminate the impurities of the blood, in a manner corresponding with the functions of the external skin and the mucous membrane generally (289), and with all the excretory organs of the body; and as organs of nutrition they digest the air, and convert a portion of it into the substance of the blood.

469. As depurating organs, the lungs by a vital process continually excrete from the venous blood, and perhaps also from the chyle, in their capillary vessels, certain substances, the elimination of which is necessary to prepare those fluids for the nutrient purposes of the system. As soon as the excreted substance or substances are thrown into the air-cells (353), the matter composing them yields to the affinities of inorganic chemistry, and issues from the lungs in the form of vapor, of carbonic acid gas, etc. The vapor thrown from the lungs in this manner, sometimes amounts to nearly a quart of water in twenty-four-hours. A portion of this is supposed to come from the chyle. The quantity of carbonic acid gas discharged from the lungs in the twenty-four hours is also very considerable. This gas is unfit for animal respiration, and when inhaled into the lungs without a mixture of atmospheric air, it soon causes suffocation, asphyxia, and death.

This effect, however, is owing to its negative rather than to its positive qualities, or to the absence of oxygen, by which alone animal respiration is supported; for carbonic acid gas can be introduced freely into the stomach without having any of the effects of a poison upon the system. It is by the consumption of the oxygen of the air, and the generation of this gas by the burning of charcoal in an open vessel in a tight room, that life is often destroyed; and for the same reason, a large number of people in a close or ill-ventilated room, by their continued respiration and perspiration, render the air very impure and unwholesome; and were it not for a wise and benevolent arrangement in the general economy of nature, in regard to this gas, all animals would soon be destroyed by it (143). Being specifically heavier than atmospheric air, it sinks below the nostrils and mouth of the animal during the little pause which follows expiration, and thus is prevented from being drawn into the lungs again in the succeeding act of inspiration. Descending towards the earth, it becomes diffused through the atmosphere, and during the day it is taken up by the vegetable organs of nutrition, and decomposed, the oxygen being set free, and the carbon retained and converted to vegetable substance (143). During the night, or prevalence of darkness, however, plants, like animals, are said to give off carbonic acid gas. But it is supposed that their consumption of it during the day is sufficient to preserve the atmosphere in a state proper for animal respiration.

470. When the blood in the capillary vessels of the lungs is purified in the manner I have described, it is prepared to receive a portion of the digested and assimilated air. This is also a purely vital process. The lungs are constantly receiving fresh supplies of aeriform aliment, which, like the food received into the stomach, consists of certain adapted proportions of nutritious and innutritious substances (438), and although expiration always immediately follows inspiration, yet the lungs are never entirely exhausted, but a considerable volume of air always remains in them, much larger than that which is inhaled at an ordinary inspiration.* The air which we expire, therefore, is probably very little, if any of it, that which was received by the immediately preceding inspiration. But each successive volume of inspired air probably displaces an equal volume of the retained air which has been acted on by the digestive powers of the lungs; and thus something like an aerial circulation, or the gradual process of digestion in the alimentary cavity, takes place in these organs.

471. If the top of the intestinal tube in a dog be tied close to the pyloric orifice of the stomach, so that nothing can pass from the gastric cavity into the intestines, and a quantity of proper food suitably masticated be introduced into the stomach, that organ will convert the nutritious properties of the food into chyme, and its lacteal or lymphatic vessels will elaborate from that chyme a quantity of chyle sufficient to answer the immediate demands of the vital economy; and the fecal parts of the food, together with some remaining chyme, will then be ejected or regurgitated from the stomach, through the meatpipe and mouth. In this manner the animal may be sustained for six or eight

* According to Menzies and Goodwill, five times the quantity of air remains in the lungs after ordinary expiration that is ordinarily expired or inspired at any one time.

weeks (388). This affords a good analogical illustration of the digestive function of the lungs. Having but one orifice, they throw off their excrementitious matter through the same aperture by which they receive their aeriform food.

472. Oxygen is undoubtedly the nutrient property of the air (465), and hence it is said that it supports respiration (92); yet I contend that it never becomes incorporated with the blood *as oxygen* (112), but it is digested or decomposed in the vital process by which it is converted into the substance of the blood, and becomes a constituent and identical part of it; and then it is not oxygen nor anything else but blood. Nor is it till the vitality of that fluid is destroyed, and its constitutional nature essentially changed, that oxygen or any other chemical element can be obtained from the perfectly healthy blood. The quantity of oxygen consumed by an individual is said to vary with the nature and degree of exercise, state of mind, degree of health, kind of food, temperature of the atmosphere, etc. Much more is consumed when the weather is cold than when it is warm, more during digestion than when the stomach is empty, and less is consumed when the food is vegetable than when it is animal, less when the body is at rest than when in action, and less when the mind is calm than when it is disturbed. The average quantity, however, is supposed to be about two pounds and eight ounces, troy weight, per day.

473. That some of those forms of matter which are called chemical elements are largely employed in supplying the wants of the vital economy of the living body, and that some of them are better adapted to supply particular wants, or produce particular effects, in that economy than others, is most evidently true (139); but this is far from proving that those forms pass unchanged through the vital processes into the vital results, and still less does it prove that the laws which govern those substances as chemical elements, in the processes of inorganic chemistry, go with them into the vital domain to control the action of their affinities, and the modes of their combination.

474. In suffering this two-fold function of the lungs, the chyle and dark-purple venous blood become converted into bright-red arterial blood, fitted to supply all the wants of the vital economy. And the more completely the function of the lungs is fulfilled, the more richly is the blood endowed with those delicate properties which gratefully exhilarate every part where the living current flows, healthfully invigorating all the organs, and giving increased elasticity to all the springs of action in the system, causing every function to be more perfectly performed, imparting buoyancy to the animal spirits (305), and delightfully exciting and facilitating the intellectual operations.

CIRCULATION, QUANTITY, AND QUALITY OF THE BLOOD.

475. The blood thus purified and renovated in the lungs, returns in the pulmonary veins to the heart (359, 369), and is emptied into the upper cavity or auricle on the left side. The walls of this cavity instantly contract, and press the blood into the lower cavity or ventricle on the same side, whence it is prevented from returning to the auricle, by the mitral valve (369), which is pressed up and closes the opening between the two cavities. No sooner does the blood enter the left ventricle, than the thick muscular walls of this cavity vigorously con-

tract, and throw it into the aorta or great arterial trunk (369), which being always full of blood, that which is thrown from the heart presses on that which is in the arterial tube; and thus, by the constant action of the heart, the column of blood in the aorta is continually moved on, in the same manner that a column of water is raised in a common pump, till it flows through the arterial branches into all the capillary extremities, and is thus, with the assistance of arterial and capillary action, diffused over the whole body (374), imparting nourishment to the bones, cartilages, ligaments, tendons, membranes, muscles, and nerves, and supplying the various secretory organs with the blood from which they separate, or elaborate their lubricating and solvent and other fluids and substances. And, passing from the capillary extremities of the arteries to those of the veins (378), the unappropriated blood, now rendered dark and impure, or unfitted for the purposes of nutrition (461), is carried back to the heart and lungs, to be purified and renovated in the manner I have described (460, 470), and then thrown again into the general circulation.

476. The whole quantity of blood in the body of an ordinary-sized man, is from three to four gallons. Of this, from one-fourth to one-third is supposed to be contained in the arteries, and from two-thirds to three-fourths in the veins (379), a large proportion of the whole being in the arterial and venous capillary vessels (313). In civic life, the ventricles of the heart in healthy adults contract from seventy to seventy-five times in a minute; and it is supposed that the left ventricle throws into the aorta from one to two ounces of blood at every contraction, and that a quantity equal to the whole volume of blood in the body passes through the heart as often as once in three minutes. In a new-born infant the heart contracts about one hundred and forty times in a minute; in the first year of life, about one hundred and twenty-four times; and in the second year, one hundred and ten, and in the third year, ninety-six times in a minute. In the decline of life, the contraction of the heart diminishes in frequency, and in old age the pulse does not exceed sixty in a minute. The rapidity of the circulation, however, varies in different individuals according to different circumstances, habits, etc. In some men the heart regularly contracts more than four thousand times in an hour; in others, less than three thousand. This difference, as we shall see hereafter (909), as a general fact, depends much on dietetic and other voluntary habits.

477. The blood, like the chyle and other substances of the body, has repeatedly been analyzed by the chemists, and we have been told the precise quantities of the muriate of soda and potash, of phosphate of lime, iron, sulphur, etc., contained in it; but without the least advantage to physiology, therapeutics, or dietetics. On no one of these points has the chemical analysis of the blood thrown the least ray of light; for it is not with a fluid composed on the principles of inorganic chemistry, of certain proportions of certain chemical elements, that the physiologist or the physician has to do, but with a *living fluid*, elaborated by vital processes, and subject to the laws and conditions of vitality.

478. The blood is most indubitably a living fluid (203), and its vitality is susceptible of very considerable increase and diminution. That it has vitality in itself has repeatedly been, and may easily be,

proved by conclusive experiments; still, however, its intrinsic vitality cannot long be sustained out of the living vessel to which it belongs. Taken from the living vase, it loses its vitality in a few minutes; but if a quantity of blood be confined to a portion of a living and healthy artery, its vitality will be preserved as long as the healthy vitality of the artery remains. The preservation of the vitality of the blood, therefore, depends on the living vessels in which it flows, or rather on the nerves of organic life which preside over the functions of those vessels (219), and the degree of vitality in the blood varies with the general condition of these nerves, and the general condition of these nerves depends very much on the character and condition of the blood.

479. If the quantity of blood in the system be excessive, there is a tendency to special or general congestion, inflammation, and death. On the other hand, if the quantity of blood be too far reduced, the functional energy of the nervous system is diminished, the conservative power of the blood vessels is impaired, and the intrinsic vitality of the blood is commensurately lessened. Hence, if a healthy robust man be copiously bled, and then several smaller portions of blood be taken from him at short intervals, each successive portion will lose its vitality sooner than the preceding one. The specific gravity of the blood is little more than that of water: it has been affirmed, however, that 'the more perfect the organization of the blood, or the higher the degree of vitality it possesses, the greater appears to be its specific gravity.'

480. By some physiologists the blood is considered a homogenous fluid, while others assert that it is a complicated compound of all the substances which compose the various solids and fluids of the living body; the substances of the bones, cartilages, ligaments, tendons, membranes, muscles, nerves, bile, salivary, gastric, pancreatic, and other fluids, etc., ready formed, and all mixed up together in the blood, like the materials of the world in the fabled chaos; and all that is further necessary for the arrangement of these materials into the several structures and organs of the body, is to have the blood pass through certain strainers which are so constructed and situated as to separate out and retain each material in its proper place. But this is obviously an expedient to cover human ignorance with the guise of science; a purely hypothetical attempt to explain the operations and results of the vital economy upon chemical and mechanical principles.

481. While the blood is healthfully flowing in its living vessels, it is impossible for us to investigate its properties; and it is equally impossible for us to know how soon our meddling with it may effect essential changes in its character. The furthest, therefore, that our knowledge of the living blood extends, is that when first taken from the living and healthy vessels, and examined under a microscope, it is found to be composed of a fluid containing innumerable minute globules, which are surrounded by a kind of pellicle or tunic of coloring matter (459, 474). A substance called fibrin is also said to be contained in the blood; but there is reason to believe that the fibrin is nothing more than an arrangement of the globules just named divested of their coloring matter, and that the fibrin as such is not to be found in the actively circulating blood.

482. When taken from the living vase and permitted to stand a short

time, the blood coagulates, or a portion of it gathers into a thick clot called the crassamentum, and the remaining portion is a thin, transparent fluid of a greenish or yellowish appearance and saltish taste,* and is called serum. By washing the clot freely in water, its coloring matter is removed, and it becomes white and has a fibrous appearance. When putrefaction commences in the blood taken from the living body, it attacks rather the coagulum than the serous portion, and this is true also of the chyle.

483. This is as far as the *physiologist* can push his analysis of the blood; and *this*, taken in connexion with several important facts and phenomena which constantly take place in the living system, justifies the conclusion that the blood is not a homogenous fluid, but naturally consists of innumerable globules or corpuscles of animaized matter held in a fluid state by an aqueous menstruum, or diluent, and that the vitality of the blood wholly resides in the globules.

484. I have said (440), that water appears to pass from the stomach into the circulation with very little if any change; and it is a well-known fact, that all the absorbent vessels of the body pour their contents of every kind, whether assimilated or not, whether salutary or deleterious, into the veins. It is also well known that large quantities of water, holding saline substances in solution, may be injected directly into the veins of living animals without destroying life. Castor-oil and other medicinal substances may likewise be introduced in the same manner; and alcohol and other poisonous substances pass unchanged from the stomach, and mingle with the blood (448). Indeed, alcohol is sometimes present in the blood in so large a quantity and so concentrated a form, as not only to be readily detected by the senses of smell and taste, but also to burn freely with a blue flame when touched by a lighted candle. When death is caused by lightning, it is well known that the blood remains in a fluid state incapable of coagulating; and in several forms of malignant putrid fever, the corpuscles of the blood are broken down and lose the power of coagulating (482); and in some instances there are manifest evidences that puterfaction has commenced in the globules of the blood before the life of the body is extinct.

485. All these facts seem to prove conclusively, that the blood cannot be a homogenous fluid, and that the serum of the blood cannot possess any degree of vitality; and they leave little room to doubt, that what is called the coloring matter which surrounds the vitalized globules (481), *is intended to shield them from the pernicious properties or influences of such foreign matters as may find their way into the blood-vessels, and come mixed with the serum of the blood.* While the animalized corpuscles remain in the lacteals and other vessels, where, in the normal state of the system, only assimilated fluids are permitted to enter, they are not invested with those pellicles or coverings which become red in the lungs, or at least not until they reach the thoracic duct (459), and are about to pass into the veins; and when they finally enter into the

* It is by no means certain that the saltish taste of the serum of the blood is not wholly attributable to the dietetic use of salt. Dr. James, formerly of the United States army, informed me in the summer of 1836, that the soldiers on the remote western frontiers used no salt with their food when he was with them, and that he found their sensible perspiration to be as free from the taste of salt as pure water

arrangements of organized structure, they are again divested of those tunics; and hence it appears that they are only thus covered while travelling in the common highway of the circulation, where they are continually exposed to the contact and influence of foreign and unassimilated substances.

486. It is probably from the serous portion of the blood mainly, that the excrementitious secretions and exhalations are made: and the impurities which sometimes accumulate in the blood from special or general derangement of function, are probably contained in this membrane; and it is possible that they exert their deleterious influence first on the nervous tissue of the blood-vessels (230), and through them on the nerves of organic life generally, producing irritation and morbid affection, which involves the blood-vessels, and by them is communicated to the living globules of the blood, and thus producing a general fever, which is modified in type and symptoms by various circumstances. Hence, the intense thirst which usually attends a fever, and which may be an instinctive demand for water to displace the offensive serum and allay the preternatural heat and action; and hence also the interesting fact, that pure soft water, freely administered, is decidedly the most efficient febrifuge in nature. The most violent fevers have been subdued by it with astonishing rapidity, when the ordinary means of medical practice had proved utterly ineffectual. I confess, however, that this is mere speculation; but it seems to me to be corroborated by all known facts relating te the subject. Yet I do not by any means suggest this as a universal theory of fever, but merely as one of the means by which fever is induced.

ANIMAL HEAT.

487. The temperature of the human blood, I have said (129), is, in a healthy state of the body, ordinarily about 98 degrees *Fah.* It rises above and falls below this point, some few degrees in particular states of disease; but in the vigorous health of the body, the differences in external temperature seem to have very little effect on it, the blood being always about the same temperature whether the individual is travelling upon the polar seas or under the meridian line.

488. Many attempts have been made to account for animal heat, on the principles of inorganic chemistry; and no one of them, as I have already observed (466, 467), has been more ingeniously constructed and more plausibly supported than that of Mr. Crawford, and no one has been so generally received. And even yet, though the essential defects of Mr. Crawford's theory have been demonstrated, many physiologists seem disposed to cling to the notion that respiration is in some way or other the immediate source of animal heat, because there appears to be a close relation, say they, between the degree of heat in the body and the quantity of oxygen consumed. But this reasoning appears to me to be very inconclusive. We have seen that the vital properties which constitute the functional powers of all the tissues and organs in the body, are rapidly exhausted by action, and that they are replenished entirely by the constant supply of fresh portions of arterial blood (376). This supply being withheld, the muscles soon lose their susceptibility to the stimulus of motion, and their power of contractility; the sensorial power of the nerves is immediately suspended, and the nervous

power is very soon lost (461). We have seen also, that the blood cannot be purified, renovated, and fitted for the replenishment of the exhaustions of the system, without the function of respiration, and that oxygen is essential to this function (472). In this view of the subject, oxygen is certainly essential to the calorific function or the production of animal heat, but not as a chemical element depending on its chemical properties and combinations (139).

489. Animal heat, like voluntary animal phosphorescence and electricity, is most unquestionably a result of vital function, depending immediately on the vital properties and functional powers of the nerves of organic life (228). Whatever, therefore, impairs the health of the system of nerves, diminishes the power of the living body to regulate its own temperature. Hence spirit-drinkers, except when under the direct influence of the alcoholic stimulus, have less power to resist cold, in proportion as the health of their nervous system has been impaired by the poison. Indigestion also, and all other difficulties of the stomach and intestinal tube, connected with the general condition of the nerves of organic life, diminish the vital powers of reaction against cold. Whether the production of animal heat, therefore, be a process of secretion, or a function peculiar to itself, or nearly resembling that of animal phosphorescence and electricity, I do not pretend to say; but I am entirely confident that it is purely a vital function, depending immediately on the vital properties and functional powers of the nerves of organic life.

490. The relaxing and debilitating effects of continued heat, always diminish the power of the body to sustain sudden and severe cold. They also diminish the powers of digestion and general nutrition, and render the system more susceptible of injury from dietetic irregularities and excesses; and, on the other hand, except in special cases of disease, continued cold weather, if it be not too intense, invigorates all the functional powers of the body, increasing greatly its ability to generate heat and maintain a uniform temperature, and commensurately increasing the powers of digestion and general nutrition; but sudden and extreme cold depresses all the physiological powers of the system.

491. Heat, I have said (129), radiates from the living body in the same manner as it does from inorganic bodies; hence, as a general fact, the temperature of living bodies is lower near the surface than in the more central parts; but this by no means sustains the conjecture that the calorific function is peculiar to the internal parts. It is probably not peculiar to any particular part of the system, but is as universal as the distribution of the nerves of organic life and the blood-vessels.

492. The interests of the vital economy seem to require that the blood under the vital control should be easily preserved in a state of fluidity, and at the same time be capable of becoming solid with ease. And it appears from numerous experiments that the blood most readily coagulates at its natural temperature of 98 degrees *Fah.*, and that any considerable variation from this point impairs and even destroys its coagulating power.

NUTRITION.

493 The blood being distributed by the arteries to every part of the body which requires nourishment (475), is regularly appropriated

according to the wants of the several parts; and with most undeviating accuracy and integrity, every structure is furnished with fresh supplies of its own proper substance. The bones, cartilages, ligaments, tendons, membranes, muscles, and nerves, all continually receive new portions of homogenous matter, elaborated by the vital processes from one and the same current of blood. How these ultimate processes of assimilation or structure are effected is wholly unknown. Various conjectures have been advanced on the subject, but they have begun and ended in guessing and hypothesis. I have already alluded to the notion (480), which attributes to the ultimate vessels the office of strainers, that merely separate from the blood substances already formed in that common fluid; yet it is well known that not a trace of gelatin has ever been found in the blood, although this substance probably enters more extensively into the solid forms of matter than any other in the body. Some physiologists, as I have said (375), have imagined that there is a system of vessels called exhalants connected with the capillary system, which perform the ultimate processes of nutrition. Other and very eminent physiologists suppose that the capillary extremities of the arteries secrete and deposite in its proper place and manner the substance of each particular structure in the body; and they assure us that, with the utmost powers of the microscope, they are unable to detect any difference between the vessels which secrete one substance and those which secrete another; that even those which supply the teeth and those which support the brain appear extremely alike; and yet the substances which they secrete from the same blood are as extremely unlike as any two in nature. The vessels which form and nourish the cartilages, ligaments, tendons, serous membrane, etc., are said to circulate only white blood (185), and some have supposed it is because they are too small to circulate the red globules; but this is a mere conjecture, and the reason assigned is of quite too mechanical a nature for a physiological explanation.

494. From the commencement of chymification to the ultimate function of structure, therefore, and indeed to the ultimate function of decomposition and elimination of the effete or worn out matter of the body, all the changes are unquestionably effected by the processes of vital chemistry, which decompose the simplest known forms of matter (139), and whose analytical and synthetical operations are governed by laws peculiar to vitality, and in direct opposition to the affinities of inorganic chemistry (121—123).

495. Besides supplying the ordinary wants of the body by the general function of nutrition, the vital economy possesses the power, to a certain extent, of repairing the injuries which are done to it by physical violence. If a bone be broken, or a muscle or a nerve be wounded, and if the system be in a proper state of health, the vital economy immediately sets about healing the breach. The blood which flows from the wounded vessels, by a law of the economy, coagulates in the breach, for the double purpose of stanching the wound, and of forming a matrix for the regeneration of the parts. Very soon minute vessels shoot out from the living parts into the coagulum of the blood, and immediately commence their operations, and deposite bony matter where it is required to unite a fractured bone, and nervous substance to heal the wounded nerve, etc. But the vital

economy seems not to possess the power of reproducing the true muscle (201), and therefore when any fleshy part has been wounded, its breach is repaired by a gelatinous substance which gradually becomes hard, and sometimes assumes something of the fibrous appearance. It however so perfectly unites the divided muscles as to restore its functional power.

496. In this wonderful process of healing, the little vessels employed in furnishing the matter for the several structures seem to know precisely where to commence and where to end their labors; and unless disturbed and driven to irregular operations by irritating causes, they never leave their labor incompiete, nor go beyond the proper bounds. But under the constant abuses of the body, when the nerves of organic life are continually tortured, and the vital economy generally disturbed, by the unhealthy habits of the individual, not only in the process of healing a wounded part, but in the ordinary function of nutrition, substances will be misplaced or imperfectly elaborated, and diseased structure will be the result.

SECRETION.

497. The common current of blood from which the solids of the body are elaborated, is also the source from which the different vessels (313) and follicles (333) and glands (334) exhale or secrete (330) the aqueous fluid or vapor which everywhere perspires from the external skin, and from the mucous membrane of the alimentary cavity (339) and of the lungs and nose and ears and eyes and every other part; and that which exhales from the serous membrane of the closed cavities (178), and moistens and lubricates the heart (368) and all other organs and parts in the thorax and abdomen (175); and that which moistens the brain (272) and the spinal marrow; and the glairy fluid which lubricates the joints (185) and the tendons, etc. (195); and the serous fluid of the proper cellular tissue (171); and the adipose matter (178) of the same tissue (498); and the marrow of the bones (179); and the humors of the eye (409); and the mucus (333) which everywhere lubricates the surface, and imbeds and protects the delicate vessels and nerves of the mucous membrane (339) and external skin (187); and the oily matter which anoints the skin and hair (421); and the wax of the ears (333); and the tears (413), and the saliva (340), and the gastric juice (332), and the pancreatic fluid (447), and the bile (451), and the secretion of the kidneys, and every other secreted and excreted fluid and substances of the body, which are subservient to the lubricating and solvent purposes of the vital economy, or are eliminated from the vital domain for the purposes of purification. But how these secretions are effected, we know as little as we do how the substances which enter into the solid structures are produced. All that is known on the subject, however, warrants the conclusion that the vital forces possess something like a transmuting power (62), as they continually elaborate from a few kinds, and even from a single article of food and the atmospheric air, all the different substances of the body, with natures and properties so diversified, so different; and which when analyzed by the chemist, afford many substances which cannot be accounted for from anything contained in the blood, nor upon any known principles of chemical analysis and combination. All these substances have been repeatedly

analysed, and the chemical results precisely stated, but without any advantage to physiology or therapeutics (431).

498. Concerning the adipose matter, or fat, which transudes from the arterial capillaries, or is in some other manner deposited in many parts of the cellular tissue (178, 497), different opinions have been entertained. It is contained in little cells, which vary exceedingly in size, form, and disposition, and which do not communicate with each other. It is said to be *always* found in the cellular tissue of the orbits of the eyes, the soles of the feet, the pulp of the fingers and that of the toes; and to be *frequently* found, and sometimes in great abundance, in the cellular tissue under the skin, and in that which surrounds the heart, kidneys, etc.; while in the eyelids, the interior of the skull, of the brain, the eyes, ears, nose, lungs, intestinal canal, glands, and some other parts, it is *never* found, except as the effect of disease. The quantity of this oily matter or fat in the human body varies greatly in different individuals, and in the same individual at different times (178). In some instances it constitutes a very considerable proportion of the bulk and weight of the whole body. Various opinions have been entertained in regard to the use of this substance in the animal organic economy. In the orbits of the eyes, the soles of the feet, and other parts where it is most invariably found, it is supposed to serve the purpose of the elastic cushions, giving facility to movements, diminishing the effect of pressure, etc. Under the skin, it is supposed, as a non-conductor of heat, to assist in preserving the natural temperature of the body, and protecting the vital domain from the effects of severe cold; and generally it is thought to be subservient in some measure to the lubrication of the solids; and also to prevent excessive sensibility. It is, moreover, a prevailing opinion among physiologists, that the disposition of this matter in the cellular tissue is a provision of nature against the emergencies of famine. They suppose that when, by any means, the food of an animal is long cut off, as in the case of hibernation or torpor through the winter, the vital economy lays hold of its adipose deposits, as bees do upon their honey, and reconverts it into blood for the nourishment of the system; and this is inferred from the fact that the bear and other hibernating animals, on entering into the torpid state for the winter, have generally a considerable quantity of fat in their bodies, and that when they come out in the spring, it is all gone, and they are exceedingly lean. But this does not appear to be conclusive. If an ox be stall-fed till he becomes very fat, and then put to hard labor for several months, he will lose a large proportion of his fat, even though he be as highly fed during the whole time of his labor as he was in the stall, and receive all the food that he will eat, and all that his vital economy can healthfully dispose of. But in this case it will hardly be said that the adipose matter is re-absorbed for the nourishment of the system. Again, if the fat be designed for the nourishment of the body during protracted fasts, etc., then if a very fat man, in the enjoyment of what is ordinarily considered good health, and a lean man in good health, be shut up together, and condemned to die of starvation, the fat man ought to diminish in weight much more slowly, and to live considerably longer than the lean man; but directly the contrary of this is true. The lean man will lose in weight much more slowly, and live

several days longer than the fat man, in spite of all the nourishment which the latter may derive from his adipose deposites.

499. That the adipose matter of perfectly healthy bodies, like the marrow of the bones (179) is subservient to some important purposes in the organic economy, cannot be doubted; but it is not necessary to infer from any known facts relating to it, that its extensive accumulation in the cellular tissue is a provision of nature for nutrient purposes, nor that it is employed for such purposes during long fasts. We have seen (314) that in the grand operations of the vital economy, the two great processes of composition and decomposition are continually going on: new matter is constantly added by the general function of nutrition to every structure and substance of the body, and old matter is constantly withdrawn and eliminated by the general function of absorption and excretion, from every structure and substance. In a perfectly healthy state of the system, while the functional power and integrity of all the organs is preserved, a nice equilibrium is always maintained between the two great processes. But if from excessive alimentation, want of exercise, or any other cause, this equilibrium be destroyed, and the function of nutrition becomes excessive, disease in some form or other must speedily result, or the vital economy must have some extraordinary mode of relief. More nutritious matter is received into the vital domain than the wants of the vital economy demand, and more than its powers can regularly dispose of. None of the regular tissues or structures of the system can incorporate it, and it cannot be eliminated from the vital domain as fast as it is received. In this exigency it must be disposed of in the safest manner possible, as a temporary resource. The cellular tissue, we have seen (158), is the lowest order of animal structure; the lowest in vital endowment and functional character; and of all the forms of this general structure, that in which the adipose matter is deposited (178), is the lowest species. In the cells of this loose tissue, which is simply employed as a kind of web to connect other and more important tissues and parts (171), the vital economy, therefore, may, with greatest safety, in its particular emergencies, deposite for a time whatever substances it is obliged to dispose of in the most expeditious and convenient manner, and which it is not able to eliminate from the vital domain; for in these cells, such substances are at the greatest remove from any important vital power or function that they can be within the domain; and hence it is that such substances are deposited in this tissue; and some of the substances which are deposited here, and in some cases retained for years, are of the most deleterious character, as we shall see hereafter (1265). Is it not obvious, therefore, that the adipose matter which results from excessive alimentation, is temporarily deposited in the cellular tissue as a necessary expedient of the vital economy in its emergency?

500. It is a general law of the vital economy, that when by any means the general function of decomposition exceeds that of composition or nutrition, the decomposing absorbents always first lay hold of and remove those substances which are of least use to the economy; and hence all morbid accumulations, such as wens, tumors, abscesses, etc., are rapidly diminished and often wholly removed under severe and protracted abstinence and fasting. When by an excess of the general

been deposited in the cellular tissue, therefore, if active exercise be considerably increased, or the quantity of food be considerably diminished, the decomposing and eliminating organs of the system, by all that their functions are relatively increased upon that of nutrition, will be employed in first removing the adipose matter, in order to restore the system to the most perfectly healthy condition.

501. The accumulation of adipose matter in the human body, therefore, always evinces more or less of diseased action in some of the organs concerned in the general function of nutrition, and can only be carried to a very limited extent without degenerating into serious disease, terminating either in morbid obesity, dropsy, or apoplexy, or reacting with violence on some of the organs belonging to the digestive apparatus. Hence the notorious fact, that almost every animal which is fatted and killed for human food, is actually in a state of disease when butchered. It is extremely difficult, indeed nearly impossible, to find in the butchers' markets of any of our cities a perfectly healthy liver from a fatted animal; and it is by no means an uncommon thing for fatted hogs to die of disease when just about to be killed for the market.

SIZE OF THE BODY, DETERMINATE.

502. But since, by the general function of nutrition, new matter is continually supplied to every structure and substance in the body, from the commencement of our existence till death closes our temporal career, why do not our bodies continue to increase in size as long as we live? Why should they grow from the infantile form to the stature of manhood, and then entirely cease to grow, and remain, with slight variations of bulk, at a fixed size through life? The general economy of nutrition by which the body attains to the ordinary stature of man, so far as we can perceive, continues its operations through life. What then defines the proportions of our bodies and fixes the limits of our growth? Human science can make no determinate reply to these interrogations; and in his attempts to answer them, the physiologist can only reason from the general laws peculiar to living bodies, and from the phenomena, facts, and analogies, which indicate the laws that govern the development and determine the form and size of all organized bodies. My own views on this interesting point will be presented in a subsequent lecture. Be it remembered, however, that the difficulty in the case is not in accounting for the matter which is constantly supplied to the body by the function of nutrition. Because, as we have just seen (499), there is in all living bodies an economy of decomposition and elimination as extensive as that of nutrition. But this economy is in active operation during the whole period of growth, as well as in subsequent life; and the question is, why, under the active and simultaneous operations of the composing and decomposing processes, the body should grow to a certain size, and then entirely cease to grow, and the two processes, as a general fact, balance each other ever after?—or if they do not, disease in some form or other necessarily results. In some rare instances, it is true, the human body continues to increase in bulk, till it becomes an enormous and shapeless mass, as in the case of Daniel Lambert and others. But these are always cases of disease, and the subject seldom reaches the middle period of life.

Indeed, as I have said (501), all obesity or corpulence is a species of disease, and denotes a want of integrity in some of the functions of the system.

DECOMPOSITION.

503. The general process of decomposition is supposed to be effected principally by the lymphatics proper (387, 388), which, as we have seen (385), arise from every surface and portion of the body; so that there is scarcely a particle of matter belonging to the whole organic system which is not within the reach of their action; and they are supposed to be continually acting on every structure and substance in the body where the function of nutrition is performed, gradually decomposing and resolving to a limpid fluid called the lymph, the hardest bones as well as the softest structures and still less consistent secretions and fluids of the system. And thus, by the constant and regular operations of the nutritive organs on the one hand, and the lymphatics on the other, every structure in the living body is continually and simultaneously undergoing the processes of composition and decomposition, of renovation and decay (314, 499). Particle by particle of new matter is constantly added to every structure, from the fluid blood; and at the same time, particle by particle of old matter is constantly absorbed from every structure, and converted to the fluid lymph. So that while the organic constitution and physiological identity of every structure and of the whole system remain permanent through life, a continual change is taking place in the particles of matter of which our bodies are composed; and, according to the estimate of some physiologists, an entire change of all the matter in our bodies is completed as often as once in seven years (314).*

504. Besides thus regularly absorbing the substance of the various structures, secretions, exhalations, etc., within the precincts of the vital domain, the lympathics are also supposed to absorb the pus and other kinds of matter which disease may cause to form or accumulate in any part of the system. If fluids accumulate in any of the closed cavities, these vessels are supposed to be the organs by which they are taken up and removed; and it is likewise supposed by some that they are the organs which in the lungs and external skin absorb the infectious and pestilential properties of an impure atmosphere, and other foreign matters. But this last opinion may be considered questionable (441, 442).

505. The lymph has been regarded by some physiologists as wholly excrementitious matter, which is returned to the circulation only for the purpose of being presented to the excretory organs which eliminate the impurities of the blood. Others consider it as of a very different character and destiny. They say that the lymphatics, like the lacteals (455), possess an assimilating power to a high degree, and that all the substances which they absorb of every description, are converted into a fluid closely resembling the chyle (459), but of a more refined and sublimated quality; and that it is returned to the pulmonary and general circulation, to be appropriated to the most delicate and elevated purposes of nutrition. The correctness of this opinion, however, is somewhat doubtful. The lymphatics evidently possess an assimilating power (441), by which they convert many, if not all, of the sub-

* Excepting the teeth.

stances that they absorb, into a nearly homogenous fluid, which mingle with the chyle in the thoracic duct, and passes with it into the blood-vessels (476). And when supplies of food in the alimentary canal are exceedingly small or entirely cut off for a considerable time, the lymphatics unquestionably become much more active than usual, and prey upon the adipose and other substances of the body (500), forming a lymph which may have many of the characteristics of the chyle and blood, and which may, to some extent, in such an emergency, serve the purposes of nutrition. But in the ordinary and undisturbed operations of the vital economy, when the alimentary organs are duly supplied with food, it is probable that the lymph, formed from the decomposed matter of the body, is mainly if not entirely an excrementitious substance.

DEPURATION.

506. The impurities which are continually accumulating in the blood, by the return of the worn-out matter of the body to the circulation, and by the absorption of such substances as are unfitted for the wants of the system, are incessantly eliminated or expelled from the vital domain by the excretory organs constituted for the purpose. The lungs, as we have seen (479), are largely concerned in this work of purification. The liver (460) is associated in the same general function; and the kidneys excrete a large proportion of the effete matter and other impurities of the blood. The mucous membrane of the alimentary canal also participates to some extent in this office; but the external skin (331) probably exceeds any other organ, and it has been supposed to exceed all the other depurating organs in the system, in the *quantity* of matter which it *eliminates*. It is in some measure a respiratory organ, corresponding in function with the lungs (479). Like these, it continually consumes oxygen, and eliminates carbonic acid gas and imperceptible vapor; and at times pours forth a flood of sensible perspiration. Foreign and unassimilated substances absorbed from the alimentary cavity are largely eliminated from the vital domain by the skin; and the decomposed matter of the body is continually passing off through this portion of the great limiting membrane (330). Since the commencement of the seventeenth century the opinion has generally prevailed, which was advanced by Sanctorius, that the skin ultimately throws off, in the form of insensible perspiration, something more than one-half of all the matter which enters the vital domain. Some modern physiologists have questioned the accuracy of this estimate; but it is admitted on all hands, that the skin is one of the most important depurating organs of the system, and that its healthy condition and functional integrity are of immense importance to human health and comfort.

507. The depurating organs, as I have stated (289), reciprocate with each other in function to a considerable extent, even in the healthy state of the body, and in a diseased condition vicarious function is often attempted. Copious perspiration diminishes the secretion of the kidneys, and on the other hand a suppression of the cutaneous function generally increases that of the kidneys. The skin and lungs reciprocate in the same manner. Excessive exhalations and excretions of the alimentary canal also frequently result from a suppression of the

function of the skin, and, by whatever cause induced, they are always attended with cutaneous depression. But the welfare of the particular parts, as well as of the whole system, requires that each organ should uniformly and vigorously perform the full measure of its own duty; because frequent excesses arising from an undue determination of fluids to any one part, lead to debility of the part, and often result in impaired function, imperfect assimilation, local diseases, and general injury and death. In this manner, sudden suppressions of the functions of the skin often lead to diabetes and pulmonary consumption, by causing undue determinations to the kidneys and lungs, and inducing inflammation and permanent disease in those organs. The liver also suffers from all want of integrity in the other depurating organs; and its derangements compel the skin, and indeed the whole system, to make an effort to throw off the matter which it should have eliminated. Still more excessively morbid and extravagant attempts at vicarious function take place when the mammary glands and other organs endeavor to perform the duties of the kidneys. But cases of this kind are very rare; frequent enough, however, to show the wonderful resources of the vital economy in extreme emergencies, and also to demonstrate the great importance of health and integrity in each and every organ.

WEAR, EXPENDITURE, AND DISEASE.

508. In the most healthful and correct performance of their functions, the several organs of the body necessarily suffer some waste of substance as well as expenditure of functional power (376). But while the general economy of nutrition is properly sustained, the replenishment keeps pace with the exhaustion. By excesses and irregularities, however, and every other means by which the constitutional laws and functional relations of the several organs are violated, not only is the system, as a whole, made to suffer, but the particular organs are often made the seats of local disease and suffering.

509. By painful experience, most of the human family who have numbered twenty years, know that the teeth may become the seats of distressing disease and decay; the gums may become softened and flaccid, and ulcerous, and otherwise diseased. The tongue and other parts in the mouth are subject to disease in a variety of forms. The salivary fluid and mucous secretions may be rendered extremely acrid and irritating to the parts over which they pass; the salivary glands may become inflamed, enlarged, indurated, and cancerous; the nose, fauces, windpipe, meatpipe, and other surrounding parts, are liable to many distressing forms of disease The lungs are subject to inflammation, ulceration, and general decay; the heart and blood-vessels are liable to enlargements, ruptures, ossification, and a variety of other forms of disease. Derangement of function, formation of calculi, chronic inflammation, change of structure, decay of substance, etc., may take place in the liver, kidneys, and other glands. In short, there is not an organ, nor tissue, nor substance, in the whole vital domain, which may not become diseased, and prove the source of death to the body. The bones (185) may become dry and brittle, or they may ulcerate or mortify. The cartilages (185), ligaments (188), and tendons (195), may also become dry and brittle, and lose their elas-

ticity, and ossify or be destroyed; and the nerves and muscles may suffer a change of structure, and decay of substance.

510. There are many external and foreign causes, as well as internal disturbances, by which these diseases are induced, and which act upon the system at different points and in various modes. But the alimentary cavity is the principal avenue through which the causes of disease commit their depredations on the vital domain; the stomach is peculiarly a centre of irritation and starting point of disease to the whole body. It is continually liable to be disturbed and irritated in itself, and always communicates its irritations more or less extensively and powerfully to other organs (297, 298). The means by which its own function is disturbed and impaired, and itself made the seat of disease, are very numerous. Substances of every kind, which are not adapted to the wants of the vital economy, if introduced into the stomach, become the causes of a degree of irritation, always proportionate to the offensiveness of their character. Alimentary substances which are in themselves proper, if introduced into the stomach in an improper quantity or condition, or at an improper time, or without suitable mastication and insalivation (426), necessarily become the causes of irritation, leading to local and general disease. The passions of every kind, and especially the painful and the violent, all mental excitements, and severe mental application (304), more or less affect the condition and function of the stomach, and often most injuriously; and if frequently repeated or long continued, they debilitate the organ, and develope in it a high degree of morbid irritability; sometimes inducing inflammation, chronic and acute. In short, whatever is unfriendly to the vital properties, or impairs the nervous power and muscular contractility of the stomach (444), or disturbs its function and deteriorates its functional results, always leads to disease of the organ itself, and tends to induce morbid irritability and sympathy, inflammation, thickening of its coats, softening and change of structure in the muscular and nervous tissues, scirrhus, cancer, etc. And it is a remarkable fact, that when the integrity of the organic sensibilities and sympathies of the parts is greatly impaired or destroyed by improper dietetic habits (296), as is universally the case in civic life, irritations, functional derangements and disease even of the most fatal character, may be induced in the stomach and intestines, and slowly progress for years, and finally terminate in death, without ever being suspected by the subject, or affording such symptoms as lead to a detection of the evil by the physician.

511. But the stomach does not suffer alone in its irritations and diseases. All irritations disturb the functions of the stomach, and more or less impair the quality of the chyme, and this leads ultimately to a deterioration of all the fluids and solids of the body. Besides, in all those irritations which affect the general condition of the stomach, the heart, lungs, liver, and all the other organs of the system sympathize (297, 298), and by this sympathetic irritation their functions are also disturbed and impaired. And if, in consequence of hereditary peculiarities, or some other cause, the lungs, liver, or any other organ, is particularly predisposed to disease, these sympathetic irritations always tend to develope it; and when developed, the local disease either reacts upon the stomach, and becomes a source of continual

irritation to that organ, or serves as a kind of outlet, or concentrating point, by which the gastric irritations are relieved, and the stomach sustained in health at the expense of the diseased part which suffers from every error of diet, from every gastric irritation however induced. Thus, continued gastric irritation often produces spinal irritation, which reacts with tremendous energy on the stomach, in some instances completely destroying its functional power; and on the other hand, disease may be induced in the lungs, liver, and other organs and parts, by gastric irritation, and carried forward to the destruction of the affected part and to the extinction of life, continually exasperated by the originating cause, while the stomach itself seems all the while to be in excellent health, and the unfortunate sufferer is confident that nothing which he eats or drinks, or swallows as medicine, does him any injury, because 'its sits well on his stomach.' In this manner, every organ and part of the human body in its turn may fall a sacrifice to the abuses and irritations of the alimentary canal; and, with very few exceptions, fevers of every type, and acute and chronic disease of every form, may spring from the same source. With what propriety, then, did the Psalmist exclaim, 'I am fearfully and wonderfully made.'

LECTURE IX.

Nature of the soul—Immortality of man—Connexion of the soul with organized matter—The laws that govern it—Brain the seat of intellectual and moral faculties—Views of Gall and Spurzheim concerning the organs of the brain and the mental and moral faculties—Elements of intellectual and moral character in man, and the diversities of manifestations—These phrenologists attribute to cerebral organization—The cerebral organs enumerated, described, and located—Temperament and physiognomy—Combinations of faculties in forming character—Plurality of cerebral organs proved by the mental relief from a change of subjects—By monomania—The laws of mind in sanity and insanity—Its organic instruments—Special senses—Sight the source of imagery—The philosophy of vision—Mental perception—Mental conception—Reflection—Perceptions of the different senses not reproduced with equal ease and vividness—Associations of perception and reflection—Associations of reflection, conception, and propensities and sentiments—Mental effects of intoxicating liquors in religion, etc.—The Mind cannot perceive two distinct objects at once, nor perceive and conceive distinctly at the same time—Perfect sleep—Dreams, how produced and affected—Conceptions of the poet, etc.—Distinct conception takes away the power of perception at the same instant—Dreams, and conceptions while awake, realities to the mind while they last—Nervous irriration, how it produces mania—All the feelings and affections by whatever produced enter into the mental operations, and affect the judgment—hence according to the feeling, so the conclusions—As we feel on a subject, so is its importance to our mind—Wine, music, beauty; their effects—Strict mental sanity defined—Insanity, what, and how caused—Mind always true in its laws—How far this favors phrenology—Does local disease of the brain cause insanity?—Insanity from irritation in the domain of organic life—Phrenology makes the brain too exclusive—Intellectual and Moral Physiology the true science.

512. We have seen that all matter, if not essentially a single element (72, 87), consists of a very few primordial substances (72), and that the same matter is common to all material forms (49), both inorganic and organic (112, 118); that the various forms of matter are produced by the different arrangements of the same primordial atoms (80, 106); and, therefore, that the nature of a thing depends in no degree on the matter of which it is formed, but entirely on the constitutional laws of arrangement (140); and these laws, it is contended, do not arise from

the intrinsic properties of matter (83), but are imparted to it, by an omnipotent and infinitely wise and benevolent Creator (89) ; and from the constitutional nature of things thus established, all their properties and powers arise (140). We have seen also, that the most primitive laws and properties imparted to matter, are those which belong to inorganic forms (106), and that the laws and affinities of inorganic matter are directly adverse to the laws and affinities peculiar to organic matter (107) ; and consequently the arrangement of matter in the formation of organized bodies is the effect of the operation of constitutional laws which suspend and overcome the laws and affinities of inorganic matter (110) : and hence the constitutional laws and properties peculiar to living organised bodies cannot arise from inorganic matter, nor result from the operations of any of the laws or affinities of inorganic matter; and therefore the constitutional laws and properties peculiar to organized bodies, were superinduced and established in the permanent economy of organic vitality, by an omnipotent and infinitely wise and benevolent Creator (89).

513. The same train of reasoning is equally applicable to the differences existing between vegetable and animal forms of matter (114), and the properties and powers peculiar to animal bodies ; and also to the differences existing between the cellular, muscular, and nervous tissues of animal bodies, and the properties and powers peculiar to each of these tissues (312).

514. It is not, therefore, in the nature of things, possible that vitality nor any of the properties peculiar to the living tissues should spring from the intrinsic properties or powers of matter (108), nor from any organic arrangement of matter ; but, on the contrary, the organic arrangement of matter is always necessarily the effect of vital action ; and the properties and powers with which each tissue is endowed as a living substance, arise, not from the arranged matter of the tissue, but from the vitality residing in the tissue. The vitality of the different tissues differs in degree, and there is reason to believe that the vitality of the muscular tissue is of a higher order than that of the cellular tissue and that the vitality of the nervous tissue is of a higher order than that of the muscular, and that the vitality of some parts of the nervous tissues is of a higher order than that of other parts; and it is possible that the vitality of some portions of the brain is of a higher order than that of others.

515. But when we speak of the laws and properties of matter, what do we mean (88)? We talk of the law of gravity ; and so far as the size, weight, distance, velocity, etc., of attracting bodies are concerned, we can reason with mathematical accuracy and precision ; but with all this extent and accuracy of knowledge in regard to the fixed order of the phenomena of gravity, what do we know of the essence of that power which we call the attraction of gravitation ? Absolutely nothing ! The chemist also speaks of the molecular affinities of matter, and the laws which govern the combinations of his experimental elements ; yet he is totally ignorant of that power or property which he calls affinity, and the fixed order of whose phenomena he calls law. The astronomer and the chemist, therefore, cannot, from their knowledge of the essences of things, either affirm or deny that *the power which produces all the physical and chemical phenomena of matter is the Omnific and Omnipotent Spirit of God.*

516. We use the word law then, in regard to matter, as an abstract term, to signify a fixed order of phenomena that are produced by a power of which we are entirely ignorant. Hence all evidences of design and of final causes go, without any drawing back, to prove either that an Omnipotent and intelligent First Cause continually exerts a direct and controlling influence on matter, or that the *essential nature* of each form of matter (140) which governs all the phenomena of its particular form, and which is the substratum of all the properties and powers of its form, was originally established, and its continually sustained, in a permanent constitutional economy by the Creator.

517. While, therefore, we cannot, from our knowledge of things, affirm what the essence of life is (41), we know as certainly as we know anything concerning matter, that it could not spring from any of the properties or powers of inorganic matter, and that its relation to the organization of matter is of necessity in the nature of things, and has ever been since the first establishment of the vital economy in connexion with organized matter, that of a cause and not of an effect (108). Hence it may be boldly affirmed, that no man possesses knowledge which justifies the assertion, that the power which governs the organization of the nervous system of animal bodies, and constitutes the substratum of all its properties and powers, is not a substance essentially different from matter. Nor does any man know anything contrary to the idea that this substance may differ in different orders of animals.

518. Purely as physiologists, then, with all the light of science around us, we can, with at least as much philosophical propriety, affirm that *the substratum of the sensorial power of the human brain* (514) *is a spiritual substance*, as any one can affirm the contrary; and the truth of our affirmation is infinitely more probable than it is that mind and moral feeling are results of organized matter. It is frankly confessed, however, that as *mere physiologists*, we can offer no evidence of the future existence of man. This, of necessity, in the nature of things, is purely a doctrine of revelation. As metaphysicians we may reason very forcibly to such a conclusion from what we regard as moral evidence and general analogy, and from the intellectual and moral fitness of man for such an existence; but, apart from the sacred Scriptures, we have no *decisive proof* that man will exist in a future state. But while it is true that physiology affords no evidence of man's future existence, it is also true that it affords no proof to the contrary; and the important fact that all the bearings of the Gospel of Jesus Christ on the present state of human existence, accord most perfectly in all respects with the physiological laws of our nature, almost amounts to a demonstration that the doctrines of that Gospel concerning our future existence are true (603).

519. Since, therefore, physiology cannot prove that the sensorial power of the human brain is a property of matter, nor that it is a result of the peculiar organization of the matter of the brain, and since all that we know of the laws and properties of matter is adverse to such a notion; and since the Gospel of Jesus Christ, which comes to us with the strongest possible evidence of its divine authenticity, explicitly affirms the existence of a soul in man which shall exist beyond the grave eternally, it may be boldly affirmed that the human soul is an

immaterial substance, and that it constitutes the substratum of the sensorial power of the human brain; and no man can show from the demonstrations or facts of science, that this opinion is not strictly philosophical, and the most probable of any.

520. It is entirely certain, however, that, whatever be the substratum of the sensorial power of the human brain, it resides in and acts through the organized matter of the nervous substance, during our present state of existence, precisely the same as if it were merely a property of that vitalized matter; and all its powers and manifestations are subject to precisely the same laws as govern the powers and manifestations of vitality. This truth is of immense importance to every human being. Indeed, it lies at the very foundation of intellectual and moral and religious philosophy, and is of vital interest to human happiness in every point of view. Instead of neglecting it, therefore, as a matter unworthy of our consideration, or of regarding it as of secondary importance, or of combating it with vain assertions and denunciations as heretical, we should diligently study to understand it, in all its depth and breadth and bearings and relations.

521. Should it be asserted that this doctrine proves the immortality of the lower order of animals equally with that of man, I reply—1, that, according to the views which I have advanced, there may be an essential difference between the substratum of the sensorial power of the nervous system of the lower animals, and that of the sensorial power in the human brain (517); 2, that the immortality of man, or his future existence, does not depend on the nature of his soul, but on the will and power of the Creator. The human soul, equally with the human body, depends on God for its existence; and if we exist in a future state, it will be purely because God wills it, and not because the human soul is self-existent. Therefore, unless it can be shown that God has revealed the doctrine of the immortality of the lower animals as explicitly and fully as he has that of man, then my reasoning does not in any manner go to prove the immortality of the lower orders of animals. But it is not the business of physiology to prove the immortality of the human soul, and it is not possible for it to prove the contrary.

522. In regard to the particular seat of the human soul, different opinions have prevailed at different periods of time, and amongst different nations; but it would neither be interesting nor instructing to review, on the present occasion, the various theories and speculations which have been advanced on this subject. The human brain is unquestionably the more immediate and special organism of the mental and moral powers; and the grand question before the world at present is, whether the mind acts in and through the brain, as a single organ, or as a system of organs. This question has, indeed, been agitated to some extent ever since the time of Aristotle, and probably ever since the human mind first began to speculate on the relations between mind and body; but it has been made a more prominent object of contemplation and inquiry in our own day, by the theory which has been advanced by Dr. Gall, and advocated and improved by Dr. Spurzheim and others (274, 279).

523. Without stopping to review the progress of this theory from its origin to the present moment, I shall proceed to present a brief

abstract of it, as it last came from the hands of Dr. Spurzheim According to this theory, as I have already stated (267, 268), the brain is composed of diverging and converging fibres of medullary substance, which are so arranged as to form in connexion with the pulpy or gray matter of the brain, a system of duplex organs; and each pair of these organs are a specific and distinct faculty (275).

524. The organs are divided, according to their functional character, into Propensities, Sentiments, and Intellectual Faculties. The Propensities are situated in the lower and back part of the skull, and are all common to man and the lower animals. The Sentiments occupy the upper portion of the skull, and are subdivided into those which are common to man and the lower animals, and those which are peculiar to man. The Intellectual Faculties belong to the fore part of the skull, or the forehead, and are subdivided into perceptive and reflective faculties.

525. This theory claims to be purely inductive, and to be founded on the correspondence between the conformation of the brain, as evinced by the shape of the skull, and the mental and moral character; and is called *Phrenology*, or the doctrine of the mind.

526. It is a matter of common knowledge, that the greatest diversity of propensity, sentiment, and habits of thinking and of acting, are continually manifested in society, by different individuals; and that this diversity may be traced through all stages of civilization and all periods of life, and often exists in a very remarkable degree even in small families. Some individuals have an intense, instinctive love of life, and always contemplate death, or the extinction of life, with the deepest dread and even horror; and this, too, without any regard to the pain of dying: while others seldom think of death, and have so little regard for life, that, were it not for their dread of the pain of dying, or of what may follow the death of the body, they would, on slight occasions of disappointment and vexation, throw life away. Some individuals are habitually given to the excesses of the table, and regard the indulgences of the palate as the highest and almost exclusive enjoyments of life; indeed they often seem not to have the power to refrain from these indulgences, even when they know that disease and suffering must inevitably be the consequences of their yielding; while others seem to eat and drink from a mere sense of duty to sustain the body, and never run into excesses. Some are extremely tender and gentle and merciful in all their actions, and are habitually careful to destroy nothing that can be of use to themselves or to any one; while others, even from early childhood, evince a disposition to destroy almost everything they can lay their hands on, and delight in killing flies and other animals, and often become murderers of their own species. Some manifest an eager desire to enter into wedlock as early in life as possible, while others coldly prefer celibacy, and spend their life, from choice, in single blessedness. Some discover the greatest fondness for little children, and seem to prefer their society to any other. In some mothers the maternal feeling is supreme, and all the energies of their soul seem to yearn over their own sweet babes; by day and by night, in health and in sickness, in prosperity and adversity, in honor and ignominy, they cling to them and hang over them in maternal devotedness, and are never weary of supplying their wants and admi-

nistering to their comforts. As the bosom of waters over which 'the viewless winds' flap their hasty wings, so is the face of such a mother when her children are acting or suffering before her; every emotion which they manifest, and almost every movement which they make, ripple her countenance into expressions of pleasurable or painful sympathy. Nor are her sympathies confined to her own children; she has always a smile for the playfulness of other babes, and a tear for their sufferings. Such mothers, even in the midst of penury and privation, consider their children their greatest earthly blessings, and never regard them as burdens under any circumstances. Others have the greatest aversion to little children, and can never bear their presence but with disquietude and annoyance. If such are mothers, they perform the maternal duties in a cold and heartless manner, and are continually complaining of the toil and vexation which their children cause them, and are frequently heard to say how much better off they should be without children. Such mothers, in whom there is a want of the proper restraint of moral sentiment or of education, will abandon, and in some cases even destroy, their own babes. Some persons are extremely fond of society, and are strongly inclined to form the attachments of friendship, and to become attached to particular things which they are accustomed to; while others seem to be isolated beings, shut up within themselves, and having no sympathies either for men or things. Some are powerfully attached to their home, and native place, and country, and are zealous and devoted patriots; while others are equally at home in all places, and have no love for any country. Some are peaceable and meek, and timid and cowardly; while others are bold and full of courage, and perhaps contentious and turbulent and quarrelsome, and always ready to fight on the slighest provocation. Some are excessively open and frank and communicative, blab everything they know and hear and think, and never can keep a secret, nor practice any concealment nor hypocrisy; they seem indeed not to be able to conceal their sentiments, even when they know their own welfare requires it; while others are always secret even in regard to trifles, and wrap everything in concealment and mystery; they never speak without first considering what they are going to say, and whether it can in any manner be turned to their disadvantage; they seldom give a prompt and direct answer to an interrogation, but reply in an indirect, ambiguous, or evasive manner, and are frequently, sly, crafty, hypocritical, and knavish, and given to falsehood. Some are excessively prodigal and improvident, and have no disposition to acquire anything; while others have a strong desire to possess everything they see, and are prompted to the most diligent and indefatigable efforts to acquire great possessions, and perhaps are extremely parsimonious and covetous and avaricious; and in some cases the propensity is so great that it leads to habitual theft. Some seem to possess no aptitude to construct even the simplest kinds of machinery; while others evince an irresistible propensity to be engaged in some kind of mechanical employment, and with astonishing aptitude soon become masters of the most difficult mechanical arts, inventing and constructing the most complex pieces of mechanism as if the whole were a result of peculiar intuition.

627. Some individuals are extremely incautious and rash, while

others are very circumspect, and excessively cautious. Some are perfectly reckless of the opinions of others, and have no desire for approbation and distinction; while others are extremely sensitive to the slightest expression of disapprobation, and feel a continual and powerful desire to be the objects of attention and admiration and praise, and have a deep and fervent longing for renown and glory, and immortality of fame. Some have little self-confidence and self-respect, and always throw themselves upon a level with those in whose company they may happen to be; while others feel a great degree of self-confidence, self-esteem, and self-importance; they speak as if they thought themselves the very oracles of wisdom, are exceedingly reserved and dignified, and perhaps consequential in their manners, and often haughty and contumelious. Some seem to live only for self; all their actions and all their plans of life begin and end in self. They feel no interest in the common welfare of mankind, and no sympathy for any cause which aims at the improvement of the condition of their species; while others appear to lose self in their extended feelings and plans and efforts of benevolence and philanthropy. Their feelings and their thoughts are continually occupied in devising and maturing and carrying into operation schemes of benevolence by which mankind may be made better and happier. They are kind-hearted, and affectionate and merciful to every human being, and indeed to every thing that feels.

528. Some feel great respect for superiors, and great deference for traditionary authority, and the most solemn reverence for the Supreme Being; while others seem to want these feelings entirely. Some possess great firmness and decision and perseverance and resoluteness and stubbornness and obstinacy, and love to exercise authority and to command; while others are unstable and yielding and submissive and obedient. Some are exceedingly conscientious in everything they do, say, and think, and always desire to be strictly just in all their dealings; and if they think they have wronged or in any manner done the slightest injustice to any one, they cannot rest till they have set the matter right: while others seem almost totally destitute of conscientiousness, and even pride themselves in their dishonesty and fraud and knavery, and boast of their success in over-reaching, deception, and cheating. Some are full of hope and expectation of good things to come; while others are inclined to despondency and despair. Some are extremely credulous, and strongly inclined to believe everything that is associated with mystery and with the marvellous and supernatural; while others are sceptical in everything, wholly reject the marvellous, deny the existence of a God, and almost doubt their own existence. Some are exceedingly ardent and enthusiastic, and have the most vivid and vigorous imaginations, and behold everything with poetic vision and feelings; and to them the earth is a paradise or a purgatory, and the human species are angels or devils: while others are always the same, unvarying, cold, matter-of-fact beings, who estimate things by weight and measure, and regard the visions of the poet as the hallucinations of a diseased brain, and his enthusiasm as the excitement of insanity. Some are always full of mirth and facetiousness, and wit, and jest, and drollery, and satire; while others are habitually sober, and serious, and saturnine. Some have a power-

ful inclination and wonderful aptitude to imitate and mimic the actions, gestures, voice, expressions, etc., of men and animals; while others have neither the disposition nor the power to imitate anything.

529. Some are remarkable for noticing with great minuteness and accuracy individual persons and things, and all the peculiar habits, qualities, and appearances of individuals; while others pay no attention to such things. Some have a great aptitude to notice and judge of forms, figures, and features, and remember countenances with great accuracy; while others are very deficient in this power. Some are remarkable for the power of measuring distance, size, etc., by the eye. Others will judge of weight with astonishing accuracy; and others have the nicest perception of colors in all the delicate varieties of hues and tints; while others seem almost totally destitute of these powers. Some persons are remarkable for their power of perceiving and remembering the relative situations and localities of external things, and all the features of a landscape, and are exceedingly fond of travelling and of seeing new places and countries; while others are the very opposite of this in all respects. Some are very notable for their great precision and systematic arrangement and order in all they do and say; everything belonging to them is kept in the most precise order: while others are as notably careless and slovenly, and destitute of method and order. Some are remarkable for their power of numeration, and will run through processes, and arrive at results in numbers with a promptitude and accuracy which seems absolutely supernatural; while others are scarcely able to carry through a simple process in arithmetic. Some are astonishly accurate and minute in their knowledge of particular events, and seem to have the whole history of the world in detail stereotyped upon their brains; while others are utterly incapable of remembering particular events, and can only retain general impressions and fundamental principles. Some will remember dates and the successive periods of events with wonderful accuracy; while others find it impossible, even with the utmost labor, to impress dates upon their memory. Some seem natural instruments of music, and have only to open their mouths, and the air issues from their lungs in the most enchanting tones and strains of melody; while others seem incapable of learning a tune, or even of distinguishing one tone from another. Some have a wonderful affluence and facility of language; they commit language to memory, and learn new languages with great ease, and are never at a loss for words; they remember names with astonishing accuracy, and in some instances they are capable of talking or speaking for hours with grammatical accuracy, and even with rhetorical richness of language, while at the same time they seem to be like mere hand-organs, uttering well-ordered sounds without a thought.

530. Some are remarkable for their very acute and discriminating power of comparison, while others are very deficient in this faculty. Some have an irresistible inclination and a wonderful power to search and find out the causes of things, and are always in pursuit of first principles, and delight in philosophic investigations, and are exceedingly fond of original pursuits and enterprises and discoveries; while others are in all respects the very opposite of this, and prefer to trudge along the common beaten track of the world, taking things as they

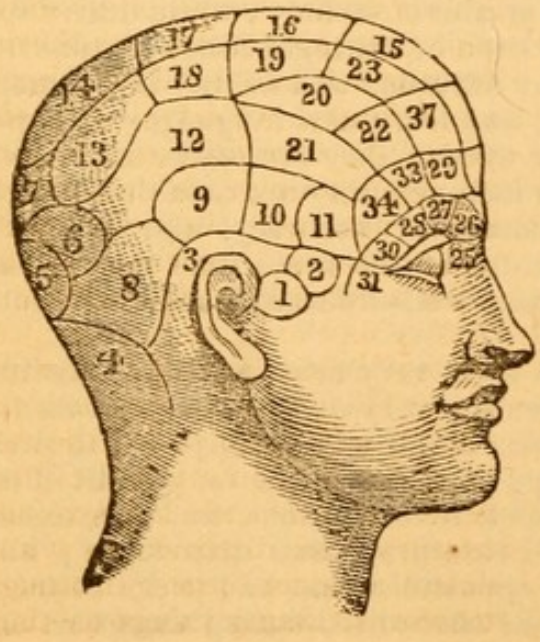
come, in the shape of separate facts and individuals, and never give themselves a care or entertain a thought about causes and general principles and relations.

531. Now, according to phrenology, the elements of all these differences and diversities are constitutionally innate, and depend entirely on cerebral organization, development, and activity; each of the propensities and sentiments and intellectual faculties being prominent and vigorous, or obscure and feeble, according to the size and activity of that particular part of the brain which is its special organ; and the relative size of the several organs being evinced by the general proportions of the head, and the particular elevations or depressions of the outer surface of the skull.

532. By carefully examining the heads of a great number of living, and the skulls of many dead persons and animals, and comparing their general and particular proportions with the mental and moral character and peculiar propensities and habits of the individual, Dr. Gall succeeded, as he believed, in ascertaining the particular location of twenty-seven pairs of the cerebral organs (275). Following the same inductive method, as he affirms, Dr. Spurzheim has added several pairs to the number described by Dr. Gall, and has left us a description and location of thirty-five pairs of these organs, and has named two other pairs, * the localities of which are not yet fully ascertained (279).

533. Thus then, according to this theory of Phrenology, we are furnished with thirty-seven pairs of cerebral organs, which are the seats of all the animal instincts, and of all the moral and intellectual powers that we possess, and which are precisely adapted to the condition and wants of the body, and to the great purposes of individual and social life. Each pair of organs performs a separate and distinct function; and 'the essential nature of each primary power,' says Dr. Spurzheim, 'is one and invariable, and no organ can produce two species of tendencies.'

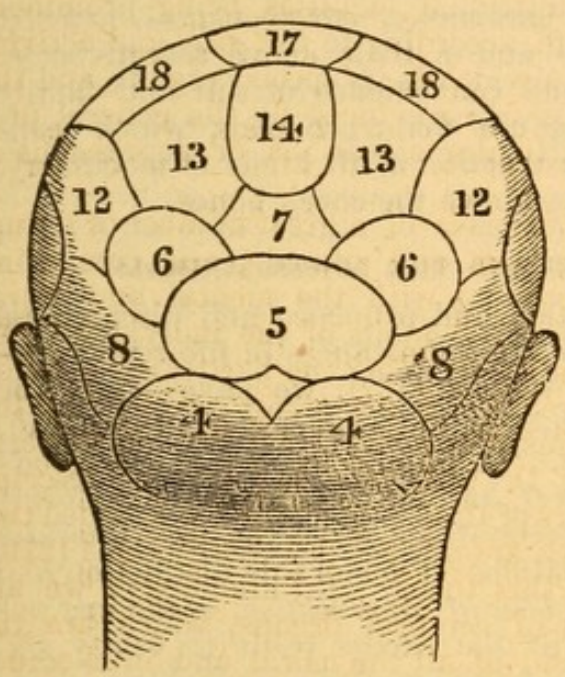
PROPENSITIES COMMON TO MAN AND THE LOWER ANIMALS.

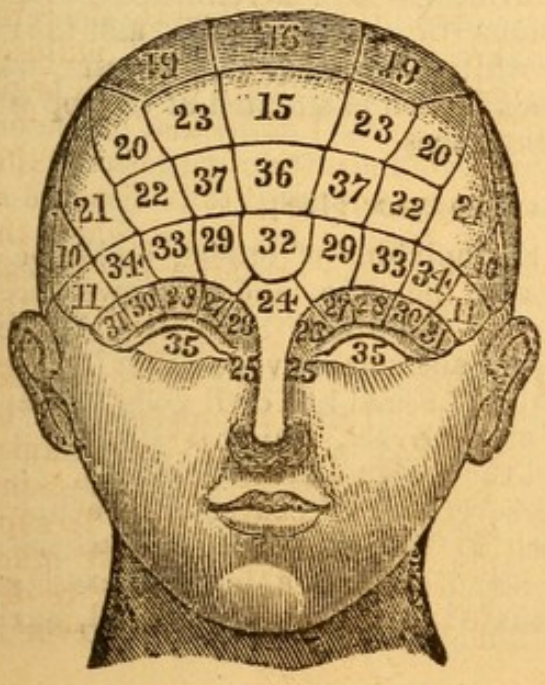


534. If we enumerate the cerebral organs in the most philosophical order (526), we shall begin with—1st, *Vitativeness*, or the organ of the instinctive desire of life. This is supposed to be situated at the base of the brain, where the middle and posterior lobes meet. To sustain life, we have—2d, the organ of *Alimentiveness*, or the instinct that prompts us to take food. This is supposed to be situated before the ear, immediately under acquisitiveness and before destructiveness. To supply the alimentary and other wants of the individual, to demolish and destroy whatever is

* Vitativeness and Alimentiveness.

hurtful to the body or endangers its existence and well-being, or whatever the good of the individual requires, we have—3d, the organ of *Destructiveness*, or the propensity to destroy; or more properly, the propensity to satisfy or execute the demands of the other instincts, at all events, even though it require the demolition and destruction of other things, or whatever stands in the way, or opposes; and, therefore, when unduly developed and active, or greatly depraved by bad education and habits, and unbalanced by counteracting moral organs, it produces cruelty, ferociousness, and murder. This is situated immediately above the ear. To secure the multiplication and perpetuity of the species, we have—4th, the organ of *Amativeness*, which consists of the two lobes of the little brain, situated at the base of the skull, behind, over the back of the neck. For the protection and cherishing of offspring, we have—5th, the organ of *Philoprogenitiveness*, or the instinctive love of children,—the maternal feeling. This is situated at the back part of the head immediately above amativeness. To secure the connexions and institutions of domestic and social life, we have—6th, the organ of *Adhesiveness*, or the instinctive propensity to form attachments to things and friendships with persons. This is situated at the side of philoprogenitiveness, and a little above. And to secure the more extended interests of domestic and social life, we have—7th, the organ of *Inhabitiveness*, or the instinctive love of home, of native place, and country, giving rise to patriotism, etc. This is situated immediately above philoprogenitiveness. For the defence of self and family and home and country, we have—8th, the organ of *Combativeness*, or instinctive courage, or the propensity to overcome obstructions and difficulties, to resist opposition, repel attacks, etc.; and when excessive and unbalanced, produces contentiousness, quarrelsomeness, etc. This is situated between philoprogenitiveness and the ear. Still further to secure the interests of self and family, and country, and to counteract and defeat superior force by management or stratagem, we have—9th,





the organ of *Secretiveness*, or the instinctive propensity to secrecy, concealment, slyness, cunning, craftiness, etc. This is situated a little above destructiveness. To provide for the wants of self and family, and to sustain the institutions of society, we have—10th, the organ of *Acquisitiveness*, or the instinctive propensity to acquire property, or whatever may be useful to us, or minister to our wants, the desire to possess, disposition to be provident, etc.; and when excessive and unbalanced, produces parsimony, coveteousness, avarice, and theft. This is situated before and a little above secretiveness. For the protection and comfort and convenience of self and family and society, we have—11th, the organ of *Constructiveness*, which leads to the building of houses, the construction of all kinds of machinery, etc. This is situated at the temples above the cheek bones.

SENTIMENTS COMMON TO MAN AND THE LOWER ANIMALS.

535. To secure that circumspection and prudence and discreetness and caution which our condition and circumstances in life render necessary for individual and social welfare (527), we have—12th, the organ of *Cautiousness*, which is situated at the back corners of the head, above and a little behind the ears. To prompt us to seek the goodwill and favorable opinion of others, and to incite us to the performance of those public and private deeds which serve the best interests of society, and become the foundations of honorable distinction and fame, we have—13th, the organ of *Love of Approbation*, or the instinctive desire for distinction, which in the excess leads to vanity and ambition and the restless strife for public applause and glory. This is situated between cautiousness and the crown. To secure a proper stability and dignity of deportment of character, and to prompt us to undertake those deeds and enterprises which we have the ability to perform, and which private and public good requires, we have—14th, the organ of *Self-Esteem*, which in the excess leads to personal pride, haughtiness, superciliousness, contumeliousness, etc. This is situated at the crown of the head. To secure that gentleness and affectionate conduct and kindness of demeanor and mercifulness, which are so essential to the happiness of domestic and social life, and those philanthropic efforts and enterprises which the public good require, we have—15th, the organ of *Benevolence*, which is situated at the top of the forehead, near where the hair commences.

SENTIMENTS PECULIAR TO MAN (498).

536 To secure that respect for the opinions of others, and especially for the aged, the experienced, and the wise, and that reverence for superiors, and for the authority of those that have lived before us; and most of all, to secure that deep and solemn veneration for the Supreme Being, which the individual and social and civil good of man requires, we have—16th, the organ of *Reverence*, which is situated at the top of the head, mid way between the crown and the forehead. To give us fortitude, decision, and perseverance of character, we have —17th, the organ of *Firmness*, which in the excess degenerates into wilfulness, stubbornness, obstinacy; and becomes a desire to exercise authority and command. This is situated at the top of the head, next

in front of self-esteem. To check our many selfish propensities, and to secure individual and civil integrity and righteousness, we have—18th, the organ of *Conscientiousness* or the instinctive disposition to do right, to be just. This is situated on the side of firmness, or between firmness and cautiousness. To sustain us under the numerous discouragements and continued disappointments of life, and to support us even when the 'life of life is gone,' and nothing of this world, either in possession or in prospect, remains to cheer or comfort us, we have—19th, the organ of *Hope*, which leads us on from day to day, with expectations of good things to come; and when it can no longer cling to the promises of this world, it stretches forward and lays hold of the promises of a future state of being. This is situated by the side of veneration. To sustain the hope of life and peace and happiness beyond the grave, and to prompt us to look for those evidences which will afford us the belief of the existence and continual care and benevolent purpose of the Supreme Being, we have—20th, the organ of *Marvellousness*, or instinctive disposition to 'look through nature up to nature's God.' This is situated in front of hope. To exalt the mind 'to all sublimer things,' to afford us the most elevated conceptions of truth and moral beauty and the perfectibility of things, and to stimulate us to the noblest and most honorable deeds, we have—21st, the organ of *Ideality*, which is situated about midway between benevolence at the top of the forehead, and the ear. To break up the monotony of life, to give elasticity to our energies, and variety to our emotions, and to increase the pleasures of our social intercourse, we have—22d, the organ of *Mirthfulness*, or instinctive disposition to facetiousness, wit, pleasantry, drollery, satire, etc. This is situated at the corners of the forehead, in front of ideality. To enable us to represent our ideas of men and animals by signs, and tones, and gestures, and to acquire the necessary and the useful and the elegant arts of society, we have—23d, the organ of *Imitation*, which is situated between mirthfulness and benevolence.

537. Of the PERCEPTIVE OR KNOWING FACULTIES of the mind (529), we have—24th, the organ of *Individuality*, or instinctive disposition to notice objects in their individual capacities, habits, and peculiarities. This is situated between the eyebrows.—25th. The organ of *Configuration*, or the instinctive disposition to notice figures, and power to recollect persons and forms seen before.—26th. The organ of *Size*, or the instinctive disposition to notice size, measure, distance, dimensions, etc.—27th. The organ of *Weight*, or the faculty of judging of the weight of things, etc.—28th. The organ of *Coloring*, or the faculty of nicely discriminating colors, hues, tints, etc.—29th. The organ of *Locality*, or the faculty which perceives and remembers the situations and relative localities of external objects, and leads to the love of travelling.—30th. The organ of *Order*, or the power and inclination to perceive and observe order, and method, and precision of arrangement. These last six organs are situated in the range of the eyebrows, arching from the inner to the outer corners of the eyes.—31st. The organ of *Calculation*, or the faculty of numeration and calculation in general. This is situated at the outer corner of the eyes, towards the ears.—32d. The organ of *Eventuality* or the faculty of acquiring a knowledge of events and occurrences, and of noticing and remembering every thing that

happens, and which leads to historical knowledge. This is situated in the centre of the forehead, immediately above individuality.—33d. The organ of *Time*, or the faculty which perceives and retains the succession of events, remembers dates, etc. This is situated on the outside of eventuality, towards the temple.—34th. The organ of *Tune*, or the faculty which perceives harmony and discord, and imparts the ability to sing and to compose music. This is situated at the outer corner of the forehead, between wit and order.—35th. The organ of *Language*, or the faculty of acquiring and retaining a knowledge of words and of languages, and the power of remembering the names of persons, things, places, etc. This is situated behind the eyes, and when large, causes the eyes to stand out prominently.

538. The Reflective Faculties (530) consist of two pairs of organs. —36th. The organ of *Comparison*, or the special power which compares the functions of all the other primitive faculties, and discerns resemblances, analogies, identities, and differences. This is situated between eventuality and benevolence.—37th. The organ of *Causality*, or the faculty which perceives the connexion between cause and effect, leads to the investigation of causes, and to the idea of the First Cause of all —God. This is situated on the outer side of comparison.

539. The ancient doctrine of temperaments, and the somewhat more modern one of physiognomy, were at first disregarded or wholly repudiated by the phrenologists, and the relative size of each organ and the general volume of brain were considered the principal or exclusive evidences of the power of the single and collective propensities, sentiments, and intellectual faculties. So that a large mass of brain, in a normal or proper state, was regarded as the sign of large powers; and the intellect, sentimentality, or animal propensities of the individual were said to predominate according as the cerebral mass lay more in the front or upper, or lower and back part of the skull. But it did not require very extensive observation to lead to the inductive conclusion that the capacity of the forehead is not always the measure of the intellectual powers, even in a well-proportioned head. For, while it may be true as a general fact, according to the common impression of all ages, that the most extraordinary minds which have at different periods in the history of the human race impressed their unperishing energies upon the world, have had their seats in capacious foreheads, and been connected with large brains, yet we may everywhere meet with individuals with large heads and capacious foreheads, who possess no extraordinary powers of mind, but in some instances are remarkable for their stupidity; while, on the other hand, we everywhere meet with active and powerful minds in comparatively small heads, and rather low and narrow foreheads. To meet these difficulties, the doctrine of temperaments has been invoked in its fullest extent; and finally, physiognomy has become completely associated with craniology in the present theory of phrenology.

540. The size and general proportions of the head, the particular prominences of the skull, the temperament and the physiognomy of the individual, are all, therefore, to be taken into consideration in judging of the intellectual and moral character of persons. Or in other words, both the size and activity or energy of the cerebral organs are to be considered; and to ascertain the activity or energy the temperament

is called in, and physiognomy is an important index of temperament, and of the mental and moral and animal energies of the brain.

541. No organ, however, is to be judged singly and absolutely, but relatively. As, for instance, if we find combativeness largely developed, we are not therefore to conclude that the individual is a disputatious, contentious, quarrelsome fellow, who is continually in a brawl and fight; but if we look still farther we may find that acquisitiveness, and cautiousness, and love of approbation, and benevolence, and conscientiousness, and ideality, and causality, are all likewise largely developed. In such a case the conflicting elements will qualify and regulate each other, so as out of the whole to form a harmonious unity of character. Combativeness will carry the individual forward with an energy which will surmount every obstacle, and subdue every resistance and overcome every opposition, or perish in the attempt; acquisitiveness will prompt him to pursue a course of gain; love of approbation will prompt him to seek his gain in a manner by which he may distinguish himself and be the object of applause; benevolence will lead him to seek his gain and glory in some enterprise of philanthropy which aims at the general welfare of mankind; causality will lead him to pursue his enterprise of gain and glory and philanthropy in an original track and manner, and in a philosophic form; ideality will give an elevated character to his enterprise, and enthusiasm to his efforts; conscientiousness will prompt him to be strictly just and righteous in all his principles and measures and operations and actions, by which he seeks to gratify his combativeness and acquisitiveness and love of approbation and benevolence and causality and ideality; and cautiousness will prompt him to be extremely careful to do nothing that will forfeit or jeopard his interest or his fame, or be in the least degree inconsistent with his principles of philanthropy and strict righteousness, and cause him to examine all the principles of his philosophy with the most rigid scrupulosity, and by the severest test of facts and experiments. With such an organization, therefore, the individual, if successful, would, like a Franklin, acquire wealth and fame in a manner which is not only consistent with, but highly conducive to, the general welfare of his species, and strictly compatible with the purest and noblest private virtues.

542. The phrenological theory of Dr. Gall, I have said (525), claims to be purely inductive; and it is apparently supported by innumerable facts and coincidences, and is now too extensively received and too ably advocated and defended to be treated with ridicule or neglect. Every honest mind, therefore, which is thoroughly imbued with the spirit of truth, will endeavor to examine it with candor and integrity, and neither seek to support nor to demolish it by any unfair means. If it be true, no one should wish to oppose it. If it be erroneous, no one should wish to defend, or to cover its errors. Yet if I mistake not, neither its opposers nor defenders have at all times manifested that candor and honesty which should always characterize our inquiries after truth.

543. I am sure that I speak honestly when I say, that I have no prejudices against this theory, but am favorably inclined towards it; yet candor obliges me to acknowledge that I am not so fully and entirely convinced of its truth as some of its zealous adherents appear

to be. Being early addicted to physiological investigation, and habituated to the closest observation of the mental and moral manifestations of man in connexion with the physiological and pathological conditions of the body, I had arrived at, and was accustomed to teach, those doctrines of intellectual and moral physiology which I still continue to advance, long before I heard of Dr. Gall, or of his theory of phrenology. I do not, however, intend to insinuate that anything like the views of Dr. Gall, in relation to the general shape and particular prominences of the skull, as connected with the mental and moral manifestations of the individual, had never entered my mind, except the common impression in regard to the capaciousness of the forehead, etc.; nor do I claim to have conceived of the plurality of organs in the brain. I had, however, embraced and publicly advanced the opinion, that the nerves of special sense, and all the other nerves and parts within the cranium, and indeed the whole cerebro-spinal system of nerves (232—307), have a common centre of perception, at or near the top of the medulla oblongata (280); but this was then purely an hypothesis inferred from the phenomena of mental and moral physiology. My attention had been directed almost entirely to the intellectual and moral manifestations as affected by the physiological and pathological conditions of the body, and to the analysis of the intellectual and moral powers as connected with the brain and nervous system as a whole; and in these pursuits I had arrived at the opinions which I still entertain in regard to intellectual and moral physiology, many of which are now claimed by writers on phrenology as belonging peculiarly to that theory.

544. There certainly appear to be many and strong reasons for believing that the brain consists of a plurality of organs, and that these particular organs perform special functions; and also that there is a correspondence between the external shape of the skull and the intellectual and moral character of the individual. Nevertheless it must be acknowledged that none of these points has yet been conclusively demonstrated, and therefore they must still be regarded as at least in some measure problematical.

545. One of the principal positions urged in support of this theory is, that when the mind has been severely applied to a particular subject till it becomes weary, if it be directed to another subject, it is instantly relieved, and feels comparatively fresh and vigorous. This, it is said, proves the plurality of organs in the brain, as the relief experienced arises from a change of the special organs in the mental operations; or, in other words, that by turning the mind from one subject to another, the weary organ is left to rest, and a fresh organ is called into exercise; for how, it is asked, could relief be experienced by a change of subjects, if the brain acted on a single organ? But this seems to suppose not only that there is a plurality of organs in the brain, but also that each individual organ possesses the capacity and power of carrying on a process of perception, reflection, reasoning, etc., independently of the other organs. Yet according to the general theory, the reflective faculties are more or less actively employed in all processes of reasoning, investigation, inquiry, etc.; and, therefore, whatever may be the subject to which the mind is applied, the reflective faculties must be exercised in every act of reasoning.

546. If I understand the theory, the power of each special organ is a simple element of the mind, and not a complex power; and all these elements together, constitute the *one mind*, and not a complex assemblage of minds: and in proportion as one or another of these elements enters more or less largely into the mental constitution, so is the mind qualified and characterized. If this statement is correct, then it is evidently unphilosophical, on phrenological premises, to suppose that one organ or any number of organs can be so exclusively employed on one subject, as that a change of the subject will call into action a wholly new set of organs, and leave the weary ones to rest. For whether the subject be algebra or geography or chemistry or any other, some of the same faculties are always principally employed in every process of reasoning. Simple perception may be performed by a single organ as an element in the mental constitution; but when reflection, comparison, and reasoning take place, other organs must also be called into exercise, and organs too which are always more or less concerned in every act of reasoning on every subject.

547. Moreover the fact assumed in the case is very questionable. If two bushels of salt be placed on a man's shoulder, and he carry it till he becomes weary, and then if the salt be taken off, and two bushels of oats be placed upon the same shoulder, the man will feel greatly relieved, and it will almost seem to him that he has no load at all. And so in the labors of the mind; if we apply our thoughts to a particular subject, till, to use common language, the mind becomes weary, and then turn our attention to some light and amusing subject, we certainly feel much relieved. But if the mind be severely employed on a particular subject till painful weariness is experienced, and then be applied with equal severity to another subject which requires an equal degree of mental power, so far shall we be from experiencing any relief, that the weariness will continue and increase till it becomes intolerable. Sometimes the mind is greatly relieved by changing the question without changing the nature of the subject. As, for example: we may attempt the solution of a question in the science of numbers, and by some accident or mistake embarrass the mental associations in some of the processes, and continue to labor without success, till the mind, as we say, becomes extremely weary and confused or confounded; and then we may turn immediately to another equally difficult question in the same science, and the mind will feel at once and very considerably relieved, and will perhaps solve the question with very little difficulty, and then return to the former question. and solve that too, in less than one-fourth of the time that was devoted to it at first; and finally quit its labors with less sense of weariness than was felt when it turned to the second question. But does this prove that in changing the question we change the organs also?—and that we have different organs for different problems in mathematics? Evidently not! On the whole, then, I conceive that this position, when properly examined, neither proves anything for nor against the theory of Dr. Gall.

548. Another, and perhaps the most important, position advanced in support of Dr. Gall's theory is, that we frequently see people totally insane on one subject, and perfectly sane on all others; and it is contended that this fact can only be accounted for by admitting a plurality of cerebral organs, and that one of these organs is diseased This

position is strictly consistent with the philosophy of the general theory, and may be correct; and if so, is very conclusive: while on the other hand, if it can be proved to be incorrect, the general principles of the theory may nevertheless be true.

549. The consideration of this position will necessarily lead us over the whole field of intellectual physiology. For, in order to ascertain what *insanity* is, we must first determine what *sanity* is; and this renders it necessary that the elements and laws of mind should be clearly ascertained. In speaking of insanity, however, it is highly important that the meaning of the term should be accurately understood. Strictly speaking, the mind in itself is incapable of insanity. It is governed by certain general laws, which it always, and under all circumstances and conditions, obeys. Even in the worst cases of madness, the mind is true to its own laws; and in obeying these laws, exhibits what we call insanity.

550. We have seen (520) that whatever be the substratum of the sensorial power of the human brain, it resides in and acts through the organized matter of the nervous substance, during our present state of existence, precisely the same as if it were merely a property of that vitalized matter, and all its powers and manifestations are subject to precisely the same laws as govern the powers and manifestations of vitality; and this is equally true whether the brain be a single organ or a system of organs. We have seen also (242, 251, 252, 253, 254, 294, 295, 397, 398, 403, 405) that man possesses several organs of special sense, all of which convey their impressions to the cerebral centre of perception (280), from which they are reflected to the mental organs. We have the special sense of touch (253), of taste, of smell, of hearing, and of sight. Hunger (247), and all the other feelings or senses by which the cerebral centre has cognizance of the specific wants of the vital economy, are likewise as truly special senses as taste, smell, hearing, and sight.

551. The effect produced on the organs of these senses, and through them on the cerebral centre, by the action of appropriate stimuli, is what we call *perception;* but neither the hemispheres of the brain (265) nor the lobes of the little brain (264), are essential to animal perception (259). Some portion, at least, of the hemispheres of the brain, however, is essential to intellectual perception.

552. The sense of sight is the exclusive source of imagery to the mind. When the light is reflected from any object upon the retina of the eye (252), certain impressions are made upon the retina, which are perceived by the mind; or, in other words, by which the mind has a perception of the object.

553. There has been a good deal of speculation about the physiological and pyschological philosophy of vision (415), but the eye has too generally been treated as merely a mechanical organ, and considered as entirely passive in the function of vision; and hence it has been compared to a camera obscura with its inverted image, etc. (416, 417). So far as regards the mechanical and physical philosophy of vision, this is all well enough; but it does not explain the vital and mental function. It does not inform us how the animal sees the object.

554. In one respect, at least, there is an essential and very important difference between the eye and the camera obscura; the optic nerve,

with its expanded extremity forming the retina, is a living organ, endowed with a peculiar sensibility to all the properties of things which are perceived by the medium of light; but this sensibility depends on the connexion of the optic nerve with the centre of animal perception, and on the healthy condition of the parts. And the perception being made by the organ in connexion with the animal centre, we do not actually see things inverted, as has been generally supposed, because the mind does not perceive the inverted image formed upon the retina of the eye, as we perceive that of the camera obscura; but the image formed upon the retina of the eye, instead of being perceived by the mind as an image or representation of an external object, constitutes what may be called the *stimulus of visual perception*, by which the external object itself is really seen. Or, in other words, the colors and all the other qualities of the image caused by the light reflected from an external object, are the real *visual properties* of the object, and are to the living organ so many specific kinds of visual stimuli, giving to the parts on which they act the impressions which, being perceived by the animal centre (280), constitute the animal perception of the real external object; and, therefore, the perception of the several parts of an external object is always made with reference to the direction of the rays of light which convey the stimuli, and consequently all external objects are seen in their natural and real position.

555. When, for instance, the rays of light which are reflected from a person, animal, tree, or any other external object, fall upon the retina of the eye, an exact image of the object is formed on the retina; but as the rays of light cross each other (Fig. 48) before they reach the retina (416, 417), the image is inverted, and turned side for side; but this image is not perceived by the mind as the image or representation of the external object, but all the elements and qualities of the image act on the peculiar sensibility of the optic nerve, as specific and delicately modified stimuli; or in other words, they are the real visual properties of the external object, which act as the appropriate stimuli on the retina of the optic nerve, in perfect analogy with the action of gustatory, olfactory, and auditory stimuli on their appropriate organs.

556. The peculiar sensibility of the gustatory nerve (294) in connexion with the animal centre of perception, feels those properties of things which it is adapted to perceive, as sweet, sour, bitter, etc.; and this is the perception of taste. The peculiar sensibility of the olfactory nerve feels those properties of things which it is adapted to perceive, as the various odors, and this is the perception of smell. The peculiar sensibility of the auditory nerve feels those properties of things which it is adapted to perceive, as the various undulations or vibrations of air, etc, causing sound, and this is the perception of hearing. And in precisely the same manner the peculiar sensibility of the optic nerve feels the visual properties of things, and this is the perception of sight. And thus the visual properties of external things as really and truly act upon the optic nerve, as the olfactory and gustatory properties of external things do upon the nerves of smell and taste. In each case the appropriate properties are brought in contact with, and act upon, the nerve, as appropriate stimuli, producing specific impressions or sensations, which the mind perceives as the properties of

the real things, and in perceiving these impressions or sensations, the mind always refers them to the things from which they are received, according to the constitutional laws of the particular function. And consequently the inverted image formed upon the retina, instead of being perceived as an image or representation of the external object, is felt as the visual properties of the real object itself, the same as its tangible properties are felt by the organ of touch, the gustatory properties by the organ of taste, etc.; and therefore the impressions or sensations produced by these properties, as the appropriate stimuli of the organs, are instinctively and necessarily referred to the real external object, whose visual properties act upon the organ, and in the direction of the rays of light which convey the properties to the retina. Thus, though the visual properties of the top of an object (Fig. 48) are thrown upon the bottom of the retina, yet from the constitutional laws of the function of vision, we instinctively and necessarily refer the impression or sensation to the top of the object, in the line of the rays of light by which the properties are conveyed to the retina, and consequently we actually see things just as they really are; unless we see them through distorting media, or through bodies which bend the rays of light, and change their colors before they reach the eye.

557. Whether the optic nerve itself, or some other part, is the seat or receptacle of those impressions or sensations which constitute the mental ideas of the visual properties of external things, is not yet ascertained, and perhaps never will be; but wherever the seat may be, it is certain that those impressions or sensations may be *reproduced* without the presence and actual perception of the external things by which they were first caused, and this reproduction is called *mental conception.*

558. We have a visual PERCEPTION of an external object when it is really before us and we actually see it, or when its visual properties are actually thrown upon the retina of the eye; and we have a visual CONCEPTION of that object when, in its absence, we reproduce the impression or sensation first caused by the action of the visual properties of the object on the retina; or in other words, when the mind distinctly perceives the external object, without the real visual function of the eye, or without actually seeing it: for the instant the impression or sensation is distinctly reproduced, the mind instinctively and necessarily refers it, according to the laws of visual perception (554), to the external object by which it was first caused; and thus, by perfect *conception*, the external object is made to stand as clearly and distinctly before the mind as it does in the real act of *perception.* And when our mental conception of external things is vivid, distinct, and complete, we call it IMAGINATION.

559. When a perception is made, it is instantly reflected to the intellectual faculties, and the reflected impression or sensation becomes a more abstract property of the mind, and is capable of being reproduced at any time, without actual *perception* or real *conception* (558), and this is called REFLECTION.

560. But our reflections always tend to produce conceptions, and are always the most clear and vigorous when our conception is the most vivid and distinct; and hence the writer or speaker who, when writing or speaking, has the most vivid and accurate conception of

the things of which he treats, always presents his subject most clearly and eloquently, and always produces the most powerful effect upon his readers or hearers, by presenting to their minds most vividly and distinctly the images of his own.

561. Conception also greatly assists reflection by enabling the mind to contemplate, examine, analyze, and compare things which have been perceived; and, by ascertaining the accidental and essential differences, resemblances, and identities, to arrive at general conclusions and first principles, and thus elaborate the general theory of things.

562. The power of recalling or reproducing the thoughts of reflection (559) in their regular associations, is called MEMORY; and consequently memory, while it is a single attribute of the mind, is nevertheless, according to phrenology, of diversified power, and pertains to each individual organ of the brain; so that we may have a very good memory on one subject, and a very poor one on another, according to the relative activity and power of the individual organs.

563. Visual perception (568), I have said (552), is the only source of that conception (558) which presents imagery to the mind. Auditory perception is also a source of mental conception, but to a more limited extent than that of vision; and we are much more rarely capable of reproducing the distinct impressions or sensations of auditory perception than we are those of vision. The reflected impressions or sensations (569) of auditory perceptions, are, however, very easily reproduced, especially when the power is cultivated, as in music. But, except in dreams and disease, we never distinctly hear sounds by conception. The perceptions of smell, taste, and touch, are also rarely the sources of mental conception, except in dreams and disease. *

564. The succession of our perceptions establishes certain relations between the sensations of perception, and also between the thoughts of reflection (559), so that the reproduction either of a sensation or perception or of a thought of reflection, naturally tends to the reproduction of others associated with it; and this is what is called the ASSOCIATION of ideas, the law of association, etc. The perceptions of the different senses become associated in the same manner. Thus we look at a certain figure, and hear it called A, till we learn so completely to associate the visual and auditory perceptions in our thoughts of reflection, that they become inseparable, and indeed seem essentially one, and the name becomes the mental abstract of the thing; and, except in cases of actual perception or conception (558), all our thoughts are of this kind; a species of algebraical abstraction or nominal representation in the mind, of things existing separately from the mind. Thus, we write and talk rapidly of trees, animals, men, etc., without having distinct images of the things we write or speak of presented to the mind. But, as I have said (560), reflection always tends to produce conception, and it rarely if ever becomes energetic and determinate, without producing some degree of conception, or reproducing to some extent the primary sensations of perception (558).

* Mr. James Hill, a respectable farmer, of West Cambridge, Mass., now about sixty years old, and in pretty good general health, entirely lost the sense of smell ten years ago, and has smelled nothing since, not even the strongest and most pungent and offensive odors. Still the sense of touch remains perfect in the nostrils. Mr. Hill says he often dreams of smelling, and has a distinct and full conception of odors, especially the offensive.—June 1, 1838.

565. The sensations of perception, both in their primary form, as reproduced in conception (558), and in the form of thoughts of reflection (559), are also intimately associated with our animal appetites and moral feelings; so that the perception, the conception, and even the thought of certain things, will arouse certain appetites or propensities, or excite certain emotions or feelings; and, on the other hand, the emotions or the appetites will call up the thoughts and conceptions. Thus, if we intently think of any kind of delicious fruit, or of any food of which we are fond, conception will soon present the fruit or food distinctly to the mind's eye; and the animal appetite for it will soon be roused, and perhaps become even painfully importunate: and on the other hand, if the appetite be excited by the want of the vital economy, the thoughts and conceptions of something fitted to gratify the appetite will instantly be produced, and if the appetite be specific and determinate, the thing thought of and conceived will be specific. So, likewise, if our perceptions of things are constantly attended with certain moral precepts, admonitions, or feelings, our conceptions of those things will always remind us of the associated sentiments, and generally, if not always, reproduce the associated feelings; and our thoughts of those things always tend to produce the conceptions (558), and thus excite the emotions. And, on the other hand, if the feelings be produced by a physiological or pathological condition of the body, the thoughts and conceptions are called up, and the mind contemplates the thing thought of, as the cause of the feeling (302—305). Thus, if an individual is devoutly and zealously religious, and always contemplates the favor of his God with pleasurable feelings, that physiological condition of his body which, in common language, is called a happy flow of animal spirits, will be sure to call up his religious thoughts and conceptions, and he will consider the feeling as entirely of a religious and spiritual character and origin. So, likewise, if he is accustomed to the use of tea, coffee, wine, tobacco, opium, or any other alcoholic or narcotic or other stimulant, the pleasurable stimulation which he receives from his stimulant will, unless his attention is directly engaged in some other matter, call up his religious thoughts and conceptions, and he will attribute his happy frame to his religion; and on the contrary, if from the pernicious effects of his stimulant on his nervous system, or from some other cause, a physiological depression results, a general feeling of distress or unhappiness will be induced, which will fill his mind with religious doubts and fears, and he will attribute his feeling entirely to those doubts and fears, or both the doubts and the feeling to the withdrawment of the favor of God.

566. It is not possible for the mind to perceive two separate and distinct objects of thought at one and the same instant, nor is it possible for the mind to have a distinct perception and conception (558), at one and the same instant. When the mind is occupied with a distinct perception of things, no mental conception can take place; and when it is occupied with a distinct conception, perception is wholly suspended. Thus, when we are completely absorbed in a reverie, or in that state in which the mind is perfectly engrossed in the contemplation of its own conceptions, the functions of all our organs of sense are totally suspended, and we no more perceive anything by

sight, hearing, smell, taste, or touch, than if all our organs of sense were paralyzed. It is, indeed, a perfect dream. The instant we are conscious of a perception (551), the ideal presence vanishes, and the reverie is destroyed. The ability to retire within ourselves from the perception of every thing around us, and shut the mind up to its conceptions and reflections, is called the power of ABSTRACTION, or in the language of phrenology, *concentrativeness*. But the constant action of the appropriate stimuli of vision, hearing, smell, etc., on the sensibilities of our organs while we are awake, renders it difficult for us to become as perfectly abstracted from the consciousness of surrounding things as when asleep, and therefore our mental conceptions are generally most vivid and distinct, and the ideal presence most perfect, in our dreams, when our external senses are locked up in sleep. For dreams are nothing more than the more or less perfect reproduction of the sensations of perception, with a varied extent of associated reflection. Whether thoughts of reflection (559) are first excited and lead to conception (558), or conception is first induced and excites thoughts of reflection in dreams, is not certain. Perhaps sometimes one and sometimes the other.

567. In perfect sleep, there is a total suspension of all the functional powers of the nerves of animal life (228, 229), and we neither dream nor are conscious of our existence. When we dream, therefore, our sleep is imperfect; and it is rendered imperfect by some nervous irritation, or some physiological oppression or depression in the body; and this disturbing cause, whatever it be, is also the exciting cause of our dreams; and the character of our dreams, as to pleasantness or unpleasantness, always corresponds with the nature and degree of the nervous irritation and the general condition of the nervous system, and especially the nerves of organic life (228). Most frequently, however, the exciting cause of dreams is some irritation in the digestive organs (297, 298, 299); but this is not always the case.

568. Whether asleep or awake, then, when our *conceptions* (558) are complete or perfect, they are as much realities to the mind as our actual *perceptions* (551); and it is only when our conceptions have given place to actual perceptions, that we know that the conceptions are not real perceptions. Nothing is more real to the mind than dreams, while they last. We do not, we *cannot* know them from realities, until they cease to be, and we wake to reality, and find we have been dreaming. And this is strictly true of our day dreams or reveries, and of all our mental conceptions. The conceptions of the poet or the painter in what is called his moments of inspiration, are as real to his mind as his actual perceptions, and their effects upon his body are generally even more powerful; and when his conceptions are vivid, distinct, and complete, it is impossible for him to know or to have the slightest suspicion, while they remain, that the ideal presence is not a reality. If, in the moments of his high and powerful conceptions, we should see the poet, without impairing the spell of his soul in the least degree, and behold the intense meaning of his eye, and all the workings and expressions of his countenance, his violent gestures, his sudden starts, his hurried or suspended respiration, and hear him break forth in his soliloquies or in his addresses to the beings of his imagination, with tender, melting tones, or with terrible vehemence

and fierce impetuosity, we should certainly believe him to be a raving maniac, and probably, as others have done before us, shrink with shuddering dread from such fearful manifestations of insanity. Yet in all this the poet's mind operates in strict accordance with those general and fixed laws which govern every human mind, and is no more insane than the mind of the merchant is, when it is so completely engrossed in the conceptions of things that relate to his mercantile business, that he walks along the public street of the city without knowing whom he meets or what he passes. The only difference is, that the conceptions of the poet are of a more exciting character and produce a more extensive and powerful effect on the whole nervous system, causing correspondent looks, gestures, etc. Besides, the general nervous excitability of those who are what we call poetic and other geniuses, is much greater than ordinary; and, in fact, this is the principal element of all genius.

569. Perception and conception (558), I have said (556), cannot take place at one and the same instant; and hence our conceptions are generally the most vivid and distinct and perfect in dreams, when the organs of perception are sealed up in sleep; and hence, also, nervous people generally prefer to have a light in their bed-rooms during the night, so that they can see things distinctly when they are awake, and thus be able to prevent disagreeable conceptions, by actual perceptions. Upon the same principle, if an individual who is much afraid of dogs, is walking along the street in the day-time, and sees a large stone by the way, he does not mistake it for a dog, because he distinctly *perceives* it to be a stone; but if it be at night, when it is too dark for him to have a distinct perception of the stone, the *indistinct perception* may instantly give place to a *distinct* and vivid conception of a dog, and while the conception lasts (568), the dog will stand as distinctly before his mind as if it were an actual perception; and the same effects will be produced on his whole mind and body.

570. No man is suspected of insanity because he dreams in his sleep; and if one who is accustomed to do so, gets up in his dream, and with his eyes open, but without *perceiving* any thing, walks about and acts and talks according to his *conceptions*, we still say he is dreaming; but if he should remain in this state through the night and the following day, we should unhesitatingly pronounce it a case of insanity. Yet the mind would strictly observe the same laws that it does in ordinary dreams, and the same that govern it always when awake.

571. The exciting cause of dreams, somnambulism, etc., I have said (567), is nervous irritation. When the system is perfectly healthy and undisturbed, sleep is death-like—a total and perfect suspension of all the functional powers of the nerves of animal life (228), and of all consciousness of existence; and the organs of external perception are, as it were, paralyzed to all external impressions, until the full purposes of sleep are effected, and the instinctive economy of organic life throws open the windows of the soul, and restores every sense to its appropriate organ. The nervous irritation which produces dreams may be carried to such an extent of disease, as will cause such a constant succession or permanence of distinct and vivid conceptions, when we are awake, that our mind will be mostly or entirely engrossed with these conceptions, and almost wholly abstracted from actual perceptions.

The things conceived will be realities to the mind (568), and we shall think, feel, talk, and act, the same as if our conceptions were real perceptions; and then, of course, we shall be called insane. If the nervous irritation runs so high as totally to engross the mind in its conceptions, and causes us to see all surrounding things as the objects of our conceptions, transforming our friends to savages, demons, etc., we shall be said to be totally insane, and perhaps raving maniacs, according to the degree of nervous irritation.

572. The constant contemplation of things conceived, as realities, will soon establish new associations of thought and feelings (564, 565), and thus lay the foundation for permanent insanity, even when the general nervous irritation has much subsided. For intellectual habitudes of every kind are easily formed, and, when once established, are with great difficulty broken up, and especially those which are associated with our feelings and propensities.

573. When the nervous irritation is less violent, and has been developed in connexion with certain qualifying circumstances and corresponding operations of the mind, as the loss of property, character, friends, etc., the morbid conceptions may be limited to a single subject, and then the case will be called *monomania*, or insanity on one subject, the mind being sound on all other subjects.

574. Yet it is obvious that in all this, the mind observes the same laws that govern all human minds at all times (549). The soundest mind in the world regards its *conceptions*, while they continue, as *real perceptions* (568); and thinks, feels, and acts accordingly; and the insane mind does the same.

575. Another general principle which I have already alluded to, is of so much importance in the intellectual and moral philosophy of man, that it requires to be more extensively explained and illustrated. I have said (565) that the sensations of perception, both in their primary form, as reproduced by conception, and in the form of thoughts of reflection, are intimately associated with our feelings or emotions, so that the perception, the conception, and even the thought of certain things, will produce certain emotions; and, on the other hand, certain feelings will excite certain thoughts and conceptions, by which the feelings or emotions will be very greatly increased. Thus, to repeat the former illustration (565), a zealously religious person who always contemplates the favor of his God with pleasurable emotions, and the withdrawment of that favor with painful feelings, will have a pleasurable train of religious thoughts and conceptions called up, and his hopes brightened and his faith strengthened, by that physiological condition of his body which we call a delightful flow of the animal spirits (305), whether produced by mental, moral, or physical stimuli; and he will consider the feeling as entirely of a religious and spiritual origin and character, and this feeling will be very greatly enhanced by the reaction of the thoughts and conceptions which it excites: and on the other hand, a physiological depression, by whatever cause produced, will be sure to call up in his mind a train of gloomy thoughts and conceptions, which will exceedingly augment his depression, and he will be filled with religious doubts and fears; his faith will become feeble, and his hopes will be darkened, and perhaps yield to despair, and he will attribute the whole of his distress to the doubts and fears

of his mind, and these he will attribute to his convictions of his very great sinfulness, and the total withdrawment of the favor of his God. He will, at such times, review his past life with the deepest anguish and remorse, and contemplate many former deeds as unpardonably sinful, which, in a healthier state of his nervous system, he regards in a very different light; and the darkness of his doubts, the depth of his despair, and the violence of his remorse, will always be proportionate to the morbid irritation and physiological depression of his nervous system. The unhappy Cowper affords a melancholy illustration of this doctrine.

576. It is, then, a general law of the mind, which governs it in all states and conditions, that the importance, in our estimation, of any subject which we contemplate, or the force of any evidence which we examine, is always equal to the degree of feeling or emotion connected with our thoughts, conceptions, and perceptions on the subject, and consequently our reasonings and conclusions correspond with our feelings. But, as we have seen (305), the mind cannot be conscious of the difference between those feelings which arise from a peculiar physiological condition of the nervous system, and which cause our melancholy or pleasing thoughts and conceptions, and those feelings which are caused entirely by our thoughts, conceptions, and perceptions; and, therefore, when the mind acts according to its own consciousness, it always and necessarily judges that all our emotions or feelings connected with our thoughts, conceptions, and perceptions are entirely caused by those thoughts, conceptions, and perceptions. And hence, unless we go out of ourselves, and judge of ourselves scientifically, and independently of our own consciousness, we necessarily attribute to the subject on which our mind is exercised, the influence or power by which all our intellectual operations and our feelings in regard to it are produced; and, therefore, we necessarily estimate the reality and importance of that subject, to us, by the degree of our feelings when contemplating it, whether those feelings are actually produced by the contemplation, by physical stimuli, or by morbid irritation and sympathy. Thus, when a person is in perfect health of body, he may hear of some expressions of disapprobation which have been made concerning himself, and regard them as a part of the common gossiping of society, and contemplate them with little or no emotion; but let the same person hear the same things when he is laboring under extreme nervous irritation and depression, and he will contemplate them with great emotion, and all the morbid sensibilities of his nervous system, while they excessively increase the vividness of his conceptions (558), and the energy of his thoughts on the subject, will at the same time be so intimately connected, and indeed identified in his consciousness with his purely mental operations, that he will, without the least suspicion to the contrary, regard them as entirely the result of his mental action on that particular subject, and therefore, of necessity, in the constitutional nature of things, he will *feel* the subject to be of very great and pressing importance to him, and he will inevitably *judge* its importance to be equal to the degree of the feeling with which he contemplates it. Under this morbid influence of his nervous system upon his mental operations, he will be very likely to think that his reputation is seriously assailed, and to cherish the most painful appre-

hensions that his character will be ruined, and all his respectability and prosperity and comfort in life destroyed. The more he contemplates the subject, the more vividly and energetically will his morbid sensibilities call up his conceptions and reflections, which will react upon those very sensibilities, to enhance them exceedingly, and augment the nervous irritation, and fearfully increase the physiological depression and derangement of his whole system; and all this, again, will react upon his mental faculties, controlling his mental operations, and forcing upon him the consciousness and the conclusion that all his suffering arises from the ruin of his character by the malicious calumny of his heartless and wicked persecutors; and he may soon come to believe that everybody is an enemy, and that there is a general conspiracy to destroy him. At the same time, he will be capable of thinking, reasoning, and judging with perfect correctness on any other subject, by which his morbid sensibilities are not excited; unless his nervous irritation and depression is continually kept up by some physical cause (571), and then he will either manifest equal insanity on all subjects, or it will be exceedingly difficult to draw his attention for a moment from the conceptions and reflections which engross his mind on the one subject; and he will constantly recur to that subject as soon as the direct efforts cease, which are made to fix his attention on real perceptions.

577. The same important law of the mind is illustrated by a case of inebriation. A person who is under the intoxicating effects of tea, coffee, tobacco, opium, wine, distilled spirit, or any other narcotic or alcoholic substance, is like an organ filled with wind, which is ready and pressing to rush out and form a tone at any pipe which is unstopped. He is filled with a nervous pathos which is ready to manifest itself in the form of a moral passion, at any pipe of the mind which may be opened to give it vent. Or in other words, he is under a nervous excitement, which becomes identified with the exercises of the mind, or any subject to which his attention may be called; and causes him to think, conceive, perceive, feel, and act, on that subject, with an ardor and earnestness commensurate with its intensity. If he be engaged in religious meditations or exercises, all his nervous excitement produced by the intoxicating substance will become to his consciousness purely religious feeling arising from the action of his mind on the subject which engages his attention (576); or perhaps he will even attribute it to Divine influence, and he will rejoice in the blessedness of his frame of mind and tenderness of heart, and he will sing, exhort, or pray, with a self-satisfaction equal to the tone of his feelings, and perhaps with a pathos of eloquence which will stir up the sympathies of all around him. While in this state, he necessarily judges according to his feelings; religion then is everything to him; he marvels that every body should not be religious; this world, with all its joys and promises and hopes, is a mere delusion; and he is ready, yea, longs, to shake off his earthly tabernacle, and hasten to the mansions of the blessed. But when his stimulation has passed away, it is possible you may find him of a very different tone and complexion of piety. If he be engaged in convivial pleasures, surrounded by cheerful companions and music and dancing, all his nervous excitement produced by the intoxicating substance will become to his

consciousness identified with his mental exercises on every subject to which his attention is directed (576). If he listens to the music, he will feel that it moves him exceedingly, and think he never heard it sound better. If he becomes attentive to the ladies, he will feel that they never appeared so bright and beautiful and fascinating; the civilities and courtesies of the gentlemen will be regarded as uncommonly generous and agreeable. Or if he thinks himself slighted or insulted, he feels the indignity with equal intensity, and the more he contemplates it, the more his wrath kindles; and in all the degrees of his passion, he judges that his feelings are produced entirely by the insult, and necessarily measures the importance and offensiveness of the insult by the intensity of his feelings; and he vents himself in violent language, or seeks revenge by physical force; and with fists, clubs, dirks, pistols, or some other weapon rushes in his madness to deeds of violence and outrage, and perhaps of blood and murder.

578. Thus, in all circumstances, the nervous excitement produced by an intoxicating substance is naturally converted into a moral affection, emotion, or passion, on any subject to which the attention of the mind is given, and, in the consciousness of the individual, becomes purely the effect of his perceptions, conceptions, and reflections on the subject which occupies his attention (576); and this affection or passion, with all the augmentation which it may receive from the mental perceptions, conceptions, and reflections, necessarily governs the conclusions or judgment of the mind, in regard to the importance or character of the subject contemplated. And this is strictly true of all other general nervous excitements, irritations, and depressions, by whatever cause produced.

579. Hence, therefore, so far as this general law of the mind is concerned, strict mental and moral sanity requires that the degree of our propensities, affections, emotions, or passions, on every subject upon which the mind acts, should be exactly equal to the relative importance of the subject contemplated, when accurately compared with all other subjects and things which exist, or of which we ever have any notion; or should precisely correspond with what is really true in the nature of things. All departure from this is a commensurate deviation from strict mental and moral sanity. He that desires, loves, hates, abhors, or in any manner estimates anything above or below its real worth, is in some degree insane.

580. This is one of the most important general laws of the mind; and the almost universal disregard of it in the education of children and youth, is the source of immense evil to mankind. It requires that in our early education, our affections should receive the utmost attention, and that every possible precaution, pains, and measure, should be taken to prevent the association of an improper degree of affection or feeling with any of our perceptions, conceptions, or reflections (565); that when we think of supplying any of the real wants of the body, and when we think of labor, pleasure, poverty, riches, dress, splendor, fame, time, eternity, life, death, virtue, vice, or anything else, our affection should always correspond precisely with the real importance of the thing contemplated, and thereby enable us to estimate each and every thing at its true value, and thus preserve a strict mental and moral and religious sanity.

581. Now, then, if we bring together the important principles which have been explained and illustrated, we shall see the philosophy of insanity, and find that even in the worst kinds of madness, the mind is still strictly true to the same general laws that always govern the human mind in all conditions (549). In the first place, we have seen (551), that perception consists in the impression or sensation received by the centre of animal perception (280), from the action of the visual, auditory, oltactory, gustatory, and tangible properties of external things, on our organs of sight, hearing, smell, taste, and touch, and from the affections which arise from the internal wants and conditions of the body (550), and that conception (558) consists in the distinct and vivid reproduction of the sensation of perception, without the real action of the properties by which it was first produced; and that the sensations of perception (559), being reflected to the intellectual faculties, form the thoughts of reflection, which are reproduced in what we call memory (562). We have seen, in the second place (564), that the succession or order in which our perceptions, conceptions, and reflections take place, establishes an association between them, so that certain perceptions or conceptions will call up certain thoughts of reflection and certain thoughts of reflection may produce mental conception: also, our propensities, feelings, emotions, and passions, are so associated with our perceptions, conceptions, and thoughts of reflection (565), that our perceptions, conceptions, and reflections, will call up our appetites, emotions, and passions; and these, in return, will call up our reflections and conceptions. But though the law of association is an essential and permanent principle in our mental operations, yet the particular associations of our thoughts and feelings may and do continually undergo changes. Our particular perceptions, conceptions, reflections, and emotions, are at different times, and in different conditions, attended with very different associations. We have seen, in the third place (566), that a distinct, vivid, and complete perception and conception, cannot take place at one and the same instant; though the mind may sometimes, in a measure, imperfectly attend to both at the same instant; or in other words, we may have imperfect visual conceptions, and auditory, olfactory, gustatory, or tangible perceptions, at the same time, in a relaxed state of the mind. But when we have a distinct and perfect visual perception, we cannot have a visual conception at the same instant; and when we have a distinct, vivid, and complete visual conception, we cannot have a visual perception, in the slightest degree, at the same instant. Thus, when a person has a distinct visual perception of a post or stump, he can have no visual conception at the same instant; but if he is excessively afraid of meeting and being killed by an Indian, his fears may produce a distinct, vivid, and complete conception of an Indian, occupying the place of the post, but the instant the conception takes place, his perception is lost: and while the conception continues perfect, he can no more see the post nor anything else, than a blind man, and the Indian which he conceives is as much a reality to his mind as the post was which he perceived; and, therefore, it is a general law of the mind, which governs it in all states and conditions, that our conceptions, when distinct, vivid, and complete, are as much realities to the mind, while they last, as our actual perceptions, and

that the mind cannot possibly know them from realities until they have ceased to be (568). We have seen, in the fourth place (565), that all general nervous irritations, excitements, and depressions, by whatever cause produced, call up reflections and conceptions of the mind, and are attended with feelings which become identified, in our consciousness, with our mental operations, and are greatly augmented by our reflections and conceptions; the degree of intensity always bearing a relation to the irritability of the nervous system. And the mind, we have seen (305), cannot, of its own consciousness, discriminate between those feelings which arise from a pecular condition of the nervous system, and which cause our pleasing or melancholy thoughts and conceptions, and those feelings which are caused entirely by our thoughts, conceptions, and perceptions; and, therefore, when the mind acts according to its own consciousness, it always and necessarily judges that all our emotions connected with our thoughts and conceptions and perceptions are entirely caused by those thoughts, conceptions, and perceptions; and hence, we necessarily attribute to the subject on which our mind is exercised, the influence or power by which all our intellectual operations and our feelings in regard to it are produced (575); and, therefore, we necessarily estimate the character and the importance of that subject to us, by the degree of our feelings when contemplating it. It is, therefore, a general law of the mind, which governs it in all states and conditions, that the importance, in our estimation, of any subject or thing which we perceive or contemplate, is always equal to the degree of feeling, emotion, or passion, connected with our perceptions, conceptions, and reflections on the subject (576); and, consequently, our reasonings and conclusions, or judgment, always necessarily correspond with our feelings.

582. If, then, an individual is laboring under a general nervous irritation, by which distinct and vivid conceptions are continually produced, the morbid sensibilities developed by that irritation, and excessively augmented by the reaction of the excited mental operations, will greatly increase the vividness and energy of his conceptions and reflections, and at the same time necessarily cause him to estimate the importance of the subjects and things contemplated, according to the degree of feeling which attends his mental operations. Continual conceptions will therefore not only take the place of perceptions, and become realities to the mind, but his conceptions and reflections will be attended with a degree of feeling which will make the things contemplated of the most absorbing interest and pressing importance to him. New associations of thoughts, conceptions, perceptions, and emotions, will soon be formed, which will aggravate and perpetuate the unhappy state of things, and if the individual be not speedily restored to health, permanent intellectual and moral habitudes will necessarily be established.

583. If the nervous irritation and excitement be very great, total insanity and raving madness will be the result; but if by slow degrees, the continued or frequently repeated action of irritating causes has developed a general morbid irritability, rendering the nervous system extremely excitable, without keeping up a permanent irritation or excitement, then the individual will manifest sanity or insanity according as his nervous system is composed or excited. In this situation,

some individuals are, when not excited, equally sane on all subjects, and when excited, equally insane on all subjects. Others, from some cause or other not difficult to explain, will, while under nervous depression, fix the mind on some particular subject, and associate their morbid sensibilities with it, and necessarily estimate it according to the character and degree of those sensibilities, till it becomes of absorbing interest to them (305), and all the reasonings, conclusions, conceptions, reflections, and associations of the mind, obey the controlling energy of that interest. These, when the nervous irritation is subdued, will be perfectly sane; but the moment they are excited by any means, the morbid sensibilities developed by the excitement, being intimately associated with that particular subject, will instantly call up the thoughts and conceptions of the mind on that subject, and they will manifest insanity on one subject alone. But though they manifest insanity only on that subject, it is almost impossible, while they are under that nervous irritation which causes them to manifest the monomania, to fix their attention for an instant on any other subject, because their morbid sensibilities continually cling to the associated thoughts and conceptions, and drag them back, as by an irresistible instinct, to the all-absorbing subject. And in many instances this subject becomes of such thrilling interest to the mind, that the bare naming or suggestion of it will instantly produce a general nervous irritation, developing the morbid sensibilities and all the manifestations of monomania; and finally, the associations become so extensive, that everything external and internal constantly suggests the absorbing subject.

584. We see, therefore, that in all species of insanity, even the worst cases of madness, the mind is true to the laws (549) which govern it in all states and conditions, and that the body alone is at fault, in the morbid irritability, excitements, depressions, and sensibilities of the nervous system, by which thoughts and conceptions of an improper kind are continually called up, and the subjects on which the mind acts are made of undue importance, and new associations and combinations of ideas are formed, and new associations of thoughts and feelings are established.

585. Now, the question is, whether, according to phrenology, the brain is the special seat of this nervous irritation, and monomania is owing to a morbid condition of a single cerebral organ? or whether the morbid irritability and irritation are common to the whole nervous system, and especially the nerves of organic life (228), and monomania and other species of insanity are results of that irritation, according to the laws which I have explained?

586. I confess that I am decidedly in favor of the latter opinion, for many more reasons than I can assign at this time. I will however adduce a few of them. In the first place, there it not a portion of the brain nor of the little brain which has not frequently been destroyed in different individuals, without the least manifestation of mental derangement, either particular or general. I well know the reply; that the organs are double, and one eye may be destroyed without destroying vision, etc.; but this argument, even if it be tenable, does not meet my position. It may answer on the question of the plurality of the cerebral organs, but not on that of monomania, as caused by the local

disease of a particular cerebral organ. In the second place, pistol and musket-balls have been shot into the brain; swords, tomahawks, and other instruments have been struck into the brain in various directions and in some instances so as to wound corresponding parts of both hemispheres at the same time; portions of the brain have been discharged at the wounds of the skull; surgeons' fingers and instruments have been thrust deep into the lobes of the brain, and all this has repeatedly taken place without the slightest manifestation of particular or general insanity. In the third place, there is no evidence, either from *post mortem* examinations or any other pathological facts, that either general or particular insanity was ever caused by the disease of a particular part of the brain which was strictly local, or which did not involve the whole brain in its irritations. On the contrary, all that we know on the subject goes decidedly to prove, that when diseases of the brain, whether caused by external violence or internal disturbances, are strictly local; when all the morbid affections are confined to the particular part diseased, no manifestations of mental insanity, either general or particular, ever take place. And it incomparibly more frequently happens that *post mortem* examination discloses local disease, change of structure, and total destruction of particular parts of the brain, where there has been no manifestation of mental insanity during life, than where there has; and I contend that when any degree of insanity has attended local disease of the brain, *that* disease has involved the whole brain at least, and probably all the nerves or organic life, in its irritations; and I can scarcely doubt that in most cases of this kind, the local disease itself, instead of being the cause of the insanity, is only an effect of the same cause that produces the insanity. I am also confident that the brains of fifty or any other number of those who have terminated life after many years of chronic mania, either general or particular, will, in the average, exhibit as healthy an appearance as the brains of an equal number of persons who have terminated life after suffering for an equal number of years under any other form of chronic disease which involves the nervous system of organic life in an equal extent of physiological derangement. In the fourth place, both general and particular insanity often, if not generally, result from irritations which have their special seat in the domain of organic life, and perhaps most frequently in the digestive organs. I once attended the dissection of the body of a hospital patient, who, according to the opinion of his attending physician, a distinguished medical gentleman, died of religious mania. His mind had been totally deranged, and his madness was at times so violent that it was found necessary to confine him; but the single subject which constantly occupied his mind was religion, and therefore his case was pronounced religious mania. A number of medical gentlemen and students were present at the dissection, and it was observed by all that the subject was depressed at those parts of the head, where phrenologists have located veneration, marvellousness, and conscientiousness. On examining the subject internally, not the slightest trace of disease could be found, till we discovered an *intus susception* of the small intestine, attended with indications of a high degree of inflammation before death, which extended over a considerable portion of the jejunum and duodenum. The subject was very recent, so that

no important *post mortem* changes could have taken place; and there was nothing to afford us the least ground of doubt that both the mental mania and the death of the body had been caused by the disease seated in the small intestine.

587. The following is a brief abstract of an interesting statement given me by an able practising physician. "D. C. M., a well-digger, 33 years old, full habits, was attacked with a relax on Monday, Sept. 16, while at labor in a well, but continued labor. Tuesday at noon, appetite poor; took little for his dinner beside pickled cucumbers, and went to his labor; relax increased, attended with spasms in the muscles of the abdomen and lower limbs, and some pain in the region of the stomach. At eight o'clock, p. m., I was called; found him vomiting and purging with spasms—bled him freely—spasms relieved—ordered warm water and a cathartic; he threw up the pickles, cathartic operated, after which he took an anodyne draught, and rested quietly during night. Wednesday he was relieved; some soreness remaining over the stomach, I ordered gruel for diet, and left him. Thursday he felt perfectly well, and notwithstanding my strict prohibition, and his wife's remonstrances, he ate a hearty dinner of flesh, with some pickled cucumbers, and went into his garden. In about one hour, returned perfectly delirious, and left home for the village, where he wandered about till near six o'clock, p. m., when he was got home. His delirium all this time had been continually increasing. Two persons were sent in haste to call me, but not finding me at home, one of them called in Dr. W. When I arrived Dr. W. was bleeding him, under the impression that he was laboring under phrenitis. On enquiry I learned from his wife what he had done, and that he was quite well at noon before he ate his dinner; and I told Dr. W. that I suspected the cause of the delirium to be in the stomach or bowels. He thought it was in the head; but as he considered the patient mine, he left him to me, and withdrew. I immediately directed measures to evacuate his stomach and bowels. His symptoms had been very little relieved by the bleeding, although it was copious, say thirty ounces, and there was no symptom present to indicate any derangement of the chylopoietic viscera. On making pressure, however, over the stomach, he flinched; and on drinking a glass of cold water he manifested uneasiness at the stomach. There was no suffusion of his face and eyes with blood; his eyes were brilliant, and their whites of a pearly whiteness; their expression mild and playful. His thirst was incessant. He would not suffer me to examine his tongue. An emetico-cathartic was administered, which operated several times. Not being satisfied with the catharsis, I ordered castor-oil, supposing from the account given by the attendants that the emesis had been quite sufficient to evacuate the contents of his stomach at least; for they said he had vomited four or five times severely. At ten in the evening his bowels had been moved seven or eight times, and he had vomited about the same number of times; but his delirium was not relieved. He had thrown up a little of what his attendants supposed to be a part of his dinner, and was still a little sick at the stomach. Warm water was ordered to be taken freely, which brought on full vomiting again. After several severe efforts, he threw up a mass of what proved on inspection to be flesh and pickled cucumbers. From that moment his

delirium ceased, and he immediately recovered." This medical gentleman is a full believer in phrenology.

588. I might add numerous cases of this kind, many of which have fallen under my own observation; but I deem it unnecessary. Puerperal insanity most unquestionably results from irritations located in the domain of organic life, and involving the whole nervous system. In short, I fully believe that at least ninety-nine cases in a hundred of chronic mania originate in the irritations of the nerves of organic life, and that when cerebral disease or change of structure supervenes, it is the result of the same cause that produces the mania, and is preceded by manifestations of mental insanity. I do not think, therefore, that monomania in any degree proves a plurality of organs in the brain.* Yet I freely admit that, all my reasoning being true, there may still be a plurality of cerebral organs, and I do not affirm that there is not; but I contend that it is a matter which yet requires proof; and whether true or not, the phrenologists have evidently made the contents of the skull too exclusively the machinery and source of the mental and moral powers and animal propensities.

589. The brain, whether consisting of a single organ or of a system of organs, is unquestionably the seat of intellect (260), but it is not equally evident that it is the seat of all the animal propensities; though it is possible that each propensity has its special organ of perception in the brain. We know that if the nervous communication between the stomach and the centre of animal perception be cut off, the animal can have no perception of hunger; and it is very certain that hunger is a special sense (550), produced by a peculiar physiological condition of the nervous tissue of the stomach, and perceived by the animal centre; but neither the hemispheres of the brain nor the lobes of the little brain are essential to the animal perception of hunger, or desire for food (259)

590. We are told that some men can *feel* the exercises of particular parts of their brain in their mental operations; but I leave those to believe such things who can, and I ask if ever any one felt his brain to be the seat of his propensities and emotions? Have not mankind in all ages, from mere feeling or consciousness, always referred these emotions to the epigastric region? What lover, or parent, or patriot, in the gush of his emotions, ever instinctively laid his hand on the back of his head, and spoke of the ardor of his feelings? (534, Nos. 4, 5, 7). But shall I be asked if I intend to affirm or imply that the mind has one seat, and the propensities and sentiments another, and that the abdominal viscera (313) have an independent power of sensibility within themselves, and constitute the special organism of the animal propensities and moral sentiments? I reply, that I mean simply to affirm that there is a oneness in the nervous system of the human body; that to a certain extent, and for certain purposes, the nerves of organic and of animal life constitute a single whole; and that the point of unity or centre of perception of this single whole is at or near the top of the medulla oblongata (280). In the domain of organic life, we have seen (219),

* If the views I have presented be correct, then monomania, as well as other kinds of insanity, should be regarded and treated as a symptom of general morbid irritability, sensibility, and sympathy, rather than as a local disease of a particular portion of the brain.

that there are special centres for special purposes, and a common centre (218), which presides over the whole internal economy; and so far as the wants of the vital economy require the exercise of voluntary functions, the animal centre has a perception of those wants (294). Or, in other words, the vital economy manifests those wants by producing certain physiological conditions of the tissues of certain organs in its organic domain; and the animal centre, by means of nervous connexions established for the purpose, perceives those physiological conditions, and thus they become special senses; and as strictly so as sight, hearing, smell, taste, and touch (550). The animal centre, then, as a unit, does, as it were, throw out its feelers into every portion of the body internally and externally. By the internal feelers it perceives those physiological conditions of the organic domain which, being perceived, constitute the senses of hunger, thirst, etc.; and thus it has cognizance of all those internal conditions which directly relate to the voluntary powers. By its external feelers it perceives those impressions made by the qualities of external things, which constitute the senses of touch, taste, smell, hearing, and vision; and thus we are enabled to perceive both our internal wants and the external supplies. The perceptions of the animal centre are all instantly reflected to the intellectual organ or organs, and produce thoughts of reflection in the manner I have described (559). Moreover, as we have seen, the brain and all the nerves of animal life continually and entirely depend on the functional integrity of the nerves of organic life for their own functional powers (209, 260); and, therefore, though we have no special sense of perception by which we are informed of all the functional aberrations in the domain of organic life, yet the brain always sympathizing in the general condition of that domain, we are conscious of the effect without knowing the source (305).

591. On the whole, then, though I do not wish to be considered as an opposer of the theory of Dr. Gall, but am strongly disposed to favor its general principles (543), yet I must contend that while the brain, either as a single organ, or as a system of organs, is the special seat of thought, the whole nervous system is so intimately connected with the brain as its intellectual and moral instruments (590), and the intellectual and moral operations of the brain are so closely associated (565) with the conditions and influences of the nerves of organic life (305), that the intellectual and moral philosophy of man cannot be accurately understood without a just knowledge of the nervous system as a whole; and that the physiological laws with their important relations constitutionally established in the organic domain, are of incomparably more importance to the philosopher, the philanthropist, and the Christian, than the external shape of the skull, or even the internal structure of the brain. For, admitting all that phrenology claims in regard to cerebal organization, it is still true that the intellectual and moral character of man can only be constitutionally reached through the medium of the nerves of organic life (306); or, in other words, it is only by a proper attention to the physiological laws of the domain of organic life, that we can justly hope to have such an effect on the shape and condition of the brain, and other parts of the body, as will secure health, wisdom, virtue, and happiness, to the human race.

592. My apprehension is, that the intellectual and moral science of

man is far more profound and intricate than phrenology contemplates, and cannot be fully understood without a knowledge of all the properties and powers of the whole human system; and therefore, instead of limiting our observations and investigations to the head, in order to find out what a man *is*, we should extend them over the whole organization, and endeavor to ascertain the particular and the general laws of animal, intellectual, and moral physiology, that we may not only know what man is, but also what he ought to be, and how to make and keep him so.

LECTURE X.

General law of relation between the instincts and the voluntary powers—Brute reason—General law of relation between the instincts and cerebral faculties—Man and animals under the same law—But man can deprave himself and multiply his wants—Not so other animals—Artificial wants of man act on his cerebral organs the same as the natural wants—Man's superior intellect sinks him deeper in depravity—What he would be without moral powers—The end for which his moral powers are established—These, his distinguishing and most exalting attributes—Relations of man to his Creator and to his fellow creatures—The Gospel agrees with physiology—The moral probation of man—His moral ability and inability—Conscience, what?—Moral sense innate; its power—A false or true conscience, how formed—Moral sense more or less active and powerful—Effect of morbid sensibility of the nervous system on the moral sense and conscience—False conscience; its sources—Man naturally and necessarily religious—Superstition, bigotry, fanaticism—Man's moral responsibility—Other moral faculties under the same laws.

593. We have seen that the nerves of organic life preside over all the functions concerned in the nourishment, growth, and general sustenance of the body (223, 227, 228); and that so far as digestion, absorption, respiration, circulation, secretion, excretion, organization, the regulation of temperature, etc., are considered, the animal, like the vegetable, is, in a state of health, destitute of consciousness (208); and could the animal, like the vegetable, be regularly supplied with nourishment without the exercise of voluntary powers, the animal body, like the plant, might be developed, attain to its full size, live out its constitutional period, and die and decay without the least consciousness of its existence (294).

594. But the animal body is constituted with such relations to the external world, as require the exercise of voluntary powers to supply the wants of its internal economy (209). Hence it is furnished with an apparatus of nerves and organs adapted to its external relations (283). This apparatus (233) consists of the nerves of animal life, which are endowed with peculiar properties and powers (294), by which the animal is made conscious of its existence, and enabled to perceive its internal wants, and those external properties and things by which its wants are supplied (209); and of the muscles and bones employed in voluntary motion, by which it is enabled to approach and seize those things which it perceives and wants (233).

595. The internal wants, I have said (590), are attended with certain physiological conditions of the organs, and these conditions being perceived by the centre of animal perception (280), become the special

senses of hunger, thirst, etc. (589). In the lowest orders of animals (209), the animal consciousness is extremely feeble, and the animal perceptions and voluntary functions are purely instinctive and rudimental. The animal is scarcely elevated above the vegetable (209). As we ascend the scale of animal existence, we find animal consciousness and perception more and more vivid and powerful, and the voluntary faculties more and more developed and active. But from the lowest to the highest orders of animals, including man, it is a universal law of the animal kingdom, that the domain of organic life manifests its wants to the centre of animal perception in such a manner as to produce a strong propensity in the animal to exercise its voluntary powers for the supply of those wants. These propensities are called INSTINCTS.

596. In many of the lower orders of animals, the voluntary powers are purely the instruments of the animal instincts. Without an act of reasoning or of reflection, the animal is moved by the sense of its wants to exercise its voluntary powers in such a manner as to satisfy the propensity; and in obeying its internal instinct, it instinctively employs its instinctive powers of external relation connected with its voluntary powers; and by smell, taste, and other perceptive senses, feels out the substances adapted to its wants, and thus fulfils the final causes of its organization. The voluntary powers of the higher orders of animals are equally obedient to the instinctive wants or propensities, but their exercise is attended with something more of thought and reasoning. The rudiments of brute reason are probably to be found in all the vertebrated animals; but they are more and more developed as we ascend the scale towards man. And there is little ground of doubt that the reasoning powers of animals bear a precise relation, as to their extent, to the developments of the brain. The monkey tribes, the elephant, the dog, the fox, the horse, the swine, and several other animals, give the most unquestionable evidences of their powers of reason and reflection. Nevertheless, whatever be the extent of the powers of brute reason in animals, those powers are always perfectly subservient to the instinctive wants of the body. All the reasoning and reflection ever manifested by the horse, dog, elephant etc., are exicited by their instinctive propensities, and are only exercised in conformity to those propensities, or for the purpose of gratifying them, and never for the purpose of resisting or restraining them. It is therefore a general law of the animal kingdom, that the cerebral faculties, whatever they may be, are subservient to the wants of the body; and all the intellectual and voluntary powers naturally concur with the animal propensities and seek their gratification.

597. It is, as I have stated (520), entirely certain, that whatever be the substratum of the sensorial power of the human brain, it resides in and acts through the organized matter of the nervous substance, during our present state of existence, precisely the same as if it were merely a property of that vitalized matter, and all its powers and manifestations are subject to precisely the same laws as govern the powers and manifestations of vitality. Hence, so far as the instinctive wants and animal propensities, and their relation to and influence upon the intellectual and voluntary powers, are considered, man is in the same general predicament with the lower animals: all his interna

wants and propensities appeal to his intellectual and voluntary faculties, and excite their action, and naturally cause them to concur with, and seek the satisfaction of, the bodily desires. And although there is an almost infinite distance between the reason of man and that of the highest order of the lower animals, yet the philosophy of his reasoning is precisely the same as that of the elephant, the horse, etc., and consequently it is governed by the same general laws. But man's superior intellectual and voluntary powers not only increase his ability to supply his bodily wants in all the varying circumstances of seasons and conditions, but also increase his power of multiplying those wants, by his artificial modes of supplying them, and by the artificial circumstances of social and civic life.

598. The horse and ox and other animals, like man, have the special sense of thirst, or natural want of water, but they have neither the reasoning nor the voluntary powers to supply this want with any thing else but water; and, therefore, from birth to death, and from generation to generation, they only feel the same natural and simple want, and are always satisfied when that want is supplied with good water; but out of this simple and single want of his body, man generates a thousand artificial wants, which become ingrafted upon his body, and exert their influence upon his intellectual and voluntary powers in precisely the same manner as his original instinctive wants do, and always with a more despotic and imperious energy, and with a continual and powerful tendency to excess. The same is true of the special sense of hunger: in the lower animals, it is always equally simple and natural, unless depraved by the artificial training of man; but man multiplies this simple natural want into a thousand artificial ones, which exert a controlling and arbitrary influence upon his intellectual and voluntary powers; and in the same manner, every other natural want and sense of the human body are multiplied by man to the extent of his capabilities (21); and out of these innumerable wants which are ingrafted upon the natural propensities and sensibilities of his body, spring a multitude of others in connexion with the social and civil institutions and customs of society. These thousands of artificial wants soon come to be so intimately and completely associated with the natural wants of the body, that few know the difference between the natural and the artificial; and all of them, with different degrees of energy and despotism, press their demands upon the intellectual and voluntary powers, urging or compelling those decisions of the mind, and those exercises of the voluntary powers, by which they can be satisfied or indulged; and upon precisely the same principles of intellectual and moral philosophy as govern the action of the original instinctive wants of the body, upon the cerebral faculties (565, 576).

599. But in thus multiplying his wants, man necessarily not only depraves the natural instincts, propensities, and sensibilities of his body, and increases the force and despotism of his wants upon his intellectual and voluntary powers, but he also impairs his mental faculties, and deteriorates his whole nature, and tends to the destruction of mind and body.

600. Hence, therefore, were man only elevated above the other animals by superior intellectual and voluntary powers, his natural elevation would answer no other end than to increase the distance of his fall,

and the depth of his degradation and misery. He would, indeed, be the vilest and most wretched of all terrestrial things. With all his intellectual and voluntary powers subservient simply to the supply of his bodily wants, and those wants multiplied beyond number, and increased continually in despotism and depravity, his superior powers would only be a superior ability to make himself miserable, and to destroy himself and others. His reasoning powers would be employed with little more than the excitements of his appetites and feelings, and in securing the means of his self-indulgence, and in devising the crafty or the violent measures by which he could procure or destroy whatever his lusts or passions demanded; his judgment would be but the dictates of his propensities; desire would constitute his only principle of action; and this would lead him downward, deeper and deeper into the abyss of animal depravity, and subjugate his intellectual powers to more and more degrading and debasing slavery to his sensuality. Never would his reason remonstrate with his passions; never would his judgment condemn his indulgence; strength would constitute the right of precedence, and power the law of possession; and man would prey upon his fellow creatures with an energy and cruelty, by so much the fiercer and more destructive and terrible than the most ferocious of other animals, as he possessed superior intellectual and voluntary powers to deprave himself, and to devise and carry into execution more crafty and skilful plans of destruction.

601. To prevent this natural tendency of man's animal nature, and to excite his intellectual powers to elevated and extensive efforts in the attainments of knowledge and wisdom, a wise and benevolent Creator has endowed him with MORAL POWERS, and made him the subject of moral government.

602. Thus God has created matter, and impressed upon it those primary laws (89), by which it enters into the various forms of the inorganic world, and by which those forms are governed as individual masses; and upon the common matter of the inorganic world he has superinduced still higher laws of action and constitution (110), by which it is made to enter into the arrangements and forms of living organized bodies; and upon organized matter he has superinduced still higher laws of constitution, by which living bodies are endowed with a consciousness of their existence, and with the power of perceiving their internal wants, and of perceiving and procuring the external supplies (114, 138); and upon animal consciousness and sensibility he has superinduced still higher laws of constitution, by which the animal is endowed with intellectual powers (165); and finally, upon the associated animal nature and intellectual powers of man, God has superinduced moral powers. It is, therefore, the *moral nature* of man which gives him his highest elevation in the scale of being, and places him at the greatest distance from his fellow animals, and nearest to angels or to devils.

603. By this wonderful union of intellectual and moral powers with organized matter, man alone, of all terrestrial beings, is brought into a twofold relation to his Creator. In his material nature, man, in common with all other material forms and substances, holds a fixed relation to his Creator as the great, first, and continually efficient Cause by which matter and all material forms and properties and powers are

what they are. This relation only embraces the natural attributes of God. In his moral nature man holds a fixed relation to his Creator, as an infinitely true and just and benevolent and good and holy Being and Judge and Father. But as there is of necessity an essential and perfect harmony between the natural and the moral attributes of God, so is there a perfect harmony between the natural and moral relations which man holds to his Creator; so that the perfect fulfilment of the one requires the perfect fulfilment of the other. That is, the constitutional laws which govern the living, organized body of man, and on which all its physiological properties and powers and interests depend, harmonize most perfectly with the constitutional laws which govern his intellectual and moral nature. So that the highest and best condition of the human body requires a perfect obedience, not only of its own physiological laws as living organized matter, but also of the constitutional laws of the intellectual and moral nature associated with it; and the highest and best condition of man's intellectual and moral nature requires the perfect obedience, not only of its own constitutional laws, but also of the constitutional laws of the body as living organized matter: and consequently, the violation of the constitutional laws of the one is necessarily attended with an infraction of the constitutional laws of the other. Hence, therefore, no moral or civil law or religious doctrine can be adapted to the highest and best condition of man's moral nature, which is not strictly consistent with the physiological laws of his body; and on the other hand, no bodily habit, indulgence, or regimen, can be adapted to the highest and best condition of his body, which is not strictly consistent with the consitutional laws of his intellectual and moral nature. And it is a deeply interesting and incontrovertible fact, worthy of all consideration, that if one who had the most perfect knowledge of the physiological laws of the human body, should draw up a code of moral and religious laws for man, which should in every principle and point be strictly conformable to the constitutional laws of man's bodily and moral nature, and most philosophically adapted to the condition and relations of man, he could not possibly produce a code more wisely fitted to the constitutional truth, and to the highest and best condition of human nature even in this world, than is contained in the New Testament of our Lord and Saviour Jesus Christ.

604. The animal nature of man may be considered as the basis of his human existence. Its passions, its propensities, its desires, with all the artificial wants that are ingrafted upon the bodily instincts and sensibilities, constitute the primary and principal elements of activity to his mental powers, and tend continually to cause his rationality to concur with his animal indulgence, or to consent to and provide for the gratifications of all his sensual and selfish appetites and desires, both natural and artificial (598). And this is what the apostle Paul, who was one of the most profound philosophers that ever lived, calls *the minding of the flesh*; and with equal physiological and moral and religious truth, he declares that the minding of the flesh is death; for, as we have seen (599), it inevitably leads, if unrestrained, to the speedy destruction of the body, and of the mental and moral powers, and to the extermination of the race. But the moral powers which God has constitutionally established in human nature (601), come in to regulate the carnal nature of man, with reference to moral law,

which, as we have seen (603), perfectly harmonizes with the physiological laws of man's nature. And the whole bearing of moral law on human nature, is to hold the carnal passions, propensities, and desires (598) in perfect subjection to a rationality which is enlightened and governed by moral truth.

605. Moral truth says, *Thou shalt love that supremely which is intrinsically most excellent and worthy of being loved*, which is the moral character of God, and which, being supremely loved, will not only secure thy own highest and best condition, but the supreme love of which, in thee, is most perfectly compatible with, and conducive to, the highest and best condition of thy fellow-creatures: but carnal nature says, *I will love that supremely to which I have the strongest intrinsic propensity*, which is self-indulgence. Here, then, is the conflict of man's moral probation: between his carnal nature, with all its natural and acquired wants and appetites (598), and God's moral truth; for the flesh lusteth against the spirit of truth, and the spirit of truth striveth against the flesh; and, therefore, the minding of the flesh, beyond the true and proper fulfilment of the constitutional laws of human nature, or beyond the true and proper supply of the real wants of the body, is, of necessity, in the nature of things, contrary to supreme love to God, for it is not obedience to the laws of God, neither indeed can be, because it is a direct transgression of those laws (603).

606. The moral nature of man is established by the Creator to preside over and control this conflict, and is made responsible at the bar of God's eternal and immutable truth for the issue, and necessarily liable to the penalties which result from the infraction of God's laws. On the one hand, man's carnal nature is continually pressing for indulgence, and exerting its seductive influences on the rational powers, to draw them into concurrence with its propensities and appetites; while, on the other hand, the moral truth of God, which perfectly harmonizes with the natural truth of God (603), constitutionally established in the physiological laws of the human body, demands of man's moral nature the entire subjugation of his carnal passions, propensities, and appetites, to the requirements of moral truth, and declares that he who desireth to transgress, is essentially guilty of the act.

607. The whole controversy of the schools concerning man's moral ability and inability may, therefore, be resolved simply to this, namely his ability to will and act in obedience to moral truth, subject as his intellectual and moral powers are to the influences of his carnal nature (598). His moral ability is always precisely equal to the degree in which his moral powers hold his carnal nature in subjection to moral truth; and his inability is always precisely equal to the degree of influence which his carnal nature exerts upon his intellectual and moral powers, in opposition to moral truth. The more the intellectual and moral powers of man are under the control of his carnal nature, the greater is his moral inability to perceive, understand, and comply with the requirements of moral truth; and therefore whatever tends to deprave and multiply the carnal passions, propensities, and appetites of man, or in any degree to excite them and increase their power, does necessarily and directly increase his moral inability to perceive, understand, and comply with the requirements of moral truth, and to obey the constitutional laws of his nature.

608. Let us now recapitulate for a moment, for the purpose o bringing our argument to a focus. Man, then, has an animal nature, with constitutional laws common to the elephant, the horse, the ox, and other animals (595). He is endowed with voluntary and intellectual powers immeasurably superior to other animals, but established with the same relations to the bodily wants and appetites (595), and with the same philosophy of action as those of the monkey, the elephant, the dog, etc. (597). The lower animals have neither the intellectual nor the voluntary powers to violate the constitutional laws of their natures, to any serious extent, and thus deprave themselves, deteriorate their natures, and exterminate their species (598), and therefore they do not require a knowledge of the constitutional laws of their nature, and of the laws of relation which grow out of them. But man has both the voluntary and intellectual powers and the natural propensity to violate the constitutional laws of his nature, and thus deprave, deteriorate, and destroy himself. The good of man, as an individual and as a species, therefore, requires that he should both know and obey the constitutional laws of his nature; and accordingly God has endowed man with moral powers (601), which are constituted with fixed and precise relations to his animal nature on the one hand, and to the moral character of God on the other; and the office of these moral powers is to prompt man to know and obey the concordant, constitution laws of his animal and moral nature (604), and thus secure his own highest good and happiness, and promote the highest good and happiness of his fellow-creatures, and thereby fulfil the divine scheme of benevolence which has, in the constitutional nature of things, identified the supreme glory of God with the highest good and happiness of man.

609. To quicken man's moral powers to the faithful and unremitting performance of this important duty, God has from time to time addressed to him such moral instructions, and placed before him such motives, as his moral and intellectual condition fitted him to receive. In the morning twilight of the intellectual and moral world, when man's moral perceptions were feeble and indistinct, and his knowledge was limited to sensible things, the motives which God placed before him to induce him to know and obey the constitution laws of his nature, were bodily health, and long life, and worldly prosperity, and honor. But when God, by the continued operations of His great scheme of benevolence, had prepared the way for the introduction of a higher dispensation of motives, he brought life and immortality to light, and placed before man not only bodily health and long life and happiness in this world, but also moral purity and God-like excellence here, and eternal life and glory beyond the grave, as motives to induce him to know and obey the constitutional laws of his nature.

Now, then, let us endeavor to understand the true nature and philosophy of man's moral powers.

610. All mankind are conscious of possessing an attribute or power which, in our language, is called the CONSCIENCE. But theologians, metaphysicians, and philosophers have seemed to be quite as much in the dark as the unlearned multitude, concerning the real nature and power of the conscience. Some tell us that it is that faculty of the soul which discriminates between right and wrong, or which ap-

proves of what is right and disapproves of what is wrong, so far at least as to establish the great lines of demarcation between right and wrong, between vice and virtue. Others, carrying this view still farther, assert that the conscience is in every breast an innate rule of right which each individual is bound to obey, and by which each may measure his own actions; and, therefore, that in all matters of conscience, man has a natural and inalienable right to entire and unrestricted liberty. Others, again, perceiving that the consciences of different persons under different circumstances and with different educations, sanction and enforce things entirely different and diametrically opposite, are led to believe and assert that conscience is wholly a result of education, and, therefore, no criterion of right or virtue.

611. But these opinions are all founded on erroneous notions of the nature and powers of man's moral faculties. Every human being who is not an idiot, and who is old enough to understand the exercises of his own mental and moral powers, has something within him which, when excited, acts determinately, and definitely approves or disapproves of specific moral actions and qualities. This is what all men call *Conscience*. But this is neither a simple nor an innate power or faculty of the soul; it is of a complex character, and, as such, wholly the result of education; and it is with no degree of certainty a rule of right.

612. It is not, however, more certain that the intellectual faculties of man are innate, than it is that the MORAL SENSE is an innate power, a constitutional principle in the moral nature of man. But this is not to be confounded with the *conscience*, in correct philosophical reasoning. It is in no degree the result of education; nor can it be in any manner educated, except in being rendered more or less susceptible and active and powerful; but still, it always necessarily remains the same simple moral sense: the same in the Pagan, the Jew, the Mahomedan, and the Christian!—the same in a Hottentot, a Newton, a Paul!—the same simple moral sense which informs no man what is right or what is wrong; and has no more power than the sense of hunger has, to discriminate, even on the broadest grounds, between right and wrong, between vice and virtue. It is ever, and under all possible circumstances, the same simple moral sense, out of which grows the consciousness that there is a distinction between right and wrong, and a consciousness of moral responsibility; and when excited to perform its function, its definite, determinate, and only language is:—'BE RIGHT! —BE RIGHT!' But what that right is, it has no power to ascertain. For this it depends entirely on the intellectual faculties, which collectively, in their mental unity, I call the UNDERSTANDING. Whatever the understanding, acting under the influence of the moral sense, fully determines to be true or right, the moral sense receives as right; and afterwards, when excited in relation to the same thing, this complex power resulting from the co-operation of the moral sense and understanding, prompts the soul to obey it as right. Thus, suppose the proposition be laid before the mind of a man totally uneducated in morality and religion, and who knows nothing of the customs and opinions of mankind, that it is his moral duty to kill his parents when they become so old and infirm as not to be able to support themselves. His moral sense can neither intuitively nor by any process of reasoning tell

him whether the proposition is true or false. His understanding only can examine and weigh the evidence in the case, and come to the conclusion or decision as to the truth or falsity of the proposition. But while the understanding is doing this, the moral sense can more or less energetically and continually exert an influence upon it, which says, 'be right! be right!' and thus cause the understanding to examine and weigh the evidence in the case, with greater attention, diligence, and scrupulosity. And if by any means the understanding, acting under this influence of the moral sense, is brought to the full conclusion that the proposition is true, the moral sense has no power in itself to test the accuracy of the conclusion; and, therefore, necessarily receives it as true: and this conclusion or mixed result of the simultaneous action of the moral sense on the understanding, and of the understanding on the proposition, becomes a definite and determinate moral sentiment of the soul, which is so intimately associated with the moral sense, as to be instantly called up as a dictate or determinate impulse of the moral sense, whenever this simple power is excited to action in reference to the same proposition. And this definite and determinate moral sentiment is what all men call the conscience.

613. We see, then, that in this supposed case, the moral sense of the individual cannot possibly tell him whether it is right or wrong for him to kill his parents when they become old and helpless. It can only tell him to be right. But the conscience formed in the manner I have described (612), tells him definitely and determinately that it is right and duty for him to kill his parents when they become old and helpless.

614. Now change the circumstances of this individual, and let the same proposition again be presented to his mind, and let his moral feelings be excited on the subject, and all the real evidence in the case presented to him in a true light; his conscience will come up at once, and say definitely and determinately, 'it is right to kill the parents,' etc. But if the new circumstances and new array of evidence can shake his confidence in the former conclusion of his understanding, and cause him to doubt the correctness of it, the voice of his conscience will become feebler and feebler as the strength of his doubts increases, while the voice of his moral sense, with more and more energy and importunity, will say, 'be right!—be right!' and if, under this influence of his moral sense, and in view of all the evidence which is now presented to him, his understanding comes fully and confidently to the conclusion that the proposition is false, and that it is wrong to kill his aged and infirm parents, and right and duty to cherish and protect them, then this conclusion will become a definite and determinate moral sentiment of his soul, taking the place of the former one. And now his conscience will determinately tell him that it is wrong to kill his aged parents. So that the conscience of the same individual may at one time tell him it is right, and at another time that it is wrong, to kill his aged and helplses parents. Yet in all this, the moral sense undergoes no change. Its simple, single, only, and unerring cry, is always, when excited to action, 'be right! be right!'

615. But the moral sense, I have said, may be cultivated as to the legree of its energy or influence. And in this respect its laws are the same as the common physiological laws of the body. It may always be extremely feeble from want of proper exercise, so that it will never

with energy urge the understanding to ascertain the truth on any point. It may also be greatly impaired and almost totally obliterated by the continued violations of the constitutional laws of human nature (603). Whatever, in food or drink, or any other bodily indulgence or habit, impairs the sensorial power of the nervous system (597), commensurately impairs the moral sense; and all intentional violation of the constitutional laws of man's moral nature, every voluntary departure from strict righteousness, truth, holiness, etc., necessarily impairs the moral sense; and when these causes are combined, and their action continued, they often so completely blunt or deaden the moral sense, that the apostle Paul justly compares the effect to the searing of a hot iron. On the other hand, the moral sense may, by much exercise and careful cultivation, be rendered exceedingly vigorous and active and delicate, so that it will on all occasions, and in every, even the most inconsiderable, moral action and operation of the mind, energetically and healthfully urge the understanding to decide aright, to act aright. But the moral sense may also become excessively and morbidly active and acute, causing the most intense moral suffering, and even producing monomania or general insanity. Whatever in food or drink, or any other bodily habit or indulgence, produces a general morbid irritability and sensibility in the nervous system (571), always tends to produce morbid excess in the moral sense of conscientious people, filling the mind with unhealthy scruples and remorseful anguish, and perhaps despair, and sometimes rouses it up in most fearful energy, in those who have never before attended to its wholesome monitions, and fills them with the most terrible remorse and horror! Religious exhortations and appeals, also, which are of an impassioned and terrific character, and which greatly excite the moral sense, without properly enlightening the understanding, always tend to produce a morbid excess in the moral sense, and frequently cause partial or total insanity, and very rarely lead to real and permanent good.

616. When the moral sense is feeble and inactive, it does not throw a proper degree of influence on the operations of the understanding, but leaves it either to neglect, or carelessly to examine, or unfairly weigh evidences, and thus come to erroneous conclusions, and form a false conscience. When, on the other hand, the moral sense by any means is rendered morbidly active and energetic, it throws so vehement and distracting an influence on the understanding as to impair the accuracy of its operations, and exceedingly weaken or totally destroy its confidence in its own conclusions; and thus the mind is kept in a distressing state of incertitude and perplexity and conscientious doubt, which only increase the insane energy of the moral sense. And in this manner the keenest and most excruciating excess of human misery is frequently produced.

617. In all cases when a morbid nervous irritation and sensibility attend the exercises of the moral sense, the diseased nervous sensibility becomes identified, in the mental consciousness, with the moral sense (305, 565), and thus increases the unhealthy energy of its influence upon the understanding, and proportionately increases, in the estimation of the mind, the importance of the subject in reference to which the moral sense is excited (576).

618. Having thus ascertained the precise nature and power of the

moral sense and of the conscience, and to what extent a want of perfect integrity in the moral sense is conducive to an erroneous or unsound conscience, I proceed to the consideration of other sources of a false conscience.

619. We have seen (612) that the moral sense ever and only says, 'be right! be right!' and has in itself no power to determine what right is, but depends entirely on the understanding to ascertain what is right; and whatever the understanding fully determines to be right, when acting under the influence of the moral sense, the moral sense necessarily receives and enforces as right. If, therefore, by any means, the understanding is fully brought to an erroneous conclusion on any moral or religious subject, the conscience on that subject necessarily becomes fallacious. Now there are several sources of erroneous conclusion in the understanding besides those which I have already named. Much has been said about intuitive knowledge, but I apprehend there is very little meaning in the term. Except in the perception of our simple ideas, there is always necessarily more or less of reasoning in every operation and exercise of the mind (546). The understanding, therefore, always arrives at its conclusions much as a jury arrive at their verdict. When any subject or proposition is brought before the mind, there must be some evidences for or against the truth of the proposition, and perhaps both. It is the business of the intellectual faculties to examine these evidences with proper care, and to come to a conclusion in the affirmative or negative of the proposition according to the true force or weight of evidence in the case. But if the true evidence in the case be neglected, or but lightly and carelessly considered, or if but a small part of the true evidence in the case be examined, or if the evidence be unfairly presented, or if false evidence be presented as true, the understanding, even under the promptings of the moral sense, may come to erroneous conclusions, and fully determine that to be true or right which is not really so, and thus a fallacious conscience will be formed.

620. Furthermore, we have seen (565, 595), that the intellectual faculties are constitutionally and intimately associated with the natural instincts, propensities, and appetites of the body; and that the thousands of artificial wants, propensities, and appetites, which are ingrafted upon the natural instincts and sensibilities of the body, act upon the intellectual faculties in precisely the same manner as the natural instincts and propensities do, but with more vehemence and despotism (598). We have seen also, that it is a general law, common to man and the lower animals, that the mental and voluntary powers always naturally obey the bodily propensities and appetites (596, 597), and seek to supply the bodily wants. Hence all the carnal influences of the human body, and especially those which result from the depravation of the natural instincts and sensibilities (598), such as every lust for every kind of intoxicating and every stimulating drink and substance, and every appetite and desire ingrafted upon the body, or growing out of the artificial habits and circumstances of society, are directly adverse to correct perceptions, reasonings, and conclusions of the mind on all moral and religious subjects; and, therefore, it is a general law, that the ability of the understanding to ascertain moral and religious truth, in view of facts and evidences presented and

accessible to it, always corresponds with the physiological and moral purity of the individual (607). Thus: suppose a man to be strongly addicted to the use of tobacco, and suppose we should attempt to convince that man that it is morally and naturally wrong to chew tobacco, or use it in any way as a means of sensual gratification. Now, in the first place, that man's tobacco has impaired the delicacy of his moral sense (615). In the second place, it has in some degree impaired the nice powers of the understanding to perceive moral truth (599). In the third place, it has established in the physiological economy of his body, an appetite whose despotic and often irresistible influence upon the intellectual and voluntary powers, vehemently urges and even absolutely compels the understanding and WILL to comply with its demands (598). When, therefore, we attempt to convince him that it is morally and naturally wrong for him to use tobacco, we shall in the first place find it extremely difficult to reach his moral sense through the opposing energy of his lust. In the second place, his lust will not suffer his mind to fix its attention seriously and earnestly on the evidence which we present, but will keep it constantly employed in contemplating the importance of the gratification to his happiness, or in seeking for arguments to defend the gratification, or for evasions and subterfuges from the force of our evidence. In the third place, if we succeed in rousing his moral sense, and fixing his attention, and forcing our evidence upon him, his lust will not suffer his understanding to weigh that evidence with impartiality and honesty, but will compel him to weigh it in unequal scales, like one who weighs the gold he receives in a pair of iron scales with a powerful magnet lying concealed under the scale which contains his weights, and drawing it down with such a force as to make the gold appear of no weight at all. His lust will not suffer him to measure our evidence by any standard of truth, but force him to measure it by his own despotic and vehement energy, and thus make it appear as nothing. Or if we happen to approach him at a moment when his lust is slumbering in the stupefaction of a recent debauch, or if by any means we can for a moment succeed in silencing his lust, and by the assistance of his excited moral sense and the force of our evidence turn the balance of his understanding in favor of truth, and convince him that it is wrong for him to use tobacco, scarcely shall we cease to urge our evidence directly upon his attention, before his reviving lust will rise up with clamorous and impetuous importunity, or irresistible imperiousness, and bring his understanding to the full conclusion that it is not morally wrong for him to use tobacco; and thus he will establish a fallacious conscience, and return like a swine to the mire, and like a dog to his vomit. In this manner, every lust and appetite, natural and ingrafted (598), according to the energy of its influence on the intellectual and voluntary powers, tends to produce erroneous conclusions in the understanding, and thus produce an unsound or fallacious conscience.

621. We find, therefore, that the carnal influence of the human body on the intellectual and moral powers (604), is the grand primary source of erroneous conclusions and of a fallacious conscience. And this important and incontrovertible principle in mental and moral physiology is explicitly and fully asserted by the apostle Paul, in his

Epistle to the Hebrews. He exhorts the Hebrew proselytes to Christianity to prepare themselves to contemplate and understand and receive and love and obey the simple and pure and sublime doctrines of the Gospel, by having their hearts sprinkled from an evil or unsound conscience; or, by being cleansed from all those lusts and appetites and prejudices which have led their understanding to erroneous conclusions, and thus established an unsound conscience in them, and unfitted them to receive the Gospel in all its naked and beautiful simplicity of truth.

622. If, therefore, by any means, the understanding, under the promptings of the moral sense, is brought to an erroneous conclusion and fully determines that to be true or right which is really erroneous or wrong, the moral sense necessarily receives it as true or right, and prompts the soul to obey it as right, and thus man acts conscientiously wrong. And this is what Jesus meant when, seeing the Jews acting with great zeal conscientiously wrong, he said to them, 'If your eye be unsound, your whole body is full of darkness.' When an unsound or fallacious conscience is once established, it is next to impossible to remove it, especially in any matter which relates to the carnal propensities and appetites. Because the moral sense has in itself no means of testing the soundness of the conscience, and no way of removing an unsound conscience, but by the correct operations and conclusions of the understanding; and the unsound conscience being the advocate of the carnal propensities and appetites which begot it, quiets the moral sense, and prevents its acting on the understanding to excite it to a new examination of evidence, and to bring it to new conclusions; and therefore man has, in himself, no disposition to reject that as erroneous and wrong, which he conscientiously believes to be true and right; and if others attempt to convince him that it is wrong, his unsound conscience instantly interposes itself between such attempts and his moral sense, and keeps that quiet, while his carnal lusts rise up to prevent the mind from attending to the evidence presented, or to force the understanding to weigh the evidence in unequal scales; and all the while they justify themselves by the unsound conscience which is their offspring: and hence, as a general rule, it is impossible by any means to remove an unsound conscience until the carnal lusts and inordinate appetites and prejudices are subdued. And it was in view of this great difficulty of removing an unsound conscience, and of the great evils to which such a conscience leads, that Jesus declared to the deluded Jews, 'If, therefore, the light which is in you be darkness, how great is that darkness!'

623. Now, as the condition of the intellectual and moral faculties, and the power of the mind to ascertain the truth, and especially moral and religious truth, greatly depend, as we have seen (620), on the conditions of the bodily organ; therefore, whatever increases the influences of the propensities, desires, and appetites of the body (607), on the intellectual and moral faculties, beyond the real and true wants of the human system, not only depraves the organs, and leads to all the forms of bodily disease and suffering, and to premature death, but also necessarily impairs the intellectual and moral faculties, stupefies the moral sense, blunts the perceptive and reflective powers of the mind, and renders man less and less capable of perceiving and appre-

ciating moral and religious truth, and of being acted on by any other than sensual motives. Here the Scriptures declare that the *animal* man receiveth not the things of the Spirit of God, because they are insipid or of no force to him: his moral susceptibilities are not adapted to them; and therefore he cannot know them, because they are spiritually discerned. And it is a gross state of sensuality, and consequent intellectual and moral stupidity and darkness, which the Scriptures signify when they say, 'The heart of this people is waxed fat or gross, and their ears are dull of hearing, and their eyes have they closed, lest they should see with their eyes, and hear with their ears, and understand with their heart, and should be converted, and I should heal them.' Hence the New Testament is replete with passages affirming the intimate relation between the carnal influences and the moral character of man, and earnestly exhorting and entreating believing Christians to crucify the flesh with the lust thereof; to walk not after the flesh; to suffer not sin to reign in the mortal body by obeying the lusts thereof; to keep under the body and bring it into subjection; to present it a living sacrifice, holy, acceptable to God; to render it a temple of the Holy Spirit, even of the living God. Because the flesh lusteth against the spirit, and the spirit against the flesh; and the minding of the flesh is death, because of sin, or the transgression of the constitutional laws of the animal, intellectual, and moral nature of man: but the minding of the spirit of truth is life and peace, because of righteousness, or the obedience of those constitutional laws: and consequently, he that soweth to the flesh, shall of the flesh reap corruption; but he that soweth to the spirit, shall of the spirit reap life everlasting. And therefore godliness, or the strict obedience of the laws which God has constitutionally established in the animal, intellectual, and moral nature of man, is profitable or serviceable to all, having the promise of the life which now is, and of that which is to come.

624. The moral faculties being constitutionally inherent in human nature, man is therefore necessarily a religious animal; but there is no constitutional necessity nor certainty that his religion will be the religion of truth. We have seen (603), that the corporeal nature of man holds, in common with all material forms and substances, a fixed constitutional relation to God as its intelligent and omnipotent first and continually efficient Cause, and that the moral nature of man holds a fixed constitutional relation to the moral character of God, as a moral Governor, Judge, and Father; and that the constitutional laws of man's moral nature perfectly harmonize with the constitutional laws of his animal nature, so that the perfect fulfilment of the one requires the perfect fulfilment of the other, and the violation of the one is necessarily attended with an infraction of the other; and furthermore, that the moral and religious instruction of the Gospel of Jesus Christ perfectly harmonize with the constitutional laws of man's moral and animal nature. True religion consists then in perfectly obeying all the constitutional laws of human nature; for this would be fulfilling our twofold relation to God, our duty to ourselves and our relations to our fellow-creatures: and thus we should love God with all the heart, soul, mind, and strength, and our fellow-creatures as ourselves. But human nature has always come short of this perfect fulfil-

ment, and from the delinquency has sprung all the natural and moral evils that man experiences in this world. And the Gospel affirms that man has thus failed through the weakness of the flesh, and therefore that God has established an economy of grace, in which He will accept the true and sincere *spirit to do*, though man, in the frailty of his nature, comes short of the perfect fulfilment of law. But this economy of grace does not save man in the present state of being, from the penalties which must necessarily result from the violations of the constitutional laws of his animal nature.

625. If from inattention to true evidence (619) or want of information, from sensuality (620), or any other cause, the understanding remains unenlightened and undecided under the promptings of the moral sense (612), the mind is thrown into a state of painful perplexity, and not perceiving distinctly where the truth lies, and still fearing lest it should not embrace every point in which it may lie, it is led to give importance to things in themselves wholly unimportant, even to the extent, in some cases, of making an object of worship of a lifeless image or of a 'four-footed beast or creeping thing.' This is SUPERSTITION. If through the power of the carnal influences, or any other cause (620), the mind is led to lay hold of erroneous evidences, or inaccurately weigh the true evidence presented to it, and thus the understanding is fully brought to erroneous conclusions, under the influence of the moral sense (622), these conclusions will constitute a false conscience; and on these conclusions man builds the superstructure of his future interests and hopes, and with such associations they become of the utmost importance to his feelings, and he consequently regards with extreme jealousy every thing which seems to militate against him. This is BIGOTRY. When the passions become excited in behalf of these conscientious errors, man often pursues them with the utmost exercise of all his energies, and perhaps accomplishes more evil in the pursuit, and performs more deeds of horror, than under any other cause of action. This is FANATICISM. Yet in all this error, the moral sense speaks but one thing: 'be right! be right!' The evil therefore lies in the errors of the understanding, and the errors of the understanding arise mainly if not entirely on moral and religious subjects, from the influences of the carnal nature.

626. According, then, as man uses the powers and means which he possesses, and which lie within the reach of his capabilities, so will his religion be true or false. If true, it will lead to his highest and best condition. If false, it leads to his greatest evil. But whether his religion be that of truth unto good, or of error unto evil, man must be religious, or cease to be what he constitutionally is! His religion may indeed be nothing but the most savage and degrading superstition and idolatry; or, if possible, it may be of a still lower and more brutal order than this; or it may run into the most atheistically religious fanaticism against religion! but still, ransack the earth and ocean, and wherever you find a human being who is not an idiot, however savage his condition, however low his state, if you are capable of studying man, you may find in him the constitutional rudiments of a moral and religious character.

627. If man, therefore, be not led to the religion of truth and thus exalted to his highest and best condition, to a holy and happy alliance

with his benevolent Creator, he will, with inevitable necessity, sink into the religion of error, and thus be degraded to wickedness and misery, in proportion as he departs from the truth constitutionally established in his nature. And in proportion as the mind becomes darkened, and the conscience erroneous, and the moral sense blunted or feeble, man becomes less and less capable of ascertaining moral truth, and of perceiving and understanding spiritual things; and more and more inclined to carnal forms and ordinances, and the worship of sensible objects, and to the grossest and most degrading idolatry.

628. Finally: we see from the views which have now been presented, that man has an animal nature, endowed with intellectual and moral powers (602); that his intellectual powers naturally obey the propensities, appetites, and desires of his animal nature (597), whether originally instinctive or acquired (598); that the grand law of action in the animal nature of man is self-indulgence; that all transgression of the constitutional laws of the animal nature of man, in supplying the natural wants or in gratifying the natural propensities, necessarily more or less depraves the natural instincts and sensibilities of the body, and rapidly generates new wants, new appetites and propensities, which act on the intellectual and voluntary powers with a much more imperious and despotic energy than the natural ones, and always tend to excess, and lead to the destruction of the individual and the extinction of the species; that the moral powers are established to preside over the operations of the intellectual faculties, with a determinate reference to the constitutional laws and relations of human nature; and therefore that their office is to prompt the mind to find out, and the individual to obey, the constitutional laws and relations of his nature. And in doing this, the moral sense cannot in itself tell what is true or right, nor has it any ability to tell whether the conclusions of the understanding are correct or erroneous. It can only say to the understanding with more or less energy or importunity, 'be right! be right!' and whatever the understanding fully and confidently determines to be right, the moral sense necessarily receives and enforces as right; and this is the CONSCIENCE. Therefore, when the conclusions of the understanding are strictly true, the conscience is true; but if by any means the understanding is fully brought to erroneous conclusions under the promptings of the moral sense, the conscience is false. And consequently, the fact that a man is conscientiously sincere in a thing, is no proof that the thing is right; nor is the fact that a man's conscience does not reprove him in what he does, any proof that he is not acting morally wrong.

629. My analysis and philosophy of the moral powers thus far, are perfectly reconcileable to the views of Gall and Spurzheim, except that they make the brain of more exclusive importance than I do (588), and attribute much less to the physiological and pathological powers and conditions of the nerves of organic life and the organs of relation. They study man more exclusively within the brain (592), while I insist much more on the physiological laws of his whole organization. They may be correct in asserting than man has other innate moral faculties, such as benevolence, veneration, etc. If there be such innate powers, and there is much and strong evidence of it, it is entirely certain that

the philosophy of them in the moral constitution and character of man is precisely the same as that which I have now explained of the moral sense (1234). And with the application of this general physiological philosophy to all the cerebral organs described by Gall and Spurzheim, I should have much less objection to their theory, because I believe it would thereby be rendered much more consistent with truth, and stripped of its most objectionable features.

LECTURE XI.

How long man can live—The testimony of Moses and other ancient writers concerning primitive longevity—Primitive computation of time—If man ever lived a thousand years, all the stages of life must have corresponded in relative length; childhood and youth much more protracted, etc.—Physiology cannot tell how long man can live; fact must determinate it—The Mosaic record of primitive longevity from Adam to Jacob—Causes which have abbreviated the life of man—The great economy of Providence by which the physical constitution of man is renovated—The successive stages of society—The grand experiment of mankind in regard to the vital power of endurance—The history of this experiment from Adam to Noah, and thence downward; and the grand result—The lowest point of constitutional power—The savage state not natural to man—Uncertainty of testimony concerning the experience of man—Anecdote of the two aged witnesses—Great misapprehension of facts—How far the facts of experience in individuals and nations may be useful to physiological science—Physiological science alone can determine how man should live—Experimental fact alone can determine how long man can live—The human constitution essentially one—If one man can live a hundred years, others may be made to—Those of feeble constitutions often live to much greater age than those of powerful constitutions—The present capabilities of the human constitution—Scriptural objections answered—But old age is not desirable—Decrepitude and dotage not essential to old age—Youthfulness, vivacity, health, activity, cheerfulness, usefulness, and enjoyment, may be preserved, and in a good measure carried up to the last hours of extreme old age—To live long is not only desirable, but a duty—The preservation of youthfulness, vivacity, and cheerfulness a duty—How this may be done.

630. HAVING taken a general survey of the anatomy and physiology and pathology of man as an intellectual and moral animal, and contemplated the wonderful complexity and delicacy, and the fearful liabilities of his organic machinery, the question which next presents itself for our consideration, is, how long can the vital powers of the human constitution, through the operation of this assemblage of organs, resist the causes which induce disorder and death, and maintain their control over the matter which composes their organic structure?

631. According to the Mosaic history, the first generations of the human race lived several hundred years, and some individuals attained to nearly a thousand; and Josephus, who lived in the commencement of the Christian era, and who was extensively acquainted with the writings and traditions then called ancient, and 'saw many works entire, of which we have now but a few scattered fragments, assures us that the tradition of this longevity extended through all antiquity.' He assigns as a reason for the great longevity of the primitive generations, that the human constitution was then vigorous and fresh from the hands of the Creator, and the food of man was then fitter for the prolongation of life; and he affirms that all the writers of antiquities, both among the Greeks and Barbarians, admit the longevity of the

first ages. 'For even Manetho,' says he, 'who wrote the Egyptian history; and Berosus, who collected the Chaldean monuments; and Mochus and Hestiæus, and Jerome the Egyptian, and those that composed the Phœnician history, all concur in testifying to this primitive longevity. Hesiod also, Hecatæus, and Hellanicus, and Acusilaus: and besides these, Ephorus and Nicolaus, relate that the ancients lived a thousand years.' Lucretius, the Roman poet, among other Latin writers, also asserts the great longevity of the first generations of the human race, and says that they were hardy 'because the hard earth produced them'; and that

'Their sinewy limbs were firmly knit and strong,
Their life was healthy, and their age was long;
Returning years still saw them in their prime;
They wearied even the wings of measuring time!

632. There has been much speculation in modern times concerning the length of the years spoken of by Moses and other early historians, in reference to the period of human life in the primitive ages of the world. Hufeland, a distinguished German physician, thinks it has been made to appear in the highest degree probable that the year, till the time of Abraham, consisted only of three months; that it was afterwards extended to eight; and that it was not till the time of Joseph that it was made to consist of twelve. These assertions,' he continues, 'are, in a certain degree, confirmed by some of the eastern nations, who still reckon only three months to the year; and besides, it would appear altogether inexplicable why the life of man should have been shortened one half, immediately after the flood. It would be equally inexplicable why the patriarchs did not marry till their sixtieth, seventieth, and even their hundredth year; but this difficulty vanishes when we reckon these ages according to the before-mentioned standard, which will give the twentieth or thirtieth year, and consequently the same periods at which people marry at present. The whole account, therefore, according to this explanation, assumes a different appearance. The sixteen hundred years before the flood will become four hundred and fourteen, and the nine hundred years which Methuselah lived will be reduced to two hundred; an age which is not impossible, and to which some men, in modern times, have nearly approached.

633. The whole argument against the great longevity of the primitive inhabitants of the earth may be resolved to the following syllogism. Man rarely attains to more than a hundred years, in the present age of the world; nor has he for many centuries past; and few even reach seventy years. But man now lives nearly or quite as long as the human constitution can be made capable of resisting the natural causes of its destruction. Therefore, man never attained to a much greater age than he now does; and consequently, the accounts of the extraordinary longevity of the antediluvians must either be wholly fabulous, or the years which they are said to have lived must have consisted of a much shorter period of time than the present year.

634. The whole, then, comes to this: The constitutional capabilities of man have, from the beginning to the present time, always remained very nearly the same. But this reasoning appears to be very inconclusive, and without any foundation in true physiological science. A

thorough investigation of the conditions and laws of organic life (121, *et seq.*) clearly shows, that from the constitutional nature of things, there must necessarily be a termination to human existence sooner or later; but there is nothing in physiology, nor in any other known science, which proves that man cannot as well live a thousand years, as fifty. The bare facts, then, that man does not live a thousand years, and has not, for many centuries past, constitute the only foundation for the assertion that he cannot live a thousand years, and therefore that he never did live a thousand years. From all we know, however, of the laws of life in connexion with the organized matter of the human body, we have not the least physiological reason for believing that those conditions and operations of living organs on which the continuance of life depends (133), may not be sustained, in a possible state of the human constitution, for many hundred years. But if there ever was such a state of the human constitution, that state necessarily involved a general keeping of parts, or harmony of proportions or relative conditions. The vital processes were much less rapid and intense, and much more complete, than at present; the development of the body was much slower, and the organization much more perfect; childhood and adolescence were proportionately protracted; and the change from youth to manhood took place at a much greater remove from birth; and boys were lads at thirty, and young men marriageable at seventy or a hundred years of age. The descent from such an elevated state of the human constitution to the common level of the human race since the time of Moses, would necessarily be more or less rapid and precipitate, according as the habits of mankind were more or less conformable to, or in violation of, the laws of life.

635. But while, on the one hand, physiological science affords us no proof that man cannot live a thousand years, neither does it on the other hand, afford us any proof that he can live even ten years. Facts and testimony, therefore, constitute our only authority on this point; and although, as I have shown (631), the tradition of the great longevity of the primitive inhabitants of the earth ran through all antiquity, and is asserted by all the Greek and Barbarian historians who, two thousand years ago, wrote what was then called the ancient history of the human race, yet the Sacred Books written by Moses are unquestionably the most ancient and perhaps the only authentic testimony which has come down to us on this interesting subject. And according to the Mosiac record, Adam lived 930 years—Seth, 912—Enos, 905—Cainan, 910—Mahalaleel, 895—Jared, 962—Enoch, 365—Methuselah, 969—Lamech, 777—Noah, 950—Shem, 600—Arphaxpad, 438—Salah, 433—Ebes, 464—Peleg, 239—Reu, 239—Serug, 230—Nahor, 148—Terah, 205—Abraham, 175—Isaac, 180—Jacob, 147. The period signified by the word year, in this record, appears to mean precisely the same length of time when applied to Adam and Methuselah that it does when applied to Abraham, Isaac, and Jacob; or in other words, Moses appears to have used the Hebrew term which is rendered 'year' in our English Bible, for precisely the same length of time when speaking of the age of the antediluvians, and when speaking of that of the post-diluvians. And, therefore, if we are to understand from the Mosiac record that Methuselah lived but 242 of our years, then the patriarch Jacob lived but 37 years. It is highly probable,

however, that the average period of life of the individuals named by Moses, from the creation to the flood, is considerably greater than the average period of human life in the whole species during the same time. Nor is the rapid abbreviation of the period of human existence after the flood by any means inexplicable or marvellous, even if it be admitted that Noah actually lived 950 of our years. It is, indeed no uncommon thing to meet with facts perfectly analogous in our own times.

636. Whatever may be true, however, as to the precise length of the period of human existence before the flood, it cannot reasonably be doubted that the primitive generations of mankind very greatly exceeded in length of life the present inhabitants of the earth. Nevertheless, it appears very evident that, for the last three thousand years, the general average of human life has remained pretty nearly the same.

637. How far the changes which have taken place in the earth and its atmosphere may have been concerned in the abbreviation of human life, cannot be known. It is probable that such changes have at times affected animal life very generally and with great power, as epidemic causes of disease and death ; but there is no reason to believe that any permanent constitutional change has taken place in the atmosphere, nor any change in the conditions of the earth, by which the human constitution has been permanently impaired to any considerable extent. Nor is there reason to believe that any thing more than natural causes have operated to produce whatever changes have taken place in regard to the longevity and general condition of the human race; and among these, the most powerful are unquestionably those which are connected with human agency, and within the control of human ability.

638. The whole history of the human race fully proves that man is so constituted as an intellectual and moral animal, that those excesses which deprave and deteriorate his nature as an individual (599), and lead to his individual destruction, and to the degeneracy of the human constitution, and the extermination of the species, inevitably so affect him in his social and political capacities and relations, as that, while they impair all the energies of the human constitution, and fit man to be the progenitor of a still more degenerate progeny, and thus gradually lead to the extermination of the race, at the same time so impair the energies of his intellectual and moral powers, so ingulf his social and civil virtues in selfishness and sensuality, as to render him incapable of sustaining those social and civil institutions and political conditions by which he is protected in his degenerating luxuries and excesses, and fit him to become an easy prey to the hardier and more warlike portions of his race, or to sink by a general decay of state and civil feuds, into an equally degraded condition of vassalage or slavery or barbarian rudeness, in which, with the loss of science and literature, and all the elegant refinements of civic life , he is also stripped of those luxuries, and compelled to forego many if not all of those enervating and deteriorating habits and circumstances by which his whole nature has been redued to the very brink of utter destruction ; and thus, like the king of Babylon, he is driven forth from the excesses of his voluptuousness and general sensuality, and forced to subsist in the simplest and rudest manner, in a state of little more than animal existence. From this state he slowly rises by the gradual cultivation of his intellectual

and moral powers, and of the social and civil virtues, till, with renovated physical energies and constitutional powers, he attains to what is universally called the golden age, in which all the circumstances of his existence seem to be best adapted to human health and longevity and virtue and happiness. To this generally succeeds the age of heroism and conquest, and then follows the age of stern and noble patriotism, and legislative wisdom, and political energy and power. The age of wealth comes next, and with it brings the age of luxury and refined sensuality and excess. Multiplying Disease raises its admonishing voice in vain. Pestilence peals a louder and more terrific note of rebuke; and man, in the moment of dismay, at first refrains from his excesses, and affords his constitution an opportunity to gather up some of its prostrated energies. But his partial reformation too often proves to be only a preparation for greater excesses than before, and he rushes on in the current of indulgence, till even the terrible rebukes and chastisements of pestilence seem only to harden him and increase his temerity, until he revels in maniac sensuality even in the lazaretto, and yields in the fierceness of his beastly lust upon the very threshold of the charnel house In this fearful manner the nations of the earth have been scourged, till it seemed as if the human race would be wholly exterminated; and only by such severe and awful retributions from the violated laws of nature, have mankind been induced to pause from their sensual excesses, and investigate even the most obvious relations between their habits and their sufferings. Nor has all this been sufficient so to restrain them in their downward course, as to prevent the necessity for those mighty revolutions which, from the beginning, have continued to roll up barbarian hordes to the zenith of civilization and luxury, and to roll down civilized and refined nations to the nadir of barbarian darkness. And thus the human constitution has, from time to time, been partially renovated, and the human race perpetuated, by the very means which have often almost blotted the intellectual and moral man from the face of the earth!

639. Indeed it seems as if the grand experiment of mankind had ever been to ascertain how far they can transgress the laws of life, how near they can approach to the very point of death, and yet not die, at least so suddenly and violently as to be compelled to know that they have destroyed themselves.

640. The primitive inhabitants of the earth, having once broken away from the simplicity and truth of nature, and begun to acquire artificial appetites of far more despotic power (598) than nature's holy instincts, rushed forward to new indulgences with increasing eagerness and celerity, and plunged downward to deeper and yet deeper sensuality, impelled by a continually accumulating moral force arising from their more and more depraved and more vehement and tyrannous propensities, till the horrible enormities of human wickedness rose up to heaven, and God, in very mercy, quenched the bursting volcano of human passions by the flood, and almost entirely exterminated the family of man, to save the earth from a bloodier deluge and a darker desolation, and man from a more violent and cruel end. And when the earth rose from her deep baptism, sanctified from the pollutions of a drowned race, the remnant of that race which God had saved for

the perpetuation of the human kind, came forth with appetites unsanctified by the terrible ablution of the world, to commence anew the downward and ruinous career of sensual excess. And surely, if the patriarchal father who, of all the earth's inhabitants, was most virtuous and most acceptable to God, brought with him from beyond the flood an appetite which, in spite of the awful judgment he had seen inflicted on a sinful world, led him to the excess of most disgraceful drunkenness, as soon as he could procure the means, it cannot be supposed that, with such an example and such opportunities before them, the sons of that patriarch, born and reared as they had been amidst the fiercest excesses of the old world's sensuality and violence, were more abstemiously and virtuously inclined than was their aged sire.

641. It is not strange, therefore, that their lives were much abbreviated by their excesses (635), nor that the succeeding generations of mankind, pursuing the same downward career of sensuality, should suffer a continual abbreviation of the period of their existence, till repeated calamities had forced them to ascertain the lowest point to which they could descend without exterminating the human species.

642. From that time to the present, mankind have revolved round the minimum point of constitutional power, in the circle which I have described (638), from savage to civilized life and luxury and every deteriorating excess; and from this, to savage life again; and thence, slowly rising to the golden age, and then again declining. And consequently, though in these succeeding revolutions, the succeeding nations of the earth have had their elevation and declension, yet the average level of human life has been nearly the same for the last three or four thousand years. Each nation has had its period of longevity, its age of heroism, conquest, patriotism, legislative wisdom political energy, wealth, luxury, etc. It is also true that the general average of life often runs low in a nation which at the same time has many instances of individual longevity; and on the other hand, the average period may be considerably elevated when there are few remarkable cases of individuals who attain to very old age. Both of these facts may easily be explained on the plainest principles of physiological philosophy. But were I to follow out all the leadings of this interesting subject, the extent of my investigations would necessarily far exceed the bounds which I have set for myself on this topic of inquiry.

643. The lowest point of constitutional power by which the human species can be preserved, is that which will sustain a sufficient number of each generation long enough in life to become the progenitors and nurturing protectors of another generation. When it falls short of this, the human race tends rapidly to extinction; and in this manner, particular families are very frequently exterminated, and even whole tribes are sometimes cut off. But as we have seen (638), a wise and benevolent Creator has so constituted things, that the human species as a whole are not permitted to go beyond certain limits, without falling into that condition in which intellectual elevation, science, literature, and all the elegant refinements and deteriorating luxuries of civic life, are sacrificed for the physical renovation of human nature. Yet if by any means the human race can be kept sufficiently above

the minimum point of constitutional power, the species can be preserved without the renovating process of which I have spoken, or without a recurrence to the severe simplicity and privations of the savage state. Be it remembered, however (26, Note), I do not affirm that the savage state is best adapted to human health and longevity, but that this state of severe privation and rudeness has hitherto been necessary to strip man of the means of luxury and excess, and thus afford his constitutional powers an opportunity to recover in some degree their impaired energies. Yet the savage state is generally attended with many circumstances which are decidedly unfavorable to health and longevity, and often with extreme violations of the laws of life.

644. Well regulated civilized life is, therefore, unquestionably best adapted to the full development of the physical and intellectual and moral capabilities of man; and it is a necessary truth established in the constitutional nature of things, that not only individual health and happiness and prosperity, but also the political prosperity and durability of nations are, as a general statement, always proportionate to the degree of conformity of the people to the laws of life.

645. To ascertain what those causes are by which the period of human existence is abbreviated, and by what means we may with greatest certainty not only secure the longest life, but also the highest degree of health and the greatest amount of happiness, consistently with those principles on which our highest intellectual and moral good depends, must necessarily be regarded by all truly rational creatures as of the utmost importance.

646. In pursuing this investigation, however, we meet with many and great difficulties; not from any uncertainty of physiological principles, but from the almost impossibility of ascertaining real facts, because we are obliged, to a very considerable extent, to take the testimony of others in regard to things which we have not the opportunity to examine for ourselves. And unfortunately for the human race, too many that have been considered valid sources of information, have only served to mislead mankind, and to establish those erroneous opinions from which have sprung some of the most pernicious practices which have afflicted our species.

647. We have been told that some men enjoy health and live to great age in warm and in hot climates, and that others enjoy health and live to great age in cold climates (15); some on one kind of diet, and some on another; some under one set of circumstances, and some under another; therefore, what is best for one man, is not for another; what agrees *well* with one, disagrees with another; what is one man's meat, is another man's poison; different constitutions require different treatment; and, consequently, no general rules can be laid down which are adapted to every man in all circumstances, and which can with propriety be made the laws of regimen to all.

648. These erroneous dogmas, so far as the world is now informed, were first advanced by Hippocrates, and with all servility have been handed down from generation to generation, till they have become the common sentiments of mankind, which he who questions will incur the charge of rashly contradicting the common sense and universal experience of the human family. And hence, the common mode of reason-

ing on this important subject is necessarily and exceedingly erroneous; and never more so than when it is supposed to be truly and rigidly inductive.

649. Among the numerous illustrations of the truth of the common notions which I have just stated, the anecdote of the two aged witnesses who appeared before the civil magistrate, is often repeated by those who are willing to observe no other rules of life than the leadings of their appetites. It is said that on a certain occasion their appeared before a civil magistrate a very aged witness, who possessed so much bodily vigor and elasticity, and retained his mental and moral faculties so remarkably, as to attract the particular attention of the court; and when the trial was closed, the magistrate asked him how old he was? 'The days of my pilgrimage are a hundred years, may it please your honor,' was the old man's reply. 'And by what means,' inquired the magistrate, 'have you reached such an advanced period of life, and retained all your faculties and powers so well?' 'May it please your honor,' the old man replied, 'I was born of healthy parents, and from my youth up have led a regular and temperate life. My food has been simple and plain, my drink has been water. I have retired to rest in good season, and risen early; I have been careful to govern my passions, and to preserve a great serenity and uniformity of mind and habit. In short, I have always been systematically regular and temperate in all things.' Pleased with the old man's appearance and his history, the magistrate embraced the occasion to expatiate on the virtues of temperance and good habits, and to exhort the numerous audience to follow the example of this 'green old man.' Soon after this, another aged witness appeared before the same magistrate, who was equally remarkable for his bodily health and vigor, and for the soundness and energy of his mental and moral powers. He also was asked by the magistrate how old he was, and by what means he had preserved his life and health, and all his faculties in so vigorous a state? 'May it please your honor,' said the aged witness, 'I am a hundred years old. I have taken no pains to preserve my life or health. I have followed no rules, but have led an irregular life. I have always indulged my appetite in just what it craved; I have eaten what I wanted, when I chose, and as much as I desired; and my food has generally been rich and savory. I have always drunk wine, beer, and ardent spirit, freely, and often to great excess. In short, I have lived just as it happened, and am now living and well as your honor sees me, because my life and health have been continued to me, and not because I have taken any pains to preserve them.' The magistrate was exceedingly confounded by this man's statement, and only remarked that he perceived some men would attain to old age in one way, and some in another.

650. Those who repeat this fabulous anecdote, seem to think that it is a true narration of facts, and that it fully proves the entire futility of all rules for the preservation of life and health, and completely demonstrates that a vigorous old age is attained to with as much certainty in one way as in another. But, in the first place, this story bears the evidence of fiction and of falsehood on its very face; for although it is possible that a man of remarkably powerful constitution may live till he is a hundred years old, and retain his faculties and

powers in considerable vigor, whose habits have been such as the second witness in this story is made to declare his own to have been, yet it is not possible for two persons, with an equally excellent original constitution, to reach a hundred years, with habits of life so different as those stated of the two witnesses in this story, without the most marked and manifest difference of appearance and condition of body and mind; and a difference, too, which would afford the strongest evidence in favor of a temperate and regular life. Therefore, in the second place, if this story were true, it would afford no evidence in favor of the position which it is intended to establish, but would simply go to show that the first witness, with an ordinary or perhaps feeble constitution, had by virtue of correct habits attained to a remarkably healthy and sound old age; while the second witness had reached the same age with equal health and vigor, in spite of exceedingly bad habits, by virtue of a most extraordinarily powerful constitution.

651. Yet, without taking the pains to examine all the circumstances of the case, most people consider the bare fact that some intemperate and irregular individuals reach a vigorous old age, a conclusive evidence that such habits are not unfavorable to long life; or that a man of intemperate and irregular habits is just as certain of reaching a hundred years, as one of the most temperate and regular habits is; and therefore almost every body has a demonstration of this kind in the history of some kinsman or neighbor or acquaintance, or somebody else. And with the same loose kind of inductive reasoning, people arrive at conclusions equally erroneous, in regard to tribes and nations. If a tribe or nation which subsists on vegetable food is weak, sluggish, and destitute of courage and manly enterprise, it is at once concluded that vegetable food is the cause; and the general proposition is laid down that an exclusively vegetable diet is not favorable to bodily strength and activity, and mental vigor and sprightliness. Yet a proper examination of the subject might have shown that other causes fully adequate to these effects existed in the condition and habits of that tribe or nation, which not only exonerated the vegetable diet from this charge, but even made it appear that the vegetable diet had a powerfully conservative and redeeming effect, and was the principal means by which the tribe or nation was saved from a much worse physical, mental, and moral condition.

652. Again, if savage tribes or nations are unprolific, feeble, sickly and short-lived, it is at once concluded that the naturalness and simplicity of savage life are unfavorable to bodily development and vigor and health and longevity. Yet a proper examination of the subject might have shown that causes existed in the habits of such tribes or nations, not at all essential to savage life, and directly opposed to true naturalness and simplicity, which were abundantly sufficient to account for all the objectionable effects attributed to savage life (25, Note).

653. The conclusions, therefore, which are drawn from the habits of individuals and of nations, can be depended on no farther than they agree with the laws of life, ascertained by an accurate and thorough investigation of the vital properties of the tissues and functional powers of the organs, and the general operations and results of the vital economy of the human system.

654. So far as the general agreement exists between all cases of remarkable longevity, some respect is to be paid to facts; and these may be adduced as illustrations of principles otherwise established. But the fact that an individual, or a number of individuals, have attained to a great age, in certain habits of living, is no conclusive evidence that those habits are most conducive to long life, nor even that they are all favorable to longevity. The only use, therefore, which we can safely make of a case of extraordinary old age, is to show how long the human constitution is capable of sustaining the vital economy, and of resisting the causes which induce death.

655. If we would correctly ascertain how man must live in order to secure the most perfect health, and attain to the greatest age of which the human constitution is capable, we must not ransack society to find all the remarkable instances of longevity, and learn the particular habits of those who have attained to old age; for such a course would only serve to bewilder and perplex us, and lead us to conclude that the whole question is involved in the most entire uncertainty; because we should find health and old age in almost every variety of circumstances in which mankind are placed; and if we were not fully qualified for the severest and most critical investigation of such an intricate subject, we should inevitably misapprehend facts, and thus be led to erroneous conclusions; but we must study the human constitution with the most rigorous scrutiny of science. We must analyze the human body to its organic elements (122, 123), and become thoroughly acquainted with all the elementary tissues (156) which enter into the formation of all its organs, and fully understand the peculiar vital properties of all those tissues (312), and the functional powers of all the organs. We must intimately and accurately know all the conditions on which the peculiar properties of the tissues and powers of the organs depend, and the various causes and circumstances by which those properties and powers are favorably or unfavorably affected. In short, we must ascertain all the properties and powers which belong to the living animal body, and all the laws of constitution and relation appertaining to the vital economy of the human system. Here, and only here, can the enlightened and truly scientific physiologist take his stand, and teach those rules of life by which man may with greatest certainty secure the best health, and attain to the greatest longevity of which the human constitution is capable.

656. But while the truly scientific physiologist, from his intimate and thorough knowledge of all the properties and powers, and laws of constitution and relation, belonging to the human body, instructs us how to live in order to secure the highest degree of health, and attain to the longest life of which the human constitution is capable, he cannot from this knowledge tell us what the capabilities of the human constitution are in regard to health and longevity. He can tell us with accuracy and confidence that such and such are the laws of life, and such and such are the best means by which health may be secured and life prolonged; but he cannot, from his physiological knowledge, tell us whether a strict obedience to the laws of life, and a correct use of the best means, will prolong our life ten or a thousand years.

657. If, therefore, we ask the truly enlightened physiologist, *how* we must live to secure the best health and longest life of which our

constitution is capable? his answer must be drawn purely from his physiological knowledge; but if we ask him how long the best mode of living will preserve our life? his reply is, 'Physiology cannot teach you that. Therefore, now go you out into the world, and find the oldest man living and enjoying health. If, after having obeyed his command, we return and say to him, 'we have found several individuals a hundred years old, and all enjoying pretty nearly the same degree of health, yet they are of very different and even of opposite habits:' his answer will be, that 'probably each of the individuals whom you have found has a mixture of good and bad habits, and has lived in a mixture of favorable and unfavorable circumstances, and that notwithstanding the apparent diversity of habits and circumstances among them, there is probably a pretty nearly equal amount of what is salutary and conservative in the habits and circumstances of each and all. Some of them have erred in one thing and some in another; and some have been correct in one thing and some in another; and therefore the diversity of which you speak is probably more apparent than real, in relation to the true laws of life Besides some, with an extraordinarily powerful constitution, may, in the constant violation of the laws of life, reach a hundred years, with as much health and vigor as others who attain to the same period in much better habits and circumstances, but with far less powerful constitutions. All that is proved, therefore, by instances of great longevity in connexion with bad habits and circumstances, is, that such individuals possess remarkably powerful constitutions, which are able to resist for ninety or a hundred years causes that have in the same time sent hundreds of thousands of their fellow creatures, of feeble constitutions, to an untimely grave; and which, under a correct regimen, would in all probability have sustained life and health a hundred and twenty, and perhaps a hundred and fifty years. The only use which you can safely make, therefore, of the instances of great longevity which you found,' he would say, 'is to show how long the human constitution, in the present age of the world and condition of the race, is capable of resisting the causes which induce death; and if you have found an individual or a number of individuals a hundred years old, it is of little importance to you how they have lived; the simple fact that they are a hundred years old is all we wish, to prove that the human constitution is now capable of reaching a hundred years.'

658. Physiology, then, alone, can teach us how man must live in order to secure the best health and attain to the greatest age of which the human constitution is capable; and the fact that there are individuals now living a hundred years old, proves that the human constitution is capable of sustaining life a hundred years at least, and perhaps much longer, if the regimen and circumstances are in all respects correct. But here I shall probably be met with the very ancient and utterly absurd doctrine, that there are different constitutions, and therefore, that what may be true of one, cannot truly be affirmed of all. It is freely admitted that, in the present state of the human race, some individuals have more vital energy and constitutional power to resist the causes of disease and death than others have, and therefore, what will break down the constitution and destroy the life of some individuals, may be borne by others a much longer time, without any striking mani-

festations of immediate injury. It is also true that, in the present state of the human race, some individuals have strongly marked constitutional idiosyncrasies or peculiarities; but these are far more rare and of a much less important character than is generally supposed, and in no instance constitute the slightest exception to the general laws of life, nor in any degree interfere with, or militate against, the correct principles of a general regimen. Indeed such peculiarities, though really constitutional, may in almost every case be overcome entirely by a correct regimen. I have frequently seen the most strongly marked cases completely subdued by such means. It is an incontrovertible truth, therefore, that so far as the general laws of life and the application of general principles of regimen are considered, the human constitution is ONE; and there are no constitutional differences in the human race which will not readily yield to a correct regimen, and by thus yielding improve the condition of the individual affected; and consequently, there are no constitutional differences in the human race which stand in the way of adapting one general regimen to the whole family of man; but, on the contrary, it is most strictly true that, so far as the general laws of life and the application of general principles of regimen are considered, what may be truly affirmed of one man may be truly affirmed of all, and what is best for one is best for all; and therefore, all general reasonings concerning the human constitution, are equally applicable to each and every member of the human family, in all ages of the world, and in all conditions of the race, and in all the various circumstances of individuals.

659. Now, therefore, if individuals can be found at the present time who are a hundred years old, the fact may be adduced as a demonstration that the human constitution has vital power enough to resist the causes which induce death and to sustain health for a hundred years, under whatever disadvantages may exist at the present period of the world, distinctly from the agency of man. But we know that there are many individuals now living and enjoying good health in different sections of our country, who are a hundred years old; and therefore it may with perfect accuracy be affirmed, that the human species in the United States of America may average a hundred years of life.

660. Is it objected that this is not a legitimate conclusion; that because one man reaches a hundred years, it is no proof that the human species may average that length of life? I ask, by what means has one man lived a hundred years? Will it be affirmed that he has been miraculously endowed with vital powers, or that his vital energies have from time to time been miraculously renovated? Certainly not! But it may be asserted that he had a remarkably strong constitution! This is not always the case. Plato, in his *Republic*, strongly censures Herodicus, one of the preceptors of Hippocrates, for teaching the delicate and infirm to regulate their exercise and diet in such a manner as to prolong their lives for many years, and thus attain to old age with a very feeble constitution. 'He was master of an academy,' says Plato, 'where youth were taught their exercise, and being himself delicate and infirm, he contrived to blend exercise with such dietetic rules as preserved his own feeble constitution from sinking under his complaints, and enabled him to protract his valetudinary existence to old age; and he did the same injury to many others of

feeble and infirm constitutions.' This Plato calls an injury, because he considered an infirm constitution an obstacle to the practice of virtue, inasmuch as it makes people always imagine themselves ill, and causes them to think of nothing but their own infirmities; and therefore he thought that if a delicate person did not soon recover health, he had better die out of the way, and not live to be miserable himself, and become the father of feeble children, and thus injure society and the race. Louis Cornaro, a noble Venetian, had completely broken down his constitution at the age of thirty-five, and had become so infirm that he despaired of ever recovering health, or of reaching the meridian of life; yet by greatly reforming and simplifying his habits of living, he recovered health, and lived to be over a hundred years old. The venerable Moses Brown, of Providence, R. I., now nearly a hundred years old,* and enjoying uncommon health and activity for his age, informs me that from his birth through the whole of the early part of his life, he was exceedingly delicate and feeble. and that his constitution has always been very delicate. He had three brothers, who were all remarkable for their stout, robust, and vigorous bodies and powerful constitutions, yet neither of these brothers reached seventy years. At the age of eighty-three, Moses Brown observed to a friend, 'I was always a feeble frail thing among my brothers, and had no expectation of out-living them; I am persuaded that if I had had the constitution of either of them, and lived as I have lived, I should be an active hale man at a hundred years old, and should probably live to the age of a hundred and ten or a hundred and twenty years in good health; but with my feeble constitution, I do not expect to exceed ninety years.' The interesting case of this family is by no means an extraordinary one. It is no uncommon thing for the most delicate member of a family, by a careful regimen and generally correct habits, to attain to a very advanced period of life, while the more vigorous and hale members, by living too fast, are cut off in the middle of life, or perhaps in early manhood. I could name a number of such instances.

661. But granting the position, that he who attains to a hundred years has a remarkably strong constitution; I ask, how the individual came to the possession of such a constitution? Was it the special, direct, and extraordinary gift of the Creator? or was it the natural result of a succession and concurrence of causes and effects operating in the constitutional nature of things? Most unquestionably the latter! and these causes and effects, as a general law, are perfectly within the sphere of human agency and under the control of human ability.

662. If by any means, therefore, the human constitution can be made to resist the causes of death, and sustain health a hundred years, in one individual, by the same means, the same results can be produced in all; because he who attains to a hundred years, depends wholly on the intrinsic energies of the human constitution, and on those circumstances and habits of life which, as a general statement, are under the control of human ability.

663. I do not however affirm, nor intend to imply, that the present

* Mr. Brown has since died of sickness from exposure, in his ninety-eighth year.

generation of the human species can by any means all attain to a hundred years of life. I know that in the present condition of the race, there is a very great inequality of constitutional power. Some individuals are born with constitutions too feeble to sustain the functions of life a single year; others have power enough to maintain the victory over the causes which induce death for three, five, ten, twenty, forty, eighty, a hundred or a hundred and fifty years. Some are born without any strong tendency to a particular disease, while others are born with the most powerful predisposition to particular disease of some kind or other. But it is entirely certain that all these constitutional differences result from the action of causes which man has the power to control; and therefore it is entirely certain that all these constitutional differences can be removed in the course of three or four generations of the race, by a strict conformity to the laws of life in all the members of each generation; and the human species can be brought to at least as great uniformity as to their health and length of life, as is found amongst all the lower animals in a pure state of nature.

664. When I affirm that the human species may average a hundred years, I do not mean to imply that the human constitution is not capable of exceeding that period. As a physiologist I cannot perceive any reason why the human race cannot return to the original longevity of the species; neither can I affirm, from any physiological knowledge, that man can live a hundred years. The bare fact that the human constitution does carry some individuals up to this period, is all the authority I have for affirming this capability of the human constitution; but this fact by no means proves that the capability of the human constitution is only equal to a hundred years of life, because it is by no means certain that those who attain to the greatest age always strictly conform to the laws of life; and therefore, we do not know but that many who die at a hundred years, might have reached a hundred and fifty years, if in all things they had obeyed the laws of life. Besides, were it a known truth that in the present state of the human constitution, no individual possesses the power to live more than a hundred years, this would not prove that individuals cannot be produced in the fourth generation from the present, with constitutional power to live a hundred and fifty or two hundred years; and I repeat that correct physiological science affords no evidence that the human constitution is not capable of gradually returning to the primitive longevity of the species.

665. On the whole, then, true physiological science alone can teach us how to live, in order to secure the best health and attain to the greatest longevity of which the human constitution is capable; and correct and continued experiment alone can prove to us how long the human constitution can be made to resist the causes which induce death (126), and sustain the healthful operations of the vital economy.

666. But I am told that all this reasoning leaves God out of sight, and contradicts the sacred scripture which affirms that 'the days of our years are three-score years and ten, and if by reason of strength they be four-score years, yet is their strength labor and sorrow, for it is soon cut off, and we fly away.' I reply that if God had actually and absolutely limited human life to seventy or eighty years, then no man could possibly exceed eighty years; but we know that many indivi-

duals do exceed eighty years of life, and that some exceed a hundred; and, therefore, we have a perfect demonstration that God has not absolutely limited the length of human life to eighty or a hundred years, and consequently we know that the scripture cited is not the annunciation of a decree of God, nor a prophecy, but simply a historical record of the fact that at the time when it was written, human life rarely exceeded seventy or eighty years, and that those who attained to eighty years were extremely infirm and helpless, and had little enjoyment of their existence. But Isaiah, when speaking prophetically of that period in the Gospel dispensation when the laws of God shall reign in the hearts and govern the actions of mankind, explicitly affirms that the period of human life shall be greatly prolonged, and that there shall be no more thence an infant of days, nor an old man that hath not filled his days, but their days shall be as the days of a tree.

667. As to my leaving God out of sight, I contend that all my reasoning is founded on the fixed laws which God has ordained and established in the nature of things (110). I acknowledge that God has the power to counteract or suspend the laws which he has established in the constitutional nature of man, as well as those which he has established in the constitution of the solar system; and I contend, therefore, that it would be just as reasonable to assert that the astronomer leaves God out of sight in all his reasonings, because he calculates the movements of the heavenly bodies according to the fixed laws which God has established in nature to govern their movements, as it is to raise that objection against the physiologist, because he reasons according to those fixed principles which God has established in the constitutional nature of man. If God has constructed man of such materials and upon such principles as render him capable of living just one thousand years and no more, by a perfect obedience of the laws of life, then God has actually set the utmost limits of human life at a thousand years, and beyond this point no means and no conditions can carry us. But if at the same time, God has established in our nature such laws of constitution and relation as that, if man lives in a certain manner he can only reach seventy or eighty years, then it may be said that God has conditionally limited the period of human life to seventy or eighty years; but this conditional limitation does not stand in the way of man's prolonging life to the full extent of the original capabilities of the human constitution. If it is objected that God foreknows or has decreed the precise length of every man's life, and no human means or conditions can add to or take from that fixed period a single hour or second of time, then I reply that God has also decreed the precise means and conditions by which the life of each individual shall be carried to its fixed termination; and God has just as certainly decreed the efforts which I make to secure human health and to prolong human life, as he has decreed the length of any man's life; and if he has decreed that the length of human life shall not be affected by my efforts, then he has also decreed that mankind shall give no heed to my instructions, but go on in their own ways, and fulfil their appointed time.

668. Again, I am told that this is making a *long* life of more importance than a *good* life, and leads people to think more of the welfare of the body than of the soul; that it causes them to feel a security in

life, and consequently to neglect their religious interests. But these objections are wholly founded in error. We have seen (603) that such are the fixed constitutional relations between the animal and moral nature of man, and such are the fixed constitutional relations between man and his Creator and his fellow creatures, that the true principles of health and longevity, and the true principles of virtue and religion, are inseparable. An individual, by a correct physical regimen, may maintain very good bodily health, and reach an advanced period of life, without any true piety, and very little moral virtue; so also an individual, by embracing correct moral and religiout principles, and cultivating correct moral and religious sentiments, may attain to much virtue and piety, without a proper regard to physical regimen; but in the former case the individual will come short of that perfect bodily health and enjoyment, and of that full duration of life; and in the latter case the individual will come short of that elevated degree of virtue and piety and happiness, which a full conformity to the laws of his whole nature would certainly secure to him. Therefore, if without any special regard to health and longevity, my only desire were to promote the highest and most perfect degree of virtue and piety in mankind, I would teach precisely the same principles that I now do. The consideration of the uncertainty of life may at first serve to awaken our inquiries concerning our nature, our condition, our destiny, and our responsibilities, and thus to some extent be the means of our becoming virtuous and pious. But the fear of death is not in itself favorable to health nor long life; neither is the dread of death nor the fear of punishment in itself virtue nor piety. The fear of hell is not the love of heaven, nor is the fear of Satan the love of God. It is only when we cherish and practice virtue because we love virtue, and love God because he is intrinsically lovely, that our virtue and piety are acceptable to God, felicitous to ourselves, and most beneficial to our fellow creatures; and all the doctrines which I teach are adapted to lead men to receive and obey the truth in the love of it, to be virtuous for virtue's sake, to dwell in God because he is Love; and thus at the same time and by the same principles secure bodily health, long life, elevated virtue, and true and exalted godliness. 'If ye know these things, happy are ye if ye do them.'

669. But many say, it is not desirable to live to be so old and decrepit, and full of infirmities and ailments. Who, they demand, would wish to outlive their usefulness and enjoyment, to lean in trembling feebleness upon the staff, to sink into the helplessness of second childhood, to have the senses one after another blotted out, and all the faculties of soul and body gradually decay, till we become a melancholy spectacle of human frailness and imbecility, a burden to ourselves and all around us, our dearest children wishing us in heaven? This is indeed a condition not to be desired! nor is it the necessary condition of old age. They who make sensual enjoyment the chief end of their existence, and live in the continual violation of the laws of their nature, must of necessity either perish untimely by violent disease, or sink into that melancholy and shocking decay which is so common to old age. But that old age to which I would lead mankind is the rich and mellow autumn of our earthly existence, that period of our lives in which the cares and conflicts of the world are left behind,

when all the passions are brought into subjection to a holy spirit, when the mind is ripe in wisdom, and the moral character has reached its full terrestrial maturity of virtue.

670. We have become so accustomed to see the sprightliness and vivacity of childhood subside into the grave sobriety of mature age even before the period of youth has passed by, and the vigor and activity of meridian life wither into decrepitude and dotage long before a hundred years are numbered, that we have learned to think such things *must* be, and to contemplate old age only as the joyless period of feebleness, infirmity, and exhausted powers and resources. But though such things are the necessary consequences of certain habits and circumstances of life in the present state of the human constitution, they are neither necessary nor natural to the constitution in its highest and healthiest state.

671. In healthy childhood we see almost an exuberance of action, cheerfulness, and enjoyment; and we love to behold the sprightliness and buoyancy of that period. With a heart full of sympathy and delight, the fond parent sees his child running and leaping like the playful lamb and colt, and rejoices in the happiness of his offspring; yet before that child has reached the age of manhood, if the baleful habits and circumstances of civic life have not completely blighted all his youthful sprightliness and vivacity, he is austerely rebuked for every manifestation of them, and sedulously taught to smother and disguise them with outward sedateness and gravity, as if youthfulness of feeling and of action were not only improper but immoral; and if in later periods of life something of the buoyancy of childhood should occasionally disclose itself, it is regarded as the effect either of mental delirium or of some intoxicating substance. For such is the general stupidity of the race, that the idea of natural youthfulness of feeling after man has reached the age of maturity, cannot be understood.

672. But this is all wrong and unnatural, in notion and in fact. If sprightliness and vivacity and cheerfulness be innocent and pleasing in early childhood, why should they not continue to be so in youth and manhood, and all along through life, even to the latest period of our earthly existence? There is no reason in nature why they should not, but every valid reason why they should; and the opinion which is commonly entertained on this subject has sprung from sheer superstition growing out of the unhealthy state of things, and not from a sound and rational morality and religion. For as we have seen (603), no moral or civil law or religious doctrine can be adapted to the highest and best condition of man's moral nature, which is not strictly consistent with the physiological laws of his body, and it is entirely certain that the highest physiological interests of our nature require that *youthfulness* should be preserved and prolonged to the greatest extent. And youthfulness is as truly capable of being preserved and prolonged as life itself is, and both depend on the same means and conditions.

673. I have said (634), that if there ever was a state of the human constitution which enabled it to sustain the functions of life for several hundred years, that state necessarily involved a general keeping or harmony of relative conditions. The vital processes were much less rapid and intense, and much more complete than at present; the de-

velopment of the body was much slower, and the organization much more perfect; childhood and adolescence were proportionately protracted, and the change from youth to manhood took place at a much greater remove from birth. And whether the constitution be capable of a thousand or a hundred years of life, this keeping or harmony of relative conditions must always neeessarily correspond with its capability of duration. Hence, therefore, if in the present state of the human constitution, we would aim at the longest and healthiest and happiest life, we can secure our object in the highest degree possible only by a strict conformity to those physiological laws by which youthfulness is also preserved and prolonged in corresponding proportion. And if by such means the duration of human life should, in the course of several generations, be prolonged to several hundred years, the period of childhood and youth would be proportionately protracted, and a much greater degree of youthfulness would extend through the whole duration of our earthly pilgrimage.

674. We have seen (124) that all organic bodies are composed of solids and fluids. In the earliest state of our existence, the human body consists mainly of fluids.* All the solids are exceedingly soft and pulpy, and moist or juicy. As life advances, the solids gradually become more and more consistent and compact and firm, and their relative proportion increases upon that of the fluids, until in old age as we now see it, they become comparatively dry and rigid, and sometimes extremely so (185, 188, 195, 200, 307.)

675. All the solids of the body, we have seen (146), are formed from fluids upon the most precise and determinate constitutional principles, and there are between the solids and fluids the most precise and fixed constitutional relations (142); so that in their perfectly normal and healthy state, they are, in their qualities and susceptibilities, perfectly adapted to act on, and to be acted on by each other, with the most healthful and happy effect; and the highest physiological and psychological interests of our nature can be secured only by the preservation of this state of things (301). In this physiological condition of the system all the functions of life are healthfully and vigorously performed, the organic and animal sensibilities are agreeably excited by their appropriate stimuli (305), the animal consciousness is grateful and joyous, and the spirits are buoyant and cheerful, filling the whole body and soul with sprightliness and vivacity.

676. In early life, when the relative proportion of the fluids is greatest, when the susceptibilities and sensibilities of the solids are most pure and delicate, and when the fluids and the solids are most perfectly adapted to each other, then also the natural activity and vivacity and sprightliness and buoyant cheerfulness are greatest (671). The infant in its mother's lap delights in the constant motion of its little limbs; the older child, which is able to run alone, is happy in continual action, and laughs aloud with instinctive joyfulness.

677. If this physiological condition of the body could always be preserved, this psychological condition or state of the soul would always remain, and the vivacity and cheerfulness of youth would con-

* The proportion of the fluids to the solids in the adult body has been estimated as to one. In early childhood the difference is much greater.

tinue through life (305). But the peculiar instinctive activity of childhood and youth has for its final cause the full and vigorous development of the body. And when this end is effected, neither the organic nor the animal nor the intellectual nor moral wants of man, as an individual or as a social being, require that this instinctive propensity to action should continue equally powerful through life; and hence, with the gradual changes which take place in the development and maturity of the body (674), this instinctive propensity to action gradually subsides, till instinct gives place to reason, and leaves the body more to the moral control of the man, to act or rest as the wants and the duties of life require. But though that exuberance of buoyant vivacity which is the spirit of the youthful instinct to action, with the instinct itself, gradually subsides to the healthful sobriety of manhood, yet much of the serenity and vivacity and cheerfulness of youth may, and ought to, be preserved through life

678. In the best regulated habits and circumstances of life, even if all the physiological laws of the system are strictly obeyed, the change in the relative proportion of the solids and fluids (674) must necessarily take place, and with that change something of the buoyancy and vivacity of youth will subside into the more serene tranquillity of mature age. But in such an obedience of the physiological laws of the body, this change will take place very slowly, childhood and youth will be prolonged, the period of vigorous manhood will be greatly protracted, the decline of life will be very gradual, old age will be free from decrepitude and dotage, and ripe in experienee and goodness; and much of the natural activity and vivacity and cheerfulness of youth will be preserved through the whole of life, even to the latest period of our earthly existence (776).

679. Such an old age, therefore, is not only desirable to the individual himself, but to society at large, for in it man will not only retain all the physiological and psychological powers requisite for his own calm and rich enjoyment, but all which patriarchal usefulness in society requires. If his bodily appetites have been kept in subjection to physiological and moral truth (603), and if his intellectual and moral faculties have been properly cultivated, his bodily powers will be adequate to all the wants and duties of old age, his natural senses will be little impaired, his intellectual and moral faculties will be vigorous and active, the more ardent passions of early life will be chastened down, the moral man will have become wholly paramount to the animal, and he will have attained to that maturity of wisdom and virtue which makes his last days the happiest period of his life, and pre-eminently fits him to commune continually in spirit with his God, and to exert a sanctifying influence on all around him. The old will reverence his counsels, and the young will love his society and his instructions.

680. Such is the old age which God designed for man in his innocence and purity, and such is the old age which man is yet capable of attaining to, and enjoying! 'But whatsoever a man soweth, that shall he also reap. He that soweth to the flesh, must of the flesh reap corruption.' This is a solemn declaration of what, in the constitutional nature of things, is necessarily true, and therefore is inevitable. By the continued violation of the laws of life, we not only hasten the change in the relative proportion of the solids and fluids of the body

(674), but yet more rapidly and mischievously effect a change in their *relative conditions* (675), developing unhealthy susceptibilities and sensibilities in the solids, and filling the fluid with acrid and irritating properties, and thus rendering them wholly unfit to act on, and to be acted on, by each other. By these means all the physiological powers and functions of the body are impaired, the periods of childhood and youth and vigorous manhood are greatly abbreviated, the natural buoyancy and vivacity and cheerfulness of childhood and youth are early annihilated, and depression and sadness and unhappiness take their place; and disease and suffering and melancholy and untimely death invade every hour of human existence: and most of the very few who, through all these ills and hazards, reach a premature old age at seventy or eighty years, find it a period of feebleness and decrepitude and ailment and cheerless dotage, in which the natural senses are exceedingly impaired or wholly blotted out, and the intellectual and moral powers appear to have sunk into fearful and perhaps utter decay! and all that remains of the living body is capable of little enjoyment in itself, and is the object of the painful care, and, it may be, the loathing, of others.

681. The change in the *relative proportion* of the solids and fluids (674), I have said (678), must necessarily take place as life advances, even with the most perfect obedience to the physiological laws of the body; and this change may slowly progress in perfect consistency with the best of health, and with scarcely an appreciable abatement of natural vivacity and cheerfulness, from childhood to the latest hours of life. The more slowly and healthfully this change is effected, the more protracted will be the periods of childhood and youth and vigorous manhood, and the more gradual and healthful and happy will be the decline of life, and the more of youthfulness will be carried up through all the stages of our earthly existence. But there is no constitutional necessity for the change in the *relative constitutions* of the solids and fluids of the body (675), with which the evils I have spoken of (680) are inseparably connected. By a strict observance of the laws of life, these may be preserved in unimpaired healthfulness and purity from the commencement of our existence till the vital functions of the system shall falter and their integrity fail from the exhaustion of the constitution in extreme old age. This change, so fraught with ill to man in all respects, is almost entirely the result of his voluntary action. The causes by which it is effected act on him by his own consent, though he may not suspect, or may deprecate, the consequences. It may be produced with terrible rapidity and violence, causing the most painful and fatal disease (990); or it may be effected so gradually and by such imperceptible degrees as to impair all the vital powers and functions of the system, abbreviate the period of life, and bring on a premature old age, full of decrepitude and infirmity, without ever being attended with any violent symptoms of acute disease, and too frequently without ever being suspected as the source of evil to the sufferer.

682. Whether, therefore, our object be the healthiest and longest life, the happiest old age, or the most exalted virtue and piety, it is equally important that by all means in our power, we should preserve our natural youthfulness and vivacity and cheerfulness with the least possible abatement, during the whole of our earthly existence (675). Instead

of endeavouring to suppress and subdue the youthfulness of our children, and to bring them to staid maturity at twenty years of age, we ought to cherish their youthfulness by every proper means, and endeavor to make them young at forty. And this is precisely the precept of Solomon, in that passage of Scripture which has been so frequently and so egregiously perverted.* 'Enjoy thy youth, O young man! cherish and preserve the healthful cheerfulness of thy young heart, and be happy in the natural buoyancy and vivacity and sprightliness of thy early life! but remember, in all thy enjoyment, that thou art an accountable being; that thou art under the natural and moral government of an omniscient, omnipotent, and infinitely wise and just God (603); and that thou canst not violate the laws of thy nature with impunity, nor transgress them without evil: and therefore, at all times carefully refrain from every indulgence and every pleasure by which thy youthfulness shall be impaired and thy soul depraved (520); and withhold thyself from all undue anxiety and labor for riches and honor, and all inordinate ambition and toil for knowledge and renown; and from every other excess by which thy health will be destroyed and thy cheerfulness blighted and thy spirit broken, and thy life filled with disquietude and suffering and sorrow, and by which thou wilt be prematurely cut off from among the living, or experience a joyless old age, full of decrepitude and despondency and gloom! For thy Creator is a God of love, and delighteth not in thy misery, but in thy happiness; and thou canst not be permanently happy without a conformity to the laws of thy nature, which he has established in infinite wisdom and benevolence!'

Ecclesiastes ix. 9

LECTURE XII.

Laws of constitution and relation established in everything: in the human blood, and all the substances from which it is formed, and which are formed from it; in and between all the organs of the body, and all substances designed for them to act on—Relations of the stomach to all organs and substances in the body; to all alimentary substances without—No organ acts for itself alone—organs of external relation, primary, and secondary—Relations of the eye to light, and the visual properties of things—Relations of the organ of smell, to odours, etc.—Healthy and unhealthy odors—Depravity of the olfactory sense—Relations of the organ of taste to gustatory properties—The depravity of the gustatory sense—Gustatory enjoyment greatest in those whose dietetic habits are most simple—Anecdote of the epicure—Constitutional relations of the teeth to the organs and substances of the body, and to the nature and condition of the food—Constitutional relations of the lungs to the blood, etc., internally; to the atmosphere, etc., externally—Constitutional relations of the stomach to the blood, etc., internally; and to all alimentary substances, externally—Its nice organic sensibility—This may be depraved—The consequence of this depravity—Relations of the stomach to the stimulating properties of food—Relations of the stomach to the bulk or proportions of the nutritious and innutritious matter of food—Illustrations—Experiments of Dr. Stark—Relations of the sense of hunger to the internal wants and external supplies—Relations of the sense of thirst.

LAWS OF CONSTITUTION AND RELATION ESTABLISHED IN THE HUMAN BODY.

683. In every part of my general argument thus far, I have endeavored to keep prominently in view the importance of the laws of constitution and the laws of relation, in every form of matter and mode

of existence (140, 144). And these, I have insisted, are established not only in wisdom, but in benevolence (682), and aim as much at a result of happiness as of utility (603). We have seen that all the solids of the human body may be resolved to three general tissues (156)—the cellular, the muscular, and the nervous; and that the vital elasticity of the cellular tissue, the vital susceptibility and contractility of the muscular tissue, the nervous and sensorial powers of the nervous tissue, together with the vital affinities which are under the control of the nervous power constitute the grand elements of power (312), by which all the operations of the vital economy are carried on, and all its effects are produced. And these vital properties of the several tissues, in all their delicate modifications, of specinl susceptibility and organic and animal sensibility (292, 296), depend on the constitutional nature of the tissues to which they belong (140, 142), and every infraction of these laws of constitution and relation necessarily impairs in some degree the vital properties of the tissues, and functional powers of the organs composed of the tissues.

684. We have seen, also, that the human blood has a fixed constitutional nature, holding a fixed relation to the substances from which it is elaborated (142). As a general statement, human blood can be elaborated from all vegetable and animal substances; every moving thing that liveth, as well as every green herb or vegetable, can be made meat for man; but the vital constitution and properties of the blood nicely vary with the varying qualities of the food; and hence the blood holds a fixed and precise constitutional relation to the particular kinds of substances on which man subsist; and consequently, the vital constitution and properties of the blood are more or less perfectly adapted to the final causes of our organization, and to the highest and best condition of human nature, according to the character of the particular substances on which we subsist. If, therefore, our food is not what it should be our blood as a general and permanent fact, cannot be what it should be. It is true, that while the assimilating powers of the vital economy are vigorous and unimpaired, a considerable integrity of functional results may be maintained by that economy, for a longer or shorter time, even though the alimentary substances from which it elaborates the blood are not best adapted to the wants of the system; yet such substances necessarily in a greater or less degree impair the assimilating powers of the vital economy, and in the end deteriorate the functional results.

685. Again, each of the solids and fluids of the human system, formed from the blood, has a fixed constitutional nature (142), holding fixed and precise relations to the blood and to each other, so that if the blood is not what it should be, these cannot be what they should be. The cellular, the muscular, and nervous tissues cannot be produced by the vital economy from anything else than true animal blood, and therefore each of these tissues has not only a fixed constitutional nature peculiar to itself, but necessarily also a fixed and precise constitutional relation to the constitutional nature of the blood, and through the blood to the substances from which the blood is elaborated; and as they are all produced by one and the same vital economy from one and the same current of blood (497), they necessarily hold fixed relations to each.

686. The *vital properties* of the tissues (312) in all their delicate modifications, depending on the constitutional nature of the tissues (683), necessarily hold fixed and precise relations to the constitutional nature of the blood; so that these properties always nicely vary with the varying character of the blood; and hence, whatever deteriorates the constitutional nature of the blood, necessarily, as a general fact, impairs the vital elasticity of the cellular tissue, the vital susceptibility and contractility of the muscular tissue, and the nervous and sensorial powers of the nervous tissue, in all their delicate modifications: and, on the other hand, whatever impairs the vital properties of the tissues, necessarily, as a general fact, deteriorates the constitutional nature of the blood. Constitutional relations equally determinate exist between all the fluids of the system, and between the fluids and the solids (675).

687. Such are the laws of constitution and relation which a wise and benevolent Creator has established in and between all the particular substances of which our bodies are composed; and hence, of necessity, the constitutional and functional laws of relation between all the organs of the system, and between each of these and each and all the particular substances of which our bodies are composed, are equally precise and determinate. Thus, the stomach is organized with fixed and precise relations to all the other organs, and to the blood and every other substance of the body; and the functions of the stomach necessarily hold fixed and precise relations to the blood, and to all the other substances of the body, and to the functions of all the other organs; and all this is true of each and every other organ of the system. Each organ has its particular function to perform, yet no organ can perform its function independently of the others, and no organ can sustain itself by its own function: on the contrary, each organ exhausts its vital powers and wastes its substance by the performance of its own particular function (376), and is replenished and nourished and sustained by the united functions of the whole assemblage of organs. The alimentary canal (320) digests food for the whole system; the lacteals (388) elaborate chyle for the whole system; and the liver and kidneys and blood-vessels and lungs and skin perform their functions for the whole system; and therefore, *the function of no one organ can be impaired, without involving the whole system in the consequences.* Such is the dependence of each organ upon the whole system, and of the whole system upon each organ; and such are the fixed and important laws of constitution and relation appertaining to the internal economy of the human body (297, 298).

688. But the human body subsists on foreign substances (209), or materials which are extrinsic and separated from itself; and therefore it is furnished with organs of external relation (210), which are constituted with fixed and precise relations to the constitutional nature of the blood, and to all the other substances of which the body is composed, and with fixed and precise relations to the constitutional nature of the external substances designed for the nourishment of the body. The primary organs of this class are the alimentary canal, the lungs, and the skin; and for the supply of the wants of the vital economy, and the protection of the vital welfare, we are furnished with organs of external perception, of locomotion, and of prehension (233). The organs of external perception are those of touch, taste, smell, hearing, and sight.

The organs of locomotion are the lower extremities, or the legs and feet. The organs of prehension are the upper extremities, or the arms and hands.

CONSTITUTIONAL RELATIONS OF THE ORGANS OF SIGHT, HEARING, SMELL, AND TASTE.

689. The organs of sight (409, *et. seq.*) are constituted with the most precise and fixed relations to the constitutional nature of light, and to those properties of external things of which light is the medium of perception (554); so that when the organs are in a perfectly normal state, and the light is pure and perfectly natural, we have a perfect visual percepiton of all external objects to which the eye is directed; but whatever impairs the constitutional nature of the organs, necessarily impairs their visual powers, and the visual perception of external things is commensurately less perfect: and hence whatever impairs the sensorial powers of the nervous system, necessarily impairs our visual powers (1126). But we have seen that there are fixed and precise constitutional relations between all the tissues (685) and substances of the body; and therefore whatever deteriorates the constitutional nature of any of the tissues of the body (686), as a general fact, impairs the visual powers of our organs of sight; and all this is true of the organs of hearing, smell, taste, and touch.

690. The organs of smell (398) and taste (397) are more especially the instruments of instinct employed in the functions of respiration and alimentation, as sentinels on the out-posts of the vital domain. Every vegetable and animal substance, and many inorganic substances, possess specific properties in relation to animal life, and to the wants of the vital economy of animal bodies. Some of these are salutary and some are baneful; and each of these substances imparts an odor to the surrounding atmosphere, exactly characteristic of its specific properties. Our organ of smell, therefore, is constituted with fixed and precise relations to the constitutional nature of the blood and other substances of the body, to the general wants of the vital economy, to the organization and functional powers of the lungs and stomach within, and with fixed and precise relations to the qualities of odors without. So that, in a perfectly normal and undepraved state of the organ, it detects the qualities of odors with the nicest accuracy, and unerringly discriminates between what is good or salutary for the living body, and what is baneful or injurious. Physiologists, judging from the depraved condition of the human organs, universally assert that the instinctive power of smell is naturally far less keen and discriminating in man than in many of the lower animals. But this is entirely incorrect. Reasoning *a priori*, from the nature of things, we should be led to conclusions different from the doctrine of the schools on this subject; and we know from the most complete experiment, that were the human species reared, from birth to maturity, in as strict accordance with the constitutional laws of their nature, as are the lower animals in a pure state of nature, the faculty of smell in man would at least equal, and probably far excel, that of any other animal, in exquisite delicacy of perception and in discriminating power, for the instinctive purposes of the system. It would enable us with unerring accuracy to select or

to avoid instinctively whatever is salutary or baneful, whatever is beneficial or injurious to us, in those qualities of things appreciable by smell. And, therefore, the faculty was given to us not only as a means of enjoyment, but pre-eminently to serve the instinctive purposes of the vital economy (596) in detecting the specific characters of external things in relation to life, by the odors which they impart.*

691). The organ of smell is a sentinel for both the lungs and the alimentary canal. It is of the utmost importance to the vital welfare of the body, that pure air should be constantly received into the lungs at every inspiration of breath; and hence the olfactory nerves are distributed over the lining membrane of the cavities of the nose (399), through which the air passes into the lungs; and when in a perfectly healthy and undepraved state, they detect, with the nicest powers of discrimination and integrity of instinct, every odorous property of the atmosphere which is unfriendly to life; and the animal being thus informed of the presence of an unwholesome atmosphere, is able to suspend respiration for a very short time (302), and to hasten from the offending cause.

692. It is not only true that some odors are in themselves baneful to the human body when received into the lungs in any quantity, but it is also true that odors which are themselves innoxious and delightful when properly diluted with pure air, become exceedingly oppressive and even dangerous to us when too much concentrated, or when the air which we breathe is too deeply freighted with them. Thus, a person whose system is pure and whose olfactory nerves are perfectly healthy and undepraved, will feel a severe nervous oppression accompanied with more or less pain in the head, flush of the face, quickened pulse, general symptoms of fever attended with chills, and perhaps followed by profuse perspiration, if he breathes for a short time the air which is loaded with the perfumes of a garden of roses and other flowers, or the air of a room containing several pots of geranium.† And, therefore, while the natural distribution of flowers and fragrant herbs over the face of earth imparts a healthful prefume to the atmosphere, affording us a rich enjoyment in the exercise of our sense of smell, and evincing the goodness as well as the wisdom of the Creator, the cultivating and crowding of large numbers of fragrant flowers and plants together in gardens and houses is decidedly unfriendly to the physiological welfare of our bodies. So true is it that an infinitely wise and benevolent God has created us with such a nature, and established in our nature such constitutional relations to external things, that, while we have high and healthful enjoyment in the proper exercise of all our faculties and powers, we cannot make the gratification of any of our senses a source of enjoyment beyond the fulfilment of the constitutional purposes for which those senses were instituted, without jeoparding all the interests of our nature, and finding disease and suffering in our pursuit of happiness.

693. But some will say that such an exquisitely delicate power of

* It is a remarkable fact, according to both Soemmerring and Blamenbach, that the organ of smell is smaller in the civilized portions of the human family than in those who are little removed from the savage state.

† Many individuals have died suddenly in consequence of inspiring the too powerful perfume of roses and other fragrant flowers accumulated in large quantities.

smell is far from being desirable ; that they would not wish to possess such keen olfactory sensibility as to feel oppressed and pained by the rich fragrance of a flower garden, and the delightful breath of the domesticated geranium. Yet let them remember, that by divesting themselves of this sensibility, they do not alter the constitutional relations between the odors which they breathe and the vital properties and interests of their bodies! Whether the olfactory sentinel which a wise and benevolent God has placed on the outpost of the vital domain performs with strict integrity the duties for which it was placed there, or not, still the properties which the inspired air carries into the lungs are equally salutary or baneful to the vital interests of the body. Let them remember also, that by divesting themselves of that exquisitely delicate sensibility of the olfactory nerves which renders them unable to inhale the air that is too deeply loaded with the fragrance of a flower garden without oppression and pain, they thereby necessarily divest themselves of that nice olfactory power with which God has endowed them, to discriminate instinctively between salutary and poisonous odors and substances. Thus, like the rebellious Israelites in the wilderness, they drive away that spirit of truth with which God has endowed their organs, to guide them in the way of life and health and happiness, and yielding themselves up to their sensualities, they sink deeper and deeper in depravity, till they learn perhaps to find their greatest delight in breathing the most poisonous odors of the vegetable kingdom ; and receive their deadliest enemy into there bosom as their dearest friend, without the slightest suspicion of their danger ; and millions perish with every form of disease and suffering, cherishing with unbounded confidence to the last moment, as their most tried friend and greatest comforter, the very enemy that thus treacherously destroys their lives. It were infinitely more wise, then, to cherish the strictest integrity of those sentinels which God, in wisdom and in goodness, has established for the protection of our vital interests, and to obey their holiest dictates, and shun or remove whatever offends them, than to destroy their integrity, that we may feel secure in the presence of our enemies, and revel in unsuspecting confidence in the midst of danger.

694. Besides thus acting as sentinel to the lungs, to protect them from impure air, the organ of smell, as I have stated (691), is also, in its perfectly healthy and undepraved state, a sentinel to the alimentary canal (294), and enables us instinctively, with unerring accuracy, to discriminate between those substances which are salutary and proper for our nourishment, and those which are poisonous or unsuitable to be introduced into the stomach. * But this sentinel may be so depraved as to lose its discriminating power, and be no longer able to detect the baneful qualities of things, and thus become wholly unfitted to answer the instinctive purposes of the system. Indeed, it may become so

* 'Without the aid of smell, the sense of taste would be very vague in its indications and limited in its range,' says Professor Roget ; and such is the prevailing opinion of physiologists ; and yet Mr. Hill, who has not been able to smell even the most pungent odors for the last ten years (see Note to 563), assures me that his sense of taste remains good and nicely discriminating in all gustatory qualities ; but he finds, since he lost his smell, that he used often to confound gustatory with olfactory perception in his mind, and suppose he tasted qualities which in reality he smelt. This is undoubtedly a common error.

excessively depraved as entirely to lose the power of appreciating odors; in which case the organ will only retain the ability to appreciate the degree of stimulation, without the least power to appreciate the quality of the stimulus. Thus, snuff-takers always exceedingly deprave the sense of smell; and greatly impair, and often wholly destroy, its power of discriminating between odors of the most opposite character; and in some instances the power of smell is completely destroyed, and the organ only retains the ability to appreciate the stimulation of the most powerful stimuli. In such cases, the parts to which the stimulus is applied, and those which are associated with them, become so accustomed to, and so dependent on, the artificial stimulus for their wonted excitement, that the natural and appropriate stimuli of the system are wholly inadequate to save them from that deep and distressing prostration which necessarily results from their habitual and shocking debauchery; and therefore they become exceedingly eager, and even vehemently importunate, in their demands for the artificial stimulus, and will not be pacified without it. Hence the power of such habits, and the great difficulty of breaking them up.

695. To preserve the natural purity and functional powers and integrity of the organ of smell, and to prevent the depravity which I have described, the sensibilities of the organ and the sympathies of the system unite to resist the encroachments of all depraving and offending causes. Numerous filaments of the trifacial nerve (254, 255, 256) are distributed over the lining membrane of the cavities of the nose, where they are intimately associated with the filaments of the olfactory, or special nerve of smell. The olfactory nerve possesses no sensibility except that which perceives odors. The common sensibility or feeling of the nasal cavities, therefore, is wholly the property of the filaments of the trifacial. These filaments have not in the slightest degree the power of perceiving odors; but so intimately connected in anatomical arrangement and functional relation are they with the olfactory nerve, that their healthy sensibility cannot be impaired without detriment to the sense of smell, and jeopardy to the whole system. Hence, when any substance comes in contact with the lining membrane of the cavities of the nose, which is of a nature to impair the sense of smell, to injure the lungs, or to impair the vital properties of the trifacial nerve, or in any manner to jeopard the interests of the vital economy, the trifacial nerve instantly feels the presence of the substance, and the membrane is excited to an increased secretion of mucus to shield the parts (339) from its poisonous or irritating properties; and if the offending cause is of such importance, either in quality or quantity, as considerably to endanger the system or the parts on which it acts, the trifacial nerve immediately gives a sympathetic alarm, which is instantly diffused over the domain of organic life (225), and the instinctive powers of the system are at once called up to expel the invading foe. A deep, full breath is inhaled, and then the arch of the tongue is raised and pressed against the veil of the palate so as to prevent the air passing out of the mouth, and the diaphragm, and the abdominal muscles which draw down the breast-bone and ribs, are suddenly and powerfully contracted, and the air of the lungs is violently driven out through the cavities of the nose, for the purpose of expelling the offending cause.

696. Thus, if a person with a pure system and undepraved olfactory nerves, comes into the vicinity of a large quantity of tobacco, he instantly perceives the loathsome odor, and at once detects its poisonous character, and finds himself urged by many distressing feelings to avoid the deadly narcotic; but if, regardless of these admonitions, he thrusts some powdered tobacco into his nose, his olfactory nerve still perceives and appreciates the poisonous odor, and the trifacial nerve feels the poisonous character of the irritating substance, and gives the alarm to the domain of organic life, and violent sneezing soon ensues as the instinctive means of expelling the offending cause. If the offending cause is not removed by sneezing, the whole system soon becomes so much affected by the poison, that the most distressing dizziness, and muscular relaxation and tremor and sickness at the stomach, and cold sweat, and vomiting and convulsions, follow in rapid succession, in order both to expel the poison from the vital domain, and to cause us ever after more cautiously to avoid so deadly and so foul an enemy. But by commencing this career of depravity with cautiously measured steps at first, we may in time succeed in utterly destroying the integrity of this important sentinel, and so completely deprave both the olfactory nerve and the nasal portion of the trifacial, that neither of them can any longer detect the poisonous character of the tobacco, but both of them will become so adapted to its properties, as to delight in its stimulation, with an intensity of morbid enjoyment equal to the depth of depravity to which they are reduced. And thus the organ of smell, instead of guarding the vital domain like a true and faithful sentinel, against the encroachments of every enemy which it is naturally qualified to detect, not only ceases to give alarm to that domain when those enemies are approaching, but even throws open its gate and earnestly entreats those enemies to enter, and embraces the foulest and the deadliest of them all as the dearest and most valuable friend, and ushers it into the vital domain, proclaiming with inebriated energy the introduction of a generous and glorious conservator. And thus, by sensual depravity, we transform a guardian angel of light into a treacherous demon of darkness; and still confiding its integrity and fidelity to the vital domain, we receive into the very citadel of life the enemy which poisons all our wells of vitality, and with perfect infatuation rejoice in his destructive influence, and regard his withering embraces as the source of our highest enjoyment, and perish in the full belief that our destroyer is our truest friend, and perhaps with our dying breath commend him to the confidence and kind regard of all around us. Such are the natural consequences of disregarding the holiest and most delicate admonitions of those undepraved sentinels which a benevolent Creator has, for the preservation of our highest welfare and happiness, placed on the outposts of the vital domain. There is indeed a sense in which it may be said that sneezing is the voice of God in our nature, distinctly and unequivocally commanding us to avoid whatever causes us to sneeze. And let it be remembered, that although the constant application of snuff and other poisonous and pernicious substances to the lining membrane of the cavities of the nose, may so deprave the tissues of that membrane, and so impair their delicate and peculiar sensibilities, that they can no longer discern between good and evil, and no longer

detect the poisonous qualities of those substances, nor give the alarm of danger to the vital domain, by which sneezing and other instinctive efforts are called up to expel the offending cause, yet the real character of those substances, and their true relations to the vital powers and interests of our bodies, remain unaltered, and equally hostile to our life and health and happiness.

697. Most of the principles which I have now stated and explained in regard to the faculty of smell, are also true concerning the faculty of taste (254, 297). Every foreign or external substance which the human body has power to derive nourishment from, possesses a specific nature which holds a fixed and precise relation to the constitutional nature of the human blood (684), and all the substances of the body (685), and to the general interests of the vital economy; and each of these foreign substances has certain properties essential to its specific nature, and exactly characteristic of its relations to our living bodies, as a nutritious substance, and which we have not the least power to perceive by our sense of sight, hearing, smell, or touch. But God has endowed us with the special sense of taste, which is adapted with infinite wisdom and benevolence to those properties of nutrient substances, and by which we can detect and appreciate and discriminate them with the nicest and most delicate accuracy; and hence, there are between our organ of taste and the constitutional nature and gustatory properties of substances intended for our nourishment, the most fixed and precise constitutional laws of relation; and necessarily, therefore, there are equally fixed and precise laws of relation between the organ of taste and the constitutional nature of our blood and other substances of which our bodies are composed. The organ of taste, then, is a most important sentinel of the alimentary canal; and its office is to perceive and appreciate the gustatory properties of all the substances received into the mouth for the nourishment of the body, and nicely to discriminate between what is salutary for the body and adapted to the alimentary wants of the vital economy, and what is pernicious or offensive. And when the system is pure, and the organ of taste is in a perfectly normal and undepraved state, its perceptive and discriminating power in man is equal to, if not greater than, that of any other animal (19), and man may be instinctively guided by it in the selection of his food (425) with unerring accuracy and safety (596, 597).* When the organ is in this state of integrity, if natural

* It is a prevailing opinion that man, being endowed with reason, required and received from the hands of his Creator a much less nicely discriminating power of taste and smell than many, and perhaps most, of the animals below him. But this notion is wrong both in fact and philosophy. Suppose God were to create a full sized man, and endow him with the highest order of reasoning faculties, and place him in some portion of the earth uninhabited by the human race, and in the midst of every variety of mineral and vegetable and animal substances. Could that man's reason tell him what to eat? or in any manner determine what is salutary and what is poisonous? Not one whit better than his hand could! If he did not possess nicely discriminating powers of instinct to guide him unerringly to his proper food, he would, with all his rational faculties, be as likely to select a poisonous as a salutary substance, for it would not be possible for reason to ascertain the qualities of any substance with reference to his alimentary wants. But having been once guided by instinct to his proper food, and having by experience found it to be good, his reason would then enable him to select the same food again, and to take measures to secure a supply of it. Man, therefore, is naturally as entirely dependent on instinct, in the original se-

substances pernicious to life, or those which are not adapted to the constitutional wants of the body, are received into the mouth, their offensive character is instantly detected, a loathing is soon felt, and mucous and salivary secretions are poured into the mouth to shield the parts acted on (339), and to flood the offending cause from the porch of the vital domain. If the character of the offending substance be such as to render it exceedingly dangerous to the vital interests, or such as is wholly unfitted for the highest and best condition of our nature, the loathing will be so intense as powerfully to urge us to expel it from the mouth; and if we do not promptly obey this admonition, the sympathetic alarm will be diffused over the whole system, by the same means and in the same manner as in the nose (695), and dreadful nausea and dizziness and muscular relaxation and tremor and cold sweat and violent vomiting will ensue, as the instinctive means of the vital economy to relieve itself from danger. But by habitually debauching the gustatory nerve and the other tissues of the mouth, with poisonous or improper substances, we soon destroy the power of the organ to discriminate between salutary and pernicious substances, and the power of the parts to give the necessary alarm and call up the necessary efforts of the system to protect itself from danger: and in a short time the tissues of the mouth become so deeply depraved, and so completely conformed to the qualities of these improper substances, that they learn to delight in their stimulation incomparably more than in that of healthful and proper substances; and thus, by destroying the integrity of this sentinel, we are given up to believe a lie. Improper substances are received into the vital domain with more or less repugnance of the instinctive powers at first, according to the character of the substances, and according to the caution or excess of our incipient transgressions, till the depravity is extended from the mouth through the whole of the alimentary canal; and the mouth and stomach not only become reconciled to, but exceedingly delight in, the character and influence of the most pernicious substances, which either with hasty ravages spread ruin over our whole vital domain, and violently precipitate us into the grave, or slowly and treacherously sap the foundations of our constitution, and fill us with disquietude and feebleness and disease, which terminate in untimely death; and still we, with the utmost confidence in the integrity of those organs, strenuously contend for the rectitude and safety of our course, on the ground that it is pleasant to the taste and agreeable to the stomach. Indeed, these organs may become so thoroughly depraved, that they will reject the most salutary substances as disgusting and pernicious, and receive the most pernicious substances as agreeable and salutary.

698. In a healthy and true condition of the system, when the organ of taste is in a perfectly normal and undepraved state, if substances designed by our Creator for our aliment be brought, in the best and

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lection of his food, as any other animal; and in the pure state of his nature, as it came from the hands of his Maker, possesses as nicely discriminating powers of taste and smell as any earthly being. And nothing is more erroneous and absurd than the claims that are set up for the dietetic and other privileges of man on the score of his reason.

most appropriate condition, in contact with the organ, the gustatory qualities of the substances will afford us the highest degree of gustatory enjoyment which it is possible in the nature of things for the same substances to yield. Thus, if a perfectly ripe strawberry, or peach, or any other kind of fruit, be received into the mouth, and masticated, our gustatory enjoyment, if our organ of taste is healthy and undepraved, will be as great as the qualities of the particular substance can make it. We cannot by any confectionary process make the qualities of the ripe stawberry more delicious. We may, it is true, by such processes, combine other qualities with those of the strawberry, and make a compound dish which will be more agreeable to some; but in such a case the increased enjoyment will be derived not from an actual improvement of the qualities of the strawberry itself, but from the addition of other qualities. So that it still remains true, that there is between our organ of taste and every substance which may properly be received into our stomach, such fixed and precise constitutional laws of relation, that each particular substance has a specific savor, which, when the substance is received into the mouth in that condition which is best adapted to our organization and vital wants, and properly masticated, will impart to us the highest degree of gustatory enjoyment that it can be made to afford. And as it is the instinctive office of the organ of taste as the sentinel of the stomach, to perceive and appreciate these specific gustatory properties of alimentary substances, with the nicest accuracy of discrimination, in order to secure the strictest fulfilment of the laws of relation between the constitutional nature of our blood and other bodily substances, and the constitutional nature of our food (684), we have, in a pure state of the system and undepraved state of the organ of taste, a delicate and highly grateful variety of gustatory enjoyment, equal to the natural variety of substances which a benevolent God has bountifully prepared for our nourishment. So that the more simple our diet, and the more conformable it is to the constitutional laws of our nature, the more we not only promote health and healthful enjoyment generally, but also gustatory enjoyment of the purest and the highest kind; for then we find in every proper article of food a new and delicate savor, and often an exquisite relish; and even pure soft water, which most men consider tasteless, and many think insipid, has a deliciousness to such a pure organ of taste, wholly unknown and inconceivable to those whose gustatory powers have become depraved by artificial habits.

699. Thus our benevolent Creator, in subjecting us to the necessity of constantly nourishing our bodies with foreign substances, has constitutionally connected that necessity with animal as well as moral powers of enjoyment, and bountifully supplied a rich variety of means for the appropriate exercise of those powers. But inseparable from these constitutional capabilities for good and happiness, are equal capabilities for evil and misery; for these very powers of enjoyment which, while preserved in their purity and integrity, and exercised in conformity to the constitutional laws of our nature, always promote the highest and best condition of that nature, yet when they become depraved and their integrity is destoyed, and they are habitually exercised in the violation of the constitutional laws of our nature, become the ministers of disease to our whole nature, and of untimely

death to our bodies. And hence the common maxim, that what is agreeable to the palate and sets well upon the stomach, is nourishing to the body and conducive to health, is strictly true while the purity and the perfect integrity of our organs are preserved, but fatally fallacious when our organs are depraved, as is universally the case in civic life, and almost universally the case throughout the human world.

700. With the organ of taste, as with that of smell, many qualities which are grateful and salutary when received in that condition in which God in nature has prepared them for us, become depraving to the gustatory power and oppressive and injurious to the system when too much concentrated by artificial means. Thus the acid and the sweet properties of nutritious fruits and vegetables are exceedingly grateful and salutary as they are naturally found in those fruits and vegetables; but when freely and habitually used in concentrated forms, they impair the power of the organ of taste to perceive and appreciate other gustatory properties, and to discriminate between the salutary and the pernicious, and become the causes of oppression and disorder to the digestive organs, and of disease to the whole system.

701. It may, therefore, be laid down as a general law, that precisely in proportion as we become accustomed to the use of any one substance which has a strongly depraving gustatory property, the power of our organ of taste to perceive and appreciate other gustatory properties, and discriminate between the salutary and the pernicious, is impaired, and our gustatory perception and satisfaction become limited to that one depraving quality. Thus the habitual tobacco-eater and spirit-drinker always exceedingly impair their gustatory powers, so that their gustatory perception and satisfaction become almost entirely confined to their tobacco and spirits; and frequently those who habitually indulge in these vile poisons to great excess, entirely destroy their powers of taste, and are only able to appreciate the degree of stimulation produced by their favorite substances. Such individuals eat to sustain their bodies, or to answer the demands of their stomachs; but they have no more gustatory enjoyment in eating than they would have if their mouths and throats were lined with copper. All high seasoning upon food produces a similar effect, though seldom to an equal extent; and indeed, all artificial stimuli, and most artificial preparations of food, in their different measures, produce similar effects on the organ of taste, and thus impair its power and destroy its integrity as an instinctive sentinel of life, which God has placed at the most important outposts of the vital domain!

702. Those, therefore, who seek for gustatory enjoyment in the artificial preparations of culinary skill, defeat their own object; for they, as a general fact, necessarily diminish their gustatory enjoyment by such means, and circumscribe it to narrower and narrower limits, in proportion as they depart from that simplicity which is required by the constitutional laws of their nature. Nor is this important doctrine any the less true, because they who are deeply sunken in gustatory depravity cannot be convinced of its truth while they remain in their depravity. The following statement of a real case, which took place at one of the principal hotels in the city of New York, during the summer of 1831, is a good illustration of the principle I have just advanced. The dinner-hour arrived, and the table, fitted for more than

a hundred persons, was richly furnished with every variety that the markets could afford, prepared and served up with the utmost exercise of culinary skill. The bell was rung, and the table was soon surrounded by those for whom it had been prepared. Some, of simpler habits and less depraved palates than the rest, selected the plainest and simplest articles of food before them, and made their repast with much gustatory enjoyment. Others, of a more omnivorous character and miscellaneous appetites, partook freely of almost every dish within their reach, and ordered supplies from many that were not within their reach. These, without any distinct gustatory perception of the specific properties of the different substances which they devoured, yielded to the morbid cravings of their stomachs, and eagerly gorged themselves, with a kind of indistinct and promiscuous satisfaction. But there was one gentleman at the table of no plebeian palate. His gustatory faculty had been educated to the very top of its capabilities. He was, in the modern sense of the term, an epicure of the highest order. He lived for the enjoyments of the palate, and had systematized eating and drinking into the most refined art. He took his station at the head of the table Before him smoked a well-cooked sirloin of roasted beef. He carved it in the most skilful manner, and after having served others, he helped himself to a delicate bit, and sat down and dressed it with a variety of seasonings, and then tasted of it, but it afforded him no relish. He called a waiter, and ordered his plate to be changed, and a dish of calf's head and feet to be brought to him, from another part of the table. A portion of this dish was taken upon his plate, and nicely seasoned and tasted. This he found not to be properly cooked; and the waiter was again ordered to change his plate, and bring him a dish of fowls. These had been mangled in carving, and were ordered back untouched. The raw gizzards of the fowls were then ordered from the kitchen; these were carefully dressed by the gentleman, and well basted with the contents of the caster and the waiter received particular instructions how to have them, broiled. This being done, and the gizzards again before the gentleman upon the table, they were again profusely basted with butter and the contents of the caster: cayenne pepper was freely showered upon them, and mustard in abundance. The gentleman then tasted of the gizzards, and found them to relish so well, that he concluded to make his dinner of them. In the meantime, however, the other gentlemen at the table had finished their first course, and the waiters were removing their plates. Our epicure, unluckily, at this moment laid down his knife and fork, and pushed his plate a little aside, to take a glass of wine, to give tone to his stomach. When he had drunk his wine, he turned to commence his dinner, but his gizzards were gone! He called aloud to the waiter, but it was too late; the gizzards, saturated and swimming as they were, in a purgatory of grease and pepper and mustard and other fiery condiments, had been scraped with ruthless hand into the common mass of the ruins of the table; and the unfortunate epicure was compelled to make out his dinner the best way he could. Now, what could have been the gustatory enjoyment of such a man, who could find nothing upon that sumptuously-furnished table from which his depraved palate could derive enjoyment, and who could only find satisfaction in such a dish as he prepared for his repast? The giz-

cards themselves, in the first place, had little more gustatory virtue in them than a cast off heel-tap of a worn-out shoe; but if they had possessed any natural savor of a grateful kind, surely the dressings must have completely destroyed it, and left nothing for the organ of taste to appreciate but the gustatory qualities of the fiery seasonings! A man with a pure system, and with an undepraved organ of taste, might have sat down beside him and dined upon a piece of good bread and a cup of cold water with a thousand-fold more gustatory enjoyment than it is possible for such an epicure to derive from any dish which culinary art can produce. For the deeply-depraved organ of taste in such an epicure, has 'no virtue to perceive the beauty of truth:' it has no power to detect the delicate, intrinsic qualities of things; and, therefore, whatever may be the article, of food, the gustatory enjoyment of such a man cannot depend on the natural savor of the nutritious substance, but either solely on the gustatory qualities of the fiery seasonings, or in the total obliteration of the gustatory power, the seared palate is only capable of appreciating the degree of stimulation. So in the religious world. People whose sympathies exceed their knowledge, and who are more accustomed to be excited than to be instructed, soon come to mistake their mere excitements for the genuine influences of the Spirit of Truth, and can only appreciate the degree of stimulation, without any power to discriminate as to the quality of the stimulus: and, therefore their hope and their confidence and their rejoicing are always equal to the degree of stimulation which they feel. Such have no distinctness nor soundness nor stability in their faith; their religion rises and falls with their emotions, and they are ever ready to be led away by whatever produces the most powerful stimulation. But they who receive and obey the truth in the love of it, have hope and confidence and rejoicing always in proportion to the distinctness of their perceptions of, and the fulness of, their conformity to the truth.

703. It is, therefore, a general law, that the more perfectly our dietetic habits conform to our laws of constitution and relation, the greater is our gustatory enjoyment, and the more certainly we secure life, health, and happiness. This law is established by physiological science, and confirmed by the experience of thousands even at the present day.

CONSTITUTIONAL RELATIONS OF THE TEETH.

704. The teeth, though possessed of no sensibility by which we detect and appreciate the qualities of our food, are nevertheless exceedingly important organs of internal and external relation. The manner in which they are produced by the vital economy has been fully described (323, 328), and also their liability to disease and decay (509). There are few parts of our whole system, the disease of which is attended with more excruciating and intolerable pain than that of the teeth; and thousands of human beings, when severely suffering the tooth-ache, have been heard to question the goodness and the benevolence of the Creator, because they have conceived that such suffering in the creature is irreconcilable with those attributes in an Almighty and infinitely wise God; but such sentiments evince as much ignorance as impiety in the sufferer. For it only requires a correct knowledge of the consti-

tutional nature and relations of the teeth, to convince every rational creature, that even the excruciating pain itself which attends the disease of our teeth, is a most conclusive demonstration of the benevolence and goodness of our Creator. God gave us our teeth for good, and only for good; and so far as the constitutional laws which he has established in our nature are obeyed, we are subject to no suffering from the teeth. The gradual growth of our bodies, from our infantile forms to sturdy manhood, renders it necessary that our little jaws should be furnished with a set of teeth in childhood, which are too small to fill up our jaws when our system is fully developed, and too small to answer the purposes of mastication through life; and hence the wise and benevolent Creator has established a special economy in our system (325), by which the first teeth of our childhood are in due time removed, and they are gradually replaced as our jaws become more and more developed, by a set of permanent teeth, which are much larger and better fitted for the purpose of mastication. But in all this there is, in the original constitution and condition of man, no necessity for the slightest disease or suffering. Were the human species uniformly and permanently to obey the constitutional laws of their nature, the first set of teeth would be produced, and, in proper time, give place to the second or permanent teeth, without the slightest pain or inconvenience in any case. But God has not placed the permanent teeth in our jaws to be removed, and therefore he has made no arrangement in the vital economy of our system for their removal without pain.

705. The teeth are organs of very great importance to the vital interests of our bodies, and their importance continues while the alimentary functions of our bodies are requisite. Most people regard the loss of a tooth as an evil, mainly because of the pain which attends the loss, some because of the disadvantage to their appearance, and some because of the inconvenience in speaking; but few, if any, regard it as an evil because of the importance of the tooth to the vital interests of the body. But God, who in infinite wisdom and benevolence has constructed the whole organic machinery of our bodies, and who perfectly understands the importance of each particular part of that machinery to the general interests of the whole, as a single system, knows that a single permanent tooth cannot be lost without crippling in some degree the powers of the vital constitution, and in some measure abridging the period of our bodily existence; and, therefore, he has constructed our permanent teeth of such materials and in such a manner, and planted them so firmly in our jaws, that they are capable of remaining perfectly sound and healthy, and of performing their proper functions with utmost integrity, from the period at which they are produced, till our vital constitution is worn out, and we die a natural death, at a hundred, or two hundred, or five hundred, or a thousand years of age; and because it is of very great importance to the vital interests of our bodies that the permanent teeth should thus remain in our jaws during our whole life, God has, in wisdom and benevolence, so fixed them there, that they cannot be removed by disease nor torn out by violence, without the most excruciating and dreadful pain.

706. The teeth are constituted with fixed and precise relations to the blood (142) and all the particular substances of the body (635); to the nerves, to the gums, to the organ of taste, to the salivary glands,

to constitution and economy; and they are constituted with fixed and precise relations to the nature, qualities, and condition of those substances which God has designed for human aliment: and if their laws of constitution and relation be strictly obeyed and never violated, the teeth will never decay nor become diseased nor painful in the human head. In this statement, however, I do not mean to affirm that the present generation of mankind, with all the disadvantages of their own and their parents' transgressions, could, by the strictest conformity to the laws of their nature, wholly redeem themselves from their physical depravities and predispositions, and preserve their teeth free from disease and pain as long as they live. The teeth are among the last organs which manifest either the deteriorations or the meliorations of the vital constitution: hence some people, with excellent teeth, may habitually violate the constitutional laws of their nature in such a manner as is calculated to destroy their teeth, and yet die at what we call an advanced age, with sound teeth in their jaws; but their iniquities will surely be visited upon their children and grandchildren; so that, if the same habits be continued, the third or fourth generation, at farthest, will be afflicted with miserable teeth. And on the other hand, people with teeth strongly predisposed to decay, may most rigidly observe the constitutional laws of their nature, without being able wholly to preserve their own teeth from disease and pain; yet they will preserve their own teeth a very great deal longer than they would otherwise last, and they will suffer comparatively little pain from their decay; and if these habits are persevered in by their posterity, the third or fourth generation, at farthest, will have excellent teeth: and thenceforward to the end of the world, if the laws of constitution and relation are strictly obeyed and never violated by the race, their teeth will never decay nor become painful. It is therefore entirely from the voluntary transgressions of mankind, and not from the want of benevolence in our Creator, that we suffer tooth-ache.

707. But it is asserted that God could either have made the teeth in such a manner that they could not decay, or that their decay would not be attended with pain. I reply, that if this be true, and if God had so made them, he would have disregarded the best interests of the human system, and neglected to establish one of the most powerful barriers to those voluntary transgressions which destroy the body. For such is the constitutional nature of the blood (142) and all the other substances of the living body, and such are the constitutional relations, and the relations of all the alimentary organs, to those foreign substances which God designed for our nourishment (688), that those laws of relation cannot be violated without injury to the vital interests of the body, and they cannot be habitually transgressed without causing bodily disease and suffering and death. And such is now the constitutional nature of the teeth (706), and *their* constitutional relations to the blood, and all other substances of the body, and all the alimentary organs, and to those foreign substances intended for our nourishment, that the constitutional relations of the blood and other substances of the body, and of all the alimentary organs to those foreign substances, and the constitutional relations of the teeth to those foreign substances, perfectly harmonize, so that a perfect fulfilment of the constitutional laws of relation in regard to the teeth is

precisely what the best interests of the whole organization and vital economy of the human body require. Precisely that kind, quality, and condition of alimentary substances, which the best interests of the teeth require, are also in the highest degree conducive to the best interests of the whole vital domain ; and, on the other hand, every infraction of the constitutional laws of relation in regard to the teeth, is necessarily, in some measure, an infringement on the particular and general interests of the body.

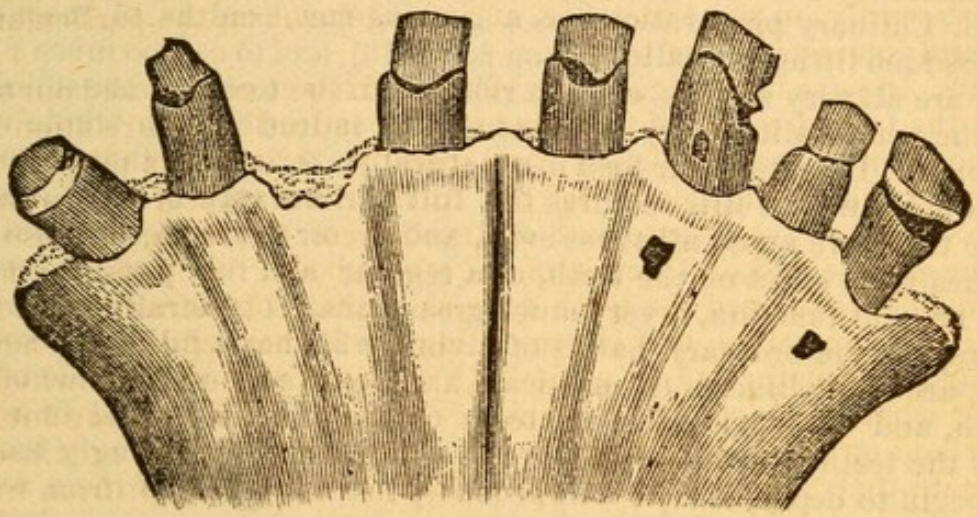
708. In pure benevolence, therefore, God has so constituted our teeth, that the transgression of their laws of constitution and relation shall cause them to become diseased and painful, for the sole purpose that the pain shall induce us to refrain from those transgressions which not only cause the disease and destruction of the teeth, but also lead to the disease and destruction of the whole body. And thus hath God in goodness ordained the tooth-ache as a means of restraining us from destroying ourselves, and of preserving the highest and best condition of our whole nature ; just as he hath ordained that the pain which we suffer when we burn our flesh shall restrain us from running into the fire: and on the same principle of benevolence hath he ordained all the pain that human nature suffers, that we may be kept from transgression, and be partakers of his holiness and happiness : and the excruciating pain which attends the disease of our teeth, and the dreadful violence attending the extraction of them, show the importance of our teeth to the vital interests of our bodies, and of our duty to preserve them.

709. Our teeth were formed to cut and grind our food preparatory to swallowing and digestion (328), and every artificial substitute for their legitimate use is more or less an infraction of their laws of constitution and relation, and necessarily results in commensurate injury to themselves and to the whole system. But when the function of the teeth is correctly and fully performed, on precisely the right substances in precisely the right condition, the laws of constitution and relation are obeyed, and the most healthful condition of the teeth is preserved. Almost all artificial preparations of food, therefore, and especially those connected with the use of fire, are necessarily more or less injurious to the teeth, and cause them to become diseased and painful.

710. The lower orders of animals, in a pure state of nature, whose food is never subjected to artificial preparations, never have accumulations of tartar upon the teeth, nor are their teeth in any way diseased. But the horse, cow, dog, and other domesticated animals, which are fed on artificially prepared food, often suffer from calcareous incrustations and decay of teeth ; and this is particularly the case with such as are fed on warm and soft food. Mr. John Burdell, surgeon dentist, of New York, who has given much attention to this subject, assures me he has always found that the teeth of cows fed on warm 'still-slops' are very much incrusted with tartar ; and in many instances the enamel is entirely destroyed (Fig. 50). This same gentleman informs me that a milkman who keeps a large number of cows, told him that he once undertook to feed his cows entirely on warm still slops, and at first thought it an excellent manner of keeping them ; but he found, in the course of three or four years,

that they were all losing their teeth, and becoming unable to eat hay, and he was obliged to fatten them as well as he could on the dregs of the still, and kill them off. Since then, he has kept his cows entirely on grass and hay, and has had no further trouble with their teeth.

Fig. 50.



The teeth of a cow fed on still-slops. The enamel is destroyed, and the bone diseased.

711. A very intelligent sea-captain, who has visited most parts of our globe, informs me that he has observed with surprise the different conditions of the teeth of the different nations and tribes which he has visited; and that he has always found that where the people use much hot drink and hot food, and smoke tobacco or other narcotic substances, their teeth are black and much decayed; and that in the islands of the Pacific and other parts, where the people seldom or never take anything hot into their mouths, use little or no animal food, and are very simple, plain, and natural in their diet, he found that their teeth were very regular, white, clean, and free from decay. 'The contrast,' says he, 'between the black, decayed teeth of the inhabitants on the western coast of South America, and the white, clean, healthy teeth of the inhabitants of some of the islands in the Pacific of nearly the same latitude, was so great and so striking as to excite my astonishment.'

712. A medical gentleman, who formerly spent fifteen years in one of the remote counties of the State of Maine, where the principal business carried on was that of getting out lumber, and where the inhabitants, with active, industrious habits, knew nothing of luxury, but subsisted on a plain, simple, and coarse diet, stated that the people were very remarkable for their fine, white, and regular teeth, which were wholly free from decay; and that, although he was the only physician in the whole county, he had occasion to extract but one tooth in the whole fifteen years; and he finally left the parts because he could find no professional business to attend to. The same freedom from decay of the teeth is found in all portions of the human family, in the same simple and temperate circumstances and habits. The peasantry of Ireland, and other parts of Europe generally, who are free from the use of intoxicating substances, and whose dietetic habits are

simple and plain, are remarkable for their fine, healthy, and regular teeth. But facts need not be multiplied. Nothing can be more certain than that most artificial processes of preparing food are injurious to the teeth (709). Indeed, so far as these organs are considered, it is unquestionably true that a perfectly natural state of our food would be incomparably better than the present artificial preparations.

713. Culinary preparations, as a general fact, lead us to masticate our food too little, to swallow it too fast (416), and to eat too much; and these are all very serious evils in relation to the teeth, to the stomach, and the whole alimentary apparatus, and indeed to the whole vital economy. By eating our food in a natural state, or with that artificial preparation which still requires the full performance of the function of the teeth, we avoid all these evils, and preserve the teeth in health. The healthful effect on the teeth, of a regular and full performance of their natural function, is very much greater than is generally supposed. Let any one of ordinary habits of living, who has a full set of sound teeth, accustom himself to masticate his food freely on one side of his mouth, and make no use of the teeth on the other side, and in a few years the teeth which he does not use will become exceedingly tender and begin to decay, and he will probably lose the whole of them, while the teeth on the other side remain sound; and let any one who has very tender teeth, accustom himself by degrees to eat crusts of bread, pilot-bread, etc., and he will soon find himself able to eat those hard substances with great ease and pleasure, and the health of his teeth will become exceedingly improved. And as a general rule it will always be found true, that in families where there are several children of the same parents, and where some of those children prefer the crusts of the bread set before them, and others the soft part, the former will have much sounder and better teeth than the latter, and will preserve them free from decay much longer in life.

714. Physiologists and dentists have differed much in regard to the nature and causes of the diseases of the teeth; yet there does not appear to be any real grounds for a difference of opinion on the subject. The teeth are organic portions of the animal body. The enamel is a species of organic crystalization (327), destitute of nerves and vessels, and therefore wholly incapable of both healthy and morbid sensibility; and yet, in the living head, its sound condition is very closely connected with the healthy condition of the bony substance which it surrounds (423). The bony portion of the teeth is supplied with both vessels and nerves, and is at least capable of a high degree of morbid sensibility; and the very fact that the disease of the teeth is attended with pain, is a full and conclusive demonstration that the disease is purely organic, and, as such, always originates in the bony portion of the teeth, by a species of inflammation. In very many instances, it is true, the disease commences on the outer surface of the bone, contiguous to the enamel, and perhaps most frequently in such instances the disease is caused by the fracture or destruction or injury of the enamel. But, strictly speaking, the enamel itself is incapable of disease. It is injured or destroyed by chemical and by mechanical causes, and is broken off in fragments, or slowly disintegrated; but this cannot properly be called disease. Whether caused by the injuries or destruction of the enamel from without, or by disorders from within, then, the *disease* of the teeth has its

seat wholly in the bony substance, and is purely organic. Among the external causes acting directly on the teeth, heat is certainly the most powerful. It is common to hear people speak of sugar, calomel, and other substances, as very injurious to the teeth, from their external action; but if these substances were only permitted to come in contact with the external surface of the teeth, and were never swallowed into the stomach, the teeth would suffer very little from them. The most extensive and pernicious causes of diseases to the teeth, are those which act on them through the general organic economy of the system. Whatever produces a general disturbance of function, and causes a general morbid irritability of the nervous system, assails the teeth in common with all the other organs: but they will react against such causes with more or less vigor, according as the performance of their function and other circumstances are more or less favorable to their health. If the food is soft and hot, or concentrated or high-seasoned, or otherwise vicious, and mastication is neglected, incrustations of tartar will gather around the neck of the teeth, and irritate the gums, and separate them from the enamel, and irritate the membrane which surrounds the roots (323); and this irritation will soon be extended to the membrane which lines the inner cavity of the roots and body of the teeth (327), the teeth will become very tender, and soon begin to be inflamed and painful; and decay will follow, and the teeth must be lost, unless the progress of the disease is arrested by correct habits, aided by the art of the skilful dentist, which should never be neglected.

715. The teeth, therefore, do not suffer alone by the violation of their laws of constitution and relation. The gums and salivary glands, as well as the mucous membrane of the mouth, the organ of taste, and the alimentary canal, are necessarily involved in the injury, and react upon the teeth and upon each other. The gums become tender and irritable, separate from the neck of the teeth, and often become flaccid and exceedingly ulcerous. All this hastens the destruction of the teeth.

716. The importance of the proper quantity and quality of saliva, in order to the healthy condition and functions of the organs of the mouth and the stomach, has been greatly overlooked. We have seen (426) that when the food is properly and thoroughly masticated and freely mixed with saliva, it is not only completely comminuted in the mouth, but it also undergoes something of a change, approaching towards the character of chyme; and hence the more completely and perfectly the functions of the mouth are performed, the more perfectly is the food fitted for the function of the stomach. Not only the quantity but the quality of the saliva may be exceedingly varied by the different conditions of the salivary glands, and these conditions depend very much on the kind and degree of stimulation which induces their secretion; and hence different kinds and conditions of substances received into the mouth, affect those glands differently, and cause correspondent variations in the character of the saliva. The imperfect mastication and insalivation of the food becomes a source of irritation to the stomach; and all irritations of the stomach, from whatever cause, react upon the salivary glands, greatly affecting their condition and the character of their secretion; and thus an unhealthy quality of saliva and other oral secretions is produced, from which the calcareous incrustation which gathers around the teeth is formed, and

thereby the gums and teeth are irritated and diseased. In this manner the saliva is sometimes rendered so vicious that it becomes exceedingly acrid, scalding and blistering the parts over which it flows, and greatly disturbing the function of the stomach.

717. When, therefore, the laws of constitution and relation in regard to the teeth are precisely fulfilled in kind, quality, and condition of the food, and when the teeth most perfectly perform their function, the laws of relation in regard to the gums and salivary glands are obeyed, and the best quality and quantity of saliva is secreted for the use of the system; and when the laws of constitution and relation in regard to the organs of the mouth are fulfilled, then is the masticated food precisely of the nature and condition best adapted to the constitution and functional powers of the stomach; for there are, as I have stated (706), the most fixed and precise constitutional laws of relation between the teeth and the alimentary canal; so that precisely that kind, quality, and condition of food which is best adapted to the constitutional nature and relations of the teeth, is also best adapted to the constitution and functional powers of the alimentary canal; and precisely that degree of mastication of the food which the highest welfare of the teeth requires, is indispensably necessary to the condition and functional conduct of the stomach and bowels. If the food is imperfectly masticated and too rapidly swallowed into the stomach, it becomes a serious cause of irritation to this organ, and always tends to produce functional derangement, not only of the stomach itself, but, by the sympathetic influences of the stomach, of all the other organs of the system (297); and when by such or other means, the functional vigor and integrity of the stomach becomes impaired, the imperfectly masticated food, after remaining in the gastric cavity for some hours, a cause of irritation and disturbance, is frequently rejected by eructations, or permitted to pass in a crude state into the intestinal tube, where it becomes a cause of serious and sometimes fatal disturbance, producing flatulence, colic, spasms, convulsions, and even death (436). It is therefore of the utmost importance, not only to the teeth, but to the whole apparatus of alimentary organs, and to the whole vital economy, that the food should be fully masticated and slowly swallowed into the stomach; and in order to do this, it is of the utmost importance that, as a general fact, the food should be of a kind, quality, and condition, requiring and compelling thorough mastication and slow deglutition.

718. Everything unfriendly to the sound constitution and permanent health of the teeth, is far more efficacious in its pernicious effects on those organs in childhood, than in later periods of life (227). Indeed there is no other period in which the teeth are so deeply and permanently injured as they are previous to their appearance above the gums. It will be remembered that during the development of the temporary or infant teeth (323, 324), the germs of the permanent teeth are formed, and deposited in appropriate cells in the spongy substance of the jaw-bone (325), where they remain till the general wants of the organic economy require that the permanent teeth should take the place of the temporary ones. During this whole period of six or seven years or more, these germs participate in all the general affections of the system, and always more or less partake of the morbid irritations

and irritability of the nerves of organic life (225). From the time these germs begin to be developed till the teeth are completely formed, or during the progress of second dentition, every disturbing cause in the organic domain strikes at the very constitution of the teeth, and does them an irreparable injury, preparing them for early disease and decay.

719. Calomel and other kinds of mineral medicine, and in fact all medicine which has a general effect on the system, is particularly injurious and often destructive to the permanent teeth, when taken before those organs are completely formed. Everything in the dietetic and other habits also, during this period, which is exciting and stimulating to the system, producing feverishness or intensity of action, and which is calculated to hasten on the process of second dentition, necessarily has an unhealthy effect on the organic constitution of the teeth, and renders them more susceptible to the action of those causes by which they are diseased and destroyed. And even after the permanent teeth are completely developed, their vessels and nerves being considerably larger, and pervading the bony substance more extensively and abundantly in youth than in later life (327), they are much more liable to deep organic injury and painful and destructive disease from the internal action of disturbing causes, than they are in later periods. And hence it is of the utmost importance to the permanent welfare of the teeth as well as of the whole system, that the diet of children should be plain, simple, and unexciting, and that every proper measure should be taken to preserve the general health of the system.

CONSTITUTIONAL RELATIONS OF THE SKIN AND LUNGS.

720. The primary organs of external relation, I have said (688), are the alimentary canal, the lungs, and the skin. In some animals the skin is supposed to be a principal organ of respiration; and it has also been supposed to be, to some extent, an organ of alimentation. In man, its powers of absorption, as an organ of alimentation, are exceedingly small, if indeed it can justly be said to possess any (331). As an organ of respiration, the human skin is of much importance. In a healthy and vigorous state, and when not too much confined by clothing, its action on the atmosphere is very similar to that of the lungs (506); and hence there are the same or similar constitutions and functional laws of relation between the skin and the surrounding atmosphere, that there are between the lungs and atmosphere; and these I shall explain when I come to speak of the lungs. As an extended organ of touch, the skin has constitutional relations to external things, the general principles of which have already been sufficiently explained in speaking of the other organs of sense (253).

721. The lungs are constituted with fixed and precise laws of relation to the external air. Pure air, I have said (463), when at the very point of truth in its constitutional nature, consists of twenty parts in a hundred, by measure or volume, of pure oxygen gas, and eighty parts of nitrogen or azote. These are not chemically combined (464) as oxygen and hydrogen are in water, but they are thoroughly mixed together, in the proportion of one fifth part of oxygen with four-fifths of azote; and they are held together, if the views of modern chemists are correct, by affinities peculiar to the atmospheric constitution; for

although a given volume of oxygen is heavier than the same volume of azote, and therefore, reasoning *a priori*, we should conclude that oxygen would be much more abundant in the lower regions of the atmosphere, and that azote would be much more abundant in the higher regions; but the air brought from the highest point of elevation to which any human being has yet ascended, is found, on analysis, to consist of precisely the same qualities and proportions that the air does which is taken from the lowest valley. The only explanation which the present state of science can afford for this interesting fact is, that oxygen, which in its pure state is a little heavier than the common atmosphere, and azote, which in its pure state is a little lighter or less dense than the common atmosphere, are thoroughly mixed together in the proportions I have named, and constitute pure atmospheric air, not only in the lowest valleys, but on the tops of the highest mountains, and at all known altitudes; and these substances are held together in those proportions, by laws of constitution peculiar to the atmospheric air. So that, if a large quantity of oxygen and azote were set free, they would at once mix together, according to the constitutional laws of atmospheric air, in the proportion of one volume of oxygen with four of azote; and if there was an excess of oxygen, it would sink towards the earth, and remain in its free state until it found something to combine with; and, on the other hand, if there was an excess of azote, it would ascend up. This, then, is the constitutional nature which God has given to the atmospheric air; and he has given to each and every individual vegetable and animal in the whole organic world a constitutional nature holding a fixed and precise relation to the constitutional nature of pure air. The small quantity of carbonic acid gas and the vapor which are always found in the atmosphere (463), need not be taken into account.

722. The human body, like other animal bodies derives what may properly be called a portion of its nourishment, from the atmosphere (470); and the nourishment is not only essential to our existence, but we cannot live many minutes without a supply of it. As a general statement, the oxygen alone is the nutritious principle of the air which we breathe (472), and the azote is wholly innutritious. Pure air, then, contains only one part of nourishment for our bodies mixed with four parts of innutritious substance; and the lungs are obliged to receive this air with its large proportion of innutritious substance, for the sake of receiving its small proportion of nutritious substance, which they separate out and appropriate to the nourishment of the system, by a vital process which may be called pulmonary digestion (471).

723. Now, it may be asked, Why it would not be an excellent plan to establish all over the face of the earth a vast multitude of large chemical laboratories for the purpose of analyzing the atmosphere, and procuring as much pure oxygen or gas as mankind would require for their nourishment, and thus save the human lungs from the very laborious and wearing task of separating the nutritious principle of the atmosphere from such a large quantity of innutritious matter, and especially in all cases of weak and delicate lungs? Considering the rage of mankind for concentrated and stimulating substances, it is indeed a marvel that an enterprise of this kind has not been undertaken; and no doubt it would have been long since, if men could have

felt their way to such a mode of pulmonary stimulation. But such an artificial preparation of air for the human lungs would be ruinous to the lungs, and destructive to the whole body; because God has organized man, and established the laws of vital power and action within him, with the most fixed and precise relations to the constitutional nature of atmospheric air as it is in a natural and pure state. He has formed the lungs to receive and digest air that is composed of four parts of innutritious matter and one of nutritious, and therefore every deviation either way from this point of constitutional truth in the character of the air, must necessarily be injurious to the lungs, and through them to the whole system. If we were to breathe pure oxygen gas or air, there would be greatly increased action in the whole system, and all the vital phenomena would be exceedingly enhanced; the lungs and other organs would become inflamed, and the vital powers would soon be completely exhausted, and the vital constitution destroyed. On the other hand, if we were to breathe pure azote, we would instantly suffocate, because it is wholly innutritious of itself, and therefore cannot alone support respiration (465). Just in proportion as the air we breathe deviates from the constitutional truth of pure atmospheric air to an excess of oxygen, the vital action and exhaustion of our system are increased, the functional power of the lungs is developed, and life is abbreviated. And just in proportion as the air we breathe deviates in the other direction to an excess of azote, the function of respiration becomes depressed, laborious, and imperfect, the blood and all other substances of the body suffer a commensurate deterioration (474), all the functions in the system languish, the lungs and other organs lose their most healthy tone and elasticity, and the whole system tends to disease and decay. When these deviations in either direction are exceedingly small at first, and gradually increase, we may not be sensible from immediate and distinctly marked manifestations that the air which we breathe is not best adapted to our lungs; nay, indeed, we may so far deprave our lungs that they will prefer the presence of air which is loaded with the poisonous odor of tobacco, to the presence of pure air (287, 290, 296, 696). Nevertheless it is most strictly true, that all deviations to an excess either of oxygen or of azote, in the air we breathe, are commensurately injurious to the lungs and to the whole system. We are therefore so organized in relation to the constitutional nature of pure air, that the innutritious property of the air is, in its true constitutional proportion, just as important to the permanent welfare of our lungs and our whole system, as the nutritious property is. I have entered thus fully into the explanation of the constitutional laws of relation between the lungs and the atmospheric air, mainly because there is, in this respect, the most perfect analogy between the lungs and the alimentary canal.

CONSTITUTIONAL RELATIONS OF THE ALIMENTARY CANAL.

724. The human stomach with the intestinal tube, I have said (687), is constituted with the most fixed and precise relations not only to the blood and all the other substances of the body, and all the other organs of the system, but also to those foreign or external substances designed by our Creator for our aliment (688). The direct

and important relations between the stomach and the teeth we have already contemplated (715), and seen that precisely that kind, quality, and condition of food which are best for the teeth, are best for the stomach, after having been subjected to the function of the teeth; and that the more perfectly the function of the teeth is performed, the better the masticated food is prepared for the function of the stomach (717). The stomach, it will be remembered, besides the mucous membrane which lines it on the inside (338), and the peritoneal coat which envelopes it on the outside (350), has a muscular coat (347), of which one set of fibres run lengthwise of the organ, and another set run around it, at right angles with the first, or nearly so; and a third set of oblique or spiral fibres, continuing from the œsophagus, and being distributed mostly to the large end of the organ. Simply as a digestive organ, the stomach, it will be remembered, is supplied from the domain of organic life (231) with three sets of nerves (230): first, those which belong to its blood-vessels concerned in nourishing its tissues, and those which belong to its secreting and absorbing vessels; second, the nerves which convey the stimulus of motion from the centre of perception and action to the muscular tissue of the organ; and third, the nerves of organic sensibility, by which the stomach is sensible of the presence and properties of the substance received into it (429).

725. Our infinitely wise and good Creator, I affirm, has organized men to subsist on certain substances, which He had previously created with fixed constitutional natures and properties; and, therefore, there is a perfect constitutional adaptation of our organs to those substances, and of those substances to our organs (688). And as God created man to be the lord of the earth, and to occupy all portions of it, he constituted him with a wide range of adaptability to meet the exigencies of the circumstances and conditions in which he might be placed; but always, of necessity, under this great and immutable law, that *in proportion as man turns aside from the truth of his natural and perfect constitutional adaptation, and educates himself, by virtue of his constitutional adaptability, to habits, circumstances, and conditions less adapted to the truth of his constitutional nature, he impairs all the powers of that nature, and abbreviates his existence.*

726. In its constitutional nature, every substance has properties adapted to the end or ends for which it was created; and this is strictly true of all substances designed for human aliment (690); and, therefore, the human organs have capacities and powers perfectly adapted to these properties (294, 296). Hence we have organs with the special sense of sight, adapted to the visual properties of things; organs with the special sense of hearing, adapted to the auditory properties of things; an organ with the special sense of smell, adapted to the olfactory properties of things, or to odors; an organ with the special sense of taste, adapted to the gustatory property of things (556); and the sense of touch, adapted to the tangible properties of things (242); and each of these properties is the natural and appropriate stimulus of the special sense adapted to it. These organs which I have now enumerated, all pertain to *animal* life, and are endowed with *animal* sensibilities (292); but the organs belonging to the domain of organic life, are endowed with organic sensibilities

equally determinate and equally specific in relation to the properties of things designed to be their natural and appropriate stimuli (296). And hence, the nerves of organic sensibility belonging to the human stomach (724), in a perfectly normal and undepraved state, are endowed with a special organic sense by which they, with the most perfect accuracy and exquisite delicacy, perceive and appreciate the specific alimentary stimulus of every substance received into the gastric cavity, and instantly convey the impression which they receive to the centre of perfection and action (220) which presides over the function of the stomach, and which immediately calls up those powers requisite for the performance of the function of that organ, according to the character of the stimulus perceived (429).

727. While the stomach is preserved in a perfectly healthy and undepraved state, its organic sensibility enables it to detect and appreciate with the utmost accuracy, both the *quality of the stimulus*, and the *degree of stimulation;* and consequently enables it to discriminate, with the same accuracy, between those substances which are best adapted to the vital interests of the system, and those which are pernicious or offensive, or even less adapted to the vital wants. When the quality and quantity of the substance received into the stomach are best adapted to the vital interests of the system, the stimulation of this organ is sympathetically diffused over the whole system (297), and the whole organic domain within us rejoices under its healthful influence, and we have an animal and intellectual and moral consciousness, not of a local organic stimulation, but of a general buoyancy of spirits, and intellectual sprightliness, and moral enjoyment (305); and when any pernicious or offensive substance is introduced into the stomach, this organ in its integrity instantly detects its character, and if necessary for the security of the vital interests, promptly gives the alarm to the whole organic domain, and when requisite, causes a manifestation of strong symptoms in the domain of animal life (300).

728. But this special organic sense of the stomach, like the special animal sense of taste and smell (694, 697), may be exceedingly depraved, and even totally destroyed; so that the stomach may become not only wholly destitute of the power to perceive and appreciate the *quality* of the stimulus which acts upon it, and to discriminate between those substances which are salutary and those which are pernicious to the system, and thus be reduced to the mere ability to appreciate the *degree* of its stimulation, but it may even be made to prefer those substances which are decidedly pernicious to the vital interests; because in its depravity, it is so adapted to the stimulating properties of those substances, that it receives from them the most satisfactory *degree* of stimulation.

729. But the stomach, as we have seen (298), is too important an organ in the vital economy, and too directly and powerfully related to all the other organs of the system, to sink to this state of depravity alone (511). By direct sympathetic irritations, and by the deterioration of functional results, the whole system is made to partake of the depravity of the stomach, and in this state of things, substances of the most pernicious character may be habitually thrown into the gastric cavity, and either rapidly or slowly destroy the constitutional powers of the system, and work out disease and death (448). And

because the stomach has no longer any power to detect and appreciate the true character of those substances, and therefore has neither the disposition nor the power to give any alarm of danger to the organic domain, but remains quiet and even satisfied with their presence, while they are perpetrating their deeds of death, we, as animals and as intellectual and moral beings, remain wholly unconscious of this state of things, and earnestly contend for the safety of our habits and conditions, on the ground that our stomachs are satisfied with them, and therefore our experience proves them to be good. Moreover, in this general condition of the system, the stomach not only loses the power to discriminate between good and evil, and to give the proper alarm when the vital interests are in jeopardy, but it also, to a very great extent, loses the power of manifesting true and proper symptoms when it is itself actually diseased. And it is a most fearful fact as we have seen (510), that extensive disease may exist in the alimentary canal, and gradually increase for a long time, and even terminate in death, without being manifested by any of those symptoms which lead either the subject or the physician to suspect it. I have found in *post mortem* examinations, astonishingly extensive disease pervading the whole stomach and intestines, of a character which indicated a progress of many years, and yet the subject was not during life the least sensible of its existence.

730. This deeply interesting fact has been considered as wholly inexplicable upon any known physiological or pathological principles; and it is very certain that those principles which I have just stated are the only ones which can afford a satisfactory and correct explanation of the phenomena in the case. While the system is in a pure state, and the organs are undepraved, the alimentary canal will always promptly detect the presence of any morbific or disturbing cause, and with perfect integrity exhibit the most distinct and unequivocal symptoms of morbid conditions and affections, or functional derangements. But when the natural sensibilities and sympathies of the system have been depraved and crippled by habitual violations of the laws of constitution and relation, the alimentary canal is robbed of its power to appreciate discriminately the character of such causes, and to awaken such sympathetic manifestations as distinctly indicate its disturbances and its diseases; and therefore, like an individual who has been deprived of his eyes and tongue, it necessarily submits to the gradual and continual encroachments of depraving and diseasing causes, without the power to perceive or to tell what harms it, till the accumulation of wrongs becomes too great for vital endurance, and the general indignation of the system is roused into an acute disease, which either throws off the oppression, or the vital powers sink under the conflict, and death ensues; or else the alimentary canal, or some other part more debilitated or morbidly predisposed, becomes the seat of slowly progressing local disease. When the lungs, liver, or any other organ whose natural sensibilities are less depraved than those of the alimentary canal, becomes the seat of local chronic disease, the symptoms of such disease are always less obscure and equivocal; but when the stomach and intestinal canal become the seat of chronic disease, not induced by any one violent cause, but by the constant and long-continued irritations almost universal in civic life, and indeed

throughout the human world, the depraved and crippled organ has no power to announce its difficulties in distinct and unequivocal symptoms.

731. It is true that symptoms of disease somewhere within the vital domain might be detected by an accurate observer; but these are often so purely sympathetic, and so remote from the real seat of the disease, and so ambiguous in their character, that it is impossible to derive any correct and definite information from them. It is true also, that when long-continued abuses accumulate oppression upon the system, till the diseased organ can no longer bear it quietly, morbid sympathies are aroused, and all the instinctive energies of organic life are sometimes thrown into a blind and terrible agony to remove the oppression; and in some cases, the powers of animal life are to a considerable extent, or even totally involved; so that spasms, cramps, convulsions, delirium, and even an entire suspension of animal life, result. But these symptoms, though dreadfully violent, do not by any means distinctly indicate local disease, and still less do they point out the seat of such disease. Thus, by violating the constitutional laws of relation in regard to the alimentary canal, we not only destroy its integrity in health, but also take away its power to make known its morbid conditions, and thereby the vital interests of our bodies are doubly endangered.

732. It is exceedingly unfortunate for mankind, that very few are capable of discriminating between the natural and healthy sensibilities of an undepraved stomach, and the morbid irritability of a depraved stomach; although the distinction, to a properly enlightened mind, is very broad and manifest. The morbid irritability of a depraved stomach renders it exceedingly capricious and peevish, and causes it to reject or receive things without any regard to the true interests of the vital economy; the natural and healthy sensibilities of an undepraved stomach, on the other hand, cause it always, at proper times, to receive in proper quantities and conditions, with great satisfaction, those substances which are adapted to the real and true wants of the vital economy, and promptly to reject, or strongly to complain of, those substances which are unfriendly to the vital interests. Yet most men exceedingly deprecate the integrity of a healthy and undepraved stomach, because it faithfully tells them when they violate its constitutional laws of relation, and causes them that distress as a penalty of their transgression, which God in benevolence designed to restrain them from those trespasses which are destructive to health and life. They call such a stomach weak and out of order, and greatly prefer one that will receive all manner of unclean things without any resistance or complaint; and consequently they condemn as exceedingly pernicious those habits of life which restore the depraved stomach to its natural and healthy sensibilities. They are given up to strong delusion, that they may believe a lie, and that they may perish, because they receive not the love of the truth, but prefer the pleasure of unrighteously gratifying their sensual appetites.

733. In relation to the digestive organs of the human body, every foreign substance designed for human aliment, or from which the body can derive nourishment, possesses, in its constitutional nature, a stimulating quality specifically proportionate in power to its quantity of nourishment. Some substances are much more nourishing and less stimulating than others; some are much more stimulating and less

nourishing; and there are also some substances in nature which are purely stimulating, without affording any nourishment. These last, of course, are never to be used as articles of food, but used only, if at all, as remedial agents, in particular conditions of the system.

734. By the stimulating properties of those substances which are designed for our daily food, our digestive organs, in a healthy and undepraved state, are excited to the performance of their functions; and in being thus excited, they always necessarily suffer an exhaustion of vital power and waste of substance (376) commensurate with the degree and duration of the excitement. But the replenishing and nourishing economy of the system is continually carried on, to counteract these effects, and sustain the organs in the regular performance of their functions (393). Yet if the excitement is very intense, the exhaustion is too rapid for the replenishing economy, and the organ is proportionably debilitated and prostrated, and a deeper and more painful sense of exhaustion is felt (508).

735. Now then, it is very certain and very obvious that those proper alimentary substances whose stimulating power is barely sufficient to excite a full and healthy performance of the functions of the digestive organs, in the appropriation of their nourishment to the system, are most conductive to the vital welfare of the body in all respects, causing all the vital processes of assimilation and organization to be most perfectly performed, without any unnecessary expenditure of vital power, and thus contributing in the highest degree to the most permanent and uniform health and the greatest longevity; for every degree of stimulating power beyond this necessarily increases the vital exhaustion, without contributing in any measure to the welfare of the body. For illustration, suppose we have one article of food which contains fifty per cent. of perfectly healthy nourishment with fifty per cent. of stimulating power, and another article of food containing thirty-seven and a half per cent. of perfectly healthy nourishment, with sixty-two and a half per cent. of stimulating power; and suppose that the first article contains stimulating power sufficient to excite the digestive organs to a full and healthy performance of their functions in appropriating its nourishment to the wants of the system: then, by taking the second article, we should receive in proportion to the quantity of nourishment, twenty-five per cent. more of stimulating power; and the results would be these. The organs would be proportionably more exhausted, the vital processes of assimilation and organization would be more rapidly and less perfectly performed (634), health would be less uniform and secure, and life would be shortened. And all these effects are produced to a yet more injurious extent by the habitual use of the pure stimulants with the nutritious articles of food because in a healthy state of the organs they are entirely unnecessary, and only serve to increase the exhaustion of the organs and to deteriorate the functional results; and if by any means the organs have been reduced to a state in which they seem to require something more than the natural stimulus of the food, to excite them to the performance of their functions, then are they really so much the less able to bear the action of the pure stimulants, and so much the less qualified to perform their functions with integrity; and the consequence is not only exhaustion, but irritation and debility, and the development of disease (508).

736. It is, therefore, one of the most important laws of the vital economy, that that aliment which is most perfectly assimilated and incorporated by the vital functions, with the least expence of vital power, is best adapted to the wants of the system, and most conductive to health and long life (634), and to the highest and best condition of human nature in all respects.

737. Like the atmospheric air (721), all those substances in nature designed for human aliment, are composed of certain proportions of nutritious and innutritious matter; and the alimentary canal, like the lungs (722), is constituted with determinate relations to the constitutional nature of alimentary substances in this respect. I do not say that the stomach, like the lungs, is constituted to receive natural substances containing precisely one volume of nutritious, with four volumes of innutritious matter, but that the stomach and intestines are, like the lungs, really and truly constituted to receive substances composed of both nutritious and innutritious matter (428); and that there is somewhere a point of truth in the proportions best adapted to the constitution and functional powers of the alimentary canal, and the vital welfare of the whole system; and that so far as we vary from this point of truth, by increasing or diminishing the proportion of the nutritious to the innutritious matter of our food, we do, as a general fact, injure the alimentary canal, and through it the whole body. And it is very certain that too great a proportion of nutritious matter in our food is little less dangerous to our digestive organs, and to the vital interests generally, than too small a proportion. If the human stomach had been designed to receive only nutritious matter, the intestinal tube would be an unnecessary appendage to it. But every thing in the anatomical structure and physiological powers of the alimentary canal clearly and fully demonstrates that it is constituted with wise and determinate relations to natural alimentary substances composed of nutritious and innutritious matter, and all experience corroborates this demonstration. It is the duty of the alimentary canal to receive these substances, at proper times and in proper quantities, after they have been thoroughly masticated and insalivated in the mouth, and completely to dissolve them or separate their nutritious from their innutritious matter, and convert the nutritious matter into chyme (428), and present this to the absorbing mouths of the lacteals, and then to remove the fecal or innutritious residuum from the organic domain (446).

738. If, therefore, instead of supplying the alimentary organs with food composed of due proportions of nutritious and innutrious matter, we artificially separate the nutritious from the innutritious (723), and supply the alimentary organs only with the concentrated nutritious matter, we shall soon destroy the functional powers of the organ, break down the general function of nutrition, and cause atrophy and death. Many experiments have been made by Magendie and other distinguished physiologists to demonstrate the truth of this doctrine; and notwithstanding there has been abundance of inaccuracy, both in the mode of the experiments and in the reasonings founded on them, yet the general results fully corroborate the *a priori* physical reasonings which I have just presented. Magendie found that dogs fed on sugar and distilled water began to droop in a few days, and gradually to

become more and more emaciated and weak, and finally became diseased with ulcers, and died in about a month. Similar experiments were made with olive oil, gum Arabic, butter, superfine flour bread, and some other articles, each given separately and exclusively, with water, to different dogs; and the results were nearly identical in all the cases; the dogs soon began to droop, their appetites became impaired, and they became extremely emaciated, and died in little more than a month. Led away by the ruling propensity, so common among the modern physiologists, to account for all the phenomena of the vital domain upon chemical principles (151), Magendie conjectured that these effects were caused by the want of azote in the substances on which the dogs were fed; but we have seen (455) that such conjectures are not sustained by any correct principles in physiological science. It is not in the power of chemistry in the least possible degree to ascertain what substances the alimentary organs of the living animal body require for the nourishment of the body, nor from what chemical elements the organic elements are formed, nor with what laws of arrangement they are constituted (122). Other physiologists, by similar experiments and results, have been led to the conclusion, that VARIETY *of aliment* is essential to animal existence and health. This, however, though it may be true of some particular animals, cannot be asserted as a general law.

739. But it is a general law, established in the constitutional nature of things, and extending at least to all the vertebrated animals, that alimentary substances composed of both nutritious and innutritious matter are necessary to sustain the functional powers of the alimentary organs, and therefore essential to animal life and health. Some species of animals require a greater proportion of innutritious matter in their food than others, but all require some. This great physiological law solves all the phenomena of Magendie's experiments, without the help of chemical science, and all correct experiments of the kind fully confirm its truth. Thus, if dogs be fed on sugar and water, they will die, in the manner I have stated; but if a considerable proportion of saw-dust be mixed with the sugar, they will not die, but they will thrive and do well, although they are naturally carnivorous animals. If dogs be fed on superfine wheat-flour bread and water, they will die in about seven weeks; but if they be fed on bread made of the whole natural substance of the wheat, or on unbolted wheat-meal bread and water, they will live and do well. An ass fed on rice will die in about fifteen days, but if a large quantity of cut straw be mixed with the rice, he will thrive on it. Horses fed exclusively on meal or grain will die in a short time; but mix their meal or grain with a suitable proportion of cut straw or wood shavings, and they will thrive and become fat. And it is an interesting fact that if horses be fed on grain alone, with water, for a number of days, they will instinctively gnaw the boards, or whatever woody substance is within their reach.

The following interesting statements are of the most unquestionable authority, and may be relied on with the utmost confidence.

740. About forty years since, Captain Josiah Hussey sailed from Boston with a deck load of horses, for the West Indies. They had been out but a few days, when a severe gale came on, and carried away all their hay, and drove them a considerable distance out of their

course. There was plenty of grain below the hatches, and Captain Hussey was obliged to feed his horses entirely on grain. For a few days the horses seemed to do tolerably well, and then they began to droop, and lose their appetite, and languish, and finally they began to die one after another, rapidly; and Captain Hussey was apprehensive that he should lose all he had on board before he got into port. In this emergency, seeing the horses eagerly gnawing the scantling and spars within their reach, he ordered his hands to take a drawing knife and shave up a quantity of stave timber which he had on board, and give the shavings to the horses with their grain. The horses devoured these shavings with greediness, and soon began to recover their health and spirits, and no more of them died, but they all continued to improve till they got into port.

741. 'About thirty years ago,' says Governor William King, of Maine, 'I went to the West Indies, and during my voyage became acquainted with the following fact, which may be relied on as strictly true. A vessel from New England, with a deck load of horses, bound to the West Indies, was overtaken by a violent gale, which swept away all the hay on board, and carried away the masts. The captain was obliged to feed his horses on corn. After a while they began to droop and to lose their appetite, and at length wholly refused to eat their grain, and began to gnaw the scantlings and spars within their reach, and to bite at the men, and everything else that came in their way. The captain threw pieces of wood before them, which they immediately began to eat. After this, he regularly supplied them with a quantity of cedar shingles, which they eagerly ate as they would hay, and soon recovered their appetite for their grain, and improved in health and sprightliness, and continued to do well on their food of corn and cedar shingles, till they got into port.'

742. 'About the first of December, 1800,' says Capt. John Mathews, of Maine, 'I left Bath, in the schooner Betsey, with a deck load of cows, oxen, horses, and one mule. Expecting to have a short passage, I took but little hay; when we had been out several days, a gale came on which swept away most of our hay, and drove us far out of our course, that we were fourteen days without hay before we made the island of Bermuda. We had plenty of corn and potatoes on board, with which we fed our stock. After three or four days, the stock all began to be indisposed, and to droop and to be unwilling to eat the food we gave them; and they seemed to be very uneasy, and to crave something which they had not; and the mule began to gnaw a spruce spar which lay before him. This suggested to me the thought that my stock all required more woody matter with their food, and I immediately caused some spruce and oak spars to be shaved up with a drawing knife, and gave the shavings to the stock. All the young cattle and horses and the mule ate these shavings greedily, and were very soon improved in their health, and continued to do well the remaining part of the voyage. The mule ate them more freely than any other animal on board, and he improved most. Indeed he was quite plump and sleek when we arrived in port. Some of the older cattle and horses would not eat the shavings, and every one of these died before we got in. About the year 1830,' continues Capt. Mathews, 'returning from Bonavista, one of the Cape de Verd Islands, I brought

several goats with me. Having no hay on board, I fed them with grain and shavings. They came every day as regularly for their shavings as they did for their grain, and ate them as greedily.'

743. 'Some years since,' says William Richardson, Esq., of Bath, Maine, 'I spent a number of weeks on the island of Bermuda, in the West Indies. The family with which I boarded had a cow, which they kept almost entirely on grain. I used to go nearly every day regularly into a ship-yard that was near the house, and sit there by the hour; and I invariably observed that the cow would come every day, and eat freely and even greedily of the shavings in the yard. At the time I could not well account for this, but supposed she ate them to satisfy hunger, but I am now convinced that she instinctively took this method of supplying herself with a due proportion of innutritious substance, the grain on which she was fed being a too concentrated form of food for her organs.' Innumerable facts of this kind might be collected, both in regard to herbivorous and carnivorous animals: and the whole history of the human species, in civilized life at least, is replete with demonstrations of the same great physiological principle.

744. Children whose food for a considerable time consists of superfine flour bread and other concentrated substances, such as sugar, butter, etc., generally become weak and sickly, and are often covered with sores, and perhaps become afflicted with scrofulous diseases; and hence some physicians who have written on the diet of children, have spoken in severe terms against confining children to an exclusively vegetable diet; but if a child be put upon a diet of good bread made of unbolted wheat meal, with milk and water or pure soft water for drink, and be allowed to indulge pretty freely in the use of good fruits in their season, none of the evils which result from concentrated forms of aliment, or which are attributed to vegetable diet, will be experienced, but the child, if in other respects properly treated (1255), will be healthy and robust and sprightly.

745. I have been informed by old whalemen, that they had long observed, and that it is a common remark among them, that during their long voyages, the coarser their bread the better their health. 'I have followed the seas for thirty-five years,' said a very intelligent sea-captain to me a few years since, 'and have been in almost every part of the globe, and I have always found that the coarsest pilot bread, which contained a considerable proportion of bran, is decidedly the healthiest for my men.' 'I am convinced from my own experience,' says another gentleman of the same calling, 'that bread made of the unbolted wheat-meal, is far more wholesome than that made of the best superfine flour, the latter always tending to produce costiveness.' Captain Benjamin Dexter, in the ship Isis, belonging to Providence, R. I., arrived from China in Dec. 1804. He had been about one hundred and ninety days on the passage. The sea-bread which constituted the principal article of food for his hands, was made of the best superfine flour. He had not been long at sea before his hands began to complain of langor, loss of appetite, and debility; these difficulties continued to increase during the whole voyage, and several of the hands died on the passage of debility and inanition. The ship was obliged to come to anchor about thirty miles below Providence, and such was the debility of the hands on board, that they were not able to get the

ship under way again; and the owners were under the necessity of sending men down from Providence to work her up. When she arrived, the owners asked Captain Dexter what was the cause of the sickness of his hands. He replied, 'the bread was too good.'

746. The eccentric Dr. Stark, of England, is said to have destroyed his life by dietetic experiments on himself, and his case is commonly but very erroneously adduced to prove that too great a simplicity in diet is not conducive to the health of the body, but that in man a mixture and variety of food are not only consistent with health and vigor, but indispensably necessary to both. Never was anything more whimsical and capricious, however, than the experiments of Dr. Stark. It is said that they were undertaken at the suggestion of Sir John Pringle and Dr. Franklin. The proposed object of the experiments was to prove that a *pleasant* and *varied* diet is equally conducive to health, with a more strict and simple one; yet most of the dishes which he ate during the experiments were neither natural, pleasant, nor simple, but exceedingly disagreeable compounds of concentrated substances. He began with fine flour bread and water; from which he proceeded to bread, water, and sugar; then to bread, water, and oil of olives; then to bread, water, and milk; afterwards he tried bread and water, with roasted goose; then bread and water, with boiled beef; then stewed lean of beef, with gravy; then oil of suet, and water; then flour, oil of suet, water, and salt; then flour, water, and salt; then bread and fat of bacon ham; then infusion of tea with sugar; then bread or flour with honey, and an infusion of rosemary. A number of other dishes equally disagreeable with these, and some of them even more so, were successively tried. These experiments were commenced in July, 1769, and prosecuted with great zeal. He began them in good health and vigor, his body weighing a hundred and seventy-one pounds. His health soon began to decline, and although it varied, it was seldom if ever good afterwards. In a very short time from the commencement, the weight of his body was reduced to a hundred and sixty-four pounds eight ounces, and though some kinds of his food increased it, by much the greater part of what he used had a contrary effect; and he continued, on the whole, to decrease, till the day of his death, which took place after the suffering of much uneasiness, Feb. 23d, 1770, having spent nine months in the experiments. 'His friend and biographer, Dr Smyth, who was intimately acquainted with his character and disposition, thinks that other causes, particularly chagrin and disappointment, had no small share in hastening his death. He was born in Manchester, England, July 1740, and died Feb., 1770, aged twenty-nine years and seven months.'

747. Here, then, is a course of experiments, undertaken for the avowed purpose of proving that a *pleasant* and *varied* diet is equally conducive to health with a more strict and simple one; and the individual, in the violation of all correct physiological principles, changes often from one improper kind of food to another, and in the course of nine months, runs through a very great variety of dishes, nearly every one of which is a compound of concentrated substances, and finally dies of disappointment and chagrin and broken down digestive powers; and yet this notable case is quoted almost universally by physiologists and writers on diet, and everybody else that ever

heard of it, to prove directly the contrary of what it was designed to prove, and of what in reality it does prove. Had Dr. Stark flourished, and enjoyed good health, and lived to old age, on his varied diet of compound concentrated substances, then his case might with some plausibility have been adduced to show that man requires a varied diet, and that compound dishes of concentrated substances are favorable to human health and longevity; but as the case is, it only goes to prove that concentrated alimentary substances, however varied, are destructive to health and life, and it might with much propriety be urged against too great a variety of food, and in favor of simplicity. Surely then, this is one of the last cases that enlightened physiologists should cite to prove that a plain, simple, and natural diet is not best for man; and men of scientific pretensions should be slow to advance such opinions, when the world is full of demonstrations to the contrary. I have known many individuals subsist for years on coarse, unbolted wheat-meal bread and water alone, and not only improve in health, but become remarkably vigorous and robust. And I am bold to affirm that no human being ever injured his health nor shortened his life by a plain and simple diet, the kind and condition of which were adapted to the physiological laws of his alimentary organs.

748. Debility, sluggishness, constipation, obstructions, and morbid irritability of the alimentary canal, have been among the principal roots of both chronic and acute disease in civic life in all parts of the world, and in all periods of time; and concentrated forms of food, compound preparations, irritating stimuli, and excess in quantity, have been among the principal causes of these difficulties.

749. The healthfulness and integrity of the digestive function of the stomach, we have seen (444), depend principally on three things: 1st, healthy and vigorous nervous power; 2d, healthy secretion; and 3d, healthy and vigorous muscular action. The absence of either of these will prevent digestion. If the nervous power is impaired, the gastric secretion is deteriorated, and the muscular contractility is diminished, and the function of the organ languishes; and if the muscular contractility is impaired, the nervous power is diminished, and the function languishes; and if either the nervous or the muscular tissue is destroyed, the function of the organ is entirely abolished. The destruction of the muscular tissue of the human stomach as effectually destroys digestion as the destruction of the nervous tissue (437). So mutually and directly are the tissues of an organ dependent on each other, and the functional power and integrity of the organ on the health of all its tissues. And we have seen (348), that certain kinds and conditions of food, if long used, will almost wholly obliterate the muscular coat of the stomach, and other kinds and conditions will largely increase the development of that coat.

750. The healthy excitement of the vital properties of the nervous and muscular tissues of the alimentary canal, requires the presence of ingested food which in its nature and condition is adapted to the anatomical structure and physiological powers of the stomach and intestinal tube; and, therefore, if the nutritious principles of those natural substances intended for our food be separated out by artificial means, and used in their concentrated forms, the laws of relation in regard to the

teeth, gums, organ of taste, salivary glands, stomach, and intestines, will be violated in such a manner as to disorder the functions of these organs (706) ; and if persevered in, will, by slow degrees, impair their functional powers, and finally disease and destroy the organs themselves. The teeth will become diseased and painful, and will decay (509) ; the gums will become soft and relaxed and tender and perhaps ulcerous. The salivary glands will become unhealthy, and the saliva will be greatly deteriorated in quality ; the nervous and muscular powers of the stomach and intestines will be much impaired ; the processes of assimilation and nutrition will be less and less perfectly performed ; emaciation, general debility, and disease will ensue ; and suffering and premature death will be the final result.

751. The innutritious properties combined with the nutritious principles in those natural substances designed by our Creator for our food are, therefore, indispensably necessary, in order to excite and keep up the healthy action of those powers of the organs which were established with direct and fixed relation to such properties in our aliment, and which are so associated with other important powers of the organs and of the system, that on the healthy condition and action of the one depend the healthy condition and action of the other. So that the general health and vigor of the organ and integrity of its function depend upon the healthy and vigorous condition and action of each and all its powers ; and, consequently, though the innutritious substances themselves afford no nourishment to the system, yet they keep up that general health and energy and activity of the organs necessary for the healthy digestion, assimilation, and organization of the nutritious properties, and therefore without them, or some good substitute for them, the energy and activity of the organs will inevitably become impaired, and their functions will soon become disordered, and the organs diseased and destroyed.

752. It is contended by some, that as the ultimate elements of all substances from which the human body can derive nourishment are nearly the same, and as the chyle formed from each and all of the different substances is so nearly identical in character that scarcely any appreciable difference can be detected by the most careful analysis, it certainly can be of little importance what substances we use for food, so that they contain sufficient nutrient matter to answer the demands of the vital economy. But this reasoning, though it may seem plausible to some, is wholly fallacious and absurd. It loses sight entirely of the grand and essential distinction between the processes of organic vital function, and those of inorganic chemistry, and assumes that the laws which govern the vital processes are the same as those which govern the processes of inorganic chemistry. It is true that the ultimate elements of all vegetable and animal substances are nearly the same, and it is also true that the ultimate elements of both vegetable and animal substances are the same as the ultimate elements of all inorganic substances. But can any inorganic compound of oxygen, hydrogen, carbon, and azote, be made to answer as a substitute for animal or vegetable food? Certainly not! And the reason is evidently not because any particular chemical character or property is wanting in such a compound, but because such a compound has not the constitutional nature which adapts it to the constitutional nature and func-

tional powers of the living animal organs. Yet if chemistry, from her own exclusive knowledge, derived from the analysis of organic and inorganic substances, were to order the diet of man, she would be quite as likely to give us a variety of mineral substances for our daily bread, as she would to give us vegetable and animal substances (455). For it is impossible for chemistry to tell, from *a priori* reasoning, why a piece of quartz or feldspar will not digest as well in the human stomach, and afford the body as much nourishment, as a piece of flesh or bread of the same weight. But after the chemist has learned from physiology what substances will, and what will not, nourish the human body, he may then, by resolving the bodies containing nourishment into their *organic elements* (122, 123), be able to distinguish between those bodies which contain nourishment and those which do not, and in what proportions the nutrient principles exist in particular bodies; and, in this limited sphere, chemistry is certainly useful to physiology. But the moment the chemist goes beyond the organic elements, and pushes his analysis to the ultimate chemical elements, or more properly speaking, to the experimental elements of inorganic chemistry, he leaves physiology behind, and is no longer serviceable to that science.

753. Physiological fact has taught us that vegetable and animal substances nourish the human body, and by analyzing these substances to their organic elements, we learn that farina, gluten, mucilage, sugar, and oil, of vegetable origin; and fibrin, albumen, jelly, oil, and osmazome, of animal origin, are those organic elements which nourish the human body, when submitted in proper form and condition to the vital operations of our alimentary organs. Now then, so far as chemistry can aid us in ascertaining the proportions of these organic elements in different vegetables and animals, she is useful to the science of physiology; but when she goes farther, and resolves these organic elements to the experimental elements of inorganic chemistry, she renders no service whatever to physiological science. For instance, it is useful to the physiologist to know what proportion of sugar may be procured from a particular kind of food; but it is of no sort of service to the science of physiology for him to know that sugar can be chemically resolved to carbon, oxygen, and hydrogen. For it is not possible for him to take carbon, oxygen, and hydrogen, in the same proportions, and form sugar for human nourishment; nor is it possible for him to form any other substance from these elements which will answer as a substitute for sugar, or in any degree nourish the human body. Nor can this chemical analysis give him the best information concerning the mode in which the vital processes convert the sugar to chyle and blood, nor tell him whether sugar alone will or will not permanently nourish and sustain the human body. Physiological experiment will tell him that it will not (738); but chemistry cannot tell him why. Let chemistry, if she can, add any quantity of pure azote to the sugar, and she will find that man can live no longer on it than he could without the azote.

754. A single pound of good wheat contains about ten ounces of farina, six drachms of gluten, and two drachms of sugar; and a robust laboring man may be healthfully sustained on one pound of good wheat per day, with pure water, for any length of time he chooses,

without the least physiological inconvenience: but let him attempt to live on ten ounces of pure farina, six drachms of gluten, and two drachms of sugar per day, with pure water, either taken separately or mixed together, and he will soon find his appetite and strength and spirits failing, and his flesh forsaking him; and death will terminate his experiment in less than a year. Can Chemistry tell us why this is so? Indeed she cannot! But Physiology tells us with promptitude and accuracy that wheat, in its whole substance, is constitutionally adapted to the anatomical structure and physiological powers of the alimentary organs of man, but that farina and gluten and sugar, in their concentrated forms, are not; and, therefore, that the wheat, while it affords healthful nourishment to the body, also sustains the organs in digesting and appropriating that nourishment, but that the farina, gluten, and sugar, though purely nutrient principles, break down the alimentary organs, destroy their functional powers, and cause the whole system to perish.

755. It is therefore nothing more than grave trifling to tell us, that as the ultimate elements of all organic bodies are nearly the same, one substance is as good as another for human food; and the other position (752) is of the same character. It is true, that while the alimentary organs of the human body are in perfect health and functional integrity and vigor, the chyle is very nearly the same in its physical and chemical properties, whatever may be the kind of food from which it is elaborated (455). But there are two things in this matter, of no small importance, which are not true. In the first place, it is not true that the *vital* properties of the chyle are the same, whatever may be the kind of food, nor any thing near the same (456). In the second place, it is not true that the health and the functional integrity and vigor of the alimentary organs can be equally well sustained and preserved by all kinds and conditions of food (684); and therefore it is not true, as a permanent fact, that the chyle is nearly the same, even in its physical and chemical character, in the same animal, whatever may be the kind of food from which it is formed.

756. In spite of all cavilling and sophistry, therefore, correct physiological science is fully established in the position that there are the most fixed and precise constitutional laws of relation between the alimentary organs and all the particular substances of the human body, and those foreign or external substances which the Creator designed for human food; so that it is perfectly certain that there are particular kinds, qualities, and conditions of food which are best adapted to sustain the highest and best condition of human nature.

CONSTITUTIONAL RELATIONS OF THE SPECIAL SENSES OF HUNGER AND THIRST.

757. The special sense of hunger (589), like that of taste and that of smell, is founded on the alimentary wants of the organic domain (597, 598), and determinately established on the constitutional laws of relation between the vital organism and economy, and the quantity and quality of aliment required, and the times of alimentation. The grand function of nutrition, appertaining to the organic domain (220), requiring the constant supply of foreign alimentary substances to the alimentary cavity, and this supply requiring the exercise of the vo-

luntary powers (283) appertaining to animal life (228), it is necessary that the centre of animal perception (280) should have cognizance of the alimentary wants of the organic economy. Accordingly, when the system is in a perfectly normal, healthy, and undepraved state, the stomach, which is the primary organ of external relation in regard to food (688), is by the vital economy of the organic domain, with utmost integrity, brought into a special and peculiar physiological condition, which is perceived by the animal centre, and thus becomes the *special sense of hunger* to the animal. This special sense, in a perfectly normal, healthy, and undepraved state of the system, always, with the utmost instinctive accuracy, informs us *when* the vital economy requires a fresh supply of alimentary substances; and it determinately asks for such food as is best for the system; but it has in itself no power to discern what *is best:* for *this*, it depends entirely on those other special senses which I have described (691, 697, 698), and on the mental powers. It only, and with unerring accuracy, tells us when the vital economy requires that the stomach should be supplied with a fresh portion of such food as is best for the system. But in a depraved state of the stomach (728), the integrity of this special sense is wholly destroyed, and the feeling which we call hunger is no certain evidence that the vital economy really requires that a fresh supply of food should be furnished to the stomach. It is a morbid craving of the stomach for stimulation (697), which returns at stated periods or irregularly, and with more or less capriciousness and despotism, according to the habits of the individual, and the condition of the stomach and nervous system. This kind of hunger recurs without any regard to the alimentary wants of the organic domain, and therefore is as likely to be felt when no food is really required by the vital economy, as when it is actually needed; and its imperiousness and vehemence are in no measure regulated by the urgency of the real wants of the system, but wholly by the intensity of the morbid demand of the stomach for stimulation; and, therefore, the supply of nourishing food to such a stomach will not satisfy its cravings, unless the food contains the customary kind and quantity of stimulus. The hunger of a depraved stomach, then, is in no respect a true indication of the real wants of the system, and consequently it is of the utmost importance that the integrity of the special sense of hunger should be preserved. The same principles and reasoning are also strictly applicable to the special sense of thirst. But I shall have occasion to speak more particularly of hunger and thirst in a subsequent lecture.

LECTURE XIII.

The simpler, plainer, and more truly natural the food of man, the better it is adapted to all his physiological and psychological interests—Original dietetic habits of man—Original adaptation of man to the state and circumstances in which he was placed—The great physiological laws the same in man and lower animals—Instinct as determinate in man as in the lower animals; as much a constitutional law of action—The importance of the human hand as an instrument of voluntary power—Man exalted by his intellectual and moral powers—Man has no power to abolish the laws of nature even in himself, but must obey them or suffer—The truly natural state of man—Man's physiological and psychological interests cannot be separated in the present state of being—The natural food of man—Uncertainty of testimony in regard to facts—The present condition of the human family a fair specimen of what it has been for several thousand years—Universal use of intoxicating substances—Tobacco, alcohol, opium, tea, coffee, etc., extensively used—The facts of human history, mixed results and easily misapprehended and misapplied—Testimony of ancient writers concerning the dietetic habits of the primitive generations of the human species—Dietetic habits of the American Indians—Primitive preparations of food—Present capabilites of the human constitution—Modern testimony—Captain Cook—Mr. Bryant—Pampa Indians of South America—Arabs of the desert—Natives of different islands—Russians—Different religious sects and schools of philosophy—Bramins of India—Pythagoreans—Essenes of the Jews—Friends or Quakers—Whites and blacks of Massachussetts and North Carolina.

758. From the laws of constitution and relation which have been explained in the preceding lecture, we perceive that, as a general statement, the simpler, plainer, and more natural the food of man is, the more perfectly those laws are fulfilled, and the more healthy, vigorous, and long-lived will be the body, the more perfect will be all the senses, and the more active and powerful may the intellectual and moral faculties be rendered by suitable cultivation (725, 765).

759. It is unquestionably true that for a considerable time, probably centuries after man was created, he received his food from the bosom of nature with very little or no artificial preparation. Flouring mills and bolting-cloths, and the innumerable culinary and other utensils since employed in preparing aliment for the human mouth and stomach, were then wholly unknown.

760. Now, then, one of two things is entirely certain—either God created man with a perfect constitutional adaptation to the state in which he first placed him, and with a constitutional capability of adapting himself, to a certain extent, to that artificial state in which man has since placed himself; or else God created man with a perfect constitutional adaptation to the state and circumstances of civic life, and placed him at first in a state to which he had a constitutional capability of being adapted, but which was not best adapted to his constitution. No enlightened and honest mind, I suppose, can hesitate a moment to decide that the first of these positions is the true one; that God created man upright, but capable of seeking out many inventions; that He placed him at first in a state for which he had the most perfect constitutional adaptation, and which was most perfectly adapted to his constitution; and hence, it should ever be remembered that man was constituted for the natural state (25, Note), and not for the artificial state, of civic life; and all that can be truly affirmed more than this, is, that man possesses a constitutional capability of educating and habituating himself to artificial modes of life; but in so doing he

necessarily impairs the physiological powers of his constitution, and, as a general fact, abridges the period of his existence (725). I wish, however, to be perfectly understood, when speaking of the natural and of the artificial state of man. By the *natural state* of man, I do not by any means intend the savage state, for I do not believe that the savage state is natural to man (764).

761. As an animal, man is constituted with the same physiological powers, and upon the same great physiological principles, as those which pertain to the constitutional nature of the horse, the ox, and other animals; and it is well known that these animals cannot be greatly diverted from their natural laws of constitution and relation without a deterioration of their natures; and this is equally true of the animal nature of man. We have seen (684, *et seq.*) that God has constituted the organized body of man with fixed and precise relations to those substances which He designed for its nourishment; that He has formed the human body with organic capacities and physiological powers (687) to receive and convert those foreign substances to its own nature; and that, in connexion with these organic capacities and physiological powers, and with fixed and precise relations to the kind, quality, and condition of those foreign substances designed for human aliment, He has established certain special senses (690) as the faculties of instinct, by which the animal, in a natural and undepraved state, with unerring accuracy selects his salutary nourishment, and avoids whatever is pernicious.

762. These faculties of instinct, then, are as determinate in their functional characters and in their *final causes*, in man as they are in the lower animals (697); and God no more designed that man should find enjoyment in the exercises of these instinctive faculties, beyond the legitimate fulfilment of their *final causes*, than He did that the horse and ox and other animals should. And I affirm this on the authority of the incontrovertible fact, that man is constituted with no more capability to do it without injury to himself, than the lower animals are (725). In all that concerns the interests of organic life and mere animal existence, therefore, man is subject to the same general laws as those which govern the lower animals; and in one respect only has God made man, as an animal, superior by his organization to other animals, and *that* involves no physiological law, and constitutes no physiological distinction between man and other animals. Nor indeed does it elevate man above other animals, except in its adaptation to his higher faculties as a voluntary power, as an organic instrument by which man is enabled to execute the designs of his mind. The monkey has a hand and arm like man; but without the reason of man, his hand serves in no degree to elevate him above any other animals. But the human hand, as the instrument of human reason, has elevated man to the heavens, and plunged him into the deepest hell. It is indeed, to him, more than the fabled wand of the magician, and is only second to the omnific power of God.

763. In the possession of his immeasurably superior intellectual and his peculiar moral powers, then (602), is man exalted far above all other terrestrial beings, and made the natural lord of the earth and sea, and holds a natural dominion over all the animal as well as vegetable and mineral kingdoms. Still man, in common with all created

things, is a subject of the great natural kingdom of God, which of necessity is governed by the supreme constitutional laws that God, in infinite wisdom and benevolence, has established in the nature of things (603); and therefore man has no *natural dominion* over the things of this world, nor is it possible for him to acquire a dominion which will enable him to abolish the constitutional laws of things under his dominion, nor the constitutional laws of his own nature, nor with impunity to violate any of the constitutional laws of God's great natural kingdom, whether established in his own nature, or the nature of any other created thing (144). *Man's superiority, therefore, consisteth not in his own absolute and arbitrary power, but in the superior constitutional nature and intrinsic capabilities which God has given him.* By a conformity to the laws of that constitutional nature, he rises in the development of his capabilities to an affiliation with angels, and to a holy and happy communion with God; but by the transgression of those laws, he inevitably sinks to the perdition of necessary consequences.

764. It is therefore a very obvious and an incontrovertible truth, that *the truly natural state of man*, or that state to which God has adapted the constitutional nature of man, is that in which his organic and animal powers, and all that primarily appertains to his organic and animal nature, are kept in strict conformity to the physiological laws of that nature, and in which his intellectual and moral powers are cultivated to God-like wisdom and virtue. For the constitutional laws of man's intellectual and moral nature, which are established with fixed and precise relations to his animal and organic nature on the one hand, and to the moral character of God and the moral interest and duties of society on the other (603), as much require such a cultivation of his intellectual and moral powers, as the highest welfare of his organic and animal nature requires the strict obedience of its physiological laws. And we have seen (613) that the physiological laws and the moral laws of man's constitutional nature perfectly harmonize, so that the true interests of his intellectual and moral nature cannot be adverse to, nor, in the present state of being, separated from, the true interests of his organic and animal nature. Moreover, it is not only true that the highest degree of intellectual and moral cultivation and refinement are compatible with the simplest and most natural dietetic regiment, but it is incontrovertibly true that such a regimen is most favorable to the highest and holiest development of man's intellectual and moral powers.

765. But when I say (758) that the simpler, plainer, and more natural the food of man is, the more perfectly his laws of constitution and relation are fulfilled, and the more healthy, vigorous, and long-lived will be his body, the more perfect his senses, and the more active and powerful may his intellectual and moral faculties be rendered by suitable cultivation, I do not mean that a man is constituted to eat grass like the horse and ox, nor that he should confine himself to a single article of food during his life. By simple food I mean that which is not compounded and complicated by culinary process; by plain food I mean that which is not dressed with pungent stimulants, seasonings, or condiments; and by natural food I mean that which the Creator has designed for man, and in such conditions as are best adapted to the anatomical structure and physiological powers of the

human system. Among all the vegetable and animal substances in nature, which afford nourishment for living animal bodies, there are some better adapted to the constitutional nature of man than others; and some which, above all others, are adapted to sustain human nature in its highest and best condition. These latter substances, whatever they may be, are the most natural food of man, and the more entirely man subsists on them, the more perfectly he fulfils the laws of his nature, and secures his highest interests.

766. In turning to the general history of the human race for a confirmation of these physiological principles, so many difficulties meet us almost at the first step, that we feel exceedingly perplexed and discouraged; and nothing but the true light of physiological science, and the most cautious and scrutinizing investigation of every thing that comes in our way, can save us from being continually misled by the false way-marks which have, on every hand, been set up by those who have preceded us.

767. The present condition of the human family, taken as a whole, is a tolerably fair specimen of what it has been, on an average, for several thousand years. And if we contemplate the present condition of mankind, over the face of the whole earth, the first view seems to present nothing which goes to confirm the physiological principles that I have advanced. We find some portions of the race in the torrid zone, some in the temperate, and some in the frigid (15). Some we find subsisting wholly on vegetable food, others on a mixture of vegetable and animal, and others entirely on animal, or nearly so; and those tribes and portions of the human family who appear to come nearest to a pure state of nature in the kind and condition of their food, present no advantages over others of more artificial habits of living (647). But if we examine this matter with a more careful and penetrating eye, we shall soon discover that all facts of this kind are completely nullified by circumstances which wholly destroy the integrity of the experiment.

768. It is a melancholy truth, that at least nine hundred and ninety-nine in every thousand members of the human family at present existing on the surface of our globe, in the most savage as well as the most civilized life, daily and constantly disturb the physiological functions and impair the physiological powers of their bodies, by the use of those alcoholic, narcotic, and other substances, which are taken purely for their stimulating effect, and which completely destroy, for any nice physiological purposes, all general facts in relation to the dietetic habits of man. That foul and loathsome weed tobacco, has found its way to every part of every continent and island, and over the whole face of the waters of our globe. It is freely used in all grades of society, from the most elegant and refined portions of civic life to the lowest state of savage existence in Europe, Asia, Africa, and America. Alcohol, in some of the numerous forms of fermented or distilled liquors, is scarcely less universally used; and opium is consumed in nearly an equal quantity. Tea, coffee, and numerous other articles of the same great family of deleterious stimulants, are, over a considerable portion of the globe, nearly as common as the atmospheric air, and are considered almost as necessary to the stomach as air is to the lungs. Besides these evils which abound in savage life, filthiness, licentious-

ness, the uncurbed exercise of all the bad passions, great irregularities, a want of intellectual and moral cultivation, and a thousand other things, militate continually against the physiological welfare of those whose dietetic habits may in many respects be simple and natural, and totally prevent the advantages which would otherwise flow from such a diet. No amount of facts of this kind, therefore, ought ever to be considered as of any real weight against well-ascertained physiological principles; for nothing can be more certain than that every real fact in the experience of the human race, when truly understood, decidedly confirms the truth of physiological science.

769. All the writers of antiquity, of every nation—historians, physicians, philosophers, and poets—assert that the first generations of men who lived nearly a thousand years (631), were perfectly natural and simple in their diet.

a. According to the Mosaic record, God said to the first parents of the human species, 'Behold, I have given you every herb bearing seed which is upon the face of the earth, and every tree in which is the fruit of a tree yielding seed; to you it shall be for food.' And again, after the transgression; God says to Adam, 'Thou shalt eat the herb of the field; in the sweat of thy brow thou shalt eat thy food till thou return unto the ground.'

b. Sanchoniathon, a Phœnician historian, who flourished about four hundred years after Moses, says that 'the first men lived upon the plants shooting out of the ground.'

c. Hesiod, the Greek poet, who is supposed to have flourished two or three hundred years later, speaking of the food of the first of those tribes and nations of which he had a historical and traditionary knowledge, says that 'the uncultivated fields afforded them their fruits, and supplied their bountiful and unenvied repast.'

d. Pythagoras, the philosopher, who flourished above five hundred years before Christ, and who travelled extensively, and made himself acquainted with all the learning of his day, and in all his researches made the history and philosophy of man the principal objects of his inquiries and studies, gives the same account of the dietetic habits of the primitive generations; and he taught his more favored disciples that they ought to live in the same natural and simple manner.

e. Herodotus, the celebrated historian, who wrote about four hundred and forty-five or fifty years before Christ, relates that 'upon the death of Lycurgus, the Lacedemonians, meditating the conquest of Arcadia, were told by the oracle that there were many brave acorn-eaters in that country, who would repel them if they attempted to carry their arms thither,—as it afterwards happened.'

f. Hippocrates, called the father of physic, who flourished about four hundred years before Christ, and who was a physician of great talents and extensive observation and research, says that 'in the beginning man subsisted on the spontaneous products of the earth, and received his food in the same simple and natural condition as the lower animals did.'

g. Didorus Siculus, who flourished about forty or fifty years before Christ, and who wrote the history of Egypt, Persia, Syria, Media, Greece, Rome, and Carthage, says that 'the first of men ranged over the fields and woods in search of food, like the lower animals, eating

every mild herb they could find, and such fruits as the trees spontaneously produced.'

h. Ovid, the celebrated Roman poet, who flourished in the commencement of the Christian era, and who undoubtedly speaks from the historical and traditionary authority of his day, says, in the first Book of his Metamorphosis, in relation to the diet of the first generations of men, as rendered by Dryden—

> 'Content with food which nature freely bred,
> On wildings and on strawberries they fed;
> Cornels and bramble-berries gave the rest,
> And falling acorns furnished out the feast.'

i. Ælianus, who in the first century of the Christian era published his treatises on animals, history, etc., says that 'the diet of the primitive inhabitants of the earth differed according to the different products of their respective countries.' Of the first inhabitants of Greece he says, 'The Arcadians lived on acorns, the Argives on pears, the Athenians on figs,' etc.

j. Pliny, the Roman naturalist, of about the same period, says that 'mankind in the first ages subsisted on acorns.'

k. Plutarch, who died about the middle of the second century of the Christian era, relates that 'the first Argives, led on by Inachus,' the founder of the kingdom of Argos, 1800 years before Christ, 'searched the woods for wild pears to support them.' The same writer, in his life of Artaxerxes Longimanus, king of Persia, who reigned in the fifth century before Christ, says that 'this unwary prince led a great army against the Cadusians, a robust and warlike people, whose inhospitable country produced neither corn nor good fruits, so that the natives were forced to live on pears and apples which grew wild and spontaneous.'

l. Galen, the celebrated Roman physician, who flourished in the second century of the Christian era, seems to admit the truth of all these accounts, for he assures us in his work on human aliment, that 'acorns afford as good nourishment as many sorts of grain; that in ancient times men lived on acorns only; and that the Arcadians continued to eat them long after the rest of Greece had begun to make use of bread-corn.'

m. Porphyry, a platonic philosopher of the third century—a man of great talents and learning, and of very extensive research and observation, who investigated the subject of human diet with great care and diligence—says that 'the ancient Greeks lived entirely on the fruits of the earth.'

n. It is well known also that the Romans, not only in the earliest period of their history, but at the time of their greatest vigor and efficiency, when their small and invincible armies were always victorious, and when the success of battle depended less on the art of war than on the physical power and personal prowess of the individual leaders and soldiers, were exceedingly simple and natural in their diet; and it was not till the artificial refinements and the excesses of luxury had relaxed their sturdy frames and rendered them effeminate, sensual, and selfish, that they were unable to withstand even the smaller numbers of those rugged barbarians whom they affected to despise (638).

o. When Bonduca, queen of the ancient Britons, was about to engage the Romans in pitched battle, in the days of Roman degeneracy, she encouraged her army with a pathetic speech in reference to the wrongs and outrages which they had suffered from their foreign oppressors, and urged in particular the following considerations: 'The great advantage we have over them is that they cannot, like us, bear hunger, thirst, heat, nor cold. They must have fine bread, wine, and warm houses. Every herb and root satisfies our hunger, water supplies the want of wine, and every tree is to us a warm house.' In those times,' says the noble historian on whose authority I state this, 'our fathers were robust both in mind and body, and could bear without much pain what would totally overwhelm us.'

p. Even the aborigines of our own country, with all their fondness for the chase, before their intercourse with the Europeans, subsisted to a considerable extent on the simple products of the earth. The Plymouth colonists found the North American Indians inhabiting those parts, under Massasoit, the father of that American Wallace, King Philip, subsisting on the plainest and simplest forms of food, and possessing noble and hardy frames and frank and friendly dispositions, remarkable for bodily symmetry and vigor and activity, and ability to endure severe and protracted labor and exposure. Ground-nuts and acorns and bread made of parched maize or Indian corn were the principal articles which Massasoit, in generous and unsuspecting hospitality, served up for the repast of his first white guests. A writer of those early days of our antiquities, informs us that 'the Indians made a bread from the meal which they made of parched maize,' and that 'it was so sweet, so hearty, and so *toothsome*, that an Indian would travel many days with no other food.' And indeed it was no uncommon thing for an Indian, starting on such a journey, to take three or four ears of corn with him as his only food, which he would either eat raw, or stop by the way and make a fire, and parch it as they needed it.'

q. For a considerable time, during the severe war which he maintained in his last struggles for his beloved country, that noble and heroic patriot and martyr to the cause of liberty, King Philip, with his few and faithful followers, 'subsisted on ground-nuts and acorns and lily-roots.' And when Colonel Church captured Annawan, a chief officer under Philip, he found his wife engaged in pounding parched corn for supper. And, taking advantage of this rude, but still lovely sound of domestic charity, he stole like the primal serpent into the sanctuary of peace, to betray and to desolate! Virtuous simplicity of a noble race! Who can covet the moral sensibilities of that man who has no sympathies for scenes like these? Most injured race! Full many a generous heart hath ached at the contemplation of your untold wrongs. Treacherously robbed of your country, and then cruelly exterminated as savages, because you were guilty of loving the spot of your birth, and the land of your fathers' sepulchres!

No more upon yon silver tide
That winds these mountain spires between—
No more along the upland side,
The native huntsmen now are seen:
Their bodies have manured the soil,
For other lords and other heirs;
Their homes became the bloody spoil
Of hearts less merciful than theirs

770. But in contemplating the history of the human race, we must not lose sight of the fact that no ancient historian, except Moses, gives us any direct and distinct information concerning the antediluvian inhabitants of the earth; and another interesting fact is, that no other early writer gives us an account of the diet of the primitive generations of the human race, which is so rational and so truly adapted to the constitutional nature of man. For, according to Moses, 'the Lord God planted a garden, and caused every tree that is pleasant to the sight and good for food, to grow out of the ground; and he took the man whom he had formed, and put him in the garden of Eden, to dress it and to keep it,' and to subsist on its fruits. Such, then, is the truly natural state of man, and such is the food which is adapted to the highest and best condition of human nature. And when man, by his disobedience, had caused his own expulsion from this delightful garden, and was doomed to eat his food in the sweat of his brow, instead of roaming through the fields and the woods like beasts in search of food, we find him soon practising both husbandry and pasturage. For Cain, the oldest son of Adam, was a tiller of the ground, and Abel, the second, was a keeper of sheep.

771. Fruits, nuts, farinaceous seeds, and roots, with perhaps some milk, and it may be honey, in all rational probability, constituted the food of the first family and the first generations of mankind.

772. These articles were, at first, unquestionably received in their natural and simple state, without any artificial preparations at all, except the rude breaking of the hard shells of nuts, with the common stones on the face of the earth. But as society advanced, and the change of seasons taught men by experience the necessity of a degree of providence, and as their provisions of seeds and other articles of food became dry and hard by keeping, they very naturally had recourse, at first, to the simple expedient of mashing or breaking those substances on flat stones, preparatory for mastication. And soon it became a general custom among them, for every family to keep one or more of these stones, as a necessary part of their domestic apparatus. By constant use, these stones, in a process of time, became concave and deeply hollowed, which rendered them much more convenient. This led to the manufacture of stone mortars, which took the place of the flat stones, as household utensils, for breaking and preparing the dry and hard articles of food. There is reason to believe that no farther improvements were made in this line, anterior to the flood. The food, which was broken in this rude but healthful manner, was probably sometimes parched before it was submitted to the processes of the mortar, and afterwards portions of it were perhaps wet up with simple water into a coarse dough, which was baked on heated stones, or in heated earth or ashes, or in the rude ovens of the times.

773. This is probably the full extent to which the artificial processes of preparing food were carried in the antediluvian period of the world. And there is obviously nothing in all this which takes away the necessity for the full performance of the function of the teeth (709), and there is no concentration, no pernicious combinations or compounds (750), no insalutary culinary processes, which violate the laws of relation in regard to the teeth, gums, salivary glands, organ of taste, stomach, or any of the alimentary organs of the human body (718).

These organs were therefore preserved in all their constitutional energies and unimpaired powers, sustained by appropriate and healthful aliment; and being thus sustained in all their primeval vigor and integrity, elaborated for the vital wants of the whole system a full supply of nourishment which was most conducive to good and permanent health and long life.

774. In circumstances and with habits such as these, unblighted with literary taint, with constitutions little enervated by ancestral sensuality, it is no marvel that the antediluvians, and all others in such circumstances and conditions, and with such habits, should average several centuries of life, and that some of them should walk erect with patriarchal dignity almost to the summit of a thousand years (634).

775. With all the deteriorations of six thousand years accumulated on the vital energies of man (638, 643), the human constitution even yet, where circumstances and conditions and habits concur to fulfil perfectly the physiological laws of man's constitutional nature, has power to climb far up towards the top of primitive longevity, with much of primitive development and symmetry and vigor and elasticity of body (673).

776. Captain Cook, the celebrated navigator, tells us that when he first visited the New Zealanders, he found them enjoying perfect and uninterrupted health (768). In all the visits he made to their towns, where old and young men and women crowded about the voyagers, they never observed a single person who appeared to have any bodily complaint; nor among the numbers that were seen naked, was once perceived the slightest eruption of the skin, nor the least mark which indicated that such eruptions had formerly existed. Another proof of the health of this people was the facility with which the wounds they at any time received healed up. In a man who had been shot with a musket ball through the fleshy part of the arm, 'his wound seemed so well digested and in so fair a way to be healed,' says Captain Cook, 'that if I had not known that no application had been made to it, I should have inquired with very interested curiosity after the vulnerary herbs and surgical art of the country. An additional evidence of the healthiness of the New Zealanders is in the great number of old men found among them. Many of them appeared to be very ancient, and yet none of them were decrepit (678). Although they were not equal to the young in muscular strength, they did not come in the least behind them in regard to cheerfulness and vivacity.'

777. This statement is strikingly corroborated by the testimony of Mr. William Bryant, a respectable merchant of Philadelphia, who, in the year 1809, went with a company of a hundred and twenty men, under the United States Government, beyond the Rocky Mountains, to conduct to their far western homes the Indian chiefs who were brought to the seat of government by Lewis and Clark. Mr. Bryant states that the company carried their provisions of food, tobacco, and spirits with them, until they had exhausted them in the western wilds, where they were far beyond the reach of any supplies. From that time, during their whole stay of about two years, among the Indians, the company subsisted entirely as the Indians did, on the flesh of the wild buffalo and other game, with such esculent fruits and roots as the forest

afforded, and water. They had no alcoholic nor narcotic substance, nor any other pure stimulant to use (733); not even salt with their flesh-meat, which at first they burnt a little to destroy its fresh and natural taste; but they soon learned to relish their flesh-meat very highly without salt, even when slightly cooked. Most of the men belonging to the company were, when they left the United States, more or less disordered in their health and afflicted with chronic ailments. They were all restored to health, and became, like the Indians among whom they dwelt, remarkably robust and active. Their wounds healed in the same manner as stated by Captain Cook of the New Zealanders. One of the company had the fleshy part of his leg torn off by a bear. The Indians stripped some bark from a tree for a bandage, and did up the wound with a little bears' oil, and it healed with astonishing rapidity, apparently without inflammation, and entirely without pain. Mr. Bryant assures me that so little did the natives regard the pain of cutting or wounding their flesh, that it was no uncommon thing for them, on any very special and important occasion, to cut off one of their fingers, and present it to a friend as a memorial, or to any opposite party as a pledge; and he saw several individuals with only the thumb and fore-finger left on one hand (768).

778. The Pampa Indians of Buenos Ayres, in South America, live almost entirely on mares' flesh and water. They wear little or no clothing, and sleep on the ground in the open air. When not sleeping, they are almost continually on horseback, and being accustomed to this kind of exercise from childhood, they acquire the power to ride very great distances with comparatively little fatigue. 'The mares' flesh which they eat,' says Sir Everard Home, 'is tough and lean, so that they only satisfy hunger, and never grow fat; but when they accidentally get a buffalo, and indulge much in eating fat, it makes them feverish and takes away their appetite. By fasting a day or two, however, they get well. They are in general a well-made stout race of men, and appear to be subject to no diseases. By virtue of the great simplicity of their diet and their constant exercise on horseback in the open air, they enjoy remarkable uniformity of health, and many of them are very athletic and capable of great endurance, especially in those feats and exploits which are performed on horseback. Captain Head, after living for three months among these Indians, on flesh and water, and being constantly on horseback, became so hardy as to tire ten or twelve horses in a day, and galloped one hundred and fifty-three miles without halting, remaining on horseback fourteen hours and a half before he arrived at the end of his journey. A French gentleman of Capt. Head's party told me,' continues Sir Everard, 'that he himself, a slim man, after living some months on flesh and water, and becoming accustomed to riding on horseback, rode one hundred miles a day without fatigue. A friend of Dr. Babington's, who lived in the Pampas for some time as a missionary, assured the doctor that he was astonished to find that upon this simple diet he was able to ride more than a hundred miles daily without fatigue' (768).

779. Some of the tribes of the Arabs of the desert, according to Captain Riley, subsist entirely on the milk of their camels. Those who adhere strictly to this diet have no sickness nor disorders, and attain to very great age, with remarkable vigor and activity (678). Captain

Riley thinks he met with some who were three hundred years old, and many who were strong and active at the age of two hundred years. 'I am fully of opinion,' says he, 'that a great many Arabs on this vast desert actually live to the age of two hundred years and upwards. Their lives are regular from birth to death; their food is simple, plain, and nutritious, and without variation; their climate is dry and not changeable; they are not subject to hard labor, yet have sufficient exercise for the purposes of health; they never taste of wine nor ardent spirit, it being forbidden by their religion.'

780. Almost every circumstance in the lives of these Arabs is unquestionably in a high degree favorable to health and longevity; and the statements of Captain Riley, if correct, clearly and fully show that the most perfect simplicity and uniformity of diet are most highly conducive to human health and strength and long life.

781. Homer also describes a race of men inhabiting the mountains of ancient Sarmatia—an extensive country at the north of Europe and Asia—who, he says, subsisted upon the milk of mares, and lived to very great age, and were 'the justest of men.'

782. Before the discovery of the Ladrone Islands by the Spaniards, about the year 1620, the inhabitants supposed themselves the only people in the world; and they were destitute of almost everything that people in civic life think necessary to existence. There were no animals on the islands except birds, and these they did not eat. They had never seen fire, nor could they at first imagine the properties or the use of it. Their food was wholly vegetable, consisting of fruits and roots in a natural state. They were well formed, vigorous, and active, and could carry with ease upon their shoulders a weight of five hundred pounds. Disease or sickness of any kind was scarcely known among them, and they generally attained to great age. It was no extraordinary thing for individuals among them to reach a hundred years without experiencing any sickness (768.) Since they have become accustomed to the use of fire in preparing their food, and have deviated considerably from their former simple and natural manner of living, diseases are much more common among them, and they do not average so great an age.

783. Modern travellers inform us that the inhabitants of the island of Malta are remarkable for their plain, simple, and abstemious diet, and active and industrious habits, and that longevity is not unusual among them, many of them living a hundred years (768).

784. The great uniformity of health, the remarkable bodily vigor and activity, and the extraordinary longevity, of those inhabitants of Russia whose food is simple, plain, and coarse, and who wholly abstain from the use of spirits, tobacco, opium, and other intoxicating substances, are well known to all who are acquainted with the present history of the human family (768).

785. It is a notorious truth, that when, from religious or other motives, any sect or society of men are induced to adopt and perseveringly observe a simple and restricted regimen, their bodily health and longevity are as much improved and increased as their virtue and piety.

786. The ancient Bramins of India were restricted by their religious principles to the most simple and natural diet; and it is well known

that so long as they rigidly and uniformly adhered to their religious principles in regard to their diet, they enjoyed the most uniform health and attained to great age; and, considering the circumstances under which they lived for many centuries, they were an eminently virtuous and excellent class of men.

787. Pythagoras founded his dietetic system on principles which he received from the Bramins of India, and the sect of Essenes among the Jews received and adopted the Pythagorean system; and what I have said of the Bramins, in relation to the effects of their simple diet, is perfectly true of the strict followers of Pythagoras and of the Essenes.

788. Josephus, who was himself a Pharisee, and therefore in no degree predisposed by his sectarian religious feelings to do more than justice to the Essenes, says, 'They lived the same kind of life as do those whom the Greeks call Pythagoreans.' 'Herod,' continues he, 'had these Essenes in highest honor, and thought more of them than their mortal nature required. They offer no sacrifice, because they have more pure lustrations of their own; their course of life is better than that of other men, and they entirely addict themselves to husbandry. It also deserves our admiration, how much they exceed all other men that addict themselves to virtue, and this in righteousness; and indeed to such a degree that, as it hath never appeared among any other men, neither Greeks nor Barbarians—no, not for a little time—so hath it endured a long while among them. They are long lived also, insomuch that many of them live above a hundred years, by means of the simplicity of their diet, and the regular course of their lives.'

789. The religious sect or society of our own times, denominated Quakers or Friends, was founded by George Fox, about the middle of the seventeenth century, on principles of the greatest simplicity, as well in regard to diet, dress, and manners, as religion; and for several generations the true followers of George Fox strictly and religiously adhered in practice to all the principles which he laid down. Not only were they exceedingly simple, unostentatious, and spiritual in their religion, and strictly honest and virtuous and pure in their morality, and mild and gentle and unobtrusive and humble in their manners, and given to hospitality and kindness and general philanthropy, and extremely plain and simple in their dress and speech, but they were also exceedingly plain and simple and abstemious in their diet. The consequence was, that in the course of three or four generations, the physiological effects, in relation to health and longevity, became too manifest and too remarkable to escape general observation. It must, however, be remembered that the dietetic habits of this society, being adopted purely from religious considerations, were therefore not regulated in their simplicity with reference to physiological principles (768). Yet such is the importance of simplicity and temperance in diet, to the physiological welfare of the human body, that the benefits of them are strikingly manifested, even when they are not in all respects perfectly consistent with true physiological principles.

790. The following article concerning the relative length of life among the Friends or Quakers, and other portions of society in civic life, appeared a considerable time since, in the *London Medical Intel-*

Eigencer, and relates to a period many years past; and it is with deep regret that I find myself compelled to add, that it relates to a state of things which has also, in a great measure, past away. Every true philanthropist must grieve to see so signal and beautiful an exemplification of the virtue of temperance in all things, fade away before the luxuries which have already too nearly assimilated the Society of Friends to the world of sensuality and excess around them.

a. 'It appears from the Register of the Society of Friends or Quakers, as a consequence of their temperance, that one-half of those that are born in that society, live to the age of forty-seven years; whereas, says Dr. Price, of the general population of London, one-half live only two years and nine months. Among the Quakers, one in ten arrives at seventy years of age; of the general population of London, only one in forty reaches this period of life.'

b. In another article from the *Derbyshire Courier*, without date, it is stated that the 'Society of Friends have recently been engaged in statistical inquiries, which tend to demonstrate that longevity in their sect is the result of their regular habits and temperance. As a proof, it is stated that in Chesterfield church-yard the aggregate age of the last hundred individuals buried to the date of 16th November (year not given), was two thousand five hundred and sixteen years and six months; while the aggregate of the last hundred Quakers amounted to four thousand seven hundred and ninety years and seven months; giving an average of the duration of life, of the former, of only twenty-five years and two months; and of the latter, or Quakers, of forty-seven years and ten months.'

c. Another article, taken from the fifty-fourth number of the *Christian Disciple*, a paper of our own country, dated Oct. 1817, states that the Rhode Island Monthly Meeting of Friends comprises about four hundred persons; the number of deaths in the last five years is about thirty-one, and in that period no one person has died of that Society under forty-eight years of age. The ages of the thirty-one persons who have died within the past five years averaged seventy-four years.

d. In 1812, eight persons died, the youngest of whom was sixty years old, the oldest eighty-four; of this last age there were two.

e. In 1813, also, eight persons died; the youngest was forty-nine, the oldest eighty-five.

f. In 1814, but one died, and that one was eighty-seven years old.

g. In 1815, five persons died; the youngest was forty-eight, the oldest was ninety.

h. In 1816, nine persons died; the youngest was fifty-seven years old, and the oldest was ninety-four.

791. These facts in relation to the Society of Friends, are certainly of very great importance, and ought not only to admonish that respectable Society of their solemn duty, both for their own sakes as individuals and as a society, and for the sake of the common cause of philanthropy, to adhere closely to those principles and practices of their founder which have wrought out for them such signal benefits, and guard most cautiously and rigorously against those treacherous inroads of sensuality among them, which will completely destroy all these benefits; but they ought also to admonish the whole civilized

world of the truth and value of those physiological principles which require plainness and simplicity and temperance in human diet.

792. I might add many similar illustrations of the principles which I have advanced, from the history of other sects and particular neighbourhoods of our own country, but I deem it unnecessary.

793. 'According to the last census of the United States, the free white male population of the state of North Carolina numbers 235,954; the female, 236,889. Total free white population, 472,843. Of these 202 only were foreigners not naturalized. Of this whole number of free white people, there are fifty-eight over a hundred years old. Of slaves, the whole number of both sexes is 245,601; and of free people of color, 19,543: making of colored persons, slaves and free, 265,144. Of this whole number of the colored population, 247 are over a hundred years old. Massachusetts, with a population of 603,359 free white persons, has only five over a hundred years old. Whilst out of 7,645 free persons of color in Massachusetts, there are fifty over a hundred years of age. There is, therefore, of the white population of Massachusetts, one in 120,671 1-2 over a hundred years old. Of the white population of North Carolina there is, over a hundred years old, one in 8,152. Of the colored population of North Carolina there is, over a hundred years old, one in 1,073. Of the colored population of Massachusetts there is, over a hundred years old, one in 152 3-4.'

794. How shall we account for this very remarkable difference in the comparative longevity of the white and colored population of these two states? The whites over a hundred years old in North Carolina, are, in proportion to those of Massachusetts, nearly fifteen to one. The colored people over a hundred years old in North Carolina, are in proportion to those of the whites of the same state, nearly eight to one; and in proportion to those of the whites of Massachusetts, more than 562 to one! While the colored people over a hundred years old in Massachusetts are, in proportion to those of the colored people in North Carolina, seven to one; and in proportion to those of the white people in North Carolina, 53 to one; and in proportion to those of the white people in Massachusetts, about 3,950 to one. Now then, why is the proportion of white *centenarians* in North Carolina so much greater than in Massachusetts? and why is the proportion of colored *centenarians* in North Carolina so much greater than that of the whites of the same state? and why is the proportion of colored *centenarians* in Massachusetts so much greater than in North Carolina?

795. It is evident from these facts, as well as from every other just consideration, that the climate of Massachusetts is more favorable to human longevity than that of North Carolina The white people of North Carolina, as a general fact, do not labor near so hard as the whites of Massachusetts, and they are far more simple and less given to excess in their *food*. The severe labor of the whites in Massachusetts, in itself considered, is in some measure unfavorable to long life. Their active employment, together with their healthful and invigorating climate, exceedingly increases their appetite for food, and their tables are always furnished, not only with great abundance, but generally with considerable variety; and too frequently this variety is very great, and comprises many dishes of compound concentrated substances; and flesh-meat is almost universally found upon their tables

three times a day. With such temptations before them, and with a keen appetite, and without thinking of the danger of excess, the white people of Massachusetts, as a body, generally eat at least double the quantity of food that the vital economy of their bodies requires, and that food is seldom of a plain and simple kind. They rise from their tables with overloaded stomachs, and go almost immediately to hard labor, or business which requires severe mental exercise, and thus, in either case, must increase the embarrassment of the stomach. It is probably true that the white population of Massachusetts and of New England generally, are, as a body, without being conscious of it, the most gluttonous people in the world! Not that they are naturally more gluttonously disposed than others, but all their circumstances and habits, and the unmeasured abundance with which their industry and enterprize are crowned, concur to make them so. It is a common thing for farmers in New England, of the most athletic frames and vigorous constitutions, to complain of being worn-out by hard labor before they are fifty years old; yet were they, from their youth up, compelled to live on half the food which they consume, and that food much plainer and more simple, they would complain less of the effects of hard labor and of the infirmities of age at eighty years, than they now do at fifty.

796. The dietetic and other habits of the colored people of North Carolina come much nearer to physiological propriety than those of the whites of the same State. Hence their much greater proportion of longevity. The dietetic habits of the colored people of Massachusetts are, all things considered, nearly as physiologically correct, and perhaps quite as much so, as those of the colored people of North Carolina; but in all other respects their habits and circumstances are much more favorable to long life. Their climate is healthier; they are less exposed to the action of foreign morbific causes; they are free from the depressing effects of slavery; and are every way more comfortable, as a general fact, and much more intelligent (764). It must also be remembered that the colored people in both Massachusetts and North Carolina have much more constitutional stamina than the whites. They are much less tainted with hereditary predispositions and influences.

797. Let it be continually kept in mind, however, that in all these cases,* with whatever correctness of habit and circumstances there may be, there is still in many respects so wide a departure from physiological rectitude (764), that the facts which they afford are greatly modified. Yet with all this detriment (768), it is nevertheless irrefragibly true, that the traditions and history of every nation and tribe of men on the face of the whole earth—both continents and islands—in all periods of time, when accurately understood, concur to demonstrate this general law of the human species: that, all other things being right, whether man subsists on vegetable or animal food, the more perfectly his diet is adapted in simplicity, plainness, and naturalness (765), to the constitutional laws of his nature, the more perfectly all the interests of that nature are sustained (758).

* From 769 to 796.

LECTURE XIV.

The natural dietetic character of man, what ?—The foundation of popular opinion on the subject—Opinion of Buffon—True statement of the question—It is a question of Comparative Anatomy and Physiology—How the criteria of Comparative Anatomy are ascertained and established—Correct mode of inductive reasoning in Comparative Anatomy—Correct practical application of general principles—The teeth of man compared with the teeth of other animals as to number and arrangement—The masticatory organs of man particularly compared with those of carnivorous and herbivorous animals—The digestive organs of man compared with those of carnivorous and herbivorous animals—The masticatory and digestive organs of man compared with those of omnivorous animals—The masticatory and digestive organs of man compared with those of frugivorous animals—The physiological capabilities of man in regard to omnivorous habits compared with those of other animals—Testimony of Linnæus, Cuvier, Lawrence Bell, and others—How far the character of the gastric juice determines the natural dietetic character of an animal—The versatility of the physiological powers of the human stomach, common to other animals—Natural simplicity best for all—False reasoning of naturalists—How far reason is paramount to instinct—Does reason make man naturally omnivorous?—General conclusion from the evidence of Comparative Anatomy—How far climate determines the dietetic character of man—How far instinct leads man to be omnivorous—Early propensities of children—Infants taught to smoke in India—Instinct, how far a primary and true law of action in man and other animals—Why the average longevity of man has been nearly the same in all climates and circumstances, and with all varieties of dietetic habits—Man always goes as far in indulgence as he can without sudden destruction, and what he has to his advantage in one point he sacrifices in another—Hence, universal sensuality—The principles stated by which true physiological evidence is ascertained—The assertion of Buffon and popular opinion in regard to the necessity for animal food to nourish and sustain the human body—Proportions of nutritious matter in vegetable and animal food—General history of the human species with regard to the use of animal food—The physiological effects of flesh meat on the human body—Physiological difference between animal and vegetable food in sustaining the body in labor—Illustrations, the Russian, Greek, and other laboring men—Patagonians and other flesh-eating tribes—General conclusions from the anatomical and physiological evidence thus far examined.

798. HAVING explained and illustrated the constitutional laws of relation between the alimentary organs and special senses of the human body and those foreign or external substances designed by the Creator for the food of man (683, 757), and having extensively exemplified the doctrines laid down by the general experience of mankind (769, 797) so far as the importance of a plain, simple, and natural diet is concerned (765), we are now prepared to inquire,—

WHAT IS THE NATURAL DIETETIC CHARACTER OF MAN ?

799. The prevailing opinion on this subject, in our country and in many parts of Europe, is, that man is naturally an OMNIVOROUS animal; that the highest and most permanent good of his nature requires that he should subsist on a mixed diet of vegetable and animal substances.

800. Custom is the only authority for this opinion with the mass of those who entertain it. But many naturalists and physiologists have endeavored to support it by what they have supposed to be the indications of man's alimentary organs. It is an important truth, however, that naturalists and physiologists, even when they claim to be strictly governed by the principles of inductive reasoning, are not unfrequently as erroneous in their apprehension and interpretation of facts (39)

and as absurd in their conclusions as the unscientific multitude, who are governed entirely by tradition, custom, habit, and feeling.

801. Buffon, whose writings have certainly as just a claim to poetry as to sound science, thus expresses himself on this subject:—'If man were obliged to abstain totally from flesh, he would not—at least in our climates—either exist or multiply. An entire abstinence from flesh can have no effect but to enfeeble nature. To preserve himself in proper plight, man requires not only the use of this solid nourishment, but even to vary it. To obtain complete vigor, he must choose that species of food which is most agreeable to his constitution; and as he cannot preserve himself in a state of activity but by procuring new sensations, he must give his senses their full stretch, and eat a variety of meats to prevent the disgust arising from a uniformity of nourishment.'

802. Nothing can well be more egregiously whimsical and fallacious than this whole tissue of assertion and reasoning of the celebrated naturalist; nor is it surprising that a mind thus fanciful in its speculations, or rather thus blinded by custom and personal feelings, should find support for its hypothesis in the structure of the teeth and digestive organs. But it is truly amazing that so many scientific men, who profess to think and to investigate for themselves, should so tamely embrace and repeat notions so utterly erroneous and absurd.

803. Let it be distinctly understood, the question is not whether man is capable of subsisting on a very great variety of both vegetable and animal substances, for we have seen (684, *et seq.*) that he does possess the constitutional capability of deriving nourishment from almost everything in the vegetable and animal kingdoms; but the question is, do the highest interests of the human constitution indispensably require that man should, as a general rule, subsist on both vegetable and animal food? It is not whether he *can*, but whether he *must*, subsist on such a mixed diet, in order to secure the highest and best good of which his nature is capable.

804. Some have considered this wholly an anatomical question, and have asserted that the structure and conformation of the teeth and digestive organs constitute the only evidence in the case by which the truth is to be ascertained. But while I admit that the anatomical evidence is very full and conclusive, I must also contend that the physiological evidence is, if possible, even more powerful and determinate; and therefore I shall proceed to examine,—first, the ANATOMICAL; and second, the PHYSIOLOGICAL evidence in relation to the natural dietetic character of man.

805. As an anatomical question, it is purely one of comparative anatomy: that is, the evidence must be obtained by comparing the alimentary organs of man with those of other animals whose natural dietetic character is well known; and, therefore, that the true nature and force of the evidence may be understood, it is necessary that we should know precisely the mode in which the criteria of reasoning on the question have been established.

806. These criteria are not self-evident or manifest principles in nature, nor have they been ascertained by *a priori* reasoning, or by reasoning from causes to effects; but by *a posteriori* reasoning, or reasoning from known effects back to principles.

807. Naturalists did not, in total ignorance of the dietetic habits of animals, go out into the fields and forests, and catch or slay individuals of the different species of animals in a state of nature, and examine their organs, and classify them as to their dietetic character, according to their organization, purely from such an anatomical inspection, without first studying the natural dietetic habits and natural history of the animals which they classified. Or in other words, naturalists did not first ascertain that the lion, tiger, and other animals of like alimentary organs, are carnivorous, from the structure and conformation of their organs. But, long before any zoological classification of these animals was attempted, they were well known to be beasts of prey—to subsist naturally on the flesh of other animals; or if their natural dietetic character was not known, it was first ascertained by carefully observing their natural dietetic habits; and with this knowledge naturalists proceeded to examine their organization, and found that the teeth and certain other organs, in all flesh-eating animals, are, in certain particulars, alike; and thus they inductively arrived at the general conclusion, or rule of reasoning in comparative anatomy, that all animals having alimentary organs of a certain description are naturally carnivorous. In the same manner, they first learned the natural dietetic character of the ox and other herbivorous animals, from their natural dietetic habits, and then proceeded to examine their organization, and found that to a certain extent all animals which were known to be herbivorous are alike in their alimentary organs; and thus again they arrived at the general conclusion, or rule of reasoning in comparative anatomy, that all animals having alimentary organs of a certain description are herbivorous animals. In this purely inductive manner the grand criteria or principles of reasoning on the subject before us have been established; so that now it is deemed no longer necessary to study the natural dietetic habits of an animal in order to know its natural dietetic character. It is sufficient for all the purposes of zoological science, to examine its organization. If found to possess alimentary organs like the lion, tiger, and other carnivorous animals whose natural dietetic character is known, it is unhesitatingly and correctly called a carnivorous animal; or if it is found to possess alimentary organs like the ox, deer, sheep, and other herbivorous animals, it is called an herbivorous animal.

808. In this manner, when the bones of animals of an extinct or unknown species are found in caves or deeply imbedded in the earth, scientific naturalists readily ascertain the natural dietetic character of those animals, by these established criteria in comparative anatomy, especially if any of the teeth or bones of the feet be found.

809. Let it be clearly understood then, that we do not, in the first place, ascertain that all animals with a certain kind of organs are carnivorous, and all animals with a certain other kind of organs are herbivorous, etc.; but we first ascertain that all carnivorous animals have a certain kind of alimentary organs, and that all herbivorous animals have a certain other kind of alimentary organs; and then, we assert the converse of these propositions, viz., that all animals of certain organization are carnivorous, and that all animals of a certain other kind of organization are herbivorous, etc.; and these last general propositions are thus established as the general principles of reasoning,

or grand criteria in comparative anatomy, by which we are to ascertain the classification and natural dietetic character of all animals whose natural history is unknown. Or in other words, we do not first learn the natural dietetic character of animals from their teeth and other organs, but we first learn the dietetic character of their teeth and other organs from their natural dietetic habits. For if we were totally ignorant of the dietetic habits of all animals, it would not be possible for us, by the most careful examination of their alimentary organs, to ascertain their natural dietetic character, with any degree of certainty. But when we have first studied the natural habits and then the anatomy of animals, and thus ascertained the correspondence between their natural dietetic habits and their peculiar organization, so as to be able to establish general principles or scientific criteria, we then think we can clearly perceive the constitutional adaptation of their alimentary organs to their natural food; we then believe that we can plainly see that the organs of carnivorous animals are manifestly fitted to seize and tear and cut the flesh on which those animals subsist, and that we can as plainly discern that the organs of herbivorous animals are fitted to crop and grind the grass and other vegetable substances which constitute the natural food of such animals.

810. With this full explanation of scientific principles or criteria of comparative anatomy in regard to the question before us, and the manner in which those criteria are established, we shall now be able to understand the true character and force of all evidence relative to the subject under consideration.

811. If the alimentary organs of an animal of an extinct or unknown species, whose natural history is entirely unknown to us, be presented for our examination, and we find that they are like those of the lion, tiger, etc., we say that they are the organs of a carnivorous animal; and the true elements of our reasoning in the case are these: these organs are like the alimentary organs of the lion, tiger, etc.; but the lion, tiger, and all other animals thus organized, whose natural history is known, are naturally carnivorous animals, therefore, these are the alimentary organs of a carnivorous animal. If, on the other hand, we find that the organs are like those of the horse, ox, deer, sheep, etc., we unhesitatingly say that they are the organs of an herbivorous animal; and the true elements of our reasoning in the case would be precisely the same as in the case just stated.

812. But suppose that, on a careful examination, we find that the organs which are the subject of our enquiry are neither like those of carnivorous nor like those of herbivorous animals, but in some respects resembling each of them, and in some respects differing from both of them? In such a case can we, according to correct principles of reasoning in comparative anatomy (807), legitimately come to the conclusion that the animal to which the organs in our hand belonged was organized to subsist on both vegetable and animal food, as his natural and most appropriate diet? Most certainly not! No man ought to make any pretensions to scientific logic who could reason thus! For it would be to disregard entirely the true elements of reasoning (809) essential to the nature of the subject, and to lose sight of all established principles in the science of comparative anatomy, which relate to the question before us!

813. How, then, do the true principles of reasoning in comparative anatomy require that we should proceed in such a case? If we find, on careful and accurate examination, that the organs under our inspection are neither like those of carnivorous nor like those of herbivorous animals, we are to conclude that the animal whose they were, belong to neither of these orders; and if the animal belonged to an extinct or unknown species, the natural history of which is also wholly unknown, and cannot now be studied, all correct principles in comparative anatomy most clearly and decidedly demand that we should diligently explore the animal kingdom, and, if possible, find some type with which the organs under our examination correspond. But if no exact type of our specimen can be found, then we must ascertain what order of animals have alimentary organs most nearly resembling our specimen, and when this is done, we must conclude that the animal to which our specimen belonged came nearer to that order than to any other known order of animals in its natural dietetic character; and in all that our specimen varies from that order, and approaches to a resemblance of some other known order, we are to conclude that the animal to which our specimen belonged differed from the former, and approached to an agreement with the latter, in its natural dietetic character. But if we find an order with the alimentary organs of which our specimen fully corresponds, then we are irresistibly led to the conclusion that the animal to which our specimen belonged was of the same dietetic character with that order, and if now we can, by studying the natural history, or observing the natural dietetic habits, of that order, fully ascertain the natural dietetic character of the animals belonging to it, then we know the natural dietetic character of the animal to which our specimen belonged (821), just so far as the most rigorously correct principles and reasonings of comparative anatomy can teach us.

814. Now, then, with the strictest application of these principles, and this mode of reasoning, to the question before us, what is the natural dietetic character of man, according to the real and true evidence of comparative anatomy?

815. In considering this question, it is important that we should remember that whatever may be true concerning the natural dietetic character of man, there is neither now on earth, nor has there been for many centuries, any portion of the human race, so far as we know, which have lived in all respects so perfectly in a state of nature (764), or in a state to which the constitutional nature of man is most perfectly adapted, as to afford us an opportunity to study the true natural history of man, and learn his natural dietetic character from his natural dietetic habits (807); and therefore, so far as this question is anatomically considered, man must in strict propriety be regarded as an extinct species; because though man is actually a living species of animals, yet the species, as a whole, have become so artificial in their dietetic habits, that it is impossible to derive from those habits any evidence which can justly be considered unquestionable, in relation to the natural dietetic character of man; and consequently, our evidence and reasoning in the case must be precisely such as would be proper if man were really an extinct species, and his natural history wholly unknown (813).

16. Let us suppose, then, that the alimentary organs of the human body are placed before us for our examination, in order to ascertain the natural dietetic character of man. In the first place, those organs speak no distinct and unequivocal language, afford no clear and determinate indications from which, without reference to anything else, we can learn the natural dietetic character of man (809.) In the second place, the purely natural dietetic habits of man are wholly unknown (815), except as a matter of extremely ancient history and tradition (770); and we have now no way by which we can became acquainted with those habits, from observation. From the nature and circumstances of the case, therefore, we are under the necessity of drawing our evidence from comparative anatomy in the same manner as we would if the species were extinct and unknown. That is, we have no other way of ascertaining the natural dietetic character of man from his alimentary organs, than by comparing those organs with the alimentary organs of other animals in a pure state of nature (811); and if we can find an order of animals whose alimentary organs perfectly correspond with those of man, and can accurately and fully ascertain the natural dietetic habits and character of that order of animals, then have we learned, so far as we can learn from comparative anatomy, the true natural dietetic character of man (813).

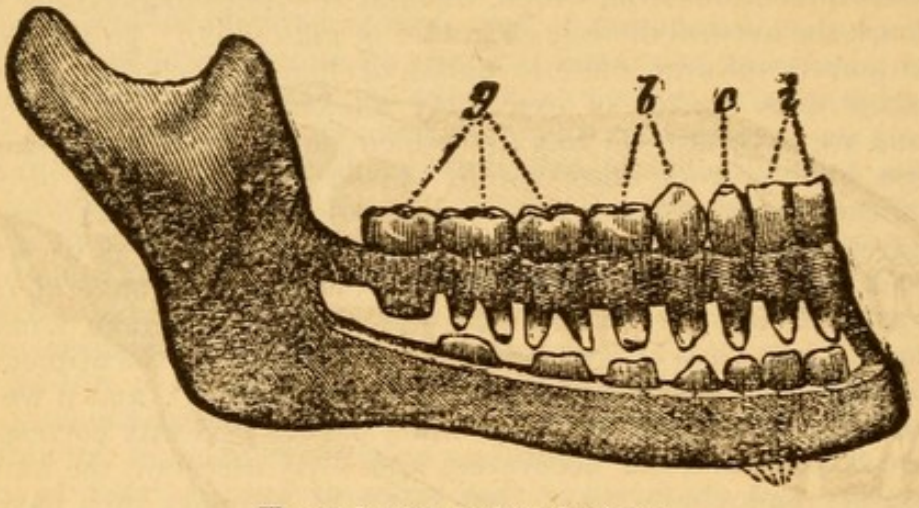
817. In the human head, as we have seen (326), there are thirty-two teeth: eight incisors, four cuspids or eye teeth, eight bicuspids or small cheek teeth, and twelve molars or large cheek teeth; and the teeth of each jaw, in a perfectly normal state, form an uninterrupted series, in close juxtaposition, and all of nearly equal length (Fig. 20). In this particular, man differs from all other animals. For even in the species nearest to man, there is a considerable space between the front and the corner teeth (Fig. 55); while in many other species, both of carnivorous and of herbivorous animals, the space is still greater, both between the incisors and the cuspids and between these latter and the cheek teeth (Fig. 52, 53). Carnivorous animals have in each jaw six incisors or front teeth, two cuspids, and from eight to twelve cheek teeth. Gnawing animals, such as the rat, the beaver, the squirrel, etc., have two incisors in each jaw, no cuspids, and from six to ten cheek teeth. Ruminating animals without horns, such as the camel, dromedary, etc., have two upper and six lower incisors, from two to four cuspids, and from ten to twelve cheek teeth in each jaw. Ruminating animals with horns, such as the ox, sheep, etc., have no upper incisors, eight lower incisors, no cuspids; except in the stag, which has them in the upper jaw, and twelve cheek teeth in each jaw. Animals with undivided hoofs, such as the horse, have six incisors in each jaw, two cuspids in the upper jaw, none in the lower jaw, and twelve cheek teeth in each.

818. The body of the human tooth above the gum, we have seen (327), consists of dense bone, which is every where covered on its external surface with a plate of enamel. In this respect, man resembles both carnivorous and frugivorous animals, and differs from the purely herbivorous, whose teeth are composed of intermixed layers of bone and enamel.

819. The incisors or front teeth of the human head, are broad, flat, chisel-shaped teeth (Fig. 51, *i*), designed to cut the substances on which

man feeds, into convenient masses for the action of the cheek teeth (326, Fig. 18, Nos. 1, 2). The front teeth of carnivorous animals are more rounded and pointed, and stand farther apart (Fig. 53), and bear

Fig. 51.

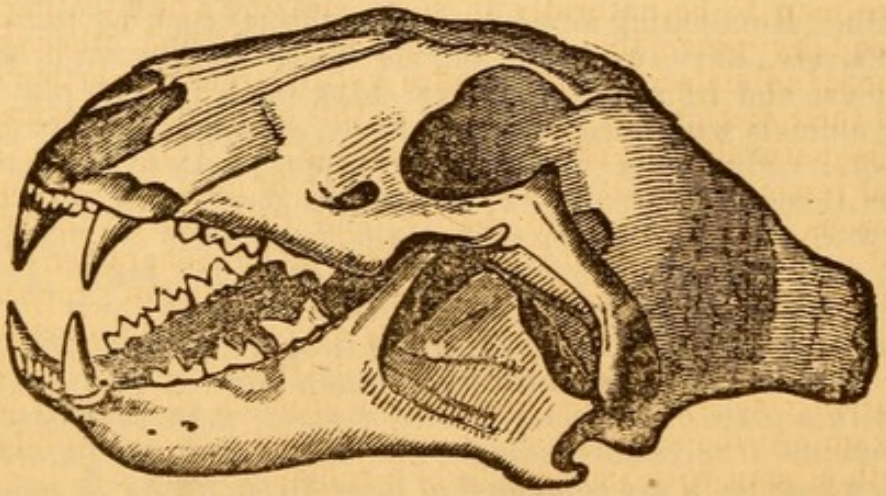


The under jaw and teeth of man.

no resemblance to those of man. The incisors or front teeth of herbivorous animals are broad like those of the human head; but they are in general much stronger, and the cutting ends are considerably thicker and more blunt; and in some species they vary almost as widely from those of man as the front teeth of carnivorous animals do.

820. The corner or eye teeth in the human head, technically called the cuspidati or cuspids (Fig 51, *c*), are usually of the same length of crown as the front teeth (326), and stand close to them. They approach more to a point than the front teeth (Fig. 18); but their peculiar shape indicates nothing more than that they constitute the first steps of transition from the chisel-shaped cutting teeth in front, to the large square grinding teeth in the back part of the jaws. The cuspids or tusks of carnivorous animals are round and pointed, and much longer

Fig. 52.

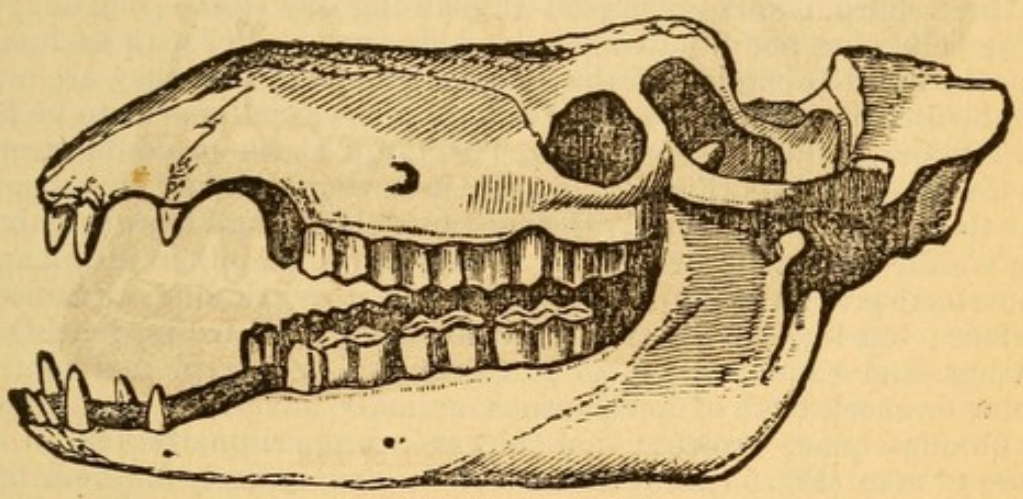


The masticatory organs of a panther.

and stronger than the front teeth, and are separated by a considerable space both from the front and cheek teeth (Fig. 52). In some species,

these teeth are very long, acuminated, and powerful, and are obviously fitted to serve as weapons of offence and defence, and may be used also to seize, hold, and tear the prey. Some of the herbivorous animals, such as the horse, the camel, and the stag (817), have the cuspids, and

Fig. 53.



The masticatory organs of a camel.

they are proportionally longer, and more pointed and powerful, than the corner teeth of the human head, and are separated from the other teeth by a large space. In the camel (Fig. 53), the cuspids bear a strong resemblance to those of predaceous animals (Fig. 52), and appear to be designed for weapons of offence and defence.

821. Between the cuspids of carnivorous animals and the corner teeth of the human head there is not the slightest resemblance! not even enough for sober fancy to build an analogy upon; and yet the *assumed* resemblance of the eye teeth of man to the cuspids of carnivorous animals has been the principal evidence urged to prove the natural flesh-eating character of man. But if it were true that this assumed resemblance had some reality, the argument founded upon it to prove man to be naturally in some measure a flesh-eating animal, would equally prove that the horse and camel and other species of herbivorous animals naturally require a still larger proportion of flesh-meat in their diet (820). According to this evidence, the camel of the desert is naturally as carnivorous as the dog (Fig. 53). But the assumed resemblance between the eye teeth of man and the cuspids of carnivorous animals has no reality, and therefore all the reasoning founded upon it, relative to the natural dietetic character of man, is utterly fallacious and destitute of any true ground of support. And this is so incontrovertibly, so palpably correct, that it does not seem possible that scientific gentlemen who have repeated the whimsical speculation concerning the *canine* teeth of man, could ever seriously have examined the subject, or for one moment actually compared the eye teeth of man with the cuspids of a common house-cat.

822. The bicuspids, or small cheek teeth of man (Fig. 51, *b*), have two prominences, or obtuse points (326)—the one on the outer, and the other on the inner side of the mashing or grinding end; the outer one being generally somewhat more prominent than the inner (Fig. 18,

Nos. 4, 5). The molars, or large cheek or double teeth of man (Fig. 51, *g*), have large and nearly square crowns (Fig 18, Nos. 6, 7, 8), presenting broad, mashing, and grinding surfaces, with the corners slightly elevated, so as to form on each tooth four or five very blunt prominences (326), thus increasing the grinding and triturating power of the teeth. The bicuspids or small cheek teeth of carnivorous animals, have two or three sharp points somewhat resembling saw-teeth (Fig. 52); and these points are not situated side by side, or parallel with each other, like the blunt tubercles of the human bicuspids, but they are placed one before the other, like the teeth of a saw, and appear to be fitted wholly for cutting and tearing. The large cheek or double teeth of carnivorous animals (Fig. 52) also rise into very high and sharp points, like those just described, only they are much larger and more prominent, the middle point of each tooth rising above the others like a spear. These teeth present nothing which approaches to a grinding or triturating surface; but like the small cheek teeth, they are fitted for tearing and cutting, and cannot admit of the grinding or lateral motion. The molar or cheek teeth of herbivorous animals have very large, square, or oblong-square crowns; not however proportionally larger than those of man (Fig. 53), but their construction is entirely different (818). They are composed of alternate longitudinal plates of bone and enamel, and the whole crown is surrounded on its sides with a plate of enamel like human teeth; but the grinding surface is not covered by enamel like human teeth, but presents the uncovered ends of the alternate, longitudinal plates of bone and enamel: and the plates of bone being much softer than those of enamel, wear away much faster in mastication, and thus the plates of enamel are caused continually to be more prominent than those of bone, and thereby a roughness is given to the grinding surface which greatly increases its dividing and triturating power upon the grass, twigs, boughs, and other vegetable and woody substances on which herbivorous animals naturally subsist. In some species, the grinding surface is nearly flat; in others, the corners of the crown are considerably more elevated than the centre.

823. The cheek teeth in the lower jaw of man shut against those of the upper jaw (Fig. 20), so as to bring the grinding surfaces of the two series together, in opposition to each other, and thus mash and grind the substances which come between them in the act of mastication. In this respect man resembles herbivorous and frugivorous animals. But the cheek teeth in the lower jaw of carnivorous animals shut within those of the upper jaw; so that, if we take a pair of shears and file the two cutting edges into teeth like a saw, and then cut with them, we shall get a very good idea of the appearance and operation of the cheek teeth of carnivorous animals in the upper and lower jaw. The manner in which these teeth shut together fits them still further for cutting the flesh on which the animals feed, into small masses preparatory for swallowing, and at the same time still further precludes all lateral or grinding motion in the act of mastication.

824. In herbivorous animals, the articulation or joint of the lower jaw is such as to admit of very free lateral motion in the act of mastication; as we see in the cow, and other ruminating animals, when chewing the cud. In man also, the articulation of the under jaw (Fig. 51, *a*), admits of very considerable lateral motion of the jaw in the

act of mastication (323), so that the grinding surfaces of the cheek teeth of the upper and lower jaws can move upon each other from right to left, and from left to right, and thus completely triturate or grind the food into very minute particles before it is swallowed (426). But in carnivorous animals, all lateral motion of the lower jaw in the act of mastication is not only precluded by the structure of the teeth (822) and the shutting of the lower cheek teeth within those of the upper (823), but it is rendered impossible by the articulation of the lower jaw, which only admits of the backwards and forwards motion. In all these animals, the muscles by which the motions of the lower jaw are effected, correspond with the articulation. In carnivorous animals, the muscles by which the lower jaw is raised up and the teeth shut together in the act of cutting or tearing the food, are very large and powerful; but those muscles which correspond with those in herbivorous animals by which the lateral motion is effected, are exceedingly small; while in herbivorous animals the muscles of lateral motion are largely developed, and those by which the under jaw is raised up are comparatively much smaller than in carnivorous animals. In this respect again, as in the articulation of the under jaw, man closely resembles herbivorous animals, and differs entirely from the carnivorous.

825. Such is a faithful and true comparison of the masticatory organs of man with those of carnivorous and herbivorous animals; and every one who will take the trouble to examine these organs in a house-cat, in a horse or cow, and in the human head, and compare them together, will find a complete demonstration of what I have stated. We see, therefore, that there is no resemblance between the masticatory organs of man and those of carnivorous animals. The latter are fitted to seize and hold the struggling prey, to tear the tenacious flesh from the bones, and to cut it into masses small enough to be swallowed; and being thus swallowed in raw masses into stomachs formed to receive it in such a condition, it passes less rapidly through the gastric cavity, and consequently sustains the animal a longer time, and causes a less hasty return of hunger, than if the flesh were finely comminuted or ground by the teeth. But the masticatory organs of man are fitted to cut the food into masses suitable to the capacity and operations of the mouth, and to grind those masses into fine particles, and thoroughly mix them with the saliva; and thus bring the food into precisely that condition which best fits it for the human stomach (717).

826. Nothing is more incontrovertibly true, then, than that, so far as the masticatory organs are considered, comparative anatomy does not afford the slightest evidence that man is in any measure a carnivorous animal; and I am bold to affirm that such an idea never was drawn from any actually perceived resemblance between the masticatory organs of man and those of carnivorous animals, but it was derived entirely and exclusively from the dietetic *habits* of man; and being thus derived, it gave birth to the creative fancy which imagined and announced the resemblance, and this imagined resemblance has been confidently relied on by thousands, because they did not care to take the trouble to examine for themselves.

827. Between the masticatory organs of man and those of purely herbivorous animals there is some resemblance, and in some respects

that resemblance is strong; but the evidence is by no means sufficient to justify the conclusion that man is naturally herbivorous. So far as the masticatory organs are considered, then, comparative anatomy affords no conclusive evidence that man is naturally an herbivorous or grass-eating animal.

828. The salivary glands (340) of herbivorous animals are, as a general fact, comparatively larger than those of carnivorous animals. In man these glands are not proportionably so large as in the purely herbivorous, nor so small as in carnivorous animals; but they are exceedingly copious in their secretion, and therefore in their physiological character they approach nearer in man to those of herbivorous than to those of carnivorous animals. They are also more largely developed in those portions of the human family who have long subsisted on vegetable food, than in those which subsist mostly on animal food.

829. As a general fact, herbivorous animals have a much longer alimentary canal than carnivorous animals, but this is not invariably the case. The hyena, which subsists on the dead carcasses of animals, eating both flesh and bones, has an alimentary canal of about the same comparative length as that of the horse, which is herbivorous. The seal and porpoise, which live wholly on animal food, have an alimentary canal twenty-eight times the length of the body, and this is equal to the greatest comparative length in herbivorous animals. 'Many species of animals,' says Carus, in his System of Comparative Anatomy, 'which live entirely on animal food, have an extraordinary length of the alimentary canal, ranging from eleven to twenty-eight times the length of the body.' Nevertheless, it is predicated as a general law, by naturalists, that the average length of the alimentary canal is relatively much less in carnivorous than in herbivorous animals. In those animals which subsist wholly on animal food, the length of the alimentary canal varies from one to six or eight times the length of the body, as a general rule; but to this rule, as we have seen, there are some exceptions. In herbivorous animals with undivided hoofs, such as the horse, the canal varies from eight to eleven times the length of the body. In herbivorous animals that divide the hoof and chew the cud, such as the ox, deer, sheep, etc., the canal varies from eleven to twenty-eight times the length of the body.

830. In ascertaining the comparative length of the alimentary canal in all these animals, naturalists have taken the length of the body in a straight line from the snout to the posterior extremity of the back bone, but in man they have measured from the top of the head to the bottom of the heel; and by this manifestly erroneous admeasurement, they have unfairly reduced the comparative length of the alimentary canal about one-half, and made it to appear that the comparative length of the alimentary canal in man varies from three to eight times the length of the body; and thus they have succeeded in associating man with carnivorous animals. But if the alimentary canal in man be compared with the length of the body, in the same manner that it is in all other animals, it will be found that its average length is about ten or twelve times the length of the body. This is evidently the true admeasurement, and it is surprising that any other should ever have been adopted, even for the sake of supporting a favorite theory; and especially one so palpably unjust as that which has heretofore been allowed.

831. Carnivorous animals, as a general rule, have a simple stomach, which is not fitted to retain the food a very long time; while herbivorous animals have either a complicated stomach (319) or a simple one, which is formed to retain its food much longer than that of carnivorous animals. The human stomach is simple (Fig. 26), but not more so than that of the horse, and it is manifestly formed to retain the food for a considerable time (347). The colon or large intestine in carnivorous animals is never cellulated, but is always cylindrical, and comparatively much smaller than in herbivorous animals. In the latter, and especially where the stomach is simple, the large intestine is very capacious, and the cœcum (346) is particularly large; and the colon, throughout its whole length, is gathered into sacs or cells by longitudinal bands. In man the cœcum is large, and the colon, as we have seen (346), is saculated (Fig. 30) as in herbivorous animals. Indeed, the calibre or diameter of the whole alimentary canal is relatively much greater in man than in carnivorous animals; and moreover, the numerous semilunar folds (346) in the mucous membrane of the small intestines of man (Fig. 29) very considerably increase the longitudinal extent of surface in the human alimentary canal.

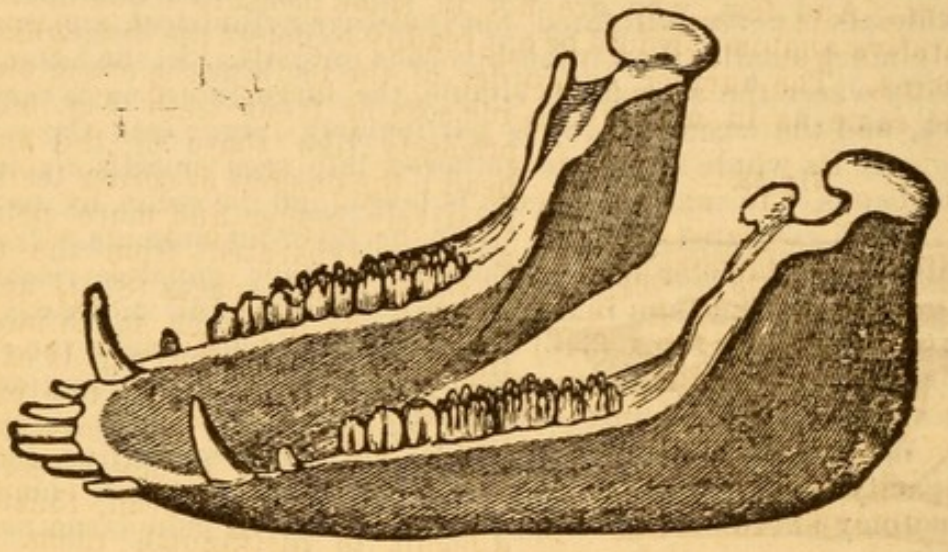
832. We see, then, that in regard to the true comparative length, the capacity, and the conformation of the alimentary canal, comparative anatomy affords not the slightest evidence that man is naturally, in any measure, a carnivorous animal; and although in most respects man very strongly resembles many of the species of herbivorous animals, yet, taking the masticating and digestive organs together, the evidences does not appear to be sufficiently complete and determinate to warrant the conclusion that man is naturally an herbivorous animal. If, however, we were obliged to class man either with carnivorous or herbivorous animals from the evidence of his alimentary organs, we should be compelled, by all correct principles in the science of comparative anatomy, to place him with the latter. But before we are driven to this necessity, it must be ascertained that in the whole animal kingdom there is no other order of animals besides the pure herbivora and carnivora, or none whose alimentary organs so nearly resemble those of the human body. But this is not true, and therefore we are bound to look still farther for alimentary organs with which we can compare those of man, before we come to a final conclusion in regard to man's natural dietetic character.

833. Is it said that no one claims man to be a purely *carnivorous*, but an *omnivorous* animal, and that his organization shows him to be designed to feed on both animal and vegetable food? Then let us ascertain whether there is any other animal in nature which is truly omnivorous, and if so, let us compare the alimentary organs of man with those of such an animal. We need not go far to find an animal of this description. Both the hog and the bear are naturally omnivorous; that is, in a pure state of nature, when left to their natural instincts, they will eat both vegetable and animal food. It is important to remark, however, that in a perfectly pure state of nature, when free to choose their aliment, and with an abundance before them, they both greatly prefer vegetable to animal substances, and neither of them, in such a state, ever preys upon living animals, unless urged by pinching hunger. Their most natural food therefore appears to consist of fruits,

nuts, roots, grain, and other products of the vegetable kingdom. Yet, strictly speaking, they are omnivorous animals, and are organized accordingly.

834. Let us then compare the alimentary organs of man with those of the swine (Fig. 54). We perceive at a glance, that there is little

Fig. 54.



The under jaw and teeth of a swine.

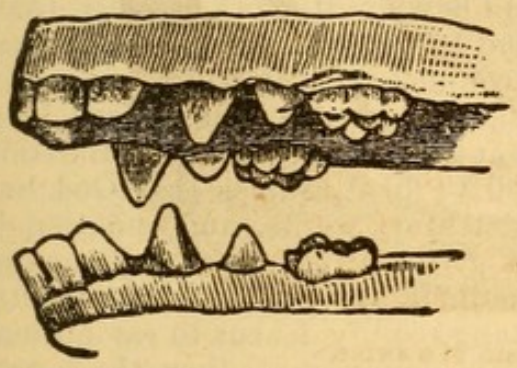
resemblance between the front teeth of the hog and those of the human head (Fig. 51), and still less between the eye teeth of man and the tusks of the hog. The bicuspids, or small cheek teeth of the hog, are almost exactly like those of carnivorous animals, but have not the most remote resemblance to those of the human head. The molars or large cheek teeth of the hog, on the other hand, have no resemblance to those of carnivorous animals, but are exceedingly like those of the human head. This comparison, therefore, does not in the smallest degree show man to be naturally an omnivorous animal. The only teeth in the hog which have any resemblance to human teeth, are the large cheek teeth, and these do not indicate a carnivorous, but a frugivorous character. The whole force of evidence derived from the masticatory organs of the hog, therefore, goes to prove that man is in no measure a flesh-eating animal.

835. The digestive organs of the hog more strongly resemble those of man, but when these are taken in connexion with the masticatory organs, which constitute the principal anatomical index of the dietetic character, and also in connexion with the fact that in a pure state of nature the hog prefers vegetable food, and principally subsists on it, and requires no animal food for the fullest and most perfect development and sustenance of its anatomical structure and physiological powers, the whole force of evidence still goes to prove that man is not naturally, in any measure, a flesh-eating animal.

836. We therefore remain without a determinate solution to our question, and are called upon to push our investigations still further in pursuit of more decided and conclusive evidence. And fortunately for us, that evidence is near at hand, and just where we should expect to find it, and where we ought first to have looked for it, and were we

should first have looked for it, if our minds had neither been sophisticated nor misled by education, custom, and depravity. In the order next below man, we find several species of animals whose alimentary organs in all respects very nearly resemble those of the human body; and in the species which comes nearest to man in general organization and appearance, the alimentary organs in almost every particular so nearly resemble those of the human body, that they are easily mistaken for them. And few, who are not in some measure acquainted with comparative anatomy, would be apt readily to detect the distinguishing differences. The number and order of the teeth in the orang outang are the same as in man. The incisors or front teeth (Fig. 56) are precisely like those of the human head; the cuspids or corner teeth are relatively longer and more pointed, and are separated from the other teeth by small spaces (817), and in all respects approach much more to the appearance of the cuspids of carnivorous animals than the corner teeth of man do. The cheek teeth, like the incisors, so much resemble those of the human head, that it is difficult to distinguish them. The only difference is that the elevations on the grinding surfaces of the orang outang's teeth are somewhat more prominent and pointed. The articulation of the under jaw, the form of the stomach, the comparative length of the alimentary canal, the relative capacity of the cœcum, and the cellular arrangement of the colon, in the orang outang, all likewise correspond very closely with those of the human body. As a general statement, however, the comparative length of the alimentary canal is somewhat greater in man than in the orang outang. Excepting, then, that the cuspids are relatively longer and more pointed and separate, and the cheek teeth somewhat more trenchant, and the alimentary canal rather shorter, in the orang outang than in man, the resemblance between the alimentary organs of these two species of animals is perfect.

Fig. 55.



The first or infant teeth of an orang outang, considerably reduced in the drawing.

837. In the other species of monkeys the cuspids are relatively longer and more pointed, and the cheek teeth more trenchant or sharp-pointed at the corners than in the orang outang. In the baboon the cuspids are large, long, and powerful weapons of offence and defence, and in all respects resembling the corresponding teeth in purely carnivorous animals.

838. In strictest accordance with the established principles in the science of comparative anatomy, then, the alimentary organs of the orang outang are to be regarded as the true type (813) with which we are to compare those of the human body, in order to ascertain the natural dietetic character of man. But we have seen (836), that in all that the organs of the orang differ from those of man, they bring the orang between man and carnivorous animals, and thus, as it were, push man still farther from a carnivorous character (813). Yet it is

well known that not only the orang outang, but all the other species of monkeys, are, in a perfectly pure state of nature, when left free to choose their own nourishment and follow their undepraved instincts, wholly *frugivorous* or fruit-eating animals, subsisting exclusively on fruits, nuts, and other esculent farinaceous vegetables. And they never in such a state of nature, feed on animal food, except in circumstances in which even the cow and the sheep become carnivorous, viz., when suffering from extreme famine, and goaded on by excessive and tormenting hunger. In such emergencies, monkeys, cows, sheep, and probably most other animals, will greedily devour such animal substances as fall in their way, or such as they are able to obtain.*

839. But it is said that the orang outang, on being domesticated or brought under the care of man, readily learns to eat animal food, and soon discovers more fondness for it and devours it more greedily than it does any kind of vegetable food; and hence, it is inferred that this animal is naturally omnivorous, and confines itself to fruits, etc., in a state of nature, only because it is unable to procure animal food in a condition adapted to its organization and alimentary wants. But this inference involves a monstrous absurdity; for it asumes that God has constituted an animal with certain alimentary wants, and endowed it with corresponding instincts, without giving it the necessary mental and volunary powers to obey those instincts and supply those wants. Besides, if the fact that the orang outang readily learns to eat animal food, proves that animal to be naturally omnivorous, then the horse, cow, sheep, etc., are all naturally omnivorous animals; for every one of them is easily trained to eat animal food, and to subsist on a mixed diet. Indeed, they readily become so accustomed to this artificial mode of living as greatly to prefer their prepared dishes of beef-steak, toast and coffee, to their own natural diet of grass or hay and water. 'In Norway, as well as in some parts of Hadramant and the Coromandel coasts, the cattle are fed upon the refuse of fish, which fattens them readily, but seems at the same time totally to change their nature, and render them unmanageably ferocious.'† Horses have frequently been trained to eat animal food, so as to demand it with great eagerness, and devour it greedily; and sheep have often been so accustomed to animal food, that they would wholly refuse to eat grass. By this dietetic change, the physiological condition of the digestive organs may be so affected, that if the animal be suddenly deprived of this diet, and exclusively confined to its own natural and proper food and drink, it will at first droop exceedingly, and perhaps become sick, and in some instances die.

840. It is also true that the lion, the tiger, and other carnivorous and predaceous animals, may be trained to a vegetable diet, and learn to live on vegetable food alone; and it is an interesting fact, that if the young of these animals be taken before they have ever tasted flesh

* The inhabitants of Nantucket used to keep many sheep and cows upon the island, without making any provision for them during the winter; and I have frequently been assured by many of the intelligent people of the island, that when the ground was covered with snow, it was a common thing for the cows and sheep to come into the town, and, like swine, greedily devour every animal as well as vegetable substance they could find in the streets,—even pulling up and consuming pieces of fish-skin and other animal substances which were trodden down and frozen into the ground.

† Life of Reginald Heber, HARPER'S FAMILY LIBRARY, No. 40, p. 360.

and carefully trained to a vegetable diet till they are grown up, they will discover no desire for flesh-meat. A friend of mine took a young kitten, and carefully trained it to a vegetable diet. It did well, and became a fine cat, remarkable for its strength and activity. When it was fully grown, flesh was put before it, but the cat would not touch it; and although the cat was an excellent mouser, yet it was never known to devour or eat any part of its prey; but, having killed the rats and mice which it caught, it would always bring them into the kitchen and lay them down at the feet of some member of the family, and there leave them. By slow degrees, however, this cat was trained to eat a portion of flesh with its dinner, and after a while appeared to relish it well: yet if flesh was offered to it in the morning or evening, it would not touch it; and this cat continued to refuse flesh-meat at all other times except at its dinner. Since this experiment, several others have been made with similar results. In one instance, after the cat was grown up, it was occasionally fed with flesh, and was invariably made sick by it.

841. In this manner, all carnivorous animals, among beasts and birds, can be trained to a vegetable diet. And it is worthy of remark, that this class of animals can be brought to subsist exclusively on vegetable food with less physiological inconvenience and greater safety to life and health, and much less deterioration of the constitution as a permament effect, than herbivorous and frugivorous animals can be brought to live exclusively on animal food. Hence, therefore, if the fact that the orang outang and other species of monkeys can be trained to subsist on a mixed diet of vegetable and animal food, proves them to be naturally omnivorous (839), then is it equally proved that the lion, tiger, cat, eagle,* and other predaceous animals, and the horse, cow, sheep, and other herbivorous animals, are all naturally omnivorous. But no enlightened and honest mind will for a moment admit that any of these animals are naturally omnivorous.

842. It is therefore perfectly certain, that the whole evidence of comparative anatomy, when correctly apprehended and accurately estimated goes to prove determinately that man is naturally a *frugivorous* animal. And thus it appears that the true evidence of comparative anatomy, and the ancient Mosaic record of the natural history and dietetic character of man, perfectly agree. That record explicitly asserts that in the truly natural state of man, ere he had transgressed any of the laws of his nature, he subsisted, according to Divine adaptation and appointment, wholly upon the fruits of trees and the seeds of herbs (769, 770), or upon fruits and farinaceous vegetables.

843. For more than two years, I had in my public lectures, presented the foregoing arguments in regard to the natural dietetic character of man, before I was aware that similar views had been published by others; as my own knowledge on the subject had been derived almost entirely from actual examinations in comparative anatomy, and from the oral information of living travellers. I have since, however, in the course of my general researches, most unexpectedly and agreeably fallen upon the testimony of several distinguished men, which, so far as the evidence of comparative anatomy is considered, fully corrobo-

* The eagle has been trained to live entirely on vegetable food.

rates my reasonings and conclusions. The sum of that testimony I shall therefore now present, not because I think truth is rendered the more valuable by the adjunct of even the most distinguished of human names, but because I am fully aware of the deeply humiliating fact that mankind generally are far more ready to bow to the authority of a name, than to yield to the evidence of truth. Before an individual has gained a moral sovereignty over the minds of his race, his evidence, however incontestible, and his reasoning, however irrefragable, are weighed and measured by the obscurity of his name; and he is sneered at as being contemptible in proportion as his opinions lack the authority of great names. In this state of things, integrity, research, science, philosophy, fact, truth, are no shield against the misrepresentations and ridicule and abuse which are heaped upon him. But if by any means he can gain a conquest over men's minds, he may sit down upon the throne, and wield the sceptre of intellectual despotism; and then his word is law, to which mankind submit with zealous alacrity, as if each were emulous to be nearest to the chariot-wheels of such a despot, in his triumphal progress through the world; while few concern themselves to enquire whether that word of authority is sustained by truth or not. Nevertheless, such are the scientific attainments and the general knowledge and integrity of some men, that their opinion on subjects to which they have given great attention, is worthy of high consideration; and when such men are compelled by the force of irresistible evidence to come to conclusions and acknowledge principles which do not accord with their preferences, nor correspond with their practices, the testimony merits a still higher respect.

844. Linnæus, the distinguished naturalist, who flourished about one hundred years since, speaking of the natural dietetic character of man, says that his organization, when compared with that of other animals, shows that 'fruits and esculent vegetables constitute his most suitable food.'

845. Sir Everard Home says, 'While mankind remained in a state of innocence, there is every ground to believe that their only food was a produce of the vegetable kingdom.'

846. Baron Cuvier, who is perhaps the highest human authority on any question in comparative anatomy, says, 'The natural food of man, therefore, judging from his structure, appears to consist of fruits, roots, and other succulent parts of vegetables; and his hands offer him every facility for gathering them. His short and moderately strong jaws on the one hand, and his cuspidati being equal in length to the remaining teeth, and his tubercular molares on the other, would allow him neither to feed on grass nor devour flesh, were these aliments not previously prepared by cooking.'

847. Professor Lawrence, of England, agrees fully with Baron Cuvier, and justly observes that 'physiologists have usually represented that our species holds a middle rank in the masticatory and digestive apparatus, between carnivorous and herbivorous animals; a statement which seems rather to have been deduced from what we have learned by experience on this subject, than to have resulted fairly from an actual comparison of man and animals.' After having accurately compared the alimentary organs of man with those of carnivorous, herbivorous, and frugivorous animals, he correctly remarks that 'the

teeth of man have not the slightest resemblance to those of carnivorous animals, except that their enamel is confined to the external surface (818). He possesses indeed teeth called canine, but they do not exceed the level of the others, and are obviously unsuited for the purposes which the corresponding teeth execute in carnivorous animals. Whether, therefore, we consider the teeth and jaws, or the immediate instruments of digestion, the human structure closely resembles that of the semiæ or monkeys, all of which, in their natural state, are completely frugivorous.'

848. Mr. Thomas Bell, lecturer on the anatomy and diseases of the teeth, at Guy's Hospital, and surgeon-dentist to that institution, in his 'Physiological Observations on the Natural Food of Man deduced from the Character of the Teeth,' says, 'The opinion which I venture to give has not been hastily formed, nor without what appeared to me sufficient grounds. It is not, I think, going too far to say, that every fact connected with human organization goes to prove that man was originally formed a frugivorous animal, and therefore probably tropical or nearly so, in his geographical situation. This opinion is principally derived from the formation of his teeth and digestive organs, as well as from the character of his skin and general structure of his limbs. If analogy be allowed to have any weight in the argument, it is wholly on the side of the question which I have just taken. Those animals whose teeth and digestive apparatus most nearly resemble our own, namely, the apes and monkeys, are undoubtedly frugivorous.

849. With such conclusive evidence from comparative anatomy, and so full an acknowledgment from the most distinguished naturalists, anatomists, and physiologists, the question in regard to the natural dietetic character of man might reasonably be supposed to be fairly and fully settled; yet surprising as it may appear, even Baron Cuvier, after declaring that the evidence of comparative anatomy proves man to be naturally a frugivorous animal, and that his masticatory organs would allow him neither to feed on grass nor devour flesh, were these aliments not previously prepared by cooking, adds that 'man once being possessed of fire, and those arts by which he his aided in seizing animals, or killing them at a distance, every living being was rendered subservient to his nourishment, thereby giving him the means of an infinite multiplication of his species.' And Professor Lawrence, with a full admission of the completeness of the anatomical evidence in favor of man's frugivorous character, and a frank acknowledgment that the general history of the human race proves that animal food is not necessary to render man strong and courageous, and that vegetable food is as little connected with weakness and cowardice; that men can be perfectly nourished and their bodily and mental capabilities fully developed, in any climate, by a diet purely vegetable, still contends that man does quite as well, and perhaps better, on a mixed diet of vegetable and animal food: and occasionally indulges in a sneer against those who favor the idea that a pure vegetable diet is best adapted to sustain the human system in all its properties and powers. In attempting to sustain this opinion, however, he misapprehends many facts, perverts many others, assumes false positions, makes wrong inferences,

arrives at erroneous conclusions, and not unfrequently contradicts himself.*

850. Were it not for the well known truth that the depraved appetites and propensities of man continually exert such a perverting influence upon his intellectual and moral powers (620) as lead him, through the misapprehension of facts, and unfair estimation of evidence, and fallacious conclusions, into the most egregious errors and absurdities, for the sake of defending and supporting those favorite opinions which are founded in sensual gratification, it would be exceedingly difficult to account for the many erroneous notions and absurd speculations which have been entertained by very intelligent men in regard to the natural history of the human species.

851. Since the advocates for the omnivorous character of man have found themselves compelled to acknowledge that the evidence of comparative anatomy is wholly and powerfully against them, they have mainly planted themselves on two positions. The one is, the peculiar quality of the gastric secretion in man, or the solvent fluid of the human stomach; and the other is, the peculiar intellectual and voluntary powers of man.

852. It is said that the stomach of every animal secretes a solvent fluid possessing precisely the properties requisite for the digestion of the natural food of the animal, and wholly inefficient on other kind of food. Thus we are told that 'the gastric juice of carnivorous animals readily digests flesh, but will not digest vegetable substances; while, on the other hand, the gastric juice of herbivorous animals readily digests grass and other vegetable substances, but will not digest flesh; and therefore the gastric secretion or solvent fluid of the stomach,

* As a specimen of Mr. Lawrence's contradictory statements, take the following paragraphs selected from different pages of his works.

'That animal food renders man strong and courageous, is fully disproved by the inhabitants of northern Europe and Asia, the Laplanders, Samoides, Ostiacs, Tungusees, Burats, and Kamtschadales, as well as by the Esquimaux in the nothern and the natives of Terra del Fuego in the southern extremity of America, which are the smallest, weakest, and least brave people on the globe, although they live almost entirely upon flesh, and that often raw.

'Vegetable diet is as little connected with weakness and cowardice as that of animal matter is with physical force and courage. That men can be perfectly nourished, and their bodily and mental capabilities fully developed, in any climate, by a diet purely vegetable, admits of abundant proof from experience. In the periods of their greatest simplicity, manliness, and bravery, the Greeks and Romans appear to have lived almost entirely on plain vegetable preparations.

'If the experience of every individual were not sufficient to convince him that the use of animal food is quite consistent with the greatest strength of body and mind, the truth of this point is proclaimed by the voice of all history. A few hundreds of Europeans hold in bondage the vegetable-eating millions of the East. We see the carnivorous Romans winning their way from a beginning so inconsiderable, that it is lost in the obscurity of fable, to the empire of the world, etc.'

Here we have it first stated and proved, that flesh-eating is not conducive to strength and courage; and secondly, stated and proved that a vegetable diet does not make men weak and cowardly, but that vegetable-eaters may be brave and powerful and heroic. And in the third place, it is asserted that a few hundreds of Europeans, because they are flesh-eaters, are able to hold in bondage the millions of the East, because they are vegetable-eaters. And the Romans, who are exhibited as vegetable-eating heroes in the second paragraph, are made to figure as carnivorous conquerors in the third. But this is quite as consistent as the reasoning of any who attempt to prove the carnivorous character of man, from anatomy, physiology, or experimental fact.

fully and unequivocally determines the natural dietetic character of the animal. But the solvent fluid of the human stomach readily digests both animal and vegetable food, therefore man is naturally an omnivorous animal.'

853. This position is so manifestly contrary to truth and fact that it would be unworthy of notice, had it not been advanced by men of considerable reputation in the scientific world, and reiterated by many who have much influence on the popular mind. Yet superficial and preposterous as it is, it is eagerly embraced by those who are determined by any means and by all means possible, to defend those habits which they regard as necessary to their highest sensual enjoyment.

854. The truth is, that though everything in nature is constituted into fixed principles (140, 144) and with determinate relations, yet in the organic world every constitution has a considerable range or compass of physiological capabilities; and although every organ in every animal has its determinate physiological character and precise constitutional adaptation (687), yet every organ possesses a physiological adaptability by which it is capable, to a certain extent, of varying from its truly natural constitutional adaptation, and still not so far impair its functional power and results as to interrupt the general vital economy of the system, or suddenly to destroy the vital constitution. Hence, whenever the physiological habits of the system are disturbed, or its particular or general condition is affected, every vital organ always endeavors to adapt itself to the requisition of circumstances; and the power and extent of adaptability in each organ, and its efforts to adapt itself to the requisition of circumstances, always correspond with the functional character and relations of the organ. This being a wise and benevolent provision of the Creator for the preservation of life, and especially with reference to the alimentary wants of living bodies, while the digestive organs are constituted and endowed with the most perfect natural adaptation to certain kinds of aliment (724), yet, to secure life as far as possible against emergencies, these organs possess the physiological capability of adapting themselves to an extensive variety of alimentary substances, as circumstances and necessities require; and, therefore, the extent of the physiological adaptability of the digestive organs is probably much greater than that of any other organs in the system.

855. Possessing these physiological powers, the human stomach, if it be regularly supplied with an exclusively vegetable diet, will soon become adapted to such a diet, and secrete a solvent fluid most perfectly qualified for the digestion of it; and if the diet be suddenly changed to one of flesh-meat exclusively, the stomach will not be prepared to receive it, and will not at first be able to digest it, but it will cause vomiting and purging, and other symptoms of physiological disturbance. Yet if the flesh diet be commenced by degrees, and regularly continued, the stomach will soon become adapted to it, and secrete a solvent fluid most perfectly qualified to digest it; and if the diet be again suddenly changed to an exclusively vegetable one, similar disturbances will take place; but if vegetable food be gradually introduced with the flesh-meat, the stomach will soon become adapted to a mixed diet, and secrete a solvent fluid qualified to digest it.

856. Now if this physiological adaptability were peculiar to the

human stomach, it would certainly go very far towards proving that man is naturally an omnivorous animal; but when we know that it is common to the horse, ox, sheep (839), lion, tiger, cat, dog (840), and indeed to all the higher classes of animals (841), and perhaps to the whole animal kingdom, we see that it proves nothing but the wonderful resources of animated nature, and the wisdom and benevolence of God. Both carnivorous and herbivorous, as well as frugivorous animals generally, in the higher classes at least, possess this scope and versatility of digestive power, nearly or quite as extensively as man; and therefore if it proves man to be naturally omnivorous, it equally proves the lion and the ox, the vulture and the lamb, and other animals generally, to be naturally omnivorous. For, as we have seen (839), even the sheep may become so accustomed to a flesh diet, that it will refuse its natural food; and if it be suddenly put upon its natural food, it will at first be unable to digest it (855).

857. Let it be remembered, however, as a very important physiological truth, that although the stomach generally possesses the power of adapting itself to the alimentary substances with which it is regularly supplied, and can at one time secrete a solvent fluid best qualified to digest animal food, and at another time secrete a solvent fluid best qualified to digest vegetable food, according to the character of the diet, and can also be trained to secrete a solvent fluid which will digest food composed of both vegetable and animal substances, yet neither the human stomach nor that of any other animal is capable of secreting a solvent fluid which, at the same time, is equally well qualified to digest both vegetable and animal substances. That is, the solvent fluid of the stomach accustomed to a mixed diet of the two substances, cannot digest flesh so well as the fluid of a stomach accustomed only to a flesh diet, nor vegetable substances so well as the fluid of a stomach accustomed only to a vegetable diet. Not even the stomach of the bear nor of the hog, which are as truly omnivorous animals as any in nature, can digest both vegetable and animal substances together at the same time, so well as it can digest each of them separately and at different times.

858. It is also true as a general physiological law, that where the stomach is accustomed to a mixed diet of vegetable and animal food, in proportion as animal food abounds and predominates in the diet, the power of the stomach to digest vegetable substances is diminished. Hence, among those portions of the human family that subsist on a mixed diet, children, before they become much accustomed to flesh-meat, will eat almost every variety of fruits and vegetables, with the greatest freedom and with little sensible inconvenience; but as they advance in life, and become accustomed to a free use of flesh-meat, and gradually increase its proportion in their diet, they find themselves obliged to become more and more careful and circumscribed in their use of fruits and other vegetable substances, till they often become unable to partake of any vegetable matter except bread and perhaps boiled rice and potatoes, or some other simple farinaceous article. Yet after all this, these very individuals, by an abandonment of flesh-meat and the adoption of a correct general regimen, may again return to their youthful enjoyment of fruits and vegetable substances generally.

859. The position that man is rendered naturally omnivorous by the

possession of peculiar intellectual and voluntary powers (851), is perhaps less obviously, but not less essentially, erroneous and absurd, than the one just considered (852). Man, we are told, is endowed with REASON, and therefore he is not, like other animals, a mere creature of instinct, but he is capable of thinking, reflecting, and judging, and of acting from the dictates of his judgment; and consequently, what he finds deficient in the adaptations of nature to his wants, he makes up in the rational exercise of his voluntary powers. Hence, though, 'judging from his structure (846), his *natural* food appears to consist of *fruits, roots, and other esculent parts of vegetables;* though neither the length nor the strength of his jaws fit him for subsisting on herbs, nor the character of his teeth for devouring flesh, were these aliments not previously prepared for cooking; yet being able, by the exercise of his rational and voluntary powers, to catch and kill animals, and to cook his food with fire, every living being is rendered subservient to his nourishment, thereby giving him the means of an infinite multiplication of his species.'

860. If the meaning of this language were simply a predication of the physiological capability of man to adapt himself to a mixed diet of vegetable and animal food, or to derive nourishment from almost every vegetable and animal substance in nature, the living demonstration of its truth from the flood to the present day would render it unquestionable. But if it means to affirm that the rational and voluntary powers of man render him capable of adapting things to his physiological powers which are not naturally adapted to them, so as to make them as perfectly congenial to his nature as things naturally adapted, it is utterly erroneous, and discovers a very superficial and limited knowledge of animal physiology (763).

861. Let us test this principle in another application. The natural drink of man appears to be water, or the juice of fruits, as in a pure state of nature he has no other beverage prepared for him. But, once acquainted with the arts of brewing and distilling, he is enabled to manufacture as much intoxicating liquor as he wants, and can drink and be merry when he chooses. Now it is perfectly obvious that this is only a statement of what is true in regard to the mental and voluntary power of man to manufacture intoxicating liquors, and in regard to his physiological power so far to adapt himself to the use of them as a beverage, as to be able to drink them pretty freely without destroying life for many years. But to carry out the principle, we must go further and assert that, because man possesses these powers, he is set free from the law of instinct, which guides the lower animal to the pure fountain or stream of water to slake his thirst, and is made more godlike in the rational privilege of drinking a generous beverage which his own superior reason has enabled him to prepare for himself; and consequently, such a beverage is more congenial to his wants, and better fitted to develop the best powers of his nature; and therefore, while the lower animals, from birth to death, from generation to generation, are bound by the law of instinct to pure water as their natural drink, more godlike man is made free, by his reason, to regale himself with every beverage that he has the ingenuity and the ability to devise and prepare (598)

862. This reasoning would undoubtedly be received with high acclaim as soundest logic and philosophy, by multitudes of human beings

whose rationality is perverted by the influence of depraved, sensual appetite (598). But is it the true logic of sound physiology? We know that it is not. And yet it is quite as much so as the logic of those who endeavor to show that the reason of man not only lifts him above the law of instinct, but enables him with impunity, and even with advantage to his whole nature, to transgress that law at pleasure. Such philosophers ought to know that human reason is not substituted for animal instinct, but superadded to it, and established on the same constitutional laws (597), not for contrary, but for the same and higher accordant purposes. And they may with as much truth deny the perfect harmony between the natural and moral attributes of the Deity himself (603), as to deny the perfect correspondence between sound reason and pure natural instinct (761, 763).

863. No physiologists, I presume, will deny that the instincts of the lower animals are founded on the physiological wants of the body, and established in perfect accordance with all the physiological powers and interests of the organized system to which they belong, and with the most determinate regard to the highest well-being of the individual and the species; and therefore, the law of instinct is not only a safe rule of action to the brute animal, but a strict conformity to it is essential to his highest welfare, and all deviation from it must be in some measure detrimental to him. Hence, though the horse, ox, sheep, and other herbivorous animals (859), can, by the exercise of the mental and voluntary powers of man, be trained to eat flesh and chew tobacco and drink ardent spirit, till they learn to love them, and greatly prefer them to their own natural diet, and feel dissatisfied and depressed and wretched without them, and languish and droop if they are suddenly withheld, and become so accustomed to them, and feel so dependent on them for comfort and enjoyment, that if they possessed the mental and the voluntary power, they would most certainly continue the use of them through life, and teach their progeny to do the same, yet in all that these habits differ from the pure natural dietetic habits of those animals, and deviate from the law of undepraved instinct in them, they must be detrimental to the constitutional nature of those animals; and none the less so, because the reason of man has been employed in creating and cherishing these habits; nor would they be any the less so, if the rational and voluntary powers of man were superadded to the natural instincts of the brute, and he should create and cherish them by the exercise of his own powers. But we have seen (761) that, as an animal, man is constituted with the same physiological powers and upon the same great physiological principles as those which pertain to the constitutional nature of the horse, the ox, and other animals; and that the faculties of instinct in man (762) are as determinate in their functional character, and established with as fixed and precise relations to the physiological wants and interest of his nature, as those of the lower animals are; and hence, in all that concerns the interests of organic life and animal existence, man is subject to the same general laws as those which govern the lower animals.

864. Suppose a man and a horse to be standing together by a barrel of ardent spirit. The two animal bodies are constituted upon the same organic principles, have the same general tissue (156), which are endowed with the same vital properties, and arranged into similar organs,

which have the same elements of functional power (312), and the same physiological relation to the nature and qualities of the ardent spirit. The horse has not the reasoning power to devise, nor does he know that he possesses the voluntary power to execute, any plan by which he can draw a quantity of that spirit from the barrel, and drink it; but the man possesses both the rational and voluntary powers requisite for such a transaction. Now, can any truly rational being believe for a moment, that, in such a case, the possession of reason by the man, or rather the possession of rational faculties, can so nullify the physiological law of relation between his organic system and the nature and properties of the ardent spirit, as that, if he drinks it, it will be less detrimental to the functinal powers of his organs, the vital properties of his tissues, and the general physiological interests of his system, than it would be to the horse? Yet this is a true illustration of the principle which they assume, who assert that man is naturally an omnivorous animal by virtue of his reason.

865. If man is not organized to eat flesh in its natural state (846), and if flesh-meat is not congenial to the highest physiological interests of his nature, then no power of reason by which he is enabled to prepare flesh-meat and get it into his stomach, can render it suitable food for him, or make him *naturally* an omnivorous animal; nor yet can it make him artificially an omnivorous animal, without detriment to all the physiological properties, powers, and interests of his nature. The question is not simply, what substances man can contrive to get into his stomach, and so adapt himself to them as to feel and believe they are very comfortable to him, but what substances are adapted to his stomach and other organs, and to all the vital interests of his system? There are many substances in nature which man can, by artificial means, bring into such a condition as that he will be able to masticate and swallow them, but this is far from proving that all such substances may thereby be rendered subservient to the healthy nourishment and sustenance of his system. In everything that relates to the dietetic habits of man, therefore, his reason must strictly accord with the pure law of his natural and undepraved instincts, or it is not true reason, but an erroneous exercise of his rational faculties; unless his deviation from that law be a case of necessity from the force of circumstances. For, as we have seen (725), while man is created to be the lord of the earth, and to occupy all portions of it, and is constituted with a wide range of adaptability to meet the exigencies of the circumstances and conditions in which he may be placed, yet it is always of necessity under this great and immutable law, that, in proportion as he turns aside from the truth of his natural and perfect constitutional adaptation, and educates himself, by virtue of his constitutional adaptability, to habits, circumstances, and conditions less adapted to the truth of his constitutional nature, he impairs all the powers of that nature, diminishes the general sum of his enjoyment, and abbreviates the period of his earthly existence (763).

866. We see, therefore, 1. That the whole evidence of comparative anatomy goes to prove that man is naturally a frugivorous animal (842); 2. That the physiological capability of man to subsist on a mixed diet, and to derive nourishment from almost every substance in the vegetable and animal kingdoms, is not peculiar to man, but is common to all th

higher classes of animals, and therefore affords no determinate evidence in relation to the natural dietetic character of man, and only proves the wonderful resources of animated nature, and the wisdom and benevolence of God (856) ; and, 3. That human reason is not a substitute for animal instinct, but superadded to it, not to nullify, but to sustain its laws, and to act in conformity with its pure dictates in supplying the alimentary wants of the body ; and therefore the rationality of man neither lifts him above the physiological laws and relations of his animal nature, nor enables him to transgress those laws with impunity (763) ; and consequently, the rationality of man in no measure determines his natural dietetic character. The evidence, therefore, which remains to be considered, and by which the grand problem before us is to be conclusively solved, is purely physiological, and is derived from the comparative effects of vegetable and animal food in nourishing, developing, and sustaining the human system in all its physiological and psychological properties, powers, and interests.

867. Notwithstanding the whole evidence of comparative anatomy goes to prove that man is naturally in no measure a flesh-eating animal (842), yet it is a notorious fact that he *can subsist* almost entirely on animal food (778), and that a considerable portion of the human family have partaken of it more or less freely ever since the flood ; and so far as observation has been made, there appears to be about an equal measure of health, vigor, and longevity, among all the different portions of the race, whether they subsist exclusively upon vegetable or animal food, or upon a mixed diet of the two (15). Hence, it is inferred that man has the physiological capability of subsisting, with equal benefit to his nature, upon either or both kinds of aliment, according to the necessity or convenience of circumstances or situation ; and, therefore, it is asserted that the diet of man is to be determined by the climate in which he dwells, and that he will always find that food best for him which is most congenial to the climate, whether it be purely vegetable, as in the torrid zone, or purely animal, as in the frigid zones, or a mixture of the two, as in the temperate zones.

868. But we have seen (857) that this physiological capability is common to carnivorous, herbivorous, and frugivorous animals ; and it is entirely certain that all these animals, if they were once accustomed to a mixed and artificially prepared diet, and endowed with sufficient mental and voluntary powers (762) to procure and prepare such a diet for themselves, would continue such dietetic habits from generation to generation, till they would learn to consider such a diet as both natural and necessary. Yet would all this aberration from nature prove these animals to be naturally omnivorous? Certainly not! And as certainly the extensiveness and long continuance of omnivorous habits in man, do not and cannot prove the human species to be naturally omnivorous.

869. It is however contended, that the fact of man's being so extensively, not to say universally, omnivorous, proves that he is instinctively led to eat flesh-meat whenever he can get it, and therefore it is as truly his natural aliment as fruit is. But this shows how carelessly and superficially men observe facts, and with what extreme looseness they reason on this important subject. Indeed they almost always *feel* their way to their conclusions, rather than arrive at them by rigorously

Inductive reasoning, and consult their appetites more than they examine evidences. Tobacco is quite as extensively used by human beings as flesh-meat is (768), and those who are accustomed to the use of it would a thousand times sooner relinquish their flesh-meat for ever, than to abandon their tobacco. Yet no one, I presume, will contend that this proves man to have a natural instinctive desire or appetite for tobacco, and that tobacco was made for the use to which man has appropriated it. We know that man has naturally a deep and utter loathing of tobacco, and that he is obliged to overcome the most powerful antipathy of his nature in adapting himself to the use of it; but if every human being were trained to the use of tobacco so early in life and by such delicate and imperceptible degrees that we could not appreciate nor remember the first effects of it upon the system, it would be almost impossible for us to believe that man has not a natural instinctive desire and necessity for it.

870. It is precisely so in regard to flesh-eating. All who have perfectly sanctified themselves from animal food, and restored their instinctive faculties of smell and taste to something of their native purity, well know that flesh-meat is most loathsome to them. And if any number of human children were born of vegetable-eating parents, and nursed by vegetable-eating mothers, and at a proper age accustomed to a purely vegetable diet, and never permitted to smell animal food when cooking, nor to see others eat it, every one of them—if there were millions —would at first discover strong loathing if flesh-meat were given them for food, and they would spit it from their mouths with as much disgust as they would tobacco. But when children are born of flesh-eating parents, and nursed by flesh-eating mothers, and are habituated from the hour of their birth to the savor and the odor of animal food, in the nourishment which they derive from the mother's breast, in the respiration and the perspiration of their parents and others around them, and in the fumes of the kitchen and the table, and are accustomed to be fed with animal substances in their infancy, and to see their parents and others devour flesh-meat at almost every meal, they, as a matter of necessity, become depraved in their natural instincts, and almost as a matter of necessity discover an early fondness for animal food. So in the East, where every human being smokes, it is nearly a universal custom for nursing mothers, every few minutes, to take the pipe from their own mouths and put it into the mouths of their sucking infants. The necessary consequence is that all those children early discover the greatest fondness for the pipe, and seize and suck it with excessive eagerness whenever it is presented to them; and they are exceedingly discontented and fretful and unhappy if it is withheld from them; and therefore, according to the logic of those who would prove man to be naturally omnivorous from his dietetic habits, it is natural and proper for those infants, and for all human beings, to smoke, chew, and snuff tobacco.

871. The truth is, as we have seen (761), all animal beings, including man, are constituted upon certain physiological principles, out of which grow certain physiological wants; and upon these wants are established certain faculties of instinct, with determinate relation to the nature and qualities of the appropriate supplies (690). These faculties, while preserved in their integrity, are a law of truth to all; but they are

capable of being depraved and rendered totally blind guides, which lead to the most pernicious errors (694, 697). The lower animals have neither the mental nor the voluntary powers to deprave their natural instincts to any considerable extent, and therefore they remain from birth to death, and from generation to generation, subject to the law of instinct, and with little deviation from their truly natural dietetic habits (598). But man, possessing the mental and voluntary power to deprave his natural instincts, has exercised that power so freely and so extensively, that he no longer seems to be able to discriminate between his truly natural and his depraved instincts and appetites, nor to distinguish his artificial from his natural wants. Let it be remembered, however, that the whole range of physiological adaptation in man and other animals, admits of little variation from the great law of relation in regard to the proportions of nutritious and innutritious matter in the alimentary substances on which the animal subsists, or to which the animal becomes adapted (739).

872. As to the statement that the different portions of the human race appear to have enjoyed about an equal amount of health, vigor, and longevity, whether their food has been purely vegetable or purely animal, or a mixture of the two (867), let it be understood that, so far as we are informed, no considerable portion of the human family ever intelligently adopted any particular mode of living, upon clear and well ascertained physiological principles, and consistently and perseveringly, from generation to generation, adhered to a course of diet and general regimen conformable to all the laws of life; but, on the contrary, nearly every thing in the nature, condition, and circumstances of man, from the first transgression to the present hour, has served to fix his attention continually on present enjoyment (32), with no further regard to future consequences than experience has taught him to be necessary, in order to avoid sudden destruction or intolerable distress; and hence, as we have seen (639), the grand experiment of the whole human family seems ever to have been to ascertain how far they can go in indulgence, how near they can approach the brink of death and yet not die so suddenly and violently as to be compelled to know that they have destroyed themselves. Whether therefore men have subsisted wholly on vegetable or on animal food, or on a diet consisting of both, they have done so without any regard to correct physiological principles, either in relation to the quality, quantity, or condition of their food; or in relation to other physiological wants and habits of body, which are nearly as important to the general welfare of the system as the quality and condition of the food. If their climate and circumstances have been less favorable than others to health, vigor, and longevity, they have learned from experience how far, as a general rule, they must restrain their indulgences, and in what manner they must regulate their habits and appetites, so as to secure life long enough for one generation to become the progenitors and nurturing protectors of another generation (643). And if their climate and circumstances have been more favorable than others to health, vigor, and longevity, they have also learned from experience how far they may go in indulgence, and still keep within the bounds necessary for the perpetuation of the race. So that, in all cases, as a general rule, what they have wanted in natural advantages, they have made up in correctness of

habits, and what they have possessed in natural advantages, they have squandered in erroneousness of habits. If their climate has been salutary, they have indulged the more freely in dietetic and other excesses. If their food has been congenial to their nature, they have balanced or counteracted its good effects by other things unfavorable to health and vigor and longevity; and, in this way, the whole human family,—whether inhabiting frigid, torrid, or temperate zones, whether dwelling on high mountains or in low valleys, whether residing in ceiled houses, or living in tents or in the open air,—whether subsisting on animal or vegetable food, or on a mixed diet of the two,—whether using their food in its simplest and most natural state, or cooked and prepared in the most complicated manner,—whether confined to simple food and water, or indulging in every variety of condiments and stimulating and intoxicating liquors and substances (768), whether moderate or excessive in quantities,—whether cleanly or filthy,—whether chaste or lewd —whether gentle or truculent,—whether peaceful or warlike,—have, in the great experiment to ascertain how much indulgence the human constitution is capable of sustaining without sudden destruction, so balanced their good and evil as to preserve throughout the world and for many centuries, very nearly a general and uniform level in respect to health, vigor, and longevity. This statement, however, is general, and admits of many particular exceptions of individuals and sects and societies and perhaps tribes; but these exceptions in no case militate against its truth as a general statement, nor against any of the facts on which it is predicated; for these are all most indubitably true, and the general reasoning and induction from them are irrefragably correct; and the whole is of so much importance to a correct understanding of the phenomena of human history with reference to physiological principles, that it ought continually to be borne in mind as we proceed with our investigations on the subject before us, and especially in ascertaining and appreciating the physiological evidence of the natural dietetic character of man.

873. The fact, then, that a large portion of the human family actually have, for many centuries, and probably ever since the flood, subsisted to a greater or less extent on animal food, or on a mixed diet of vegetable and animal food, and apparently done as well as those who have subsisted wholly on a vegetable diet, does not in any degree invalidate the evidence of comparative anatomy that man is naturally and purely a frugivorous animal (842).

874. In entering upon the consideration of the purely physiological evidence in relation to the natural dietetic character of man (804), it is necessary that we should clearly understand and keep in view those nice physiological principles by which the character and force of the evidence are to be determined.

875. We have seen that the human body is formed from the common matter of the world (118), brought into organic arrangement and structure by vital forces acting in and by living organs (121), and that these organs are composed of several primary tissues which are endowed with certain vital properties, which constitute the elements of the functional power of the organs (312). These properties of the primary tissues have a certain range of increase and diminution consistent with the continuance of vital control. By some means they are exhausted, by

others they are replenished. When these vital properties are healthfully increased, there is always a corresponding increase of function, power, and activity, in the organ or organs to which the tissue belong; and when they are diminished, there is always a corresponding debility and sluggishness and langor of function. The action of all extrinsic laws and agents upon us (126) tends to exhaust our vital properties; and all our intrinsic actions and operations, both voluntary and involuntary, have an exhausting effect upon the acting organs (376). Even in the performance of those very functions which belong to the economy of nutrition, and which co-operate to replenish and repair the exhaustions and injuries of the system, each organ necessarily suffers some exhaustion of its vital properties and waste of its organized substance from its own particular action (687). Hence all our organic operations from birth to death, simultaneously carry on the two great processes of vital exhaustion and repletion, of organic composition and decomposition, of destruction and renovation (314).

876. Were the *constitutional principles* upon which this renovating capability of the vital economy depends, in themselves inexhaustible, then were these bodies of ours, even in the present state of being, capable of immortality; and by strictly obeying the laws of life, we might live on for ever, in the eternal ebb and flow of vital energy, and the unceasing incorporation and elimination of matter! But this is not so. The vital constitution itself wears out! The ultimate powers of the living organs, on which their replenishing and renovating capabilities depend, are, under the most favorable circumstances, gradually expended and finally exhausted (133).

877. Though the vital energies and sensibilities, therefore, which we exhaust to-day, are replenished to-morrow, yet of necessity the process has taken something from the measured fund of life, and reduced our vital capital in proportion to the frugality or the profligacy of our expenditure. However proper the nature and condition of our aliment, however completely all our laws of external relation are fulfilled, however perfectly the functions of our organs are performed, and however salutary their results, yet every digestive process of the stomach, every respiratory action of the lungs, every contraction of the heart, draws something from the ultimate and unreplenishable resources of organic vitality (687); and consequently the more freely and prodigally we expend the vital properties of our organs, the more rapidly we wear out the constitutional powers of replenishment, and exhaust the limited stock of life (875). Nothing can therefore be more dangerously fallacious than the opinion which is too generally cherished and too frequently promulgated, that our daily trespasses upon the laws of life are as the dropping of water upon a rock—wearing indeed, but so slowly and imperceptibly as scarcely to make a difference in the duration and in the comfort of our lives.

878. In explaining and illustrating the constitutional laws of external relation, I have stated (897) that every substance in nature from which the human body can derive nourishment, possesses specific and peculiar qualities which the human organs have vital powers to perceive and appreciate (726). Thus the visual properties of things are perceived by the special sense of sight (456); the auditory properties by the special sense of hearing (252); the olfactory properties, by the

special sense of smell (691); the gustatory properties, by the special sense of taste (693); and the tangible properties by the special sense of touch (253). These external substances have also certain other properties, which are only perceived and appreciated by the special organic senses (296) residing in the organs belonging to the domain of organic life, or the ganglionic system of nerves (228). These properties, in all proper alimentary substances, are the natural and appropriate stimuli of those nerves of organic sensibility (230) which are adapted by the Creator to perceive and appreciate them, and to convey the impressions received from them to the special centre which presides over the functions of the particular organ or apparatus (219). But we have seen (733) that some alimentary substances are much more stimulating than others, in proportion to the quantity of nourishment which they actually afford the system, and that some substances in nature are purely stimulating without affording any nourishment (735).

879. The stimulation produced by these various substances is always necessarily exhausting to the vital properties of the tissues on which they act, just in proportion to its degree and duration; and every stimulus impairs the vital susceptibilities and powers, just in proportion as it is unfitted for the real wants of the vital economy, and unfriendly to the vital interests.

880. But whatever may be the real character of the stimulus, every stimulation to which the system is accustomed increases, according to the power and extent of its influence, what is called the tone and the action of the parts on which it is exerted, and *while the stimulation lasts, it always increases the feeling of strength and vigor in the system*, whether any nourishment be imparted to the system or not.

881. Yet by so much as the stimulation exceeds in degree that which is necessary for the full and healthy performance of the function or functions of the organs stimulated, by so much the more does the expenditure of vital power and waste of organized substance exceed for the time the replenishing and renovating economy of the system (502); and, consequently, the exhaustion and indirect debility which succeed the stimulation are always necessarily commensurate with the excess (735).

882. Hence, though that food which contains the greatest proportion of stimulating power to its quantity of nourishment causes, while its stimulation continues, a *feeling* of the greatest strength and vigor, it also necessarily produces the greatest exhaustion in the end, which is commensurately importunate and vehement in its demands for relief, by the repetition of the accustomed stimulus; and as the same food, more readily than any other, affords the demanded relief, by supplying the requisite degree of stimulation, our feelings always lead us to believe that it is really the most strengthening.

883. Hence, whenever a *less* stimulating diet is substituted for a *more* stimulating one, a corresponding physiological depression, or want of tone and action, always necessarily succeeds, varying in degree and duration according to the general condition of the system, and the suddenness and greatness of the change; and this depression is always attended by a feeling of weakness and lassitude, which is immediately removed, and the feeling of strength and vigor restored, by

the accustomed *degree* of stimulation, by whatever produced, whether any increase of nourishment is actually afforded to the system or not.

884. The pure stimulants, therefore (733), which of themselves afford no nourishment to the system, and only serve to increase the expenditure of vital properties and waste of organized substance, by increasing vital action (735), cause, while their stimulation lasts, a sense of increased strength and vigor; and thus we are led by our feelings to believe that the pure stimulants are really strengthening; and in the same manner we are deceived by even those pernicious stimulants which not only exhaust by stimulation, but irritate, debilitate, and impair, by their deleterious qualities (768).

885. The feeling of *strength* produced by stimulation, therefore, is no proof either that the stimulating substance is nourishing, or that it is salutary, nor even that it is not decidedly baneful.

886. But we have seen (735), that those proper alimentary substances whose stimulating power is barely sufficient to excite a full and healthy performance of the functions of the digestive organs, in the appropriation of their nourishment to the system, are most conducive to the vital welfare of the body in all respects, causing all the processes of assimilation and organization to be most perfectly performed, without any unnecessary expenditure of vital power (875), and thus contributing to the most permanent and uniform health and vigor of the body, and to the greatest longevity. For every degree of stimulating power beyond this, necessarily increases the vital exhaustion, without contributing in any measure to the welfare of the body.

887. With a true application of these well ascertained principles, the physiological evidence in relation to the natural dietetic character of man may be correctly apprehended and accurately estimated; yet the utmost caution (766) and perspicacity and circumspection are requisite at every step, to avoid deception and error in the mazy and delusive paths of human experience and history.

888. It is generally, and, perhaps universally, believed by those portions of the human family which subsist on animal food, either wholly or in part, that man requires a more nourishing and invigorating aliment than can be derived from the vegetable kingdom, and therefore that without the use of animal food, his body cannot be properly nourished and sustained. 'An entire abstinence from flesh,' says Buffon (801), 'can have no effect but to enfeeble nature. If man were obliged to abstain totally from it, he would not, at least in our climate, either multiply or exist;' and this is but the declaration of the common sentiment of flesh-eaters. But a correct examination of the subject will show that this position is a mere assumption in the face of facts, and as utterly destitute of any foundation in truth as are the anatomical reasonings from the fancied resemblance of the human teeth and digestive organs to those of carnivorous animals.

889. It is indeed surprising, that observing and reflecting minds, even long before the experiments of science had afforded demonstrations of the truth, did not detect and proclaim the error of the common notion, that flesh-meat is a more nutritious aliment for man than the best vegetable food. A proper attention to the history of the human race might long ago have convinced the world of the inaccuracy of such an opinion. But unfortunately for man, he learns but little from

experience, either in his individual or aggregate capacity; and Wisdom, though she meets him in ten thousand forms, and seeks to win him in ten thousand ways, is left unheeded by him, because his attention is so continually and completely engrossed in the present feeling and impulse, and in the pursuit of the most immediate gratification.

890. From the careful investigations of some of the ablest and most accurate chemists of the present age, it appears that the various kinds of flesh-meat average about thirty-five per cent. of nutritious matter, while rice, wheat, and several kinds of pulse, such as lentils, peas, and beans, afford from eighty to ninety-five per cent. And even potatoes, which, by some writers on human diet, have been denounced as too crude and innutritious for the aliment of man, afford twenty-five per cent. of nutritious matter. So that, according to these results, a single pound of rice absolutely contains more nutritious matter than two pounds and a half of the best butchers' meat; and three pounds of good wheat bread contain more than six pounds of flesh; and three pounds of potatoes more than two pounds of flesh.

891. Incredible as this may at first appear to those who have given but little attention to the subject, yet a reference to facts in the history of the human species will abundantly prove the correctness of what is here stated. According to the united testimony of all the ancient writers who have spoken of the primitive generations of mankind, the first of the species, as we have seen (769), subsisted entirely upon vegetable food, in the plainest, simplest, and most natural forms.

892. Farinaceous seeds contain a greater proportion of nutritious matter than any other kind of natural aliment; and it is more than probable that these and other farinaceous vegetables in some form or other, have in all ages of the world constituted 'the staff of life' to the greater part of the human race, and that this kind of food mainly constituted the healthful and invigorating diet, not only of the antediluvians, but also of those who have occupied that period in the history of every nation which all their earliest writers call the golden age (638).

893. Different opinions have been entertained in regard to the dietetic use of flesh in the latter part of the antediluvian period. The enormous wickedness and atrocious violence and outrages of mankind immediately preceding the flood, strongly indicate, if they do not prove, an excessive indulgence in animal food. The fact also seems to be implied in the Divine annunciation to Noah after the flood, that every living thing that moveth, as well as the green herb, is constituted to afford nourishment to the human body; and is strongly evinced by the great and somewhat sudden abridgment of the period of human existence after the deluge. It appears to be very certain, however, that if such was the fact, the custom was a very great innovation on the early habits of the antediluvians, and that it had not long prevailed before the terrible catastrophe of that period. Still it does not appear from the Mosaic record that Noah received any Divine 'permission' to eat flesh, before the deluge; for in the sixth chapter of Genesis we find him instructed to gather and take with him into the ark, of all food that was eaten, which should be for food for him and for all the animals with him. Nor is there any historical evidence that animal food came into general and common and frequent use, until many centuries after the flood.

894. During the days of Abraham, flesh seems to have been eaten only on special occasions; such as some of their religious and social feasts, and when strangers were entertained as guests. The same general custom continued down even to the time of the bondage of the Hebrews in Egypt; and during their long and severe servitude there, it appears that they subsisted mostly on the products of the vegetable kingdom; as indeed the inhabitants of that country have ever done, even to the present day. Coarse bread with cucumbers, melons, leeks, garlics, onions, and other vegetables, constituted the principal part of their diet; and with these—more however as a condiment than as an aliment—they consumed perhaps occasionally a small quantity of fish, and on particular occasions they indulged in flesh-meat. During their extremely tedious and winding journey through the wilderness, in which they were forty years in getting into a place which lies but about three hundred miles from Egypt, they subsisted entirely on vegetable food, except that they were a very few times suffered to indulge in flesh. For their manna appears to have been, if not real vegetable structure, at least of the nature of vegetable substance; and it seems to have become dry and hard, for 'the people went out and gathered it and ground it in mills, and beat it in mortars, and baked it in pans, and made cakes of it.' And after the conquest and possession of the 'Promised Land,' and the full establishment of the nation in Palestine, excepting the more luxurious and voluptuous few, the Jews ate but little animal food, and that principally on the occasion of their religious and social feasts and special hospitalities. In the reign of Saul their first king, we find Jesse, who was the owner of probably extensive flocks and herds, sending his son David, not with beef and mutton, but 'with parched corn and loaves of bread to his sons in the army, and with cheeses to the captains of thousands.'

895. It has been supposed by some that the Jews and other nomadic or shepherd tribes, who possessed extensive flocks and herds, must have made a free use of the flesh of their sheep and other animals in their ordinary diet, because, say they, no other sufficient reason can be perceived why they should possess themselves of such property, and be so anxious to increase it. But it should be remembered, that besides the tendency of their religious institutions to lead them to cultivate such possessions, this species of property constituted their wealth, and gave them respectability and influence in their tribe or nation, the same as do many acres of land, or many slaves, or ships, or much merchandize or money, the husbandman, or planter, or merchant, or banker; and hence, the extensiveness of their flocks and herds was a source of ambition and pride and satisfaction to them.

896. This same state of things is found even at the present day among the nomadic or shepherd tribes in Asia and Africa, and in fact in all parts of the world. The enterprizing Landers inform us that in their late expedition in Africa, they found tribes 'who possessed abundance of bullocks, pigs, goats, sheep, and poultry, but they preferred vegetable food to animal; notwithstanding which, their animals were always held exceedingly dear, because the owners took pride in displaying the number and quality of them' (1032).

897. It is well known that from the earliest period of their history, the people of India generally, and particularly the Hindoos, who con-

stitute a considerable portion of the human family, have subsisted mainly on vegetable food, making rice the principal article of their diet. And indeed the greater part of the inhabitants of Asia and Africa have in all ages derived nearly all of their sustenance immediately from the vegetable kingdom. 'Children of the sun!' said one of the ancient and distinguished priests of India, 'listen to the dying advice of your faithful and affectionate instructor, who hastens to the bosom of the great Allah, to give an account, and to enjoy the expected rewards of his services. Your regimen ought to be simple and inartificial. Drink only the pure, simple water. It is the beverage of nature, and not by any means nor in any way to be improved by art. Eat only fruits and vegetables! Let the predaceous animals prey on carnage and blood! Stain not the divine gentleness of your natures by one spark of cruelty to the creatures beneath you! Heaven, to protect them, hath placed you at their head! Be not treacherous to the important trust you hold, by murdering those you ought to preserve! nor defile your bodies by filling them with putrefaction! There is enough of vegetables and fruits to supply your appetites, without oppressing them by carrion, or drenching them in blood!'

898. Many parts of Asia are far too densely populated to admit of any considerable indulgence in animal food; for it is a well ascertained truth, that the use of animal food diminishes the alimentary resources of the human family, in all densely populated countries. It has been estimated by some writers on political economy, that the soil which is necessary to raise animals enough to supply the alimentary wants of one man who subsists wholly on animal food, will produce vegetable substance enough to sustain sixteen men who subsist wholly on vegetable food. Hence in China, where the population is so dense as to form almost a crowded congregation of hundreds of millions of human beings (1029), the nourishment of the people is of necessity derived immediately from the soil, which is made to produce two crops of rice annually, to meet the alimentary wants of its cultivators,* and the small portion of animal food which they derive from domesticated animals, such as hogs, cats, dogs, etc., fed on the offals of the house, is nothing more than a mere condiment to their rice and other vegetable substances. And then again, on the other hand, it is because the soil of China is capable of being made to produce two crops annually, of one of the most nutritious vegetables in the world, that it is able to sustain such a population. It is therefore only in those countries where the population is small in proportion to the extent of soil, that the inhabitants can indulge freely in the dietetic use of flesh; unless they are a commercial people, and derive their supplies of animal food from other countries.

899. The early inhabitants of Greece and Rome, and of Europe generally, subsisted almost entirely on vegetable food. The Spartan simplicity of diet was by no means peculiar to Sparta nor to Greece. 'The Romans encouraged the use of vegetable diet, not only by the private example and precepts of many of their great man, but also by their public laws concerning food, which allowed but very little flesh,

* The population of China in 1812 was 361,278,897; making an average of 278 individuals to the square mile, throughout the empire.

but permitted without limitation all kinds of food gathered from the earth, from shrubs, and from trees.'

900. Plutarch, a man of great learning and extensive research, who flourished long after the stern simplicity of Roman virtue had passed away,—long after the foundations of the Roman Empire had begun to crumble under the influence of luxury and excess,—thus expresses himself on the subject of human diet. 'I think it were better to accustom ourselves from our youth to such temperance as not to require any flesh-meat at all. Does not the earth yield abundance, not only for nourishment, but for luxury? some of which may be eaten as nature has produced it, and some dressed and made palatable a thousand ways.'

901. The inhabitants of modern Europe, even to the present day, to a very great extent subsist on the immediate products of the vegetable kingdom. The peasantry of Norway, Sweden, Denmark, Poland, Germany, Turkey, Greece, Italy, Switzerland, Spain, France, Portugal, England, Scotland, Ireland, and a considerable portion of Russia, and most other parts of modern Europe subsist mainly, and many of them entirely, on vegetable food. The peasantry and laboring people of modern Greece subsist on coarse brown bread made of unbolted meal, and on different kinds of fruits, which they eat with their bread; and they are remarkably vigorous and active and cheerful. 'In all the world,' says a recent traveller in Italy, 'there is not to be found a more lively mercurial population than the lazzaroni and laborers of Naples, whose diet is of the simplest kind, consisting mainly of bread, macaroni (a vegetable dish), or potatoes, or the fruits of the season, including a large supply of watermelons for their greatest luxury, with water for their drink. They are generally tall, stout, well formed, robust, and active men.' The peasantry in many parts of Russia live on very coarse bread, with garlics and other vegetable aliment; and, like the same class in Greece, Italy, and other parts of Europe, they are obliged to be extremely frugal even in this kind of food; yet they are very healthy, vigorous, and active. Many of the inhabitants of Germany live mainly on rye and barley, and mostly in the form of coarse bread. The Swiss peasantry subsist in much the same manner; and a very similar diet sustains the same class of people in Sweden, Poland, Spain, Portugal, and many parts of France. In the last three named countries, however, fruit is more abundantly used than in the others; but in all these countries, the people who live in this manner, and refrain from the use of alcoholic and narcotic drinks and substances, are well nourished, healthy, robust, active, and cheerful.

902. The potato, as is well known, is the principal article in the diet of the Irish peasantry; and few portions of the human family are more healthy, robust, athletic, and active, than they are, when uncontaminated by intoxicating substances, both alcoholic and narcotic. But alcohol, either in the form of distilled or fermented liquors, and tobacco, opium, coffee, and tea, have extended their blighting influence, as we have seen (768), over the greater portion of the human world; and nowhere do these scourges of mankind more cruelly afflict the self-devoted race, than in the cottages and hovels of the poor. 'I would sooner live on two beans a-day than do without my snuff,' exclaimed

an aged female mendicant, to a gentleman who expostulated with her for indulging in the vile practice of thrusting powdered tobacco up her nose, even when in the act of asking alms! 'O, it does me good! I could not live without it!' said she; and doubtless she sincerely *felt* that what she said was true. And this is but the miniature resemblance of a large portion of the human species. And when by these indulgences, and the consequent neglect of cleanliness (872), and other means of health, they generate a variety of chronic diseases, and sometimes extensive epidemics, we are told, even by professional men of character, that all these evils arise from their *poor, meagre, low, vegetable diet.* Yet whenever these different species of intoxicating substances are avoided, and a decent degree of cleanliness observed, the vegetable diet is not thus calumniated.

903. That portion of the peasantry of England and Scotland who subsist on their barley and oatmeal bread and porridge, and on potatoes and other vegetables, with temperate and cleanly habits, are healthy and robust and active, and able to endure more fatigue and exposure than any other class of people in the same countries.

904. In short, from two-thirds to three-fourths of the whole human family, in all periods of time, from the creation of the species to the present moment, have subsisted entirely, or nearly so, on vegetable food; and always, when their alimentary supplies of this kind have been abundant and of a good quality, and their habits have been in other respects correct, they have been well nourished and well sustained in all the physiological interests of their nature.

905. But if one pound of good bread absolutely contains more nutritious matter than two pounds of flesh-meat (890), why is it that those who are accustomed to animal food immediately droop and feel weak and languid when flesh-meat is wholly withheld from them? and why is their usual vigor restored when they return to their customary diet?

906. It is now well ascertained and universally acknowledged by those who are properly informed on the subject, that flesh-meat is far more stimulating or exciting in proportion to the quantity of nourishment which it actually affords the human body, than proper vegetable food is; and we have seen (880) that whatever be the real character of the stimulating substance, every stimulation to which the system is accustomed increases, according to the power and extent of its influence, what is called the tone and action of the parts on which it is exerted, and the whole domain of organic life being intimately united by a common and universal sympathy (225), is correspondently affected; and hence, while the stimulation lasts, it always increases the *feeling* of strength and general vigor in the system, whether any nourishment be imparted or not. By so much, therefore, as flesh-meat is more stimulating than vegetable food, it gives to those who are accustomed to it a *feeling* of greater strength and vigor; and as it is a law of the vital economy (883), that whenever a *less* stimulating diet is substituted for a *more* stimulating one, a corresponding physiological depression, attended with a feeling of weakness and lassitude, always succeeds, and as this physiological depression is promptly removed, and a feeling of strength and vigor restored by a return to the customary stimulus (882), those who are accustomed to animal food, and have only made temporary experiments of abstinence from it, have always

found that when they abstain wholly from flesh-meat, they feel weaker and less energetic, and when they return to it they feel stronger and more vigorous and active; and hence they have inferred that animal food is much more nourishing and strengthening than pure vegetable food is.

907. But if this kind of *experience* proves animal food to be more nourishing and strengthening than vegetable food, then it also proves that the pure stimulants which actually afford no nourishment to the system, are really invigorating to the body (884); for every one who is accustomed to the use of the pure stimulants, always experiences a physiological depression and feeling of debility and lassitude from the sudden disuse of them, commensurate with the degree to which the system had been affected by them, or made dependent on them for tone and action; and this depression is instantly removed and the feeling of strength restored by a return to the use of the accustomed stimulants. Hence all who habitually use the pure stimulants, and especially the diffusable stimulants, such as the alcoholic, fully and sincerely believe that their bodies are invigorated and rendered stronger and capable of more effort and endurance, by the use of such stimulants.

908. It is true, however, that as the pure stimulants afford no nourishment to the system, and flesh-meat nourishes while it stimulates, the physiological depression and general emaciation and debility experienced from a sudden abandonment of the latter, though less violent and distressing at first, are generally of greater duration, and sometimes even more dangerous to life, than from a sudden abandonment of the former.

909. But as flesh-meat is more stimulating to the system in proportion to the nourishment which it affords, than pure vegetable aliment is (906), so all the processes of assimilation and nutrition in the use of the former are more rapid, and attended with a greater expenditure of vital power and waste of organized substances, than in the use of the latter (879). The flesh-meat in the stomach, the chyme formed from it in the alimentary cavity, the chyle in the lacteals, the blood in the heart, arteries, veins, and capillaries, and all the fluids and substances elaborated from the blood, are more exciting to the parts on which they severally act, and cause a greater intensity and rapidity of vital action and expenditure in the whole system, than is affected by alimentation, digestion, and nutrition, in the use of pure and proper vegetable food * (991). And hence the well-known fact, that in the most healthy and robust men who have been accustomed to a pure vegetable and water diet from infancy, the skin is uniformly much cooler, and the pulse is slower from ten to thirty beats in a minute, than in those who subsist on a mixed diet, in the ordinary manner of civic life (476).

910. As flesh-meat passes more rapidly through all the processes of assimilation than most kinds of vegetable food (909), it is generally supposed to be more easily digested, and consequently the most suitable food for the dyspeptic and those of feeble digestive powers; and hence it has been a prevailing practice among physicians to prescribe for such persons a diet consisting mostly of flesh-meat. But this is

* The feverish excitement attending the digestion of flesh-meat has been called by medical writers 'the fever of digestion'

contemplating the assimiliating functions of the living body as purely chemical, and the stomach and other organs as mere lifeless vessels which have no direct agency in the processes effected in the substances which they contain (425); and therefore, the digestibility of different alimentary substances is determined purely by the time required for their solution. Such a view of the subject, however, is very far from being correct. The assimilating processes of the living body are to be contemplated by the physiologist as purely vital, effected by the living organs, and attended with an expenditure of the vital properties of the tissues, and the functional powers of those organs (875); and consequently, in the true physiological sense of language, the ease or difficulty with which any alimentary substance is digested by the human stomach, is not determined by the time in which it undergoes the chymifying process of that organ, but exclusively by the amount of vital power required to digest it. The substance which causes the greatest expenditure of vital power in undergoing the functional process of the digestive organs, and leaves those organs most exhausted from the performance of their function, is the hardest or most difficult to digest, whether the time in which it is undergoing that process be longer or shorter.

911. But we have seen (906) that flesh-meat is more stimulating in proportion to the quantity of nourishment which it affords to the human body than pure vegetable aliment is, and that all processes of assimilation and nutrition in the use of the former, are more rapid and attended with greater expenditure of vital power and waste of organized substance than in the use of the latter. It is therefore a physiological truth of great importance, that while animal food, or flesh-meat, passes through the stomach in a shorter time than most kinds of vegetable aliment, and therefore has been supposed to be more easily digested, yet it actually draws upon that organ and upon the sources of innervation for a greater sum of vital energy, and consequently causes a greater abatement of the sensorial power (165) of the brain and nervous system during the process of digestion, and leaves the stomach much more exhausted from the performance of its function, than vegetable food does. And hence, they who subsist principally on animal food or flesh-meat always feel more stupid and dull during gastric digestion, and feel a much greater degree of exhaustion in the epigastric region, when the food has passed from the stomach into the intestinal canal (328), and suffer much more distress from hunger when deprived of their accustomed meals (882), than they do who subsist entirely on a pure vegetable aliment. And this is one important reason why—all other things being equal, and the system being fully established in its habits—they who subsist on a well-chosen vegetable diet can endure protracted labor, fatigue, and exposure much longer without food, than they can who subsist mostly or entirely on flesh-meat.

912. Though according to chemical analysis, therefore, a pound of good wheat bread absolutely contains but fifty per cent more of nutritious matter than a pound of flesh-meat (890), yet the physiological difference between the two kinds of aliment is much greater than is indicated by the results of chemical analysis. For the flesh-meat being more stimulating than the bread, in proportion to the quantity of nourishment which it actually affords to the human body, not only exhausts the stomach more in the process of gastric digestion but works

the whole organic machinery of life with more rapidity and intensity (909), and therefore causes a proportionably greater waste of the substance of the organs in a given time, and consequently increases the demand of the system for fresh supplies of aliment. Hence, as extensive experiment has fully proved, two pounds of good wheaten bread will actually sustain a man accustomed to such a diet, longer and better than eight pounds of the best flesh-meat.

913. The Russian and Greek laborers, and those of many other countries, will work from twelve to sixteen hours a day, with great power and activity and cheerfulness, and subsist on about one pound of coarse bread, with a small bunch of garlics, figs, raisins, apples, or some other fruit containing little nourishment. While, according to Ross Cox, who spent several years beyond the Rocky Mountains, as an agent of the American North-western Fur Company, the Canadian boatmen and others in the Company's service, receive, according to stipulation, and regularly consume (when they have no other food) eight pounds of clear flesh a day for each man; and ten pounds if it contains any bone: and these men, if their rations of food are cut short for two or three days, are exhausted and unstrung. 'The Patagonians,' says the Rev. Mr. Armes, who spent three months among them as a missionary, 'subsist almost entirely upon the guanaco, which they take in the chase. They will often, in their indolence, suffer their provisions to run very low, and for two or three days, subsist on very little; and then, when urged by hunger, they will mount their horse, and go out in pursuit of fresh supplies. And when they return with their game, it is a very common thing for a single Patagonian to consume from fifteen to twenty pounds of flesh in the course of a day. Indeed, I have frequently seen a single man, after two or three days' severe abstemiousness, consume at one meal, in the course of three hours, the half of a guanaco, which would weigh from fifteen to twenty pounds. This flesh was generally eaten very slightly cooked.' The accounts which have been given of the voraciousness of the Esquimaux and other flesh-eating tribes in the northern regions of Europe, Asia, America, and of the enormous quantities which they consume in a day and at a single meal, are almost incredible, yet they have been repeatedly corroborated by the best authority. On the other hand again, millions of the inhabitants of India and China subsist on a few ounces of rice a day for each individual; and where they are in other respects temperate and correct in their habits, they are well nourished and athletic and active.

914. We have seen (735) that in proportion as the stimulating effect of any alimentary substance exceeds what is necessary for the full and healthy performance of the functions of the organs of assimilation and nutrition, the vital action, not only of the particular organs, but of the whole system, is rendered more rapid and intense, all the functions are commensurately precipitated, and the vital processes of assimilation and nutrition are less perfectly effected. Hence, though while the health and integrity of the assimilating organs are preserved, the physical and chemical character of the chyle is nearly identical, whatever may be the alimentary substance from which it is elaborated (455), yet the *vital constitution* of the chyle and blood, and consequently of the solids, is greatly affected by the quality of the food. When chyle

is taken from the living vessels, the vital constitution of that which is elaborated from flesh-meat is capable of resisting the action of inorganic affinities (126) only a short time, but will begin to putrefy in three or four days at the longest; while the vital constitution of that which is elaborated from pure and proper vegetable aliment will resist the action of inorganic affinities for weeks (456); yet it will, in the end, putrefy with all the phenomena of that formed from flesh-meat, thereby demonstrating that it has at least equal claims to the character of animalized matter, and leaving little grounds to doubt that in the processes of chymification and chylification, the vital changes are so much more complete and perfect, when the vegetable food is used, as to give the chyle more power of vital constitution to resist the action of the principles of putrefaction than is possessed by the chyle formed from flesh-meat. It is well known, also, that human blood formed from animal food will putrefy when taken from the living vessels, in a much shorter time and much more rapidly than that formed from pure vegetable aliment; and that there is always—other things being equal—a much greater febrile and putrescent tendency in the living bodies of those who subsist mostly on animal food, than in those who subsist wholly on pure vegetable aliment. Hence, if two healthy robust men of the same age—the one subsisting principally on flesh-meat, and the other exclusively on a diet of vegetable food and water—be suddenly shot down and killed, in warm weather, and both bodies be laid out in the ordinary manner, and left to the action of the elements and affinities of the inorganic kingdom, the body of the vegetable-eater will remain two or three times as long as the body of the flesh-eater will, without becoming intolerably offensive from the processes of putrefaction.

915. These, then, are truths which defy all controversy—truths which are established in the constitutional nature of things, and confirmed by all correctly apprehended and accurately estimated facts in human experience relating to the subject, that flesh-meat is not necessary to nourish and sustain the human body in the healthiest and best manner, where proper vegetable food can be obtained (913); that it is much more stimulating to the system, in proportion to the nourishment which it actually affords, than a pure and proper vegetable diet (906); that it renders the general physiological action of the system more rapid and intense, accelerates all the vital functions (909), increases the expenditure of the vital properties of the tissues and functional powers of the organs (302), and more rapidly wears out the vital constitution of the body and exhausts the ultimate and unreplenishable resources of life (877); and it is almost equally certain that it renders all the vital processes of assimilation and nutrition less complete and perfect (914).

916. Animal food or flesh-meat, therefore, as a general law, is not so conducive as a proper vegetable diet, to healthfulness of growth, perfectness of development, symmetry, beauty, agility, permanent strength, uniformity of health, and great longevity of the human body; nor to the acuteness and integrity of the special senses, and the activity and power of the intellectual and moral faculties (736).

LECTURE XV.

Original perfection of the organic structure of man, and constitutional relations between the progenitor and the progeny—Original perfection of all created things—The human body the highest order of material forms, combining matter, life, mind, and moral powers; forming a part of the harmonious whole of nature—Fixed relations between bodily symmetry and mental and moral powers—This proposition illustrated—Fixed relations between the bodily symmetry and beauty, and the moral influence of man as an individual, and the moral character of society—This proposition illustrated—Moral power of personal beauty—This effect not from depravity, but from natural fitness—The original improvability of man asserted because of the present improvability of animals and vegetables—This position refuted—The truth of bodily perfection harmonizes with the intuitive sentiment of every soul that such perfection is the true bodying forth of intellectual and moral beauty—Beauty and vanity not necessarily connected—Perfect symmetry extremely rare—Power of beauty in the cause of virtue—Man's obligations to cultivate the bodily symmetry and beauty of the species—Illustration from Scripture—Natural harmony of all the attributes and interests of man's nature—the cultivation of beauty in the lower animals—Power of fashion in dress, etc.—Beauty seldom met with in civic life—Organized bodies produce their like—The results of the reproducing economy, how modified—These effects greatest in the primitive ages—The reactions of the vital powers under disturbing causes—Greatest deviations from normal results in the early ages—Mental and moral influences greatest on the reproducing economy in the primitive ages—Early separation into families, and forming of tribes—Varieties of the human species accounted for—Varieties of lower animals—Fixed relations between the economy of nutrition and reproduction—Means of securing symmetry of development, and of returning to the perfect form of the original type of the species—The size and form of the human body, by what determined—Physiological laws of development—Comparative effects of vegetable and animal food on the development and symmetry of the human body—Illustration from the history of the human family—The flesh-eating tribes, Patagonians, etc.—Vegetable-eating tribes and nations—Original size of man, and other animals—Daniel and his three friends—Natives of different islands—The Circassians, Irish, etc.—Pitcairn Islanders—The hermit—General conclusion on this topic.

917. EVERY thing that we can learn from Nature and from Revelation concerning the character of the Deity, and of the harmonious principles of wisdom and benevolence and utility which governed all his operations in the original creation and construction of this world of ours, with all its varied forms of matter and mode of existence, leads us to believe that God created our first parents perfectly beautiful; that they were designed to be the grand types or models of our species; and that in them was established a constitutional economy by which like beings, in size, symmetry, and beauty of body, and excellence of faculties and powers, were to be propagated through successive generations, so long as the species exists (125). And God unquestionably had a fixed purpose, a moral design in this. God must himself be perfect; and all the elements of his character must be perfectly harmonious; and all that he produces by his immediate omnific efficiency must partake of the perfection of its cause. It must be *a bodying forth of the truth and wisdom and beauty and harmony and benevolence of the Divine Mind, in appropriate forms.*

918. We have seen (140, 144) that from the simplest arrangements or combinations of the element or elements of nature, to the most complicated forms of matter, throughout all the variety of material things, each particular form has its specific laws of constitution and relation; and by virtue of these laws each form is what it is, in nature

and in qualities, and has its own individual existence, and all forms are held together in a harmonious universe.

919. The human body is the highest order of material forms. In it, matter and vitality and mind and moral feeling are mysteriously associated; and, in our present state of being, not only hold fixed and precise relations to each other (603), but to all things else in nature (7); and thus human nature constitutes an essential and congruent part of the harmonious whole; and the entire and perfect harmony of all created things, in themselve sand in their relations to their Creator, requires that man should possess a nature perfect in its kind, and that there should be fixed and precise relations between the bodily symmetry and mental and moral powers of man.

920. It is true that, in the present state of things, we often see the most splendid minds and the most exalted moral characters that adorn our race, associated with infirm and even with deformed bodies; yet in all such cases, could we examine them with the eye of Omniscience, we would probably perceive that a want of mental and moral symmetry corresponding with that of the body, always coexists.

921. It is true also, that in bodies the most symmetrical and beautiful, there is frequently a want of the same degree of intellectual and moral beauty; but in all such cases there is either less symmetry of the entire organization, or great defect of education.

922. With all the seeming contradictions in nature to the principles which I have advanced, therefore, I still contend for the interesting truth, that the most perfect intellectual and moral character of which human nature is capable, is only to be developed in the most perfect body,—a body which is the most perfectly symmetrical, not only in its general contour and proportions, but in all the details of its organization And, if I am not over fanciful, this same doctrine was indicated in those regulations of the Mosaic dispensation which required a lamb without blemish for certain sacrifices, and men without blemish for the priesthood. And even in the choice of rulers and kings, in ancient times, this consideration had a very controlling influence. Thus, we are informed that Saul, the first king of the Jews, 'was a choice young man and a goodly; and there was not among the children of Israel a goodlier person than he: from his shoulders and upwards he was higher than any of the people;' and for these reasons mainly, he seems to have been selected for the first king of that nation. Nor was this regulation peculiar to the Hebrews. Bodily symmetry and personal beauty were regarded by many, if not all, of the ancient nations, as favorable evidences of the intellectual and moral powers of man.

923. Nebuchadnezzar, king of Babylon, commanded the masters of his eunuchs to select from among the captive children of Israel, 'men in whom there was no blemish, but well favored and skilful in all wisdom and cunning and knowledge, and understanding science; and such as had ability in them to stand in the king's palace and whom they might teach the learning and the tongue of the Chaldeans;' and these were to be nourished with the king's wine and food, for three years, to prepare them, as well in personal comeliness as other things, to stand before the king. And according to the sacred record, Daniel and his three particular friends were, in the end, not less distinguished from the other selected children of Israel, for personal comeliness, than for their wisdom and knowledge and understanding.

924. Socrates, the most eminent philosopher of antiquity, used to say that when he saw a beautiful person, he always expected to find it animated by a beautiful soul. And Horace, the celebrated Roman poet, says in his Art of Poetry, 'You must look for a perfect mind only in a perfect body.' In, fact, this sentiment seems almost intuitive in our very nature. It it hardly possible for us to read the works of any author, which greatly interest and delight us, without forming a notion that the author is comely and agreeably in his or her person, unless we have either seen or heard the contrary. And when, for the first time, we read the description of a favorite author, if we learn that he was or is symmetrical and comely in person, it harmonizes with our feelings, and accords with our notions of what is fit and proper and ought to be; and if we learn that he was or is disproportioned, uncomely, dwarfish, or deformed, our notions of the natural fitness of things are shocked, and our feelings are dissatisfied. And, on the other hand, we cannot look upon a symmetrical and beautiful person, of whom we know nothing, without being impressed with an idea of a corresponding intellectual and moral character. Indeed, the sight of a beautiful face, or even of a beautiful hand or foot, when nothing more of the person is seen, almost necessarily causes us to imagine that the whole body to which that portion belongs is equally symmetrical and beautiful! Such is our seemingly innate idea of the natural fitness and harmony of things; and this being universally true of the human race, amounts to a strong if not conclusive proof that God, in the original constitution of things, established fixed and precise relations between the bodily symmetry and beauty, and the intellectual and moral powers and character of man (919).

925. In the original constitution of things, also, the Creator established the most determinate relations between the bodily symmetry and beauty, and the moral influence of man, as an individual, and the moral character of society.

926. This important truth is a living sentiment in every human breast, and I had almost said that it is an element in our intellectual and moral coustitution.

927. In all ages of the world, mankind have been so strongly impressed with this sentiment, that they have at times conceived that it extends to the lower animals, and even rules in the breasts of the most ferocious beasts of the forests; and accordingly, fables of antiquity tell us that the tiger has melted into kindness, and the lion has crouched in lamb-like gentleness, in the presence of the overpowering loveliness of woman! But whether lions or tigers ever felt the subduing influence of human loveliness or not, it is certain that spirits not less fierce, and hearts not less ferocious, have bowed before its moral omnipotence! God only knows to what extent the moral influence of female beauty has affected the destinies of the human race! But all history and all tradition, and the every-day experience of every generation of our species, conspire to prove its vastness and importance. The Grecian Helen, and the Egyptian Cleopatra, whose charms involved whole nations in long and bloody wars, and affected the history and modified the character and condition of the world, are only the more conspicuous instances of what, in every period of time and in every quarter of the earth, has been experienced by mankind. Who has not felt the power of female loveliness? and who has not wit-

nessed the moral influence which a beautiful woman exerts on all around her, if her mental and moral qualities correspond with the symmetry and comeliness of her person?* The sage, even in the winter of his years, when all his natural sensibilities seem chilled and chastened down by time and stoic wisdom, the veteran hero, the grave divine, the crafty politician, all true to Nature in this respect, like the ardent youth, and like the unsophisticated and untutored child of the forest even in his rudest state, instantly feel a peculiar and irresistible influence break upon them, subduing their sterner and their harsher passions, and kindling a warm and generous emotion in their breasts, when a beautiful woman comes into their presence.

928. Nor is the moral influence of personal beauty confined to the female sex. The annals of our race are full of instances in which the bodily symmetry and comeliness of *men* have raised them from humble obscurity to the highest stations of human power, and enabled them to manage the affairs of kingdoms as their passions or caprices instigated. The history of the kings of England alone affords us numerous instances of this kind, wherein men, without birth, without virtue, without learning, without political experience or skill, in short without anything to recommend them but the symmetry and beauty of their persons, have become, for the sake of their bodily charms solely, the special favorites of kings, and been elevated from humble life to the highest honors of the State, next to the crown, and by their moral influence have wielded the authority of the crown with as much power as if it actually encircled their own heads. And, from the ruling favorite of a crown, down to the humble gallant of a neighbourhood, the man of great bodily symmetry and beauty exerts a much more powerful and extensive moral influence than those who are in all other respects his equals, but want his corporeal charms.

929. And who will say that aught of this is evil? and that it springs from the depravity of our nature? Does it betoken human depravity that we should be charmed and delighted with the harmony and the soul-stirring melody of music? Or that we should contemplate with admiration and delight the beautiful and the sublime of nature, in

* The celebrated and beautiful Georgiana Spencer, Duchess of Devonshire, is an instance of this kind.

'A traditionary halo invests this beautiful, accomplished, and virtuous lady. From her cradle she was as beautiful as Hebe, and her mind is said to have been as beautiful as her person. For many years she led the fashion at the Court of George III, and perhaps was the only woman of fashion, in that reign, who did not lose caste by mixing in the strife of politics. From the moment that Lady Georgiana Spencer appeared in public, she was the object of admiration, from both sexes. If her own sex envied her the possession of extreme loveliness, the suavity of her manners and the purity of her mind dispelled the bitter feeling.

'She was an accomplished musician, drew well, knew many of the modern languages, and wrote poetry so exquisitely, that Coleridge praised it as superior to his own. In a word, she was formed to win all hearts, and she did win them.

'In politics she was a Whig. The Duke of Marlborough—the conqueror at Blenheim—was her grandfather, and his life was devoted to the vindication of the principles whose triumph caused the revolution of 1688. The family maintained the same principles, and, accordingly, when Charles James Fox stood forward as their champion, the youthful Duchess flung herself into the arena of politics, to accomplish his return to Parliament by the electors of Westminster. This was in 1784. She, a high-born exclusive, mingled with the mob of Westminster, as a vote-canvasser for Fox, and it is recorded that her smiles gained for her favorite many a suffrage which, to a less fascinating applicant, would have been refused.'—ENGLISH PAPER.

earth, and ocean, and the starry heavens? Whence spring the raptures of our kindled moments, when we contemplate the beauty and magnificence and grandeur and sublimity of nature, but from the soul's *perception* of the beauty and the harmony of truth? and from the soul's *conception* that the truth of beauty and of grandeur and sublimity in nature, *is but the shadowing forth, in perceptible forms, of the infinite perceptions of the invisible and* ETERNAL MIND?

930. Who, in imagination, pierces the veil between eternity and time, and soars away to that pure world of happiness and glory where the good man hopes, when this probationary pilgrimage is done, to dwell in immortality of soul and endless bliss, and contemplates the sanctified inhabitants of that holy place, risen incorruptible to eternal life and everlasting glory with the Eternal One, that does not see the glorified bodies of all the spirits of just men made perfect, as perfectly symmetrical and beautiful as those spirits are holy and happy? Does not the natural harmony of things demand it? Can we conceive of any thing deformed in heaven? or any want of perfectness in any thing there? And what is heaven but *the supreme and perfect reign of all the laws of God, in everything?* It *must* be, then, that the perfection of the human body is an essential part of the complete and perfect harmony of nature (919); and that God, in the original constitution of things, established fixed and precise relations between the bodily and the intellectual and moral perfections of man; and between the bodily symmetry and personal comeliness and the moral influence of man (925).

931. Some, it is true, contend that as the horse and dog, and many other species of the lower animals, and also many species of the vegetable kingdom, are capable of being very greatly improved in size and vigor and symmetry and beauty, by being taken from their natural state, and cultivated by the care of man, therefore analogy exceedingly favors, if it does not establish, the conclusion, that the human form was not originally so well developed—so large and vigorous and symmetrical and beautiful—as it has been rendered, and is capable of being rendered, by cultivation in civic and artificial life. But this reasoning appears to be wholly inconclusive and illogical. It assumes as true what I am by no means prepared to grant. I believe there is a general evidence in nature that many species of the lower animals, if not all, and of the vegetable kingdom as well as man, have undergone a considerable degeneration since they were originally produced; and this is at least clearly implied, if it is not explicitly asserted, in our Sacred Scriptures. It therefore remains to be proved, that what is called the *natural state* and condition of the horse and other animals, and of the rose and other vegetables, is truly such, and not a degenerated state and condition; and consequently, it remains to be proved that they are really capable of being cultivated into a higher state of perfection than they originally possessed.* The general evidences and analogies of nature certainly do not appear to favor such a notion.

* Those who have seen the horse in a perfectly natural state, in a climate congenial to his nature, speak of him as being superlatively beautiful. It is undoubtedly true, however, that in any species of organized bodies, either vegetable or animal, an individual of good health and vigorous constitution may be more rapidly developed and considerably increased in size, by means which, if continued through several genera-

932. But admitting this opinion to be true, it does not follow that man—the highest order of terrestrial beings—endowed with intellectual and moral powers, and for whom, in one sense, all other things were made; prepared to serve his natural and intellectual and moral wants, and designed to be subject to his husbandry and cultivation—was also himself originally created less perfect as an organic and animal being, than he was capable of being rendered by artificial cultivation. Certain it is, that what is now regarded as the *natural state* of man affords no evidence for reasonings of this kind; because the savage state (25, Note), such as it now exists, and such as it has existed for many centuries, and probably for several thousand years (768), is most indubitably not the *natural state of man* (764). We know that many of the habits and circumstances of savage life are very far from being natural to man, and powerfully serve to deteriorate his nature (643). Yet if it were true that the original, organic, and animal nature of man was capable of great improvement in size and strength and symmetry and beauty, by cultivation, it would not in any measure militate against the doctrine that in the original design, and in the constitutional nature of things, the Creator established fixed and precise relations between the bodily and the intellectual and moral perfections of man, and between his bodily symmetry and beauty and his moral influence.

933. But account for it as we may, it is a truth, the demonstration of which we all have in our breasts, that when we find a truly beautiful person with intellectual and moral deformity, or one of high intellectual and moral beauty with a disagreeable or deformed person, whatever conclusion our education and our reasoning powers may strive to lead us to, we *feel*, and irresistibly we feel, that in either case there is a natural incongruity—a want of harmony! Indeed, we *feel* it to be something of a monstrosity!

934. It is *not* that the mere curves and lines and complexion of the body, as material qualities, afford us this delight, in beholding the corporeal beauty of man; but it *is* that the truth of bodily perfection harmonizes with the intuitive sentiment of every soul, that such perfection is the true bodying forth of intellectual and moral beauty. We feel that, as an unseen energy controls the aggregation and arrangement of the particles of matter, and brings them into the perfect form of a beautiful crystal, so the efficient spirit of intellectual and moral beauty should control the aggregation and arrangement of the matter of its

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tions, would inevitably deteriorate the race, and which would also necessarily increase the liability to disease in the individual in whom the experiment began, and in some measure shorten his life. 'When a boy,' says my excellent friend Alvan Clark, Esq., 'I planted a number of peach trees on my father's farm. Some of them I planted in a very rich soil, and others in a drier, more sandy, and poorer soil. In a few years, those which I planted in the rich soil were fine large trees, and began to bear; while the others were very backward and small, and seemed to promise little. In this state I left them and my native place. After several years' absence I returned home, and found that the trees which I planted in the rich soil were all dead and dry; but the others, which were so unpromising at first, had become noble trees, and were still in full vigor and laden with delicious fruit.' This is an excellent illustration of what is true in animals as well as vegetables. Thousands of human beings are made to grow rapidly, and are kept plump and ruddy by means which rapidly expend the resources of the vital constitution, and commen[illegible] shorten life, and increase the danger of disease; and which, if continued in a direct line without interruption, through successive generations, would inevitably cut off the line in three or four generations at longest.

bodily form, and make that body the true type of its own beauty and perfection. And hence, whenever we behold a beautiful human form, concerning the mental and moral qualities of which we are wholly ignorant, our admiration of it always necessarily involves the idea of the harmony of its mental and moral qualities with itself. We inevitably admire it as the true form of the mental and moral beauty of its soul; and consequently, so long as we continue to be enamoured with a beautiful person, we continue to believe that person possessed of a degree of intellectual and moral beauty equal to the degree of our passion (576); and when we discover that this is not the case, and find that with such a beautiful person there is associated intellectual and moral imbecility or deformity, the beauty of the person no longer excites our admiration, but the individual becomes the object of our pity or disgust or abhorrence.

935. But it is said that symmetry and beauty of body serve no other end than to minister to the personal vanity of the possessor, and the delusion of the admirer, and therefore it could not have entered into the design of the infinitely wise and holy Creator to establish a fixed constitutional relation between the bodily symmetry and beauty of man and his intellectual and moral excellence, and between those bodily qualities and his moral influence! It is true that, in the miserably perverted and deranged state of things, in the present condition of the human world, personal beauty is too generally associated with excessive vanity, and too often with a vacant mind, and not unfrequently with a vicious heart. But these facts conflict not with the sentiment which I have advanced. They only show that those powers and qualities which God designed for good, may, by man, as a free moral agent, be abused and perverted, and made the means of evil. But whether for good or for evil, still it is true that, all things else being equal, he or she that possesses the greatest personal charms, or bodily symmetry and comeliness, exerts the greatest moral influence upon others.

936. There are many comparatively beautiful persons in society, who are still not perfectly symmetrical in all their organization and harmonious in all their proportions; some want of development in particular parts, or some undue development in others, destroys the perfect symmetry and harmony of the system, and causes a correspondent blemish in the intellectual or moral character, or both. But where the symmetry is perfect, and there is a complete harmony of all the parts, if the intellectual and moral beauty are not equal to the symmetry and comeliness of the body, it is entirely the fault of education, and not in any degree owing to the want of natural faculties or powers. Nor is there any more natural necessity for vanity in connexion with personal beauty, than there is for any other folly or vice. Yet the very fact that such people are vain of their beauty, is itself a proof of the moral influence of bodily symmetry and comeliness! How else should a beautiful person become vain of his or her bodily charms, except by the continual experience that every one admires and praises and shows a deference to those charms? But were bodily symmetry and comeliness as common as they are now rare, the grounds of this vanity would be done away; all would require these qualities as much as we now do; yet the few could not pride themselves in a

monopoly of those attributes which they considered would secure them all the favor and admiration they desired, without the addition of intellectual and moral beauties, because they only possessed them; but knowing that personal charms were the common endowments of their fellow-creatures, they would feel the necessity for proper intellectual and moral cultivation to secure their welfare and their happiness. And if, by proper cultivation, their intellectual and moral excellence became equal to their bodily perfection, they would be living illustrations of our ideas of angels, and their moral influence would be almost omnipotent in the cause of virtue; refining, chastening, elevating, all on whom it was exerted, and by whom it was felt! And this would be a fulfilment of the design of the Creator, in the original constitution of man and things.

93 . If it be true then—and we cannot justly doubt its truth—that the infinitely wise and benevolent Architect of Nature, ere he had called the substances and forms composing the material universe into existence, conceived with all the perfectness of the Eternal Mind, the nice design of each particular form he was about to order into being, with a determinate regard to its own *final cause* and its relations to all other forms, and in that perfect conception of the scheme of nature, the Omnific Mind, as it were, pencilled out in its imagination the human form with fixed and precise regard to all its attributes of body and of soul; and if it be true that the Creator perfectly bodied forth the conceptions of his mind in the material form of man, and thus made the first parents of our species the exact images of his thoughts and the perfect models of their kind; and, with determinate reference to the general harmony of things, established in the constitutional nature of man, fixed and precise relations between his corporeal and intellectual and moral perfection (917), and between his bodily symmetry and comeliness and his moral influence (925); and established also in the constitutional nature of man, an economy by which like beings, in nature, size, symmetry, and beauty, were to be propagated through succeeding generations, during the existence of the species; and if the results of that economy as to the size and symmetry and beauty of the human body may be greatly modified by the voluntary actions and habits and conditions of mankind—then it is manifestly our natural and moral and civil and religious duty to cultivate, by all true and proper means in our power, the bodily symmetry and beauty of our species.

938. They who have thought little on this interesting subject, may perhaps feel disposed to smile at reasonings of this kind; yet if they will give their attention thoroughly to the matter, they will find that these views are not chimerical, but that they are founded in the deep philosophy of things.

939. The apostle Paul involves the same idea in his beautiful illustration of moral and spiritual things. He tells us that the highest good of man, as well as the glory of God, requiring that man should be perfectly reconciled and conformed to God, the Eternal Father, in order to adapt his economy of grace—designed to effect this glorious end of salvation to the nature and condition of man, and to show man precisely and truly what he must be reconciled to, spiritually and morally bodied forth, in Jesus Christ, the exact image of himself

and predestinated that all his children should be conformed to the image of his Son.

940. The beautiful idea is, that the Father delineated the exact image of himself in Jesus Christ as a perfect model of a child of God, and established an economy of grace by which all that were begotten of God should be born in the image of his Son, being moulded after the perfect model, and should grow up in the exact likeness of that model, till, as they had naturally borne the image of the earthy man Adam, so they should morally and spiritually bear the image of the heavenly man Christ, and attain to the measure of the fulness of his stature, or morally and spiritually become in size, symmetry, comeliness, and in all other respects, exactly like him. And God having established this perfect model with fixed and precise relations to himself and to the nature and condition of man, and predestinated that all his children should be conformed to it, and having established an economy of grace by which man may become conformed to that image, and the results of which, man, as a free moral agent, can greatly modify by his voluntary actions, habits, and conditions, the apostle earnestly exhorts and entreats those whom he addressed, and all mankind, to use all their powers and means to become conformed to that perfect image of God in Christ Jesus, and thus to work out their own salvation with earnest solicitude and perseverance, and secure their own highest and eternal well-being, and make their calling and election sure.

941. But I hope that I shall not be misunderstood on this subject. In advancing the proposition that it is our natural and moral and civil and religious duty to cultivate, by all true and proper means in our power, the bodily symmetry and beauty of our species, I do not mean that we are to do this merely for the sake of bodily symmetry and comeliness, but because, in the constitutional nature of things, these corporeal attributes hold such a relation to all the other qualities of our nature, that the perfection of our whole nature requires such a cultivation of these attributes (930); and precisely these measures which are best adapted to produce and preserve bodily symmetry and comeliness, are also most favorable to all the vital interests of our bodies, and to our highest intellectual, and moral, and social, and civil, and religious welfare (668).

942. The various attributes of our nature are, like the commandments of the Decalogue, so essentially one, that he who offends in one, offends in all. We cannot violate nor neglect those physiological interests which are connected with our bodily symmetry and comeliness, or with the perfect organization and symmetry and harmony of our whole corporeal system, without violating or neglecting those interests which are essential to the highest and best condition of our whole nature (603). So that, if our sole object were to attain to the highest intellectual and moral excellence of which our human nature is capable,—if the means which we used to gain our object, were, in all respects, most truly and perfectly adapted to the end which we aimed at,—they would also be best adapted to produce and preserve the most perfect bodily symmetry and comeliness, and would be most favorable to bodily health, strength, and longevity (668). Hence I affirm that it is our natural and moral and civil and religious duty to cultivate

by all true and proper means in our power, the bodily symmetry and beauty of our species.

943. And surely, to say the least of it, there is quite as much reasonableness in our endeavoring to cultivate the bodily symmetry and comeliness of our own species, as there is that we should cultivate these qualities in the lower animals. Many think no trouble and expense of time and money too great to be devoted to the cultivation of the bodily symmetry and beauty of their horses and oxen and cows, and even of their swine and domesticated fowls, and other animals; but no one seems to think it of any importance to cultivate these qualities in the human species,—though the common sense of every man that reflects a little on the subject, must enable him to perceive that all the constitutional interests of our nature are to some extent connected with these corporeal attributes.

944. Omnipotent Fashion, with most capricious and yet most absolute and imperative authority, defines and ordains for us the shapes and forms that we must worship, and to which we must become assimilated, however unfriendly to the physiological and intellectual and moral interests of our nature! If the body and limbs can be compressed or stretched into the mould of fashion, it is of little consequence whether they possess any natural symmetry or not. If the garment is shaped exactly according to fashion, and the body can be squeezed into it, it is no matter how much deformity that garment hides. If the waist is too large, it must be reduced by the tournequet of fashion; if the shoulders or other parts are not sufficiently broad or prominent, they must be filled out by padding and buckram; and thus human beings are tortured into such shapes as despotic fashion capriciously chooses to assume as the models of gentility and elegance; and, unfortunately for poor human nature, almost every one of the caprices of fashion is seriously unfavorable to our physiological, intellectual, and moral well-being; and the very means which fashion takes to make us artificially beautiful according to her ever-changing standard, are directly calculated to destroy the natural symmetry and comeliness of our bodies, and to make us ugly and deformed. So that, by the operation of these and other causes, there is little real bodily symmetry and comeliness to be found among the present generations of the human race; and what little there is, is mostly to be found among those tribes which are not considered as within the pale of civilization and refinement, or which, at most, have not advanced beyond that simple state which, in all times, has been called the 'golden age' (638), and whose habits and circumstances most nearly accord with the constitutional laws of human nature.

945. It is truly surprising how very rarely bodily symmetry and comeliness are to be met with in civic life! If we make it a matter of particular attention, we shall find that hundreds of the fashionable and genteel and elegant ones of society, may pass in review before us without affording one instance of real beauty; and in a thousand we may not be able to find one who is even moderately symmetrical and beautiful throughout. For it often happens that we find a tolerably pretty face belonging to a body possessing no natural symmetry; but a fashionable dress can make up for this defect, sufficiently to answer the ends of fashion—the mutual deception and fraud of civic life. And

how frequently do we see moving before us, an artificially manufactured figure, which fills our imagination with the idea of all that is enchantingly beautiful in the face belonging to that form, which is covered from our curious and eager gaze by an envious hood or bonnet; yet if an unlucky turn presents that countenance full to our eye, it is like the disclosure of the visage of the veiled prophet; we feel a deep and powerful revulsion of the soul, and almost instinctively recoil from the reality of our visual perception, which at once dashes the spell of our imagination and our sensibilities, and forces upon us the sudden and painful conviction of our delusion.

946. The artificial symmetry and comeliness of civic life may enable us to hide our natural deformity and deceive others till we can get married, but they do not fit us to become the parents of symmetrical and comely and healthy offspring, and thus—so far as we are concerned—to bless the world with a symmetrical and beautiful and noble race of human beings, such as God made man to be, in the highest and best condition of his nature, and such as God has made man capable of being, if he will, but not without a strict conformity to those laws of constitution and relation which are wisely and benevolently established in his nature.

947. Organization, as we have seen (121), being the result of the vital action of living organs, and all organized bodies deriving their existence from pre-existing bodies of the same kind, living organized bodies in a perfect state possess a constitutional economy by which they can produce other organized living bodies like themselves in all respects (125, 133), unless the operations and results of that economy are affected by disturbing and modifying causes distinct from its original constitutional laws. When all the constitutioual laws of that economy are perfectly obeyed, its results will nicely correspond with the design for which it was established, or perfectly resemble the original type or model in which the Creator instituted that economy, with fixed and precise relations to all the physical, mental, and moral faculties, attributes, and powers of that model; but all infractions of the constitutional laws of that economy necessarily disturb its operations, impair its powers, and modify its results. And as all living bodies are capable of being deteriorated and afterwards improved, so the reproducing economy of living bodies is affected by their condition, and its results correspondently modified. Hence, certain causes acting on the human species, through several generations, will exceedingly degenerate the race, and establish those peculiarities in tribes and nations which will give the appearance of strongly marked varieties, if not of distinct species of the human family.

948. It is important to remark, however, that in the earliest generations of the human species, when the constitutional powers were least impaired, and all the vital susceptibilities and sympathies of the system most delicate and vigorous, all disturbing causes would produce more powerful effects in the physiological operations and results of the vital economy, than when the system had become more deteriorated or depraved in all its properties. Thus, we have seen (696), when all the organs are pure and undepraved, the presence of the baneful odors will not only be perceived by the olfactory sense, but if their quality or power be such as to endanger the vital welfare of the system the

alarm will be given through the medium of the vital sympathies to the whole domain of organic instinct, and every part will be called into vigorous and perhaps violent action, to protect the vital interests; and in the general array of all the vital powers against a common enemy, the particular functions of the several organs are necessarily more or less disturbed. So, when a state is invaded by a foreign foe, the husbandman, and artisan, and merchant, and other members of the commonwealth, roused by a common sympathy of patriotism, rush to the field of arms to protect the common interests of the state; and by these means, the particular functions of these several men, in agriculture, arts, and merchandise, upon which the very existence of the state depends, are necessarily more or less disturbed; and if these disturbances are too powerful, too frequent, or too long, famine and poverty and pestilence and general ruin must result.

949. But when the vital sensibilities and sympathies of the organs have become depraved and generally impaired, the poisonous odors, though equally hostile to the vital interests of the system, are not perceived and appreciated by the olfactory sense (696), and consequently no alarm is given and no general effort is made to resist the encroachments of the enemy, but the whole system stupidly succumbs, and gradually sinks and perishes beneath its baneful influence, and the unhappy subject never perhaps suspects the cause of his destruction Or if, from the potency of the disturbing cause, the particular organ upon which it more immediately acts is somewhat irritated, the vital sympathies of the system are too much depraved to communicate the alarm with integrity, and all the physiological powers of the body are too much impaired to admit of a prompt and vigorous co-operation of the several parts to resist or to expel the invading foe (697).

950. In the same manner, when the system is in a perfectly healthy and pure state, if any substance unfriendly to the vital interests be taken into the gastric cavity, the organic sensibility of the stomach (727) will instantly detect its pernicious character, and not only will the stomach itself be disturbed, but it will promptly give the alarm through the medium of the healthy sympathies to the whole domain of organic instinct, and all the vital powers will at once be arrayed against the hostile invader, and act with an energy and violence proportionate to the real banefulness and power of the disturbing cause. And perhaps in the mighty conflict, life will be exhausted, and death ensue, before the enemy can be expelled, and the system relieved from its destructive influence. Yet in such a case, death would be more the result of exhaustion than of poison (875). But when the physiological powers of the system have become generally depraved and impaired, pernicious substances may be introduced into the stomach habitually, and that organ will not detect their poisonous character (728), nor spread the alarm over the domain of organic instinct; and while a morbid irritation injurious in its effects will be more or less extensively felt, there will be no array of the vital powers against the invader (729), but the poison will be permitted to extend its ruinous influence into every part and substance of the whole system; the functional results of every organ will be deteriorated, and the constitution slowly impaired, and life destroyed. And perhaps, through the whole progress of the work of death—except in the agonies of the first debauch—the

sensibilities and sympathies of the system will scarcely indicate a struggle of the vital powers to arrest the career of the destroyer!—so completely will they be stupefied and subdued by that destroyer's influence. In such a case, death is truly the result of poison. Or if the disturbing cause is very powerful, the morbid irritations of the organ immediately acted on will be extended over the system by unhealthy sympathies, and there will be a blind array and violent action of the vital powers, which, instead of relieving the system, will only increase its sufferings and hasten its destruction; and in these terrible conflicts, such a system will exhaust its vitality, and death will result much sooner than in a healthy body. So, when a state is generally depraved by the universal selfishness and sensuality of the people, the constitutional interests of that state may be assailed and gradually destroyed, and none will have the courage nor the inclination to rise in the cause of freedom and of patriotism, but all will stupidly submit to the encroachments of usurpation, and suffer their liberties to be continually abridged, and themselves degraded to very slavery; and when oppression bears so heavily upon them as to be intolerable even to a slave, they will groan under it as under an incubus, which by the very principle that gives distress, deprives them of the ability to act. Or if they should be goaded on to action, it will only be in blind and violent convulsions, without direction, without aim; and their tumultuous struggles will only serve to exhaust and to destroy themselves, or sink them deeper in their miseries, without effecting any good for the cause of freedom and the rights of man.

951. But when I say (948) that in the early state of the human constitution, when its physiological powers were far less impaired, and all the vital susceptibilities and sympathies of the system far more delicate and vigorous, all disturbing causes would produce more powerful effects in the physiological operations and results of the vital economy than when the system had become, in all its properties, more deteriorated or depraved, I do not mean that in the most healthy and vigorous state of the human constitution, disturbing causes more readily and more easily induce disease and death, but that all the vital powers, according to the instinctive economy of organic life, more promptly and more powerfully and more determinately co-operate to resist the action of those causes which are unfriendly to the vital interests; and, therefore, disturbing causes acting on particular parts, more powerfully affect the physiological operations and results of parts not immediately acted on by these causes, but sympathetically affected by them. Thus, if a piece of tobacco is taken into the mouth of one whose system is in perfect and vigorous health, and whose physiological properties and powers are perfectly undepraved and unimpaired, the poisonous character of the tobacco will be instantly perceived by the vital sensibilities of the parts on which it acts (296), and the alarm will be promptly given to the whole domain of organic instinct, and the physiological operations and results of the stomach, the liver, the lungs, and every other organ in the body, will be more or less powerfully and extensively affected by the sympathetic irritations of the system (300), and by the general effort of the vital powers to resist the poisonous effects of the tobacco, and to expel the enemy from the vital precincts But when the system has become depraved, and its physio-

logical properties and powers impaired by the habitual use of tobacco, its poisonous character is not detected, no alarm is given to the domain of organic instinct, and while the vital interests are continually injured, and life itself jeoparded by the habitual presence of the poison, no general and energetic effort is made to resist its action, and consequently the physiological operations and results of the stomach and other organs of the body are not at any time so powerfully affected by the tobacco, though they are continually suffering, to some extent, from its deleterious influence.

952. Hence, therefore, when the physiological properties and powers of the human system are in the most perfectly healthy and pure and vigorous state, the disturbances of one special economy of the system will most powerfully affect the physiological operations and results of another special economy. Moreover, in such a state of things, the extent to which the physiological operations of the system deviate from normal results, under the action of disturbing causes, must always be proportionate to the force of the disturbing cause and the physiological power of the disturbed economy.

953. It therefore clearly and necessarily follows, that the greatest deviations from normal results in the reproducing economy of the human system could only be effected by the influence of disturbing causes in the early generations of the human species, when the constitutional powers were little impaired, and all the vital susceptibilities and sympathies of the systems still nicely delicate and vigorously active. Abortive and puny and deformed results are infinitely more numerous in the more degenerate state of the constitution; but great deviations from the regular results of the economy, and enormous monstrosities, are only to be expected from the disturbances of the most vigorous physiological powers.

954. It is also a fact of great interest and importance to the subject before us, that in the primitive generations of the species, when the human constitution was little impaired, and the physiological properties and powers of the system comparatively little depraved, the direct effect of mental and moral influence on the reproducing economy (303) was vastly greater than at present. Besides, in the earlier period of the world, when the inhabitants of the earth were few, they divided themselves off into families, and formed separate tribes; and, as a general fact, for many centuries the members of each tribe formed matrimonial connexions only with their own tribe, or very rarely with members of other tribes; and the separation and distinctness of the different tribes were still further secured by the peculiar religious views and institutions of each tribe. Consequently, the strongly-marked variations of the reproducing economy of the human system, in single instances, in that period, would almost of necessity become the heads of separate families, which would grow into separate tribes, and, in time, into separate nations; and thus the original peculiarities of the variations would naturally and inevitably be preserved, and perhaps increased, by peculiar habits and circumstances, in tribes and nations through all succeeding time, unless a complete amalgamation of all the different tribes and nations in the earth should be effected; and this, natural affinities and many other causes would conspire to prevent.

955. These principles and facts, together with what may properly

be allowed for the effects of climate and other circumstances, and also the peculiar habits of different families and tribes, are quite sufficient to account for all the varieties of the human species at present existing on the earth, and also to afford a satisfactory reason why those varieties may be traced back to very early age. Indeed, if those varieties had not originated in the earliest ages, it would have been extremely difficult for them to be preserved. For, as the earth becomes more densely populated, and the borders of one nation fade into those of another, and the artificial wants of civilized life are greatly multiplied, and lead to the extensive intercourse of nations, it is extremely difficult, if not impossible, for one individual to become the progenitor of a separate and distinct nation or tribe. And as the general improvements of civilization increase and become extended, and yet more especially, as a more truly rational and enlightened religion prevails, every thing tends more and more powerfully to a gradual obliteration of all national distinctions and peculiarities, and to a universal blending of all the different portions of the human family into one great and harmonious fraternity!

956. It is, therefore, with the strictest regard to the physiological principles and powers of the human system, and to those effects which, from the constitutional laws of things, would almost necessarily result from the action of disturbing or modifying causes, in different conditions of the human constitution, that I confidently affirm the truth of the position, that the most strongly marked varieties of the human species sprung from one and the same original stock, in the very early periods of the existence of the species; and that, by the natural affinities and repellances of human taste, these varieties were originally separated from each other, and preserved and strengthened in their peculiarities by the long continued operations of a variety of causes.

957. It is well known, that in several species of the lower animals, varieties quite as strongly marked as any in the human species have been effected by the modifying influences of cultivation, climate, etc. In a pure state of nature, great uniformity in color, size, and shape, pervades the whole species; but when any species of animals comes so far under the control of man as to have the condition and operations of its physiological powers considerably affected, strongly-marked variations from the truly normal results of the reproducing economy very soon take place, and the different members of the species soon become of all varieties of color, and vary greatly in size, and very considerably in form. It is so common for entirely black lambs to spring from parents both of which are entirely white, that it is no longer a matter of remark, and no one thinks of denying the fact nor of attempting to prove that such a thing cannot be. Yet we frequently meet with most elaborate tissues of reasoning and speculation against the possibility of such results of the reproducing economy of the human species, in any condition of its physiological powers, or in any state of the human constitution. But these objections all appear to be founded on quite too partial and too limited views of things. The objectors do not seem to contemplate nature in the wide range of her normal and abnormal capabilities, nor fully to appreciate the difference of the effects of similar causes in different states of the constitution and different conditions of the physiological properties and powers of the human system.

958. We have seen (687) that there are the most precise and determinate relations between the organs and functions of the human body, and the nature and condition of the human aliment (688); and it is equally certain that there are the most precise and determinate constitutional relations between the economy of nutrition and that of reproduction in the human system.

959. In order that living bodies, in their original state and condition, should produce their like (917) in perfectness of organization, size, symmetry, beauty, etc., it is necessary that the laws of constitution and relation should be exactly fulfilled in those bodies; and in order that the results of the reproducing economy of the human system should come up to the original model of our species, it is only necessary that the original laws of constitution and relation should be exactly and permanently fulfilled.

960. The causes which modify and deteriorate the results of the reproducing economy in the human system are many and interesting; but it is more particularly our present business to inquire into the influence of diet on these results, and, if possible, to ascertain the comparative effects of animal and vegetable food in modifying them.

961. The interesting question (502) now recurs and demands solution. Since the economy of nutrition sustains the growth of the body from birth to adult age, why, by the same economy, does not the body continue to increase in size so long as its life continues? or what limits the dimensions or establishes the determinateness of the development of living bodies?

962. In regard to individual cases, as a general rule, the ordinary results of the reproducing economy, as to size, definition, proportions, etc., of the body, greatly depend on the peculiarities of constitution, the physiological condition, and the general organic economy of the immediate parents.* But as a general physiological law of the species, the development, proportions, size, symmetry, and termination of growth, as well as the natural termination of the life of the human body, are unquestionably connected with the relative proportion and conditions of the solids and fluids in the system (674). Whatever changes the relative conditions of the solids and fluids from the true constitutional character, necessarily impairs the processes and results of the vital economy (680); and whatever changes the relative proportion of the solids and fluids more rapidly than is strictly consistent with the physiological interests of the system, necessarily produces

* Peculiarity of size and shape often runs in particular families through several generations; and where those families become separated from the rest of the species, and intermarry among themselves and originate separate tribes, as in the early periods of the world (904), these peculiarities will be perpetuated for centuries, and especially if they be of a character which is favored by the situation and habits of the people. And even in the midst of other society, and without any exclusiveness of marriage connexions, such peculiarities are often preserved in particular families for three or four generations. 'In Sampson county, North Carolina,' says the Rev. Thos. P. Hunt, of that State, 'the people generally are above the ordinary size, and several families are remarkably large. One family of the name of Murphy has six or seven sons measuring six feet and six inches, and one of them measures six feet seven inches. Another family by the name of Holmes, is equally remarkable for stature. Twelve young men of this family weighed thirty-two hundred and seventy-five pounds. A family by the name of Preston, in the western part of Virginia, exhibits the same giant size of body.'

similiar effects (681). When the relative proportion and conditions of the solids and fluids, by whatever cause, are brought into a certain state, the growth ceases, whether the body is fully developed in size, proportions, and symmetry, or not; and when this effect is produced by greatly hurried and imperfect processes in the physiological operations, from the action of disturbing, or irritating, or even too accelerating causes, the results will be commensurately imperfect and perhaps deformed (914).

963. It is from this physiological law that the use of opium and other substances in the mother, often dwarfs and deforms the offspring; and it is upon this principle that excesses in particular vices in early youth, often prematurely arrest the growth of the body, and bring on an untimely old age, and early decrepitude, and death.

964. Now, then, from the constitutional laws and relations of the vital economy of the human body, which have been fully explained in reference to the subject before us (874, 963), it must be clearly evident that animal food or flesh-meat cannot be so conducive as proper vegetable food to the perfect development, symmetry, and comeliness of the body; because animal food, possessing a greater proportion of stimulating power to its quantity of nutrient matter (906,) more rapidly exhausts the vital properties, and wastes the substance of the organs (909), and accelerates all the functions of the system, and renders the vital changes less complete, and the general results of the vital economy less perfect (914).

965. There is no law of organic life, extending over the whole animal and vegetable kingdoms, which is more general and more certain than this. The slower the growth of organic bodies, consistently with the perfectly healthy and vigorous condition and action of the vital powers, the more complete are the vital processes, and the more perfect and symmetrical is the general development. Indeed this law, or one very analogous to it, extends throughout the material world, and governs the formation of all material bodies. Even the crystals of the mineral kingdom which are formed most slowly, and, as it were, in the undisturbed tranquillity and serenity of nature, are the most perfect and the most beautiful.

966. In the vital economy of the human body, we have seen (906, 916) that all the changes concerned in the nourishment and development of the system are the most healthfully slow and complete (736) when the food is purely vegetable; and it therefore must follow from every known physiological principle in the human constitution, that, all other things being equal, a pure and well-chosen vegetable diet is most conducive to completeness of bodily development, and perfectness of symmetry and beauty (930).

967 In illustrating these principles from the history of the human species, however, a thousand difficulties, as we have seen (872), lie in our way, which require the exercise of the most constant and cautious and rigorous inspection, to prevent our being betrayed into the apprehension of erroneous facts, and led to false conclusions (887). For in a cursory survey of the extended history of man, we meet with innumerable phenomena which are in the highest degree calculated to deceive us (902). We find, perhaps, many living mostly or entirely on vegetable food, who are far from being well-developed and symmetrical;

and we seem to be forced to the conclusion that vegetable food is by no means favorable to the most perfect development of the human body. But it is entirely certain, that if we examine such cases with close and severe and thorough scrutiny, we shall find in the condition, circumstances, and habits of such people, causes more than sufficient to account for all the apparent contradiction between the physiological principles which I have explained, and the phenomena presented by such cases (766, 768). Again, we find, perhaps, many subsisting mostly or entirely on animal food, who are large in size and at least quite as symmetrically formed as most other portions of the human family. Here again we seem forced to conclusions adverse to the physiological principles which I have advanced. But here, again, a full and accurate investigation of the matter will clearly show that there are no real facts in the case which are not perfectly consistent with the principles contended for. Nay, indeed, the more extensively and rigorously we push our researches and investigations, and the more clearly and distinctly we ascertain the truth, the more fully shall we be convinced of the accuracy of those principles.

968. Ancient history gives us accounts of a few tribes scattered over Europe and other parts of the earth's surface, and situated mostly upon the borders of seas, rivers, etc., who subsisted mainly or entirely on flesh or fish, or both. But we are not sufficiently well informed concerning them to draw any safe conclusions from any known facts which their cases present. We are therefore obliged to take our illustrations from those authentic detailed accounts of tribes and nations subsisting mostly or entirely on animal food, which are of a much more recent date. The celebrated voyager, Captain Cook, is one of the earliest and most valuable sources of information on this interesting subject, of modern times; and since him, many enterprising voyagers and travellers have corroborated his statements, and very greatly extended our means of information.

969. Professor Lawrence, who probably eats flesh himself, and who is willing that every body else should eat it, and therefore is neither by theory nor practice interested to decry the use of animal food, yet being willing as a public teacher of physiological science to avow what he believes to be true, frankly acknowledges (849, Note) that 'the Laplanders, Samoides, Ostiacs, Tungooses, Burats, and Kamtschadales, in northern Europe and Asia, as well as the Esquimaux in the northern, and the natives of Terra del Fuego in the southern extremity of America, although they live almost entirely on flesh, and that often raw, are the smallest, weakest, and least brave people of the globe.'

970. Dr. Lamb, of England, whose experiments and researches on this subject have been very extensive, has collected and published a greater number of valuable facts concerning the effects of vegetable food in chronic disease, and the comparative effects of vegetable and animal food in the development of the human body. From an interesting work of his, which has recently fallen into my hands, I shall borrow largely for the illustration of those physiological principles which I have advanced in relation to the subject before us.

a. 'The Laplanders subsist principally on animal food; and we are informed by those who have travelled and resided among them, that they are feeble, awkward, and helpless beings.'

b. 'The inhabitants of the Andeman Islands, situated in the Pacific Ocean,' says Dr. Lamb, 'practise no sort of agriculture; they inhabit the coast; their only vegetable food is the scanty produce of the woods; but their principal subsistence is drawn from fish, shell-fish, and the animals they catch in the woods. They seldom exceed five feet in stature, their limbs are disproportionately slender and ill-formed, with high shoulders and large heads; their aspect is extremely uncouth.'

c. 'The Ostiacs are the Tartar tribes inhabiting the regions watered by the Obi. They subsist mostly by fishing, though a portion of their food is the produce of the chase. 'The greater number of them,' says Pallas, 'are rather below the middle stature. They are not strong: the leg is particularly thin, and with a small calf. Their figure is, in general, disagreeable, and the complexion pale, without any characteristic trait.''

d. 'The natives of Van Dieman's Land and of New Holland subsist chiefly on flesh and fish. They are disproportioned in their limbs and in other respects, and have less strength than Europeans.'

e. The natives of the coast of New Holland are,' says Mr. Goldsmith, 'perhaps the most miserable of the human species.'

f. 'The tribes on the coast of Terra del Fuego have a very scanty supply of vegetables, but subsist mainly on fish and some flesh. 'Their shoulders and chest,' says Foster, 'are large and bony; the rest of their body is so thin and slender, that on looking at their different parts separately, we could not persuade ourselves that they belonged to the same individuals. They are a short, squat race, with large heads; their color yellowish brown, their features harsh, their faces broad, their cheek bones high and prominent, their nose flat, their nostrils and mouth large, and the whole countenance is without meaning. They are remarkably stupid. Besides fish, there is the greatest abundance of birds and animals which gain their food from the ocean. Some of the islands are absolutely covered by these animals, which may be killed in any numbers, with greatest ease; and if animals such as these were proper food for man, these Islanders would be rioting in abundance and luxury. But, instead of this, they are very few in number, and, as Captain Cook says, a little, ugly, half-starved race.'

971. The Indians of Patagonia, and of the great Pampas or plains of South America (778), seem to form the most remarkable exception to the general rule in regard to flesh-eating tribes and nations. The earliest accounts which we have of the Patagonians, describe them as almost a race of giants; some of them measuring ten or eleven feet, and being, on the average, much taller than any other known portion of the human family, and every way well proportioned. These accounts, however, are undoubtedly great exaggerations, and very far exceed the truth. But admitting that much which has been said of them by different voyagers and travellers who have been among them is true, they are far from constituting a very strongly outstanding fact against my theory. It is unquestionably true that these people have subsisted mainly on flesh ever since they have inhabited Patagonia, and it is unquestionably true that they are, as a race, much larger

and more symmetrical than any other known tribe of flesh-eaters; and perhaps, on an average, larger than the Hindoos, who live on vegetable food. So far, then, the facts in the case seem to be against the doctrines which I have advanced. But let us examine the matter. If any dependence can be placed on the opinions of those who have written and testified concerning this people, the Patagonians originally sprung from a race of islanders of very great bodily size and harmony of proportions, and who were strictly vegetable-eaters. If this is true, it would naturally require a succession of several generations under the most unfavorable circumstances and diet of savage life to degenerate the race to the diminished size of other flesh-eating tribes (962). But such has not been wholly the case with the Patagonians. In the first place, the climate of Patagonia is exceedingly mild and uniform, and the atmosphere is very dry and salubrious. These things are in the highest degree favorable to the full and symmetrical development and health and vigor and longevity of the human body, and to the multiplication of the species. In the second place, their children nurse long, and wear no clothes till they are twelve or fifteen years old; and as soon as they are of sufficient age and size, they engage in the sports of childhood, and take a great deal of exercise in the open air,—running, exerting the upper limbs, riding on horseback, etc. These things are all of them, likewise, in the highest degree favorable to the full and symmetrical development of the human body. The adult Patagonians perform little or no servile labor; but the food on which they subsist is sufficiently scarce and difficult of attainment to require a very considerable degree of physical and mental exercise. They ride a great deal on horseback, and indulge much in social amusement. They have been taught by civilized man to love tobacco and intoxicating liquors, but are very rarely able to indulge themselves in the use of these pernicious substances; certainly not enough to produce any general and permanent physiological effect in their bodies worthy of consideration. They use no other pure stimulants (733). Their food is perfectly plain and simple. They mount their horses pursue and take their game, and return with it to their tents, where it is slightly cooked, either by roasting or boiling, and eaten. The animals on which they subsist (913) contain no fat, and therefore the Patagonians live wholly on the lean flesh of wild game, which is the healthiest kind of flesh-meat that can be eaten.

972. With the exception, therefore, of the bare facts that the Patagonians subsist on flesh, and are not careful to keep their bodies clean, every thing in their condition and circumstances, and nearly every thing in their habits, are decidedly and highly favorable to the full development and perfect symmetry of their bodies; and, consequently, if flesh-meat were favorable to the physiological interests of the human body, the Patagonians must naturally have at least retained the size and symmetry of their progenitors. But after making a liberal allowance for the exaggerations of the earliest accounts of the Patanians, it is very evident that they were a much larger and better formed race when first discovered, than at present. For they have always been described by those who first went among them, as a gigantic race of people. But according to the testimony of Messrs. Armes and Coan, the American missionaries who have recently spent three months

among them, the present inhabitants of Patagonia fall very considerably short of the description given of their ancestors some two or three hundred years back. They are still a tall and tolerably well formed people; but the missionaries found on measuring the very tallest of them, that they did not exceed six feet and two inches in height, and few of them came up to this. 'They are evidently,' says Mr. Armes, 'a degenerated race of men, and are still becoming more degenerated.'

973. The whole truth, then, concerning the Patagonians, seems to be plainly this. They sprung from a race of gigantic and well-formed vegetable-eaters; they have always inhabited a mild climate, and lived in a dry salubrious atmosphere; and all the circumstances of their lives, and nearly all their habits, have been highly conducive to the full development and the symmetry of their bodies. Yet, in spite of all these advantages, they have, in consequence, mainly, if not entirely, of living exclusively on flesh, gradually degenerated in size and symmetry; for although they are still tolerably well formed, yet there are among them none of those perfectly symmetrical and beautiful models for statuary which are common among vegetable-eaters in the rude state of life.

974. In contemplating the effects of pure vegetable diet in the development and symmetry of the human body, it is necessary, as I have repeatedly remarked (872, etc.), to be exceedingly on our guard lest we be deceived by the numerous disturbing and modifying causes which almost universally operate in the various conditions of mankind (768).

975. As we have already seen (739), all the ancient histories and traditions of our species inform us that vegetable substances constituted the whole food of the primitive inhabitants of the earth, and that the human race at that early period were exceedingly vigorous, athletic, of full development, and symmetrical. I am, however, by no means inclined to assert and vindicate the notion that our first parent, when compared with the present inhabitants of the earth, was a huge giant, nor that his immediate posterity were of mammoth size. There may have been, in the earliest generations of our species, when the physiological powers of the human body were most vigorous and least impaired, some wonderful monstrosities in size, as well as in other respects, produced by some of the freaks of nature, under the action of disturbing causes peculiar to those times (953). Nor does the fact that no such mammoth remains of man have been discovered, prove that no such mammoth forms of man ever existed. Neither, as we have seen (931), does the fact that other animals, found in what is commonly called a state of nature, may often be considerably improved in size and symmetry, and many other qualities, by cultivation, afford the unequivocal evidence of analogy that the original size and symmetry of man were such as to admit of considerable improvement by cultivation, because, with very few exceptions indeed, if any, it is a matter of entire uncertainty whether any of the animals at present inhabiting the earth's surface are truly and perfectly in their original state of nature. The horse, for instance, had originally some native spot, whose climate and soil and productions were best adapted to the physiological interests of his nature. If, therefore, the horse species become dispersed over the globe, climate and other circum-

stances must necessarily so affect their physiological powers, as in time considerably to diminish the size and impair the symmetry and other qualities of different portions of the species, and thus produce strongly-marked varieties of the same species. If, then, we take some of the most degenerate varieties of this species of animals, and by cultivation greatly improve their size, symmetry, and other qualities, the fact affords no unequivocal evidence of analogy that the original form of man admitted of similar improvement.

976. I do not pretend to know, nor shall I contend, that the original size of man very much exceeded the average size of the race for two or three thousand years past; but I insist upon it that we have every reason to believe (917) that the original form of man was perfectly symmetrical and beautiful, and that if all the physiological laws of human nature were perfectly and permanently fulfilled, the symmetry and beauty of the original model would be preserved in the posterity (959); and that a well-chosen vegetable diet is more conducive to such effects than animal food or flesh-meat (964). The sacred scriptures, in at least one instance, clearly and fully set forth this same doctrine.

977. During the Babylonish captivity of the Jews, Nebuchadnezzar, the king of Babylon, commanded one of his officers to select from the children of Israel a number of such as had no blemish (923), but were well-favored and skilful in all wisdom, and cunning in knowledge, and understanding science, and such as had ability in them to stand in the king's palace, and whom they might teach the learning and the tongue of the Chaldeans. And the king appointed them a daily provision of the king's food, and of the wine which he drank; so nourishing them three years, that at the end thereof they might stand before the king. Among the number thus selected were Daniel and his three friends, best known by the names, Shadrach, Meshach, and Abednego. But Daniel purposed in his heart that he would not defile himself with the portion of the king's food, nor with the wine which he drank. Therefore he requested of the king's officer that he might not be obliged to partake of the royal provisions. But the officer replied, 'I fear my lord the king, who hath appointed your food and your drink; for why should he see your faces worse looking than the children which are of your sort? then shall ye make me endanger my head to the king. Daniel said to the officer, 'Prove us, I beseech thee, ten days; and let them give us pulse to eat and water to drink, then let our countenances be compared with the countenances of those that eat of the portion of the king's food, and as thou seest, deal with us.' So the officer complied with Daniel's request, and proved him and his three friends, ten days; and at the end of the ten days their countenances appeared fairer and fatter in flesh than all the children which did eat the portion of the king's food. So the officer took away the portion of the food and the wine appointed for their sustenance, and gave them pulse. And God gave the four children knowledge, and skill in all learning and wisdom; and when the time arrived for them to appear before the king, they were brought into his presence, and the king communed with them; and among them all was found none like Daniel and his three friends; therefore stood they before the king; and in all matters of wisdom and understanding that the king inquired of them, he found them ten times better than all the magicians and astrologers that were

in all his realm. And Daniel continued even unto the first year of king Cyrus.*

978. The lovers of flesh, with an intention to dodge the obvious inference of this statement, assert that a miracle was performed in the case; because, say they, no kind of food could naturally produce such a very marked effect in so short a time. To this I reply, that the case presents no necessity for a miracle, and affords no evidence of a miracle, and it is contrary to all sound rules of Biblical interpretation to assume the fact of a miracle where both the necessity for and evidence of one are wanting. There is no evidence in the case that any considerable change took place in the appearance of Daniel and his three friends in the ten day days during which they were proved; but all the evidence in the case leads us naturally to the conclusion that Daniel and his three friends had long, if not always, subsisted on pulse and water, or a diet of a similar kind, and that now, instead of adopting a new diet, they simply continued on their previous habit of living, to which they were indebted for that remarkable fairness and comeliness, as well as wisdom and understanding, for which they were at first selected by the king's officer, and at the end of the ten days, they had perhaps somewhat improved, by special care, in the fairness and plumpness and comeliness of their countenance for which they were distinguished when first selected; whilst the rest of the selected Jews making a considerable change in their diet, at the end of the first ten days probably did not appear so well for it, and thus produced a stronger contrast between their countenances and those of Daniel and his three friends. But if a miracle be admitted in the case, it only goes still more strongly, if possible, to establish the principles for which I contend, for it proves the divine authority for the truth of those principles by miraculous evidence.

979. It is not, however, necessary for us to seek for illustrations of these principles in the history of ancient times. The facts of modern history are sufficient for all our purposes. Let us contemplate them for a few minutes as collected and arranged by Dr. Lamb; remembering, however, that the statements which he makes relate to a condition of things which, in many instances, has undergone a considerable change within a few years past.

a 'The natives of Otaheite,' says Dr. Lamb, 'though they use both flesh and fish in moderate quantities, draw their principal subsistence directly from the soil, practising agriculture in no mean degree of perfection. Of all the food of these people, it has been said that at least four-fifths was vegetable, and a large portion of that was unchanged by culinary preparations. Dr. Foster gives the following description of the bodily organization of the better sort of these islanders. 'The features of the face were generally regular, soft, and beautiful; the nose something broad below; the chin is overspread and darkened by a fine beard. The women have an open cheerful countenance; a full, bright and sparkling eye; the face more round than oval; the features arranged with uncommon symmetry, and heightened and improved by a smile which beggars all description. The rest of the body above the waist is well proportioned, included in the most beautiful,

* Daniel i 3—21

soft outline; and sometimes extremely feminine. The common people are likewise, in general, well-built and proportioned, but more active, and with limbs and joints delicately shaped. The arms, hands, and fingers of some, are so exquisitely delicate and beautiful that they would do honor to a Venus de Medicis.'

b. 'The inhabitants of the Marquesas are acknowledged by the current testimony of all voyagers to be a still more beautiful race. And it may be said in general of the inhabitants of the other Society Islands —the Friendly Islands, Tanna, New Caledonia, the Sandwich Islands (in all of which the natives subsist chiefly on vegetables)—that they have a bodily organization of a high degree of perfection.'

c. 'Judging from the accounts of all navigators who have visited the Friendly and Society Isles, I am inclined to think,' says a recent voyager, 'that the people of the Marquesas and Washington Islands excel in beauty and grandeur of form, in regularity of features, and of color, all the other South Sea Islanders. The men are almost all tall, robust, and well made. We did not see a single cripple nor deformed person; but such general beauty and regularity of form, that it greatly excited our astonishment. Many of them might very well have been placed by the side of the most celebrated masterpieces of antiquity, and they would have lost nothing by the comparison. One man, a native of Nukahiwa, whom he carefully measured, corresponded perfectly, in every part, with the Apollo Belvidere. The food of these people consists of bread-fruit, cocoa-nuts, bananas, yams, battatas, etc., and mostly in a natural state.'

980. Dr. Lamb has also with great propriety instituted a comparison between tribes living nearly in the same climate, and with no other difference of general condition and habit than in what concerns their food.

a. 'We may select for this purpose,' says he, 'the New Zealanders and New Hollanders. Both of these nations are destitute of domestic animals, both draw a considerable portion of their subsistence from the sea, and both live in a climate sufficiently mild, and nearly equally removed from the equator. But the New Zealander cultivates the soil, from which he draws perhaps one-half of his subsistence. The New Hollander uses no vegetables except what he picks up accidentally, the spontaneous produce of the earth. A few berries, the yam, the fern-root, the flowers of the different banksias, with at times some honey, make up his whole catalogue of substances from the vegetable kingdom. The whole quantity is of course very small. The consequence is, the New Zealander enjoys a good organization, but the New Hollander is defective. Their size, says Dr. Foster of the former, is generally tall; their body strong and formed for fatigue; their limbs proportioned and well knit. Of the latter, Collins testifies that in general, indeed almost universally, the limbs of these people were small; of most of them, the arms, legs, and thighs, are very thin.'

b. 'The Calmucks and the Circassians are not remote from each other, but wonderfully different in their form and physiognomy. The portrait of the former is thus drawn by Dr. Clarke. Nothing is more hideous than a Calmuck. High, prominent, and broad cheek bones;

very little eyes, widely separated from each other; a flat and broad nose; coarse, greasy, and jet-black hair; scarcely any eyebrow; and enormous, prominent ears, compose no very inviting countenance. And so horrible and coarse was the appearance of the women, that it was difficult to distinguish the sex. Of the Circassians, we have from the pen of the same writer the following description. 'The beauty of features and form for which the Circassians have been so long celebrated, is certainly prevalent among them. Their noses are aquiline, their eyebrows arched and regular, their mouths small, their teeth are remarkably white, and their ears are not so large nor so prominent as among the Tartars; although from wearing the head always shaven, they appear to disadvantage according to our European notions. They are well shaped and very active, being generally of the middle size, seldom exceeding five feet eight or nine inches. Their women are the most beautiful perhaps in the world; of enchanting perfection of countenance, and very delicate features. Those whom we saw, the accidental captives of war, were remarkably handsome. The most chosen works of the best painters, representing a Hector or a Helen, do not display greater beauty than we beheld even in the prisons of Ekaterinadara, where wounded Circassians, male and female, loaded with fetters and huddled together, were pining with sickness and sorrow.'*

c. 'Few will hesitate,' says Dr. Lamb, 'to pronounce that this ugliness of the Calmucks is the natural consequence of their diet. The horse is to the Calmuck, what the rein-deer is to the Laplander—his slave in life, and his food after death. But besides horse-flesh, which he often eats raw, the Calmuck devours, indiscriminately, every animal he can kill; horses, dogs, cats, marrots, rats, etc., and even in a carrion state. Of the Circassians we know little, except that they subsist chiefly by agriculture. Their country is cultivated like a garden; and the remarkable whiteness and regularity of their teeth indicate great purity both of the solid and fluid matter which enters into their diet.'

d. Lewis and Clark found a tribe of Indians on the banks of the Missouri, called the Ricaras. They cultivated the earth, and raised corn, maize, and other produce, in qualities sufficient both for their own consumption, and for sale, and exchange with their neighbors. They drank only water. This tribe was distinguished for the beauty of their persons; the men were tall and well proportioned, and the women were tall and handsome.'

e. 'The Laplanders are of a dwarfish stature. It may be thought that this is the effect of the rigors of their polar cold. But we find interspersed among them, and inhabiting the very same country, numerous families of industrious Finns, who cultivate the earth, and subsist chiefly on its produce; and this race, though they remain for centuries in the same country, do not appear to be in the least smaller than the Swedes or Norwegians. This difference, therefore, between the Finns and the Laplanders, must be attributed mainly or entirely to diet.

f. 'Finally,' says Dr Lamb, 'there is every reason to believe, and particularly from the observations of the navigators in the Pacific Ocean,

* It should be remembered that the utmost attention is devoted to the cultivation of bodily symmetry and beauty among the Circassians.

that those races of men who admit into their nutriment a large proportion of fruit and recent vegetable matter unchanged by culinary art, have a form of body the largest, of the most perfect proportions, and the greatest beauty; that they have the greatest strength and activity, and probably that they enjoy the best health.'

981. The peasantry of Lancashire and Cheshire, who live principally on potatoes and buttermilk, are celebrated as the handsomest race in England. Two or three millions of the inhabitants of Ireland subsist in the same way; and probably no portion of the civilized world can present more bodily symmetry and beauty than the peasantry of Ireland who are free from the use of narcotic and alcoholic substances, and of temperate, cleanly, and industrious habits (902). Adam Smith, in his Wealth of Nations, says that 'the most beautiful women in the British dominions are said to be, the greater part of them, from the lower rank of people in Ireland, who are generally fed with the potato.

982. The interesting natives of Pitcairn's Island, who sprung from the mutineers of his Britannic Majesty's ship Bounty, strikingly illustrate the principles before us. 'Yams constitute their principal food, either boiled, baked, or mixed with cocoa-nut, made into cakes, and eaten with molasses extracted from the tea-root. Taro-root is no bad substitute for bread; and bananas, plantains, and *appoi*, are wholesome and nutritive fruits. The common beverage is water; but they make a tea from the tea-plant, flavored with ginger, and sweetened with the juice of the sugar-cane. They but seldom kill a pig, living mostly on fruit and vegetables. With this simple diet, early rising, and taking a great deal of exercise, they are subject to few diseases; and Captain Beechey says they are certainly a finer and more athletic race than is usually found among the families of mankind. The young men, all born on the island, were finely formed, athletic, and handsome; their countenances open and pleasing, indicating much benevolence and goodness of heart; but the young women, particularly, were objects of attraction, being tall, robust, and beautifully formed, their faces beaming with smiles, and indicating unruffled good humor. Their teeth are described as beautifully white, like the finest ivory, and perfectly regular, without a single exception. Captain Pipon thinks that from these fine young men, and handsome, well formed-women there may be expected to arise hereafter in this little colony, a race of people possessing in a high degree the physical qualifications of great strength united with symmetry of form and regularity of features.'

983. 'The Indians of Mexico on the Tobasco River,' says a very intelligent gentleman, who has resided a number of years among them, 'subsist almost entirely on vegetable food; their principal article of diet is Indian corn. Those who abstain from the use of ardent spirit are muscular and strong, and among them are to be found models for the sculptor.'

984. 'On entering the cottage of the Hermano Mayor,' says the author of A Year in Spain, 'he came to the door to receive me, signed the cross over my head, and pressed my hand in token of a welcome reception. Like other hermits, the Hermano Mayor wore a large garment of coarse cloth, girded round the middle with a rope, and having

a hood for the head. The only covering of his feet consisted of a coarse shoe of half-tanned leather. Yet there was something in his appearance which would have enabled one to single him out, at once, from a whole fraternity. He had a lofty and towering form, and features of the noblest mould. I cannot tell the curious reader how long his beard was, for after descending a reasonable distance along the chest, it returned to expand itself in the bosom of his habit. This man was such a one, as, in any dress or situation, a person would have turned to look at a second time; but as he now stood before me, in addition to the effect of his apostolic garment, his complexion and his eye had a clearness that no one can conceive, who is not familiar with the aspect of those who have practised a long and rigid abstinence from animal food and every exciting aliment. It gives a lustre, a spiritual intelligence to the countenance, that has something saint-like and divine.'

985. Repeatedly as I have spoken of the dangers of deception and misapprehension in all investigations of this kind (766, 767, 768, 872, 887, 902, 967), I am so extremely unwilling to be misled or to mislead any one, that I feel constrained again to remark that a great variety of modifying causes are to be taken into consideration, when we attempt to test physiological principles by the apparent facts of human experience and history. Some of those causes are detected with great difficulty; and it is still more difficult to estimate their true force with exactness and certainty. As I have already remarked (872), no considerable portion of the human family has ever adopted and permanently pursued a mode of living which in all respects was regulated by correct physiological principles; and therefore, no human experience can justly be considered as a full and fair test of such principles. Nevertheless, the principles themselves may be ascertained with entire certainty. The facts which have been adduced as evidence on the topic before us, are all of them to be regarded as in some measure mixed results. Flesh-eating is not to be considered as the exclusive cause of all the physical and physiological facts in the history of those who subsist on animal food; other causes, favorable or unfavorable (767) to the physiological interests of the human constitution, universally, and in some instances, powerfully, co-operate; and all this is true of those who subsist on vegetable food. Human history as it is, therefore, when taken in the detail, is of little value to physiological science. Yet when taken in its general average, and correctly estimated, its evidence becomes very conclusive. If we contemplate flesh-eating tribes and nations, we find some individuals comparatively small and some comparatively large, some comparately ill-formed and some comparatively well-formed; and if we turn our attention to vegetable-eating nations, we find the same facts. If also we compare vegetable-eaters with flesh-eaters in the detail, we find some of the former smaller and less symmetrical than some of the latter, and the contrary; and from such views we are led to conclude that nothing is to be proved from human experience in regard to the natural dietetic character of man, except that he is made to eat every thing with equal advantage. Yet when we take a general view, and compare average results, we find a manifest difference, and the evidence becomes perfectly conclusive. We find that taking all flesh-eating tribes and nations together, though some of them whose circumstances and habits

are most favorable to the physiological interest of the human constitution, are comparatively large and well-formed, yet as a general average they are a comparatively small and ill-formed race; and even the very best of them never approach to any thing like complete and perfect bodily symmetry. And we find that, taking all vegetable-eating nations together, though many of them, from their excessive use of narcotics (963), and from other bad habits and unfavorable circumstances (902), are comparatively small and ill-formed, yet as a general average, they are a larger and much better formed race than the flesh-eaters; and it is only among those tribes and nations whose general habits are simple and temperate, and who subsist on a pure vegetable and water diet, that the most perfect specimens of human symmetry and beauty are found; and here they are very numerous, and deformity is very rare (1030).

986. It is unquestionably true, that if an individual be fed on flesh, with a regimen in all other respects correct, and if from infancy up to manhoood he be carefully trained with reference to bodily development and symmetry and beauty, he will be much better formed than one who subsists wholly on vegetable food, but whose habits and circumstances are in most or all other respects unfavorable to the symmetrical development of his body. But all other things being equal, it is entirely certain that, as a permanent fact extending from generation to generation, pure, well-chosen vegetable food will better sustain the human constitution in all its powers, and more healthfully and symmetrically develop the body, than a diet consisting of any portion of flesh-meal (916).

LECTURE XVI.

Comparative effects of vegetable and animal food on the human body, with reference to suppleness, activity, agility, vigor, ability to endure protracted efforts, etc.—Relative proportion and conditions of the solids and fluids with reference to suppleness, activity, etc.—Causes that render the solids rigid and unyielding—Comparative rapidity of the pulse in flesh and vegetable eaters—Illustrations of suppleness—various instances—Qualifying causes—Vegetable and animal food in relation to strength—Mechanical and physiological elements of voluntary power—Nervous stimulus of voluntary action—Relations between the functions of the arterial system and the physiological power of voluntary action—Law of muscular development and action—Permanency of the power of voluntary action—Qualifying cirumstances and conditions—Training of the ancient athleræ—Strength of the lion and rhinocerous—Jewish, Persian, Greek, and Roman soldiers—Russian and Polish soldiers—Peruvian soldiers, native Indians, etc.—Natives of India generally—The Hindoos, their dietetic and other habits, their general condition—Hindoos from the mountains and Hindoo couriers—The Burmese, their habits, etc—Chinese, their dietetic and other habits, etc.—Egyptians, their dietetic and other habits—Natives of interior Africa—Natives of Pitcairn's Island—Spaniards of South America—Porters and laborers of various countries and islands—Irish porters and coal-heavers—Porters of Smyrna—John of Thessaly—Benjamin Howland—Brindly, the English engineer's testimony—General conclusion.

987. STILL pursuing the physiological evidence in relation to the natural dietetic character of man, we are next lead to contemplate the comparative effects of vegetable and animal food on the human body, with reference to suppleness, activity, agility, vigor, ability to endure protracted effort, etc

988. We have seen (146) that all the solids of the human body are formed from fluids; that in the early stage of infancy the solids are extremely soft and pulpy, and the proportion of the fluids is very great to that of the solids (674); and that as life advances, even under the strictest obedience of the physiological laws of the system, the solids gradually become more consistent, dry, and rigid: and the proportion of the solids gradually increases on that of the fluids (978); and the cartilages (185), ligaments (188), and tendons (195), by degrees become more dry and hard and less flexible and elastic, and the muscles more rigid and unyielding (200); and hence the body, which in childhood is exceedingly supple and nimble and elastic, becomes stiff and clumsy and inelastic in old age.

989. Now it is very obvious that the more rapidly we hasten on these changes (681), the sooner the body loses its suppleneness and elasticity, and becomes stiff and unyielding; and hence, habitual spirit-drinkers and those who indulge freely in various stimulants and heating condiments which so greatly abound and are considered so essential to comfort and almost to existence in civic life, become stiff and clumsy much earlier in life than those who refrain from the use of such things.

990. It is a general physiological law, therefore, that the more stimulating and heating the diet, the more rapidly the changes in the relative proportion and condition of the solids and fluids take place—the more rapidly the solids become dry, inflexible, inelastic, rigid, and unyielding, and the body loses its suppleness and activity. Hence, flesh-meat is not so conducive to suppleness, agility, grace, etc., as proper vegetable food (909).

991. Scientific experiment has fully proved that much more of the oxygen of the atmosphere is consumed in respiration (472), by the same individual, during the digestion of flesh-meat, than during the digestion of proper vegetable food; and the temperature of the stomach is considerably higher (434) in the former case than in the latter. And, as we have seen (909), it is a fully ascertained fact of great interest and importance, that the most hale, vigorous, active, and athletic men, who habitually subsist on pure vegetable food and water, have a much cooler skin and a much slower pulse than those who live on a mixed diet of vegetable and animal food. It was found on careful and repeated examination in different parts of the day, that the skin of the remarkably healthy and robust young men of Pitcairn's Island, always felt cold in comparison with that of the Europeans, and that the pulse of the former was from ten to twenty beats in a minute slower than that of the latter (982).

992. According to every known physiological principle, therefore, we are led to the conclusion from *a priori* reasoning, that proper vegetable food is more conducive to the suppleness, activity, agility, and gracefulness of the human body, than flesh-meat; and all facts in the history of man, in relation to this point, when properly ascertained, will be found to agree mostly strictly with the physiological principles which I have advanced. Indeed, this is so obviously true, that it is hardly necessary to adduce any facts in exemplication of it. I shall therefore present but a few.

993. 'A mulatto girl,' says George Paine, Esq., of Providence,

R.I.,* 'came to live in my family in her twelfth year, previously to this, she had remained at home with her parents, who were very poor. She had always lived in the plainest, simplest, and coarsest manner. During her summers she had subsisted almost entirely on fruit, in its natural state; and through the whole year she ate very little except the plainest vegetable food. On very rare occasions she ate a little flesh, but not enough to render it, in any proper sense, a part of her diet. She drank water exclusively, and slept on straw. When she first came to live with me, her suppleness, activity, agility, and strength so far exceeded any thing that we had ever seen before in such a child, that she absolutely filled us with astonishment by her feats. Of her own accord she was up in the morning as soon as it was light, and wherever she went she always went upon the run, and with the nimbleness and fleetness of a deer. In all her movements she exhibited uncommon natural ease and gracefulness, and in her muscular efforts she evinced a surprising degree of strength. She would, for our amusement, often throw herself down at length in the grass, and imitate the motions of a snake so exceedingly like a snake, that it sometimes gave one very unpleasant feelings to look at her; and in a great variety of ways she exhibited the most wonderful suppleness, nimbleness, and agility, that I ever beheld in a human body. Her mind seemed to be as active and vigorous as her body. Her powers of mental apprehension and retention, and facetiousness and wit, were a continual source of surprise and amusement to us. On coming into my family she began gradually to accustom herself to flesh-meat, and in the course of two or three months she became very fond of it, and ate it very freely. And to our astonishment—for we could not then account for the change—in less than six months, all her remarkable suppleness, activity, and agility were gone, and she had become exceedingly sluggish, heavy, and stupid. We could not get her up in the morning until breakfast-time, without special and direct means; all her movements became slow, heavy, and sluggish, indicating great indolence; and her mind became as stupid and inactive as her body: and such she has ever remained since, being now fifteen years old.'

994. 'I took a boy from the Alms House, in the year 1827,' says Mr. Thomas H. Burling, of Westchester county, New York. 'He was then in his thirteenth year, and had always before this subsisted entirely on vegetable food. When he first came to my house he was very remarkably supple and nimble, and would throw a somerset backwards two or three times in succession with great ease. I had a notion that he would be good for nothing to work unless he ate flesh, and so I encouraged and urged him to do so. He soon became fond of flesh, and ate it freely, and in less than six weeks he became so clumsy, that whenever he attempted to throw a somerset he fell like a log.'

995. The interesting young natives of Pitcairn's Island exhibited the same qualities in a very remarkable manner. 'A young girl,' says Captain Pipon, 'accompanied us to the boat, carrying on her shoulders as a present, a large basket of yams, over such roads, and down such precipices, as were hardly passable by any creatures except goats, and over which we could scarcely scramble with the help of our hands.

* This statement was made in 1834. Mr. Paine has since deceased.

Yet with this load on her shoulders, she skipped from rock to rock like a young roe.' Capt. Beechey testifies to the same suppleness and agility in all the youth of the island (982).

996. The Greek peasantry and the lazzaroni of Naples, who subsist on the simplest and plainest vegetable diet, are distinguished for their suppleness, activity, and grace (1042).

997. 'I returned from Greece with Captain Floyd in the ship Factor,' says the venerable Judge Woodruff, of Connecticut, who went out as the agent of the New York Committee for the relief of the Greeks. There came over with us to New York, as one of the ship's crew, a Greek youth, a native of Thessaly, whom we called John. He was nineteen years old. He had from his childhood been driven about among the Turks, almost in the condition of a dumb beast, and subsisted on the plainest, simplest, and coarsest vegetable food, mostly in a natural state, and chiefly fruit. His nimbleness and agility far exceeded any thing that I ever before saw in a human being. Without exaggeration I can truly say, that he would run up and down the shrouds, and out on the yards, and jump about on the rigging, with all the nimbleness and rapidity of a squirrel. Indeed, his exploits of nimbleness upon the rigging often filled me with amazement, which was sometimes mingled with fear for his safety.'

998. The wild men found at different times in the forests of Europe, and who in their rude state subsisted entirely on fruits and vegetables, have all been remarkable for their natural suppleness and activity. The wild girl that was found in the forest, would run up trees and leap from branch to branch and from tree to tree, with the nimbleness of a squirrel; but she lost all this remarkable suppleness and activity when she became accustomed to eat flesh.

999. Benjamin Howland, Esq., of East Greenwich, R. I., was quite a feeble and infirm man at forty years of age. He abandonad the use of flesh-meat, and took to a plain, simple, and unstimulating vegetable diet. He soon became a healthy and remarkably active man; and now at the age of eighty-two,* he has more suppleness and agility than most men at fifty. 'Few young men, indeed, walk with so quick and elastic a step as he does. When crossing the fields, if a fence comes in his way, instead of pulling it down or crawling clumsily over it, he places one hand on the top of it, and springs over it like an active youth.' The same experiment has produced the same result in Thomas Shillitoe, of England,† and a great number of others in that country and in America, whom I might mention, but it is unnecsssary.

1000. If we make general comparisons between flesh-eating and vegetable-eating tribes or nations, the difference is very striking, and has long been a subject of remark by travellers. Tho-e portions of the human family which subsist mostly on flesh-meat, have always been noted for their sluggishness, their indisposition to action, and their indocility, as well as their savage rudeness; while all those portions of the human family which subsist on vegetable food, excepting such as are besotted by the habitual and excessive use of opium, tobacco, alcoholic liquor, and other intoxicating substances (768), have always been noted for their cheerfulness, vivacity, activity, gracelfulness, and

* This statement was written in 1834. Mr. Howland has since deceased.
† Mr Shillitoe has also deceased since the text was written.

urbanity. The natives of Hindostan and Java, when temperate and regular in their habits, are remarkable for their suppleness, dexterity, agility, and gracefulness of movement (1026).

1001. In regard to this topic of investigation, however, as well as to the preceding one (985), it must be remembered that there are many circumstances and modifyng causes to be kept in view. If an individual subsists mostly on flesh, drinks only water, sleeps on a hard bed, spends most of his time in the open air, has considerable active exercise, and is always strictly temperate in the quantity of his food, he will be far more supple and active than one who lives in the ordinary mode of civic life on vegetable food, and eats freely. However correct and pure our diet may be in quality, if we run to excess in quantity, we are proportionately less supple and active than we should be if we never exceeded the real wants of the vital economy. I once knew a vegetable-eater who was an expert gymnast; he indulged in over-eating for about one week, and became so clumsy and lost so much muscular power, that he could not go through his ordinary feats. He then fasted twenty-four hours, and without breaking his fast went to his gymnasium and performed all his feats with the greatest ease and agility.

1002. It is true also that some individuals, by constantly practising certain feats, learn to exhibit extraordinary suppleness and agility in their particular educated modes of action, though they may live on a mixed diet. Nevertheless, it is most indubitably true, that, all things else being equal, the pure vegetable-eater is naturally and spontaneously more supple, elastic, nimble, active, and graceful, than the flesh-eater, or those who subsist on a mixed diet, and he will retain these qualities to a much later period in life.

1003. Among the hundreds of individuals in the United States who have, within five or six years past, adopted a vegetable diet in every case where temperance in quantity and general propriety of habits have been regularly and consistently observed, there has been experienced a very considerable increase of activity, suppleness, and vivacity, and in numerous instances this increase has been remarkably great. Many a man who had begun to feel what he considered the stiffness and rigidity of old age coming upon him, has in a few months after adopting a pure vegetable diet, found, with delight, that much of his youthful suppleness and activity were restored to him; and he has been able to cast aside his staff, and to forego his stiff and tardy gait, and resume the easy and elastic step of early life, and even to run and leap like a youth.

STRENGTH, OR MUSCULAR POWER.

1004. In regard to bodily strength, or power of voluntary action, two classes of principles are to be considered: viz., the mechanical and the physiological. The mechanical construction of the body, with reference to the power of voluntary action, varies greatly in different animals. Thus in the lion, the remarkable power of voluntary action in the fore limbs does not depend on any extraordinary endowment of the muscles of that animal, but on the peculiar mechanical construction of the parts, by virtue of which the same contractile power in the muscles exerts a much greater mechanical force. Human bodies differ considerably in this respect. Some individuals have such a mechanical construction of the body as gives them truly astonishing strength or power of voluntary

action, while at the same time their muscles really possess no more power of vital contractility, in a given volume, than those of individuals of much less bodily strength. Individual instances of great strength, therefore, are not always to be considered as accurate exemplifications of physiological principles.

1005. The object of our present inquiry (874) demands that our evidence should be purely physiological, and therefore it is only to the pure physiological elements of voluntary power that our attention at present is to be directed. These elements, as we have seen (191), are the vital susceptibility and contractility of the muscles (172), and the nervous stimulus of motion (193). All these are purely vital properties or powers, depending on the vital constitution and condition of the tissues to which they belong (914), and consequently, are necessarily affected by every thing that affects the physiological character and conditions of those tissues.

1006. The grand, primary, physiological element of voluntary power of action, is the vital contractility of the muscular tissue; and the amount or degree of contractile power in any muscle always depends on the perfectness of its vital constitution (142), the healthiness of its structure and condition, its compactness, and its volume. There are certain kinds of diet and modes of living which, so long as the vital economy can sustain their forcing and oppressing influence, increase the general function of nutrition considerably beyond the real wants of the economy (499), and stuff out the skin and round out the limbs, and seem very much to increase the real muscular fibre, when in fact the true healthy muscular structure is very little increased, but, instead of it, a large quantity of adipose (498) or oily matter is deposited in the delicate cellular tissue which surrounds every muscle, envelops every muscular fascicle, and sheathes every muscular fibre (170); and thus the limbs and trunk, and particularly where the muscles are more collected into masses, are filled out, and become very plump, and have the appearance of a very great augmentation of the real muscular substance. But such an increase of volume in the trunk and limbs is so far from increasing the muscular power, that it always and necessarily diminishes it. It is only the development of pure, compact, healthy muscle, that increases the power of voluntary action and continued effort in the human body.

1007. The second grand physiological element of voluntary power of action is the organic sensibility or susceptibility of the muscular tissue to its appropriate stimulus of motion, by which it is excited to contract. This property of the muscular tissue, like its contractility, depends, as we have seen (193), on its own vital constitution, or on what may properly be called the *instant* vitality of the tissue; and this instant vitality is sustained by the constant supply of arterial blood (192). By every action of the stimulus of motion on the muscles, the vital susceptibility of the muscle to the action of the stimulus is in some measure exhausted, and by every contraction of the muscles under the action of the stimulus, the vital contractility is in some measure exhausted (192); so that, if these properties were not constantly replenished, the susceptibility of the muscle to the action of the stimulus and the contractility of the muscle would soon be completely exhausted. Hence, if the supplies of arterial blood be entirely

cut off from the muscle, its susceptibility to the action of its natural and appropriate stimulus is soon so much exhausted that contraction ceases; but if galvanic stimulus be brought to act on the muscle, it again contracts for a few times, till its susceptibility to the action of this stimulus is exhausted, and it again ceases to act in the utter exhaustion of all its physiological powers. But when the supplies of pure healthy arterial blood are constant, and the stimulus of motion healthy and appropriate, and its action not excessive, the replenishment of the vital properties of the muscle keep pace with the expenditure, or nearly so (976). In a perfectly healthy state and action of the organs of voluntary motion (377), this equilibrium is perfect. In the organs of voluntary motion the expenditure somewhat exceeds the replenishment during their action, and hence the necessity of rest to these last organs.

1008. The third grand physiological element of voluntary power of action is the nervous stimulus of motion. This stimulus, as we have seen (193), acts on the vital susceptibility of the muscle, and causes it to contract. In powerful muscular effort, therefore, great energy of nervous stimulus is necessary; and hence men in anger, in delirium or madness, in fever, and when highly excited by intoxicating substances, and also when intensely stimulated by the passion of emulation, often exert a muscular force which they are utterly incapable of in an unexcited state of the system. But these violent excitements and actions are excessively exhausting and greatly disturb the vital economy, and are always more or less hazardous to life. The greatest degree of healthy and permanent strength requires the most perfect vital constitution and full development of the nervous tissue, and a regular and full supply of healthy and energetic vital stimulus of motion. The vital properties and powers of the nervous tissue, like those of the muscular, are in some measure expended by every vital action, and replenished by the constant supplies of arterial blood. Hence, if the arterial blood be entirely cut off from this tissue, its vital properties and powers will soon be wholly exhausted, and it will no longer supply the stimulus of motion to the muscles; and if the physiological character and condition of the blood be affected, the physiological powers of the nervous and other tissues of the body will always and necessarily be in some measure correspondingly affected (686).

1009. We perceive, therefore, that there are the most precise and determinate relations established between the functions of the arterial system, and the physiological power of voluntary action in the living animal body. A constant supply of fresh arterial blood is poured into the muscular and nervous tissues to sustain their vitality, and to all necessary extent, replenish their exhausted properties and powers, and also to nourish their substances; and hence, as we have seen (393), whenever there is an increased action of the muscles of a limb or any other part, there is an increased flow of arterial blood into the tissues of that part; and if the action is habitual, and if the duty of the part requires much muscular power, the unnecessary adipose matter, if any, is thrown off (500), the muscle becomes compact, and the pure muscular fibre is considerably increased, and the limb or part becomes largely developed, and strongly marked with large and powerful muscles, as in the arm of the blacksmith and other of similar employ-

ment. And even in very fat and heavy people who walk a great deal, the muscles of the lower limbs become largely developed, and are far more compact and much less loaded with adipose matter than any other part of their bodies; and hence, such people are often very fleet in the foot-race, while they have comparatively little power for any other muscular effort.

1010. The habitual exercise of our body or limbs, therefore, in any particular kind of employment, enables us to put forth more muscular power in that employment, or one requiring the action of the same muscles, than in any other. Hence, one individual may excel in the muscular powers of his arms, another in that of the lower limbs, and another in that of some other part, according to the nature of the regular employment of each. All these things must be taken into consideration, in our inquiries concerning the comparative effects of animal and vegetable food in relation to the muscular power, or the powe. of voluntary action in the human body.

1011. Now, from what has been said (1006), we perceive that in order to put forth, in a single effort, very great muscular power, we require a full development of compact, healthy muscle, and a full supply of healthy nervous stimulus of motion (1008); and in order to sustain long-continued effort or voluntary action with the least weariness, we require such a state of the muscular and nervous tissues, and such a character and supply of the arterial blood, as will both effect and sustain the continued action of the stimulus of motion and the vigorous contraction of the muscles, with the least excess of expenditure (1007) over the concomitant replenishment of the vital properties of the tissues; and from every ascertained physiological principle, and every known fact in relation to this point, it is entirely certain that a diet of pure vegetable food and water is more conducive to this state of things than flesh-meat, or than a mixed diet consisting of vegetable and animal food. Flesh-meat, as we have seen (906), being more stimulating than proper vegetable aliment, in proportion to the nourishment which it affords to the system, increases the intensity of the vital action (909), precipitates the functions, renders the processes of assimilation and nutrition less complete, and the vital constitution of the organic structure less perfect, and increases the expenditure of all the vital powers and waste of organized substance in all the vital actions of the system (914); and therefore gives to the muscular tissue less constitutional power of healthy and permanent susceptibility and vigorous contractility, and to the nervous tissue less constitutional power to furnish the due and regular supply of healthy and energetic vital stimulus of motion; and produces blood which is less adapted to replenish the vital properties of the tissues and sustain the vital actions of the organs (685).

1012. It is true that a man, living like Alexander Selkirk on the Island of Juan Fernandez, on simple flesh and water, without so much as the stimulus of salt; sleeping on a hard bed, and taking a great deal of very active exercise in the open air, and breathing the pure atmosphere of a small island in the midst of the ocean, without any of the debilitating habits or influences of civic life, will become much stronger than a vegetable-eater who connects with his vegetable diet almost every other habit, circumstance, and condition, unfavorable to muscu-

lar power. So also, a whole tribe like the Pampa Indians of South America (778), who subsist almost entirely on the lean flesh of mares, are continually in the open and pure air of those extended plains, and from infancy to death almost continually upon horseback and in motion, may have much more muscular power and ability to endure fatigue, and especially in that kind of exercise to which they are most accustomed (1010), than multitudes of vegetable-eating Asiatics, whose habits, circumstances, and condition in all other respects, are exceedingly unfavorable to bodily vigor and activity. Moreover, it is true that those who subsist on a mixed diet of vegetable and animal food, and who systematically and severely train themselves for certain feats (1010), will exhibit much more muscular power in those feats, than vegetable-eaters not trained and not accustomed to muscular effort. Nevertheless, as a general physiological law of the human constitution, it is entirely certain that, all other things being precisely equal, he who habitually subsists on a diet of pure and well-chosen vegetable food and pure water, will possess greater spontaneous muscular power than those who subsist on animal food, or on a mixed diet, and he will still farther excel them in the ability to endure continued muscular effort; or he will be able to perform more labor in a given time and to continue hard labor a longer time, and with less exhaustion or weariness.

1013. When the public games of ancient Greece, for the exercise of muscular power and activity, in wrestling, boxing, running, etc., were first instituted, the athletæ, in accordance with the common dietetic habits of the people, were trained entirely on vegetable food. 'Those who were destined to this profession,' says Rollin, 'frequented from their most tender age the Gymnasia or Palæstræ, which were a kind of academies maintained for that purpose at the public expense. In these places, such were under the direction of different masters, who employed the most effectual methods to inure their bodies for the fatigues of the public games, and to form them for the combats. The regimen they were under was very hard and severe. At first they had no other nourishment but dried figs, nuts, the recent curd of milk, or new cheese and boiled grain, or a coarse kind of bread called maza. They were absolutely forbidden to use wine, and required to observe the strictest continence.' Every measure was taken to keep the vital powers in the most healthy and vigorous state, and to develop the most compact and powerful muscles. As the time of their public performances drew near, they were trained with increased care and industry, and were rubbed and exercised in such a manner as to consolidate, increase, and strengthen the muscles in the greatest possible degree. In later times, after animal food had begun to be common among the people, and flesh-meat was found to be more stimulating, and to render their pugilists and gladiators more ferocious, a portion of flesh was introduced into the diet of the athletæ But, according to the testimony of early Greek writers, it was soon found that the free use of this kind of aliment made them 'the most sluggish and stupid of men;' and therefore, those who had the training of the athletæ withheld flesh meat from them entirely, till a short time before their public performance, and then it was introduced in very small quantities at first, and gradually increased. Yet with all this care, the stupefying effect of the flesh-meat was so

manifest, and especially on the mental powers, that the stupidity of the athletæ became proverbial.

1014. All this, it will be remembered, was done to prepare them for extraordinary efforts of very short duration, and not for the ordinary and continued efforts or exercise required in the common concerns and employments of life. Yet even for such purposes, it is very certain that the muscular power of the ancient athletæ was not increased by the addition of flesh-meat to their originally simple vegetable and water diet. It is remarkable that those who are accustomed to the stimulus of flesh-meat, should so pertinaciously contend that it is necessary to produce the greatest muscular power, when it is well known that, so far as the pure physiological elements of the power of voluntary action are considered, vegetable-eating animals are stronger and are capable of greater endurance than carnivorous animals. The lion, it is true, is called 'the king of beasts,' 'the king of the forest,' etc.; but neither his strength nor his courage entitles him to this distinction. In pure muscular power the rhinoceros undoubtedly exceeds all animals now known on earth, and this animal subsists on the lowest order of vegetable food, eating the twigs, branches, and limbs of trees, and even shivering their trunks in his terrible power, and consuming them like grass. This animal is not more than half the size of an elephant, and yet a whole drove of elephants will fly with terror from the presence of a single rhinoceros, and every other beast shuns him with fear.

1015. It may, therefore, be laid down as a general law in relation to the human constitution, that that food which is adapted to the anatomical structure and physiological powers and wants of our bodies, and which, from its own nature, is longest in passing healthfully through the processes of assimilation and nutrition, and which, while it affords a proper quantity of nourishment, causes the smallest degree of exhaustion of the vital properties of the tissues and waste of organized substance, will sustain a man longest in labor, or in continued voluntary action. And we have seen (911), that in all these respects, a well chosen diet of pure vegetable food and pure water, is better than animal food, and better than a mixed diet.

1016. We have seen that (69), according to all ancient history and tradition, the primitive generations of our race subisted entirely on vegetable food, and generally in its simplest, plainest, and most natural state, and that they possessed far more bodily strength and ability to endure protracted labor than any of their more modern descendants. The accounts which have come down to us in the writings of the most ancient historians, poets, and philosophers, concerning the bodily strength and achievements of the early inhabitants of the earth, are rendered incredible to us by a comparison with what we know to be true of the present generations of mankind.

1017. To say nothing of the mighty warriors of still earlier times, the Jewish army in their conquest of the Promised Land, subsisted wholly on vegetable food of the simplest kind (894), performed such wonders, that the astonished nations whom they conquered believed them to be endowed with supernatural power. Cyrus, who raised Persia from an obscure, rude colony, to one of the most powerful and most splendid empires that the world ever saw,—who performed more ex-

traordinary marches, fought more battles, won more extraordinary victories, and exhibited more personal prowess and bodily power of effort and endurance, than almost any other general that ever lived,—subsisted from childhood on the simplest and plainest diet of vegetable food and water; and his Persian soldiers who went with him through all his career of conquest, and shared with him all his hardships, toils, and dangers, and on whom he always placed his main dependance in battle, and with whom he was able to march thousands of miles in an incredibly short time, and conquer armies of double the number of his own, were, like himself, trained from childhood on bread, cresses, and water, and strictly adhered to the same simplicity of vegetable diet throughout the whole of their heroic course, without relaxing from the stern severity of their abstemiousness, even in the hour of victory, when the luxuries of captured cities lay in profusion around them. In the most heroic days of the Grecian army, their food was the plain and simple produce of the soil. The immortal Spartans of Thermopylæ were from infancy nourished by the plainest and coarsest vegetable aliment, and the Roman army in the period of their greatest valor and most gigantic achievements subsisted on plain and coarse vegetable food. The same is true of all those ancient armies whose success depended more on bodily strength and personal prowess, in wielding war-clubs, and in grappling man with man in the fierce exercise of muscular power, and dashing each other furiously to the earth, mangled and crushed and killed, than in any of the nicer tactics and refinements in the art of war.

1018. It is said that after the Romans became a flesh-eating people, the Roman army was equally heroic and victorious; but it should be remembered that whatever were the practices of the wealthy and luxurious Roman citizen, flesh-meat entered but very sparingly into the diet of the Roman soldier till after the days of Roman valor had begun to pass away; and with equal pace, as the army became less simple and less temperate in their diet, they became less brave and less successful in arms. And it should be remembered also, that after the Romans had become a flesh-eating people, the success of the Roman army did not, as at first, depend on the bodily strength and personal prowess of individual soldiers, but on the aggregate power of well disciplined legions, and on their skill in systematic war. So far as bodily strength and ability to endure continued voluntary action are considered, the Roman soldier was far the most powerful and heroic in Rome's earliest days, when he subsisted on his simple vegetable food.

1019. The same important principles are demonstrated by the facts of modern times. 'Very few nations in the world,' says a sagacious historian, 'produce better soldiers than the Russians. They will endure the greatest fatigues and sufferings with patience and calmness;' and it is well known that the Russian soldiers are from childhood nourished by simple and coarse vegetable food. It is well known also, that among the bravest and most hardy and enduring soldiers that composed the army of Napoleon Bonaparte in his wonderful career of carnage and conquest, were those who had all their lives subsisted on a coarse vegetable diet. 'The Polish and Hungarian peasants from the Carpathian mountains,' says a young Polish nobleman, 'are among the most active and powerful men in the world; they live almost en-

tirely on oatmeal bread and potatoes. The Polish soldiers under Bonaparte,' continues he, 'would march forty miles in a day, and fight a pitched battle, and the next morning be fresh and vigorous for further duties.'

1020. In 1823, General Valdez (a Peruvian general) marched to Lima with an army of native Indians, expecting to find General Santa Cruz with the patriot army there; but learning that the enemy were advancing at a considerable distance, General Valdez resolved on meeting them as soon as possible by forced marches. Usually a large number of women, the wives of the soldiers, and sometimes their children accompany the army; and when the army moves from one place to another, notice is given each morning where they will quarter at night; and then the women immediately start away (with their children and baggage if any), and when the army arrives at its quarters for the night, the women are always found upon the spot, and the supper prepared for the soldiers. But on this occasion, General Valdez wishing to take the enemy by surprise, selected between two or three thousand men, ordered them to leave their women and all unnecessary baggage behind, and every man to fill his pockets with parched corn for his food. Thus prepared, he appointed, each morning, the place of meeting and stopping for the night, and then left every man to take his own way as he pleased. In this manner, General Valdez led his army from near Lima to the southward of Arequipa, a distance of two hundred and fifty leagues, or seven hundred and fifty miles, in eleven days, or more than sixty-eight miles a-day, for eleven days in succession; and at the close of this forced march, met and routed the patriot army of between three and four thousand men. 'These Peruvians,' says a highly intelligent gentleman who has spent twenty years among them, 'are a more hardy race, and will endure more fatigue and privation, than any other people in the world. They subsist wholly on vegetable food, and being very improvident, their diet is generally coarse and scanty. Parched corn is their principal, and generally their exclusive, article of food when engaged in any particular enterprise or effort which requires great activity and power of body; at other times they subsist on such of the various products of their climate as they happen to have at hand. In travelling, and in many other respects, the women are quite equal to the men in muscular power and agility.'

1021. The inhabitants of Hindostan, and of India generally, are constantly named by the advocates for flesh-eating, as a proof that those who subsist wholly on vegetable food are inactive, effeminate, and feeble, and totally destitute of energy and enterprise. But such objectors ought to be too well acquainted with the history, condition, and circumstances of these people, to attribute these effects to their vegetable food. They ought to know that for thousands of years their political, civil, social, and religious institutions, and usages, have been such as are calculated to crush, or rather to preclude, all enterprise, to subdue all energy, and to make the people indolent and inactive. Indeed with the exception of their vegetable food, it is not easy to conceive of a complication of circumstances and combination of causes more omnipotent to suppress and annihilate all the nobler attributes of man, than have surrounded and acted on the people of India for the last twenty-five hundred years. In the first place, they have nothing to

call into action the better energies of human nature; and in the second place, they have every thing to suppress and paralyze those energies. They have nothing to awaken the flame of political ambition—nothing to beget a desire for civil elevation—nothing to develop the character of the statesman nor the intellect of the philosopher or the scholar. The love of gain and the desire of wealth and the social distinctions of life, which are among the most powerful elements of activity, and are most efficient in awakening the spirit of enterprise and in developing the physical and intellectual resources of man, are in India all smothered and subdued; and there is nothing to induce the degraded native to attempt to individualize himself from the stagnant mass of human population, unless it be to become distinguished in a religion which only sinks him deeper in degradation. If by any means the people can obtain sufficient alimentary subtances of any kind to keep them alive, it is nearly all they are permitted to possess. Every thing beyond this is sure to invite oppression, extortion, and outrage. If they cultivate the soil, or plant fruit-trees for the purpose of providing sustenance for themselves and families, the hand of extortion comes in, and leaves them nearly as destitute as the indolent beggar. If they are known by any management to have laid up a little money, it is by some iniquitous means extorted from them. The natural consequence is that all individual enterprise is crushed; and the people have no heart to labor when they know they shall not enjoy the fruits of it. But still, they are human beings—they are intellectual and moral animals, and as such they possess the constitutional instincts of their nature, which prompt them to seek enjoyment. Their intellectual and moral resources are cut off, and they sink down into an animal existence, and seek to keep alive their consciousness, and to procure what enjoyment they can, in the exercise and indulgence of their animal sensibilities and appetites. From early infancy they become accustomed to narcotic and other exciting and intoxicating substances (870), and through life indulge excessively in almost every species of stimulation. They marry at twelve, and even at ten years of age, and are only bounded in their licentiousness by the want of physiological ability to go farther. Though they profess to subsist on vegetable food, yet from their poverty and improvidence and depravity, their diet, and especially among the lower classes, is generally of the most meagre and miserable kind, and they eagerly consume whatever alimentary substance they are able to obtain, whether it be vegetable or animal; and thousands of them devour both vegetable and animal substances of the most crude and filthy and unwholesome quality. But this food they almost universally, from the oldest to the youngest, and in all conditions of life, season very highly with their favorite curry powder—a composition made of cayenne pepper, black pepper, ginger, mustard, and several other ingredients of a very heating and irritating character, calculated to produce the worst disorders of the alimentary canal, and consequently to reduce the vital energies of the nerves of organic life, and impair all the functions of the system. Besides these stimulants with their food, almost every man, woman, and child, habitually and often to a very great excess, chew a cud composed of opium, cheenam, or lime and betel nut, wrapped up in a sera leaf of very acrid and pungent qualities. Tobacco, one of the worst of narcotics, whose effects are

exceedingly pernicious on the powers and functions of organic life, is the almost universal, and generally excessive use among them; and a great portion of the natives make a free use of arrack—a very intoxicating, fiery, and destructive alcoholic liquor. Lieutenant Colonel James Todd, than whom no better authority can be given, in his Annals and Antiquities of Rajast'han, or the central and western Rajpoot states of India, says that 'to Baber, the founder of the Mogul Empire, India is indebted for the introduction of its melons and grapes, and to his grandson for tobacco; but for the introduction of opium, we have no date, and it is not even mentioned in the poems of Chund. This pernicious drug has robbed the Rajpoot of half his virtues, and while it obscures these, it heightens his vices, giving to his natural bravery a character of insane ferocity, and to the countenance, which otherwise beamed with intelligence, an air of imbecility. Like all other stimulants, its effects are magical for a time, but the reaction is not less certain; and the faded form or amorphus bulk too often attests the debilitating influence of a drug which alike debases mind and body. In the more ancient epics we find no mention of the poppy juice, as now used, though the Rajpoot has at all times been accustomed to this intoxicating cup. The essence called arrack, whether of grain, of roots, or of flowers, still welcomes the guest, but is secondary to the opiate. To eat opium together, is the most inviolable pledge, and an agreement ratified by this ceremony is stronger than any adjuration. If a Rajpoot pays a visit, the first question is, 'have you had your opiate?' The *Calcutta* (India) *Gazette*, describing the recent celebration of one of the Hindoo religious festivals, says: 'The conception of the horrors with which these ceremonies strike every refined heart, is strong in our mind. We see the effeminate lust that inspires the Baboo to bring the first beauties into his house; we see spirits and liquors of all sorts freely indulged in, and terrible tumults excited by their heat; we see excesses of every kind committed without hesitation, and boys of very tender age freely allowed to ramble over nights and nights, and spend hours and hours in immoral pursuits; we witness youths of fourteen or fifteen years old, indulging to excess in the stupifying and mischievous fumes of tobacco and other drugs; we see goats, rams, and buffaloes, savagely butchered, and men rolling on the ground, besmeared with blood and dirt; and at the time when the idols are thrown into the water, young men go upon the river with their lewd companions, and revel in all sorts of licentiousness. In short, if there be any action which is, to the utmost degree, degrading to the dignity of man, and demoralizing to his mind, it is perpetrated at these holidays.'

1022. By these means, and many others of a similar tendency, they have, as a general fact, greatly diminished their stature, and rendered themselves comparatively feeble, effeminate, indolent, and stupid. For it is a well ascertained truth in physiological science (963), that the early and free and habitual use of powerful narcotics, prevents the full development of the body, and impairs all its physiological energies; and where narcotics are so universally and excessively used as in India, and especially by mothers and children (870), the inevitable result is a general diminution of size; and this effect is greatly increased when to general excesses in narcotics there is added a general and early excess in lasciviousness.

1023. But it is said that, according to the statement of Rammohun Roy, the Mahomedans in India who eat flesh, have better bodies than the Hindoos; and hence it is inferred that a portion of flesh-meat is essential to the most complete development of the human body even in India. General statements of this kind are not to be received as specific evidence in relation to particular physiological principles (872). A thorough knowledge of all the circumstances in the case would probably show a wide difference between the Mahomedans in India, and the Hindoos, in many other respects besides the kind of their food. When the Spaniards had dominion in Peru, they enslaved the native Indians, and reduced them to the most wretched condition, and kept them in the most ignorant and degraded state, that they might not know their rights Since the Spanish yoke has been thrown off, the Government of Peru, when it is necessary to recruit their armies, take these native Indians by force, and convert them into soldiers; and others they seize and compel to work in the mines. To avoid these oppressions and outrages, the Indians endeavor to shun their oppressors, and retire as far as possible from what is called civilization. They seek an asylum in the mountains, and dwell in rude huts made of logs or cane and mud. These huts are filthy and miserable abodes, and the Indians are extremely filthy in their persons. They wear but little clothing, which they never change. They put on a garment, and never take it off till it is worn out. They subsist wholly on vegetable food. They have in the valleys, all the vegetable productions of a tropical climate, and on the hills, all those of a temperate climate; and they can sow and reap, cut grass and grind sugar-cane every day in the year. But so long and so cruelly have these Indians been oppressed, and they feel it so uncertain at what hour they may be torn from their homes, that they are utterly improvident, and never seem to think of to-morrow, but subsist from day to day on what vegetable substance is most easily and readily obtained; and therefore their diet is generally very scanty. They are universally given to chewing a pungent, exciting leaf, which they call coca-leaf, and are all fond of an intoxicating liquor made by fermenting corn, and will drink to excess whenever they can get it. In this wretched state, these interior Indians are exceedingly meagre and miserable looking creatures. Yet they have great strength and activity, and will endure severe labor and fatigue for a very long time. The men will carry immense weights. They think nothing of carrying a barrel of flour, and other burdens of equal and greater weight, considerable distances. Some of these men are commonly employed as couriers, to go on journeys of several hundred miles, as special messengers, with despatches, into the interior and elsewhere. They prepare for their journey by filling one pocket full of parched corn, and another with coca-leaf, and these constitute their entire sustenance during their journey. Yet subsisting on this very small quantity of parched corn, they will travel with great speed, very commonly sixty miles a-day, for eight or ten days in succession (1027).

1024. When these native Indians are taken from their wretched abodes and irregular habits in the mountains, and brought under the regular training and severe discipline of the army, and furnished with a proper supply of good vegetable food, they are in a short time trans-

formed into very fine-looking, active, and valiant soldiers, with well proportioned and athletic bodies.

1025. Here, then, we find that without resorting to the use of flesh-meat, the meagre, squalid, vegetable-eating Indian of Peru, is, by the systematic training and regular habits of the army, soon transformed into the fine-looking, brave, and powerful soldier. And it is perfectly certain that a similar experiment in Hindostan would be attended with similar results. Let the indolent, inactive, miserable-looking Hindoo be taken from his idle, irregular, and sensual habits, and put under the systematic discipline and regular training of a well-managed army, and be regularly fed with good, wholesome vegetable food, in proper quantities, and in a short time his appearance would be so much improved in every respect, that he would look as if he belonged to another race of men. And it is also perfectly certain, that if the everlasting chewing and smoking and drinking narcotic and alcoholic and other stimulating substances, and the excessive licentiousness of the Hindoos, could be wholly abolished, and the people could be brought into regular and systematic habits of temperance, cleanliness, and industry, and fully supplied with good, wholesome vegetable food and pure water, and relieved from all oppression, and awakened to a spirit of enterprise and a consciousness of freedom and independence, and roused to the pursuit of the rational and proper objects and enjoyments of life, it would require no flesh-meat to develop their bodies in the most healthful, symmetrical, and vigorous manner, and render them an active, energetic, and happy race; and in the course of a few generations they would probably rise to an average stature considerably above the present.

1026. And even in the present state of things, the more temperate and virtuous and industrious Hindoos are far from being a feeble and inefficient class of men; on the contrary, they are among the strongest and most active men in the world, and few if any can surpass them in the ability to sustain powerful and continued voluntary action or labor. The laborers from Upper Hindostan, or from the mountainous regions, are far more powerful and active men than the stoutest European sailors and soldiers that visit or are employed in India. The *Encyclopædia Americana* says of the Hindoos:—'They are in general of a brownish yellow complexion, but the higher and richer classes are almost as white as Europeans. They are somewhat above the middle height, well proportioned, and, in particular, very flexible and dexterous (1000). They possess great natural talents, but are at present deprived of opportunities for their development. In earlier times, before they were oppressed by a foreign yoke, they had reached a higher degree of civilization, and their country has been considered as the cradle of all the arts and sciences. The division of the people into several entirely distinct orders or classes, has existed from the remotest times. The three higher classes are by their religion prohibited entirely the use of flesh-meat; the fourth is allowed to eat all kinds except beef; but only the lowest classes are allowed every kind of food without restriction.' And it is in these lowest classes that the most miserable, ill-formed, and indolent portion of the native inhabitants of India are found; while among the higher and more intelligent, temperate, and virtuous classes, which subsist on a more pure and whole-

some vegetable aliment, men of six feet stature, and with well proportioned, symmetrical, vigorous, and active bodies, are by no means uncommon; and for natural ease, grace, and urbanity, this class of Asiatics are exceedad by no people in the world.

1027. 'There is a caste of Hindoos,' says Sir John Sinclair, 'called on the western side of India, Pattamars, whose sole occupation is to carry letters and despatches by land; and they perform journeys almost incredible in the time allotted, as is the small quantity of food they subsist on during their journey. They generally go in pairs for fear of one's being taken ill, and are allowed rewards in proportion to the expedition with which they perform their journey. From Calcutta to Bombay, I think twenty-five days are allowed (about sixty-two miles a day); from Madras to Bombay, eighteen days; and from Surat to Bombay, three days and a half. They are generally tall, being from five feet ten inches to six feet high. They subsist on a little boiled rice (1023).

1028. What has been said of the Hindoos, is nearly all true of the Burmese. In the Burman Empire there is the strongest prohibition against taking life and using anything which intoxicates. Yet male and female, old and young, rich and poor, all smoke excessively. The women smoke almost incessantly, and it is a common custom among them when nursing their children, to take the pipe frequently from their own mouths and put it into the mouths of their infants (870). Everybody also, from the infant up, chews the betel-nut—a pungent and exciting vegetable. Rice is the principal food for all who can afford it. The lowest classes use what they consider a poorer kind of food, such as wheat, Indian corn, sprouts, leaves, etc. Excellent wheat grows in the hilly regions, but the Burmese, not knowing how to make bread, boil the wheat whole, and eat it as they do rice. They use some fish, but rather as a condiment than as an aliment. At their times of eating, they take about a teacupfull of dried fish and pound it fine, and season it very highly with red pepper and other hot spices, and this preparation they eat with their rice and other vegetable substances. The Burman government is probably as despotic and oppressive as any on the globe. It require seven-ninths of all the people can raise or produce. The people are taxed for their fruit trees, their fishing nets, and every thing else they possess; so that the more an individual has, the worse he is oppressed by the government. If a man is known to have money, he is vexatiously prosecuted on false pretences, and harassed till he will give up his money to get released. If the king wants supplies of any kind, he calls upon his officers next in grade to himself, and these go out and demand the service, first of all those wealthy people who they know will not perform it, but will pay large sums to be exonerated; and after the officers have satisfied their cupidity in this way, and pocketed all the money themselves, they will go to those who will perform the service, and order them to do it. Under such a system of oppression and tyranny, the people feel little inducement to make efforts for the acquisition of property, or to aim at the improvement of their condition and circumstances. The spirit of enterprise is crushed, and the great mass of the population sunk to a mere animal existence, exerting themselves little more than is absolutely requisite to secure the necessaries

of life, and those often of the poorest kind. Still, however, with all this weight of oppression and discouragement pressing them down, and with all the enervating and stupefying effects of their bad habits, the Burmese possess no small degree of bodily vigor and activity, and mental elasticity. The boatmen and other laborers possess great muscular power and ability to sustain continued effort, and frequently show themselves capable of feats which require extraordinary strength and agility.

1029. In China, as in Hindostan and Burmah, the people derive their nourishment from the soil (898). A small quantity of animal substance, mostly of fish, frequently constitutes a portion of the diet of many of them, it is true, but yet it is always more as a condiment than as an aliment. They use no butter nor cheese, and very seldom milk. The chief thing they wish and work for is rice; and they can no more understand how human beings can exist without rice, than American flesh-eaters can understand how man can live without flesh-meat. Every substitute for rice is considered meagre, and indicative of the greatest wretchedness. 'Inquiring whether the western barbarians eat rice, and finding me slow to give an answer,' says Gutzlaff, 'they exclaimed, "Oh, the sterile regions of the barbarians, which produce not the necessaries of life! Strange that the inhabitants have not long ago died of hunger!" I endeavored to convince them that there were substitutes for rice, which were equal if not superior to it; but all to no purpose; they still maintained that it is rice only which can properly sustain the life of a human being.' 'Next to rice, the most universal food in the empire is the white cabbage, a species of brassica. Besides this vegetable, the northern provinces consume millet and the oil of sesamum as a general article of diet. In the more southern provinces, several species of gourds and cucumbers, together with sweet potatoes, and one or two species of kidney beans and of peas, are used.'* 'The Chinese,' says Gutzlaff, 'may fitly be compared to ants. The land is filled with men. The houses are not inhabited, but stuffed, with human beings. Multitudes issue from a few small hovels, and swarms seem to rise from the very earth.' 'The Chinese are probably the most laborious people on earth, and their bodies seem to require the least repose. They labor every day in the year except the first, appropriated to reciprocal visiting among families, and the last, consecrated to the memory of their ancestors.' Yet notwithstanding this great industry and the fertility of their soil, which yields them two crops of rice annually, the population is so exceedingly numerous (898, Note) in proportion to their productive resources, that a large majority of the people are compelled to live very abstemiously, and hundreds of thousands of them are so pressed with the demands of hunger, that they eagerly consume whatever alimentary substance they can get from the vegetable and animal kingdoms. Dogs, cats, rats, worms, etc., are indiscriminately devoured by them, and even very considerable quantities of gypsum are eaten with their vegetable substances, to satisfy the cravings of the stomach. It is important to remark, however, that most if not all this poverty and wretchedness is caused by the great intemperance of the people in the use of opium; for, poor as they are, they

* China, by J. F Davis Esq.

all contrive to indulge more or less extensively in this pernicious practice; so that the three hundred millions of people in China consume nearly eighteen millions of dollars' worth of opium annually. The consumption of this vile drug, while it diminishes their means of subsistence and their ability to labor, at the same time greatly increases the morbid cravings of their stomachs. Still, with all this privation and evil habit, the Chinese generally possess considerable muscular power, and particularly for continued labor. Gutzlaff, speaking of his travels in China, says that on a certain occasion, 'not being able to walk, we procured sedan chairs. The bearers appeared to be the lowest of the low, clad in a few rags, and looking as emaciated as if they were going to fall down dead. But under this unseemly exterior they hid great strength. I certainly believe that a well-fed horse would not have been able to carry some of us who were stout and hale over the cragged mountains without sinking under the load. But these men walked on briskly and sure-footed, and ascended acclivities with greater speed than we could have done in walking. Yet though these men were meagre, and hungry as wolves, they were cheerful and boisterous. Of the scanty livelihood upon which the poorer classes, and indeed nine-tenths of the nation, are obliged to subsist, those who have not witnessed the reality can hardly have an adequate idea. The wages are so low, that a man who has worked from morning till evening as hard as he could, gains perhaps ten cents, and with this he has to maintain wife and children.'

1030. In China, however, as in every other country where narcotic and intoxicating substances are generally used, many individuals are to be found of more temperate and correct habits, and these are always favored with better health, and more vigorous and active bodies. 'A finer shaped and more powerful race of men exists nowhere,' says Mr. Davis, 'than the coolies or porters of Canton; and the weight they carry with ease on a bamboo between two of them, would break down most others. The freedom of their dress gives a development to their limbs, that renders many of the Chinese models for the sculptor.'

1031. In Egypt, the diet of the peasantry and laboring people is much the same as in China. They use some animal substance, particularly fish, as a kind of relish or condiment, but their nourishment is derived immediately from the soil. Their food chiefly consists of coarse bread made of wheat, of millet or maize, together with cucumbers, melons, gourds, onions, leeks, beans, chickpeas, lupins, lentils, dates, etc. Most of these vegetables they eat in a crude state. 'It is indeed surprising to observe how simple and poor is the diet of the Egyptian peasantry,' says Mr. Lane,* 'and yet how robust and healthy most of them are, and how severe is the labor which they can undergo. The boatmen of the Nile are mostly strong muscular men. They undergo severe labor in rowing, poling, and towing; but are very cheerful, and often the most so when most occupied, for then they frequently amuse themselves by singing.' 'The Egyptian cultivators of the soil, who live on coarse wheaten bread, Indian bread, lentils and other productions of the vegetable kingdom,' says Mr. Catherwood, 'are among the finest people I have seen.' Opium is not so generally and

* Lane's Egypt.

freely used in Egypt as in many other countries. Tobacco is the principal means (768) of excitement and intoxication employed by the Egyptians, and this they use universally and to very great excess. Here, as in Burmah (1028), both sexes and all classes, ages, and conditions, smoke at all hours of the day and night, and almost incessantly. Coffee also is drunk at all hours of day and night, and is used nearly as universally and excessively as tobacco; hemp, a violently intoxicating plant, is likewise smoked to some extent by the lowest classes. The Egyptians are also excessively lascivious.

1032. The natives of Central Africa, who subsist wholly on vegetable food, possess astonishing bodily powers. The enterprising Landers inform us that most of the tribes which they were amongst in Africa subsist principally, and many of them entirely, on vegetable food. 'The people of Jenna,' say they, 'have abundance of bullocks, pigs, goats, sheep and poultry; but they prefer vegetable food to animal: their diet, indeed, is what we should term poor and watery, consisting chiefly of preparations of the yam and of Indian corn; notwithstanding which, a stronger or more athletic race of people is nowhere to be met with (895). Burdens with them are invariably carried upon the head; and it not unfrequently requires the united strength of three men to lift a calabash of goods from the ground to the shoulders of one, and then, and not till then, does the amazing strength of the African appear. Some of the women which we saw, bore burdens on their heads that would tire a mule, and children not more than five or six years old, trudged after them with loads that would give a full-grown person in Europe a brain fever.' The Kroomen are a particular race of people differing entirely from the other African tribes. They inhabit a country called Setta Krow, on the coast near Cape Palmas. Their principal employment is of a maritime nature. A certain number of these men are always employed on board of the ships of war on the African coast, for the purpose of performing those duties where a considerable fatigue and exposure to the sun is experienced. They only require a few yams and a little palm oil to eat, and they are always ready to perform any laborious work which may be required of them.

1033. 'The principal article of food among the Indians of Mexico, and more particularly in the state of Tobasco,' says Mr. Pope, who has resided several years among them, 'is Indian corn. It consequently constitutes the most important article of agriculture, and three crops may be obtained in a year without the labor of tillage. From the corn they prepare a thin cake called the Fortilla, which is a bread universally used by the better class of the inhabitants, and a dough from which is made what they call Posol. The latter article is prepared by boiling the corn, and afterwards crushing it on a flat stone fitted for the purpose, and which every family possesses (772), it being substituted for grinding, as corn mills are unknown in the country. This dough is laid aside until wanted for use, and in a short time becomes sour, in which condition it is generally preferred. It is then mixed with water to such a consistency as may be drunk, and sometimes a little sugar is added. And on this food alone they are enabled to subsist and undergo far more fatigue under the tropical sun of Mexico, than our northern laborers in the northern latitudes, with the free use of animal food. I have not unfrequently been forty hours in ascending the Tobasco

river, to the capital—a distance of about seventy-five miles—in one of their canoes, against a current of from three to four miles an hour; the men poling the canoe (a very laborious employment) sixteen hours out of twenty-four. Those who abstain from the use of ardent spirits are muscular and strong, and among them are to be found models for the sculptor.'

1034. The interesting natives of Pitcairn's Island, of whom I have already spoken (982), until within a few years, had always subsisted on plain, simple, vegetable food, and most of it in a natural state. They were remarkably well formed, active, and athletic. 'Their agility and strength were so great,' say the British officers who visited them, 'that the stoutest and most expert English sailors were no match for them in wrestling and boxing. Two of them, George Young and Edward Quintal, each carried at one time a kedge anchor, two sledge hammers, and an armorer's anvil, weighing together upwards of six hundred pounds; and Quintal once carried a boat twenty-eight feet in length.'

1035. The Spaniards of Rio Salada in South America, who come down from the interior, and are employed in transporting goods over land, live wholly on vegetable food. They are large and very robust and strong, and bear prodigious burdens on their backs, such as require three or four men to place upon them, in knapsacks made of green hides; and these enormous burdens they will carry fifty miles into the country, travelling over mountains too steep for loaded mules to ascend, and with a speed which few New England men can equal without an incumbrance. The slaves of Brazil are a very strong and robust class of men, and of temperate habits. Their food consists of rice, fruits, and bread of coarse flour, and from the farrenia root. They endure great hardships, and carry enormous burdens on their heads, a distance of from a quarter of a mile to a mile, without resting. It is a common thing to see them in droves or companies, moving on at a brisk trot, stimulated by the sound of a bell in the hands of the leader, and each man bearing upon his head a bag of coffee weighing a hundred and eighty pounds, apparently as if it were a light burden. They also carry barrels of flour and even barrels of beef and pork upon their heads. They are seldom known to have a fever or any other sickness. The Congo slaves of Rio Janeiro subsist on vegetable food, and are among the finest-looking men in the world. They are six feet high, and every way well proportioned, and are remarkably athletic. The laborers at Laguira eat no flesh, and they are an uncommonly healthy and hardy race. A single man will take a barrel of beef or pork on his shoulders and walk with it from the landing to the custom house, which is situated upon the top of a hill, the ascent of which is too steep for carriages. The cargoes of their vessels are also all lifted by them from their lighters on to the wharves or landing, without any mechanical aid whatever. Their soldiers likewise subsist on vegetable food, and are remarkably fine-looking men. The laboring men or porters at the Island of Terceira (one of the Azores), subsist wholly on coarse, vegetable food, and are exceedingly strong, and able to bear very great burdens on their shoulders. A single man will take on a pad upon his shoulders, a half-pipe of wine containing fifty-two gallons (and weighing in all about five hundred pounds), and carry it to warehouses and up a number of steps.

The Moorish porters at Gibraltar from the Barbary shore, live on coarse vegetable food, and are very athletic and hardy. They will carry casks of wine, and other burdens of prodigious weight, on their pads upon their shoulders.

1036. 'With respect to the Moorish porters in Spain,' says Captain C. F. Chase, of Providence, R.I., 'I have witnessed the exceedingly large loads they are in the habit of carrying, and have been struck with astonishment at their muscular powers. Others of the laboring class, particularly those who are in the habit of working on board of ships, and called in that country *stevedores*, are also very powerful men. I have seen two of these men stow off a full cargo of brandy and wine in casks (after it was hoisted on board and lowered in the hold), apparently with as much ease as two American sailors would stow away a cargo of beef and pork. They brought their food on board with them, which consisted of coarse brown wheat-bread and grapes.'

1037. 'I have made several voyages to St. Petersburg in Russia,' says Captain Cornelius S. Howland, of New Bedford, Mass. 'The people of Russia generally subsist for the most part on coarse black rye bread and garlicks. The bread is exceedingly coarse, sometimes containing almost whole grains, and it is very dry and hard. I have often hired men to labor for me in Russia, which they would do from sixteen to eighteen hours, and find themselves, for eight cents per day (the sun shining there sometimes twenty hours in the day). They would come on board in the morning with a piece of their black bread weighing about a pound, and a bunch of garlicks as big as one's fist. This was all their nourishment for the day of sixteen or eighteen hours' labor. They were astonishingly powerful and active; and endured severe and protracted labor far beyond any of my men. Some of these men were eighty and even ninety years old; and yet these old men would do more work than any of the middle aged men belonging to my ship. In handling and stowing away iron, and in stowing away hemp with the jack-screw, they exhibited most astonishing power. They were full of agility, vivacity, and even hilarity,—singing, as they labored, with all the buoyancy and blithesomeness of youth' (1031).

1038. 'The Irish chairmen, porters, and coalheavers in London,' says Adam Smith, in his Wealth of Nations, 'who have been raised principally on the potato, and who continue to subsist on vegetable food, are perhaps the strongest men in the British dominions.'

1039. 'I have frequently witnessed, both in England and in Spain, the amazing bodily strength of the salt and coal-heavers, and their ability to perform an astonishing amount of labor in a day,' says Captain Chase. 'They perform so much, that they generally work by the ton, and not by the day. Much however probably depends on their being accustomed to their particular kind of employment. These men subsist on a simple vegetable diet; except that in England some of them use milk or buttermilk, with oatmeal, bread, mush, potatoes, etc. I have visited many respectable families in Ireland, who never allow their children to partake of any other than this simple fare. Moreover, I have been informed by many of the young Irishmen from sixteen to twenty-five years of age, that they had never eaten a pound of flesh in their lives; still they were remarkably vigorous, sprightly, and exceedingly well-formed; and the women are uncommonly hand-

some. And of all classes with which I have ever been acquainted, in all countries and climates, the Irish who have been thus reared, and who lead temperate lives, will endure more hardships, fatigue, and exposure, than any other.' 'The finest specimens of the human body I ever beheld, I saw in Ireland, and they had never tasted animal food, says the Rev. Howard Malcolm, of Boston, who has travelled extensively in America, Europe and Asia.

1040. 'The Salt and coal-heavers in Liverpool and London are principally Irish,' says Captain John Price, of New Bedford, Mass. 'I have often employed these men in lading and unlading my ship, and have been surprised at their great strength and power of endurance in connexion with their simple and scanty diet. Their food consists principally of oatmeal and other coarse bread, and cheese, dining on about four ounces of coarse bread and two or three ounces of cheese. On one occasion, two of these men came alongside of my ship with a boat-load of salt for me; and one of them actually threw that salt with a shovel, up nine feet on to the deck of my ship, as fast as two of my men could throw it into the hold.'

1041. 'I once discharged a cargo of oil at the port of Lisbon in Portugal,' says Captain Cornelius S. Howland, 'and the casks of oil were carried from my ship to the storehouse by porters. These porters came from the interior, on the borders of Spain and Portugal. They subsisted wholly on vegetable food, almost entirely on coarse rye-bread, and were remarkably stout and healthy. I had a cask of oil of uncommon size on board, weighing upwards of thirty-two hundred pounds; and four of these porters, yoked two and two, took it up by means of ropes going from their yokes under each end of the cask, and carried it about fifteen rods to the storehouse.'

1042. 'The Greek boatmen,' says the venerable Judge Woodruff, whose interesting mission to Greece I have already named (997), 'are seen in great numbers about the harbors, seeking employment with their boats. They are exceedingly abstemious. Their food always consists of a small quantity of coarse black bread, made of unbolted rye or wheat-meal (generally rye), and a bunch of grapes or raisins, or some figs. They are nevertheless astonishingly athletic and powerful, and the most nimble, active, graceful, cheerful, and even merry people in the world. At all hours they are singing,—blithsome, jovial, and full of hilarity. The laborers in the shipyards live in the same simple and abstemious manner, and are equally vigorous and active and cheerful. They breakfast and dine on a small quantity of their coarse bread and figs, grapes, or raisins. Their supper, if they take any, is still lighter; though they more frequently take no supper, and eat nothing from dinner to breakfast. It is indeed astonishing to an American to see on how small a quantity of food these people subsist. It is my serious opinion that one hearty man in New England ordinarily consumes as much food in a day, as a family of six Greeks. Yet there is no people in the world more athletic, active, supple, graceful, and cheerful (996). In Smyrna, where there are no carts nor other wheel-carriages, the carrying business falls upon the shoulders of the porters, who are seen in great numbers about the wharves and docks, and in the street near the water side, where they are employed in lading and unlading vessels. They are stout, robust men, of great mus-

cular strength, and carry at one load, upon a pad fitted to their backs, from four hundred to eight hundred pounds. Mr. Langdon, an American merchant residing there, pointed me to one of them in his service, and assured me that, a short time before, he carried at one load, from his warehouse to the wharf (about twenty-five rods), a box of sugar weighing four hundred pounds, and two sacks of coffee weighing each two hundred pounds,—making in all eight hundred pounds; that after walking off a few rods with a quick and firm step, he stopped and requested that another sack of coffee might be added to this load, but Mr. Langdon apprehending danger from so great an exertion, refused his request.'

1043. Mr Jones, in his Sketches of Naval Life, published at New Haven in 1829, speaking of the porters of Smyrna, says that 'the weight which they bear at one load, is often astonishing. I have been credibly informed,' says he, 'that five hundred and sixty pounds is a common burden for them, and that it frequently amounts to eight hundred and forty pounds.' 'I once saw one of the porters of Smyrna,' says Lieutenant Amasa Paine, of the U. S. navy, 'carry three bags of coffee at a load; and I saw those bags of coffee weighed, and carefully took down the weight of each bag at the time. One of them weighed three hundred and twenty-two pounds, another three hundred and twenty-seven, and another three hundred and eleven pounds,—making in all nine hundred and sixty pounds.' These porters very seldom if ever partake of any animal food—never enough to produce any effect on their bodies; but they subsist mostly on a very spare, simple, and coarse vegetable diet.

1044. 'Captain Thayer, in the schooner Lydia, belonging to me,' says Mr. Luther Jewett, of Portland, Maine, 'came into Portland in the summer of 1831, with a cargo of barilla (an ankali made of kelp, and used in making soap), from the Canary Islands. I stood by when the schooner was discharging her cargo, and saw four stout American laborers attempt, in vain, to lift one of the masses of barilla, which the captain and mate both solemnly affirmed was brought from the storehouse to the vessel by a single man, a native laborer, where they freighted, and he subsisted entirely on coarse vegetable food and fruit.'

1045. 'On our passage home from Greece,' says Judge Woodruff, 'we encountered a number of severe gales, in which all the sailors were obliged to exert themselves to the utmost. During these times, our Greek boy, John of Thessaly (997), displayed the most astonishing agility and muscular power. He would run out on the rigging, and, hanging by one leg, he would handle the sails with a degree of strength which seemed almost supernatural, when the storm was so severe and the sea so rough that he would often swing so as to describe a considerable part of a circle, and it seemed impossible for any creature to hold fast. I witnessed these exploits with painful dread, expecting every moment to see him shook from the rigging into the ocean; but he felt perfectly secure, and even loved the sport, and seemed 'proud to be daring.' One day, we were sailing under a pleasant breeze, and nothing for the hands to do, the men amused themselves in performing various feats; and among other things, they tried to lift a cannon which was lying upon the deck. We had one very large, stout-built, powerful man amongst the crew—a native of Kentucky—who went by

the name of 'big Charley.' He prided himself in his strength: and after several others had tried in vain to lift the gun, he took hold and laid out his whole strength, but did not stir it. He changed his position and tried the second and the third time with all his might, but was not able to move the gun at all After big Charley had given up, and all supposed, of course, that it was entirely useless for any one else on board to try, the Greek boy John, who had been idly looking on, came lazily up, and took hold of the gun, and, to the utter amazement of the whole crew, he, with apparent ease, raised it up full two inches from the deck, and laid it down again. The astonished spectators could not believe their own eyes; and to satisfy them that there was no deception about it, he raised it up the second time. This feat appeared so extraordinary to me, that I could not divest myself of a suspicion that there might be some peculiar sleight in it; and as I had been, in my prime, a pretty stout man, I thought I would try my own hand at it. I accordingly watched my opportunity when no one was present to witness my attempt, and, taking hold of the gun in the manner the Greek boy had done, I exerted all my strength; but I could no more move it than if it had been riveted to the deck.'

1046. 'My health,' says Dr. Jackson, a distinguished surgeon in the British army, 'has been tried in all ways and climates; and by the aids of temperance and hard work, I have worn out two armies in two wars, and probably could wear out another before my period of old age arrives. I eat no animal food, drink no wine nor malt liquor nor spirits of any kind. I wear no flannel, and neither regard wind nor rain, heat nor cold, when business is in the way.'

1047. 'I was born,' says Benjamin Howland (999), 'according to the record, on the 13th day of April, A. D. 1752. In early life I was frequently troubled with the diseases common to children, and as I advanced in life, I became subject to turns of the colic and of the sick-headache, which often rendered me unable to labor. After I had arrived at the age of twenty-five years, I concluded that the complaints with which I was afflicted were caused by some errors in my diet, and I therefore left off eating milk and hot bread, which in a great measure prevented my turns of the cholic, but not the headache; and from that time until I arrived at the age of forty years, generally speaking, my health was but poor. Still apprehending that my frequent indisposition was occasioned by errors in my diet, and being in the habit of using much animal food at that time, I thought my difficulties might proceed from that, and concluded that I would not use any more, not even fowl, the advice of my attending physicians and some of my friends to the contrary notwithstanding. I then adopted the use of molasses and water with brown bread or biscuit in it for my dinner, and tea or coffee for my breakfast and supper, my coffee generally being made from parched barley; and I have continued to use this beverage to the present day, having perceived no ill consequences to proceed from it. My health began to improve immediately, and continued to improve for a number of years, and much of my youthfulness and activity returned (1003). I became able to labor, travel, or exercise, as in early life. I could make stone wall, mow grass, chop wood, etc.; and have continued to the present to be blessed with a good use of my limbs to travel or labor. My mind, although perhaps never equal to some men's,

yet I may say without boasting has not, as I can perceive, diminished in its vigor and activity in doing business, for twenty or thirty years past. My sight is as good as common, though I am now eighty-two years old. I see to read out of doors or at a window, without glasses, although I have lost the sight of one eye. I have no recollection of ever having tasted of rum but once, and that was before I was twenty years old. I never drank brandy nor any other distilled spirits, and I think not to the amount of a bottle of wine or strong beer. In my younger years I sometimes drank a small quantity of cider, but for the greatest part of my life I have only drank a little, when first made, at the press. I carefully avoid eating all greasy substances as far as possible. I seldom take any butter. I eat vegetables of various kinds, have no fixed quantity to eat, generally eat what my appetite craves, which is not increased by missing a meal, as it was when I made use of animal food. I never was in the habit of using tobacco at any time of life. I retire at nine o'clock in the evening, and rise about sunrise. I generally sleep well; and after a day of hard labor, rise the next morning quite refreshed. I have two brothers younger than myself, who are not in my way of living, and do not enjoy so good health, nor are they able to labor as I do; although in younger years, one of them enjoyed much better health than I did. I had a sister who in her youth was unable to walk for fourteen years, in consequence of a kind of rheumatic cramp During the latter part of that time, she left off the use of animal food, except drinking a tea made from boiling birds in clear water; she also left the use of that before she recovered, and never afterwards made use of any animal food of any kind. She was soon after entirely relieved from her rheumatic complaints, and enjoyed a comfortable state of health; was active, cheerful, and sensible, and so continued to her latest moments. She lived over seventy years. I have for many years been in the habit of leading my field at mowing, and have continued to do so to the present time. I generally cut from sixteen to twenty-five tons of fodder.'

1048. 'I have been acquainted with Mr. Benjamin Howland for several years,' says Christopher Robinson, Esq., 'and I know he is a very extraordinary instance of bodily vigor and activity, and of unimpaired faculties, for an octogenarian. There are few men at any period of life capable of doing so much work in a day as he is. Few young men walk with so quick and elastic a step as he does. When crossing the fields, if a fence comes in his way, instead of pulling it down or crawling clumsily over it, he places one hand on the top of it, and springs over it like an active youth (999). Though I consider myself a pretty active young man, yet I do not think I can walk from East Greenwich to Providence (a distance of fourteen miles) in so short a time as Mr. Howland can. His mental powers seem to have suffered as little from old age as his physical. He appears to possess all the soundness of judgment, freshness of memory, and shrewdness of mind, that he ever did; and for the performance of labor or the transaction of business, he is a much more capable man than many at half his years.'

1049. 'I have resided many years near Mr. Benjaman Howland, and know him well,' says Albert C. Green, Esq., attorney-general of the state of Rhode Island. 'He possesses the activity and vigor

ordinary able-bodied laboring men at forty years old, and is capable of doing as much work. He has, for many years past, been in the habit of leading his hands in the field, and has considered that they did a good day's work who held their way with him. Mr. Robinson read law with me, and had a good opportunity of becoming acquainted with Mr. Howland. His testimony concerning him is perfectly correct. Mr. Howland is indeed a very remarkable man for one of his years.'

1050. 'A fright, when a lad,' says Mr. Thomas Shillitoe, of Tottenham, England (999), 'brought on a very severe nervous complaint, which increased as I grew up. At the twenty-fourth year of my age, my health became so impaired that my medical attendant ordered me to quit London altogether, and put me on a very generous diet. A beef-steak, and some of the best ale that could be procured, were ordered for my breakfast; and at my dinner and supper, plenty of good ale and wine, and, to avoid obesity, vegetable diet. This mode of dieting I pursued for twenty years. My health gradually more and more declined, and my nerves were so enfeebled, that twice I was confined to my bed, from the sudden sight of a mouse. These frights, too, which proceeded from different causes, produced such dread, such horror, such debility, and such sinking and frequent craving for food and stimulants, for several days afterwards, and my frame became so overcharged with the quantity of food and liquids, and my nervous irritability so increased, that I felt as if I could not live. Smoking, and spirits and water, were then recommended Although the quantity was increased from time to time, they did not produce the effect I desired. I became alarmed at the consequences, not knowing where it would end. These not producing sleep, I was then advised to have recourse to laudanum. I began with ten drops, yet I found I was obliged to increase my dose three drops every third night, until it got to one hundred and eighty drops. I left off at that quantity In addition to my nervous attacks (I apprehend in consequence of my generous and high manner of living), I became bilious, rheumatic, and gouty; I frequently had very bad colds and sore throat; and I can only describe the situation I was brought into by saying I went about day by day, frightened for fear of being frightened—a dreadful situation indeed to be living in. I made a visit to a medical friend of mine in Hampshire, where I spent some time. This afforded him an opportunity of observing the state of my health, and the effect which my manner of living had on my constitution; and before I quitted his house he advised me to make a general change in my manner of living—to abandon my beef-steak, and the use of all fermented liquors, and to use animal food but very sparingly. At first, it appeared to me as if human nature could hardly be willing to submit to my friend's prescription; for my physician in London had desired me to double my portion of ale in the morning, saying my hypochondriacal habit required it. At last I called upon him for his advice, in as debilitated a state of body, I think, as I well could be, to walk about. His advice to me was, to procure some of the oldest Madeira wine that could be got, and to take a bottle in as short a time as possible. A friend of mine provided me some, which he told me was twenty years old. I took the bottle of wine between the hours of eight and ten at night, and it produced very

little more effect, such was my state of debility, than if I had taken so much water. But feeling satisfied of the sincerity of my friend, who had enforced to me the necessity of a general change, I made up my mind to be willing to seek help from Almighty God, that I might give it a fair trial, satisfied as I was that nothing short of His help could enable me to endure the conflict I must undergo. When I returned to my own home, favored as I believe I was with that help which would bear me up in making the attempt, I proceeded all at once—for I found tampering with these things would not do—and gave up my laudanum, fermented liquors of every kind, and my meat breakfast. My health began gradually to improve, although I felt some of the effects of the old complaint in my stomach, after I had taken my dinner meal; I therefore confined myself wholly to vegetable diet, and my health has gradually improved from that time to the present, so that I am able to say, to the praise of Him who enabled me to make the sacrifice of these things, that I am stronger now in my eightieth year, than I was fifty years ago, when in the habit of taking animal food, wine, strong malt liquor, and spirits and water; and my bilious, my rheumatic, and my gouty complaints, I think I may say, are no more; nor have I, since this change ever had an attack of that most dreadful of maladies, hypochondria. I call it most dreadful from what I have felt of it. It exceeds derangement, because when derangement takes place, the mind is gone. I find, from continued experience (it being thirty years since I ate fish, flesh, or fowl, or took fermented liquor of any kind whatsoever), that abstinence is the best medicine. I don't meddle with fermented liquors of any kind, even as medicine. I find I am capable of doing better without them than when I was in the daily use of them. When I think of my friend who put me on this mode of living, I am satisfied of this, that he did more towards my comfort here, and towards my endeavoring to seek after a better inheritance in the world to come, than if he had given me *ten thousand sovereigns*. It is probable such a present would have promoted an increase of the indulgence in which I was living, and would have been almost sure to increase that state of disease which I had from time to time been laboring under. And another way in which I was favored to experience help in my willingness to abandon all these things, arose from the effect my abstinence had on my natural temper. My natural disposition is very irritable, and was not helped by my nervous complaint, irritability being very much attached to such complaints. I am persuaded that high living has more or less effect in tending to raise into action our evil propensities, which, if given way to, war against the soul, and render us displeasing to Almighty God. When about seventy years old, Mr Shillitoe visited this country, and he was then truly remarkable for his youthlike sprightliness and activity; and the latest accounts of him since his return to England inform us that, though over eighty years of age, he still continues to walk from Tottenham to London, a distance of six miles.*

1051. 'Thomas James, a laboring man of Nantucket, has never eaten any flesh, though he sometimes eats fish. He informed me, a short time since,' says Mr. William Macy, 'that he had never been sick, never

* Mr. Shillitoe died about a year since.

felt any of the aches and pains of which others complain, and never experienced any painful weariness from labor. He said he could work all day and all night if necessary, without any considerable sense of fatigue. I have known him to go into the field in the morning, and labor through the day, and come in at evening and eat his supper, and go into the oil-mill and work all night, and then go into the field again in the morning, without a moment's sleep, and work all day, and yet at the close of the second day he assured me that he felt no oppressive sense of weariness or exhaustion. He once observed to me, that he had several brothers, all of whom ate flesh freely, and, said he, I am worth the whole of them to endure labor, privation, and exposure. He is uncommonly nimble and active.'

1052. Thomas M'Goodin, a laboring man in the Callender factory in Providence, is about forty years old (Feb. 1834), small frame, and weighs about a hundred and thirty pounds. From religious considerations he was induced, about the year 1825, to abandon the use of animal food, and adopt the simple vegetable and water diet. After living in this way about seven years, and laboring hard, a competition arose in the beetling department of the factory, in which the ability of the laborers to endure powerful and protracted effort was severely tried. Two stations requiring precisely the same exertion were to be occupied for several days in succession. M'Goodin took one of these stations, and occupied it through the whole time without flagging in the least; while the other station was successively occupied by three or four of the strongest men in the establishment, all of whom were actually tired out and obliged to be relieved. The overseer of the department declared that he believed M'Goodin would kill every man in the establishment, if they were obliged to hold their way with him till he gave out. M'Goodin also labored from one to two hours a-day longer than any other man.

1053. Brindly, the celebrated English canal engineer, informs us that in the various works in which he has been engaged,—where the workmen, being paid by the piece, each exerted himself to earn as much as possible,—men from the North of Lancashire and Yorkshire, who adhered to their customary diet of oat-cake and hasty-pudding, with water for their drink, sustained more labor and made greater wages than those who lived on bread, cheese, bacon, and beer—the general diet of laborers in the south.

1054. I might add a multitude of instances of individuals in the United States, who within the last five or six years, have adopted a vegetable and water diet, and who have experienced a very considerable increase of strength since they have wholly abstained from animal food; and some of those instances have been remarkable; but it is sufficient to state in general terms, that excepting those invalids who were, at the time they made the change, affected with an incurable disease, all who have adopted and strictly adhered to a diet of pure vegetable food and water, and at the same time consistently observed a correct general regimen, have experienced a decided increase of muscular power, and have found themselves able to perform more labor with less fatigue. Indeed the general experiment has so completely demonstrated the truth of the physiological principles which I have advanced on this point (1015), as to render it perfectly certain that, all

other things being precisely equal, they who understand a correct general regimen, subsist on a diet of pure and well-chosen vegetable food and pure water, possess more muscular power, and are able to perform more labor in a given time, and to labor much longer without rest and without weariness, than they who subsist either on animal food exclusively, or on a mixed diet of vegetable and animal food.

LECTURE XVII.

Comparative effects of vegetable and animal food in enabling the human system to resist the action of morbific causes and to recover from disease—Popular ignorance in regard to the nature of disease, its source and its remedy; and what is required of the physician—Popular error in regard to the virtues of medicine—True health defined—The three opinions of the schools in relation to the nature of disease—The grounds of self-deception and of the success of quackery—The true province of the physician—Disease not natural to the human body—Caused mostly by our voluntary habits—All medicine a poison—The true physician—The abominations of quackery—Causes of disease, of epidemics, etc.—Animal and vegetable food in relation to epidemics—Illustrations; Howard and others—Cholera in New York—Dietetic sources of disease—Correct medical treatment—Little drugging necessary—Medicines often create and perpetuate disease—Importance of correct regimen—Virtues of vegetable diet—Hippocrates' opinion—The principles which should govern every practitioner—Dr. Cheyne and Dr. Lamb of England—Diseases of every type and character have been cured by correct regimen, with little or no medicine—How the diet of a chronic patient should be regulated—The diseased part the standard of power—False notions in regard to nourishing diseased bodies and being fleshy—Instability of invalids—Comparative effects of vegetable and animal food with reference to longevity, prolificness, and the ablity to endure cold.

1055. THE physiological evidence in relation to the natural dietetic character of man, derived from the comparative effects of animal and vegetable food on the human body, in enabling it to resist the action of morbific causes, to recover from disease, and to attain to old age, next demands our attention.

1056. In relation to disease, and the true principles and means of cure, the most universal and lamentable ignorance prevails among mankind (12). Few, probably, ever attempt to define their own notions on the subject, but are content to go through life with the most vague and indistinct impressions. Yet if they were to take the actions of men as true expressions of their ideas, we should unhesitatingly say, that human beings almost universally consider health and disease as things absolutely and entirely independent of their own voluntary conduct, and of their ability to control. They regard diseases as substances or things which enter their bodies with so little connexion with their own voluntary actions and habits, that nothing which they can do can prevent disease, nor vary the time nor violence of its attack (32); and, according to their education, they believe it to be the effect of chance or of fate (14), or a direct and special dispensation of some overruling Power or Powers (28). The consequence is, that they either submit to disease, as an element of their irresistible destiny, or seek for remedies which will kill it, or expel it from their bodies, as a substance or thing independent of the condition and action of their organs. This latter notion is probably far the most prevalent. People generally consult their physicians as those who are skilful to prescribe remedies

that will kill disease; and these remedies they expect to act either as an antidote to a poison, or as an alkali to an acid, or in some other way, with little or no reference to the condition and action of their organs, and to their dietetic and other voluntary habits. Many, indeed, seem to think that their physicians can take disease out of them and put health into them, by the direct application of remedies, and that there is in the remedies themselves, when skilfully chosen and applied, a health-giving potency which, of its own intrinsic virtue, directly and immediately imparts health to the body.

1057. This erroneous notion, as a matter of course, leads people to place their dependence on the sovereign virtue of remedies, and consequently to undervalue the highest qualifications of the well-educated and truly scientific physician (34), and to place equal or even greater confidence in the ignorant and blustering quack who impudently pretends to have discovered a true and infallible remedy for every disease. The result of all this error is, in the first place, mankind do not believe that their own dietetic and other voluntary habits and actions have much, if any thing, to do with the preservation of health and the prevention of disease; in the second place, when diseased, they expect to be cured by the sovereign power of medicine alone, and do not believe that any particular diet can of itself be of any great importance either in preventing or promoting their restoration to health; in the third place, relying wholly on the intrinsic virtues of medicine, they conceive that that *medicine* is quite as potent from the hands of one man as another, and are ever ready to run after those who are the loudest and most confident in their pretensions, and this opens the door for unbounded empiricism and quackery, and for the immense evils which flow from blind and indiscriminate drugging.

1058. All this mischief arises mainly from a want of correct knowledge of the nature of health, and the general principles and philosophy of disease. Life, I have said (41), is a mystery to man; we cannot appreciate nor detect it by any of our senses, nor by any scientific powers or means which we possess. It is therefore only known to us by its phenomena, or by the powers which it manifests and the effects which it produces. It cannot, as we have seen (108), be the effect of organization, but it is necessarily the cause of organization. Nevertheless, so far as we know anything about it, organization is the essential medium of its manifestations and perpetuity (121). It resides intimately and constitutionally in the tissues and substances of our bodies (203), and endows those tissues with all their peculiar properties; and entering with those tissues into the composition of all our organs, imparts to those organs their peculiar functional powers (312).

1059. The organization with which life is thus intimately connected, consists of certain arrangements of the matter which is common to all material forms, organic and inorganic (106), and which, as matter, is subject to the more primitive laws and affinities of the inorganic world (115). But, as we have seen (117), the arrangement of matter in organic forms, according to the constitutional laws of vitality, is an effect directly contrary to the more primitive laws and inorganic affinities of matter (110); and hence, vitality produces all of its peculiar effects, and maintains its controlling sovereignty in its organic dominion, in direct opposition to the more primitive laws and inorganic affinities

of matter (126); and consequently, those laws and affinities continually act to overcome and destroy life (127). And vitality, in resisting the hostility of those laws and affinities, and maintaining its own sovereignty and carrying on its peculiar operations, acts in and through its organization, and depends on the power of the vital constitution of the tissues (914) and the integrity of the organs.

1060 Health, therefore, may briefly be defined to consist in the correct condition and action of all the vital powers and properties of our bodies; and this necessarily involves the proper development and correct operation and condition of all the organs, tissues, and substances of our bodies.

1061. Concerning disease, medical men have been divided into three schools. First, those who have considered disease to consist essentially, in certain conditions of the fluids of the body. 'The human body,' says Hippocrates, 'contains four humors, very different with respect to heat and cold, moisture and dryness, viz., blood, phlegm, yellow bile, and black bile. Health consists in a due mixture of these four; and whatever produces a redundancy in any of them, does hurt.' This is the foundation of humoral pathology, which, with various modifications, has been embraced by a very large proportion of the medical profession from the days of Hippocrates to the present; and, of course, has constituted the basis of the theory and practice of medicine of that school. Their remedies and modes of treatment have been exhibited and pursued mainly, if not entirely, with a reference to the state of the fluids, and aiming to correct the humors. This scheme of humoral pathology has opened the widest door for every kind of quackery in all ages. Medical astrology and alchymy of earlier times, and the elixirs of life, catholicons, panaceas, hygeian pills, and other species of quackery in our own day, have all been founded on humoral pathology, and their proprietors have always talked about the impurities of the blood, the humors, etc., and the potency of their remedies to purify the blood, and sweeten the humors, and thus remove or prevent all diseases of every kind and type.

1062. The second school of physicians consider that disease consists essentially in the peculiar condition and action of the solids. They believe that by the action of disturbing causes and morbific agents on the solids of the body, these latter are irritated and diseased, and thus derangement of function, morbid irritability, local or general inflammation, fevers, change of structure, etc., are induced. This school also, of course, adapt their therapeutics, or theory and practice of medicine, to their scheme of pathology. They seek to subdue irritation and restore healthy action by abstracting irritating causes, and by the exhibition of sedative and narcotic medicine, or to overcome the irritation and unhealthy action of one part by producing special irritation in another part, on the principle of counter irritation: and it is upon this principle almost entirely, that all those accidental cures are effected to which all quack medicines owe their reputation. By improper quantities and qualities of food (510), and other errors of diet and habits, people oppress and irritate their systems, till they begin to be affected with unpleasant and perhaps painful symptoms of disturbed action, and, it may be, diseased condition of some of their organs. These symptoms they mistake for the disease itself, and fly to the use

of remedies for sour stomachs, dizziness, headache, sore eyes, rheumatism, pain in the breast, side, or back, or for catarrh, cough, cramps, eruption, debility, or something else. If these symptoms do not arise from the actual disease of any particular part, but from the general oppression of the system, caused by excessive alimentation, any drug which will powerfully evacuate the alimentary cavity and cause considerable depletion, will at once relieve the symptoms for which it was taken. Or if the symptoms arise from the morbid condition and unhealthy action of some particular organ or apparatus of the system, the medicine, if it possess any potency, by rallying the vital forces in reaction against its pernicious properties, induces a new disease, which, upon the principle of counter-irritation, causes a determination from the old to the new point of morbid action, and thus perhaps subdues the symptoms for which it was taken, and receives the credit of curing the disease. Where there is considerable constitutional and restorative energy in the system, and no particular part is very deeply diseased, the vital economy will often avail itself of the new action and determination caused by the medicine, to recover the health and integrity of the part previously affected; yet it is always necessarily at the expense of greater or less injury to other parts and to the constitution generally, from the action of the medicine. And if the cause which induced the primary difficulty be continued, the inevitable result will be, either that the old symptoms will sooner or later return with increased violence, or other symptoms arising from the diseased condition of the same part, and modified by the action of the medicine, will occur; or new symptoms arising from the diseased condition of other parts predisposed by the effect of the medicine, will take place. But, so that the symptoms are temporarily subdued or mitigated, or changed, the unfortunate sufferer is deceived into the belief that he is benefited by the medicine; and under this delusion perhaps, perseveres in the use of remedies which often become the most efficient causes of his sufferings, till he drugs himself to death, to the glory of the medicine and the emolument of the mercenary quack.

1063. The third school of physicians combine to some extent the views of the other two. They consider that the solids and fluids are both concerned in disease, and their theory and practice of medicine correspond with this opinion. And there can be no doubt that the diseased condition and action of the solids produce, to a greater or less extent, a morbid state of the fluids, and that this morbid state of the fluids reacts upon the solids to increase their irritations and aggravate their disease. But let us look at this matter a little more in detail. Pure healthy chyme is produced exclusively by the healthy function of the alimentary canal (320), and the alimentary canal can perform this function healthfully only while itself is in a healthy and undisturbed condition. Pure healthy chyle can only be produced by the healthy function of the lacteals (455). Pure healthy arterial blood can only be produced by the healthy functions of the lacteals, lungs, and other organs concerned in hæmatosis, or the formation of blood (474). Perfectly healthy bile can only be produced by the healthy function of the liver; and so on, of all the other fluids and humors of the whole system. Now then, suppose the chyme, or chyle, or blood, or bile, or any other fluid or any other humor of the body, to be unhealthy and impure; is

it possible for any physician, or any other human being in the universe, to apply such a remedy as will of its own intrinsic virtues, directly and immediately impart health and purity to any of those substances? Most certainly not. There is no possible way in nature of producing these effects, but by the healthy function of the organs constituted for that purpose. If the bile is unhealthy, no medicine in the universe can directly impart health to it. The healthy function of the liver alone can make the bile healthy; and while the function of the liver is perfectly healthy, the bile cannot be unhealthy. If the blood is impure, no medicine in the universe can, by its own intrinsic virtues, directly and immediately impart purity to it. There is no possible way in nature by which it can be purified, but by the healthy function of the appropriate organs of the body.

1064. If, then, by any means the blood becomes impure, the healthy functions of the appropriate organs will very soon purify it. But whatever may be the quality and potency of the medicines used to purify it, so long as the functions of those appropriate organs are unhealthy, the blood will and must remain impure; and this is true of all the fluids and humors of the system. It is true, however, as we have seen (1062), that by the continued application of such remedies, the original symptoms for which they were applied may, upon the principle of counter irritation, be removed and other symptoms be established, which will disappear when the remedies are abandoned; and thus, in some instances, health may be restored: in other instances, the old symptoms will return after a short time, and probably in a more aggravated form: and in other instances, new symptoms, and perhaps of a much more serious character, may be permanently established. while the patient himself, and very often his physician also, will never suspect that the new symptoms have been produced by the very remedies by which the old symptoms were removed.

1065. We see, therefore, that the essential elements of health are the healthy condition and functions of the organs of the human body (1060); and these elements are preserved by a strict conformity to the laws of constitution and relation established in our nature (683, *et seq.*), and they are destroyed or impaired by every infraction of those laws. And such are the sympathies of the system (297, 298, 511), that not only are the organs immediately acted on by disturbing and morbific causes themselves affected and their functions deranged and diseased by such causes, but other organs also, sympathizing with those immediately acted on by those causes, partake of their irritations, and by these sympathetic irritations are often made themselves the seats of local disease; and when disease is thus once induced, even slight habitual disturbances and irritations from dietetic errors and other causes are sufficient to keep it up for many years, till it terminates perhaps in death.

1066. We see, also, that no physician, nor any other human being in the universe, can come to us when we are diseased, and by any exercise of skill or the application of any remedy, directly and immediately impart to us any health, or remove from us any disease. But the truly enlightened, scientific, and skilful physician, is generally, able to discover the nature of our disease, and to ascertain what disturbing causes must be removed, and what means must be employed in order to the restoration of the healthy action and condition of every organ and part,

and thus, by assisting nature's own renovating and healing economy, relieve the system from disease, and enable it to return to health.

1067. For, it ought to be well understood that DISEASE IS NEVER THE LEGITIMATE RESULT OF THE NORMAL OPERATION OF ANY OF OUR ORGANS. The natural and legitimate result of all the normal operations of our vital economy is always health, and only health; and if disease is induced, it is always by causes which disturb those operations. Indeed, disease itself, as a general fact, may be said to be, in its incipient state, nothing more than an excess of healthy action to resist morbific causes; and this excess being carried too far, and continued too long, the overacting parts are brought into a morbid condition, and perhaps involve the whole system in sympathetic irritation. All that nature asks, or can receive, from human skill, in such a condition, therefore, is the removal of disturbing causes; and she will, of her own accord, as naturally as a stone falls to the earth, return to health, unless the vital constitution has received an irreparable injury. Disease is therefore not only induced by disturbing causes in the first place, but it is kept up by the continual action of such causes. It is true that when the action of disturbing causes has induced diseased structure in our organs, this, while it remains, will in the absence of all other morbific causes keep up diseased action to a greater or less extent in the system. But as a general law, in chronic complaints, where change of structure has not actually taken place and gone too far for vital redemption, diseased action will not long continue, after the entire removal of the disturbing causes; and hence, chronic disease is in almost every instance kept alive and cherished from day to day, from month to month, and from year to year, by the constant action of those disturbing causes, which are mostly to be found in our dietetic and other voluntary habits.

1068. It ought, furthermore, to be well understood that ALL MEDICINE, AS SUCH, IS IN ITSELF AN EVIL; that its own direct effect on the living body is in all cases, without exception, unfriendly to life (1062); and the action of all medicine, as such, in every case, to a greater or less extent wears out life, impairs the constitution, and abbreviates the period of human existence. Still, however, in the present condition of human nature, there are frequent cases of disease in which medicine, to some extent, is indispensably necessary to the salvation of life; yet even in all such cases, medicine is at best a necessary evil, and therefore should only be used when, and to the extent, indispensably necessary. And, consequently, the physician who assists our nature to throw off disease and recover health, with the least use of medicine, is the best friend to our constitution, and evinces the most true science and skill, and deserves our highest respect and warmest gratitude. To throw an immense quantity of medicine into the diseased body, and accidentally kill or cure, as the event may happen to be, requires but little science or skill; and extensive experience has taught us that it may be done as well by the acknowledged quack as by the licensed physician: but to understand all the properties, powers, laws, and relations of the living body, so well as to be able to stand by it in the moment of disease, and, as it were, to look through it at a glance, and detect its morbid affections and actions, and ascertain its morbific causes, and to know how to guide and regulate the energies of life in accordance with

its own laws, in such a manner as to remove obstructions, relieve oppressions, subdue diseased action, and restore health, with little or no medicine, but principally or entirely by a regimen wisely adapted to the case, evinces the most extensive and accurate professional science and the most profound skill; and such qualifications are essential to the character of a truly enlightened and philanthropic physician; and such physicians truly deserve the support and respect and admiration and love of every member of society, as standing among the highest benefactors of the human family.

1069. But what must we think of those creatures wearing human shape, who, either with the good intentions of honest ignorance, or with the base motives of cupidity, with exceedingly little or no knowledge of the human constitution and the laws of life, and without ever seeing their thousands of patients, or knowing any thing of the nature or causes of their diseases, open their patent medicine manufactories in London and Philadelphia and New York and other places, and deluge the earth with their panaceas and catholicons and hygean pills, and thousands of other vile preparations, and boldly recommend them as infallible specifics for every disease that man can force upon his nature? Surely they are to be regarded as among the very worst enemies of their species; and many, if not most of them, ought to be ranked with pirates and assassins; for, with little if any less turpitude of heart and wickedness of intention, they destroy the lives of hundreds, where pirates and assassins do of one. And they will continue their successful career of human butchery, till the all-pervading ignorance and delusion of our fellow creatures, which render them capable of being deceived by such impostors, and made willing to swallow immeasurable quantities of their pernicious drugs, shall be dispelled by the universal diffusion of knowledge in regard to the constitutional nature and relations of man.

1070. Health, I have said (1060), may briefly be defined to consist in the correct condition and action of all the vital powers and properties of our bodies, and this necessarily involves the proper development and correct operation and condition of all the organs, tissues, and substances of our bodies; and the more perfectly we conform to the laws of constitution and relation established in our nature (683, *et seq.*), the more perfectly and certainly we preserve such a state of things; and in such a state of things, our bodies possess their greatest vital power to resist the action of foreign disturbing and morbific causes generally, and of all special and extraordinary morbific or pestilential causes.

1071. But whatever irritates our organs and disturbs their functions, not only tends to originate disease in the system, but always commensurately diminishes the power of our bodies to resist the action of foreign morbific and pestilential causes. It is possible that in some exceedingly rare instances, changes in the state of the earth or atmosphere, or the influence of comets or some other heavenly bodies, may be such as absolutely to induce disease in man and other animals, in any condition of their vital powers, and wholly independently of their dietetic and other voluntary habits. But it is very questionable whether such a state of things ever happens; and it is certain that if it does, it is extremely seldom, and only on a very limited extent of the earth's surface; for in such a case not only many, but every human being without

exception, and probably most or all the lower animals, at least of the same natural class, would be diseased at the same time, over the whole extent of the earth's surface where such a cause prevailed. But neither history nor tradition gives us any information that such an event ever took place.

1072. Changes in the state of the earth and its atmosphere, and especially of the latter, have undoubtedly very often, and very extensively, been immediately exciting causes of disease in man, when there was a considerable predisposition to disease induced by other causes. As a general fact, however, the grand sources of disease are the erroneous dietetic and other voluntary habits and actions of mankind. By introducing into the nose, mouth, lungs, and stomach, substances unfriendly to life (510), and by introducing into the stomach proper alimentary substances in an improper condition or quantity, or at improper times, —by error in regard to exercise, rest, sleeping, cleanliness, clothing, etc.,—by an undue exercise of the mental faculties and over-excitements of the mind,—by an inordinate exercise of the passions, such as love, fear, anger, etc.,—and by many other causes within the compass of man's voluntary agency, the nervous system is almost continually, and in nearly every member of the human family, kept in a state of more or less powerful and extensive irritation; and by this means the functions of the several organs are disturbed, and their functional results deteriorated; the healthy condition of the organs themselves is impaired, and more or less of a morbid irritability and sympathy are induced in the nervous system generally; and thus diseases of every description are originated in the system by internal disturbances; and by the same means, the power of the living body to withstand the action of foreign morbific and pestilential causes is exceedingly diminished.

1073. We perceive, then, that not only whatever produces irritation in the system, but also whatever excites the nerves and accelerates the functions of the organs and increases the exhaustion of their vital properties beyond what is essential to the most healthy operations of the vital economy (735) and the most perfect results of the vital processes of composition and decomposition (314), always necessarily diminishes the power of the living body to resist the action of foreign morbific and pestilential causes, and increases its liability to be morbidly affected, or to become diseased by the action of those causes.

1074. We have seen (906) that animal food or flesh-meat is decidedly more stimulating in proportion to the quantity of nourishment which it actually affords the system than proper vegetable food; that it increases the vital action of the whole system, causes a more rapid pulse, and a hotter skin (909); hastens all the vital processes, and renders the vital changes less perfect. We have seen also (914), that the chyle formed from animal food, when taken from the living vessel, much more readily becomes putrid than that which is formed from vegetable food; and that the human blood formed from animal food will putrefy, when taken from the living vessels, in a much shorter time and much more rapidly than that formed from pure vegetable aliment; and that there is always, other things being equal, a much greater febrile and putrescent tendency in the living bodies of those who subsist mostly on animal food, than in those who subsist wholly

on pure vegetable aliment; and hence, the susceptibilities of both the fluids and the solids to the action of morbific causes is greater in the flesh-eater than in the vegetable eater. Moreover, it is a very important fact, and especially in relation to civic life, that the pulmonary and cutaneous evacuations of the human body are much less morbific and pestilential in their tendencies, when pure vegetable aliment is used than when flesh-meat is used. As a general fact, therefore, all the vital powers of the human body are preserved in a more vigorous condition, and all the vital functions are more healthfully and perfectly performed, in the use of proper vegetable food, than in the use of flesh-meat; and, consequently, the human body has more vital power to resist the action of foreign morbific and pestilential causes, and to maintain permanent health, when nourished by well-chosen vegetable food, than when nourished by flesh-meat, or than when nourished by a mixed diet of vegetable and animal food.

1075. I wish to be clearly understood on this point, however; I do not affirm that the mere abstinence from animal food, and living on vegetable food exclusively, without any regard to a proper regimen, will better enable our bodies to withstand the action of foreign morbific causes, than a mixed diet under good regulations. I continually insist upon it, and wish it to be distinctly remembered, that vegetable food *can* be made incomparably more pernicious than plain simple animal food in temperate quantities. It is infinitely better to subsist on a mixed diet of vegetable and animal food under a good general regimen, than to live wholly on vegetable food badly selected, viciously prepared, and eaten in inordinate quantities, while at the same time we live in the violation of almost every other correct rule of health. Be it remembered, therefore, that in all the comparisons which I draw between the effects of animal and vegetable food on the human body, I always proceed upon the condition that all other things are precisely equal. It is indubitably true that individuals living on poor and scanty vegetable food, in filthy and miserable hovels, indulging habitually in the use of tobacco, opium, ardent spirit, and the numerous other intoxicating and stimulating substances used by human beings (768), would be far more likely to be morbidly affected by pestilential causes, than those who, surrounded by comforts, with cleanly and well-regulated habits, subsist temperately on a mixed diet of vegetable and animal food. But the question is, Would the same individual, or any number of individuals whose habits and circumstances are in all other respects correct, be better able to resist the action of foreign morbific causes when subsisting exclusively on a well-chosen and well-regulated vegetable diet, than when subsisting on a mixed diet of vegetable and animal food? To this question I reply, unhesitatingly, that both physiological science and facts prove that the pure vegetable diet is the safest and the best, because it is best adapted to the organization and to the physiological properties and powers of the human body.

1076. As to facts, they may be gathered in great abundance from the history of the human family in all periods and portions of the world; but enough can be found in modern times, and even in our own day and country, to satisfy every mind that is willing to receive the truth.

1077. Howard, the celebrated philanthropist, was probably more exposed to the influence of pestilential causes than any other human

being that ever lived. 'In the period of sixteen or seventeen years, says his biographer, 'he travelled between fifty and sixty thousand miles, for the sole purpose of relieving the distresses of the most wretched of the human race. The fatigues, the dangers, the privations he underwent or encountered for the good of others, were such as no one else was ever exposed to, in such a cause, and such as few could have endured. He often travelled several nights and days in succession, without stopping, over roads almost impassable, in weather the most inclement, with accommodations the meanest and most wretched. Summer and winter, heat and cold, rain and snow, in all their extremes, failed alike to stay him for a moment in his course; whilst plague and pestilence and famine, instead of being evils that he shunned, were those with which he was most familiar, and to many of whose horrors he voluntarily exposed himself; visiting the foulest dungeons, filled with malignant infection, spending forty days in a filthy and infected lazaretto, plunging into military encampments where the plague was committing its most horrid ravages, and visiting where none of his conductors dared to accompany him;' and through all this, he subsisted entirely on a most rigidly abstemious vegetable diet, carefully avoiding the use of wine and all other alcoholic drinks: and such was the result of this man's extensive experience and observation, that he earnestly advised others who were exposed to the plague, to abstain entirely from the use of animal food; and this, it cannot be supposed, he would have done, had he not been fully confident of the correctness of such advice, both from what he had experienced in himself, and from what he had seen in others. And it must be remembered that Howard's opportunity to test the correctness of this opinion was neither brief nor limited, but the most extensive, varied, and long-during, ever experienced by any one man; and such were the accuracy of his observations and the soundness of his judgment, that although not himself a physician, yet he was more successful in treating the plague than any of the physicians where he went. Howard's opinion, therefore, on such a subject is of the highest value. 'The abstemious diet which, at an early period of his life, he adopted from a regard to his health,' says his biographer, 'he afterwards continued, and increased in its rigor from principle and from choice, as well as from a conviction of the great advantages which he derived from it.' And after all his experience, near the close of his life, he made the following record in his diary:—'I am firmly persuaded, as to the health of our bodies, that herbs and fruits will sustain nature in every respect far beyond the best flesh.' Yet with all the practical good sense and wisdom of this philanthropic man, there is every reason to believe that he fell a victim to his free use of tea. Substituting its deleterious stimulation for the sustaining nourishment of food, he rushed with the utmost temerity into the presence of the greatest danger, when his body, by fatigue, cold, wet, and exhaustion from severe fatigue, was wholly unprepared to resist the virulent action of malignantly noxious agents, and then neglected the early symptoms of disease in his system, and perseveringly refrained from the use of any efficient means of restoration.

1078. The distinguished botanist Charles Whitlaw, speaking of the ravages of the yellow fever in New York says:—'I was then in the full vigor of health, having been brought up on a vegetable diet, which I

have no doubt was the chief cause of preserving my health and life, as I attended and nursed a considerable number during the whole of their illness without taking the fever. Being anxious to know the cause of the dreadful malady, I attended the dissections. The doctors were astonished how I escaped the contagion. Mr. Hardy, a celebrated Scotch philanthropist, like Howard, went from place to place in the city, administering comforts to the diseased and miserable. I was induced to follow his course. It would be impossible to describe the distress I witnessed.' Mr. Whitlaw also informs me that he spent a season in New Orleans during the prevalence of the yellow fever, and was much among the sick, nursing and administering to them, and by virtue of a pure and simple vegetable diet he wholly escaped an attack of the fever,

1079. Copeland's Medical Dictionary contains an article on climate in relation to the food of man, in which the writer says:—'When travelling in the most unhealthy parts of intertropical Africa, in 1817, I met with an Englishman who had lived there between thirty and forty years, and was then in the enjoyment of good health. The circumstance was singular; and in answer to my enquiries as to his habits, he informed me that soon after his removal to that pestilential climate, his health had continued to suffer, till, after trying various methods without benefit, he had pursued as closely as possible the modes of life of the natives, adopting both their diet and beverages (the natives living almost exclusively on rice and maize and water), and from that time he had experienced no serious illness.'

1080. The Rev. Mr. Mylne, missionary to Africa, makes the following mention of the health of his colleague, the Rev. Mr. Crocker. Having given an account of his own severe sickness and recovery, he adds:—'Brother Crocker has been very much favored; he has had no real attack of fever all this time, which I suppose is unprecedented for a white man here; but he began three months before leaving America to live on farinaceous food, and has strictly adhered to his principles since he arrived, living on rice, cassada, sweet potatoes, etc.—a fact worthy of the consideration of emigrants to this country.'

1081. Mr. G. W. M'Elroy, of Kentucky, visited Liberia in Africa in the summer of 1835, arriving in July. He spent two months in Monrovia, and two months on the coast. During his voyage to Africa, while there, and on his passage home, he abstained wholly from animal food, lived on rice and other farinaceous vegetables, and on fruits. He enjoyed the best of health the whole time (although much exposed while in Africa), and in fifty-seven days he gained fifteen pounds in weight.

1082. But the most signal demonstration of the truth of the principles which I am contending for, was afforded in the city of New York during the prevalence of the cholera in the summer of 1832. The opinion had been imported from Europe, and generally received in our country, that a generous diet embracing a large proportion of flesh-meat, flesh-soups, etc., with a little good wine, and a strict abstinence from most fruits and vegetables, were the very best means to escape an attack of that terrible disease. Nearly four months before the cholera appeared in New York, I gave a public lecture on the subject in that city, in which I contended that an entire abstinence from flesh-meat and flesh-soups, and from all alcoholic and narcotic liquors and substances, and from every kind of purely stimulating substances, and the observance

of a correct general regimen in regard to sleeping, bathing, clothing, exercise, the indulgence of the natural passions, appetites, etc., would constitute the surest means by which any one could rationally hope to be preserved from an attack of that disease. I repeated this lecture after the cholera had commenced its ravages in the city, and notwithstanding the powerful opposition to the opinions which I advanced, a very considerable number of citizens strictly adhered to my advice. And it is an important fact, that of all who followed my prescribed regimen uniformly and consistently, not one fell a victim to that fearful disease, and very few had the slightest symptoms of an attack.* The following statements, which were received from respectable individuals soon after the disease had disappeared from the city, may be relied on with the fullest confidence.

a. 'In stating my views of a simple diet,' says Dr. Amos Pollard, 'as a means of preserving health and preventing disease, I must necessarily be brief for want of time. I think I have the most ample evidence of its salutary and conservative effects in my own person. I had been afflicted both before and during my medical studies with the worst of diseases, chronic dyspepsy, from which I never obtained any permanent relief until about eighteen months since, when I put myself on the simple mode of living recommended in your Lectures. For nearly a year I subsisted principally upon coarse wheat-meal bread and milk, with great advantage to my health; when happening to get some milk which tasted and smelled of garlics, I became so disgusted with it, that, in May last (1832), I exchanged my milk for spring water, which, with the coarse bread, has constituted my diet mainly ever since. During the past summer, and especially the cholera season, my professional duties were exceedingly arduous, and I often felt myself nearly worn-out for want of rest and sleep. Yet through the whole sickness I subsisted on one pound per day of coarse unleavened wheat-meal crackers, with some fruit and spring-water, and experienced no disorder of the stomach and bowels, but enjoyed, and still continue to enjoy, far better health than I have experienced before for the last fifteen years. I also gained several pounds in weight during the cholera season. On looking over my notes of cholera cases, taken at the bedside of the patients, I find that the occasion of the disease could be traced, in a very large majority of cases, either to confirmed habits of intemperance, or to some prominent act of imprudence. I speak here of patients both in hospital and in private practice. Many people—and among them some of my own profession—have asserted that simple vegetable diet is conducive to, and in many cases, has actually produced cholera. I have taken considerable

* During the prevalence of the cholera in New York in 1832, it was most extensively, clamorously, and continually asserted, that the 'Grahamites' were dying by scores with the epidemic, and this opinion has gone abroad through the country, and is perhaps generally believed. Yet I solemnly declare that I made the most diligent search in every part of the city where any such case was reported, and called on every physician who I heard had made such assertions, and in the newspapers of the city publicly called for the specification and proof of such cases, yet I could not find a single instance in which an individual who had adopted and consistently observed the regimen I had prescribed had died of cholera or any other disease, and but two or three instances in which there had even been a slight attack, and in each of these cases there had been decided imprudence.

pains to investigate these matters, and in not a single instance have I been able to verify their assertions; but, on the contrary, I have uniformly found that every person who has strictly and judiciously observed such a diet under a well-regulated general regimen, has not only escaped the cholera, but enjoyed excellent general health.'

b. 'After having been grievously afflicted for several years with dyspepsy,' says Mr. A. Woodman, 'I adopted a simple vegetable diet, and entirely recovered my health. Through the cholera season I subsisted almost entirely on coarse wheat-meal bread and water, and enjoyed the most perfect and uninterrupted health, and gained several pounds in weight. Our family, consisting of ten members, who lived on what the physician call a more 'generous diet' of flesh, fine bread, tea, coffee, etc., all had a pretty severe attack of cholera, and some of them two and three attacks. My brother David, a very healthy and robust young man, who lived as the rest of the family did, but used no spirits, went with me three several times through the cholera hospitals, to see the sick, and during the night following me each time he had a severe attack of cholera, while I had not even a premonitory symptom of the disease through the season.'

c. 'Myself, wife, and sister,' says Mr. Evander D. Fisher, 'had all been afflicted with poor health, and particularly my wife and sister, for many years before we adopted our present mode of living on simple vegetable food. Neither of us has eaten any flesh since, which is now more than a year. We spent the past summer in the city, and never enjoyed better health than we did through the whole cholera season. That dreadful disease raged terribly all around us, and cut off many of our neighbours, and even came into our house and attacked our mother, who did not live as we did, but ate flesh, etc.; and I was among the dying and the dead, and assisting in laying out and putting into their coffins at least a dozen dead bodies of those who had died of cholera, yet neither myself, wife nor sister, had the least premonitory symptoms of cholera, nor any other illness during the whole season.'

d. 'We remained in the city during the cholera season last summer,' says Mr. William Mitchell, 'and living near one of the cholera hospitals, we daily saw the dying and the dead carried by our door. Our whole family, except my mother, subsisted entirely on a simple vegetable and milk diet. My mother thought she required the more *generous diet* to which she had always been accustomed, and continued to eat flesh and live in the usual mode. She had a very severe attack of the cholera, while the rest of us had not a symptom, but enjoyed the best of health through the whole season.

e. 'Four members of our large family,' says Mrs. Pike, 'lived strictly on a simple vegetable diet during the cholera season last summer, eating no flesh, and subsisting principally on coarse wheat-meal bread. They enjoyed excellent health, and none of them had the slightest symptoms of cholera during the season; while every other member of the family had more or less of that disease.

f. 'During the prevalence of the cholera last summer,' says Mrs. Harriet Wheeler, 'all of our family had an attack of that disease, except myself. They ate flesh, and lived in the usual manner. I ate no flesh, but lived strictly on a simple vegetable diet, consisting principally of coarse wheaten bread. But what, in all probability, would

have been my case, if that awful epidemic had found me in that condition of body in which I was before I adopted my present mode of living? I verily believe I should not now be among the living on earth. Thanks to God, I am not only living, but well. I have scarcely known an hour's indisposition during the past twelve months. And what a change is this, after having been afflicted as I have been for more than twenty years.'

g. 'Since about the year 1818, says Mr. Ferdinand L. Wilsey, 'I have been afflicted with very feeble health. In the autumn of 1831 I commenced living on a simple vegetable diet, and continued to live in this manner very strictly during the cholera season, subsisting mainly on coarse wheaten bread. My health improved very much, and continued good through the summer. With a medical friend I attended many cases of the cholera, and stood over several patients, and administered to them and rubbed them, but had not a symptom of the disease; while my medical friend, who ate flesh and drank wine, and urged me to, had several attacks.'

h. 'Myself and wife,' says Mr. Edmund Van Yorx, 'had long been in very feeble health, and laboring under many serious symptoms of pulmonary consumption, when we adopted a simple vegetable diet; since which time our health has improved exceedingly. We and our children and other members of our family spent the cholera season in the city, all living strictly on our plain vegetable diet. Our immediate neighbourhood was exceedingly sickly. The cholera raged all around us, and the people died on every side of us. One man died next door, so near to us, that I could reach my hand out of my window into his room; and the offensive smell of his body after death came in and scented our whole house, and yet none of us had any thing of the disease. I have two apprentices, both of whom lived as we did on a vegetable diet through the worst of the cholera season, without the least indisposition. The older one then went into the country where he spent two weeks, living quite generously on animal food, etc., and then returned to the city and took the cholera immediately, and had three physicians to keep him alive. The younger one continued in the city, adhering closely to his simple vegetable diet. His health improved very much indeed during the summer, and he had not the slightest symptom of cholera nor any other disease.

i. 'After having been afflicted with miserable health for many years, says Mr. David I. Burger, 'I was induced to adopt a plain and simple vegetable diet, and by degrees became more and more strict in my regimen, till I got on to a diet of coarse wheaten bread and pure rain-water exclusively. This regimen I observed rigorously through the whole cholera season, and not only became wholly relieved from all my ailments, but recovered and enjoyed the most entire and perfect health, feeling strong, active, and cheerful. My sleep was as sweet as an infant's; and when I rose in the morning, I always felt fresh and clear and vigorous and sprightly, as ever I did in my boyhood. During the cholera season I was very much among the sick of that terrible disease. Several times a-day I visited a family occupying a house belonging to me in James-street, and of which five members died. I stood over the beds of the sick, handled their bodies, assisted in taking care of them, etc., and after the house was deserted and others were

afraid to enter it, I went into it, took up the beds, clothes, and other things appertaining to the rooms from which the dead bodies had been removed, and carried them out of the house, and was three or four times a-day there, handling the things, etc. After this I visited several other families who were sick of the same disease, sat beside the sick by the hour, watched with them, rubbed them, lifted them, etc.; yet through the whole season I had not the least touch of the complaint, nor the slightest indisposition of any kind.'

j. Benjamin Tytler, an aged Scotchman in the employ of Daniel Fanshaw, Esq., living on the simple vegetable diet, purposely exposed himself in almost every possible way, frequented the most infected parts of the city, but had not a symptom of the disease.

k. William Goodell, Esq., editor of the *Genius of Temperance*, who had been for many years afflicted with chronic diarrhœa, was relieved by a simple vegetable diet, and was much exposed during the cholera season, but wholly escaped an attack.

l. James Whitelaw, a Scotch gentleman, had been afflicted in the same manner, and recovered his health by the same means. He was daily in the midst of the cholera, but had not a symptom himself.

m. Mrs. Phebe Corlies, an excellent member of the Society of Friends, had been most severely afflicted for thirty years with a chronic diarrhœa, which had baffled every mode of medical treatment. She was relieved by a simple vegetable diet and correct general regimen, and enabled to remain in the city through the cholera season without a symptom of that complaint.

n. Two sisters of the name of Primrose, had been out of health, and both recovered excellent health by adopting a simple vegetable diet and a correct general regimen. The older sister returned to her tea, coffee, flesh meat, etc., but the younger continued to adhere closely to her vegetable diet. During the prevalence of the cholera, the older sister was severely attacked, and but just escaped with her life, while the younger sister nursed her, stood over her night and day, administered all her medicine, rubbed her body, took her breath, and even put her mouth to hers and kissed her when in a state of collapse, and yet had not a symptom of the disease, nor any indisposition during the whole season.

o. William Cooke, wife, and children, living strictly on a simple vegetable diet, enjoyed the best of health through the cholera season, without having a symptom of that disease; while a young woman residing in the same family, and eating flesh and living in the ordinary manner, had three severe attacks.

p. Dr. D. M. Rees, whose practice and success were at least equal to any other physician's in New York, declares that when the cholera broke out in that city, and he was called to practice among it, he found that the disease was making its greatest ravages among the excessive flesh-caters, and he consequently went home and requested his family to abstain entirely from the use of flesh during the continuance of the epidemic in the city, and he and his family subsisted wholly on a vegetable and milk diet while the cholera prevailed, without having any thing of the disease,—excepting in one instance, near the close of the sickness, when Mrs. R., without his knowledge, partook of flesh-meat, and in a few hours after was taken with diarrhœa. Precisely the same thing happened to Mr. Henry R. Percy and his wife; and Dr. Rees says

that he advised all his friends to abstain from flesh, and that all who conformed strictly to his advice wholly escaped the disease

q. Dr. Tappan, who superintended the Park Hospital, has assured me that out of twelve house pupils (students of medicine and young physicians) who assisted him in the Hospital during the prevalence of the cholera, Mr. Sharrock, who had lived more than a year very strictly on a simple vegetable diet, was the only one who entirely escaped all symptoms of the disease; all the others being attacked more or less violently, and some quite severely.

r. 'My health was very feeble, and I had suffered much from hemorrhage of the lungs,' says Mr. Lewis St. John, of New York, 'when I was induced, in the spring of 1832. to adopt a simple vegetable diet. From this change I almost immediately experienced considerable benefit; and during the prevalence of the cholera in the city, I not only escaped all symptoms of that disease, but enjoyed much better health than usual. Being still feeble, however. and dreading the effect of our northern winter, I left New York for Mobile, by water, in the fall of 1832. About forty other gentlemen left New York with me, in the same ship for the same place. We were shipwrecked on an island in the Gulf of Mexico, about half way between Key West and Havana, or ninety miles from the latter place. We remained on this island fourteen days, and were then taken off (sixty-five of us in all) and carried to Mobile in a schooner of sixty-seven tons. About one week after my arrival at Mobile, the cholera broke out there, and even came into the house where I boarded, but I had no symptom of it. I took no other precaution to avoid it except to adhere strictly to my simple mode of living, and washing every morning. I remained in that climate nearly four years. Of the forty gentlemen who went out with me, every one was sick more or less within the first year, and some of them died; and within three years from the time of our arrival, a number of them died, and many more of them were sick a great deal, and apparently came very near dying. Some of the most healthy and robust of the company were cut off in the vigor of manhood and the prime of life, and I followed them to the grave. Yet during my whole stay at Mobile, I enjoyed continually improving and uninterrupted health, and paid nothing for physic or physician. In the spring of 1836 I returned to the North with health wonderfully improved. While travelling in the month of August of the same year, not finding it convenient to adhere to my simple diet, I yielded to the exigency of circumstances, and lived as others did at the hotels and other places where I stopped. This brought on a pretty severe turn of bleeding at the lungs, which laid me up for a fortnight. The physician who attended me was very much surprised that my system was so little affected by the hemorrhage and recovered so soon, and declared that he never before saw such a case. After this I found that any considerable departure from my simple mode of living was sure to admonish me with symptoms of my old complaint: but for the last fifteen months my habits have been regular, and I have had no bleeding; my general health is very much improved; my lungs are stronger than they have been before for ten years, and my body is very vigorous. About three months since, as a matter of experiment, I drank one cup of what is called good coffee. Having been out of the habit of drinking it for many years, it operated powerfully as an eme-

tic in fifteen minutes. When I had vomited freely I felt perfectly well again.'

1083. I might continue to multiply cases of this kind to a very great extent, but I have already given enough to satisfy every unprejudiced mind that a well-chosen vegetable diet is better than a mixed diet of vegetable and animal food, to enable the human body to resist the action of foreign morbific and pestilential causes.

1084. From the principles and facts already advanced, it appears too evident to require much further reasoning to prove that pure vegetable diet, as a general rule, is better adapted to assist the diseased body in recovering health, than flesh-meat, or even a mixed diet of animal and vegetable food.

1085. It is possible that in some instances, pernicious principles in the atmosphere or other foreign agents, acting on the system through the lungs, or through the cutaneous organs or functions, may be the principal causes of disease. But as a general fact, these causes are mainly adventitious or supplementary, coming in to prostrate the system which was previously poising to its fall, and, as it were, to give a determinate direction and unity of effect to the co-operation of many other causes.

1086. In general, therefore, the predisposing, and for the most part, the immediately exciting, causes of disease in the human body are to be found within the precincts of man's dietetic and other voluntary habits and actions (1072); and probably his dietetic errors are by far the most extensive source of his disease.

1087. Whether we embrace the scheme of humoral pathology or either of the other two which have been named (1061, 1063), we must admit that, as a general fact, organic irritation, disturbing the functions and deteriorating the functional results, and inducing a morbid condition of the solids (1067), leading to acute and chronic inflammation, general fever, local disease, change of structure, etc., is the ordinary source of our diseases; and these irritations are produced by the dietetic use of substances unfriendly to vitality and to the physiological interests of our bodies, and by the improper qualities and quantities and conditions of our food, and by many other means and circumstances pertaining to our dietetic and other voluntary habits and actions (510). But, by whatever cause induced, disease, when once established in the system, can only be removed by the constitutional economy of the living body, by the healthy functions of the several organs. Yet so long as irritation is kept up, the healthy functions of the organs cannot be restored.

1088. The only aid, therefore, that human skill and science can afford the diseased body in recovering health, is, with strict regard to the physiological properties and laws of the system, to assist it, as far as possible, in throwing off oppressions, removing obstructions and all irritating causes, and in subduing irritations, and restoring healthy action and function. And in order to this, it is requisite, in the first place, that the physician should well understand the physiological powers and laws of the body; in the second place, that he should understand the nature of the disease; and in the third place, as a general rule, that he should fully and clearly ascertain the cause of the disease. For, as Hippocrates justly observes, 'the man who

attempts to cure a disorder without knowing the cause, it is like a blind man, or one groping in the dark,—he is as likely to do harm as good.'

1089. It is true that there are some instances of acute disease, in which the symptoms are so violent that the physician cannot safely delay his practice to investigate the case extensively, and ascertain obscure, remote, and accumulate causes, before he endeavours to subdue the violent symptoms and mitigate the sufferings of his patient. But as a general rule, even in acute disease, the physician acts not wisely who prescribes a remedy before he has carefully inquired after the cause. For all he does without a knowledge of the cause, is necessarily groping in the dark; he may relieve or he may aggravate the symptoms with equal credit to his skill and science. So far as his agency is concerned, it is a pure contingency whether he kills or cures. Thus, to state a real case (587), a physician is called to a patient laboring under violent delirium; without inquiring carefully after the cause, he treats the case according to his view of the symptoms, and bleeds copiously, and rapidly reduces the patient, without mitigating the symptoms in the least. Another physician is called in, who first sets about ascertaining the cause; this done, an emetic is prescribed, and soon a large quantity of undigested beef and pickelled cucumbers is thrown from the stomach, and instantly the symptoms disappear, and the patient is restored to reason, and shortly to health. Had the first physician in this case continued his practice, he would surely have killed his patient. Cases of this kind are continually occurring in society, and the effects of the mal-practice are always attributed to the incorrigibleness of the disease, and mankind rest satisfied in their ignorance and unbounded credulity.

1090. In chronic diseases, all practice which is not based upon a careful and thorough investigation of the causes, as well as the symptoms of the case, is in fact nothing but downright quackery, and far more frequently does harm than good. For in such practice, the causes of the disease, existing in the dietetic and other voluntary habits of the patient (1067), are suffered to remain and constantly exert their morbific influence by which the disease was originally induced, and continues to be perpetuated. Nay, indeed, those very causes are frequently employed as remedial agents to remove the disease which they have originated and are perpetuating. Thus I have in multidutes of instances seen people who have been severely afflicted for years, by diseases which were principally induced by the habitual use of alcoholic and narcotic substances, and which had been kept alive by the continued use of those substances as medicine; and all that was necessary to remove the diseases and restore the sufferers to health, was to take away their medicine. Again, I have seen instances in which individuals had suffered under the most cruel affections of the heart and head and other parts, and submitted to medical treatment for years without the least relief. Yet on taking away their tea and coffee, which were the principal originating and perpetuating causes of their sufferings, they were soon restored to perfect health. But the practitioners had wholly overlooked or entirely disregarded these causes, and suffered them to keep alive the symptoms which they were combating with their medicine, and by their medicine rendering their patients only the more morbidly susceptible to the effects of those morbific causes. And

I have seen hundreds of miserable dyspeptics who had suffered almost everything for years; scores of those whose symptoms strongly indicated pulmonary consumption, and sometimes apparently in its advanced stage; many who had been for years afflicted with epileptic and other kinds of fits and spasmodic affections, or with cruel asthma, or sick-headache; in short. I have seen nearly every form of chronic disease with which the human body is afflicted in civilized life, after resisting almost every kind of medical treatment for months and years, yield in a very short time to a correct diet and well-regulated general regimen. And why was all this? Because, in almost every case, the diseases had been originated and perpetuated by dietetic errors; and the practitioners had been unsuccessful, because with all their administration of medicine, they had suffered those dietetic errors to remain undisturbed, unquestioned—nay, perhaps even recommended.

1091. Hippocrates, who possessed one of the most powerful and discriminating minds ever devoted to medicine, depended mainly on regimen for the cure of disease. His first business was to ascertain the character of the disease, then the cause or causes; and then he proceeded to remove, as far as possible, all extrinsic or external causes existing in dietetic habits, etc., and if he found internal causes requiring medicine for their removal, he gave medicine. But his materials of medicine were few and simple, and only used to a very limited extent. In fact, as I have already said (1068), a free and continued use of medicine in almost every case only evinces a want of true skill and science in the practitioner. It is, indeed, the appropriate business of the quack to drug mankind to death; and the enlightened and philanthropic duty of the physician, to assist nature in strict accordance with her own fixed laws. In chronic disease, at least, but little medicine can be given, without doing more harm than good. A single dose or two, or a few doses at most, to remove obstructions and prepare the way for a correct regimen, is, as a general rule, all that can be wisely used; and whatsoever is more than this is evil.

1092. The great question is, how to remove all irritation from the system, and restore each part to healthy action and condition. But almost all the articles of medicine, not excepting those called tonics, are either directly or indirectly irritating or debilitating in their effects on the living body, and therefore should be avoided as far as possible. Many of the articles of diet ordinarily used in civilized life are also decidedly irritating and pernicious; and many of the modes of preparing food, are sources of irritation to the system. In fact, when the body is seriously diseased, even the necessary functions of alimentation, under the very best regimen, are, to a considerable extent, the sources of irritation; and were it possible to sustain life without nutrition, entire and protracted fasting would be the very best means in many cases of removing disease and restoring health. I have seen wonderful effects result from experiments of this kind. But nutrition must be sustained; and the grand problem is, how it can be sustained to the necessary extent, with the least degree of irritation to the diseased parts, or with the least possible increase of diseased action. In solving this problem, the physician requires the aid of profound science. It is necessary that he should thoroughly understand the physiological properties and laws of the human body, and its constitutional relations, and the qualities of

alimentary and medicinal substances in relation to the organization and to the vital properties and powers of the body. With such scientific qualifications, with sound judgment and mature experience, he will be able to adapt his regimen to the particular condition of his patient,—to remove, as far as possible, every irritating cause in the quality, quantity, and condition of the diet, and to retain only such articles as will afford sufficient salutary nourishment, with the least degree of irritation and excitement; while at the same time, it is best adapted to promote the particular and general functions of the alimentary and other organs of the system.

1093. Such a physician, if he gives his mind fully to the subject, will discover in the course of a few years, at longest, that though in particular cases, where individuals have long been accustomed to a free use of animal food, it may be inexpedient to make too sudden and entire a change of diet, and though great improvements may be made in health, on a plain and temperate mixed diet, and in some instances the patient may increase in flesh and strength most rapidly, for a season, on animal food, yet as a general fact, however well-ordered his regimen in other respects, if he retains any portion of flesh-meat in the diet of his patient, he in some measure retards, if he does not prevent, his complete restoration to perfect and permanent health. He will find that it is much more stimulating in proportion to the quantity of nourishment which it actually affords the system, and consequently causes a greater exhaustion of the functional powers of the organs of assimilation and nutrition, than pure and proper vegetable food (906), that it always increases the general excitement and diseased action of the system, and tends to perpetuate its morbid irritability and susceptibility, and produces fluids and humors, less bland and genial to the solids (650), and in all respects less adapted to promote the prophylactic and sanative process of the vital economy.

1094. The celebrated Dr. Cheyne, of England, who flourished about a hundred years ago, says:—'For those who are extremely broken down with chronic disease, I have found no other relief than a total abstinence from all animal food, and from all sorts of strong and fermented liquors. In about thirty years' practice, in which I have in some degree or other advised this method in proper cases, I have had but two cases in whose total recovery I have been mistaken: and they were both too deeply diseased and too far gone for recovery before I undertook with them.' Dr. Lamb, of England, now upwards of seventy years old, after a very long, extensive, and successful practice, speaks most decidedly against the use of animal food of any kind in chronic disease. And during the last seven years, my own opportunity to prove the virtues of different kinds of diet in chronic disease, has probably been more extensive than that of any other individual in any age; and I have, as a general rule, always found that a pure and well-regulated vegetable diet, under a correct general regimen, is decidedly better than that which contains any portion of animal food. I have, it is true, met with some invalids whose general physiological condition seemed to require that a portion of animal food should be retained in their diet for a few weeks, and perhaps a few months, till the general sluggishness and torpor of their systems should be overcome; but such cases are not common; while, on the other hand, as I have already

stated (1090), I have seen multitudes of chronic diseases of every name and type, which had long and incorrigibly withstood medical treatment of every kind, yield in some instances immediately, and in others in a few weeks or months, to a pure vegetable diet and general regimen regulated by physiological principles. I could fill a large volume with well-authenticated and most interesting detailed accounts of a very great variety of cases of chronic disease cured in this manner. But this is not the place for such a detail.

1095. In regulating the diet of chronic patients, however, it should always be remembered that the extensiveness and suddenness of any change should correspond with the physiological and pathological condition and circumstances of the individual; and most especially should it be remembered that the *the diseased organ or part should be made the standard of the ability of the system.* If the boiler of a steam-engine is powerful enough in some parts to bear a pressure of fifty pounds to the square inch, while in some other parts it can only bear ten pounds to the square inch, we know that it would not do for an engineer to make the strongest parts of the boiler the standard of its general ability or power, and to attempt to raise a pressure of forty pounds to the square inch, because some parts can bear fifty pounds; for in such an attempt he would surely burst the boiler at its weakest parts. He must therefore make the weakest parts the standard of the general power of the boiler, and only raise such a pressure of steam as those parts can safely bear. So he who has diseased lungs or liver or any other part, while at the same time he has a vigorous stomach, must not regulate the quality and quantity of his food by the ability of his stomach, but by the ability of the diseased part. This rule is of the utmost importance to the invalid, and one which cannot be disregarded with impunity, and yet it is continually and almost universally violated. Few things are more common than to find individuals who are laboring under severe chronic disease, indulging in very improper qualities and quantities of food, and other dietetic errors, and still strongly contending for the propriety of their habits and practices, on the ground that '*their stomachs never trouble them.*' Alas! they know not that the stomach is the principal source of all their troubles (51!); yet by adopting a correct regimen, and strictly adhering to it for a short time, they would experience such a mitigation of their sufferings, if not such a restoration to health, as would fully convince them of the serious impropriety of making a comparatively vigorous stomach the standard of the physiological ability of a system otherwise diseased.

1096. Another equally common error of opinion is that the fleshiness and the muscular power of the body are to be considered as criteria of the excellence of any regimen prescribed for a chronic invalid. Every intelligent person knows that when an individual is taken with an acute disease of a highly inflammatory character, the physician cuts off all food at once, and adopts a course of treatment which rapidly reduces his strength and flesh; because it is believed that there is no other way of arresting the progress of the disease and preventing fatal consequences, but by greatly reducing the general action of the vital powers; for always, when the action of the vital powers is diseased action, the more violent it is, the sooner will it destroy the vital constitution of the diseased part or parts and the more speedily will it

break up the vital economy of the system. But the main difference between acute and chronic disease is in the *degree* of the morbid activity of the vital powers; and if we would not indulge in 'a generous diet' of highly seasoned flesh-meat, rich pastry, wine, etc., when laboring under acute inflammation of the pleura, lest we should destroy life by the violence of a general fever and the mortification of the inflamed part, with what propriety can we indulge in such a diet when laboring under a chronic inflammation of the same or any other part, since the chronic inflammation as certainly tends to change of structure as the acute, though with less rapidity and violence? with less rapidity, because the morbid activity of the vital powers is less excessive, and with less violence, because the conservative economy of the system makes less resistance to the progress of the disease (1067), but, as it were, more quietly succumbs and suffers the enemy with stealthy death-tread to march perhaps unsuspected into the citadel of life (729). Nevertheless, the chronic invalid himself, and generally his friends, and sometimes also his physician, seem to think that fleshiness and muscular strength are the things mainly to be desired and sought for, and that any prescribed regimen is more or less correct and salutary in proportion as it is conducive to these ends. Whereas if they were properly enlightened, they would know that the more they nourish a body while diseased action is kept up in it, the more they increase the disease. The grand, primary object to be aimed at by the invalid, is to overcome and remove diseased action and condition, and restore all parts to health, and then nourish the body with a view to fleshiness and strength, as fast as the *feeblest parts* of the system will bear, without breaking down again. And the regimen best adapted to remove the diseased action and condition, more frequently than otherwise, causes a diminution of flesh and muscular strength, while the disease remains, in regulating the general function of nutrition to the ability of the diseased part (1095). But when the diseased action ceases, and healthy action takes place, the same regimen perhaps will increase the flesh and strength as rapidly as the highest welfare of the constitution will admit.

1097. Some invalids, after trying the virtues of medicine and generous living for many years, with a continual increase of their sufferings, have adopted a simple vegetable diet and severe general regimen, and very soon experienced a great alleviation of their distress, and in the course of a few months, an entire removal of their disease, and a restoration of the healthy action and condition of every part. But at the same time, and by the same means, they have also experienced a great diminution of flesh and muscular strength; and believing that there can be no health without these, and having neither faith nor patience to wait for the more slow and safe effects of a mild unstimulating diet, they have, after subduing their disease by their abstemious regimen, returned to the use of flesh-meat and to a generous living, and, for a while, increased in flesh and strength with great rapidity, and of course believed that their restoration to health was wholly attributable to their generous diet, and that if they had persisted in their abstemiousness it would surely have killed him. It is strange that such people can so soon forget, that before they adopted their abstemious regimen, all the animal food and wine and medicine

they could swallow failed to give them flesh or strength, but, on the contrary, only increased their sufferings. This, however, is but one of the innumerable delusions with which mankind are cursed; and happy is it for them if it does not soon lead them into deeper and more inextricable difficulties than those from which they have been relieved.

DIET WITH REFERENCE TO LONGEVITY.

1098. Concerning the comparative effects of animal and vegetable food in prolonging human life, the principles which I have already explained (673, 679, 909, 916, 965), and the facts which I have presented, are such as to leave little necessity for physiological discussion and demonstration in regard to this point.

1099. There is no more general and invariable physiological law appertaining to the animal kingdom, and indeed to the whole organic world, than this (965). The more slowly the healthy and complete vital functions are performed, the more slowly living bodies are developed and attain to maturity, the longer will be the natural duration of life (678). It is admitted by all eminent physiologists, that *intensive* and *extensive* life are incompatible. 'The more slowly man grows,' says Professor Hufeland 'the later he attains to maturity and the longer all his powers are in expanding, the longer will be the duration of his life,—as the existence of a creature is lengthened in proportion to the time required for expansion. Everything, therefore, that hastens vital consumption, shortens life; and consequently, the more intensive the vital action, the shorter the life (990). We have seen that the human body is formed from fluids (146); that in early childhood all the solids are exceedingly pulpy and moist (674); that the proportion of the fluids to the solids is very great—more than ten to one; and that as life advances, even under the most favorable circumstances, the relative proportion of the fluids gradually diminishes, and that of the solids increases (678); and, at a certain period, depending in a measure on the general habits of the individual, all the solids begin to be less pulpy and to become more dry, inflexible, inelastic, and unyielding, producing the various phenomena of old age (988.) We have seen also, that this change in the relative proportion of the fluids and solids may be effected more slowly or rapidly, according to the dietetic and other voluntary habits of the individual (680); and moreover, that a change in the relative qualities and conditions of the fluids and solids may be very rapidly effected by dietetic and other voluntary errors, causing irritation and disease, and bringing on a premature old age, with a thousand-fold more decrepitude and infirmity than are incident to the most extreme natural old age (681).

1100. All alcoholic liquors of every kind, distilled and fermented; all narcotic substances, fluid and solid (963); all pure stimulants, or those substances which stimulate without nourishing the body (733); all improper quantities and qualities of food; all pernicious preparations and conditions of aliment; all inordinate exercise of the passions; in short, all things that produce over-excitement and irritation in the system, increase the intensity of life, hasten the changes in the relative proportion, qualities, and conditions of the fluids and solids of the body, and shorten the period of its existence. Hence Professor Hufeland very justly observes—'If you would live long, live moderately,

and avoid a stimulating, heating diet, such as a great deal of flesh, eggs, chocolate, wine, and spices.'

1101. I do not, however, intend to class flesh with alcoholic and narcotic and other intoxicating and stimulating substances, as equally pernicious to the physiological properties of the human body, but I simply intend to compare it with a pure well-ordered vegetable diet. And here again (1075), I acknowledge that an exclusive vegetable diet, with every other circumstance unfavorable to life, will not sustain human existence so well and so long as a mixed diet of vegetable and animal food, with every other circumstance favorable to longevity. The Hindoos, for instance, subsist mostly on vegetable food; but, as we have seen (1021), they always eat with that food an excessive quantity of stimulating, heating, and irritating spices. And from the highest to the lowest—males and females, old and young, from morning till night—they smoke a composition containing opium; and almost every man, woman, and child, habitually and often to a very great excess, chews a cud composed of opium, lime, and betel-nut, wrapped up in a sera-leaf of very acrid and pungent qualities. The properties of the betel-nut are too sharp and violent to be borne without being qualified by the arec-nut and a little lime. Tobacco, one of the worst of narcotics, and arrack, a very intoxicating, fiery, and destructive alcoholic liquor, are also in common and excessive use among them. They marry at twelve, and even ten years of age,—are unboundedly licentious, indolent, and inactive; and their climate is by no means the most favorable to long life. Is it strange then, that such people should afford comparatively few instances of longevity? Yet it is common for the Bramins of India, who are strictly temperate and of correct general habits, to attain to a hundred years (756).

1102. In comparing the effects of vegetable and animal food on the human body, with reference to long life, therefore, the simple question is, whether, all other things being precisely equal, flesh-meat is as conducive to longevity in man as a well-chosen and well-ordered vegetable diet?—and to this question I affirm, that both physiological science and fact fully and unequivocally answer, no!

1103. As I have repeatedly stated (906), and as every physiologist must admit, flesh is always of a more stimulating and heating nature, causes a more rapid pulse (909), a hotter skin, hastens all the vital functions of the body (914), causes a greater exhaustion of the vital powers of the organs, and wears out the human constitution considerably faster than a proper vegetable diet. Hence, great longevity is never found among those tribes and portions of the human family who subsist principally or entirely or animal food of flesh-meat. The Patagonians, with a climate and almost every other circumstance except their diet exceedingly favorable to longevity, rarely attain to seventy years of age; and the average duration of life is greater with them than with any other flesh eating tribe or nation (971).

1104. We have already seen (769) that, according to all history and tradition, the primitive inhabitants of the earth subsisted entirely on vegetable food, and lived to a very great age (631). The ancient Chinese, who subsisted on rice and water, are said to have been remarkable for their great longevity. 'The Pythagoreans, who lived on a simple vegetable diet,' says Hufeland, 'afforded the most numerous instances

of old age.' 'The Essenes, as we call a sect of ours,' says Josephus, 'live the same kind of life as do those whom the Greeks call Pythagoreans. They are long-lived also, insomuch that many of them live above a hundred years old, by means of their simplicity of diet, and the regular course of their lives' (787, 788).

1105. In fact, it is true of those portions of all the ancient tribes and nations who preceded the period of luxury (638), and who subsisted on a plain, simple, coarse, and natural diet of vegetables, fruits and water, that they possessed great bodily vigor, and lived to a very great age, exempt from most of the diseases of body and mind, which so abundantly afflict the luxurious and the intemperate. 'It has been established by nature on the best grounds,' says Hufeland, 'that our nourishment should be used in a form rather coarse, securing full mastication and insalivation, and a longer retention in the stomach. Plain, simple food only, promotes moderation and longevity, while compound and luxurious food shortens life.' 'The most extraordinary cases of longevity,' continues Hufeland, 'are to be found among those classes of mankind who, amidst bodily labor, and the open air, lead a simple life agreeable to nature; such as farmers, gardeners, hunters, etc. The more man follows nature, and is obedient to her laws, the longer will he live; the further he deviates from these, the shorter will be his existence (725). This is one of the most general of laws. In the same districts, therefore, so long as the inhabitants lead a temperate life, as shepherds or hunters, they will attain to old age; but as soon as they become civilized, and by such means sink into luxury, dissipation, and corruption, their duration of life will be shortened. It is, therefore, not the rich and great, not those who take gold tinctures and wonder-working medicines, who become old, but country laborers, farmers, etc. Mortality prevails in the greatest degree where men deviate most from nature,—where her most sacred laws are despised. Rich and nourishing food, and an immoderate use of flesh, do not prolong life. Instances of the greatest longevity are to be found among men who, from their youth, lived principally on vegetables, and who perhaps never tasted flesh. Even very sound health may shorten the duration of life; and on the other hand, a certain kind of weakness may be the best means of prolonging it' (660).

1106. Such are the opinions which one of the most distinguished medical men in Germany has embraced and published, after the most careful and extensive research on the subject of human life; and I am the more gratified to cite them from such authority, because I had advanced them in my public lectures for three years, before I knew that they had been expressed by Hufeland or any one else. I might proceed to corroborate the physiological principles and general statements which I have advanced, by a very extensive and interesting detail of individual cases of extraordinary longevity. I might narrate the case of Robert Bowman, who, subsisting wholly on a vegetable and milk diet of the plainest and simplest kind, retained his bodily vigor and mental and moral powers to a very great age; who, when a hundred years old, joined the chase and ran after the hounds; and at the age of a hundred and twelve assisted his family in the harvest field. Or the case of the French peasant, who, subsisting on coarse brown bread baked semi-annually, and goats' milk, and breathing the pure air of the mountains

on the borders of Switzerland, retained all his faculties and powers to the age of a hundred and fifteen, with uninterrupted health and remarkable vigor and activity; and at the age of a hundred and twenty was carried to Paris and presented to the king; and there, by a change of diet and other circumstances, rapidly declined for two or three years, and died. Or the case of Thomas Parr, of England, who subsisted almost all his life on bread, milk, old cheese, and whey, and who, at the age of a hundred and thirty, was able to perform every kind of work of a laborer; who, when a hundred and forty years old, manifested little of the failing of age, and who was removed to London, where an entire change took place in his mode of living, and he soon died at the age of one hundred and fifty-two. Yet, judging from the condition in which all his viscera were found on examination after death, it was the opinion of Dr. Harvey that he might have lived till he was two hundred years old, had he remained in his native country air, and continued his regular, plain, simple, and temperate habits. Or I might narrate the case of Henry Jenkins, of England, who, subsisting much in the same manner as Parr did, retained his faculties and powers in great vigor for nearly a century and a half, and with little abatement carried them up to the age of a hundred and sixty-nine; or the case of Demetrius Craboski, who was recently living near Polask, on the frontiers of Lithuania, at the age of one hundred and sixty-eight. 'The Russian Methuselah,' says the *St. Petersburgh Gazette*, 'has always led the humble and tranquil life of a shepherd, assisted by his two sons, the eldest of whom, Paul, is one hundred and twenty, and the younger, Anatole, ninety-seven years old.'* But it is more entertaining than useful to devote our time and attention to such details. There are, as I have frequently remarked (985), so many modifying circumstances and causes to be taken into consideration when reasoning from individual experience, that without the best physiological knowledge to guide us in our researches, we are quite as likely to arrive at erroneous as at correct conclusions (653, 654).

1107. There are two grand facts, however, in relation to this matter, worthy of all consideration. The one is, that when individuals who have lived to old age on simple vegetable food, begin in advanced life to partake of animal food, the infirmities of age always increase upon them with a manifestly increased rapidity, and they rarely long survive the change. The other is, that when individuals who have lived to sixty or seventy years of age and upwards on a mixed diet of vegetable and animal food, and begun to feel much of the decrepitude of old age and to experience many of its infirmities, if before they are completely broken down and brought upon their death beds they adopt a well-chosen vegetable diet and good general regimen, they always greatly improve in health, throw off many if not most or all of their infirmities, and retrieve much of the activity and vivacity of earlier life (1047).

* Indeed, it is very common for native Russians living on a coarse and scanty vegetable diet, even in that severe climate, to exceed a hundred years of life. The late returns of the Greek church population of the Russian empire, give, in the table of deaths of the male sex, more than one thousand over a hundred years of age. There were forty-nine between a hundred and fifteen and a hundred and twenty; forty between a hundred and twenty and a hundred and twenty-five; sixteen between a hundred and twenty-five and a hundred and forty; and four between a hundred and forty and a hundred and fifty.

I have witnessed this fact in numerous instances (1003). But I have said enough on this point. No intelligent and unprejudiced individual can faithfully examine this subject, and long remain in doubt that a pure and well-ordered vegetable diet is better adapted than one containing any portion of flesh-meat, to prolong human life, and to preserve the elasticity and activity of the body, and the vivacity and cheerfulness and vigor of the mind (682).

DIET WITH REFERENCE TO PROLIFICNESS AND ENDURANCE OF COLD.

1108. There are two other departments of evidence pertaining to the physiological powers common to all organized bodies, which require a brief considreation, because they have been pre-occupied by the advocates of the carnivorous character of man, and insisted on as affording irrefragable proof of the constitutional necessity of at least some portion of flesh-meat in the diet of human beings The first relates to the perpetuation of the species, and the second to the ability of the human body to endure the intense cold of the frigid zones.

1109. It has been asserted by Buffon and others, and is perhaps generally believed by professional men in flesh-eating countries, that 'if man were obliged to abstain totally from flesh, he would not multiply' (801). To an intelligent and unsophisticated mind, this position must, on a little reflection at least, appear so palpably erroneous, that it hardly seems necessary to attempt a serious refutation of it. Yet when we consider how powerful is the force of education, preconceived and long-cherished opinion, and deeply established habit, we are less surprised that men of certain kinds of training should cling to opinions which they have been systematically taught to believe indubitably true; and we see the importance of endeavoring to set men right even in regard to errors which are most obviously preposterous.

1110. It is not necessary that I should enter into any physiological reasonings on this point. If, as I have endeavored to show, a pure and well-chosen vegetable diet is best adapted to sustain the organic economy of the human body in all other respects (916), it cannot be possible in the nature of things that this particular point is a special exception to the general physiological laws of the system. And on this point we may with more propriety than in regard to almost any other, appeal directly to the general history of the human kind. We know that in all times, and in all climates, those portions of the human family which subsist mostly or entirely on vegetable food, are vastly more prolific than those portions which subsist mostly or entirely on animal food. The purely flesh-eating tribes are never prolific. Indeed, as a general law, the number of births among them, in a given time, rarely much exceeds the number of deaths; and hence such tribes, if they continue to be strictly carnivorous, generally remain for centuries with very little increase in their numbers, and sometimes, even in the most favorable climates, they slowly decrease.

1111. There is probably no purely carnivorous portion of the human family whose climate, quality of food, habits, and circumstances generally, are more genial to the physiological interests of the human body, and more favorable to the multiplication of the species, than those of the Patagonians (971). If, therefore, flesh-meat were adapted to render the human species prolific the Patagonians ought to multiply

very rapidly. But the reverse of this is signally true. For three hundred years, at least, they have inhabited a country whose mild climate and salubrious atmosphere are exceedingly favorable to human life; and yet in all eastern Patagonia south of the Rio Negro—an extent of country which might contain a population of several millions—there are at the present day less than eight hundred inhabitants. If this fact were owing to the mere scarcity of the food on which they subsist, then it would appear either that they have taken precautionary measures to prevent too great an increase of population, or else that whenever the population exceeds the alimentary supplies of the country, they have swarmed like bees, and sent off the excess of their population to some other part of the country. But neither of these hypotheses is true. They are as prolific as they can be, and yet their number is vastly less than might be sustained by the alimentary resources of the country. Though prone, like all other human beings in similar circumstances, to indulge in tobacco and intoxicating drinks, yet they are so situated, and hitherto have had so little commerce with the rest of the world, that they have been able to procure only occasional and very scanty supplies of those articles, and therefore have probably never suffered to any considerable extent from the use of them. Neither is there any evidence that their population has been often and considerably reduced by frequent and destructive wars, nor by epidemic disease or pestilence. There is therefore the strongest evidence that the nature of their food is the principal if not the only cause of their being so unprolific; and this conclusion is powerfully corroborated by the general fact already stated (1110), that all tribes and nations subsisting wholly on flesh and fish are remarkably unprolific. The inhabitants of Terra del Fuego, we have seen (970, *f*), have the greatest abundance of animal food, and yet their number is very small.

1112 On the other hand, we find the vegetable-eating portions of the human family are so exceedingly prolific that they are constantly under the necessity of devising means and adopting measures to check or to dispose of the excess of population. To say nothing of the vegetable-eating millions of Asia, with whom the very earth and atmosphere seem to teem, we find nearer home a fact so signal and so notorious, that it is greatly marvellous that it has never met the eye and fixed the attention of those philosophers who so strenuously contend for the necessity of a portion of flesh-meat in the diet of man. It is well known to almost every body in Europe and America, that a very large majority of the inhabitants of Ireland, from generation to generation, never partake of flesh-meat enough to have any appreciable physiological effect on the organic economy of their bodies; and yet Ireland, besides being at all times in such a state of overfulness of population as to be constantly threatened with, and frequently suffering extensive distress from want of food, and the lives of hundreds of thousands are shortened by starvation, has poured out such a tide of emigration that she has deluged England, Scotland, and America with her naturally hardy and energetic offspring.

1113. On the whole, therefore, the true evidence in the case, when correctly apprehended and accurately appreciated, instead of serving in any measure to prove that the integrity of any function in the organic

economy of the human body requires that flesh-meat should form a portion of the diet of man, goes very powerfully and conclusively to prove that the physiological interests of the human constitution are in every respect best sustained by a pure vegetable diet (986).

1114. In regard to the necessity for flesh-meat to enable the human body to endure severe cold, it is contended that God, in creating man with a constitutional capability of acclimating himself to the wintry regions of the North, has made it essential to his most perfect and successful adaptation to those regions that he should subsist mostly or entirely on animal food. To this I reply, that so far as God has constituted and ordained things in such a manner as that animal substances are all or nearly all that the frigid zones afford for human aliment, and in such a manner as that the human body is far less injuriously affected by the free use of flesh-meat in cold regions than in the torrid or even in the temperate zones, so far it may with propriety be said that God has made it necessary for the inhabitants of the frigid zones to subsist on animal food. But the notion that the physiological powers and functions of the human body are better sustained by flesh-meat than they *can* be by a well chosen vegetable diet in the wintry regions of the poles, is entirely false. Could proper vegetable food be had in abundance in the frigid zones, it would be better aliment for man in every respect than flesh-meat, even in the coldest spot where human life can be preserved. That is, provided man is accustomed to such a diet in those regions from his childhood up, or fully habituated to it before he enters those regions. Or, in other words, all other things being precisely equal, the man who is fully accustomed to a pure vegetable diet, can endure severer cold, or bear the same degree of cold much longer, than the man who is fully accustomed to a flesh diet.

1115. Were animal heat a mere chemical effect, or were it produced in the same manner as we produce a sudden sensible glow throughout the system by drinking alcoholic liquor, it might not be easy to perceive how the same diet which best enables us to endure the intense heat of the torrid zone should also best enable us to endure the intense cold of the frigid zone. But let it be remembered that animal heat is purely the effect of vital function (489), and that the power of the body to regulate its temperature according to the surrounding medium, so as to sustain the extremes of heat and cold, is always greatest when its physiological properties and powers are in the most healthy and vigorous state and condition. And this, we have seen (986), is most perfectly secured by a pure and well-chosen vegetable diet.

1116. Reasoning from false notions derived from mere momentary sensation, mankind long clung to the opinion that alcoholic liquor would enable them better to endure both heat and cold; and although modern experiments are beginning to set them right concerning alcohol, yet they blindly cherish the idea that flesh-meat is better for them in cold regions than vegetable food, without pausing to consider that while it actually affords them less real and permanent nourishment (906), it stimulates them more, and exhausts the vital powers of the organs more rapidly, and therefore in all that it differs in its effect from vegetable food, it approaches more nearly to the character of alcohol.

1117. We know that in some of the coldest portions of the Russian

Empire, the people subsist on coarse vegetable food, and are exceedingly hardy and vigorous. I have been assured by highly intelligent gentlemen who have spent many months in Siberia, that no exiles to that wintry region endure the severities of the climate better than those who have been all their lives accustomed to a simple vegetable diet. And it has proved universally true, except in cases of far-gone and incurable disease, that all those who have adopted a strict vegetable diet and correct general regimen in this country, within six or seven years past, have experienced a decided increase of physiological power to endure severe cold, and have found themselves able to preserve the temperature of their bodies more uniform and agreeable with less clothing by day and by night.

1118. It is unquestionably true, however, as testified by those who have attempted to explore the polar regions, that when British sailors and others who have been accustomed to live mostly on salted animal food, are taken into those regions, they are enabled to endure the intense cold better by subsisting on the fresh animal food of the natives. Nevertheless, it is entirely certain that both they and the natives would endure the cold still better if they were well trained to a correct vegetable diet.

LECTURE XVIII.

Comparative effects of vegetable and animal food on the sensorial power of the nervous system; particularly on the special senses and the intellectual and moral faculties—Relations between the nervous and sensorial powers—Excessive expenditure of one diminishes the other—Great intellectual and great animal powers rarely combined—All over-working or over-excitement of the stomach impairs the sensorial power—Excessive alimentation diminishes the sensorial power—Narcotic stimulants still more detrimental—Flesh-meat impairs the sensorial power—Vegetable food most favorable to the sensorial power and the acuteness of all the senses—Objections in regard to the lower animals made and answered—The case of Caspar Hauser—His wonderful power of vision, hearing, smell, taste, and touch, and the discriminating sensibility of his stomach—Effect of flesh-meat on his special senses—Other cases adduced—Effect of flesh-meat on the intellectual powers—Opinions of ancient philosophers—Stupidity and indocility of all flesh-eating tribes—Irish children, and the Irish in general—Caspar Hauser—the wonderful activity and power of his intellectual faculties—These diminished by flesh-meat—The children of the Orphan Asylum of Albany, New York—The Greek children of Syria—The young slaves of the West Indies—The Zulus of Africa—the Hindoos—Great men that live on a mixed diet—True intellectual power—Difference between mind and soul—Capabilities of flesh-eaters—Wild boy of Mississippi—Vegetable diet and insanity—Principles explained and illustrated, and facts adduced.

1119. The physiological evidence in relation to the natural dietetic character of man that next demands our attention, is that which is afforded by the comparative effects of animal and vegetable food on the sensorial power of the nervous system, and particularly on the functional powers of the organs of special sense (396, 409), and those more immediately concerned in the intellectual and moral manifestations (260).

1120. We have seen (164) that the nervous system of the human body possesses the wonderful vital endowments of nervous and sensorial power. The nervous power is wholly employed in those important vital operations which are concerned in the growth and sustenance of the body (164), and which we have already contemplated. The senso-

rial power is employed in the functions of animal sensation, perception, reflect on, volition, voluntary motion, etc. (165). These two properties of the nervous system, though very different from each other, are yet so intimately related, that they both equally depend on the most healthy and perfect state of the nervous system for their highest and best condition; so that whatever in any measure deteriorates the nervous structure, or impairs its vital properties, always necessarily diminishes the healthy nervous and sensorial power of the system. And it is an invariable law that all excessive exercise or expenditure of the one, always diminishes the functional energy of the other; all excessive exercise of the passions and of the mind always necessarily diminishes the functional power of the stomach and all other organs concerned in the growth and sustenance of the body, and which depend on the nervous power of the system: and on the other hand, everything that increases the demand for the concentration of the nervous power in the stomach and other organs, for the performance of their functions, and increases the exhaustion of that power in the performance of those functions, beyond what is indispensably necessary for the healthy operations and results of the vital economy, always necessarily diminishes the sensorial power of the system, and the functional energy and integrity of all the organs depending on that power. Hence the notorious facts, that they who greatly cultivate the intellectual powers and follow intellectual pursuits, and more especially if those pursuits are of an exciting kind, always find it necessary to give much care to the preservation of the functional power and integrity of the organs concerned in the general office of nutrition; and for the most part, though mainly from errors of regimen, such individuals are delicate in their health and feeble in their muscular ability; while on the other hand, those who greatly cultivate their bodily powers, and maintain a high state of health and possess great muscular strength, very rarely if ever manifest much compass and energy and activity of mind.

1121. With these facts the ancients were perfectly well acquainted, though they knew nothing of the physiological principles by which they are accounted for. The statues and all other representations of Hercules and of the ancient athletæ which have come down to us, exhibit great muscular development, and indicate small intellectual powers.

1122. All over-working, over-excitement, and irritation of the stomach and other organs concerned in the general function of nutrition, necessarily cause an abatement of the sensorial power of the nervous system. And by over-working I do not mean merely that oppression of the stomach and other organs which is attended with immediate distress or uneasiness; but I mean all that exceeds the real wants of the vital economy, and is attended with a greater expenditure of vital power than is indispensably necessary to the healthy and perfect operations and results of the economy. Before the constitution has been broken down, while its springs are yet elastic and its energies are great, the most vigorous and high-toned health of body may be maintained for a considerable time, at a most prodigal expense of vitality, without any of those painful feelings which tell us that we are excessively over-working the system, and warn us that we are pushing

our health to the extremes which approach to the very verge of violent disease and sudden death.

1123. However pure and well-adapted our food, and correct our regimen in other respects, therefore, if we are habitually excessive in quantity only, we necessarily oppress our organs, and diminish the sensorial power of the nervous system, and commensurately render our intellectual and moral and voluntary faculties sluggish, inactive, and feeble. But when our excesses include over-stimulation and the use of irritating and deleterious substances, we greatly increase the injuries of the system and the reduction of the sensorial power.

1124. It is true, however, that diffusive stimulation, produced by even the most pernicious substances introduced into the nose or mouth or stomach or other organs—if the system is accustomed to them—will, while it lasts, by increasing the general excitement of the nervous system, increase the activity of the mental faculties, and especially in persons in whom the sensorial power has been impaired by previous debauches of the kind, or by excesses of any sort. Yet such stimulations always necessarily, in the end, leave the nervous system more depressed and impaired, and the sensorial power more diminished than they found them; and, therefore, the physiological principles which I have laid down on this point are always and without exception true.

1125. Flesh, I have repeatedly stated (906. *et seq.*), is much more stimulating in proportion to the nourishment which it affords the system than proper vegetable food; and hence, while it passes through the stomach in a shorter time, and therefore has been supposed to be more easily digested (910), yet it actually causes a greater concentration of nervous energy and a greater expenditure of vital power in that organ during the process of digestion, and consequently causes a greater abatement of the sensorial power of the nervous system, and leaves the assimilating organs more exhausted from the performance of their functions than vegetable aliment (911). And moreover, the nervous structure itself, organized from blood formed of flesh-meat, is less perfectly adapted to high sensorial power and activity than that resulting from pure vegetable aliment.

DIET WITH REFERENCE TO THE SPECIAL SENSES.

1126. In every respect, therefore, a correct vegetable diet is more conducive to a high and healthy state of sensorial power in the nervous system of the human body, than flesh meat; and consequently, the functional powers of all the organs of the special sense, or of touch, taste, smell, hearing, and sight, and of the intellectual and moral faculties, are rendered more perfect, vigorous, and active, by a correct vegetable diet than by animal food, or by a mixed diet of vegetable and animal food.

1127. And this is not only evident from physiological principles, but it is fully proved, first, by those who had for many years wholly abstained from flesh-meat and afterwards commenced the use of it; and second, by those who had long been accustomed to the use of flesh-meat and afterwards totally abstained from it. And first, let us consider the facts in relation to the special senses.

1128. But I anticipate the objection that predaceous animals, which subsist entirely on flesh, possess the most powerful and discriminating

special senses. This assertion I admit to be partly correct and partly erroneous; and still contend nevertheless, that even its truth does not militate in the least against the principle which I have advanced. In regard to the special senses, it should be understood that there is a nice distinction between simple *power* and *discrimination*. A hound, for instance, may have the olfactory power of scenting its game much farther than a sheep can smell its food, while at the same time the olfactory sense of the sheep may be much more nicely discriminating than that of the hound. The first of these properties depends on anatomical arrangement, the second is purely physiological, and depends entirely on the sensorial power. Hence, in all those predaceous animals which have the power of scenting their game or food at a considerable distance, the olfactory nerves are proportionably larger than in other animals, and are ramified over more extensive nasal surfaces; while in those herbivorous and other animals which simply require an olfactory sense to discriminate the qualities of substances near at hand, the olfactory nerves are proportionably smaller, and the olfactory apparatus more simple in its mechanical construction; and it is worthy of remark that in this respect the organization of man decidedly places him with vegetable-eating animals.

1129. We see, therefore, that the fact that predaceous animals, with a more extensive and complicated olfactory apparatus, have a greater power of smell than herbivorous animals, does not in the least degree go to prove that flesh-eating is favorable to the sensorial power of the special senses. For it may nevertheless be true that the olfactory sense of herbivorous animals discriminates the delicate qualities of things near at hand, and especially those which relate to the alimentary and respiratory wants of their bodies, much more nicely than that of predaceous animals. And in fact we know it to be true that the sensorial power of the organ of smell, even of carnivorous animals themselves, is greatly exalted by abstinence from flesh-meat. I have the authority of some of the most experienced sportsmen in England for saying, that 'always in preparing hounds for the chase, they are carefully trained. For at least a fortnight before they are put on the chase, all animal food is taken from them, and they are kept strictly upon coarse dry bread with a little water, because flesh-eating has a powerful effect to deaden the nice sensibility and discriminating power of the olfactory nerves, and to make the hounds heavy and sluggish. If they are permitted to eat flesh freely till they enter upon the chase, the sense of smell is so blunted that they will not open on the track and get the fox up. They are not suffered therefore to touch a morsel of animal food for two weeks before they are put on the chase.'

1130. If men were to live like beasts of prey, on simple uncooked flesh, and water, and breathe only the pure air of the forest, the discriminating power of his special senses would undoubtedly be much greater than he possessed in civic life, living on a mixed diet, or even on vegetable food, with the ten thousand depraving and deteriorating influences of the artificial circumstances and pernicious habits of society continually acting upon him and impairing all the physiological properties of his system. But the simple question before us is, Would man, either living in all the natural simplicity of the lower animals, in the open and pure air of the fields and forests or cribbed up in cities and in

civic life, possess an equal power and discriminating keenness of the special senses, whether he lived on animal food, or a mixed diet of animal and vegetable food, or on pure vegetable food, being in all other respects, in either case, equally temperate and correct? To this question I confidently answer, No! and affirm that both physiological science and facts clearly and conclusively prove that a pure and well-ordered vegetable diet is more conducive to the functional power and integrity of the organs of special sense than animal food, or than a diet which includes any portion of flesh-meat. The physiological principles I have already sufficiently explained (1119, *et seq.*); and we have seen that even in the hound, which is naturally a carnivorous animal, the sensorial power of the organ of smell is much exalted by an entire abstinence from flesh-meat (1129).

1131. The story of Caspar Hauser is probably known to everybody.* He was, we are informed, for some cause or other, confined in a narrow, dark dungeon from early childhood till he was about 17 years old, when he was released, and on the 26th of May, 1828, was found at one of the gates of the city of Nuremburg, in Bavaria, Germany, and was soon taken under the care of the city authorities. During the whole time of his confinement he was kept in a sitting posture with no other clothing than a shirt, and made to subsist on coarse brown bread and water exclusively. Considering the position in which he was kept during the greater part of the period of his growth, his total want of exercise, and the confined air which he breathed, and the entire absence of light, his body was developed with remarkable symmetry and beauty. When he first came out of his dark dungeon, and for considerable time afterwards, the acuteness and power of his sight, hearing, smell, taste, and touch, far exceeded any thing of the kind ever before known in a human being.

1132. Being accustomed during the whole confinement to what is ordinarily called total darkness, his eyes acquired the power of perceiving things by the aid of so extremely small a quantity of light, that he was able to see distinctly where ordinary human eyes could see nothing. 'It has been proved, by experiments carefully made,'

* Since the death of this extraordinary youth, it has been attempted, even by the noble gentleman who adopted him, to prove that Caspar was an impostor, and his whole story a falsehood. But I am bold to declare that neither Caspar Hauser nor any other human being could fabricate such a story. The intrinsic evidences of its genuineness are irrefragable, and such as could not have been forged. There are many physiological principles developed in his case which have since been repeatedly demonstrated in other cases, but which could not have been known to him, and which were evidently not understood by the gentleman who wrote his history, nor by any other one connected with him (1140). It is very possible, and even probable, that Caspar learned to dissimulate and practice falsehood, and that the unbounded attention which he received begat in him an insatiable desire to be the object of continued and increased attention. Indeed he must have been something more than human, if he was not thus vitiated by the circumstances in which he was placed and the treatment he received after he became the object of public attention and excitement. Whether he was the child of a nobleman or a peasant, I neither know nor care, nor shall I insist that he was actually confined in a dark dungeon just 17 years. But that he had long been secluded from the light and from the ordinary influences of society, and subsisted on an extremely simple vegetable and water diet and that the statements made by his biographer of the physiological and psychological phenomena attending his first appearance in Nuremburg and during the change of his habits, are true, cannot be doubted by any one who is thoroughly acquainted with the science of human physiology.

says his learned biographer, 'that in a perfectly dark night he could distinguish different dark colors, such as blue and green, from each other. He could walk anywhere as well in the dark as in the light, and was astonished to see others groping and stumbling along in the dark. When, at the commencement of twilight, a common eye could not yet distinguish more than three or four stars in the sky, he could already discern the different groups of stars, and could distinguish the different single stars of which they were composed, from each other, according to their magnitude and the peculiarities of their colored light.'

1133. But all this will perhaps be said to be wholly the effect of his having been long accustomed to darkness, and had nothing to do with his diet. We shall see, however, in the sequel, that this conclusion is erroneous. His being long confined to what we call total darkness certainly caused his eyes to acquire the power of seeing by the aid of an exceedingly small quantity of light, and also unfitted them to bear full daylight with comfort; and consequently, when he first left his dark prison, the full light of day was distressing to him, and rather served to dazzle and blind him than to increase the distinctness of his vision: hence, for some time after he was set at liberty, he could see more distinctly and much farther after sunset than at noonday. Now if all this had been exclusively the effect of his having been so long confined in darkness, then as his eye became more and more accustomed to the full light of day, his extraordinaary power of vision would gradually have diminished, till it became nothing more than ordinary. But this was not the case. As he became more and more accustomed to the full light of day, his distinctness and power of vision in the night gradually decreased, and at the same time commensurately increased in the day, till he became as remarkable for his visual power by day as he had been by night, and could distinctly see small objects far beyond the reach of ordinary vision; and 'his sight,' says his learned biographer, 'was as sharp in distinguishing objects near, as it was penetrating in discerning them at a distance. In dissecting plants, he noticed subtile distinctions and delicate particles which had entirely escaped the observation of others.'

1134. Moreover, if long confinement in darkness had been the sole or even the principal cause of the astonishing visual powers of Caspar Hauser, it certainly could not account for the fact that he was equally remarkable for the discriminating acuteness and power of his other special senses.

1135. 'His hearing,' says his biographer, 'was scarcely less acute than his sight. When walking in the fields, he once heard, at a distance comparatively great, the footsteps of several persons, and he could distinguish these persons from each other by their walk.'

1136. His acute sense of smell was most troublesome and painful to him, exposed as he constantly was to those concentrated and offensive odors that almost everywhere abound in that artificial state of things peculiar to civic life; while it fitted him the more perfectly for that pure and uncontaminated state of nature in which the special senses are the true sentinels of organic life (690), and with the most perfect discrimination and integrity act determinately for the security of the vital interests of the body. By so much the more, therefore, as he

was fitted for such a simple and natural state, he was in a condition to be offended and distressed by an artificial and unnatural state of things. The odors of the rose and other fragrant flowers and shrubs, which, in a state of nature, thinly scattered over the earth, and breathing their sweetness to the pure and diluting air, would have been exquisitely delightful to his keenly discriminating sense, when greatly concentrated and densely freighting the atmosphere from the flower-gardens of artificial cultivation, were extremely oppressive and even painful to him (692). 'He was able to scent things at a very great distance. He could distinguish apple, pear, and plum trees from each other, at a considerable distance, by the smell of their leaves. Different coloring materials, pencils, etc., imparted a painful odor to his keen sense. He smelled tobacco when in the blossom in the fields, at the distance of fifty paces; and at more than one hundred paces, when it was hung up in bundles to dry, causing him headaches, cold sweat, and fever. The smell of old cheese made him feel unwell and vomit. The smell of strong vinegar, though full a yard from him, operated so powerfully upon his nose and eyes as to bring tears into his eyes. When a glass of wine was filled at table, at considerable distance from him, he complained of its disagreeable smell, and of a sensation of heat in his head. The opening of a bottle of champagne was sure to drive him from the table or to make him sick. The odor of flesh was to him the most horrible of all smells. When walking by a graveyard, the smell of the dead bodies, of which others had not the slightest perception, affected him so powerfully as almost immediately to bring on an ague and cause him to shudder. The ague was soon succeeded by a feverish heat, which at length resulted in a violent perspiration, by which his linen was thoroughly wet. He afterwards said he never experienced so great a heat, and complained, on his return to the city gate, that his sight had been affected thereby. Similar efforts were once after experienced by him, when he had been for a considerable time walking by the side of a tobacco field.'

1137. His sense of taste and sense of touch were equally acute and astonishing. Indeed the power of all his senses seemed miraculous. He would instantly detect the nicest qualities, and the slightest difference in qualities of things of taste and of touch, and he could not be deceived in these respects by any devices or means. Nothing was more loathsome to his taste than flesh. Even enveloped in bread, it caused great disgust and distress as soon as he took it into his mouth. With equal discrimination and power would he detect the nicest difference in the tangible properties of things.

1138. 'One of the most difficult undertakings was to accustom him to the use of ordinary food; and this could be accomplished only by slow degrees, much trouble, and great caution. The different preparations of farinaceous food most readily agreed with him and became agreeable. At length, he was gradually accustomed to eat flesh, by mixing at first only a few drops of gravy with his gruel, and a few threads of the muscular fibre of the flesh with his bread after the juices had been boiled out, and by gradually increasing the quantity.'

1139. But it will be said that it is far from being desirable to possess such an exquisite keenness and discriminating power of the senses (693), for it would only serve to unfit one for society, for usefulness, and for

all the enjoyments of civilized life, and render human existence a curse rather than a blessing. So, if I were accurately to describe the pain which every sin, and the slightest departure from spiritual truth and righteousness, would cause a perfectly holy human being, were such a one on earth, most of mankind, even in Christian lands, would make the same objection to such a state of the soul, and on precisely the same grounds; and the analogy between the two cases is perfect.

1140. But it should be remembered that whatever may be our power to reconcile our special senses to the deleterious and the offensive properties of things, we have no power to reconcile those properties to the vital interests of our bodies (725): and therefore, though we may succeed in so far depraving the sentinels of life (690), and so completely destroying their natural instinctive integrity as even to cause them to delight in the poisonous properties of tobacco and other pernicious substances (697), yet those properties always remain equally unfriendly to the physiological interests of our bodies, always necessarily retain their *anti-vital* character. It would, therefore, be quite as rational and as wise for a traveller who, finding his journey lay continually among pitfalls and precipices, and feeling himself constantly alarmed and tormented by the perception of the dangers that surrounded him, should put out his eyes, and in his blindness congratulate himself on his deliverance from all his perils and annoyances, as it is for human beings to desire to escape from the perception of the dangers that surround them in the deleterious properties of things, by an entire depravity of their senses of smell and taste. The truth is, that the case of Caspar Hauser affords many of the most important physiological facts and demonstrations that have ever been presented to the scientific world; and happy will it be for mankind if they will learn wisdom from such extraordinary instruction.

1141. But how, it is inquired, can we arrive at any definite and determinate physiological conclusions from the evidences of this remarkable case, when we find his special senses taking offence indiscriminately at noxious and innoxious substances?

1142. This is not a true statement of the case, and only evinces the very superficial observation and limited attention which have been given to the subject. The real fact is, his sense of smell and of taste discriminated with exquisite delicacy and infallibility between salutary and deleterious substances. It was only when the odors of innoxious substances were in great excess, and therefore unfriendly to the physiological interests of his body, that his olfactory sense was oppressed, and pain induced by them; while the odors of noxious substances were always, in all quantities, even the smallest, offensive and distressing to him, producing all those physiological phenomena or symptoms which indicate the instinctive efforts of the system to repel or reject morbific causes (300).

1143. The odors of roses and other innoxious flowers and shrubs, when properly diluted by the pure atmosphere, so as to be compatible with the physiological interests of his system, were exquisitely delightful to him; but when the air was too deeply freighted with the dense fragrance of flower-gardens, etc., his olfactory sense, true to the vital welfare of the body, became oppressed by the concentrated sweets, rendered pernicious by excess (692). The odors of tobacco and of the dead

bodies in the grave-yard and other pernicious substances, on the other hand, even when most slightly perceived, were loathsome and distressing to him (1136), and when strongly perceived, his system powerfully manifested those symptoms which indicate the presence of substances directly and irreconcileably hostile to the vital interest of the body. And it is a matter of great importance to the physiologists to observe the natural instinctive economy of the human body in such a state, by which it first indicates the invasion of the vital domain by noxious agents, and then by which it expels those agents from that domain: and also to observe the intimate relation and powerful sympathy existing between the different special senses. The loathsome odor of the dead bodies greatly affected his sight (1136).

1144. And surely the civilized world should learn a deep lesson of wisdom from the physiological facts before us, so far at least as regards the location of grave-yards. For although we, in the depravity of our senses, perceive not the baneful odor of the decaying dead, yet the facts that Caspar Hauser could perceive it so strongly, and experienced such violent effects from it, are physiological demonstrations for the whole human species; and show with what propriety the Mosaic dispensation guards with most rigorous caution against all contact of the living with dead bodies.

1145. The same reasoning holds good in regard to the physiological demonstrations of the sense of taste in Caspar Hauser that I have presented concerning his smell. All simple farinaceous preparations and proper fruits very readily became agreeable to him; while flesh-meat, in whatever way prepared, caused the deepest loathing and abhorrence, both as perceived by the sense of smell and of taste: and the physiological perception of the stomach (727), with equal promptitude and power, and with equal delicacy and accuracy of discrimination, detected in it those properties which are not adapted to the purest condition and highest interests of the body.

1146. The want of physiological knowledge in those who had the care of Caspar Hauser led them to many erroneous practices and no little confusion of statements concerning him; still, however, an accurate physiologist is able to reduce the facts in the case to their true order, and to derive from the extraordinary experiment the most complete physiological demonstrations. As in the case of the olfactory sense, so with that of taste, many substances naturally innocent, and perhaps in a measure salutary, were, by artificial concentration and other insalutary preparations, rendered oppressive and offensive to him (700); and substances which were naturally more stimulating than those to which he had been accustomed, at first produced somewhat unpleasant effects on his organs. But in regard to the smell and taste of flesh, there was a deep instinctive loathing and abhorrence, which, as we have seen (1138), could only be overcome by the smallest degrees and in the slowest and most cautious manner. 'When the first morsel of flesh was offered to him, scarcely had it touched his lips before he shuddered; the muscles of his face were seized with convulsive spasms, and with visible horror he spat it out.' 'Some flesh was subsequently concealed in his bread; he smelt it immediately, and expressed a great aversion to it, but was nevertheless prevailed upon to eat it, and he

felt afterwards extremely ill in consequence of having done so.'* 'Even milk, whether boiled or fresh, possessed so much of the animal odor and flavor, and was so much more exciting than his bread and water, to his stomach and alimentary tube, as to be unpleasant to him.' Beer, wine, brandy, tobacco, coffee, and all other alcoholic and narcotic substances, were most powerfully offensive to his senses of smell and taste, and distressing to his body, producing even more violent effects on his system than flesh.

1147. Now then, in regard to the effects of flesh-eating on the special senses,—we learn from the case before us, in the first place, that the very extraordinary power and acuteness of the special senses of Caspar Hauser were not caused by his long confinement in darkness and silence, because they remained equally extraordinary when he had become fully accustomed to the light of noonday and the noise of civic life; neither were they owing principally to the entire absence, during his long confinement, of those properties of external things which, acting immediately upon the organs of special sense, deprave and impair their peculiar powers. It is very certain, however, that after his release from his dungeon, and his entrance into the city of Nuremburg, the constant action of offensive olfactory and gustatory properties on his organs of smell and taste, had considerable effect to deprave and impair the peculiar powers of those organs; yet, notwithstanding all this, the acutenesss and intensity of the perceptive power of his special senses remained almost supernatural, while he continued to subsist on his simple diet of bread, or plain farinaceous food and water; but precisely with equal step, as he became gradually more and more accustomed to the use of flesh-meat (1138), the extraordinary acuteness and power of his special senses diminished.

1148. 'After he commenced eating flesh,' says his biographer, 'he had no opportunity of comparing the acuteness of his hearing with the still greater acuteness of the hearing of a blind man, who could distinguish even the most gentle step of a man walking barefoot. On this occasion, Caspar observed that his hearing had formerly been much more acute, but that its acuteness had been considerably diminished since he began to eat flesh, so that he could no longer distinguish sounds with so great a nicety as that blind man.'

1149. But it will be asked, How came the blind man by such an extraordinary acuteness of hearing? Did he too live on bread and water? There are many nice physiological and psychological principles involved in this fact, the full explanation of which would require an extensive treatise. Suffice it to say, however, that the organs of sight and hearing are in a more eminent degree than those of the other special senses, the instruments of the mind, and are not liable to be depraved like those of smell and taste, by the direct action of deteriorating substances (391); that all the special senses, are capable of a high degree of cultivation; and that it is wisely and benevolent so ordered, that the destruction of the sight may be, to a very considerable extent, compensated by an extraordinary increase of the power and acuteness of hearing, by means of careful and long-continued cultivation, or at-

* The same effects are invariably produced when flesh-meat is first given to children which have been accustomed only to a pure vegetable diet under a correct general regimen. See 870.

tention to the nicest auditory impressions. And thus the blind man is enabled to *hear* his way along the public streets, and to avoid running against surrounding objects, with almost as much accuracy as those who see.

1150. That we may fully understand and appreciate the truth in the statement before us concerning Caspar and the blind man, therefore, it is important to observe, that whatever may have been the diet of the blind man, which was undoubtedly very simple, his auditory power to perceive the slightest vibrations of the atmosphere, and to discriminate between the nicest differences in the auditory qualities of those vibrations, had been cultivated probably to the very top of his capabilities; while Caspar's extraordinary acuteness and power of hearing were in no degree the effect of cultivation, but depended entirely on the pure natural sensibilities of his organs, or on the very great degree of natural and healthy sensorial power of his nervous system; and hence, while the blind man exhibited only a highly cultivated power of hearing, which is not uncommon with blind men, Caspar manifested a most extraordinary natural power of all the special senses, and which, at the time of this trial, as he himself justly remarked, had already been very considerably diminished by his eating flesh.

1151. As he became more and more confirmed and free in his habits of flesh-eating, the extraordinary acuteness and energy of his special senses continued to diminish, till in a short time they wholly disappeared, and he retained nothing but the most ordinary powers. And as if Divine Providence had, by special design, raised up this youth for the most specific and important physiological and psychological purposes, it is remarkable that he perseveringly refused to defile himself with wine, beer, tea, coffee, and all other alcoholic and narcotic substances, and rigidly abstained from the use of spices and heating substances, and thus in the most signal and unquestionable manner demonstrating that flesh-meat was the principal cause of the very great abatement of the acuteness and energy of his special senses.

1152 The same general facts as those exhibited in the case of Caspar Hauser, though not of so remarkable a character, have been observed in numerous other instances, where individuals had for many years been accustomed only to a plain, simple, and wholesome vegetable diet, and afterwards become habituated to the use of flesh.

1153. On the other hand, it has been a matter of very frequent and extensive observation, that those who, having been always accustomed to the use of flesh-meat, abandon it entirely, and subsist on a plain and simple vegetable diet, experience a very great improvement in their special senses. I have seen many such instances within the last six or seven years, and some of them of a very marked character. This improvement, however is generally perceived much sooner in the smell and taste than in the sight and hearing; and in some cases the sudden substitution of a less for a more stimulating diet, will cause a temporary depression of the physiological powers and functions of the system, and especially those appertaining to organic life (883); and while the depression or species of indirect debility continues, the special senses, and particularly sight and hearing, are often to a considerable extent involved in the general effect, and their functional powers are commensurately diminished,—in consequence, however, of a relaxation of the

anatomical mechanism of the organs, rather than an abatement of sensorial powers; but as soon as the vital properties of the body become perfectly adapted to the character of the new diet, the general tone of the system is elevated, and the functional powers of the special senses greatly improved; provided always that the vegetable diet is of a proper kind and condition, and the individual is not intemperate in quantity, nor improper in his regimen and habits in any other respect: for every species of excess is necessarily injurious to the special senses, and none more so than gluttony and licentiousness.

1154. Dr. Lamb, of England, of whom I have frequently spoken (1094), and who has probably been the most extensive and accurate observer on this subject of any man in Europe, confidently affirms that 'not only are the the special senses improved by the disuse of flesh, but this improvement,' says he, 'pervades every organ and influences every function of every part of the system. Observation shows,' continues he, 'that there is no organ of the body which, under the use of vegetable food, does not receive a healthy increase of its peculiar sensibility, or that power which is imparted to it by the nervous system.'

DIET WITH REFERENCE TO THE INTELLECTUAL POWERS

1155. I have now so fully shown that flesh-eating diminishes the sensorial power of the nervous system, and consequently the functional powers of the organs of special sense, and have so extensively explained the physiological principles pertaining to the subject (1120, *et seq.*), that it is not necessary for me to enter any farther into physiological explanations before I proceed to the statement of facts in relation to the comparative effects of vegetable and animal food ON THE INTELLECTUAL POWERS AND MANIFESTATIONS.

1156. That flesh-meat is less friendly to intellectual vigor and activity than vegetable food, is by no means an opinion peculiar to modern times. Theophrastus, who studied under Plato and Aristotle, and succeeded the latter in the Lyceum,—the number of whose auditors, we are informed, become two thousand, and who died at the age of one hundred and seven, two hundred and eighty-eight years before Christ,—says that 'eating much and feeding upon flesh makes the mind more dull, and drives it to the very extremes of madness.' 'It was,' says Dr. Lamb, 'proverbial among the ancients, that the athletæ were the most stupid of men; and Diogenes the Cynic asserted that it was wholly owing to their excessive use of the flesh of swine and oxen.'

1157. The Calmucks, and indeed all other portions of the human family that subsist principally upon flesh, are remarkable for their mental stupidity, sluggishness, and indocility.

1158. Sir John Sinclair, in his Code of Health,—a work replete with research and historical knowledge—says that 'vegetable food has a happy influence on the powers of the mind, and tends to preserve delicacy of feeling and liveliness of imagination, and an acuteness of judgment seldom enjoyed by those who make a free use of animal food. The celebrated Franklin ascertained that a vegetable diet, promoting clearness of ideas and quickness of perception, is to be preferred by those who labor with the mind.' 'In proof of the assertion,' continues Sir John, 'that a vegetable diet promotes clearness of ideas and quick-

ness of thought, and that a transition from vegetable to animal food produces injurious effects, a friend of mine states that he has more than once selected from his tenants' children in Ireland, a boy remarkable for that smartness of intelligence so common in the Irish youth, while in the capacity of errand boys on the farm, or helpers in the stables, and before they became pampered with better food than their parents' cabins afforded. The lads, at first, were lively and intelligent, and displayed a degree of shrewdness exceeding what is generally met with from the youth of a more elevated walk in England. But he invariably found, that in proportion as those boys became accustomed to animal food, and (according to common notions) were better fed, they relaxed in activity, and became dull and stupid (994) ; and he is confident that the change in the disposition was the effect of the change of diet, and was not owing to corruption of mind from intercourse with the other servants. In fact, they lost all their vivacity of manner, so inherent in the Irish boys, whether born in the vast bog of Allen, or in the dry and rocky counties of Mayo and Galway. He is therefore inclined to think that the character of the people does not depend so much upon climate and soil as upon food, for no part of the globe can differ more than those parts of that kingdom.'

1159. These facts in relation to the Irish youth are of very great importance, and deserve far more attention from philosophers and philanthropists than has ever been given to them. The Irish peasantry, wherever they are known in the civilized world, are proverbial for their peculiar expressions, commonly called *Irish bulls*, and which are generally considered as attributable to their peculiar national stupidity, or natural *crookedness* of mind, if I may so express myself. Whereas directly the opposite of this is true. There is probably no class of people on earth more remarkable for natural quickness and shrewdness of mind than the Irish peasantry of pure and simple habits ; but they are, as a general fact, entirely destitute of the advantages of education, and therefore have a very limited and imperfect use and knowledge of language. The consequence is, that their intellectual quickness and activity, with their ignorance of the grammatical force and arrangement of words, continually leads them to express their ideas in a very peculiar, generally shrewd, often ludicrous, but always spirited and witty, manner. Their very blunders, therefore, are really evidence of their remarkable natural quickness and activity of mind, and hence, when well educated, they are often found among the most eloquent and witty men and able writers in the world.

1160. The case of Caspar Hauser in relation to this point is, of itself alone, a complete and unequivocable demonstration of the principle I am contending for. I have already briefly stated many important facts in his history (1131, *et seq.*), and have spoken of his deep aversion to flesh, tobacco, wine, beer, brandy, tea, coffee, and many other things, and of the very great difficulty and caution with which he was slowly accustomed to animal food (1138).

1161. While he continued to subsist entirely on his simple diet of bread and water, as he had done in his dungeon, 'the activity of his mind,' says his learned biographer, 'his fervent zeal to lay hold of every thing that was new to him, his vivid, his youthfully powerful and faithfully retentive memory, were such as to astonish all who witnessed

them.' 'The curiosity, the thirst for knowledge, and the inflexible perseverance with which he fixed his attention on any thing which he was determined to learn or comprehend, surpassed every thing that can be conceived of them.'

1162. About two months after he entered the city of Nuremburg, he was taken to the house of Professor Daumer, with whom he afterwards resided, and from whom he received regular and systematic instruction, and where he was also carefully and regularly educated to the use of animal food in the manner I have described (1138). 'In Professor Daumer's notes respecting Caspar,' says his biographer, 'he has made the following observations:—'After he had learned regularly to eat flesh, his mental activity was diminished, his eyes lost their brilliancy and expression, his vivid propensity to constant activity was diminished, and the intense application of his mind gave away to absence and indifference, and the quickness of his apprehension was also considerably diminished.'

1163. 'Caspar's present mode of living,' says his biographer, in the conclusion of his narrative, 'is that which is common to most men. With the exception of pork, he eats all kinds of flesh-meats that are not seasoned with hot spices. His drink continues to be water; and, only in the morning, he takes a cup of unspiced chocolate instead of it. All fermented liquors, beer, and wine, as also tea and coffee, are still an abomination to him. If a few drops of them were forced upon him, they would infallibly make him sick.' 'The extraordinary and almost supernatural elevation of his senses has also been diminished, and almost sunk to the common level. He can, indeed, still see in the dark, but not to read nor perceive small objects as he once could. Of the gigantic powers of his memory, and of his other astonishing qualities, not a trace remains! He no longer retains any thing that is extraordinary.'

1164. That excesses in quantity of food, and many other causes existing in civic life, were to a considerable extent concerned in producing these deteriorations in Caspar Hauser, there appears to be no just ground of doubt; but it is entirely certain that flesh meat was the principal cause of the remarkable diminution of his sensorial powers, and the abatement of his intellectual activity and energy. For these effects are in precise accordance with the well-ascertained principles of physiological science, and strictly correspond with the facts in all similar cases.

1165. In the ORPHAN ASYLUM of Albany, New York, from eighty to a hundred and thirty children were, in the close of 1833, changed from a diet which included flesh or flesh-soup once a day, to a pure vegetable diet regulated by physiological principles. Three years after this change was made, the principal teacher of the institution thus speaks of it:—'The effect of the new regimen on the intellectual powers of the children has been too obvious and too striking to be doubted. There has been a great increase in their mental activity and power. The quickness and acumen of their perception, the vigor of their apprehension, and the power of their retention, daily astonish me. Indeed they seem eagerly to grasp, with understanding minds, almost any subject that I am capable of presenting to them in language adapted to their years.'*

* See Appendix, Note A.

1166. 'On my way to Smyrna, in Greece, in 1828,' says Judge Woodruff (997), 'I stopped at Syra, where I was detained by contrary winds about twenty days. I there became acquainted with Dr. Korke, an eminent teacher from Switzerland. He had the charge of the principal school at Syra, containing from two hundred to three hundred pupils. During my stay at Syra, I took great pleasure in visiting this school, which I did almost every day. I very soon began to feel and express astonishment at the remarkable vivacity, sprightliness, and mental activity and power of these children. Their memory was truly surprising. Dr. Korke assured me that he had never, in any country, found children equal to these for clearness, sprightliness, and power of intellect,—for aptitude to learn and ability to retain. And I can truly say that these Greek children manifested a capacity for learning which exceeded any thing I had ever before or have since witnessed. Dr. Korke attributed this extraordinary ability in his pupils mainly to their habits of living, which were extremely simple. Coarse unbolted wheat-meal bread, with figs, raisins, pomegranates, olives, and other fruit, with water, constituted their diet. Figs and other fruit composed a large proportion of their food; but I am confident they did not consume an ounce of flesh a month.'

1167. 'I spent the winter of 1836-7 on the island of St. Croix, in the West Indies,' says Mr. John Burdell, of New York (710), 'and devoted much of my leisure time to instructing the young slaves. The little field negro children from five to ten years old, which never saw a letter nor had any idea of one till I taught them, on being promised that they should have a Bible given to them if they would learn to read, would, in the course of one week, learn the alphabet and learn to read ba, be, bi, ab, etc. In three or four weeks they would learn to read short sentences, such as, 'No man may put off the law of God;' and in a few months they would learn to read the New Testament. With all these little field negroes, which lived on corn-meal, yams, peas, etc., there was the utmost avidity as well as aptitude to learn. But the little negroes of the same age in the house, living on what came from their master's table—animal food, etc.—are wholly different, They are totally disinclined to receive instruction, and are slow to learn, like our well-fed white children at the north, It is an irksome task to them to apply their minds to study and they never get a lesson unless they are regularly tasked and urged on. I saw one of these house children, which was twelve years old, and which had been long under the instruction of the master's daughter, and was just beginning to read a little in the New Testament.'

1168. The Rev. Alden Grout, who has recently returned from a three years' mission among the Zulus on the southeast coast of Africa, says that that people depend on the products of the soil for subsistence, living mostly on corn and milk. The children go entirely naked, and live in the simplest manner. They are sprightly, active, and full of vivacity, and their aptitude to learn is almost incredible. It is a common thing for them, in the course of fifteen months from the first time they ever saw a letter, to learn to read well in the New Testament, and to do sums in the fundamental rules of arithmetic. They all discover the greatest eagerness for knowledge, and seem to think nothing so desirable. On leaving them, I asked what I should bring them when

I returned? they all cried at once, 'Bring us more teachers—more books!'

1169. But I shall be told that the Hindoos and other Asiatics, who live on vegetable food, are remarkable only for their mental imbecility and inactivity; while, on the other hand, men of the most gifted minds in Europe, such as Fox, Pitt, and others, have been flesh-eaters. In reply to these objections, I remark that I have already (1021) fully accounted for the mental indolence and stupidity of the Asiatics, so far as these statements are true of them. For more than two thousand years, at least, and how much longer we know not, their political, civil, religious, and social institutions, have been such as are calculated in the most direct and powerful manner to suppress and prevent all public and private enterprise, and all intellectual activity and energy, and to produce a general intellectual and moral stagnancy. To find a relief from this total want of mental and moral stimulation, they have, almost as a natural and necessary consequence, endeavored to give a current to their existence, or a tide to the ocean of life, by those sensual stimulations and excitements of which I have spoken (1021), and the excesses of which have produced all those evils of a physical, mental, and moral nature, that are too commonly attributed to a vegetable diet. Yet with all these deteriorating causes co-operating to deprave and destroy them, the Hindoos as a nation possess great natural talents (1026); and among their learned men and philosophers, who with strict temperance subsist on pure vegetable food and water, there have been many as clear and deep and powerful thinkers as have ever done honor to human nature in any portion of the world. Moreover, it is well known that not only Pythagoras, who is said to have studied with the Brahmins of India, but all the most eminent philosophers of antiquity, subsisted on a pure and simple vegetable and water diet.

1170. In regard to Fox, Pitt, and other Europeans and Americans who have possessed great intellectual powers and yet were flesh-eaters, two things are to be taken into consideration. First; in nearly all civilized countries where a mixed diet is used, flesh-meat is very sparingly eaten in the early part of life, or during that period in which the mind is mostly developed and educated; and when once the mental powers are disciplined and the mind furnished with knowledge, though the subsequent habits of the individual may be such as to superinduce general sluggishness and disinclination to mental application and activity and severe and continued employment, yet in moments of strong excitement the mental faculties may be roused to great activity, and the individual may on such occasions exhibit astonishing intellectual powers, while as a general habit his mind is inactive and indolent. Such men are never distinguished for intellectual industry, and seem not to possess the spontaneous power of mental action, and can only make a great effort when excited by great occasions, or by some intoxicating substance which is sufficiently stimulating to overcome their habitual sluggishness. Or if they occasionally do deliberately prepare for an extraordinary intellectual effort, they invariably restrict their diet, and become comparatively simple and abstemious, and perhaps for a while subsist wholly on vegetable food. 'Milton studied in Italy, where the diet is olives, macaroni, and ice-water, and there laid the plan of his Paradise Lost,' says Sir Everard Home. It is admitted

that men who in this manner ordinarily subsist on a mixed diet of vegetable and animal food, *can* possess great intellectual powers; but at the same time it is contended that they would have possessed still greater powers if they had always subsisted entirely on a pure vegetable and water diet. Second; there are at least two general classes of intellect, or kinds of intellectual power. The one is more particularly dependent on the general excitement of the nervous system, the other on the pure sensorial power of the brain. The former is a combination of mind and emotion (576), the latter is pure mind. The former belongs to the orator, the poet, the painter, and others, who mainly aim to awaken the imagination, the sympathies, and passions, and to determine the judgment by the force of feeling (598); the latter belongs to the mathematician, the intellectual and moral philosopher, etc.

1171. It is true, therefore, that a man who, like Pitt, eats flesh and drinks wine, may, on particular occasions, when under a strong excitement, pour forth a torrent of impassioned and powerful eloquence, or produce a splendid piece of poetry, or music, or painting, exciting the sympathies and admiration and astonishment of all who witness his performance. But let us remember that it is a thousand times easier to make our hearers *feel* with us, than to make them *think* with us; and hence, a thousand will appreciate the powers of the impassioned orator, where one will appreciate those of the profound thinker; and, consequently, mankind always over-rate the impassioned order of intellectual power.

1172. We should remember, also that the extraordinary intellectual power of Pitt and Fox, and others of that class, who were free livers, was only occasional (1170); they could not put it forth at will, under all circumstances and in any situation, but always depended on some strongly exciting cause to bring the nervous system into the requisite state of stimulation; and then, like one in a fever, they were able vividly to recollect those impressions which had been stored away at other times, when their habits were better adapted to mental development and cultivation, and also distinctly to produce those conceptions of the mind (560) which constitute the ideal presence of things contemplated; and by these means they were enabled to exhibit the highest degree of intellectual power of which they were capable, and which, after all, is little more than an extraordinary mental paroxysm.

1173. But the mighty minds which with untiring industry are continually employed, and which with a giant grasp lay hold of the deep foundations of things, and move the intellectual and moral universe, are of another class. With penetrating and profound and unremitting thought, they explore the heavens and the earth, and scrutinize the forms and properties and law of things; and with keen analysis and induction, and elaborate reasoning, and rigorous demonstration, sort out the truth, and arrange it into the physical and intellectual and moral sciences of the human world. Such minds are not sustained nor excited by flesh and wine.

1174. The mightiest intellectual performance of Sir Isaac Newton, and one of the mightiest of the human mind in any period or portion of the world, was made while his body was nourished only by bread and water; and if Bacon and Locke and Boyle and Euler and La Place, and a host of other intellectual giants, did not, during their severest

mental labors, subsist exclusively on bread and water, it is certain that they were temperate even to abstemiousness, and that their diet was exceedingly simple, and in many, if not in most instances, exclusively vegetable.

1175. Before I dismiss this topic of investigation, however, it is important that I should remark on the distinction between the intellectual faculties and the mind itself. The human soul, I have said (519), is an immaterial substance, and constitutes the substratum of the intellectual and moral powers or faculties. The soul and the intellectual and moral faculties, therefore, are innate constitutional principles; but the mind and moral character are wholly the results of the exercise of the innate faculties. Whatever may be the intellectual faculties of the soul (520), if they are never exercised, there will be no mind; if they are little exercised, there will be little mind. Now I do not pretend that a pure vegetable diet will actually produce mind, but that it is most favorable to the development of those organs on which the intellectual manifestations more particularly depend and most conducive to the healthy and vigorous susceptibility and activity of the intellectual faculties, and therefore is most favorable to mental action and power. Thus, Caspar Hauser (1131), at the age of seventeen years, had little more mind than a child of twelve months old; but, as we have seen (1161), he possessed the most astonishing susceptibility and activity and energy of the intellectual faculties, which, had they been preserved, would have enabled him to make very great intellectual attainments with ease and delight. A Patagonian youth has also intellectual faculties which it is possible to cultivate to a very considerable degree of mental elevation and power, but he has none of that remarkable susceptibility and activity and energy of the intellectual faculties possessed by Caspar Hauser before he began to eat flesh (1161); and, therefore, it would be incomparably more difficult and laborious for the young Patagonian to make high intellectual attainments, than it would for a youth subsisting wholly on a simple vegetable diet; and, all other things being equal, it would not be possible for the young flesh-eater, by any labor, to equal the vegetable-eater in the extent of his acquirements.

1176. In the year 1808, a wild boy was found in a swamp in Mississippi, not far from the present site of Pinckneyville He was first discovered walking naked, on the shore of a lake, hunting frogs, which he dexterously caught and voraciously devoured raw. He was apparently about nine years old, perfectly wild and truculent, and without any intelligible language. After he had learned to make himself understood by those who were accustomed to him, he told them that he had a dim remembrance of coming down the Mississippi with his father's family, in a flat boat; that his father killed his mother, and that he fled in terror into the swamps, expecting that his father would kill him also; and that from that time he had subsisted on frogs, animals, and berries; living in warm weather among the cane, and in cold weather in a hollow tree. After this boy was domesticated, he continued to prefer raw flesh to any other kind of food, and soon discovered a fondness for intoxicating liquor, and greatly preferred to go entirely without clothes. He was utterly averse to any kind of employment, and his principal amusement was riding on horseback, of which

he was passionately fond. When playing with lads of his age, the moment his anger was excited, his first movement was to strike them with any weapon or instrument he could most readily get hold of. In short, he proved to be very quarrelsome, soon became addicted to drunkenness and other vices, and was found to be totally indocile and intractable. A gentleman who saw him in 1825, seventeen years after he was caught, says: 'At that time his mind appeared wholly incapable of cultivation. To an entire stranger his language was unintelligible, consisting of a kind of gibberish, understood with ease only by those intimately acquainted with it. He was still an untameable creature, often found around small ponds catching frogs and eating them raw. It was with great difficulty he could be compelled to wear any kind of clothing or come under any restraint.'

1177. This case has been brought forward by the advocates for flesh-eating, to prove that man has a *natural* appetite for animal food and for strong drink; and it is said by them to be decidedly more of a true case of nature than that of Caspar Hauser. But it is very obvious that neither case can justly be considered as making any very near approximation to the truly natural state of man. It is not claimed that Caspar's dietetic *habits* were the result of natural instinct, and that they prove the natural dietetic character of man; but it is contended that the comparative effects of vegetable and animal food on his physiological and psychological powers, afford the strongest evidence in relation to the natural dietetic character of man; and that evidence is fully corroborated by the evidence in the case of the wild boy of Mississippi. From this boy's account of himself, he must have been at least four or five years old when he fled in terror from his father; and, all things considered, it is scarcely to be doubted that his father was an intemperate man, and was intoxicated when he killed his wife. It may, therefore, be regarded as a certainty, that the boy had become accustomed to the free use of flesh-meat, and very probably also to the use of strong drink, while in his father's family; and it is well known that when these appetites are formed in early life, they are generally powerful and abiding, and nothing but strong moral self-control can ever overcome them. The dietetic *habits* of this boy, therefore, afford no determinate evidence in relation to the natural dietetic character of man; but the psychological evidence in the case, when compared with that of Caspar Hauser and all other relevant cases, is strong and conclusive; for with his flesh-eating we find that he had no aptitude to learn—no docility; that 'his mind appeared wholly incapable of cultivation;' that after seventeen years' intercourse with civilized human beings, his language was a kind of gibberish, unintelligible except to those who were intimately acquainted with it; and that he continued to be intractable and truculent.

DIET WITH REFERENCE TO INSANITY.

1178. It has been reserved for the sagacity of modern philosophers to discover that abstinence from animal food leads to insanity. A physician of considerable professional standing, in an article which appeared in the *Boston Medical and Surgical Journal*, February 24th, 1836, made a most violent and abusive attack upon me, for propagating the doctrines contained in these Lectures; and asserted that the tendency of

the principles which I teach is to break down the physiological and psychological powers of the human body, induce insanity, and destroy life; and these bold and imprudent assertions he endeavored to support by some four or five cases of insanity, which he brought forward with extreme disingenuousness, and stated with evident dishonesty. I called on him for further information, and assured him of my readiness to renounce any principles which I had advanced, if I could be convinced of their error; but he utterly refused to give me the names of the persons whose cases he had adduced, or to afford me the means of investigating those cases, or of coming to any other knowledge of them than I could derive from the hostile statements which he had made in the *Medical and Surgical Journal*. Fortunately for the cause of truth and humanity, however, the individuals themselves, or the near relatives of the individuals, whose cases he had named, proved to possess more moral sensibility and regard for justice than my adversary manifested, and they spontaneously communicated to me correct statements of those cases. The result was, that every case stated by my assailant proved to be an entire misrepresentation, so far as it had any relation to an exclusive vegetable diet; and so far as facts could be accurately ascertained, instead of militating against the principles contained in these Lectures, they decidedly harmonized with them.

1179. But since the charge has been made, and since popular ignorance and popular prejudice have eagerly embraced and extensively propagated the opinion that an entire restriction to vegetable food leads to insanity, it may be well briefly to enquire how far a change from a mixed diet of vegetable and animal food, with tea, coffee, etc., to a diet of pure vegetable food and water, can possibly be a predisposing cause of insanity.

1180. It is beyond all controversy true, that every human being who abandons an ordinary diet of vegetable and animal food, with tea, coffee, spices, etc., to which he has been accustomed, and takes at once to a simple diet of pure vegetable food and water, in temperate quantities, will experience a considerable increase of healthy sensorial power and mental activity (1126); and at the same time he will suffer a physiological depression (883) or atony, commensurate with the degree of excess to which he has formerly carried the use of flesh, tea, coffee, etc.: and this physiological depression will be more or less distressing, and continue a longer or shorter time, according to the peculiar condition, circumstances, and habits of the individual.* People of vigorous bodies, who are accustomed to active and energetic exercise in the open air, will recover from it in a short time; while those who are of sedentary and studious habits, given much to anxiety and confinement,—and yet more, those who are of feeble health and impaired constitution, will far more slowly recover. But while this physiological depression remains, that portion of our organization which is more immediately concerned in the operations of the mind, partakes of the general debility of the whole body; so that, while the *sensorial power* and *mental activity*

* By physiological depression or atony, I mean that state of the body resulting from the abstraction of accustomed stimulus, in which the organs are consequently depressed below their usual tone, and fall short of their usual energy and action, causing a sense of debility and lassitude, and sometimes of great oppression, and in some instances—as when spirituous liquor is withheld from the habitual drunkard—a distressing sense of sinking and extreme exhaustion.

are increased, the *organic power* of the intellectual organs to sustain severe and protracted *mental action and excitement*, is somewhat diminished, or at least not proportionably increased. Hence students, who from motives of ambition and other causes, are sometimes induced to make a sudden change in their diet, and take to an abstemious vegetable and water diet for the sake of being enabled to dispense with exercise, and to make the greatest proficiency in their studies in a given time, always experience a great increase of sensorial power and mental activity; but if they apply their minds with extreme severity, and especially if at the same time they neglect all bodily exercise, they will soon find, to use their own language, that 'their minds are becoming weak.' Yet if such students, on changing their diet from more to less stimulating food, etc., would refrain from severe mental application till they had recovered from their physiological depression, and then continue to govern themselves by a correct general regimen, they would experience nothing of what they call weakness of the mind, and which in reality is weakness of the bodily organs concerned in the mental operations, but would enjoy a degree of mental vigor and power of endurance which it is impossible for man to attain to in any other way.

1181. Again; most of the laboring and business people in our country, as everywhere else, exercise their intellectual faculties and develop their intellectual powers little beyond what they find immediately necessary for their success in their particular pursuits of life. A vast amount of intellectual and moral capability lies wholly undeveloped through their earthly existence, and their intellectual and moral energies are to a very great extent kept in a state of sluggish inactivity and stupidity, by their dietetic habits and sensual excesses. Let the habits of these people be suddenly changed, and bring them at once to a simple diet of pure vegetable food and water, and they will, if strictly temperate in all things, soon experience such an increase of sensorial power and mental activity as greatly to astonish them. They will find themselves possessed of faculties and powers which they before were scarcely conscious of. There will also be an increase of cheerfulness, vivacity, and buoyancy of spirits; and it cannot be surprising that they should be much delighted with this new state of things. *

* An intelligent farmer of Pennsylvania, whose health had for some time been declining, and who, at the age of sixty years, finding himself completely broken down, and laid by with all the infirmities of a premature old age, was induced to adopt a simple diet of vegetable food and water, with the hope of mitigating in some degree the severity of his sufferings. Of the effects of this experiment he thus expresses himself. 'In less than twelve months from the time I commenced living on my abstemious vegetable and water diet, I was perfectly restored to health, and seemed to have renewed my life. I was entirely free from every pain and ailment, and was very active and vigorous, and more serenely and truly cheerful and happy than ever before since my childhood. My sight improved astonishingly, insomuch that, whereas before my change of diet I could with difficulty see to read with the best glasses I could procure, now I could easily read the finest print of my newspaper without glasses. But the most wonderful effect was produced on my mind, which became far more clear and active and vigorous than it had ever been before. Indeed no one who has not experienced the same can have any adequate conception of the real intellectual luxury which I enjoyed. It seemed as if my soul was perfectly free from all the clogging embarrassments and influences of the body. I could command and apply my thoughts at pleasure, and was able to study and investigate the most abstruse subjects, and to write with an ease and perspicacity and satisfaction which I had never known nor had any idea of.'

But this change of diet and increase of sensorial power and mental activity cannot immediately impart knowledge and discipline to the mind (1075); and therefore it cannot be expected that these people are to be transformed at once into philosophers and men of science: but their increase of mental *activity* may only serve to expose more glaringly their want of mental education and discipline, as in the case of the uneducated Irish (1159).

1182. Now then, while individuals are in this state of physiological depression, with an increase of sensorial power and mental activity, if some new cause should supervene, such as the loss of friends, of property, of reputation, religious anxiety, projects of ambition, speculations in land and other property, etc., producing and keeping up intense and continued mental excitement, and causing a neglect of most or all of those principles of general regimen which are quite as important as the quality of the food, insanity might and perhaps would in some cases result, especially where there was a predisposition to that disease. And this would be far more likely to be the case in those persons whose intellectual faculties were not much cultivated, and had been little accustomed to intellectual effort and excitement.

1183. While I admit, however, that under these peculiar circumstances, the pure vegetable-eater is more likely to be rendered insane by supervening causes—which have no necessary relation to his diet—than when he is in the most vigorous state of his physiological powers, yet I must in solemn honesty, and upon the most fully ascertained principles of science, deny that it is ever, in any degree, the legitimate tendency of a pure vegetable diet, of itself, to produce insanity; or that, as a general statement, mankind are more likely to become insane by changing, in a proper manner, from a mixed diet of vegetable and animal food, with tea, coffee, etc., to one of pure vegetable food and water; while, on the other hand, it is a well-ascertained matter of science and of fact, that, in civic life at least, the free use of flesh-meat in itself tends to produce insanity.

1184. More than two thousand years ago, it was taught in the schools of philosophy in Greece, as a well-established fact of experience, and became a generally received doctrine, that 'eating much and *feeding upon flesh*, makes the mind more dull, and drives it to the very extremes of madness' (1156). And from that time to the present day, the whole history of civilized man has corroborated the statement. In the rude state of the flesh-eating tribes, where almost every other cause of mental insanity is absent, such a calamituous result is rarely experienced; but in civic life, where almost every thing conspires to reduce the physiological powers of the human constitution,—where continual excitements of body and of mind,—where perplexities, and vexations, and disappointments, and misfortunes, are ever occurring, and all are co-operating to induce and establish an excessive nervous irritability, attended always with more or less of disturbance and derangement of organic function, and predisposing to bodily disease and mental insanity and madness,—it is certain, entirely certain, that flesh-meat, as a general fact, increases all these evils more or less in proportion to the freedom with which it is used (1075), and greatly aggravates the symptoms of both bodily and mental diseases.

1085. The success which has attended the otherwise improved regi-

men, and perhaps still more, the much improved moral treatment of some of our Lunatic Asylums, has, there is reason to believe, greatly blinded the eyes of the public and the conductors of those institutions to the real effects of the flesh and opium which are so freely used in them. And while prejudice and empiricism are allowed, by the suffrages of general ignorance, to occupy the high places which belong only to scientific wisdom and skill, we shall probably be obliged to see the theory and practice of professional men conform to their own sensual appetites and habits, and the unfortunate sufferers who fall under their care must endure the consequences.

1186. 'Dr. Halloran, having been physician to the Lunatic Asylum of Cork from the year 1798,' says Dr. Lamb (1094), 'states that there are certain festival seasons of the year when the Asylum is supplied with flesh-meat. The consequence of these occasions has been uniformly the same. The strictest precautions were necessary to guard against a scene of uproar which was sure to follow. The same was the case when the establishment was new and flesh-meat furnished once a week.'

1187. This statement of Dr. Halloran's is in perfect accordance with what we know to be true in physiologico-psychological science (549, *et seq.*), and what all experiment made upon correct physiological principles will demonstrate to be true. The human system so readily adapts itself to all sorts of things and habits, that under almost any mode of treatment which is uniformly and regularly pursued, some, of many cases of recent insanity, will be restored to health in spite of whatever particular bad principles and practices may constitute a part of the general regimen adopted; and hence, when the general regimen is in all other respects excellent, as in the institutions to which I have alluded (1185), there may be many recoveries in spite of the free use of flesh and opium. But it is nevertheless true, that in every case there is less *certainty* of recovery, and in all cases of recovery under such a mode of treatment there is a greater liability to a return of the same calamity, than there would be if the mode of treatment were in all respects in strict accordance with correct physiological principles.

1188. Where there is an hereditary predisposition to insanity, I know of no precautionary measure more sure to prevent the development of that most terrible of all earthly calamities, than the intelligent adoption of a simple diet of pure and well-chosen vegetable food and pure water, together with a correct general regimen; for it is nearly in vain to limit ourselves to any particular kind of diet, while in many other respects our habits are greatly at variance with the constitutional laws of our nature.

1189. Mr. J. C., a higly respectable and intelligent gentleman of Massachusetts, called on me in Boston, in January, 1836, and stated to me that insanity had been an hereditary affliction in the family to which he belonged; that he found himself seriously threatened with it, and had begun to experience many distressing symptoms; that he attended my lectures in the summer of 1832, and strictly adopted the system of living which I recommended; that soon after this, he found his health improving in every respect; his mental disorder in a short time wholly disappeared, and he had ever since enjoyed the most perfect health of body and mind, with a decided and very considerable increase of vigor

and activity of both. I might add a large number of cases similar to this, which have come to my knowledge within a few years past. But it is unnecessary. It is already sufficiently evident that a pure vegetable and water diet, under a correct general regimen, is most conducive to that state of perfect soundness of body, on which perfect soundness of mind depends (579).

LECTURE XIX.

Comparative effects of animal and vegetable food on the animal propensities and moral sentiments—Relation of the animal propensities and moral sentiments—The doctrine of phrenology—Particular and general relations between the cerebral and other organs in the body and the wants of the vital economy—Effects of physiological depravity on the propensities and passions—How far the intellectual and moral organs are involved—Means by which the size, activity, and vigor of particular cerebral organs are increased—The effects of cultivation or exercise—The effects of diet—The physiological economy by which the mental, moral, and other peculiarities of the parent are transmitted to the offspring—Comparative effects of vegetable and animal food in developing particular cerebral organs, and in exciting the animal propensities and passions—Doctrine of phrenology concerning the relative proportions of the brain—This doctrine applied to facts—The shape of the head of the Hindoos and other vegetable-eating portions of the human family, and their natural character—The same principles applied to flesh-eating tribes—Effects of dietetic intemperance on the moral character; particular cases given—Comparative effects of flesh-meat and pure stimulants on the moral organization and character of man—The testimony of the Sacred Scriptures—The characteristic immoralities of flesh-eaters and of vegetable-eaters—Brief synopsis of the moral organs and their philosophy—Conclusion of the topic—General conclusion from the anatomical and physiological evidence in relation to the natural dietetic character of man.

1190. Our next and last department of physiological evidence in relation to the natural dietetic character of man, embraces the comparative effects of vegetable and animal food in developing and strengthening the animal propensities and passions, and in modifying the moral sentiments.

1191. But here we shall be told that all the propensities, as well as the moral sentiments and intellectual powers, are immediately connected with organs which have their seat within the cranium (523, 524), and together as a complete system, make up the whole encephalic mass, or the whole brain and little brain; and therefore, if it is true that flesh-eating diminishes the sensorial power of the nervous system, and consequently diminishes the functional power of the organs of special sense, and the healthy activity and energy and integrity of the intellectual and moral faculties, it is not easy to perceive why it must not necessarily be true, according to the same physiological principles and reasonings, that flesh-eating will also diminish the propensities and passions. I will endeavor to explain this point in such a manner as to remove the apparent difficulty.

1192. Granting all that phrenology claims in regard to the cerebral organs (533), it must nevertheless be remembered that there are very important distinctions between the constitutional relations and functional powers of these different organs; some of them holding special relations to particular corresponding organs in other parts of the body, others holding general relations to the physiological wants of the system, and others holding general relations to the social and moral circum-

stances and conditions of man. Thus, suppose that, according to the conjectures of phrenologists, there is situated somewhere in the brain an organ of alimentiveness (534) ; this has a particular corresponding organ in the abdominal cavity, which is the stomach ; this latter organ, according to its constitutional laws of relation, takes on a certain physiological condition (589), demonstrative of a particular want of the system ; this physiological condition of the stomach is perceived by the cerebral organ of alimentiveness as the special centre of animal perception of that special sense, and being thus perceived by this animal centre or cerebral organ, it is what we call hunger, or desire for food ; and this, appealing to other organs of the brain, calls into action those whose functions are necessary in order to the gratification of the desire.

1193. Now then, according to the philosophy of phrenology, the grand fundamental element in the functional character of the organ of destructiveness, is the supply of this alimentary want (534, No. 3) ; and consequently this organ sympathizes with, or partakes of the excitement of that of alimentiveness, and is thereby roused to the performance of its function, which is to urge on the animal to destroy that which is necessary to gratify the propensity of hunger, and thus supply the general alimentary want of the system ; and hence, beasts of prey are always more ferocious and cruel when hungry than when they have fully gratified their appetite for food ; and all other animals, including man, are more irritable and apt to become angry when hungry than when the stomach is full. It is not, however, by any means *necessary* to call in the aid of phrenology to account for any of these facts. But I admit the premises for the sake of meeting the objection on the ground where it is set up. And from the statement I have made, we perceive that the organ of destructiveness has a general relation to the physiological wants of the system (1192) ; and that so long as it retains its primitive functional character and integrity, it always and only acts consistently with the general physiological interests of the system. All this is true of the organs of combativeness, acquisitiveness, and all the other propensities (534).

1194. But the stomach may be so affected as entirely to destroy the integrity of that physiological condition which demonstrates the alimentary wants of the system (757) ; so that the sense of hunger may become a mere demand for accustomed stimulation, and in no degree indicate the true alimentary wants of the body (727, 728). And this morbid appetite is always the more despotic and imperious in proportion as it is removed from the original integrity of the function (598). Moreover this condition of the stomach always involves the whole nervous system (298), and increases the irritability of all those cerebral organs whose functions, according to phrenology, constitute the propensities common to man and lower animals (534). The consequence is, that destructiveness, combativeness, secretiveness, acquisitiveness, amativeness, alimentiveness, and other organs holding special or general relations to the physiological wants and conditions of the body, lose their original integrity in reference to those wants, and act in relation to the depraved physiological condition and affections of the system, and by such action necessarily increase not only their irritability, but their tendency to excess and violence ; and thus the organs which were originally instituted and endowed for the good of individual and social

man, are by depravity made to urge him on to restless dissatisfaction and contention, and deceit, and lying, and cheating, and theft, and quarrelling, and cruelty, and murder, and war. For it is an important fact, that these crimes are far less frequently committed from any real extrinsic exciting motive, than from the internal condition of the nervous system; and hence, a large proportion of the murders and manslaughters and thefts and other crimes committed in our country, are connected with the use of intoxicating liquors.

1195. The organs of the intellectual and moral powers are so far involved in the condition of the other cerebral organs, as to partake in common with them of the general state of the nervous system; and their peculiar functional powers, as we have seen (1120), are always proportionably impaired by whatever diminishes the healthy sensorial power of that system; but the perceptive and reflective faculties, and the moral sentiments, such as benevolence, veneration, conscientiousness, etc., do not hold those important special and general relations to nutrition and other functions within the domain of vegetative or organic life (283), which render them particular cerebral centres of perception to the special or general physiological wants of the vital economy, in like manner with alimentiveness, destructiveness, combativeness, etc. Hence, though the causes which increase the determinate functional action and the irritability of these latter organs involve the former in the general increased and perhaps morbid irritability of the whole nervous system (305), yet they never directly tend to produce their determinate functional action, as in the case of the organs of the propensities. Thus, physiological dissatisfaction in the domain of organic life always leads to more or less of disquietude and restlessness and impatience and testiness and anger and contentiousness and perhaps violence and crime; and it excites the intellectual faculties (537, 538) so far as its own gratification requires their action, and this, always and exclusively, to secure such gratification, and never to oppose it in any measure (595); and it perhaps excites cautiousness, but only to produce unhealthy and generally vague and indefinite apprehension and fear; and it excites the other organs of sentiment, and renders them, during the excitement, more morbidly susceptible of the action of other causes; but it never of itself tends determinately to produce the function of benevolence, veneration, etc., but always the contrary.

1196. It is true that when a long-continued over-excitement of a moral or religious nature has induced a preternatural or morbid irritability and mobility in the organs of veneration, marvellousness, hope, conscientiousness, cautiousness, etc., a general stimulation of the nervous system, through the medium of the domain of organic life, will always increase the action of those organs in relation to the particular moral or religious subject which they have become accustomed to contemplate; but such increased action will only continue while the direct stimulation continues, and be followed by a commensurate degree of exhaustion, depression, debility, and increase of morbid irritability, tending to derangement of function, and inflammation and change of structure in the organs; hence, it always necessarily tends directly and indirectly to induce or aggravate monomania or general insanity (549, *et seq.*). It is true, also, to use the language of phrenology, that when the organs of benevolence, adhesiveness, and others of this class of character, are

exceedingly large and very greatly predominate, the stimulation of alcoholic, narcotic, and other pernicious substances, if kept within certain bounds, will, for a while, produce an increased manifestation of kind and perhaps excessively generous and foolishly fond feeling; but the ultimate and more permanent effects of such stimulations always tend to produce the general morbid irritability of the nervous system, which sooner or later transforms the unfortunate individual into a demon of anger and cruelty and violence. It is not, therefore, so much the momentary effects of direct stimulation on the cerebral organs, as the permanent and constitutional effects, which it concerns us to investigate on the present occasion.

1197. According to phrenology, the particular organs of the brain may not only be rendered morbidly irritable, in the manner I have described, but by certain means their healthy energy and activity may be very considerably increased; and by certain means also, the organs themselves may be very much enlarged, so that a single organ may be made to have a very modifying and even predominating influence in the character of the individual. It is notoriously true also, that the peculiarities of character in the parent are very often manifested in the child, and this too under circumstances which entirely exclude the possibility of their being derived by imitation. Phrenology affirms that in such cases the child inherits a cerebral organization corresponding with that of the parent whom it resembles in character.

1198. Two problems, then, present themselves for solution. The first is, by what means does the individual increase the size and activity and vigor of particular cerebral organs in himself?—and the second is, by what means are the peculiarities of cerebral organization in the parent transmitted to the child?

1199. In regard to the first problem, phrenology affirms that all exercise of the cerebral organs which does not become so excessive as to induce morbid condition, increases the activity, vigor, and size of the organ or organs exercised. Thus, if benevolence be much exercised, the organ will become proportionably more active, vigorous, and large; and so of each and all the other organs of the brain; and in this manner the individual may greatly increase the size, activity, and vigor of a single organ or of several organs, and wholly neglect the cultivation of the other cerebral organs, and thereby exceedingly modify and give a permanent shape to his character; making himself a sly, cunning, crafty knave, or an avaricious miser, or a thief, or liar, or a quarrelsome, turbulent fellow, or a morose and cruel wretch, or a bloodthirsty murderer; or making himself a devoted philanthropist, or a profound philosopher, etc.

1200. Admitting phrenology to be true, such exercise of the cerebral organs certainly does increase their activity and vigor, and unquestionably also it increases to a certain extent their size or volume; but I think phrenologists have erred in making this the too exclusive means of development, and in depending too entirely on mental and moral discipline and education, to bring forward or retard the growth and increase or diminish the relative activity and vigor of particular organs. It has been the boast of phrenology that it could afford the only rational explanation of monomania (548), and that it had done much for the cause of humanity, in pointing out the only true and

philosophical mode of treating that disease and other species of insanity; but after all that has been said about topical applications to diseased organs, phrenologists and all others will soon find, if indeed they have not already found, that the grand point to which the physician must direct his attention in the treatment of every species of chronic insanity, is the alimentary canal (588, Note). And this is true to an almost equal extent in regard to the proportionate development and power and activity of the several organs of the brain.

1201. Be it remembered, however, I do not discard intellectual and moral discipline and education as means by which these effects are to be produced; on the contrary, I insist upon them as of the utmost importance; but I contend that they should go hand in hand with the strict fulfilment of the laws of constitution and relation appertaining to the digestive organs and to the domain of organic life generally. I contend that it is nearly if not entirely in vain to attempt, by moral discipline and education, to develop benevolence or suppress destructiveness, while all the dietetic habits of the individual are operating directly against us. It is like attempting, when a building is on fire, to quench the flames by throwing upon them a quantity of water with one hand, and a quantity of oil with the other.

1202. All pure stimulants, or those substances which stimulate without nourishing (733), increase the general irritability of the nervous system; and all alcoholic, narcotic, and other deleterious stimulants, always produce more or less of morbid irritability in the system, according to the extent to which they are used. The action caused by such means never healthfully increases the size of any organ or organs thus excited. But, as we have seen (1195), it always increases the influence of certain cerebral organs over the others,—always tends to cause a predominance of the more exclusively selfish propensities over the intellectual and moral faculties.

1203. There are some kinds of aliment by which the body may be nourished and sustained, and which, from their adaptation to the organization and physiological properties, powers, and laws of the system, naturally tend to such a symmetrical and harmonious development of the several portions of the brain as well as of every other part of the body, as the highest and best condition of man as an individual, and as a social, intellectual, and moral being requires; and there are other kinds of aliment by which also the body can be nourished and sustained, but which, being less perfectly adapted to the general physiological interests of the system, always naturally tend to develop some parts more rapidly and fully than others, and thus to impair the symmetry and harmony of the system. And from what has already been said, it must be perfectly obvious to every physiologist, that whatever aliment increases the appropriation of nervous energy to the organs concerned in the general function of nutrition and in the perpetuation of the species, beyond what is indispensably necessary to the most perfect performance of the functions and the most complete fulfilment of the final causes of those organs, always necessarily increases the power of those physiological conditions of the organs which, being perceived by the animal centre or centres, constitute the more exclusively selfish animal propensities; and consequently, if phrenology be true, the cerebral organs with which these propensities are connected, will be proportionably increased in size, vigor, and activity.

1204. For, be it known and remembered, as a matter of the utmost importance in physiological and psychological science, that, admitting phrenology to be true in regard to the organization of the brain, the cerebral organs have nothing to do in modifying the peculiar physiological powers and functional character of corresponding organs in the domain of organic life (1192), in the original development of the system, but directly the contrary is true (217, *et seq.*): that is, the peculiar physiological character of particular organs in the domain of organic life, involving the whole condition and economy of that domain, causes a proportionate development, vigor, and activity in the corresponding cerebral organs; and those cerebral organs of animal instinct or propensity which have no particular corresponding organs in the domain of organic life, but hold a more general relation to the wants and conditions of that domain, are also proportionably developed by the general physiological condition and economy of that domain.

1205. Dietetic as well as intellectual and moral causes are therefore largely concerned in regulating the general proportions of the brain, and in increasing the relative size, vigor, and activity of particular organs.

1206. But when, by any means, an individual has produced a large development and a high degree of vigor and activity of certain cerebral organs, by what means does he transmit his own cerebral peculiarities to his offspring?

1207. I do not know that phrenology has attempted a solution of this problem, but I am sure that on its own peculiar grounds it can afford none that is satisfactory. The brain of the parent can have no direct influence on the development of the brain of the child. All that the parent can impart of his own substance or properties to the offspring, must, even in himself, pass through those vital processes over which the nerves of organic life exclusively preside; and so far as it acts in controlling or modifying that vital economy by which the body of the offspring is developed, previously to its own voluntary agency, it acts exclusively in and through the nerves of organic life (228) belonging to the body of the child, and in no degree in and through the brain or any of the nerves of animal life. For, as I have fully shown (234) the nerves of organic life exclusively preside over all the functions concerned in the development of the body; the nerves of animal life being entirely passive, at least until respiration and alimentation commence (233); and then only active in certain organs of external relation, as mere instruments by which certain foreign substances are brought within the sphere of the vital action of the organic domain, etc. Indeed, as we have seen (215), the brain and spinal marrow are in no degree essential to the perfect development of the body in every other part; and hence, in the normal state, the brain is among the very last portions of the whole system which become so completely organized and confirmed as to be capable of performing their appropriate functions (214).

1208. All the peculiar cerebral effects produced in the original development of the body, therefore, must result exclusively from causes acting in and through the nerves of organic life; and these causes originate mostly from the intellectual, moral, dietetic, and other voluntary habits and actions of the parent. But whether arising from one or all

of these, they necessarily, in all cases, affect the offspring by first affecting the physiological condition and economy of the domain of organic life in the parent himself, and through this medium are transmitted to the nerves of organic life in the offspring, where they act to modify the development of the several organs belonging to organic life, and impart to them a physiological condition and character corresponding with the state of things in the parent; and then they proceed to produce a cerebral development corresponding with the physiological condition and character of the domain of organic life in the offspring (1204). Hence the parent may, by his dietetic and other voluntary habits and action, so affect his own nerves of organic life, as to produce a strong constitutional predisposition in his offspring to pulmonary consumption and other diseases, or to insanity, without actually inducing those diseases in his own body, or suffering that affliction in his own mind. Or he may, by such means, produce a large development of destructiveness, combativeness, secretiveness, acquisitiveness, amativeness, and other organs of this class, even though these organs are of moderate size in his own head.

1209. It is therefore perfectly evident, as I have asserted (306), that all hereditary predispositions and peculiarities are transmitted from parent to child, from generation to generation, exclusively through the medium of the nerves of organic life; and through this constitutional medium, God visits the iniquities of the parents upon the children unto the third and fourth generation, and remembers mercy to the children of those that love him and keep his commandments, equally long.

1210. With these explanations before us, we are prepared to enter more particularly upon our inquiry concerning the comparative effects of vegetable and animal food in developing and strengthening the animal propensities and passions, and in modifying the moral sentiments.

1211. We have seen (906) that a pure vegetable diet is more conducive to the symmetrical and harmonious development of each and every part of the human body than animal food. We have seen also (909) that flesh-meat is decidedly more stimulating and heating than proper vegetable food, and that it quickens the pulse, increases the heat of the skin, accelerates all the vital functions, hastens all the vital processes of assimilation and organization, and renders them less complete and perfect (914); and consequently develops the body more rapidly and less symmetrically, exhausts the vital properties of the organs considerably faster, and wears out life sooner. Furthermore, we have seen (911) that flesh-meat causes a much greater concentration of nervous energy in the several organs through which it passes in all the successive processes of assimilation, than proper vegetable food (909), and consequently leaves those organs more exhausted from the performance of their functions, and causes a greater abatement of the sensorial power of the nerves of animal life; and if phrenology be true, it causes a greater concentration of that power in those cerebral organs which are constitutionally and functionally most nearly related to the viscera of organic life (1192).

1212. It follows therefore of necessity, that flesh-meat increases the power of those physiological conditions and affections of the viscera of organic life which, being perceived by the animal centre or centres in the brain, constitute the animal instincts or propensities (595); and

also increases the action and relative force and size of those parts of the brain which, according to phrenology, are the organs of those propensities (1203).

1213. The controlling power of that instinct which we call hunger, on the intellectual and moral faculties, is much greater and more imperious in the flesh-eater than in those who subsist on a pure vegetable diet (598). If the flesh-eater is deprived of his customary meals or supplies of food, he feels a degree of gastric depression which is often painful, and is always attended with more or less of restless dissatisfaction (911), which, to speak phrenologically, appeals to the organs of destructiveness and combativeness, and others of that class, and tends to excite them to vigorous action, in order to relieve the instinctive disquietude and distress; and hence, men in this state often burst into fits of anger with their wives, or children, or domestics, and sometimes commit acts of violence without the slightest provocation from those toward whom their wrath is manifested. But the pure vegetable-eater, though he experiences, according to his habits as to times of eating, a regular recurrence of his appetite for food, yet it has nothing of that despotic, vehement, and impatient character which marks the craving desire of the flesh-eater, and he can lose a meal with very little dissatisfaction, and can even fast for days with comparatively little distress or disquietude. And all this difference is true between the flesh-eater and the vegetable-eater, in relation to all the more exclusively selfish propensities in man (911).

1214. It is one of the most important doctrines of phrenology, that the greater the proportionate width of the head between and back of the ears, and depth from the ears to the back of the cranium,—or, in other words, the more the portions of the encephalic mass lying in the lower and back part of the skull, exceed those lying in the upper and fore part, the more the animal propensities will predominate, and the more active and powerful will be the selfish and evil passions; and, as I have stated (1193), one of the principal final causes assigned by phrenologists for the organ of destructiveness, which increases the width of the head between the ears, is the alimentary wants of the body requiring the destruction of life in other animals for their supply. And hence Gall and Spurzheim infer the carnivorous character of man from his cerebral organization. And yet Spurzheim admits that the organ of destructiveness is, in general, relatively largest in infancy, when flesh-meat is not wanted, and when it would not be proper.

1215. But admitting the doctrine of the width and occipital depth of the head as connected with the more exclusively selfish propensities and mischievous passions, there is one general fact in relation to the subject of great interest, and worthy of much consideration. The Hindoos and other Asiatic tribes who, from their earliest history, have subsisted wholly on vegetable food, as a general fact—and especially those portions of them who have preserved most of their primitive simplicity, purity, and temperance—are proportionably much narrower between the ears than those portions of the human race who have, for many generations, fed freely on flesh. The question therefore is, whether the Hindoos have, from time immemorial, abstained from the use of flesh-meat, and adopted a system of religion which forbids the use of it, because they were originally, and always have been, pro-

portionably narrow between the ears; or whether this shape of their heads is the effect of their abstinence from flesh through so many generations?

1216. I imagine that no one will hesitate to say, that if either of these propositions is true, it is unquestionably the latter. That is, the proportional narrowness of the head, as a national fact, is the effect of their subsisting purely on vegetable food; and if this be admitted, the fact, according to the theory of phrenology, is very conclusive on the score of morality, and fully proves that no physiologist ought for a moment to doubt that flesh-eating tends decidedly to increase the development of the more exclusively selfish propensities in man, and to promote the action and power of the evil passions.

1217. As a general fact, it is true of all those tribes in savage life which subsist principally upon flesh, that much the greater proportion of the brain lies in the lower and back part of the skull. This may be said to be owing to the want of education to develop the intellectual and moral organs lying in the front and upper part of the head; but I reply that, as a general fact, it is true of all those tribes in savage or uncivilized life subsisting mostly or entirely on vegetable food, that the brain is much more symmetrically developed, and a far greater proportion lies in the upper and fore part of the skull, than in the heads of the flesh-eating savages.

1218. Admitting, however, that regular moral and intellectual cultivation from generation to generation will increase the relative proportion of the upper and front part of the brain in flesh-eaters, yet the fact that without such intellectual and moral means of cerebral development the lower and back parts of the brain naturally and greatly predominate, proves conclusively that these parts, in point of function and development, hold nearer and more special relations to the primary wants of man as a mere animal; and consequently, that whatever tends as a permanent fact to increase the concentration of the healthy vital energies in those parts which are concerned in the development, sustenance, and perpetuation of the material organization, always necessarily tends also to increase the relative proportion of the lower and back part of the brain. And the fact that, in those tribes destitute of intellectual and moral cultivation, or in the uncivilized state, which subsist principally or entirely on pure vegetable food, the brain is more symmetrically developed, and the upper and front parts are much larger in proportion to the lower and back parts, than in the uncivilized flesh-eaters, proves conclusively that flesh-meat increases the relative size and power of those cerebral parts which, according to phrenology, are the organs of the more exclusively selfish propensities, and tends to cause the animal to predominate over the intellectual and moral man (607); while a pure vegetable diet, without neglecting to secure, by the most complete and harmonious organization and perfect physiological endowments, all the interests of organic life and animal instinct, at the same time naturally tends to produce that symmetry of particular and general development and harmony of parts which give comeliness and beauty to the person (964), and fit man as an intellectual and moral being to understand and appreciate and fulfil his duties to himself and his relations to his fellow-creatures and to his God (603). Hence the notorious fact, that in the perfectly rude and

uncultivated state of man, the vegetable-eating tribes and nations never sink so low on the scale of humanity, never approach so near to an utter extinction of the intellectual and moral faculties, never become so deeply degraded and thoroughly truculent, as the flesh-eating tribes. However rude the state of the uncivilized vegetable-eater, he always, other things being equal, manifests more intelligence, more moral elevation, more natural grace and urbanity, than the flesh-eating savage. This fact has been observed by travellers and writers from the days of Homer to the present time.

1219. That those portions of the brain which, according to phrenology, are the organs of the propensities, hold a more immediate and particular relation to the physiological condition of the nerves of organic life, than the intellectual and moral organs do, may be strongly illustrated by particular cases. F. R., of M., was an affectionate husband, a kind father, a peaceable neighbor, and a worthy member of society. Following the universal custom of the times, of sipping intoxicating liquor on all occasions, with every one he met, he gradually became more and more addicted to the use of ardent spirit, till he fell into occasional excesses. These excesses were soon marked by a great change of character, and finally by a fearful exhibition of the destructive propensity. On one occasion, while under the influence of intoxicating liquor, he entered his house, and finding his wife nursing her infant, he deliberately fastened the doors and windows, and then got a butcher's knife and whetstone, and sat down and began to whet his knife, and at the same time told his wife that she had but a few minutes to live, for it was his determination to kill her and her child. She calmly asked him if he would permit her to lay her child on the bed before he executed his design. He assented, and she stepped into the bed-room, laid her child down, and sprang upon the bed and threw up a window behind it which was not fastened, and escaped to the neighbors. Ever after this, measures were taken to protect his family from his outrages, when he came home under the influence of ardent spirit. But on all such occasions for more than twenty years, he invariably discovered the strongest propensity to murder his wife and children. Yet at all other times he was perfectly kind and affectionate to his family, and peaceable towards everybody, and a good member of society; and after the temperance reform induced him wholly to abstain from the use of intoxicating liquors, his cruel and murderous propensity entirely disappeared, and his character and behaviour were uniformly good.

1220. The pirate Gibbs, who according to his own confessions was one of the bloodiest murderers of modern times, had a head which would lead every intelligent beholder to take him for an extraordinary man. The first thing that struck the eye of the phrenologist was his towering benevolence, and then his large veneration, and still larger conscientiousness and firmness and cautiousness, and large philoprogenitiveness and adhesiveness; and his capacious and well-marked forehead indicating a high order of intellect and a splendid imagination, and all this associated with a finely formed and harmonious and interesting countenance. But on further examination the phrenologist could also discover very large destructiveness and combativeness

and amativeness and acquisitiveness.* Now then, how shall we reconcile the actual character of the man as a pirate and extensive murderer, with this cerebral development? I reply that phrenology, or more properly speaking, craniology, cannot do it satisfactorily. There were very large destructiveness and combativeness and acquisitiveness, it is true, but there was certainly sufficient intellectual and moral development to control these propensities, and out of the whole cerebral organization to produce a highly exalted, efficient, and most estimable intellectual and moral character, if due attention had been paid not only to intellectual and moral discipline and education, but to the true relations between the cerebral organs and functions and the physiological conditions and affections of the domain of organic life (1192). So long as the dietetic habits of Gibbs were correct (even in the ordinary sense of the term), he had no disposition to murder nor to be cruel nor quarrelsome; but when he had developed a high state of irritability in his nervous system by the habitual use of stimulating and intoxicating substances, and when in this condition he brought his whole system under the powerful stimulant of ardent spirit, then, as he himself declared, he felt the demon of his destiny urging him on to wickedness and violence (1194). Yet when this stimulation has passed away and the irritation of his nervous system is permitted to subside, we find reflection and conscientiousness and veneration and benevolence, all busily and powerfully at work to redeem him from his vices and his crimes, filling his soul with deep contrition and tenderness and kindness and feelings of affectionate dutifulness, all prompting him to the best resolutions for the future; but then would return upon him the temptations and the appetite to drink intoxicating liquors, and with their stimulation the demon of his ruin possessed his soul again, and immediately his conscientiousness and veneration and benevolence and all his better feelings were hushed, and destructiveness and combativeness and other selfish and cruel propensities and lusts ruled his whole nature.

1221. Now I ask, why was it that his moral sentiments were not equally excited with his more exclusively selfish propensities, by the stimulation of the ardent spirit; and why they did not maintain that relative degree of influence on the conduct and character of the individual at such times, which they exerted when the nervous system was free from the stimulation and irritation of the spirit? For we see that, according to Gibbs' own confession, when he was under the influence of ardent spirit, combativeness and destructiveness were the ruling elements of his character; but when he was wholly free from the influence and effects of intoxicating substances, those elements no

* False casts of the head of Gibbs, modified to correspond phrenologically with his character as a pirate and a murderer, have been extensively circulated; but the analysis which I have given in the text is strictly according to Gibbs' own living head, and according to the true cast of his head taken by Coffee under the gallows immediately after he was cut down. This analysis shows that Gibbs was not a pirate and a murderer from a natural necessity arising from his cerebral organization, but from a moral necessity arising from his voluntary depravity; for destructiveness was not proportionably larger in the head of Gibbs than in the head of Spurzheim. And this view of the subject, besides being the true one, fully exonerates phrenology from the charge of 'fatality,' which has ever been considered its most odious feature (629).

longer exerted their controlling sway within him, but gave place to conscientiousness and benevolence and other elements of this kind. Surely, if all the cerebral organs held the same relation to the physiological conditions and affections of the domain of organic life, all of them must be equally excited to action by the general stimulation of the nervous system; and in such a case, if the stimulation of alcohol considerably increased the functional energy and action of the organ of destructiveness, combativeness, etc., it would increase in exact proportion the functional energy and action of the organ of conscientiousness, etc. So that, so far as the cerebral organs were affected through the medium of the domain of organic life, the relative influence of the several organs would be preserved in all states of the system—all being equally increased in energy and action by general stimulation, and all suffering an equal abatement of that energy and action as the stimulation subsided—and thus Gibbs and every other man, so far as the causes which we are now considering are concerned, would always have the same relative degree or force of propensity to contention and cruelty and destruction, etc., and the same relative force of benevolence and veneration and conscientiousness, etc., whether the nervous system was under the powerful stimulation of alcohol, or only under the bland and healthful stimulation of appropriate aliment. And the various intellectual and moral causes in life alone could excite particular cerebral organs, and arouse one or more to a high degree of functional energy and action, while others remained inactive and quiet. But the cases which I have presented, and thousands of other similar facts continually met with in the history of man, as well as every true principle of human physiology, conclusively demonstrate the error of such a notion, and clearly and incontrovertibly prove that if phrenology be true in regard to the organization of the brain, the organs of destructiveness, combativeness, acquisitiveness, etc., hold nearer and more special functional relations either to particular organs or apparatuses in the domain of organic life, and through them to the general economy of that domain, or immediately to the general economy itself, than the intellectual and moral organs do.

1222. And hence it may be predicated as a general law, that whatever increases the stimulation of the domain of organic life beyond what is essential to the most healthy and complete performance of the functions of that domain, always increases the direct influence of that domain on the cerebral organs (595). And again, it may be predicated as a general law, that whatever increases the direct influence of the domain of organic life on the cerebral organs, proportionably increases the influence of the propensities over the intellectual and moral faculties (598), rendering more difficult for the understanding to weigh correctly the evidence which is presented to it, and to arrive at conclusions of truth, and more difficult for the moral faculties to preserve their functional integrity (620).

1223. But I have clearly shown (915, 916) that pure vegetable aliment is sufficiently stimulating to excite the system to the most healthful and complete performance of all its functions, and that flesh-meat is decidedly more stimulating and heating than proper vegetable food (906); and increases in man the force or power of those physiological conditions in the domain of organic life, which being perceived by the

cerebral centre or centres, constitute the animal instincts or propensities (1203); and consequently increases the influence of those propensities over the intellectual and moral faculties (598).

1224. There is, however, an important distinction to be observed between flesh-meat and pure stimulants (733), whether of a deleterious character or not. Flesh-meat, like pure stimulants, but in a much less degree, increases the general stimulation of the nervous system, and the exhaustion of the vital properties and organized substances of the body; but here all resemblance between them ends. The pure stimulants, almost without exception, produce direct irritation as well as stimulation, and the ultimate exhaustion which they cause always results in increased irritability; and all the poisonous stimulants, such as the alcoholic, narcotic, etc., produce a still greater degree of direct irritation, and directly impair the vital properties of the organs, and cause a far greater degree of irritability. The pure stimulants, therefore, not only stimulate the nervous system while their direct influence continues, but they also, and particularly the deleterious, produce a permanent irritability of the system, which is often of a highly morbid character, rendering the system extremely irritable under the action of other causes, physical, intellectual, and moral; but as they only serve to exhaust the vital properties and waste the organized substances of the body, without affording any nourishment in return, they do not increase the size of any part of the system, but rather tend to diminish the whole. Flesh meat, on the other hand, in a healthy system that is accustomed to it, nourishes as well as stimulates, and therefore replenishes the exhaustion and repairs the waste which its stimulation and the consequent action occasion, and without producing that preternatural irritability which results from alcoholic, narcotic, and other pure stimulants of that general class. And by affording a high order of stimulating nourishment to the system, it not only increases the power of those physiological conditions and affections in the domain of organic life which, being perceived by the cerebral centre or centres, constitute the animal instincts or propensities of a more exclusively selfish character (1203), but it also naturally, if not necessarily, increases the relative size of those cerebral organs which hold the most immediate and special functional relations to particular organs in the domain of organic life, or to the general wants and economy of that domain (1192).

1225. But size alone does not necessarily give an organ a proportionable influence in the cerebral system. An individual, for instance, may have a very large organ of benevolence and moderate destructiveness and combativeness, yet all the habits and circumstances of that individual may co-operate to keep his combativeness and destructiveness in constant exercise, and to prevent the action of his benevolence. Another individual may have large combativeness and destructiveness and moderate benevolence, yet all his dietetic and other habits and circumstances may be such as exert a quieting influence on his organs of combativeness and destructiveness, and a constantly exciting influence on his benevolence. In each of these cases the actual moral character of the individual will differ from the phrenological character of the head, and this is frequently the case. I have often found much

better heads, phrenologically speaking, on convicts in prison, than I have found on some excellent members of society.

1226. From all the considerations which I have presented on this subject, therefore, I am constrained to regard *that* system of fortune-telling which depends on the proportions and prominences of the head, as extremely uncertain and of very questionable utility even at best, and as capable of being made exceedingly injurious in its effects on society. Phrenology, admitting all that it contends for concerning the anatomy of the brain, can only become a true and complete science by embracing the whole human system with all its physiological properties and powers, conditions and relations; and then it will become INTELLECTUAL AND MORAL PHYSIOLOGY.

1227. In regard to the comparative effects of pure stimulants and flesh-meat, then, the latter tends to increase the relative *size* of the lower and back parts of the brain, or of the cerebal organs of the animal propensities, but without necessarily making men quarrelsome and cruel and destructive. If their dietetic and other habits are in other respects simple and correct, and their general circumstances favorable to a pacific and kind temper, they may seldom or never outrage the laws of society in its simplest and rudest forms. The pure stimulants, and especially the alcoholic and narcotic, etc., on the other hand, without increasing the size of the organs, always greatly increase the action and depraved energy of the more exclusively selfish propensities, and tend to make men quarrelsome, cruel, and destructive(1202); and when freely used by those in whom the organs of these propensities are relatively large, they are sure to transform them to incarnate demons of wickedness and violence (1220). In the uncivilized state, therefore, flesh eaters who, like the Patagonians (971), are rarely able to indulge in alcoholic and narcotic substances, and who in other respects have little to produce a preternatural or morbid irritability of the nervous system, may live together in small tribes with comparatively little exhibition of the fiercer and more cruel and wicked and violent passions; but flesh-eating savages who indulge freely in tobacco and ardent spirit and other like stimulants, are always extremely fierce and cruel and blood-thirsty, delighting in violence and murder. While, on the other hand, those uncivilized tribes and nations which subsist wholly on vegetable food, and indulge freely in alcoholic and narcotic substances, never become thus fierce and cruel and blood-thirsty. And it is only when the vegetable-eating natives of India and the islands of the ocean have tortured themselves to the fiercest extremes of suicidal madness, by their excess in opium and arrack and other pernicious stimulants, that they rush furiously forward in the work of violence and destruction, and seem equally intent on giving and receiving death (1021).

1228. So far as physiological and moral evidence can go to establish the point, therefore, there is the strongest reason to believe that the antediluvians, immediately preceding the flood, indulged to great excess in both flesh and wine; for such a diet only could produce the enormous wickedness and violence recorded of them. If the Patagonians were as numerous as the Hindoos, and as densely crowded together, and indulged as freely in the use of alcoholic, narcotic, and other intoxicating and stimulating substances, the wickedness and

violence which would prevail among them would exceed all description and all power of imagination.

1229. Whether phrenology be true or false, then, it remains equally true that flesh-meat, more than proper vegetable food, developes and strengthens the animal propensities and passions, and especially those of a more exclusively selfish character, rendering man more strongly inclined to be fretful and contentious and quarrelsome and licentious and cruel and destructive, and otherwise vicious and violent and ferocious. If any dependence can be placed on the statements which have come to us from reputable authority, even the tiger, if taken very young and reared upon a vegetable and milk diet, without ever being permitted to taste of flesh, becomes remarkably gentle, and manifests none of that ferociousness which is common to its species; but if afterwards it be fed on flesh, it soon becomes ferocious and cruel and destructive. The same demonstration, as we have seen (839), is afforded by feeding herbivorous animals on animal food. 'In Norway, as well as in some parts of Hadramant and the Coromandel coasts,' says Bishop Heber, 'the cattle are fed on the refuse of fish, which fattens them rapidly, but serves at the same time totally to change their nature and render them unmanageably ferocious.' And it is an interesting fact, that the Sacred Scriptures fully confirm this doctrine. The prophet Isaiah, foretelling the coming of the gospel kingdom, and figuratively describing that reign of righteousness and peace when all the rancorous and ferocious passions of man shall give place to placableness and gentleness and meekness and benevolence and charity,—when the bear and the calf, the leopard and the kid, the lion and the lamb, and all other ferocious and gentle animals, shall associate and dwell and lie down together in peace, says, '*The lion shall eat straw like an ox.*' Now whatever interpretation any one may see fit to give to this passage in other respects, it is not possible there should be two opinions concerning the point under contemplation. Whether it be said that the prophet literally means that the lion and the lamb shall dwell together in peace, and the lion shall eat straw like an ox, or that by this language he intended to teach figuratively what shall take place in the human family, it remains equally true and equally evident that he designed expressly and clearly to teach the important relation between the natural temper and moral character, and the nature of the diet of the animal or individual. I cannot conceive that any one can be so blind or so perverse as not to see at a glance, that the prophet intended in a prominent manner to associate the wonderful gentleness of the lion with his vegetable food, and thereby clearly to teach the relation between the carnivorous character of the lion and his natural ferociousness, and between his remarkable gentleness in the new state of things and his vegetable aliment. If, therefore, the prophet had explicitly affirmed, in so many words, that flesh-meat tends more to develop and strengthen the selfish and contentious and cruel and ferocious passions, than pure vegetable food does, he would not have taught the doctrine more clearly than he has done in the passage before us.

1230. I do not however affirm, that those who subsist exclusively on vegetables and water will never exhibit any unamiable passions. To use the language of phrenology, combativeness and destructiveness

and acquisitiveness, etc., are essential elements in the constitutional nature of man, originally designed for good and adapted to good; and no kind of aliment can ever obliterate them, nor is it desirable that they should be obliterated, but rather that they should be properly subordinate to the intellectual and moral powers, and strictly maintain their functional integrity with reference to their final causes. It must necessarily always be true, therefore, in the present state of being, that man will be naturally capable of anger and other violent passions. And a thousand other causes besides flesh-eating and the use of intoxicating substances are continually operating in civic life to excite unlovely and injurious passions in man; and for that very reason, flesh-eating is a far more powerful cause of these effects in civilized than in savage life. The Patagonian may subsist wholly on flesh, with his other habits and circumstances of life, and be tolerably gentle and peaceable; but bring him under the ten thousand exciting and irritating and debilitating mental and moral and physical causes of civil life, and he would soon find that his exclusively flesh diet was a powerful source of evil to him (1228).

1231. Vegetable-eaters certainly may, and often do, become vicious under certain circumstances; but as a general fact, their vices are of a different character from those of flesh-eaters under similar circumstances; they are less violent, less ferocious and blood-thirsty. The Hindoos, with their greatest excesses in opium, arrack, and other intoxicating and stimulating substances, and situated amidst many circumstances unfavorable to industry and virtue (1021), are often given to low and degrading vices, such as deceit, lying, fraud, theft, etc. But when we consider how densely they are crowded together, how indigent and how idle thousands of them are, and how universally they are accustomed to excess in various stimulants, we have reason to be surprised that so little of violence and bloodshed should be perpetrated among them. The lazzaroni of Naples present a similar general fact. Fortunately for the cause of humanity, those tribes of the human race who subsist wholly or principally on flesh cannot be prolific (1110), and therefore the population never becomes dense like that of India; nor can they procure the means of habitual and free indulgence in the use of intoxicating substances.

1232. On the whole, then, the comparative effects of animal and vegetable food in relation to the propensities and passions in the human species, are these. Flesh-meat is more stimulating, more heating, than vegetable food; and its immediate effect on those who eat it, is to increase the energy of the more exclusively selfish propensities, and the violence of the more turbulent, ferocious, and mischievous passions. Its permanent effects, from generation to generation, as a general fact, are to increase the relative proportion of the lower and back part of the brain, and to cause the animal to predominate over the intellectual and moral man; and when the numerous exciting, irritating, debilitating, and depraving causes which abound in civic life, co-operate with this, their combined efficiency of evil is tremendous. And surely it is of less importance to us to know how far the savage in all the rude simplicity of his habits and his circumstances may be able to endure the effects of an exclusively flesh diet, than to know what are the effects of flesh-meat on man in civil life.

1233. We have seen (1113, etc.) that in all conditions of life and in all circumstances, a well-chosen vegetable diet is better adapted to the organization and physiological properties, powers, laws, and interests of the human body than flesh-meat; yet that, in some conditions and circumstances, man can subsist on flesh-meat with less disadvantage than in others. But the fact that the Esquimaux and Patagonian in their conditions and circumstances can subsist on flesh with less disadvantage than the Hindoos could in theirs, should not lead us to conclude that flesh is better for the Esquimaux and the Patagonian in their conditions and circumstances than vegetable food, nor that it is as good.

1234. If now we recur to the explanation which I have given of the moral powers of man, or rather of the moral sense and conscience (593, *et seq.*), and apply the principles there laid down to the reasonings before us, we shall find that flesh-meat, by augmenting the carnal influences on the intellectual and moral powers (607), always increases the tendency of our understanding to misapprehend and inaccurately weigh the evidences presented to it (620), and to arrive at erroneous conclusions on all questions of right and wrong (621), and more especially when self is in the slightest degree interested; and consequently, it always increases our tendency to form an erroneous conscience (623). And also, if phrenology be true, in regard to the organs of benevolence and veneration and hope and marvellousness (536), flesh-meat always tends to impair the functional integrity of those organs, and increases our tendency to misapply our benevolence, to exercise our veneration superstitiously on unworthy objects, even the basest idols; to cherish delusive and debasing hopes, and to give ourselves up to a superstitious faith and fanatical credulity. The moral sense tells us to be right, but the understanding only can determine what is right (612). Hope prompts us to hope, but the understanding only can determine what to hope for (629). Veneration prompts us to reverence, but the understanding only can determine what we should venerate. Marvellousness prompts us to exercise faith, but the understanding alone can determine what we may properly believe. Thus all the sentiments, as simple elements in our moral constitution, merely prompt us to be cautious, to be right, to hope, to venerate, to believe, etc., but depend entirely on the understanding to determine what is true in regard to their simple dictates or promptings.

1235. But the understanding can only determine what is true, by examining and weighing evidences presented or apprehended; and false evidences may be presented, or but part of the evidence in the case may be examined, or the evidence may be inaccurately weighed (619); yet if by any means the understanding is fully brought to erroneous conclusions under the promptings of the moral sense, veneration, hope, etc., an erroneous conscience, a false reverence, a false hope, etc., necessarily result. Now flesh-meat comes in to diminish the sensorial power of the nervous system (1125), and thus to impair the pure healthy energy and activity of the sentiments, and the delicate power of the understanding to perceive moral and religious truth (623); then it increases the relative power of the animal propensities (1229), or the carnal influences on the operations of the understanding (620), deceitfully seducing it to neglect or misapprehend or inaccurately weigh

evidences, and thus bringing it to erroneous conclusions; and finally, as a general and permanent fact, it tends to diminish the relative size of the upper and front parts of the brain, and thus to cause the animal to predominate over the intellectual and moral man (1218).

1236. Thus, after having carefully and minutely examined all the anatomical and all the physiological evidence in relation to the natural dietetic character of man, we perceive that there is not the slightest reason for considering man an omnivorous animal; but that every jot and tittle, both of anatomical and physiological, and I may add of psychological, evidence relevant to the question, go to prove most clearly and conclusively that MAN IS NATURALLY A FRUGIVOROUS AND GRANIVOROUS, OR A FRUIT AND VEGETABLE-EATING ANIMAL.

1237. But I shall again be asked, what will you do with the grand fact, that a considerable portion of the human family have for at least thousands of years subsisted on a mixed diet of vegetable and animal food?

1238. I reply that God has created man with a constitutional adaptation to vegetable food, so that a pure and proper vegetable diet is essential to the highest and best condition of human nature; but God has also created man with a constitutional *capability* of adapting himself, within certain limits, to that which is not compatible with the highest and best condition of human nature, but which, as it is more or less of an infraction of the laws of constitution and relation established in his system, will sustain the physiological and psychological interests of his nature with more or less disadvantage and deterioration (725).

1239. This point may be illustrated by a most complete analogy. Man was originally created with a constitutional adaptation to some particular climate; so that there is, or has been, somewhere on the face of the earth, a particular climate which is perfectly adapted to the highest and best condition of human nature in every respect; and every departure from this is necessarily attended with some disadvantage to the physiological interests of man's nature; yet we find that mankind have actually spread themselves out over the whole globe, and acclimated themselves to every portion of the earth's surface; and from this grand fact we learn, not that man is created with a constitutional adaptation to every climate over the whole face of the globe, nor that one man is created with a constitutional adaptation to one climate and another to another, but that man is created with a *constitutional capability* of adapting himself to a very great variety of climates. Nevertheless it remains strictly true, that there is a particular climate which, of all others, is best adapted, to the highest and best condition of human nature, and man possesses no such constitutional capabilities of adaptation as will enable him to adapt any other climate to the highest and best interests of his nature, nor to adapt himself to any other climate in such a manner as to secure the highest and best interests of his nature; but in all cases he necessarily makes some sacrifice of those interests by every departure from that particular climate to which man, as a species, is constitutionally adapted (763). True, if he goes into a cold climate, he can regulate the temperature of his body by clothing and other means; yet the very means by which he thus artificially regulates the temperature of his body, are necessarily in all cases, to a greater or less degree, injurious to the physiological inter-

ests of his nature; and still, with all these disadvantages, he may maintain life and health perhaps for a hundred years and more. But does this last fact prove that the climate in which he lives is in the highest degree favorable to human health and longevity? Most certainly it does not (872).

1240. This reasoning is all strictly applicable to the dietetic character and capabilities of man. The grand fact that considerable numbers of the human family have long subsisted on a great variety of vegetable and animal substances, proves, not that man is created with a constitutional adaptation to all the vegetable and animal substances from which the human body has physiological power to elaborate any nourishment (684), nor that one man is created with a constitutional adaptation to one kind of aliment and another man to another kind, but that man is created with a constitutional capability of adapting himself to a great variety of aliment. So that, if necessity requires it, in case of shipwreck or any other emergency, he can sustain life for a while on almost any vegetable or animal substance in nature. Still it is none the less true that there are particular kinds of food which, of all others, are most conducive to the highest and best condition of human nature, in every climate and in all circumstances. Nor does man possess any such constitutional capabilities of adaptation as will enable him to adapt any other kinds of food to the highest and best interest of his nature, nor to adapt himself to any other kinds of food in such a manner as to secure the highest and best interests of his nature (763); but in all cases he necessarily makes some sacrifice of those interests by every departure from those particular kinds of food to which man as a species is constitutionally adapted (725). He may, it is true, by the exercise of his intellectual and voluntary powers, artificially prepare many substances to which he is not constitutionally adapted, in such a manner as to render them more palatable and perhaps less pernicious to him; but he can never make them in the highest degree salutary to the physiological and psychological interests of his nature: while the very artificial means which he employs in preparing those substances are, in all cases, to a greater or less extent sources of evil to him (408); and though he may maintain life and health in this way for seventy or a hundred years, yet it by no means proves that his mode of living is most favorable to human health and longevity.

1241. Is it said that I make a distinction where there is no difference, when I speak of constitutional adaptation, and constitutional capability of adaptation? I reply that the difference is obvious and essential. Man is constitutionally adapted to water or the aqueous juices of fruits as a drink, and pure water is therefore in the highest degree favorable to the physiological and psychological interest of man in all climates and in all circumstances when drink is required; but he is not constitutionally adapted to ardent spirit as a drink, nor has he the capability of adapting ardent spirits as a drink to the physiological and psychological interests of his nature; yet he has the constitutional capability of adapting himself to ardent spirit as a drink, but not in such a manner as to secure in the highest degree the physiological and psychological interests of his system (763); on the contrary, he does great injury to those interests by such an adaptation, and in all cases necessarily sacrifices those interests to

a greater or less extent, by every departure from pure water as a drink (725). Nevertheless, extensive experience has fully demonstrated that man can so adapt himself to tea, coffee, cider, beer, wine, ardent spirit, and other kinds of alcoholic and narcotic beverages, as to be able to use them habitually, and yet to maintain a degree of health, in some rare instances, for fifty, sixty, seventy years, and more. Yet he always does it to the injury of the physiological and psychological interests of his nature, and at the risk of his life, and knows not at what moment his habits may precipitate him to destruction. All this is true in regard to food; and therefore, the fact that man is capable of adapting himself to any particular kind of aliment, and of habitually subsisting on it, by no means proves that that kind of aliment is adapted to the highest and best condition of human nature, nor even that it is best adapted to the particular condition and circumstances in which he may individually be placed. I repeat, then, in the conclusion of this general topic, what I have frequently before stated, that nothing is more erroneous than our reasonings from experience on subjects of this kind may easily, and almost inevitably will be, if our investigations are not governed by the most rigidly accurate principles of physiological science.

LECTURE XX.

Experience in favor of a mixed diet, does not militate against the physiological principles advanced in these lectures—Health may be maintained at the expense of life—Intensive and extensive life incompatible—Healthiness not a proof of good habits: cases given—Healthiness of butchers—Ruddiness, how far an evidence of health—Brief recapitulation of the effects of animal food—What, on the whole, is best for civilized man in regard to flesh-meat—The necessity for flesh-meat in childhood—Scrofulous diseases in connexion with vegetable diet—If people will eat flesh, the best kind and manner—The Mosiac regulations physiologically correct—The flesh of clean animals in a state of nature best—Fatted animals diseased—Blood should not be eaten; why—Fat should not be eaten; why—Beaumont's experiment in regard to fat—The muscular fibre of clean healthy animals the best part of the body—Birds, what kinds best—Fishes, what kinds best—Preparations of animal food—Best raw—Best modes of cooking it—Liquid forms of food objectionable—Salted flesh and fish not good; smoked still worse—Butter better avoided; if any used, what and how—Butter bad for invalids—Cheese better avoided; the best and most wholesome kind—Milk; general opinion and experience concerning it—Anatomical and physiological principles concerned—General conclusion concerning milk—Important that it should be from healthy cows fed on clean healthy food—Cream, if sweet and good, better than butter—Eggs, how best used, if used at all—Flesh impairs the power of the stomach to digest vegetables and fruits—Concluding remarks in regard to animal food.

1242. We have seen (698,797), that whatever be the diet on which man subsists, simple, plain, coarse, natural food is most perfectly adapted to the laws of constitution and relation established in his nature; the most conducive to the health, vigor, and long life of the body, and most favorable to the energy and activity of the intellectual and moral faculties. We have seen also (798, 1241), that all the anatomical and physiological evidence which the human system affords in relation to the subject, fully and conclusively proves that man is naturally frugivorous and granivorous, or a fruit and vegetable-eating animal.

1243. But the experience of a considerable portion of the human

family for several thousand years has also provod that man *can* subsist on a mixed diet of animal and vegetable food, and in many instances enjoy good health, and possess great bodily and mental vigor, and attain to what is ordinarily considered very old age.

1244. This fact, however, does not in any degree militate against the general conclusion established by anatomical and physiological evidence; for, it should ever be remembered as one of the most important and invariable laws of our nature, that *we may maintain health at the expense of life.* Or, as Professor Hufeland expresses it (1105), 'very sound health may shorten life.' Or, to state the proposition with more exactness and accuracy, we may, by virtue of a sound and vigorous constitution, and by the help of many circumstances and habits favorable to health, strength, and longevity, maintain comparative health and vigor, until we attain to what in modern times is ordinarily considered old age, in spite of some circumstances and habits which are unfriendly to the highest physiological interests of our bodies, and which necessarily hasten the consumption of life, and consequently shorten the period of our human existence. For as I have stated (1092), nothing is more true than that *intensive* and *extensive* life are incompatible with each other, and it is universally admitted that flesh-meat always causes more vital intensiveness than pure and proper vegetable food does (909). High-toned and vigorous health, therefore, is not a conclusive proof that our dietetic habits are most favorable to health, nor is the long continuation of such health a proof that our dietetic habits are most conducive to longevity. The truth of this important proposition is often strikingly demonstrated by individual experience. I will present a single illustration.

1245. At the close of my introductory lecture, in one of the beautiful villages of New England, I was addressed by a professional gentleman of very considerable intelligence, who was not far from seventy years of age, of portly appearance, and seemingly in what is commonly considered good health. He had a large frame, well clothed with flesh, and a somewhat florid complexion. Yet he was strictly temperate in regard to alcoholic liquors. 'I am glad to see you,' said he, 'and rejoice that you have consented to come and give a course of your lectures to our people. I think there is great need of such instructions at the present day. In our land of overflowing abundance, every body is in danger of excess, and I lament to see our young people so much devoted to the indulgences of luxury. I shall certainly attend your lectures, and doubt not that I shall listen to them with great interest, although I do not expect to be benefited by them in my own person. I am now too far advanced in life to make any changes in my habits with the hope of being benefited, even though some of my practices might be considered a little exceptionable. Yet I have by no means been inattentive to these things, and I think I have the best evidence in the world that my habits have been very salutary; for I am now an old man, in the enjoyment of uncommon health and vigor for one of my age; and during my whole life, since my remembrance, I have not been so much indisposed as to be obliged to keep my house for a single day.' 'Indeed, sir,' I replied, 'that may be very greatly your misfortune.' 'Misfortune!' he reiterated with much emphasis and surprise, 'How can it be a misfortune to enjoy uninterrupted health for seventy

years?' 'Because, sir,' I answered, 'judging from the original soundness and vigor of your constitution, you are now but little past the meridian of your natural life; and the continued health of which you boast, may only have served to blind you to your dietetic and other errors relative to the laws of life, and to give you full confidence in the correctness of those habits which may in the end prove to have robbed you of nearly half of your natural existence. It should be remembered that not one human being in a million dies a natural death. If a man is shot or stabbed or poisoned or killed by a fall, or some other means of this kind, we say he dies a violent death; but if he is taken sick and is laid upon his bed, and is attended by physicians and friends, and waxes worse and worse, and finally dies, perhaps with dreadful agonies and anguish, we say he dies a natural death. But this is wholly an abuse of language, a mis-statement of fact; the death in this latter case is as truly a violent death as if the individual had been shot or stabbed or poisoned. Whether a man takes a dose of arsenic and kills himself at once, or takes small doses which more gradually and by more imperceptible degrees destroy his life, he equally dies a violent death, though the convulsive agonies which attend his dissolution may be less violent in the latter, than in the former case (1096). And whether he gradually destroys his life with arsenic, or any other means however common, he equally dies a violent death. He only dies a natural death, who, during his whole existence, so perfectly obeys the laws of constitution and relation established in his nature, as neither by irritation nor intensity to waste his vital energies, but naturally and slowly passes through the progressive changes of his system from childhood to old age, and finally, in the sheer exhaustion of his vital powers, lies down and falls asleep in death, without a struggle or a groan.'

1246. The worthy gentleman, if not entirely convinced, was at least made thoughtful by my remarks; and so we parted. At my next lecture I observed he was not present. The third and fourth were given, and he still was absent. This excited my curiosity to make inquiries after him, and I was surprised to learn that he was very ill. A few days more elapsed, and I was informed that his physician considered him dangerously sick; that his disease had thus far baffled the physician's skill; and his symptoms had from the first continued to become more and more violent, in spite of all the means which had been used to subdue them. I now called to see him, and was exceedingly astonished to behold how great a change had taken place in his appearance in so short a time. A few days after this, he died. I however visited him frequently before his death; and at each interview, scarcely had I entered his room before he began to exhort me with much earnestness and pathos to be faithful in my public labors, to warn the rising generation of the dangers of the table, and to entreat parents not to destroy their children by multiplying and pampering their appetites in early life, till they had become such perfect slaves to them as not to be able to deny themselves, but were led captives by their lusts to their destruction. Before he died, he requested that his body might be opened and examined after his demise. I was politely invited to attend this *post mortem* examination. And though I have seen many diseased bodies opened after death, yet never in any instance have I found disease so

extensive as in this case. The entire stomach and intestinal canal and other portions of the abdominal contents presented one general mass of deep and irremediable disease, which clearly indicated a progress of several years, and which was of a character that fully evinced that it was not produced by any sudden or violent cause, but that it was the result of causes which had been gradually operating, and by imperceptible degrees developing their effects, probably through the whole course of life.

1247. This individual was a pious, and I doubt not a good man. His habits in all respects had been such as good people in modern times consider strictly consistent with Christian principles; and there was no one thing nor practice nor circumstance which could be fixed on as the specific cause of his disease. He loved, indeed, the good things of the table, and enjoyed the social repast; but always, as he believed, within the bounds of Christian propriety, and was probable never more excessive than is extremely common for good men. The cause of his untimely death was therefore no particular outrage or violence done to his system, but the habitual oppression and over-working and consequent irritation of his organs, which a vigorous constitution had sustained for a remarkably long time; and by that depravity of his physiological powers which I have pointed out (729), his system was unable to manifest those symptoms of the early stages of the disease in his organs which would have enabled him to take timely measures to remove it, and therefore it proceeded to the destruction of his life, without being even suspected by himself or his physician. For, before his body was opened, no one had the least expectation of such a disclosure as was made.

1248. This single case, then, fully demonstrates for the whole human family, the important proposition, that present health is not a conclusive proof that the dietetic and other habits of the individual are most favorable to health, nor does the continuance of health prove that those habits are most conducive to long life.

1249. Butchers are often referred to as evincing the healthy and invigorating effect of a free use of flesh-meat. But I apprehend that there is a very general error of opinion on this point. I have taken great pains to investigate this subject, and have made my inquiries very extensively among this class of men, in several of our principal cities. From the concurrent testimony of all intelligent butchers with whom I have spoken on the subject, I learn—1, That as a general fact, there is far less flesh-meat consumed by butchers than is commonly supposed. Indeed they all assure me that as a class they do not consume more of this kind of aliment than other members of society, and many of them eat less of it. 2. That butchers are more particular in regard to the kind and quality of their flesh-meat than other people, or to use their own language, they 'eat none but the best.' 3. That there is much more indisposition and sickness among butchers than is acknowledged by those who write in favor of animal food; and that where there is a free use of flesh-meat, the diseases are generally violent, and are apt to terminate fatally. 4. That those who indulge freely in flesh-meat rarely attain to old age. And, 5. That the healthy and robust appearance of butchers is more attributable to their regular habits and active employment in the open air, than to their animal food.

1250. There is another thing concerning which a general error of opinion prevails. It is a common notion that a florid countenance, when not produced by intoxicating liquors, is a sure sign of good health, and that a pale complexion is an invariable indication of poor health. It is true that there is a kind of sallow sickly paleness which is a pretty sure sign that the functions of the system are not all healthfully performed; but it is far from being true that a ruddy countenance is always the index of good health; and still farther from being true that it is always the index of that health which is most compatible with long life. 'Too much ruddiness in youth,' says Hufeland, 'is seldom a sign of longevity.' As a general fact, at all periods of life, it indicates that state of the system in which, either from disease or from intensity, the vital expenditure is too rapid for permanent health and for longevity. The clear complexion in which the red and white are so delicately blended as to produce a soft flesh-color, varying from a deeper to a paler hue according as the individual is more or less accustomed to active exercise in the open air, or to confinement and sedentary and studious habits, is by far the best index of that kind of health and of that temperament which are most favorable to continued health and length of days.

1251. As a general law of the human constitution, then (to which particular individuals may form temporary exceptions), flesh-meat in any quantity is not necessary nor best for man in any situation, while excessive flesh-eating deteriorates his nature in every respect. It impairs the symmetry of his body and the beauty of his person; renders him less supple and active, and less able to endure severe and protracted effort and fatigue and exposure and privation; impairs his complexion; causes his breath to be fetid, and his body more liable to disease and less able to recover from it; abbreviates the period of his earthly existence; renders him less able to endure heat and cold, and as a species less prolific; diminishes the sensorial power of his nervous system, and consequently the functional power of his organs of special sense, and of his intellectual and moral faculties; increases the energy and violence of his more exclusively selfish propensities and passions; and renders him more dull, stupid, sluggish, and sensual. Nevertheless experience has proved that the dietetic use of flesh is, to a certain extent which is regulated by circumstances, compatible with present health and strength; and where certain circumstances are favorable to longevity admits of what is ordinarily considered old age (915).

1252. But while all this is true of the healthy and vigorous body accustomed to much active exercise in the open air, it should ever be remembered that in civic life, as a general rule,* the diseased, the invalid, the delicate, cannot with the same safety suffer flesh in any quantity or in any form to enter into their diet (1095). It has been well observed by the distinguished Dr. Cheyne, of whom I have before spoken (1094) that although they who are laboring under chronic diseases of certain kinds may, by a strict and careful regimen, which admits of a small portion of flesh-meat in their diet, very considerably mitigate their symptoms, and perhaps for many years continue in a tolerably comfort-

* There may be particular cases of disease in which individuals who have always been accustomed to flesh-meat, may find it necessary to continue the use of this kind of food for a short time, on the same principle that they use medicine.

able state as invalids, yet they cannot hope entirely to eradicate their disease and recover their original health without a total abandonment of animal food. It has also been judiciously observed by another celebrated writer on health, that when all the circumstances of civic life are taken into consideration, citizens generally should be regarded as invalids, by those who lay down rules of diet and general regimen for them; for although they may not be actually diseased, yet the causes which continually conspire to make them so are so numerous and so powerful, that they need to use the caution and the prudence of invalids in order to preserve the health which they possess. Let it be understood, however, that the caution and prudence here suggested do not mean that citizens should be always taking medicine, or trembling lest a free breath of air should blow upon them, nor always thinking about their health, but that they should carefully avoid those excesses and errors in their dietetic and other habits which are decidedly unfavorable to human health, and which none but the robust active laborer in the open air can long endure without disease, and even he never with impunity.

1253. But whatever claims may be urged on the score of habit for the necessity of flesh-meat, by those who have been long accustomed to the use of animal food, certain it is that no such claim can be set up in regard to the diet of children; and it is equally certain that, as a general and permanent law of the human constitution, affecting not only the individual but the species from generation to generation through all time, a pure and well-chosen vegetable diet, under a correct general regimen, is in every respect most favorable to the physiological and psychological interests of man, and therefore it is the most suitable nourishment for children, and is best adapted to develop and sustain their bodies in all their physical and vital and intellectual and moral powers.

1254. I am fully aware that the opinion has been frequently advanced, and is perhaps generally entertained by medical gentlemen and others in England, Scotland, and America, that the total absence of animal food in the diet of children leads to scrofulous and other cachectic diseases, and that the best remedy for these diseases is a generous diet consisting mostly of flesh-meat; and the fact that in Scotland and other countries where the food of children is principally vegetable, these diseases greatly abound, has been repeatedly urged in proof of the correctness of the opinion. But I am none the less confident that the opinion is entirely erroneous, and that it has arisen from a total misapprehension and misinterpretation of facts. In our own country, where animal food is almost universally consumed in great excess, and where children are trained to the use of it even before they are weaned, scrofulous affections are exceedingly common, and lead to that fearful prevalence of pulmonary consumption which has rendered that complaint emphatically the *American disease.*

1255. That a crude watery diet of ill-prepared vegetable food, in connexion with an improper general regimen, may lead to an unhealthy state of the solids and fluids of the body in childhood, is unquestionably true; but an accurate and thorough investigation of the subject will show that filthiness, impure air, and other unwholesome circumstances and errors of regimen, are infinitely more concerned in producing scrofulous diseases in the children of Europe, than the want of animal food.

To say nothing of the well-fed vegetable-eating children of other countries in all periods of time, the private and public experiments which have been made in the United States within the last ten years, have fully demonstrated, not only that the very best health can be preserved in childhood without the use of flesh-meat, but that feeble and cachectic children, and even those who are born with a scrofulous diathesis, can be brought into vigorous health on a well-ordered vegetable diet, under a correct general regimen. The extensive experiment which has been made in the Albany Orphan Asylum, since the close of 1829, has afforded results so conclusively in favour of a pure vegetable diet for children, that they ought to command the serious attention of every philanthropist, of every parent, and of every one who may come under the responsibilities of a parent.*

1256. I say then, to every one and to all, as Moses said to the Israelites in the wilderness concerning their future habits in the promised Land,—if notwithstanding all that I have said against the use of flesh-meat, ye still say, 'We *will* eat flesh, because our souls long to eat flesh, then eat ye whatsoever your souls lust after,'—only permit me to point out to you with utmost brevity, the least objectionable kinds and modes of such transgression.

1257. It is true, as the scriptures affirm, and as I have before remarked (684), that the human body is capable of deriving nourishment from 'every living thing that moveth' in the animal kingdom: reptiles and vermin, as well as four-footed beasts, and fowls of the air, and fish of the sea; and among the different portions of the human family, animals of nearly every known species belonging to our globe are devoured as food. But it is nevertheless true that some kinds of animals are less objectionable for human aliment than others, and some portions of the animal body may enter into the diet of man with less injury to his physiological interests as an individual and as a species than other portions.

1258. It is perhaps the prevailing opinion that the dietetic regulations of the Jews, instituted at Mount Sinai, constitute a special regimen adapted to the particular condition and circumstances of that people, and to the peculiar economy of the Mosaic dispensation; and it is undoubtedly true that, in some respects, those regulations were more immediately necessary to the preservation of individual health among the Jews, in their particular climate, condition and circumstances, than they are to people who, in these respects, are very different. Still, however, it is an interesting and important truth that the dietetic regulations of Moses are founded on the physiological laws of the human constitution, and therefore are universally applicable and always valid; for although, as a general fact, a disregard to those regulations would not produce the same morbid results in the transgressor in Arabia and in Lapland, yet in all cases and in every place if animal food is used, a strict conformity to those regulations would be better for man as an individual and as a species.

1259. If it be said that the dietetic regulations of Moses tolerate the use of flesh-meat, my reply is that I shall show in another work that Moses permitted the Jews to eat flesh on the same principle that he

* See a full account of this interesting Institution in the Appendix, Note A.

suffered them to put away their wives, and that the whole economy of the Mosaic dispensation aimed rather to restrict than to encourage the Jews in the use of this kind of food, and that his dietetic regulations concerning it were obviously designed to restrain them as much as possible, and confine them to the least objectionable kinds and preparations.

1260. It is not necessary for me to specify the kinds of animals to which Moses limited the Jews. Every one who is curious on this subject can easily refer to the Old Testament. It is sufficient for me to state in general terms, that they consist of those species whose natural food is the most pure, mild, and unexciting, and whose flesh, when used as human aliment, is least stimulating in its nature, and least febrile and putrescent in its tendency, and of these animals none but the perfectly healthy and those that were properly killed* were allowed to be eaten. It is also an exceedingly important and interesting fact to flesh-eaters, that in those days when tillage was less artificial, and when flocks and herds grazed more at large, and subsisted more upon the spontaneous produce of the uncultivated soil, than in modern times, the flesh of the ox and sheep and other domesticated animals was far less unwholesome than the flesh of the same species of animals fed and fattened on the produce of an exceedingly depraved, and, if I may so speak, morbidly excited soil, which has long been subject to the forcing and depraving processes of modern agriculture. Moreover, the confinement and stall-feeding, and all the other artificial circumstances and educated habits of domesticated animals, render their flesh less wholesome for human aliment. Indeed, as I have already remarked (501), most of the animals which in modern times are fitted for the slaughter-house and for interment in living sepulchres, are actually in a state of disease when they are killed; and therefore, shocking as the thought may be, the human stomach in these days of elegant refinement and of science and religion, is actually made a kind of 'potter's field' to receive the unknown dead of every disease! Why should we marvel, then, that putrid and malignant and violent disease, as well as those of a more chronic character and less alarming symptoms, but more general prevalence, should so severely scourge the human family, and especially in civic life?

1261. As a general rule, therefore, the flesh of wild animals regarded as clean by the Mosaic regulations, and of the ox and sheep and other domesticated animals, when suffered to roam at large in the pure air of the field, and to select their food from the produce of the natural or virgin soil, according to the undepraved instincts of their nature, is far less unwholesome than the flesh of those animals which are reared and fattened on the produce of a cultivated soil, and in the customary manner of modern times. The very process of fatting, I have said (501), and I repeat it solemnly,—the very process of fatting, and most especially in the artificial mode of stall-feeding, is a decreasing process, and the large

* The animal is not stunned with blows, producing stagnation and congestion of the blood; the throat is cut with a remarkably sharp knife, and all the veins and arteries are emptied; the lungs are searched with the hand; if the liver attaches to the ribs, or there are impurities, malformation, or any apparent disease, it is condemned, and the leaden seals are not attached to the meat. It is thus that the observance of ancient laws by this ancient people gives them great protection against feeding on diseased animals.—N. Y. Eve. Star, November 1833.—M. M. Noah

accumulation of adipose or fatty matter in the body is always in some measure a morbid result of the unbalanced functions of the system.

1262. The Mosaic regulations most strictly prohibited the use of blood as human aliment. This prohibition is founded on important moral as well as physiological principles. The sacredness of life in all cases, except when its destruction is necessary for the good of man or other animals, was more highly appreciated by the wise moralists and lawgivers of antiquity than by the Christian philosophers of modern times. The Mosaic prohibition recognizes the great moral truth, that the wanton destruction of life in the lower animals not only deadens the moral sensibilities and sympathies of man, but greatly diminishes in his estimation the sacredness of human life. Nothing is more true than that familiarity with blood always hardens man, and makes him more wantonly cruel. And when man not only sheds, but also devours blood, he is both morally and physiologically affected by it; his moral sensibilities and sympathies are deadened, and his selfish and destructive propensities are increased and rendered more vehement and ferocious (1212). Blood is oppressive to the human stomach, and digested by it with difficulty, and always produces a general increased excitement in the system, and tends to febrile and putrid diseases. It putrifies much sooner than the animal solids; and when animals are strangled or put to death in any manner by which the blood is retained in their bodies, it causes an earlier and more rapid change and putrid decomposition in the solids, rendering them far less wholesome for human nourishment. It is also an important fact, that when animals have eaten or inhaled any poisonous substance, and it has been taken up by the absorbents (448), the state of the blood is more immediately and extensively affected by it than that of the solids; and when by any means the animal becomes either locally or generally diseased, the blood and other fluids of the system are much sooner brought into that morbid state which will produce disease in the consumer than the solids. Hence thousands of cattle are slaughtered in a state of disease, and their flesh is eaten without producing any immediate symptoms of disease in the consumers; but if those same cattle were strangled, and their flesh eaten with the blood in it, or the blood eaten alone, it would almost inevitably produce immediate disease in the consumers.

1263. Another exceedingly important dietetic regulation in the institutions of Moses, was the prohibition of fat. He proclaimed it as 'a perpetual statute for their generations, throughout all their dwellings, that they should eat no manner of fat, of ox nor of sheep nor of goat nor of any other beast' And this is not merely a special statute adapted to particular situations and circumstances, but it is a regulation founded on the permanent physiological laws established in the human constitution.

1264. The adipose or fatty matter of animal bodies, we have seen (498, 501), is a crude oily substance, resulting, when exceeding a small quantity in particular parts (498), from excessive alimentation, or unbalanced action between the organs of composition and decomposition (499); and is deposited in small sacs in the cellular tissue, till it can be removed by the absorbents and eliminated from the system. In the cells of this same tissue, also, and closely associated with the adipose matter, other capillary exudations are often deposited, and among these

are some of a very morbid and even of a very deleterious character. Thus, when tobacco, alcohol, and other poisons are taken into the system, there is, as we have seen (950), at first a general rallying of the vital forces, and energetic reaction till they are wholly expelled from the vital domain; but when these substances are habitually used till the organic sensibilities are depraved (728) and the integrity of the vital functions greatly impaired, the vital reaction is less energetic, and instead of an entire expulsion of the deleterious substances of the body, a portion of them is deposited in the cellular tissue with the adipose matter, where it often remains for months, and sometimes causes extensive bloating and even general dropsy. I have known persons who have been greatly addicted to chewing, smoking, or snuffing tobacco, and who, after an entire abstinence from it in every form for several months, on coming from a vapor bath which had caused profuse perspiration, emit a powerful tobacco odor from their whole surface. Indeed I once saw a young person made sick at the stomach by rubbing the body of such an individual when he came from the bath. The individual was a friend of mine whom I had taken to the bath on purpose to try the experiment, and he assured me that he had not used a particle of tobacco in any manner for four months. The keeper of the bath informed me that he had observed the same fact in many instances; and that some invalids who had boarded with him and been under his care, taking the bath three times a week, had continued to emit the tobacco odor on coming from the bath, for several weeks in succession, when not a particle of tobacco had been used by the individuals for months. The same thing he had also observed in persons who had previously been much addicted to drinking alcoholic liquor, and others who had taken much medicine of certain kinds.

1265. These facts, which may be relied on with entire confidence, clearly prove that the vital economy has some depository out of the general circulation, and at the greatest remove from the most important vital properties and functions of the system, where it disposes of those deleterious and other offensive and superabundant substances which, from any cause, it is unable wholly to eliminate from the vital domain; and this, we have seen (499), is none other than the adipose tissue. And hence it is evident that when, from poisonous or unwholesome food, or from any other cause, morbid and deleterious deposits take place in the animal system, the general receptable is that portion of the cellular tissue which contains the adipose matter; and there is the strongest reason to believe that those substances become closely associated with the fat.

1266. But whatever may be thought of this objection to animal fat as a portion of human aliment, there are other physiological reasons which show most determinately and conclusively that it is not proper for the food of man. We have seen (452) that the assimilating organs of man digest this substance with great difficulty, and that they cannot digest it at all except in very small quantities, without a departure from the perfectly regular and normal order of their functions; and even by these means they are never able to assimilate it so perfectly but that its crudeness is always manifested in the chyme, chyle, and blood, when it is freely eaten. Dr. Beaumont, of whose interesting "Experiments and Observations on the Gastric Juice and the Physiology

of Digestion' I have already spoken (421, Note), has fully settled this question.

1267. Bile, it will be remembered, is secreted by the liver (451), and emptied into the duodenum (338) or small intestine, about four inches below the pyloric orifice of the stomach (341), and naturally ought to descend along the intestinal tube (451) with other excrementitious substances; but it may, by a reverted action of the parts, be carried up and emptied into the stomach, and discharged by vomiting, as when emetics are taken, in paroxysms of sick-headache, etc. As a general fact, whatever produces irritation in the stomach has a tendency to cause the bile to be brought into the gastric cavity. 'Bile,' says Dr. Beaumont, 'is seldom found in the stomach except under peculiar circumstances. Irritation of the pyloric extremity of the stomach, and external agitation by kneading with the hand on the right side over the region of the liver and pylorus, and also violent fits of anger, occasion the flow of bile into the gastric cavity; and I have observed that when the use of fat or oily food has been persevered in for some time, there is generally the presence of bile in the gastric fluids. Magendie expresses the belief that 'in certain morbid conditions the bile is not introduced into the stomach; implying that in a healthy state it is always to be found there. But there can hardly be a greater mistake. With the exceptions that I have mentioned, *it is never found in the gastric cavity in a state of health*, and it is only in certain morbid conditions that it is found there. Where much fat meat or oily food has been used, the oil always maintains an ascendency in the gastric cavity. Bile is required and necessarily called into the stomach *only* for the purpose of facilitating the chymification of all fatty and oily aliments (452), and *its admixture with the gastric juice seems to retard the digestion of all other than oily food.*'

1268. It is, therefore, fully ascertained by the experiments and observations of Dr. Beaumont, that in a perfectly healthy state of the stomach and equable frame of mind, *bile is never introduced into the gastric cavity by the action of the parts;* and its presence in the stomach may be regarded as an indication of morbid gastric irritation from mental and physical causes; and it may be considered a foreign and offending substance in that organ, retarding or otherwise disturbing the function of digestion in all cases except when oily substances are eaten, and then it is necessary in order to convert the oil into a kind of saponaceous substance, and thus prepare it for the action of the gastric fluid (452).

1269. By whatever means introduced, then, bile is always a cause of more or less irritation to the stomach, and through it to the whole domain of organic life, and frequently to the whole animal system, and particularly the brain; hence it is fully evident that as procuring causes of gastric irritation and aberration of function, fat meats and animal oils of every kind tend to debilitate the digestive organs, and to induce in them a chronic morbid irritability, and especially in civilized life, where numerous other causes co-operate to produce the same result. Moreover, the great difficulty with which they are digested, and the imperfectness with which they are assimilated in all the vital processes (452), render them still further the causes of irritation and disease to the system. The particular character of the disease which

they cause, varies according to the peculiar predisposition and general circumstances and habits of individuals. In some, it will take the form of dyspepsy; in others, of liver complaint; in others, of chronic diarrhœa; in others, of pulmonary consumption; in others, of sick-headache; in others, of eruptions of the skin, salt-rheum, St Anthony's fire, erysipelas, etc.; in others leprosy, etc. In very hot climates the injurious effects of oily food are much sooner and more powerfully felt than in very cold climates; and hence, though it may be tolerated with *apparent* safety in the latter, it must be avoided in the former. Nevertheless it is decidedly objectionable in all climates, situations, and circumstances.

1270. After what has been said concerning the dietetic regulations of Moses (1258), and the use of animal fat as human aliment (1263), it is hardly necessary to remark, that from every consideration, pork, or the flesh of swine, is wholly unfit for the food of man, and will never be eaten by those who know and regard the physiological laws which a wise and benevolent Creator has established in their constitution.

1271. The muscular fibre, or lean meat of clean healthy animals, which are allowed to run at large and feed according to their undepraved instincts on the pure produce of the natural soil, is therefore the most wholesome kind of flesh-meat, or the least unwholesome kind that can be employed for human nourishment.

1272. What I have said in regard to the flesh of four footed-animals, is also true of the feathered tribes. Birds that subsist on flesh and fish should never be eaten by man; those which live on fruits and seeds and grass are less objectionable. The wild are, generally speaking, less unwholesome than the domesticated or tame. Of the latter, the common farm-yard fowl and turkey, when kept on proper food, and not diseased in fatting, are decidedly less objectionable than geese and ducks. The flesh of these last is too oily and too compact and hard to be digested without much difficulty, and therefore requires a vigor of the digestive organs rarely possessed in civilized life except by robust active laboring men.

1273. Concerning fish, the Mosaic regulations are strictly correct. Fresh scale fish recently taken from the ocean or rivers of pure water, or from clear running streams, or from lakes which are continually fed by living fountains, and have outlets by which they send forth their waters incessantly, are the only kinds of the inhabitants of the deep which men who use animal food should ever taste of, unless it be to prevent starvation, in cases of extreme necessity.

1274. The flesh of such fish is less exciting and also less nourishing than the flesh of the ox and sheep and other quadrupeds. Those portions of the human family who subsist from generation to generation principally or almost entirely on fish, are, on an average, under the middle size, and often even dwarfish in stature, and generally, if not invariably, destitute of bodily symmetry. But where a little dried or boiled fish is occasionally eaten as a condiment, with bread or other kinds of vegetable food, its effects upon the human system can scarcely be appreciated, and it is perhaps no farther objectionable than as it involves a general principle in relation to the use of animal food, and is, so to speak, a stepping over the line of demarkation between the two kingdoms, and an opening of the way for unbounded excesses in carnivorous habits in others, if not in ourselves.

1275. In regard to shell-fish, notwithstanding clams, oysters, and lobsters are such favorite articles of food with multitudes in civic life, and notwithstanding oysters have been so extensively recommended by physicians to invalids and convalescent patients, it is nevertheless certain that the Mosaic prohibition of them is well founded, and that they never should be eaten by mankind except in extreme emergencies, when nothing less objectionable can be procured for food; and most especially should they be avoided in civic life, where so many other causes are continually operating to impair the health and destroy the life of man. I am aware of all that has been said in praise of their effects on invalids; but these effects are generally, if not invariably, specious and delusive, and do not deserve the credit which they have received. When an individual of considerable constitutional power experiences an attack of acute disease, and is suddenly reduced by remedial means, and kept for several days under the effect of medicine, with very little or no food till the disease is subdued and healthy action restored, the demand of the vital economy for alimentation is so great that there is, as it were, a general rallying and concentration of the vital forces in the digestive organs, giving them a functional power far in advance of the general ability of the system, and enabling them to perform their assimilating function with uncommon energy and rapidity, and in many instances to digest food with apparent ease which would occasion a fit of dyspepsy in the ordinary state of the stomach in civic life. This important fact, not being understood, has led to unbounded delusion in regard to the dietetic regimen of convalescent patients, and caused relapses and death in thousands of instances.

PREPARATION OF ANIMAL FOOD.

1276. Revolting as it may sound to ears refined, and shocking as the idea may be to civilized human beings, still the stern truth of physiology compels me to declare, that flesh recently killed and eaten entirely raw is least injurious to any animal that subsists upon it. It is less rapid in its progress through the stomach (735), less exhausting and debilitating to the digestive organs, less exciting to the system generally, and is more permanently sustaining to the physiological powers of the body, than when it has been subjected to the changes of culinary preparations.

1277. I know that for a single meal or for a short time, a stomach unaccustomed to raw flesh would not so comfortably dispose of it as it would of that which had been previously prepared in a customary manner. Nevertheless, as a general fact, extending from generation to generation, it is strictly and incontrovertibly true, that if mankind eat flesh at all, they will better serve the physiological interests of their bodies in every respect, maintain more vigor of the organs, more integrity of their functions, secure more uniform and sounder health and longer life, and a clearer, more active and powerful intellect, by eating it entirely raw, than by eating it after it has been prepared by cooking in any manner whatever.

1278. But it may perhaps be said that the great naturalist Cuvier declares that 'neither the jaws nor the teeth of man will allow him to devour flesh unless it is previously prepared by cooking' (846). I reply that Cuvier was incomparably better acquainted with comparative anatomy and the natural history of animals than with physiology. He

was entirely correct when he said, that 'judging from his structure, the *natural* food of man appears to consist of fruits, roots, and other esculent parts of vegetables;' but when he said that 'once possessed with fire, and those arts by which he is aided in seizing animals or killing them at a distance, every living being was rendered subservient to his nourishment, thereby giving him the means of an infinite multiplication of his species,' he only offered a fanciful apology for the carnivorous habits of a considerable portion of the human family. But the truth is, that if man chooses to eat flesh, his jaws and teeth will not only allow him to eat it raw, but they and all his other alimentary organs and all the physiological interests of his body will suffer less injury from eating it in that state than from eating it after it has been cooked by fire.

1279. If, however, the civilized portion of the human race will not consent to eat their flesh-meat entirely raw, the best mode of cooking it is to roast, or broil, or boil it. The old-fashioned way of roasting flesh suspended by a string before a large fire, and constantly turned round till it is moderately done through, is perhaps the very best manner of cooking it. Boiling renders it less stimulating and also less nourishing. Stewing flesh is a more objectionable mode of preparing it; and frying it in fat or grease of any kind is decidedly the most pernicious manner in which it can be prepared by culinary art. It is enough to break down the digestive powers of any stomach. The muscular fibre and other parts become thoroughly permeated and saturated with the hot fat, so that if the flesh thus cooked is ever so much masticated or retained ever so long in the mouth, the particles cannot imbibe the saliva (426), and they descend into the stomach prepared to resist the action of the gastric fluid and all the physiological powers of that organ, and thus to retard digestion, and cause irritation and derangement of function, and prepare the way for a terrible train of evils.

1280. Flesh soups and broths are also very objectionable forms of animal food. Soups are altogether too complicated to be healthy. Besides, it may be laid down as a general and very important rule, founded on the anatomical and physiological laws of the human system, that in proportion as artificial preparations of food render the function of mastication unnecessary, they are injurious to the teeth (709), and detrimental to all the alimentary organs, and to the physiological interests of the whole system. I am aware that flesh broths, chicken broth, etc., have formerly been very commonly ordered by physicians for their convalescent patients; but practising physicians have not all been very careful to make themselves thoroughly acquainted with those physiological laws which should govern them in prescribing the diet of the sick, and this is probably one of the principal reasons why they have not been more successful in the treatment of disease.

1281. We have seen (738—745), that every kind of concentrated aliment is more or less injurious to the stomach, and through it to the whole system. Flesh broths consist of a quantity of water holding in solution or in a fluid state some of the nutrient principles of the flesh in a very concentrated form. When this kind of food is swallowed into the stomach, the very first duty which that organ performs is to take up (440), with its absorbents (442), all the water which contains the concentrated nutrient principles of the flesh, and with the water, the salt, if any, held in solution by it, while the concentrated animal matter

is retained in the stomach, like a kind of sediment, to be digested into chyme, and pass into the intestinal tube like other food; and as there is no mastication of this food, and consequently no mixture of saliva with it in the mouth, when the water of the broth is all absorbed, the remaining concentrated animal matter is left even more dry than is the ingested food which was received into the mouth in a solid form and freely masticated and mixed with the salivary fluid. Moreover, solid aliment, when properly masticated and slowly swallowed into the stomach, always excites a more ready and more copious secretion of the gastric juice, and a more free and vigorous action of the muscular tissue of the stomach. Fresh broths, therefore, always serve to vex and irritate and to debilitate the digestive organs, and should be particularly avoided by those whose digestive powers are feeble.

1282. Salted flesh and fish of every kind are less easily digested and less nourishing than fresh; yet they will sustain a laboring man longer, because they pass less rapidly through the stomach (1015), and for this reason salted pork is commonly considered the best food for hard laboring men, as, to use their own language, it will stick by them longer than any other food. Salt is itself an indigestible substance, and when it has penetrated animal substances so as to preserve them from the process of putrefaction, it renders them much more difficult of digestion, and consequently in some degree causes irritation to the digestive organs. Fat pork thus preserved, being an oily substance, as well as containing salt, is still longer in passing through the stomach than other kinds of salted animal food; and when the digestive organs have sufficient vigor to perform their functions in spite of its disturbing qualities, the individual feels himself remarkably well sustained in the gastric region by such aliment; yet if he is an accurate observer of his own experience, he will soon learn that though his stomach is longer kept employed by salted pork, his body is not saved by it from great weariness at the close of his day's labor. This weariness, which is scarcely felt at all by the laborer who subsists on a pure vegetable diet, is much increased by the protracted employment of the stomach in disposing of the salted pork (1266—1270).

1283. Flesh and fish that are both salted and smoked are yet more difficult of digestion, and more oppressive and irritating to the assimilating organs. Yet it is not uncommon to see upon the breakfast table of feeble invalids, a dish of salted or smoked fish, broiled and perfectly saturated with butter, and perhaps also dressed with mustard and pepper. Such a dish is enough to give a hyena a fit of dyspepsy.

1284. From what has been said concerning the dietetic use of animal fat (1261), it must be very obvious that gravies of every kind containing oily matter, whether the drippings of the flesh or melted butter, are exceedingly objectionable and mischievous. Indeed, most of the made gravies on our public and fashionable tables, and all too common everywhere in civic life, are execrable compounds, which are infinitely more fit for the soap-boiler's vat than for the human stomach! It is not easy to use language too strong in reprehension of these vile dishes, for it would not be easy to measure the extent of the evil which they cause. They are truly abominable preparations, and ought to be regarded with deep and permanent abhorrence.

1285. Concerning the use of BUTTER as an article of diet, it is some-

what remarkable that with all the diversity of opinions in regard to the food of man, nearly all who have written or spoken on the subject of human aliment with reference to health, have been entirely agreed in considering this favorite article as decidedly objectionable, and some have spoken of it in the severest terms of condemnation. Dr. Beaumont's experiments and observations (431) fully prove that when butter is taken into the stomach with other substances 'it becomes a fluid oil, and floats upon the top of the chymous mass, retaining its oily character and appearance, till all the other contents of the gastric cavity are nearly or entirely chymified and emptied into the duodenum' (338), and it, like all other animal fat (1267), is digested only by being first acted on by a portion of bile and converted into a kind of saponaceous substance, and then it receives the action of the proper solvent fluid of the stomach. The point is, therefore, for ever established beyond all controversy, that butter is better avoided than eaten by mankind.

1286. But if civilized human beings are determined to continue the use of butter, in spite of every physiological demonstration, and in defiance of consequences, then certain regulations in regard to it at least should be observed. In the first place, none but the healthy and vigorous and active and full-grown should ever presume to use it. Diseases of every kind, both acute and chronic, are aggravated by it, though it may produce no distress nor sensible disturbance in the stomach. The delicate and feeble and inactive suffer more from it than the robust. And children and youth are always more injured by it than healthy adults; and this is none the less true and important, because in consequence of the energy and elasticy of the youthful constitution, the injurious effects do not immediately manifest themselves by powerful and indubitable symptoms. In the second place, none should be used but that which is perfectly sweet, and recently made from the milk of healthy cows which are permitted to run at large in the open air, or if housed at all, kept in clean and well-ventilated stables, and fed on good clean grass or hay of the best kind, free from weeds and every poisonous herb; for every impurity and pernicious substance that finds its way into the bodies of the cows by absorption, will inevitably affect the quality of the butter (1294). When butter becomes old and strong or rancid, it is still more offensive to the digestive organs, and more unfriendly to health. In the third place, those who use butter at all, should use it very sparingly, and never in the melted form.

1287. If a small quantity of butter is spread upon cold bread or other kinds of food, the article upon which it is spread may be masticated and freely mixed with the salivary fluid in the mouth, and thus its particles will be prepared to resist the penetrating quality of the butter when converted into oil in the stomach, and prepared also for the action of the gastric fluid. But if the butter is spread upon hot bread or other kinds of food, or is first melted and turned upon the food—unless it be some impenetrable substance—it will permeate it so thoroughly, that, however finely it may afterwards be masticated or ground in the mouth, the particles being saturated with the oil will wholly resist the action of the salivary fluid, and descend into the stomach prepared to stand out long against the action of the gastric juice. This is the reason why all kinds of pastry in which butter or lard or some other kind of oily substance is freely and intimately mixed up with flour, are so exceedingly op-

pressive and embarrassing to the debilitated stomach, and always so trying and injurious even to the most vigorous and unimpaired digestive organs.

1288. Bread toasted and completely saturated with butter is a very common dish for those who are laboring under chronic disease, and yet few preparations of food could be worse for them. I have seen individuals in the last stage of pulmonary consumption partaking freely of such dish; and when I have remonstrated with them, they have defended the improper indulgence on the ground that it agreed perfectly well with their stomachs. Poor souls! they knew not that the iniquities of their stomachs were visited upon their suffering lungs, and through them on the whole system (1095); and that to this fact alone their stomachs owed their immunity from distress whenever they partook of such a dish (511). I have seen others laboring under painful chronic diseases of many years' standing, frequently and freely partaking of hot short cakes swimming in melted butter, and I have often seen them very much displeased when I pointed out to them the impropriety of their eating such food. It is needless to say that such invalids never recover health while they continue such practices. As a general rule, then, butter should never be used in a melted form, nor upon any thing hot enough to melt it.

1289. CHEESE, in the stomachs of dyspeptics, and others of feeble digestive powers, is always a difficult thing to manage; but robust active laboring men, of general simplicity of habits, are able to digest it in small quantities, without experiencing any immediate sensible inconvenience, when it is pure and good, and used as a condiment with bread and other kinds of farinaceous food. Rich old cheese, which is most sought after by epicures, and which has been recommended by some as a good promoter of digestion, is always digested with great difficulty, and causes much irritation in the stomach, and not unfrequently produces extensive eruptions or inflamed pustules or blisters of the mucous membrane of the stomach and mouth. Cheese not more than three months old, made of milk from which the cream or oily matter has mostly been taken, is far more easily digested, and is in every respect less unwholesome and less objectionable than that which is ordinarily considered the best. But in making this as well as other kinds of cheese for market, it is quite fashionable for the manufacturer to put in annatto and even arsenic and other poisonous substances, to give it a rich and creamy appearance and taste. It is so uncommon thing for whole families to be made seriously sick by eating cheese which is thus adulterated. The curd made by the ancients, and in modern times by the Germans and others, called pot-cheese, is decidedly the most wholesome cheese that is used.

1290. MILK has been praised by almost every writer on human diet, as being one of the most nourishing and wholesome kinds of food that man can eat. Chemical physiologists have told us that it is the only single article which contains within itself every element essential to human nourishment. Mr. Riley informs us that the Arabs of the desert live two or three hundred years, in excellent health, exclusively on the milk of their camels (779). Milk, we know, is the natural diet for children and the young of all mammiferous animals. And the experience of the human family for thousands of years has proved that

milk is a very nourishing and wholesome and invigorating article of food for man in almost every situation, condition, and circumstance in which he may be placed. In short, there is a vast amount of evidence in favor of milk as an important article in the diet of mankind. And it is very certain that, not only for those who are laboring under disease of any kind, and for the delicate and feeble, and for the young and for the sedentary, but also for those whose situations and duties require the greatest bodily streng h and activity and ability to endure protracted fatigue and privation and exposure, a milk and vegetable diet is far better than a flesh and vegetable diet. Nevertheless, eight years of very extensive experiment and careful observation have shaken many of my preconceived opinions concerning milk as an article of human food.

1291. The testimony of hundreds of individuals in all the various situations and conditions and circumstances of civilized life is entirely unanimous on this subject. All explicitly affirm that though they do better on a milk and vegetable diet than on one of flesh and vegetables, yet they do best when they confine themselves to a diet of pure vegetable food and pure water. I have found that dyspeptics and invalids of every description do better when they abstain from the use of milk than when they use it, and in many cases it is indispensably necessary to prohibit milk. Farmers, mechanics, and others whose labors are severe, and who require great bodily strength and ability of endurance, all declare that they feel more vigorous and active, and labor with greater ease and elasticity, and experience less exhaustion and sense of fatigue at the close of the day, when they abstain from milk and subsist exclusively on vegetable food and water, than when they use milk.

1292. And this general testimony from experience is certainly in strict accordance with the anatomical and physiological evidence of the human system and the general analogy of nature. The young of all mammiferous animals, including those of the human species, naturally subsist for a certain period exclusively on milk. Those of the lower animals in a state of nature, in proper time instinctively begin to accustom themselves to other kinds of food adapted to their systems, and finally abandon their milk aliment entirely, and the fountains from which they drew it wholly dry up. The alimentary organs of children are in a condition requiring liquid food, and milk is peculiarly adapted to their physiological wants and powers. As they grew older, however, new organs are developed (324), adapted to new functions, and adapting the system to new kinds of aliment; and there is no good reason to doubt that, simultaneously with the development of the teeth, in a perfectly normal state of the system, correspondent changes take place in the physiological properties and powers, if not in the anatomical properties of the digestive organs. So that, while they retain the capability of continuing to sustain the body on milk, they are fitted to serve the general interests of the system better on more solid forms of aliment.

1293. On the whole, then, as general rules for adult man, those who are laboring under disease of any kind, and especially if the disease is of a serious character, and more particularly if it is of an inflammatory nature, or one which all increased excitement of the system aggravates, had better abstain entirely from milk, or at most only use it in the

quantity and manner which I shall point out when I come to speak of the various modes of preparing vegetable food (1401). The sedentary, the studious, and the delicate, had better observe the same rule. Dyspeptics almost invariably find it oppressive to their stomachs, causing a sense of distention and heaviness (440). It is possible, however, that there may be particular cases in which the invalid and the delicate and the sedentary may be benefited by a temporary use of a milk diet. This is a point to be decided by the intelligent physician who knows the symptoms and circumstances of the case, and by the careful observation of the individual. Those who are healthy and active and athletic can do exceedingly well on a milk and vegetable diet ; but, as a general rule, they can do still better by abstaining from the use of milk, and subsisting wholly on a diet of pure and well-chosen vegetable food and pure water: and by vegetable food I mean to comprehend all fruits and farinaceous seeds and roots, and other kinds of esculent vegetables proper for human aliment.

1294. Concerning the use of cow's milk as the food of children and youth, I shall speak more particularly in a subsequent lecture, when I come to treat of the diet and regimen proper for them. It is important to remark in this place, however, that whether this kind of food be used for the nourishment of children or adults, the utmost care should be taken that it is of a good quality. We have seen (1264) that whatever foreign substance is introduced by absorption into the vital domain of the animal body, is mingled more or less extensively with the blood; and in proportion to its deleteriousness or offensiveness to the vital properties of the system, so is the rallying of the vital forces to expel it as soon as possible from the circulation and to eliminate it from the body (506). In such emergencies nature avails herself of all the means in her power to effect the expulsion, and consequently all those organs which secrete or excrete substances which are designed to pass from the body, are largely employed in the general work of depuration. Hence, if the cow or the female of any species of mammiferous animals, receive any poisonous or foreign substance into the vital domain by absorption, during the period of lactation, the milk is almost immediately affected by it. And is has been ascertained by experiment, that if two cows, the one nursing a calf and the other giving no milk, receive in their food a quantity of poison sufficient to cause death, the latter cow will be killed by it, while the calf of the former will be killed and the mother will escape. In this way thousands of nursing infants have been distressed, made sick, thrown into convulsions, and even killed, by the poisonous substances voluntarily swallowed by their mothers and nurses ; and in this way thousands of human beings have been made seriously sick, and many have been killed, by the poisonous substances which cows have eaten.

1295. But the milk of cows is far more frequently rendered exceedingly impure and unwholesome than actually poisonous. Every thing that affects the health of the cow correspondently affects the quality of her milk. Impure and unwholesome food of every description, improper confinement, impure air, filthy stables, and every thing else that by absorption or otherwise affects her body unfavorably, inevitably deteriorates the milk and renders it unwholesome. When cows are kept in dirty and ill-ventilated stables, and the filth is suffered to remain

upon their bodies, and is too generally the case during the winter, the milk always becomes highly charged with the odor and taste of the filth; and when, besides all this, the cows are fed on the vile dregs of distilleries and other improper substances, their milk is any thing but wholesome, and can hardly fail to impair the health of those who use it freely as an article of diet. Even too stimulating food, however pure, such as the meal of Indian corn and other kinds of grain, necessarily renders the milk less suitable for human aliment, and especially for the food of children. Such food is given to increase the quantity of the milk, and always renders that secretion somewhat more exciting and febrile in its tendency.

1296. The best milk, therefore, can only be procured from perfectly healthy cows which, during the season of grazing, run at large in the open field and crop their food from a pure soil, and during the winter are fed on good hay, and if housed at all, kept in clean and well-ventilated stables, and every day thoroughly curried and cleaned, and supplied with pure water for drink, and suffered to take regular exercise in the open air (1286).

1297. The cream of milk, though capable of being converted into butter, yet, when recent and sweet, is perfectly soluble in water, and mixes freely with the fluids of the mouth and stomach; and therefore, if it is free from any deleterious properties (1294—1296), it is very far less objectionable than butter as an article of diet. It may be used instead of butter in a variety of ways, as I shall point out hereafter, and without any sacrifice of gustatory enjoyment, but with decided benefit to health; that is, if one or the other must be used. Nevertheless, as a general rule, the physiological interests of our bodies are better served without the use of either. The butter spoken of in the scriptures, in connexion with honey, etc., as an agreeable article of food, was probably rich sweet cream.

1298. Eggs are somewhat more highly animalized than milk, and perhaps rather more exciting to the system. Yet when fresh and good, if taken raw or very slightly cooked by boiling or otherwise, without the use of fat or oily matter, they are not difficult of digestion, and are quite nourishing. But when they are so much cooked as to become hard or solid, they require a vigorous stomach to digest them without oppression. All that I have said concerning milk, and those by whom it may be used as food (1290, 1293), I consider strictly applicable to eggs; but care should always be taken that they are not too old, and that their vitality is not in any measure impaired.

1299. In closing my remarks on this general topic, I deem it proper to repeat what I have said (858, 859), that animal food of every kind, and particularly flesh meat, when freely used, so affects the physiological powers of the digestive organs, that they cannot chymify vegetable substances with the same ease and comfort that they can when accustomed only to vegetable food. Hence, many kinds of fruits and vegetables which a flesh-eater cannot partake of without more or less inconvenience, and which in certain seasons of the year and during the prevalence of epidemics are sure to make him sick, may be freely eaten with perfect comfort and safety by those who subsist wholly on vegetable food.

1300 The conclusion of the whole matter then, concerning animal

food, is briefly this; as a general and permanent rule for the human species, in all situations, conditions, and circumstances, where man can have his choice of aliment, it is best that every one should wholly abstain from flesh-meat; but if any *will* eat it for the gratification of depraved appetite, it should only be those who are healthy and vigorous and active, and much in the open air. And they should never allow themselves to indulge in the use of it more than once a day, and then in great moderation, and only prepared in the simple manner which I have described (1279). All other kinds of food pertaining to the animal kingdom should, as a general rule, be avoided by the diseased and the feeble and delicate (1252, Note). In short, I am convinced that, as a general and permanent rule, the whole human family would do best, after a certain period in very early life, to subsist entirely on the products of the vegetable kingdom and pure water.

1301. In regard to the use of salt and other seasonings in preparing the different kinds of animal and vegetable substances for human aliment, I shall speak fully in a subsequent lecture.

LECTURE XXI.

What shall we eat?—The abundant supplies of the vegetable kingdom, and resources of the earth—General physiological laws in regard to preparing food, and the use of artificial means as aids to the vital powers—All artificial preparations of food, in themselves considered, are evil—General principles which should govern the artificial preparation of food in relation to mastication, insalivation, deglutition, temperature, concentration, combination, quantity, etc.—Practical application of these principles—Primitive simplicity of food and manner of preparing it—The history of bread, and the kinds used by different portions of the human family—'Bread the staff of life'—Wheat the best material for loaf bread—Where and how raised and best prepared—Adulterations of bread—coarse bread most wholesome—properties of meal—Yeast, fermentation, etc.—Mixing, kneading, and baking bread—Use of alkalies in bread-making—Alcohol in bread—How to keep bread sweet—Who should make bread—Bread-making the highest art of cooking—Perfect bread making the very top of culinary skill—Varieties of bread—Other less simple preparations from farinaceous substances—Cakes, etc.—Sweets and acids—All fats should be avoided—Cream and milk how used, if at all—Puddings, pies, etc.—Other vegetables, fruits, etc. how prepared and used—General conclusions in regard to the kinds, conditions, qualities, quantities, and preparations of the food of man.

1302. Those who have accompanied me thus far along my course, are by this time perhaps disposed to cry out, with the multitudes who only know what they have learned from rumor concerning my opinions, What will you leave us to subsist on? What shall we eat when all our customary food is taken away?—when flesh and everything pertaining to the animal kingdom is denied us?

1303. And has it come to this? Is it indeed true that man is under the necessity of making his body a sepulchre for dead carcasses, in order to keep himself alive, and to preserve his civilization, and the elegant refinements and arts of civic life? I do confess and deeply regret that truth compels me to acknowledge, that in many portions of the civilized world mankind have become so accustomed to depend on the products of the animal kingdom for their principal articles of diet, that they have greatly neglected to develop and foster the capabilities of their more natural and proper source of aliment, and learned to

think that starvation would be the inevitable consequence of an entire abandonment of animal food.

1304. It is true that at the public tables of our steamboats and hotels, and in fact all the fashionable tables in civic life, which almost literally groan beneath the multitudinous dead that lie in state upon them, embalmed and decorated like the bodies of Egyptian potentates prepared for solemn interment, emitting their spicy odors to disguise their natural loathsomeness; it is true that, at one of these tables, loaded apparently with every luxury and savory dainty that the market can supply and culinary skill prepare, if one sits down determined to abstain from animal food and the still more pernicious preparations of vegetable substances, he may look in vain throughout the wilderness of viands before him for a single dish of plain and wholesome vegetable food, such as a wise man would willingly and freely partake of. He might order any form of aliment that the products of the animal kingdom can be tortured into, which happens not to be upon the table, and he would probably be promptly and with alacrity supplied; but if he calls for a simple dish of fruits or vegetables, his call will either be utterly neglected, or he will be answered in a surly tone—'We have not got them, sir!'—and he may therefore either make his meal upon a crust of miserable bread, or conclude to fast entirely, and pay his dollar or half dollar for the refined and ennobling pleasure of seeing his more carnivorous and literally omnivorous fellow creatures glut themselves, much after the same manner of the giant Polyphemus when he feasted on the quivering bodies of the Greeks which he had dashed to pieces in his wrath, excited by the fierceness of his appetite for flesh.

1305. But is there a necessity for such a state of things? Must it be so, that we must either deny ourselves every enjoyment of the table, or consent to become associated in our dietetic habits and character with the hyena and the wolf and other beasts of prey? and with the vulture and the owl and bat, and other harpies of the winged kind? Nature shudders and recoils, and answers, 'No!' in the deepest tones of loathing and abhorrence, and points us to our beautiful mother earth, and asks us to contemplate her all-bountiful bosom, and the still greater capabilities of her soil, which, in the depths of our putrescent sensuality, we have too long and too ungratefully neglected and despised. What! talk of starving, in the face of Heaven, when our benevolent Creator has spread for us so bountiful a table in the vegetable kingdom, of fruits and seeds and roots and other esculent substances innumerable, and which may be cultivated and multiplied in quantity and variety without bounds? Why did not our first parents famish in Eden, when they kept the garden and fed on fruit? Why have not the myriads of the human race who, from the earliest periods of the world even to the present hour, have subsisted on vegetable food, famished and left their portions of the earth depopulated? Indeed we do abuse our own nature and our God when we suppose there is not in the products of the vegetable kingdom and in the capabilities of the soil a full supply of nourishment for man, and such as is best adapted to sustain the highest physiological and psychological interests of his nature, and to afford him the purest and richest and most wholesome enjoyments of sense.

1306. In regard to the preparations of vegetable food, when considered with reference to the very highest capabilities of human nature, it is unquestionably true that, in the climate most natural to man (1239), his physiological interests would be best sustained by those vegetable products which require no culinary change or cooking (760). But as man migrates and becomes acclimated in different portions of the earth, where he finds it necessary to subsist on different vegetable or other substances, it is possible that he may also find it necessary to prepare some of those substances by fire or otherwise, in order to render them most compatible with his organization and his physiological properties and powers and interests.

1307. It is a general physiological law of organized bodies, to which there is no exception, that all artificial means to effect that which the living body has natural faculties and powers to accomplish, always and inevitably impair and tend to destroy the physiological powers designed to perform the function or to produce the effect. Thus, as we have seen (709), every artificial means substituted for the natural and proper use of the teeth in mastication inevitably injures those organs and always tends to destroy their power to perform the function for which they were intended. And thus, every artificial means employed for the regulation of the temperature of the body always and inevitably diminishes the natural power of the body to regulate its own temperature (490). If our feet are cold, for instance, and we by walking, dancing, or other exercise of the lower limbs, increase in a natural and healthy manner the calorific function of the feet, and thus restore them to a comfortable temperature, we invigorate all the physiological powers of the parts, compatibly with the general physiological interests of the body; but if instead of this, we warm our feet by a fire, we necessarily weaken all the physiological powers of the parts, and consequently diminish the calorific function of the feet, or their natural power to generate animal heat and regulate their own temperature, and thereby render them more liable to suffer from cold. All this is true of every other member and part of the system, and also accurately illustrates the effects of all other artificial means on the physiological powers of the body (418).

1308. It may therefore be laid down as a general law, that all processes of cooking, or artificial preparations of food by fire, are in themselves, considered with reference to the very highest and best condition of human nature, in some degree detrimental to the physiological and psychological interests of man (725). Yet inasmuch as man may be so situated as to be under the necessity of subsisting on substances which are less wholesome in their natural state than when properly prepared by fire, therefore in such cases the evil of the artificial preparation by the process of cooking would be less than that which it would prevent, and consequently it would be a *necessary* evil, and in effect a relative good.

1309. This view of the subject presents the matter in a simple and true light, and clearly teaches us that whatever may be the situation and circumstances and diet of man, cooking, or the artificial preparation of his food by fire or otherwise, is always to be considered as a real and actual evil, except in so far as it is rendered indispensably necessary to his physiological interests by the character of the substances on which he

is compelled to subsist; and when thus rendered necessary, it should always be governed by the laws of constitution and relation established in his nature (683, 757); or, in other words, the preparations should always be made, as far as possible, consistent with his organization and with his physiological properties and powers.

1310. If man were to subsist wholly on alimentary substances in their natural state, or without any artificial preparation by cooking, then he would be obliged to use his teeth freely in masticating his food (709), and by so doing not only preserve his teeth from decay and keep them in sound health (713); but at the same time and by the same means he would thoroughly mix his food with the solvent fluid of his mouth (426), and thus prepare it both for swallowing and for the action of the stomach (426); and by the same means also he would be made to swallow his food slowly, as the welfare of the stomach (429), and of the whole system requires he should * (717).

1311. Again, if man were to subsist wholly on uncooked food, he would never suffer from the improper temperature of his aliment (490). Hot substances taken into the mouth serve more directly and powerfully to destroy the teeth than any other cause which acts immediately upon them (714); and hot food and drink received into the stomach always in some degree debilitate that organ, and through it every other organ and portion of the whole system, diminishing, as an ultimate result, the vital power of every part, impairing every function, and increasing the susceptibility of the whole body to the action of disturbing causes, and predisposing it to disease of every form. Moreover, the use of hot food and drink always and inevitably diminishes gustatory power and enjoyment. On this point the most egregious error of opinion prevails, wherever fire is employed in the preparation of human aliment. It is universally believed that a nigh temperature of food gives it a greater relish, but the contrary is true Heat acts on the gustatory nerve like other stimulants, always diminishing the power of that organ to perceive and appreciate the delicate qualities of alimentary substances (702); and hence they who never receive any thing into the mouth warmer than the blood, always—other things being equal—have the nicest gustatory perception, and the richest and most varied gustatory enjoyment of their food. This every one may demonstrate for himself by a fair experiment of three months' entire abstinence from hot food and drink and other hot substances. By a general abstinence from these things, also, diseases of the throat, lungs, and indeed of every part of the body, would be far less numerous and frequent than at present. In short, many and great benefits would result, without the sacrifice of a single good or real comfort, or the production of a single evil, from the total and universal abandonment of hot food and drinks; and however complicated and pernicious the artificial preparations of our aliment may in other respects be, there certainly is no necessity for its being received into the mouth and swallowed when it is hot, or even warm.

* On introducing food into the stomach of St. Martin (431, Note) through the artificial aperture, Dr. Beaumont found that the organ would not receive it rapidly even in the liquid state. 'If a few spoonfuls of soup or other liquid diet be put in with a spoon or funnel,' says he, 'the rugæ quickly close upon it, and gradually diffuse it through the gastric cavity, entirely excluding more during this action. When a relaxation takes place another quantity will be received in the same manner' (426, 429).

1312. Again, if man were to subsist entirely on food in a natural state, he would never suffer from concentrated aliment. We have seen (737, 754) that every substance in nature suitable for the food of man consists of both nutritious and innutritious matter, varying in proportions, in different substances, from three or four per cent. of nutritious matter up to ninety or ninety-four per cent. (890). But nature, without the aid of human art, produces nothing for the alimentary use of man which is purely a concentrated nutrient principle. And the human body, as we have seen (683, 757), is organized and endowed with precise and determinate reference to this state of things; and hence, as we have seen (751), a due proportion of innutritious matter in our food is as important to health as nutritious matter is. Human beings may subsist from childhood to old age on a simple diet of potatoes and pure water exclusively, and enjoy good uninterrupted health, and possess great muscular power and ability to endure protracted fatigue and exposure. But if the purely nutrient matter be separated out by artificial means, and human beings be fed exclusively on this concentrated form of aliment and pure water, they will soon perish (738), not because this matter contains no azote or nitrogen, nor because man *necessarily* requires a variety of alimentary substances (738), but simply and exclusively because the anatomical construction and physiological powers of the alimentary organs of the human body are constitutionally adapted to food which consists of both nutritious and innutritious matter.*

1313. Again, if man subsisted wholly on uncooked food, he would not only be preserved from improper concentrations, but also from pernicious combinations of alimentary substances. We have seen (852, 858), that the alimentary organs of man, like those of the horse, ox, sheep, dog, cat, and most or all other animals of the higher orders, if not in fact of all other animals without limitation, possess the physiological capability of so accommodating themselves to emergencies, that they can be made to digest almost every vegetable and animal substance in nature, and they can by long training be educated to digest a mixture of these substances at the same time. Nevertheless it is incontrovertibly true that the alimentary organs of man and of all other animals can digest one kind of food at a time better than a mixture of different kinds; for it is impossible that the solvent fluids secreted by the stomach and other organs belonging to the alimentary apparatus, (426, 447) should be, at the same time, equally well adapted to entirely different kinds of food.

1314. I do not say that the alimentary organs of man cannot, by long habit, be brought into such a state as that, while that state remains, they will not digest a mixture of animal and vegetable food with more immediate comfort and satisfaction to themselves and the individual than they will vegetable food alone. But this does not militate in the least against the general principle which I have advanced, for it is nevertheless true that the same organs are capable of being brought into a state in which they will digest a meal of unmixed food, of either kind, with less embarrassment and injury to themselves and to the

* 'Bulk,' says Dr. Beaumont, 'is nearly as necessary to the articles of diet, as the nutrient principle. They should be so managed that one will be in proportion to the other. Too highly nutritive diet is probably as fatal to the prolongation of life and health, as that which contains an insufficient quantity of nourishment.'

whole system, than they can the mixed food in any state. Hence it is a general physiological law concerning the dietetic habits of man, that simplicity of food at each meal is essential to the highest well-being of the individual and of the race.

1315. God has unquestionably provided a great and rich variety of substances for man's nourishment and enjoyment; but it is equally certain that he did not design that man should partake of all this variety at a single meal, nor in a single day nor season; but from meal to meal, from day to day, and from season to season, varying his enjoyment in strictest consistency with the great laws of his nature. And hence all artificial combinations of alimentary substances, and particularly of a heterogeneous kind, and yet more especially the concentrated forms (750), must be more or less pernicious to the alimentary organs, and, through them, to the whole system.

1316. Finally, if man subsisted wholly on uncooked food, the undepraved integrity of his appetite (757), his thorough mastication (717), and slow swallowing, and his simple meal, would greatly serve to prevent his *over-eating*, and thus save him from the mischievous effects of one of the most destructive causes operating in civic life. For excessive alimentation is indubitably the cause of more disease and premature death in civilized man, than any thing else which affects his existence; and there is no other possible way by which the evil can be removed, consistent with the highest physiological interests of the human constitution, than by a stern simplicity of diet commenced in childhood and rigidly adhered to through life.

1317. In all our artificial preparations of food, therefore, these important principles or general rules should ever be kept in view, and an intelligent and reasonable and conscientious regard to them should always be entertained and cherished, and particularly by woman, whose dominion over these matters, as the wife and the mother, gives her immense power to act either as the angel of mercy or of woe to the human race!—as the angel of mercy, if in the integrity of her soul she leads the way in truth and holiness, and teaches those on whom her moral influence is exerted to follow her;—as the angel of woe, if she suffers sensual gratification to seduce her from the path of duty, and becomes the minister of depraved appetite and indulgence.

1318. Whatever may be the kind of food on which man subsists, when the artificial preparation is made as far as possible in accordance with the physiological laws of constitution and relation established in his nature (683, 757), and is of that simple character which leaves the proportions of nutritious and innutritious properties as nature combined them (737), or in the general average conforms in this respect to nature, and effects little change in the nutritious principles, and retains the natural requisition for the function of the teeth (426), and thus secures the proper chewing of the food, and the mixing of it with the solvent fluid of the mouth (716), and the swallowing of it slowly (717), the artificial process of preparation militates very little, if at all, against any of the physiological interests of the body. But if the preparation concentrates the nutrient properties, and destroys the true proportion between the bulk and nourishment, and effects improper changes and combinations in the nutrient elements, and does away the necessity for mastication, and presents the food in too elevated a temperature and enables us to

swallow it too rapidly with little or no exercise of the teeth, and without properly mixing it with the saliva, the artificial process of cooking is decidedly and often exceedingly inimical, not only to the physiological interests of the alimentary organs, but of the whole human system. And let it ever be remembered, that, as a general rule, the processes of cooking when regulated in the very best manner, cannot so perfectly adapt the substances which it is necessary to cook, to the physiological properties and powers of the human body, as to render them equally conducive to the highest and best condition of man, with those substances which are naturally adapted to his alimentary wants (1240). And, therefore, as already stated (1308), all processes of cooking, or artificial preparation of food by fire—considered in reference to the very highest capabilities of human nature—must be regarded as in some measure an evil; and the grand desideratum is to ascertain how far the various circumstances in which man is placed, and the quality of the aliment on which he is obliged to subsist, render this evil necessary, or to what extent the artificial preparation of food can be carried without causing a greater evil than it prevents.

1319. In the application of these principles to the various situations and circumstances in which man may be placed, we readily perceive that the first great question is, What are the substances *necessarily* entering into the diet of man which require cooking, or any kind of artificial preparation, in order to render them most genial to the physiological interest of the human constitution? The second great question is, What kind or manner of preparation of those substances do the highest physiological interests of man require or admit of? And the third question is, To what extent, and in what manner, may we artificially prepare other substances which we *choose* to comprehend in our diet, without seriously infringing our physiological and psychological interests?

1320. To enter into these several inquiries with critical accuracy and complete detail, would not only require a very great deal of time, but also an intimate and perfect knowledge of the alimentary character of all the substances which man, in all the varieties of situation and circumstances of the species, may find it necessary or convenient or agreeable to eat. It cannot therefore be expected that I shall, in this place, attempt it to any considerable extent.

BREAD—BREAD-MAKING—THE HISTORY OF BREAD, ETC.

1321. It is nearly certain, as I have already stated (772), that the primitive inhabitants of the earth ate their food with very little if any artificial preparation (769). The various fruits, nuts, seeds, roots, and other vegetable substances on which they subsisted, were eaten by them in their natural state, with no other grinding than that which was done by the teeth. As the human family increased, and population became more dense and extended, and providential measures more necessary, the condition and circumstances of society gradually led to the invention and adoption of the simple, and, at first, rude arts of domestic life (29). Among these was that of bruising the harder articles of their food, such as nuts and seeds, or grain, on flat stones, selected and kept for the purpose. By constant use, these stones in time became hollowed out, and being thereby rendered more convenient, men at length began

to form mortars and pestles from stones; and probably the next step was the construction of the rude kind of hand-mills, which continued in use for many centuries, and indeed which, with the stone mortars, have, throughout all ages and in almost every portion of the earth, been used in the ruder states of society.

1322. When men became acquainted with the use of fire, they probably often parched their corn or grain before they pounded it, and afterwards they learned to mix it with water into the consistency of dough, and to bake this in an unleavened or unfermented state, on flat stones before the fire, or in the hot ashes or hot earth, or in the rude ovens which they formed by digging holes in the earth, into which they put heated stones, and slightly covered them with leaves or grass, and then laid in the article they wished to bake, and over this strewed some leaves and then covered the hole with earth.* This kind of unleavened bread undoubtedly constituted a very important, if not the principal, article of artificially prepared food in the diet of the primitive inhabitants of the earth, for many centuries; and the same, or very nearly the same, kind of bread continued in general use down to the days of Abraham; and it is probable that the unleavened bread used by his descendants at the feast of the Passover, before and after they left Egypt, was of the same kind.

1323. It is hardly possible, however, that it could have been otherwise than that, at a much earlier period, larger quantities of this dough were occasionally made than were immediately baked, and consequently portions of it were suffered to stand and ferment: and by this means, men were in process of time learned to make leavened or raised bread. At how early a date loaf or raised bread came into common use, it is impossible now to ascertain with any considerable degree of precision. The scriptures do not afford us any evidence that Abraham was accustomed to such bread; but the fact that Moses, at the institution of the supper of the Passover, the night before the Jews left Egypt, commanded them strictly to abstain from leavened bread, and to eat only the unleavened, proves conclusively that the Israelites at least were then accustomed to fermented or raised bread.

1324. Neither history nor tradition enables us to speak with any degree of confidence in regard to the period at which other nations became acquainted with the art of bread-making; but from all that has come down to us from ancient times, we learn that the primitive generations of every nation subsisted on fruits and other products of the vegetable kingdom, in their uncooked or natural state (769). 'The Greeks assert that they were taught the art of making bread by their god Ban; and Pliny informs us that this art was not known at Rome till near six hundred years after the foundation of that city. The Roman armies, he says, on their return from Macedonia, brought Grecian bakers into Italy. Before this time, the Romans prepared their meal in a kind of pap or soft pudding, and on this account Pliny calls them pap-aters.'

1325. But though the Egyptians and Israelites were probably among the earliest portions of the human family who became acquainted with the arts of making loaf or raised bread, the quality of their bread con-

*In this same manner the Sandwich Islanders cooked all their food when they were first discovered

tinued to be exceedingly simple and coarse for many generations. Even after the establishment of the Hebrew nation in Palestine, in the most splendid days of Jerusalem, at the period of the highest refinement of the Jews in the arts of civil and domestic life, their fine flour, from which their choicest bread and cakes were made, was, in comparison with modern superfine flour, extremely coarse,—ground mostly by females, in hand-mills constructed and kept for that purpose.

1326. From Rome the art of bread-making very slowly found its way over considerable portions of Europe. A thousand years after Julius Cæsar first entered Britain, the rude people of that country were little acquainted with raised bread. 'Even at present,' says Professor Thompson, 'loaf bread is seldom used except by the higher classes of inhabitants, in the northern countries of Europe and Asia.'

1327. In Eastern and Southern Asia, rice principally constitutes the bread of the inhabitants, and this is generally prepared with great simplicity. In Middle and Western Asia, and in Africa, bread though consisting of different kinds of grain, is prepared with almost equal simplicity. In Scotland, Ireland, and indeed throughout Europe generally, the bread of most of the laboring people or peasantry consists of barley, oats, rye, potatoes, peas, beans, chestnuts, and other farinaceous vegetables. In the islands of the Pacific and Southern Oceans, the bread of the inhabitants consists of the plantain, bananas, yams, bread-fruit, and other like vegetables, simply roasted, baked or boiled.

1328. Bread, in the most extended sense of the word,* therefore, of some kind or other, made of some of the farinaceous products of the vegetable kingdom, has probably in almost every portion of the world and every period of time, been one of the first and most important and universal articles of food artificially prepared by cooking, which has entered into the diet of mankind, and hence it has with great propriety been called 'the staff of life.'

1329. If we contemplate the human constitution in its highest and best condition, in the possession of its most vigorous and unimpaired powers, and ask, what must be the character of our bread in order to preserve that constitution in that condition? the answer most indubitably is that the coarse unleavened bread of early times when of proper age, was one of the least removes from the natural state of food,—one of the simplest and most wholesome forms of artificial preparations, and best adapted to fulfil the laws of constitution and relation (1310, *et seq*), and therefore best adapted to sustain the most vigorous and healthy state of the alimentary organs, and the highest and best condition of the whole nature of man, as a general and permanent fact; and hence, it is very questionable whether loaf or raised bread can be made equally conducive to all the interests of our nature, with the simple

* In the English version of the sacred scriptures, the term bread is frequently used to signify vegetable food in general. Thus in Gen. iii. 19, the Lord says to Adam — 'In the sweat of thy face shalt thou eat bread (or food) till thou return to the ground.' See also Gen. xviii. 5, and xxviii 20 and Ex. ii. 20. The most extended sense of the word, however, according to general usage, comprehends all farinaceous vegetable substances included in the diet of man: such as the farinaceous seeds or grain, nuts, fruit, roots, etc. And in this extended sense, bread, in some form or other, has been the principal article in the diet of mankind from the earliest generations of the human race to the present time, except among the few small and scattered tribes which have, perhaps, ever since the days of Noah, in different parts of the earth, subsisted mainly on animal food.

unleavened bread, I am aware that many professional men entertain a very different opinion on this subject, and speak of unleavened bread as being less nourishing and less easily digested. This may be true to a limited extent in special cases of impaired and debilitated alimentary organs; but I am confident, as a general fact, the notion is entirely erroneous.

1330. 'The whole people of Asia,' says Dr. Cullen, 'live upon unfermented rice. The Americans, before they became acquainted with the Europeans, employed, and for the most part still employ, their maize in the same condition. Even in Europe, the employment of unfermented bread and unfermented farinacea in other forms, is still very considerable, and we are ready to maintain that the morbid consequences of such a diet are very seldom to be observed. In Scotland, nine-tenths of the lower class of people—and that is the greater part of the whole—live upon unfermented bread and unfermented farinacea in other forms, and at the same time I am of opinion that there are not a more healthy people anywhere to be found. We give it to all classes and both sexes with advantage.'

1331. It is incontestibly true, that if two portions of the same kind of wheat-meal be taken and made, the one into unleavened and the other into leavened bread, and both be eaten warm from the oven, the leavened bread will prove much more oppressive and difficult to digest in the stomach than the unleavened. But aside from the changes that are produced by the process of fermentation, there are many other considerations why unleavened bread of a proper quality and age is better adapted to sustain the alimentary organs and general constitution of man in their highest and best condition. Nevertheless it is very certain that loaf or raised bread can be made so nearly in accordance with the vital laws and interests of our bodies, as scarcely to militate against them in any perceptible or appreciable degree. And when I say this, I mean not merely its effects on the health and longevity of a single individual, but its effects upon the human constitution through successive generations, for a thousand years or more.

THE BEST MATERIAL FOR LOAF BREAD—HOW PREPARED, ETC.

1332. Among the materials used for making raised bread in our country, and, in fact, of all the known productions of the vegetable kingdom in any country, wheat is decidedly the best; and it is a remarkable fact, and wheat comes nearer to man than perhaps any other plant, in its power of becoming adapted to different climates, over a wide extent of the earth's surface, so that it may almost be said that wherever the human species can flourish, there wheat can be cultivated.

1333. 'It is not certainly known,' says Professor Thomson, 'in what country wheat was first produced. Mr. Bruce informs us that he found it growing wild in Abyssinia, and in his opinion that kingdom is the native country of the plant. It would seem,' continues the Professor, 'to be originally an African plant, since it thrives best in Barbary and Egypt; and perhaps the mountains of Abyssinia, though within the torrid zone, may not differ much in point of climate from the more northern plains of Egypt. Wheat is perhaps cultivated over a greater extent of the globe than any other plant. Excellent crops are raised as far north as Sweden, in latitude 60 degrees; it is cultivated in the East

Indies, considerably within the limits of the torrid zone; and in the north of Hindostan it constitutes a chief article in the food of the inhabitants. In India, however, the plant seems to have deteriorated. It is always dwarfish, and the crop is said to be less abundant than in more northern climates.' Yet a cold climate is not most genial to the nature of this plant. 'The wheat of France is superior to that of England; the wheat of Italy is still better than that of France; and perhaps the best of all is raised in Barbary and Egypt.' Excellent wheat is raised in the southern and western and middle portions of the United States; and even in the northern and eastern parts of New England. very fine crops have been produced.

1334. But the wheat and other cultivated products of the vegetable kingdom appropriated to the nourishment of man, like those on which our domestic animals subsist (1260), are too generally, in civilized life, very considerably deteriorated, as to their wholesomeness, by the improper tillage of the soil. I have no doubt that it is true, as stated by those who have made the experiment, that the flour of wheat raised on a cultivated soil recently dressed with crude stable manure, may readily be distinguished by its odor, from the flour of wheat raised on a new and undepraved soil, or from that raised on a cultivated soil which has been dressed with properly digested manure. And if such and similar results of improper tillage can become the sources of serious evil to the human family through their effects on the flesh of animals which man devours, and on the milk and butter which he consumes (1204, *et seq.*), surely the immediate effects of such a deteriorated vegetable aliment on the human system must be very considerable.

1335. They who have never eaten bread made of wheat recently produced by a pure virgin soil, have but a very imperfect notion of the deliciousness of good bread, such as is often to be met with in the comfortable log houses in our western country. It is probably true that the new soil, in its virgin purity, before it becomes exhausted by tillage, and debauched by the means which man uses to enrich and stimulate it, produces most if not all kinds of vegetables appropriate for human aliment, in a more perfect and healthy state than any soil which has been long under cultivation can be made to do. Nevertheless, by a proper application of physiological principles to agriculture, many of the evils which now result from improper tillage may easily be avoided, and the quality of all those vegetable substances which enter into the diet of man may be very greatly improved, both in regard to wholesomeness and deliciousness. But while the people of our country are so entirely given up as they are at present to gross and promiscuous feeding on the dead carcasses of animals, and to the untiring pursuits of wealth, it is perhaps wholly in vain for a single individual to raise his voice on a subject of this kind. The farmer will continue to be most eager to increase the number of his acres, and to extort from those acres the greatest amount of produce, with the least expense of tillage, and with little or no regard to the quality of that produce in relation to the physiological interests of man; while the people generally are contented to gratify their depraved appetites on whatever comes before them, without pausing to inquire whether their indulgences are adapted to preserve or to destroy their health and life. Yet if some one does not raise a voice upon this subject,

which shall be heard and heeded, there will soon reach us, as a nation, a voice of calamity which we shall not be able to shut our ears against, albeit we may in the perverseness of our sensualism incorrigibly persist in disregarding its admonitions, till the deep chastisements of outraged nature shall reach the very 'bone and marrow' of the human constitution, and fill our land with such a living rottenness as now, in some other portions of the earth, renders human society odious and abominable. Whether, therefore, my voice shall be heard and heeded or not, I will obey the dictates of my sense of duty, and solemnly declare that this subject demands the prompt and earnest attention of every agriculturist and of every friend to the common cause of humanity; for it is most certain, that until the agriculture of our country is conducted in strict accordance with physiological truth, it is not possible for us to realize those physical and intellectual and moral and social and civil blessings for which the human constitution and our soil and climate are naturally capacitated.

1336. Sometimes, in consequence of the peculiarities of the season or climate or soil, or some other cause, there will be a species of disease affecting the wheat and other grains; and this may be of such a character as not easily to be removed nor counteracted by any means; but more generally the rust and smut and dust which attach themselves to the skin of the grain, may, by proper care, be so far removed, as at least to render the meal or flour far more pure and wholesome than it otherwise would be. And here let me remark, that they are greatly deceived who suppose that the bolting cloth which separates the fine flour from the outer skin or bran also separates the impurities attached to the outer skin from the flour. By the process of grinding, these impurities are rubbed from the outer skin, and made quite as fine as any portion of the flour, and for the most part pass with the fine flour through the bolting-cloth. To remedy this, it is perhaps generally true, that in large flouring establishments a kind of smut or scouring-mill is in operation, through which the wheat passes, and is pretty thoroughly rubbed or scoured without being broken; and after this, it passes through a screen or winnowing-mill, and thus is tolerably well cleansed and prepared for grinding. Yet this process by no means renders the wheat so perfectly clean and wholesome as washing.

1337. Those who have given little attention to this subject, will probably think that the trouble of washing all their bread-stuff before it is ground, would be much greater than any benefit which would result from it. But a short experience in the matter would convince every one who has a proper regard for the character of his bread, that the trouble of washing his grain bears no comparison to the improvement effected by it. Indeed, they who become accustomed to washing their grain, will soon cease to regard it as a trouble; and the improvement in the whiteness and sweetness of their bread will be so great, that they would be extremely unwilling to relinquish the practice.

1338. When people are so situated that they can have things as they wish, they will also find that their bread is much richer if the grain be ground but a short time before it is cooked. The best way, therefore, is, for every family to raise or purchase a sufficient quantity of the best new wheat that can be produced by proper tillage in a good

soil, and put that away in clean casks or bins, where it will be kept perfectly dry and sweet; and, according to the size of the family, take, from time to time, as they need it, one or two bushels, and wash it thoroughly but briskly in two or three waters, and then spread it out on a drying sheet or table, made for the purpose, and which is considerably inclined, so that the water remaining with the wheat will easily run off. The skin or bran of the wheat is so well protected by its own oily property, that little or no water will penetrate it, unless it be suffered to remain in the water much longer than is necessary. Being thinly spread out upon the sheet or table in a good drying day, it will be sufficiently dry in a few hours for grinding. And I say again, let any one who loves good bread, wash his grain a few times in this manner, and he will be very reluctant to return to the use of bread made of unwashed grain.

1339. It would be difficult to ascertain at how early a period in the progress of society, mankind, in the preparation of wheat for bread-making, began to put asunder what God has joined together, and to concentrate the more purely nutrient properties, by separating the flour from the part commonly called the bran. The Bible speaks of fine flour or meal as a portion of the meat-offerings of the temple, but it is not probable this approached very near to the superfine flour of the present time. We are informed also that the Romans, more than two thousand years ago, had four or five different kinds of bread, one of which was made of the purest flour from which all the bran was separated. This was eaten only by the rich and luxurious. A second kind, in more common use, was that from which a portion of the bran was taken; and a third kind, which was more generally used than any other, was that which was made of the whole substance of the wheat. A fourth kind was made mostly of the bran, for dogs. But at whatever period in the history of the race this artificial process was commenced, certain it is, that, in direct violation of the laws of constitution and relation which the Creator has established in the nature of man (1312), this process of mechanical analysis is at the present day carried to the full extent of possibility; and the farina and glutten and saccharine matter of the wheat are almost perfectly concentrated in the form of superfine flour. Nor is this all; these concentrated nutrient properties of the wheat are mixed and complicated in ways innumerable with other concentrated substances, to pamper the depraved appetites of man, with kinds of food which always and inevitably tend to impair his health and to abbreviate his life (1313). Even the bread, which is the simplest form into which human ingenuity tortures the flour of wheat, is by other causes besides the concentration I have named, too frequently rendered the instrument of disease and death, rather than the means of life and health, to those that eat it.

1340. In cities and large towns, most people depend on public bakers for their bread. And I have no doubt that public bakers, as a body, are as honest and worthy a class of men as any in society. I have no wish to speak evil of any one; and it is always painful to me to find myself compelled, in fidelity to the common cause of humanity, to expose the faults of any particular class of men, when probably every other class in society is as deeply involved in errors which, in the sight of God, evince at least an equal degree of moral turpitude. But

public bakers, like other men, who serve the public more for the sake of securing their own emolument than for the public good, have always had recourse to various expedients in order to increase the lucrativeness of their business. To secure custom and profit at the same time, they have considered it necessary that a given quantity of flour should be made into a loaf as large and as white as possible, and free from any disagreeable taste, while at the same time it retains the greatest possible weight.

1341. From a variety of causes, the quality and price of flour have always been very unstable. Sometimes the crops are small, or the foreign demand for flour or the home consumption is unusually great, or the season is unfavorable to the health of grain, and the wheat becomes diseased, or the harvest time is unfavorable, and the wheat sprouts before it is secured, or large quantities of flour become soured or musty, or in some other manner damaged. To counteract these things, and to make the most profitable use of such flour as the market affords them, the public bakers have been led to try various experiments with chemical agents, and there is reason to believe that in numerous instances they have been too successful in their practices for the well-being of those who have been the consumers of their bread.

1342. According to treatises on bread-making which have within a few years past appeared in European scientific journals, 'alum, sulphate of zinc, sub-carbonate of magnesia, sub-carbonate of ammonia, sulphate of copper, and several other substances, have been used by public bakers in making bread; and some of these substances have been employed by them to a very great extent, and with very great success in the cause of their cupidity. They have not only succeeded by such means in making light and white bread out of extremely poor flour, but they have also been able so to disguise their adulterations, as to work in with their flour, without being detected by the consumers, a portion of the flour of beans, peas, and potatoes; and even chalk, pipe clay, and plaster of Paris, have been employed to increase the weight and whiteness of their bread.' 'The use of alum in bread-making,' says a distinguished chemist, 'appears to be very ancient. It is one of those articles which have been the most extensively and successfully used in disguising bad flour and the various adulterations of bread. Its injurious action upon the health is not to be compared with that of sulphate of copper, and yet, daily taken into the stomach, it may seriously affect the system.'

1343. 'Thirteen bakers were condemned on the 28th of January, 1829, by the correctional tribunal of Brussels, for mixing sulphate of copper or blue vitriol with their bread. It makes the bread very white, light, large, and porous, but rather tasteless; and it also enables the bread to retain a greater quantity of water, and thereby very considerably increases its weight. A much larger quantity of alum is necessary to produce these effects; but when of sufficient quantity, it strengthens the paste, and, as the bakers say, *makes the bread swell large.*' If the statements of our large druggists can be relied on, the public bakers of our own country probably employ ammonia more freely at present, than any other substance I have named. Pearlash or saleratus is also used by them in considerable quantities.

1344. But even where these adulterations are not practised, the bakers bread is very rarely a wholesome article of diet. If any dependence is to be placed on the testimony of several of the principal bakers and flour-

merchants in New York, Boston, and other cities, the flour which most of our public bakers work into bread is of a very inferior quality to what is called good 'family flour,' and for which they pay from one to three dollars less per barrel; and they sometimes purchase large quantities of old spoiled flour from New Orleans and elsewhere, which has heated and soured in the barrel, and perhaps become almost as solid as a mass of chalk; so that they are obliged to break it up, and grind it over, and spread it out, and expose it to the air in order to purify it in a measure from its acid and other bad properties; and then they mix it with a portion of much better flour; and from this mixture they can make, as they say, the very largest and finest looking loaf.* But should the public bakers always use the best of flour, their bread, as a general statement, would still be very inferior to well made domestic bread, in point of sweetness and wholesomeness. Their mode of manufacturing bread, to say the least of it, destroys much of the virtue of the flour or meal; and hence their bread is only palatable, even to those who are accustomed to it, within twelve, or, at the longest, twenty-four hours after it is baked.

BREAD MADE OF UNBOLTED MEAL MOST WHOLESOME.

1345. Whether our bread is of domestic manufacture or made by the public baker, that which is made of superfine flour is always far less wholesome, in any and every situation of life, than that which is made of wheaten meal which contains all the natural properties of the grain (744, 751). It is true that when much flesh is eaten with our bread, or when bread constitutes but a very small and unimportant portion of our food, the injurious effects of superfine flour bread are not always so immediately and distinctly perceived as in other cases. Nevertheless it is a general and invariable law of our nature, that all concentrated forms of food are unfriendly to the physiological or vital interests of our bodies (739). We have seen (510) that a very large proportion of all the diseases and ailments in civic life are originated by causes which are introduced into the alimentary canal as articles of diet; and disturbance and derangement of function, obstructions, debility, and irritations, are amongst the most important elements of those diseases. And it is probably speaking within bounds to say that nine-tenths of the adults, and nearly as large a proportion of youth, in civic life, are more or less afflicted with obstructions and disturbances in the stomach and bowels and other organs of the abdomen, the symptoms of which are either habitual costiveness or diarrhœa, or an alternation of both, or frequent and severe attacks of what are called bilious colics, etc.; and in children and youth, worms, fits, convulsions, etc. And I cannot but feel confident that the use of superfine flour bread is among the important causes of these and numerous other difficulties. I have indeed been surprised to observe that in the hundreds of cases of chronic diseases of every form and name, which have come to my knowledge within the last six or eight years, costiveness of the bowels has in almost every instance been among the first and most important symptoms. And I have never known this difficulty, even after an obstinate continuance of five, ten, twenty, or thirty years, fail to disappear in a short time after

* An aged and very respectable member of the Society of Friends, New York, who had long been extensively engaged in the flour business in that city, and who had always had his family bread made in his own house, was one day asked by his daughter, why he never used the bakers' bread? 'Because my child,' replied he, 'I know what it is made of.'

the coarse wheaten bread of a proper character has been substituted for that made of superfine flour.

1346. Some physicians and other individuals, without properly examining the subject, have raised several objections against the coarse wheaten bread. It is said, in the first place, that bran is wholly indigestible, and therefore should never be taken into the human stomach. This objection betrays so much ignorance of the final causes and constitutional laws, clearly indicated by the anatomical structure and physiological economy of the alimentary organs, that it scarcely deserves the slighest notice (438). If the digestive organs of man were designed to receive nothing but digestible and nutrient substances, they would have been constructed and arranged very differently from what they are. As we have fully seen (737), everything which nature provides for our sustenance consists of certain proportions of nutritious and innutritious matter; and a due proportion of innutritious matter in our food is as essential to the health and functional integrity of our alimentary organs, as a due proportion of nutritious matter is to the sustenance of the body (1312).

1347. Another objection is, that although bran may serve, like other mechanical irritants and excitants, for a while to relieve constipation, yet it soon wears out the excitability of the organs, and leaves them more inactive than before. Here, again, a false statement is urged by inexcusable ignorance; for it is not true that the bran acts in the manner supposed in this objection, nor are the effects here asserted ever produced by it. It is true, however, that the very pernicious habits of some people who use the coarse wheaten bread, entirely counteract the aperient effects of the bread; and it is true that others, depending wholly on the virtues of this bread for peristaltic action, and neglecting all exercise, by their extreme inertness and indolence and *over-eating*, bring on a sluggishness and debility and constipation of the bowels, and perhaps become severally afflicted with piles, in spite of the natural fitness of the bread to promote regular peristaltic action and to prevent all these results.

1348. A third objection is, that though the coarse wheaten bread may do very well for those who are troubled with constipation, by mechanically irritating and exciting the stomach and bowels, yet for that very reason it is wholly unfit and improper for those who are afflicted with chronic diarrhœa. Here is still another objection founded in ignorance of the true physiological and pathological principles which it involves. The truth is, that the coarse wheaten bread under a proper general regimen, is as excellent and sure a remedy for chronic diarrhœa as for chronic constipation. I have seen cases of chronic diarrhœa of the most obstinate character, and which had baffled the highest medical skill and every mode of treatment for more than 20 years, yielding entirely under a proper general regimen in which this bread was the almost exclusive article of food, and not a particle of medicine was used. And, excepting in cases where the complaint was symptomatic of some incurable organic disease,* I have never known such a mode of treatment to fail of wholly relieving diarrhœa, whether recent or chronic, although a very great number of cases have come under my notice.

1349. It is fully evident, therefore, that the bran does not act on the digestive organs as a mere mechanical irritant; for if it did, it would

* Even in cases of this kind the distressing symptoms are always mitigated by the use of the coarse wheaten bread.

always necessarily aggravate rather than alleviate diarrhœa. Nor does it relieve diarrhœa on the principle of a narcotic nor of a stimulant; for the effect of these is always to give an immediate check to that complaint, and in such a manner as to expose the system to a return of it. But the coarse wheaten bread *seems* to increase the disease for a short time at first, and then gradually restores the healthy condition and action of the bowels. The mucilage of wheat bran is probably one of the most soothing substances in the vegetable kingdom, that can be applied to the mucous membrane of the stomach and bowels.

1350. Chronic constipation and chronic diarrhœa both spring from the same root. Where the constitutional vigor of the alimentary canal is very considerable, continued irritations, resulting in debility, will produce constipation; and these continued causes operating for some time, will often induce such a state of debility and irritability as is attended with diarrhœa; and in other cases, when this constitutional vigor of the alimentary canal is much less, diarrhœa is far more readily induced and rendered chronic.

1351. Coarse wheaten bread, then, by its adaptation to the anatomical structure and to the physiological properties and functional powers of our organs (1312), serves to prevent and to remove the disorders and diseases of our bodies only by preventing and removing irritation and morbid action and condition, and thereby affording the system an opportunity of recovering its healthy and vigorous action and condition. And the thousands of individuals in our own country of every age, of both sexes, of all situations, conditions, and circumstances, who within the last eight years have been benefited by using the coarse wheaten bread instead of that made of superfine flour, are living witnesses of the virtues of that bread.

1352. But the testimony in favor of coarse wheaten bread as an important article in the food of man, is by no means limited to our country nor to modern times. In all probability, as we have already seen (1322), the first generations of our species who became acquainted with the art of making bread, continued for many centuries to employ all the substance of the grain, which they coarsely mashed in their rude mortars or mills. And even since mankind began by artificial means to separate the bran from the flour, and to make bread from the latter, the more close and discerning observers among physicians and philanthropists have perceived and asserted that bread made of fine flour is decidedly less wholesome than that made of the unbolted wheat meal. Hippocrates, styled *the father of medicine*, who flourished more than two thousand years ago, and who depended far more on a correct diet and general regimen both for the prevention and removal of disease than he did on medicine, particularly commended the unbolted wheat-meal bread, 'for its salutary effects upon the bowels' It was a fact well understood by the ancients, that this bread was much more conducive to the general health and vigor of their bodies, and every way better adapted to nourish and sustain them, than that made of the fine flour. And accordingly their wrestlers and others who were trained for great bodily power, 'ate only the coarse wheaten bread, to preserve them in their strength of limbs.' The Spartans were famous for this kind of bread; and we learn from Pliny that the Romans, as a nation, at that period of their history when they were the most remarkable for bodily vigor and personal prowess and achievement, knew no other

bread for three hundred years. The warlike and powerful nations which overran the Roman Empire, and finally spread over the greater part of Europe, used no other kind of bread than that which was made of the whole substance of the grain; and from the fall of the Roman Empire to the present day, a large proportion of the inhabitants of all Europe and the greater part of Asia, have rarely used any other kind of bread.

1353. 'If you set any value on health, and have a mind to preserve nature,' said Thomas Tryon, student in physic, in his *Way to Health, Long Life, and Happiness*, published in London in the latter part of the fifteenth century, 'you must not separate the finest from the coarsest flour, because that which is fine is naturally of an obstructive and stopping quality; but, on the contrary, the other, which is coarse, is of a cleansing and opening nature; therefore the bread is best which is made of both together. It is more wholesome, easier of digestion, and more strengthening, than bread made of the finest flour. It must be confessed that the nutrimentive quality is contained in the fine flour, yet in the branny part is contained the opening and digestive quality; and there is as great a necessity for the one as the other, for the support of health: that which is accounted the worst is as good and beneficial to nature as the best; for when the finest flour is separated from the coarsest and branny parts, neither the one nor the other has the true operations of the wheat meal. The eating of fine bread, therefore, is inimical to health, and contrary both to nature and reason, and was at first invented to gratify *wanton* and *luxurious* persons, who are ignorant both of themselves and the true virtue and efficacy of natural things.' 'Baron Steuben has often told me,' says Judge Peters, 'that the peculiar healthfulness of the Prussian soldiers was in a great measure to be attributed to their ammunition bread, made of grain triturated or ground, but not bolted; which was accounted the most wholesome and nutritious part of their rations.' 'The Dutch sailors in the days of their naval glory, were supplied with the same kind of bread.'

1354. 'During the war between England and France, near the close of the last century,' says Mr. Samuel Prior, a respectable merchant of Salem, New Jersey, 'the crops of grain, and particularly wheat, were very small in England, and the supplies from Dantzic, the Netherlands, and Sweden being cut off by the French army, and also the usual supplies from America failing, there was a very great scarcity of wheat in England. The British army was then very extensive, and it was exceedingly difficult to procure provisions for it, both at home and abroad, on land and sea. Such was the demand for the foreign army, and such the deficiency of crops at home and supplies from abroad, that serious fears were entertained that the army would suffer, and that the continental enterprise of the British Government would be defeated in consequence of the scarcity of provisions; and every prudential measure by which such a disastrous event could be prevented was carefully considered and proposed. William Pitt was then prime minister of state, and at his instance government recommended to the people generally throughout Great Britain, to substitute potatoes and rice as far as possible for bread, in order to save the wheat for the foreign army. This recommendation was promptly complied with by many of the people. But still the scarcity was alarmingly great. In this emergency, parliament passed a law (to take effect for two years) that the army at home should be supplied with bread made of unbolted wheat meal, solely for the

purpose of making the wheat go as far as possible, and thus saving as much as they could from the home consumption, for the better supply of the army on the continent. Eighty thousand men were quartered in barracks in the counties of Essex and Suffolk. A great many were also quartered throughout the towns, at taverns, in squads of thirty and forty in a place. Throughout the whole of Great Britain the soldiers were supplied with this coarse bread. It was deposited in the store-rooms with the other provisions of the army on the day it was baked, and at nine o'clock the next morning was distributed to the soldiers, who were at first exceedingly displeased with the bread, and refused to eat it, often casting it from them with great rage and violent execrations. But after two or three weeks they began to be much pleased with it, and preferred it to the fine flour bread.'

1355. 'My father,' continues Mr. P., 'whom I have often heard talk these things over, was a miller a and baker, and resided in the county of Essex, on the boarder joining Suffolk, and near the barracks containing the eighty thousand soldiers. He contracted with government to supply the eastern district of the county of Essex with the kind of bread I have mentioned, and he used always to send me with it to the depositories on the day it was baked; and though I was then a youth, I can still very distinctly remember the angry looks and remarks of the soldiers when they were first supplied with it. Indeed they often threw their loaves at me as I passed along, and accompanied them with a volley of curses. The result of this experiment was, that not only the wheat was made to go much farther, but the health of the soldiers improved so much and so manifestly in the course of a few months, that it became a matter of common remark among themselves, and of observation and surprise among the officers and physicians of the army. These gentlemen at length came out with confidence and zeal on the subject, and publicly declared that the soldiers were never before so healthy and robust, and that disease of every kind had almost entirely disappeared from the army. The public papers were for months filled with recommendations of this bread, and the civic physicians almost universally throughout Great Britain pronounced it far the most healthy bread that could be eaten, and as such recommended it to all the people, who very extensively followed the advice; and the coarse wheaten bread was very generally introduced into families, female boarding schools, and indeed all public institutions. The nobility also generally used it; and in fact, in many towns, it was a rare thing to meet with a piece of fine flour bread. The physicians generally asserted that this wheaten bread was the very best thing that could be taken into the human stomach, to promote digestion and peristaltic action; and that it, more than anything else, would assist the stomach in digesting other things which were less easily digested, and therefore they recommended that a portion of it should be eaten at every meal with other food Still, after this extensive experiment had been made with such happy results, and after so general and full a testimony had been given in favor of the coarse wheaten bread, when large supplies of superfine flour came in from America, and the crops at home were abundant, and the act of parliament in relation to the army became extinct, most of the people who had before been accustomed to the use of fine flour bread now by degrees returned again to their old habits of eating fine bread. Many of the nobility, however, continued to use the coarse bread for a number of years after-

wards. General Hanoward, Squire Western, Squire Hanbury, and others living near my father's, continued to use the bread for a long time, and some of them still used it when I left home and came to America, in 1816.'

1356. The testimony of sea captains and old whalemen is equally in favour of wheaten bread (745). 'I have always found,' said a very intelligent sea-captain of more than thirty years' experience, 'that the coarser my ship bread, the healthier my crew is.' A writer in Rees' Cyclopædia (article Bread), says—'the inhabitants of Westphalia, who are a hardy and robust people, and capable of enduring the greatest fatigues, are a living testimony to the salutary effects of this sort of bread; and it is very remarkable that they are very seldom attacked by acute fevers, and those other diseases which are from bad humors.' In short, as I have already stated (1327), the bread of a large portion of the laboring class or peasantry throughout Europe, Asia, and Africa, and the islands of the ocean, whether leavened or unleavened, whether more or less artificially prepared, is made of the whole substance of the grain from which it is manufactured; and no one who is sufficiently enlightened in physiological science to qualify him to judge correctly in this matter, can doubt that bread made in the best manner from unbolted wheat meal, is far better adapted to the anatomical structure and physiological powers of the alimentary organs of man, than bread made of superfine wheat flour; and consequently, the former is far more conducive to the health and vigor and general well-being of man than the latter.

1357. If, therefore, mankind will have raised bread which in every respect most perfectly conforms to the laws of constitution and relation established in their nature (1312), and is most highly conducive to the welfare of their bodies and souls, then must it be well made, well baked, light, and sweet bread, which contains all the natural properties of the wheat. And if they will have this bread of the very best and most wholesome kind they must, as I have already stated, see that the soil from which their wheat is raised is of a proper character, and is properly tilled; that the wheat is plump, full grown, ripe, and free from rust and other diseases; and then, before it is ground, they must see that it is thoroughly cleansed, not only from chaff, cockles, tares, and such like substances, but also from all smut, and every kind of impurity that may be attached to the skin of the kernel. And let every one be assured that this is a matter which really deserves all the attention and care that I suggest. If human existence is worth possessing, it is worth preserving; and they who have enjoyed it as some have done, and as all the human family are naturally endowed with the capabilities to enjoy it, certainly will not doubt whether it is worth possessing; nor, if they will properly consider the matter, can they doubt that its preservation is worthy of their most serious and diligent care. And when they perceive how intimately and closely the character of their bread is connected with the dearest interests of man, they will not be inclined to feel that any amount of care and labor is too much to be given to secure precisely the right kind of bread

1358. I repeat, then, that they who would have the very best bread, should certainly wash their wheat and cleanse it thoroughly from all impurities before they take it to the mill; and when it is properly dried it should be ground by sharp stones which will cut rather than mash it; and particular care should be taken that it is not ground too fine. Coarsely ground wheat meal, even when the bran is retained, makes decidedly

sweeter and more wholesome bread than very finely ground meal. When the meal is ground, it should immediately be spread out to cool before it is put into sacks or casks; for if it is packed or enclosed in a heated state, it will be far more likely to become sour and musty. And I say again, where families are in circumstances to do wholly as they choose in the matter, it is best to have but little ground at a time, as the freshly ground meal is always the liveliest and sweetest, and makes the most delicious bread.

1359. When the meal is thus prepared and brought home, whether in a barrel or sack, the next thing to be attended to is, that it be placed and kept in a perfectly clean and sweet and well-ventilated meal room. It should on no consideration be put into a closet or pantry or store-room, which is seldom aired and more rarely cleansed, and into which all manner of rubbish is thrown, or even where other kinds of provisions are kept. If the meal be put into a pantry or store-room which is confined and dirty, and into which old boots and shoes and old clothes and pieces of carpet and other things of this kind are thrown, or where portions of vegetable or animal substance, whether cooked or uncooked, are habitually or even occasionally put and permitted to remain, it must be expected, as a matter of course, of necessity, that the quality of the meal will be considerably deteriorated by the impurities with which the air of the place will be loaded, and which will be continually generated there. People generally have but a sorry idea of what constitutes true cleanliness; but they may be assured that they cannot be too deeply impressed with the importance of keeping their meal-room as clean and sweet and well-aired as possible.

PROPERTIES OF MEAL.—YEAST—FERMENTATION.

1360. According to the statement of Professor Thomson, of Edinburgh, one pound of good wheat meal contains ten ounces of farina or starch, three ounces of bran, six drachms of gluten, and two drachms of sugar; and it is because wheat contains such proportions of these substances that it makes the very best loaf bread. The farina or starch is the principal nourishing property; the saccharine matter or sugar is also highly nutrient; but in the process of making loaf bread it serves mainly, by its vinous fermentation, to produce the gas or air by which the dough is raised and the bread made light. The gluten is likewise a very nutrient property, but in loaf bread it principally serves, by its cohesiveness, like gum elastic or India rubber, to prevent the gas or air formed by the fermentation of the sugar from escaping or passing off; and the gas being thus retained, inflates or puffs up the dough, and makes it porous and light. The bran, with its mucilaginous and other properties, not only adds to the nutritiousness of the bread, but eminently serves to increase its digestibility, and to invigorate the digestive organs, and preserve the general integrity of their functions.

1361. The next thing indispensably necessary to the making of good loaf bread, is good, lively, sweet yeast or leaven, to produce what is called the panary, or more properly the vinous fermentation of the saccharine matter or sugar. Some bread-makers will do best with one kind of yeast or leaven, and some with another. I have generally found that people do best with those materials to which they have been most accustomed; but I am sorry to find so general a dependence on breweries for yeast. To say

nothing of the impure and poisonous substances which brewers employ in the manufacture of beer, and which always affect the quality of their yeast, I am confident that domestic yeast can be made of a far superior quality. However light and good in other respects that bread may be which is made with brewers' yeast, I have rarely if ever seen any in which I could not at once detect the disagreeable properties of the yeast. There are various ways of making domestic yeast. One of the simplest, and perhaps the best, is the following, which was communicated to me by one of the best bread-makers I ever saw:—'Put into one gallon of water a double handful of hops; boil them fifteen or twenty minutes, then strain off the water while it is scalding hot: stir in wheat flour or meal till it becomes a thick batter, so that it will hardly pour; let it stand till it becomes about blood warm; then add a pint of good lively yeast, and stir it well and then let it stand in a place where it will be kept at a temperature of about seventy degrees Fah. till it becomes perfectly light, whether more or less time is required; and then it is fit for use. Or if it is desired to keep a portion of it, let it stand several hours and become cool, and then put it into a clean jug and cork it tight, and place it in a cellar where it will keep cool; and it may be preserved good ten or twelve days, and even longer.' Another way by which yeast when thus made may be preserved much longer and perhaps more conveniently, is, to take it when it has become perfectly light, and stir in good Indian meal until it becomes a hard dough; then take this dough and make it into small thin cakes, and dry them perfectly, without baking or cooking them at all. These cakes, if kept perfectly dry, will be good for several weeks and even months. When yeast is needed, take some of these cakes (more or less according to the quantity of bread desired) and break them fine and dissolve them in warm water, and then stir in some wheat flour till a batter is formed, which should be kept at a temperature of about sixty degrees Fah. till the yeast becomes light and lively, and fitted for making bread. Others, in making this yeast, originally put into the water with the hops a double handful of good clean wheat bran, and boil them up together and strain off the water as above described; others, again, boil up a quantity of wheat bran without the hops, and make their yeast in all other respects as above described.

1362. The milk yeast is greatly preferred by many, and when it is well managed, it certainly makes very handsome bread. The way of making it is simple Take a quart of milk fresh from the cow (more or less according to the quantity of bread desired); a little salt is generally added, and some add about half a pint of water blood warm, but this is not essential; then stir wheat flour or meal into the milk, till it forms a moderately thick batter, then cover it over, and place it where it will remain at a temperature of from sixty to seventy degrees Fah. till it becomes perfectly light. It should then be used immediately; and let it be remembered that dough made with this yeast will sour sooner than that made with other yeast, and also that the bread after it is baked will become extremely dry and *crumbly* much sooner than bread made with other yeast. Yet this bread, when a day old, is exceedingly light and beautiful; albeit some dislike the animal smell and taste which it derives from the milk.

1363. In all these preparations of yeast and dough, it should ever be recollected that 'the process of fermentation cannot go on when the temperature is below thirty degrees Fah.; that it proceeds quite slowly at fifty

degrees, moderately at sixty degrees, rapidly at seventy degrees, and very rapidly at eighty degrees.' If, therefore, it is desired to have the yeast or dough stand several hours before it is used or baked, it should be kept at a temperature of about fifty degrees. But in the ordinary way of making bread, a temperature varying from sixty degrees to seventy degrees, or about summer heat, is perhaps as near right as it can well be made.

1364. Professor Thomson gives the following directions for making yeast in large quantities:—'Add ten pounds of flour to two gallons of boiling water; stir it well into a paste: let this mixture stand for seven hours, and then add about a quart of good yeast In about six or eight hours this mixture, if kept in a warm place, will have fermented and produced as much yeast as will make 120 quartern loaves' (of 4 lbs. each). A much smaller quantity can be made by observing due proportions of the ingredients. To raise bread in a very short time without yeast, he gives the following receipt:—' Dissolve in water 2 ounces 5 drachms and 45 grains of common crystalized carbonate of soda, and mix the solution well with your dough, and then add 7 ounces 2 drachms and 22 grains of muriatic acid of the specific gravity of 1.121, and knead it as rapidly as possible with your dough; it will rise immediately, fully as much if not more than dough mixed with yeast, and when baked will be a very light and excellent bread.' Smaller quantities would be required for small batches of bread. A teaspoonful or more (according to the quantity of dough or batter) of super-carbonate of soda dissolved in water, and flour stirred in till it becomes a batter, and then an equal quantity of tartaric acid dissolved and stirred in thoroughly, will in a few minutes make very light batter for griddle or pancakes; or if it be mixed into a thick dough, it will make light bread. Good lively yeast, however, makes better bread than these alkalies and acids; howbeit these are very convenient in emergencies, when bread or cakes must be prepared in a very short time, or when the yeast has proved inefficient.

1365. We see then (1360) that wheat meal consists of certain proportions of starch, gluten, sugar, bran, etc.; and that in making loaf bread, we add yeast or leaven, in order to produce that kind of fermentation peculiar to saccharine matter or sugar, which is called vinous, and by which the gas or air is formed that raises the dough. But the sugar is an incorporate part of every particle of the meal, and is therefore equally diffused throughout the whole mass, and hence if we would make the very best loaf bread, the fermentive principle or yeast must also be equally diffused throughout the whole mass, so that a suitable portion of yeast will be brought to act at the same time on every particle of saccharine matter in the mass. But let us endeavor to understand this process of fermentation. To speak in the language of chemistry, sugar is composed of certain proportions of carbon, oxygen, and hydrogen. The yeast, acting on the sugar, overcomes those affinities by which these substances are held in the constitutional arrangement of sugar, and the process of decay or decomposition of the sugar takes place, which is called vinous fermentation. By this process of decay, two other forms of matter are produced, of an essentially different nature from each other and from the sugar. One of them is called carbonic acid gas or air, being formed by a chemical combination of certain proportions of carbon and oxygen. The other is known by the name of alcohol, and consists of a chemical combination of

certain proportions of carbon, oxygen, and hydrogen. Carbonic acid gas, as we have seen (143), is also produced by animal respiration or breathing, by the combustion of wood, coal, etc., and in other ways of nature and of art; but neither in nature nor in art is there any known way by which alcohol can be produced, except by that process of the decay or destruction of sugar called vinous fermentation. The carbonic acid gas produced in the manner I have stated, is the air which inflates or puffs up and swells out the bread, when there is sufficient gluten or other cohesive matter in the dough to prevent its escape. If the dough be permitted to stand too long in a warm place, the fermentation, having destroyed most or all of the sugar, will begin to act on the starch and mucilage, and destroy their nature, and produce vinegar; and therefore this stage of it is called the acetous fermentation; and if it still be permitted to go on, it will next commence its work of destruction on the gluten; and this is called the putrefactive fermentation, because it in many respects resembles the putrefaction of animal matter.

1366. The vinous fermentation, therefore, by which the dough is raised and made light, may be carried to all necessary extent, and still be limited in its action to the saccharine matter or sugar, leaving the starch and gluten and other properties of the meal uninjured; and this is the point at which the fermentation should be arrested by the heat that bakes the dough. If it be permitted to go beyond the sugar, and act on the mucilage and starch, and produce acidity, the excellence of the bread is in some degree irreparably destroyed. The acid may be neutralized by pearlash or soda, so that the bread shall not be sour; but still, something of the natural flavor of the bread is gone, and it is not possible by any earthly means to restore it; and this injury will always be in proportion to the extent to which the process of the acetous fermentation is permitted to go in destroying the nature of the starch, and the bread will be proportionably destitute of that natural sweetness and delicious richness essential to good bread. Yet it is almost universally true, both in public and domestic bread-making, that the acetous fermentation is allowed to take place; and saleratus, or soda, or some other chemical agent, is employed to neutralize the acid. By this means we may have bread free from acidity, it is true, but it is also destitute of the best and most delicious properties of good bread; and generally by the time it is twenty-four hours old—and this is particularly true of baker's bread—it is as dry and tasteless and unsavory as if it were made of plaster of Paris. Many bread-makers mix their saleratus or soda with their yeast, or introduce it when they mix their dough, so that if the acetous fermentation does take place, the acid is neutralized by the alkali, and therefore not being perceived, it is supposed never to have existed, and the bread is called sweet and good, especially if a small quantity of molasses be employed in making the dough. Others far more wisely withhold their alkali till the dough is raised enough to mould into the loaf, and then if it is found to be in any degree acid, a solution of saleratus or soda is worked into it, so as just to neutralize the acid, and no more. This is infinitely better than to have sour bread, which, after all, is almost everywhere met with; yet the very best bread that can be made in this way is only second best. Happy are those who can make good, light, and sweet bread, without the use of molasses, without suffering the least degree of acetous

fermentation to take place, and without employing saleratus, soda, or any other kind of alkali.

1367. The third or putrefactive stage of fermentation rarely takes place in domestic bread-making, but it is by no means uncommon in public bakeries. Indeed, it is thought necessary in the manufacture of certain kinds of crackers, in order to make them split open, and render them brittle, and cause them readily to become soft when dipped in water, but dyspepsy crackers, and all other kinds of bread made in this way, are, to say the least of them, miserable stuff. For besides the fact that all the best qualities of the flour or meal have been destroyed by fermentation, the great quantity of alkali employed in neutralizing the acid is necessarily injurious to the digestive organs.

MIXING, KNEADING, AND BAKING BREAD.

1368. Now, then, the business of the bread-maker is to take the wheat meal, prepared in the manner I have stated, and with all the properties I have described (1360), and convert it into good, light, sweet, well-baked bread, with the least possible change in those properties; so that the bread, when done, will present to the senses of smell and taste, all the delicious flavor and delicate sweetness which pure organs perceive in the meal of good new wheat, just taken from the ear and ground, or chewed without grinding; and it should be so baked that it will, as a general rule, require and secure a full exercise of the teeth in mastication (709).

1369. Take, then, such a quantity of meal, in a perfectly clean and sweet bread trough, as it is necessary for the quantity of bread desired, and having made a hollow in the centre, turn in as much yeast as a judgment matured by sound experience shall deem requisite; then add such a quantity of water, milk and water, or clear milk, as is necessary to form the meal into a dough of proper consistency. Some prefer bread mixed with water alone; others prefer that which is mixed with milk and water; and others think that bread mixed with milk is much richer and better; while others dislike the animal odor and taste of bread mixed with milk. Perhaps the very best and most wholesome bread is that which is mixed with pure soft water, when such bread is made perfect. But whether water, milk and water, or milk alone is employed, it should be used at a temperature of about blood heat.

1370. Here let it be understood, that the starch of the meal is of such a nature that, by a delicate process peculiar to itself, it becomes changed into sugar or saccharine matter; and when the fluid used in mixing the dough is of a proper temperature, and the dough is properly mixed and kneaded, this process, to some small extent, takes place, and a small portion of the starch is actually converted into sugar, and thereby increases the sweetness of the bread. Let it also be recollected here, that the saccharine matter on which the yeast is to act, is equally diffused throughout the whole mass of meal (1365); and therefore, if the yeast be not properly diffused throughout the whole mass, but it is unequally distributed, so that an undue quantity of it remains in one part, while other parts receive little or none, then the fermentation will go on very rapidly in some parts of the mass, and soon run into the acetous state, while in other parts it will proceed very slowly or not at all; and consequently, large cavities will be formed in some

parts of the dough, while other parts of it will remain as compact and heavy as when first mixed, and sometimes even more so. I need not say that such dough cannot be made into good bread; yet it is probably true, that more than nine-tenths of the bread consumed in this country is more or less of this character. Nor, after what I have said, should it seem necessary for me to remark, that good bread cannot be made by merely stirring the meal and yeast and water or milk together into a thin dough or sponge, and suffering it to ferment with little or no working or kneading. Bread made in this manner, if it is not full of cavities large enough for a mouse to burrow in, surrounded by parts as solid as lead, is almost invariably full of cells of the size of large peas and grapes; and the substance of the bread has a shining, glutinous appearance; and if the bread is not sour, it is because pearlash or some other kind of alkali has been used to destroy the acid. The very appearance of such bread is forbidding, and shows at a glance that it has not been properly mixed, that the yeast has acted unequally on different portions of the meal, and that the fermentation has not been of the right kind.

1371. But if the yeast be so diffused throughout the whole mass as that a suitable portion of it will act on each and every particle of the saccharine matter at the same time, and if the dough be of such a consistency and temperature as not to admit of too rapid a fermentation, then each minute portion of saccharine matter throughout the whole mass will, in the process of fermentation, produce its little volume of air, which will form its little cell about the size of a pin's head, and smaller; and this will take place so nearly at the same time, in every part of the dough, that the whole will be raised and made as light as a sponge, before the acetous fermentation takes place in any part. And then, if it be properly moulded and baked, it will make the most beautiful and delicious bread, perfectly light and sweet, without the use of any alkali, and with all the gluten and nearly all the starch of the meal remaining unchanged by fermentation.

1372 Who that can look back thirty or forty years to those blessed days of New England's prosperity and happiness, when our good mothers used to make the family bread, but can well remember how long and how patiently those excellent matrons stood over their bread troughs, kneading and moulding their dough? and who with such recollections cannot also well remember the delicious bread that those mothers used invariably to set before them? There was a natural sweetness and richness in it which made it always desirable, and which we cannot now vividly recollect without feeling a strong desire to partake again of such bread as our mothers made for us in the days of our childhood.

1373. Let it be borne in mind, then, that without a very thorough kneading of the dough, there can be no just ground of confidence that the bread will be good. 'It should be kneaded,' says one of much experience in this matter, 'till it becomes flaky.' Indeed I am confident that our loaf bread would be greatly improved in all its qualities if the dough were for a considerable time subjected to the operations of the machine which the bakers call the break, used in making crackers and sea bread.

1374. The wheat meal, and especially if it is ground coarsely, swells

considerably in the dough, and therefore the dough should not, at first, be made quite so stiff as that made of superfine flour; and when it is raised, if it is found too soft to mould well, let a little more meal be added.

1375. When the dough has been properly mixed and thoroughly kneaded, cover it over with a clean napkin or towel, and a light woollen blanket kept for the purpose, and place the bread trough where the temperature will be kept at about sixty degrees Fah., or about summer heat, and there let it remain till the dough becomes light. But as it is impossible to regulate the quantity and quality of your yeast, the moisture and temperature of your dough, and several other conditions and circumstances, so as to secure at all times precisely the same results in the same time, it is therefore necessary that careful attention should be given that the proper moment should be seized to work over and mould the dough into the loaf, and get it into the oven just at the time when it is as light as it can be made by the vinous fermentation, and before the acetous fermentation commences. If, however, by any means, there should unfortunately be a little acidity in the dough, take a small quantity of saleratus, or, what is better, carbonate of soda, and dissolve it in some warm water, and carefully work in just enough to neutralize the acid. The best bread-makers are so exceedingly careful on this point that they dip their fingers into the solution of saleratus or soda, and thrust them into the dough in every part, as they work it over, so as to be sure that they get in just enough to neutralize the acid, and not a particle more. But I must here repeat, that they who would have the very best bread, must always consider it a cause of regret that there should be any necessity to use alkali; because the acetous fermentation cannot in any degree take place without commensurately and irremediably impairing the quality of the bread. And here it should be remarked, that dough made of wheat meal will take on the acetous fermentation, or become sour, sooner than that made of fine flour. This is probably owing principally to the mucilage contained in the bran, which runs into the acetous fermentation sooner than starch.

1376. While the dough is rising, preparations should be made for baking it. Some bake their bread in a brick oven, some in a stove, some in a reflector, and some in a baking kettle. In all these ways very good bread may be baked, but the baking kettle is decidedly the most objectionable. Probably there is no better and more certain way of baking bread well than in the use of the brick oven. Good bread-makers, accustomed to brick ovens, can always manage them with a very great degree of certainty; and as a general fact, bread is sweeter baked in this way than in any other. Yet when it is well baked in tin reflectors, it is certainly very fine, and so it is also when well baked in iron stoves. But the baking of bread requires almost as much care and judgment as any part of the process of bread-making. If the oven is too hot, the bread will burn on the outside before it is done in the centre; if it is too cold, the bread will be heavy, raw, and sour. If the heat is much greater from below than from above, the bottom of the loaf will burn before the top is done; or if the heat is much greater from above than from below, the top of the loaf will burn before the bottom is done. All these points, therefore, must be carefully attended to; and no small excuse ought to be considered a satisfactory apology for sour, heavy,

raw, or burnt bread; for it is hardly possible to conceive of an absolute necessity for such results, and the cases are extremely rare in which they are not the offspring of downright and culpable carelessness. The best bread-makers I have ever known, watch over their bread-troughs while their dough is rising, and over their ovens while it is baking, with about as much care and attention as a mother watches over the cradle of her sick child. Dough made of wheat meal requires a hotter oven than that made of fine flour, and it needs to remain in the oven longer. Indeed, it is a general fault of bread of every description, made in this country, that it is not sufficiently baked. Multitudes eat their bread hot and smoking from the oven, in a half-cooked state, and very few seem to think there is any impropriety in doing so. But they who would have their bread good, not only a few hours after it comes from the oven, but as long as it can be kept, must see that it is thoroughly baked.

1377. I have said that the process of vinous fermentation converts a portion of the saccharine matter of the meal into carbonic acid gas or air, by which means the dough is raised and made light; and that the same process converts a portion of the saccharine matter into alcohol (1365). The alcohol thus generated is mostly driven off by the heat of the oven when the dough is baking. and in modern times, ovens have been so constructed in England as to serve the double purpose of ovens and stills, so that while the bread is baking, the alcohol is distilled off and condensed, and saved for the various uses of arts and manufacture.

1378. The question has, however, been frequently started, whether a portion of the alcohol thus generated is not contained in the bread when it comes from the oven? The notion commonly entertained is that the alcohol is wholly expelled by the heat of the oven, in the process of baking; and this opinion I supposed to be correct, until careful and repeated investigation convinced me of its error. I have in numerous instances, within the last twelve months found, in thoroughly baked bread, soon after it was drawn from the oven, so large a quantity of alcohol that it was strongly perceptible to the sense of smell. Moreover, it is well known that if two portions of wheat meal or flour be taken from the same barrel or sack, and one portion be made into unleavened bread, and the other portion be made into the very best fermented or raised bread, and both be eaten as soon as they are baked, the fermented bread will digest with more difficulty, and oppress and disturb the stomach more than the unleavened bread will (1331). Indeed, it is well known and very generally understood, that few of the articles which compose the food of man in civic life, are so trying to the human stomach, and so powerful causes of dyspepsy, as fresh-baked raised bread. It is now well known also, that alcohol wholly resists the action of the solvent fluid of the stomach, and is entirely indigestible and always retards the digestion of those substances which contain it (443). How far all this may be true of carbonic acid gas, is not yet ascertained; but it is difficult to account for the difference between leavened and unleavened bread, as above stated, without supposing that the alcohol or carbonic acid gas, or both of them, are in some degree concerned in rendering the leavened bread, when newly baked, peculiarly oppressive and injurious to the stomach. Be it as it may, however, it is very certain that when the bread has been drawn from the oven, and permitted to stand in a proper place twenty-four hours, either by evaporation or some other means, it becomes perfectly matured, and so

changed in character that it is, if properly made, one of the most wholesome articles entering into the diet of man; and at that age, there is not the slightest reason to believe that a particle of alcohol remains in the bread.

1379. When, therefore, the bread is thoroughly baked, let it be taken from the oven and placed on a perfectly clean and sweet shelf, in a perfectly clean and well-ventilated pantry. Do not, as you value the character of your bread, put it into a pantry where you set away dishes of cold meat, cold potatoes, and other vegetables, and keep your butter, cheese, and various other table provisions—in a pantry which perhaps is seldom thoroughly cleansed with hot water and soap, and where the pure air of heaven seldom if ever has a free circulation. The quality of your bread should be of too much importance to allow of such reprehensible carelessness, not to say sluttishness. And if you will have your bread such as every one ought to desire to have it, you must pay the strictest attention to the cleanliness and sweetness of the place where you keep it. If in baking, the outer crust should become a little too dry and crispy, you can easily remedy this by throwing a clean bread or table cloth over it for a short time, when it first comes from the oven; but if this is not necessary, let the bread stand on an airy shelf till it becomes perfectly cool, and when it is twenty-four hours old, it is fit for use; and if it is in all respects properly made and properly kept, it will continue to be sweet and delicious bread for two or even three weeks, except perhaps in very hot and sultry weather.

1380. When we have acquired the art of making such bread as I have described, in the very best manner, then have we carried the art of cooking to the very height of perfection; for it is not only true that there is no other artificially prepared article in human diet of so much importance as bread, but it is also true that there is no other preparation in the whole round of cooking which requires so much care and attention and experience and skill and wisdom.

WHO SHOULD MAKE BREAD?

1381. Who, then, shall make our bread? For after all that science in its utmost accuracy can do, in ascertaining principles and in laying down rules, there is little certainty that any one who undertakes to make bread by merely rule, will be anything like uniformly successful. We may make a batch of bread according to certain rules, and it may prove excellent; and then we may make another batch according to the same rules, which may be very poor. For if we follow our rules ever so closely, there may be some slight differences in the quality or condition of the meal or the yeast, or something else, which will materially alter the character of the bread, if we do not exercise a proper care and judgment and vary our operations according as the particular circumstances of the case may require. Correct rules are certainly very valuable, but they can only serve as general way-marks in the art of bread-making. Uniform success can only be secured by the exercise of that mature judgment which is always able to dictate those extemporaneous measures which every exigency and circumstance may require; and such a judgment can only result from a care and attention and experience which are the offspring of that moral sensibility which duly appreciates the importance of the quality of the bread, in relation to the happiness and welfare of those that consume it.

But are we to look for such a sensibility in public bakers? Can we expect that they will feel so lively and so strong an interest for our enjoyment and for our physical and intellectual and moral well-being, that they will exercise all that care and attention and patience, and watch with that untiring vigilance and solicitude in all the progress of their operations, which are indispensably necessary in order to secure us the best of bread? Or can we reasonably expect to find these qualifications in domestics—in those who serve us for hire? Many a female domestic, it is true, can make much better bread than her mistress can. Many a female domestic has an honest and sincere desire to do her duty faithfully; but can she be actuated by those sensibilities and affections which alone can secure that careful attention, that soundness of judgment, that accuracy of operation, without which the best of bread cannot uniformly if ever be produced?

1382. No; it is the wife, the mother only—she who loves her husband and her children as woman ought to love, and who rightly perceives the relations between the dietetic habits and physical and moral condition of her loved ones, and justly appreciates the importance of good bread to their physical and moral welfare,—she alone it is who will be ever inspired by that cordial and unremitting affection and solicitude which will excite the vigilance, secure the attention, and prompt the action requisite to success, and essential to the attainment of that maturity of judgment and skilfulness of operation which are the indispensable attributes of a perfect bread-maker. And could wives and mothers fully comprehend the importance of good bread in relation to all the bodily and intellectual and moral interests of their husbands and children, and in relation to the domestic and social and civil welfare of mankind, and to their religious prosperity both for time and eternity, they would estimate the art and duty of bread-making far, very far more highly than they now do. They would then realize that as no one can feel so deep and delicate an interest for their husbands' and children's happiness as they do, so no one can be so proper a person to prepare for them that portion of their aliment which requires a degree of care and attention that can only spring from the lively affections and solicitude of a wife and mother.

1383. But it is a common thing to hear women say—'We cannot always have good bread, if we take ever so much pains; it will sometimes be heavy, and sometimes be sour, and sometimes badly baked, in spite of all our care.' It may be true that such things will sometimes happen, even with the best of care; but I believe that there is almost infinitely more poor bread than there is any good excuse for. The truth is, the quality of bread is a matter of too little consideration, and therefore too little care is given to the making of it. Moreover, the sense of taste is so easily vitiated, that we can very easily become reconciled to the most offensive gustatory qualities, and even learn to love them; and it is a very common thing to find families so accustomed to sour bread, that they have no perception of its acid quality. 'It is very strange,' said a lady to me one day at her dinner table, 'that some folks always have sour bread, and never know it.' She then went on to name a number of families in the circle of her acquaintance, who, she said, invariably had sour bread upon their tables when she visited them—'and they never,' continued she, 'seem to have the least consciousness that their bread is not perfectly sweet and good.' Yet this very lady, at the very moment she was thus addressing me, had sour bread upon her own table; and although I had for many

months been very frequently at her table, I had never found any but sour bread upon it. Still she was wholly unconscious of the fact.

1384. Difficult, however, as most women think it is, to have good bread always, yet there are some women who invariably have excellent bread. I have known such women. The wife of Thomas Van Winkle, Esq., of the beautiful valley of Booneton, New Jersey—peace to her ashes!—was deservedly celebrated throughout the whole circle of her acquaintance for her excellent bread. Few ever ate at her hospitable board once, that did not desire to enjoy the privilege again. I know not how often it has been my good fortune to sit at her table; but the times have not been few; and though long past, and she who presided there has slept for years in her grave, yet the remembrance of those times and of those hospitalities awakens in my bosom a deep and fervent sentiment of gratitude while I write. Never at the table of Mrs. Van Winkle did I eat poor bread; and of my numerous acquaintances who had sat at her table, I never heard one say he had eaten poor bread there. Her bread was invariably good. Nay, it was of such a quality that it was impossible for any one to eat of it, and not be conscious that he was partaking of bread of extraordinary excellence.

1385. 'Mrs. Van Winkle,' said I to her one day, while I was feasting on her delicious bread, tell me truly, is there either a miracle or mystery in this matter of bread-making, by which you are enabled to have such excellent bread upon your table at all times, while I rarely ever find it equally good at any other table, and at ninety-nine tables in a hundred I almost invariably find poor bread? Is it necessarily so? Is it not possible for people by any means to have good bread uniformly?' 'There is no necessity for having poor bread at any time if those who make it will give proper care and attention to their business,' replied Mrs. Van Winkle, confidently. 'If every woman will see that her flour is sweet and good, that her yeast is fresh and lively, that her bread trough is kept perfectly clean and sweet, that her dough is properly mixed and thoroughly kneaded, and kept at a proper temperature, and at the proper time moulded into the loaf, and put into the oven, which has been properly heated, and there properly baked, then good bread would be as common as poor bread now is. But while there is such perfect carelessness and negligence about the matter, it is not surprising that bread should be generally poor.'

1386. Mrs. Van Winkle was undoubtedly correct. If any thing like the care were given to bread-making that its real importance demands, a loaf of poor bread would rarely be met with. Indeed, if the same degree of care were given to bread-making that is devoted to the making of cakes and pastry, we should far more generally be blessed with good bread. Who does not know that as soon as girls are old enough to go into company and to give parties, they begin to notice with great interest the qualities of the different kinds of cakes and pastry which they meet with; and whenever they find anything very nice, they are exceedingly curious to learn precisely how it was made. And lest memory should be treacherous, they will carefully write down the exact rules for mixing and cooking it; —'so many pounds of flour, so many pounds of butter, so many pounds of sugar, so many eggs, and spice to your taste; the eggs to be beaten so and so, the whole mixed so and so, and baked so many minutes,' etc. And thus with great care and industry they collect and write down in a book which they keep for the purpose all the recipes they can get hold of, for

making every kind of cake and pastry used in society. And when they are preparing for company, they rarely if ever order Dinah or any other domestic to make their nice cake They do not regard it as a menial office, but as a highly genteel employment; and their great desire to have their cake and pastry as good as it can be made, prompts them to undertake the manufacture of it themselves. And during this operation, the scales, the measure, the clock or watch, all are brought into requisition; the Recipe Book is placed upon the table before them, and carefully consulted; and everything is done with the utmost precision and exactitude and vigilance. And if the young lady feel any misgiving as to her own judgment or taste or experience, she earnestly enquires of Ma, or some one else who she thinks is capable of giving her advice in so important a matter. If in the midst of this employment some one knocks or rings at the door, and a young gentleman is announced, she is not at all embarrassed, but perhaps hastens to the parlor with her delicate hands covered with dough, and with an air of complacency and self-satisfaction, says—'Good morning, Frank! how do you do? I am just engaged in making some cake; I hope you will excuse me for a few moments.'

1387. All this shows that she regards the quality of her cake as of very great importance, and considers it not only perfectly respectable, but highly *genteel* for a young lady to be employed in making cake. But in regard to bread and bread-making, every thing is very different; there is none of this early curiosity to learn how to make good bread. Young ladies do not on every occasion when they find excellent bread, carefully and minutely inquire how it was made, baked, etc., and write down the recipe; but when a batch of bread is to be made for the family. they either leave it for Mother or some other domestic to make, or go about it themselves as some irksome and disreputable piece of drudgery, and consequently they turn the task off their hands with as much despatch and as little trouble as possible. If all things happen to be as they should be, it is well; if not, they must answer for the present. If the yeast happens to be lively and sweet, very lucky. If otherwise, still it must be used. If the dough rises well and is got into the oven before it becomes sour, very fortunate; if not, why, 'nobody can avoid mistakes, and bread will sometimes be poor in spite of the greatest care;' and if a batch of miserable bread is the result of such an operation, then all that remains to be done is to eat it up as soon as possible, and hope for better the next time. If Frank, or Charles, or Edward, should call while the young lady is engaged in making bread, she is perhaps quite disconcerted, and would not for the world have him know what she is doing; she sends word to him, either that she is out, or that she is particularly engaged, and begs he will excuse her; or if by any means she happens unexpectedly to be caught at her employment, she is greatly embarrassed, and makes the best apology she can for being engaged in such menial services.

1388. As a matter of course, while such are the views and feelings entertained on this subject, and while such is the manner in which this duty is performed, it will ever be a mere accident if good bread is made, and a mere accident if such girls ever become good bread-makers when they are wives and mothers. But if parents, and especially mothers, could view this matter in its true light, how differently would they educate their children. They would then feel that, grateful as it is to a mother's heart to see her daughters highly refined and elegantly accomplished, and able to

'make the instrument discourse most eloquent music,' and to transfer living nature, with all its truth and beauty and sublimity, to the canvass, still the art of bread-making, when considered in all its relations and intimate connections with human health and prosperity and virtue and happiness, and with reference to the natural responsibilities and duties of woman, is actually one of the highest and noblest accomplishments that can adorn the female character And then, too, would they consider it of exceedingly great importance that their daughters should possess this accomplishment, even though they may never be in circumstances which will require the exercise of it.

1389. Some eight or ten years since, I spent several months in the delightful village of Belvidere, on the banks of the Delaware, in Pennsylvania. While there, I enjoyed for a number of weeks the kind hospitality of J—— S ——, Esq., a lawyer, and a gentleman of great moral excellence. Mrs. S. was born and brought up, I believe, in Philadelphia. Her father was a man of wealth, and she was the only daughter, and—almost as a matter of course—was indulged in all that she desired. But there were so many of the elements of a good wife and mother in her natural composition, that as soon as she entered into those interesting and important relations, she began to devote herself to the duties of them with a sincerity and conscientiousness which could not fail of success. Surrounded as she was with health and every comfort and convenience of life, and all of its luxuries that she desired, still she was industrious in her habits, and vigilantly attentive to all the concerns of her household. She usually kept three female domestics, who, by her kind maternal deportment towards them, were warmly attached to her. She had no difficulty in procuring nor in keeping help, because she always treated them in such a manner that they loved to stay with her; and she took much pains to qualify them for the proper discharge of their duties. They evidently loved her, and were sincerely desirous of performing all their services in such a manner as would be pleasing to her. Yet with all these advantages to justify her leaving such a duty to her domestics, Mrs. S. invariably made the family bread with her own hands. Regularly as the baking day came, she went into her kitchen and took her stand beside the bread trough, and mixed and kneaded the dough, and put it in its proper place for rising, and in due time moulded it into the loaf and baked it. 'Do you always make your bread, madam?' I inquired one day, as she returned from the performance of that task. 'Invariably,' she replied, 'that is a duty I trust no other person to do for me.' 'But cannot your domestics make good bread?' I asked. 'I have excellent domestics,' answered Mrs. S., 'and they can, perhaps, make as good bread as I can; for they have been with me several years, and I have taken pains to learn them how to do my work; and they are exceedingly faithful and affectionate, and are always willing to do all they can to please me; but they cannot feel for my husband and my children as I do, and therefore they cannot feel that interest which I do in always having such bread as my husband and my children will love and enjoy. Besides, if it were certain their care and vigilance and success in bread-making would be always equal to mine, yet it is wholly uncertain how long they will remain with me. Various circumstances may take place, which may cause them to leave me, and bring me into dependence upon those who know not how to to make good bread; and therefore I choose to keep my own hand in

But, apart from all other considerations, there is a pleasure resulting from the performance of this duty, which richly rewards me for all the labor of it. When my bread is made and brought upon the table, and I see my husband and children eat it and enjoy it, and hear them speak of its excellence, it affords me much satisfaction, and I am glad to know that I have contributed so much to their health and happiness; for while my bread is so good that they prefer it to any thing else upon the table, there is little danger of their indulging, to any injurious extent, in those articles of food which are less favorable to their health.'

1390. I need not say that this lady invariably had excellent bread upon her table. But instances of this kind are, I regret to say, extremely rare, even in Christian communities; and therefore, when such cases are known, they ought to be held up as most noble examples of female virtue, and receive such high commendations as their intrinsic merit deserves, and such as will be calculated to beget in the minds of others an exalted sense of the dignity and importance of such duties, and prompt every wife and mother to the intelligent and affectionate performance of them. For it should ever be remembered, that though our children, while they depend on us for protection, are also properly the subjects of our government, yet as soon as they are capable of appreciating our authority and our influence, they are, like ourselves, moral agents, and ought in all respects to be governed and nurtured as such; and, therefore, it is not enough that we can give them such food as we think best for them, and *compel* them to eat it; but the grand point at which the mother should always aim in this matter is, to place before her children such food as is the very best for them, and at the same time to make it the most agreeable to them, and thereby make their duty and their enjoyment perfectly coincide.

1391. Let no one, therefore, say she cannot always have good bread, until she can truly affirm that she has fairly made the experiment; that she has, in view of all its relations and bearings, accurately estimated the importance of the quality of her bread in regard to the welfare of her household, and, with a proper sense of her responsibilities as a wife and mother, has *at all times* felt that interest and exercised that care and attention which so important a duty demands, and without which it must ever be a mere accident whether her bread is good or bad. They that will have good bread, not only for a single time, but uniformly, must make the quality of the bread of sufficient importance, in their estimation and feelings, to secure the requisite attention to the means by which alone such an end can be made certain. They must not suffer themselves, through carelessness, to get entirely out of bread unexpectedly, and thus be obliged without due preparation to make up a batch of such materials as they may happen to have at hand, and bake it in haste, and hurry it to the table. But they must exercise providence and foresight: they must know beforehand when their supply of bread will probably be out, and when they will need to make another batch; and then they must see, beforehand, that measures are taken to secure a proper supply of all the requisite materials—see that they are furnished with good meal or flour, and they must be sure to have the best of yeast or leaven, when they need it; and when the time comes for them to make their bread, if by any means the yeast should not be good, let them throw it away and make good, before they proceed to make their bread; for it is infinitely better that the family should even do without bread one day, and eat roasted potatoes, than that they should eat poor

bread three or four days ; and if, from any cause, the bread should be poor, it is incomparably better to throw it away, than to set it upon the table, to disgust the whole family with bread, and drive them to make most of their meal on something else. If a lady can ever find a good excuse for having poor bread, she certainly can find none, except perhaps extreme poverty for setting her poor bread on the table the second time. Yet, too generally, women seem to think that, as a matter of course, if they, by carelessness or any other means, have been so unlucky as to make a batch of poor bread, their family and friends must share their misfortune, and help them to eat it up ; and by this means many a child has had its health seriously impaired, and its constitution injured, and perhaps its moral character ruined, by being driven in early life into pernicious dietetic habits.

1392. It was observed many years ago, by one of the most eminent and extensive practitioners in New England, that during a practice of medicine for thirty years, he had always remarked that in those families where the children were most afflicted with worms, he invariably found poor bread, and that, as a general fact, the converse of this was true ; that is, in those families where they uniformly had heavy, sour, ill-baked bread, he generally found that the children were afflicted with worms.

1393. A careful and extensive observation for a few years, would convince every intelligent mind that there is a far more intimate relation between the quality of the bread and the moral character of a family than is generally supposed. 'Keep that man at least ten paces from you, who eats no bread with his dinner,' said Lavater, in his *Aphorisms on Man*. This notion appears to be purely whimsical at first glace ; but Lavater was a shrewd observer, and seldom erred in the moral inferences which he drew from the voluntary habits of mankind ; and depend upon it, a serious contemplation of this apparent whim discloses a deeper philosophy than is at first perceived upon the surface. Whatever may be the cause which turns our children and ourselves away from the dish of bread, and establishes an habitual disregard for it, the effect, though not perhaps in every individual instance, yet, as a general fact, is certainly, in some degree, unfavorable to the physical and intellectual and moral and religious and social and civil and political interests of man. Of all the artificially prepared articles of food which come upon our table, therefore, bread should be that one which, as a general fact, is uniformly preferred by our children and our household,—that one, the absence of which they would notice soonest, and feel the most,—that one which, however they may enjoy for a time the little varieties set before them, they would be most unwilling to dispense with, and which, if they were driven to the necessity, they would prefer to any other dish, as a single article of subsistence. To effect this state of things, it is obvious that the quality of the bread must be uniformly excellent ; and to secure this, I say again, there must be a judgment, an experience, a skill, a care, a vigilance, which can only spring from the sincere affections of a devoted wife and mother, who accurately perceives and duly appreciates the importance of these things, and, in the lively exercise of a pure and delicate moral sense, feels deeply her responsibilities, and is prompted to the performance of her duties. Would to God that this were all true of every wife and mother in our country, in the world!—that the true relations and interests and responsibilities of life were understood and felt by every human being, and all the duties of life properly and faithfully performed.

VARIETIES OF BREAD.

1394. I have thus far spoken almost entirely of wheaten bread, because I consider that the most wholesome kind of loaf bread for ordinary use for 'daily bread.' When bread is made of superfine flour, the same general rules should be observed. Rice, barley, oats, rye, Indian corn, and many other farinaceous products of the vegetable kingdom, may also be manufactured into bread, but none of them will make so good bread as wheat. Good rye raised on a sandy soil, when cleansed and ground in the manner I have already described, and prepared in all respects according to the rules I have laid down, will make very excellent bread. Rye, coarsely ground, without bolting, and mixed with Indian meal, makes very wholesome bread, when it is well made. Good rye and Indian bread is far more wholesome for common or every-day use, than that made of superfine flour.

1395. There are various ways of preparing Indian meal bread; and when such bread is well made, it is very wholesome,—much more so for every-day use than superfine flour bread. Indeed Indian corn, in the various simple modes in which it is prepared for human aliment, is one of the most wholesome productions of the vegetable kingdom. 'In a memoir lately read before the French Academy,' says the *Journal of Health*, 'the author undertook to show that maize (Indian corn) is more conducive to health than any other grain; and, as a proof of this, the fact was adduced that in one of the departments in which this grain was most abundantly and universally used, the inhabitants were remarkable for their health and vigor.' One great drawback to the wholesomeness of Indian meal bread, however, is that it is almost universally eaten hot, and too generally pretty well oiled with butter, or some other kind of animal fat or oil. Nevertheless it can be prepared in such a manner as to obviate these difficulties, and render it very wholesome.

1396. Barley and oats may be manufactured into very wholesome bread, but they are little used for such purposes in this country. Rice, arrow-root, tapioca, sago, peas, beans, chestnuts, millet, buckwheat, potatoes, etc., may also, by mixing them with a portion of wheat or rye flour, be manufactured into loaf bread; but, as I have already stated, there is no other kind of grain or farinaceous vegetable substance from which so good loaf bread can be made as good wheat.

1397. In making bread from Indian meal, and other kinds of farinaceous substances containing little or no gluten, yeast or leaven is rarely if ever used to make it light. More generally sour-milk or butter-milk and saleratus or soda are used for this purpose; and they who do not well understand the principle upon which these substances make their bread light, often greatly impair their own success by their mismanagement. It is, perhaps, most common for them to mix their sour-milk or butter-milk and saleratus together, and wait till the effervescence is over, before they stir in their meal. But by this means they lose the greater part of the gas or air by which their dough should be made light. The true way is to take their sour-milk or butter-milk, and stir meal into it till a thin batter is formed, and then dissolve their saleratus or soda, and stir that quickly and thoroughly into the batter, and then hastily add meal till the batter or dough is brought into the consistency desired. If, instead of sour-milk or butter-milk, a solution of muriatic or tartaric acid is used, the bread will be equally light. In this case, the batter should be first made with a

solution of saleratus or soda, and then the solution of acid should be stirred in as above described. Batter cakes are made in this manner very light and very promptly. When from any cause batter or dough mixed with yeast fails to rise according to expectations, the thorough mixing in, first, the solution of muriatic or tartaric acid, and then the solution of saleratus or soda, will in a few minutes make the whole mass very light; but such cakes and bread are not so sweet and savory as those raised with good sweet yeast.

1398. I have said (1338) that recently ground meal makes far sweeter and richer bread than that which has been ground a considerable time; but as it is not convenient for many families to send to a mill as often as they would like to have fresh meal, they are obliged generally to use staler meal or flour than they would choose. Yet every family might easily be furnished with a modern patent hand-mill, constructed after the plan of a coffee-mill, with which they could at all times, with great ease, grind their wheat and rice and corn, as they want it, for bread and other purposes. With these mills they can grind their stuff as finely or coarsely as they wish, for bread or hominy, and always have it very fresh and sweet.

1399. Perfect bread-making, I have said (1380), is the top of perfection in the art of cooking. When good bread is made, therefore, culinary skill has done its utmost. Wheat-meal and flour, and the flour of other kinds of grain and vegetables, may be prepared in a great variety of other ways; but the stern truth is, that, as a general rule, every departure from the simple form of bread, in cooking these substances, is more or less detrimental to the physiological interests of man; and all those mixtures and compounds of flour and butter or lard, and the sugar or molasses or honey, and eggs and spices, etc., comprehended by the terms 'pastry,' 'cakes,' 'confectionary,' etc., are among the most pernicious articles of human aliment in civilized life.—doing incomparably more mischief than simply prepared flesh-meat (1075). Yet there are some deviations from the simplicity of bread, which are far less objectionable than others. Let it be continually kept in mind, as a general rule, however, that all concentrations of vegetable as well as animal substances (1312), and all artificial combinations of those concentrated substances, in preparing the food of man (1313), are always more or less at variance with the physiological laws of constitution and relation established in our nature (683—757). Hence, though the saccharine matter of vegetables is highly nutritive and salutary when received in the state in which nature produces it, yet when concentrated in the form of syrup, like molasses or honey, and still more in the crystallized form of sugar, it is decidedly unfriendly to the physiological interests of our bodies, and especially when used alone, or too freely with other substances. All this is likewise true of the vegetable acids (700). Nevertheless molasses and honey and sugar and vegetable acid may occasionally be used, to a limited extent, with other substances, without greatly infringing the physiological laws and interests of our bodies; provided always, that as a general rule, a proper regard be paid to the due proportions of nutritious and innutritious matter (1312), or of bulk and nutrient, and that butter or lard or any kind of fat or oil does not enter into the composition. For it must ever be remembered as a most important consideration, that the mixing of lard or butter, or any kind of animal fat or oil, with flour or meal or any other vegetable substance in the making of puddings, cakes, or pies, or preparing any other

kind of food, is a great violation of the physiological laws of the digestive organs (1278, 1279, 1323), and that the articles thus prepared are more difficult to digest and more irritating to the stomach than almost any other kind of food eaten by civilized man (1287).

1400. The sweet cream of good milk (1296), though essentially an oleaginous substance, yet, in its recent state, or when taken from milk not more than twelve hours from the cow, being perfectly soluble in the fluids of the mouth and stomach (1297), is far less objectionable than even the best of butter, and incomparably more wholesome than any other animal fat: and, therefore, if any kind of shortening *must* be used that is, if human beings are determined they *will* use it—in the preparation of pastry and other kinds of food, good sweet cream is in every respect vastly preferable to any other kind. Puddings, cakes, pies, and all other kinds of pastry, may be made more truly rich and delicately nice with sweet cream and new milk, than by the use of butter or any other animal fat or oil; and no one can become accustomed to pastry thus prepared, without greatly preferring it to that in which lard or butter largely abounds.

1401. A small quantity of new milk, or cream, or both together, may also be used in making toast, with comparatively little objection. When bread has become stale, if it be carefully toasted, and then some new milk, heated and seasoned with a little salt, be poured upon it, it makes a most delicious toast, which will sit perfectly well upon the most delicate and feeble stomach. If a little sweet cream is used with the milk, it makes the toast richer but not more wholesome. In short, if in every case and for all purposes pertaining to the diet of man, people would substitute good sweet cream for butter and other animal fats or oils, they would be great gainers in health and comfort, and even in the amount of their gustatory enjoyment; and if they would go still further, and abandon the use of cream also, they would as a generation and as a species be still greater gainers.

402. Rice, wheat, Indian corn, and all the other farinaceous grains and substances, may be converted into puddings, in a comparatively simple and wholesome manner. Custards made of good fresh eggs (1298) and milk and sugar, very slightly cooked, are also comparatively innocent for occasional use. The custards, squash, apple, blackberry, and other pies, may be made comparatively simple and wholesome by a proper regard to the principles which I have already laid down. The pastry can be made very nice and very delicious without a particle of lard or butter. A little sour butter-milk or sour milk, with at most a little good cream, skilfully managed, will make a much more delicious as well as more wholesome pie-crust that can be made with lard or butter; and some make it very good without using even these, by employing boiled and finely mashed potatoes for shortening.

1403. After all, however, it must be remembered that all these things are greater or less departures from the strict line of physiological truth (1210—1318), rendering our food somewhat less wholesome in itself, and increasing our temptation to indulge to excess (1316). If we have vigorous constitutions, and are in good health and of active and athletic habits, they may never so affect us as to enable us distinctly to perceive their evil consequences in ourselves; yet it is not more certain that the continual revolutions of a wheel gradually though by imperceptible

degrees wear the axle on which the wheel revolves, than it is that every deviation from the laws of constitution and relation established in our nature impairs in some degree our physiological powers, and abbreviates the period of our existence (725); and though the effects may not always be evident and unequivocal in the individual, yet they are conspicuous in the race, when regarded in a succession of generations (877).

1404. What then? it is asked; shall man live by bread alone? I answer, No! the vegetable kingdom affords us a boundless variety of substances for our food (1305), and the capabilities of the soil for the improvement and augmentation of that variety are almost unlimited. Some of these substances may be prepared with the greatest simplicity, and a very large proportion of them may be eaten without any artificial preparation.

1405. Besides the several kinds of grain which I have mentioned, beans, peas, potatoes, beets, carrots, parsnips, turnips, pumpkins, squashes, cabbage, etc., are among the vegetables common to our climate, and which at most require no other preparation than simple boiling, roasting, or baking. Cabbage, radishes, cucumbers, lettuce, and other salads, which are often complained of in civic life as being too crude and indigestible for the human stomach, are managed with perfect ease and comfort and safety by those who are healthy and vigorous, and who subsist wholly on vegetable food properly prepared, and abstain from stimulating and heating substances. Hence they who subsist in the ordinary manner of civic life are unfit to give rules from their own experience for the dietetic habits of others in different circumstances. In fact, no rules which are not founded on, or are not compatible with, the general and permanent physiological principles of human nature, are good for any thing, except possibly in some instances, as mere temporary expediencies for particular emergencies.

1406. But besides bread in some form or other (1328), fruit is the most natural and appropriate food of man (770); and here the earth is truly bountiful in her variety and abundance. Apples, pears, peaches, plums, cherries, grapes, strawberries, raspberries, blackberries, whortleberries, gooseberries, watermelons, muskmelons, etc., are produced in great abundance, and are capable of being improved to the highest perfection and in almost infinite varieties; and these may be eaten with or without bread, when perfectly ripe, without any artificial preparation or cooking. And our benevolent Creator has so ordered the seasons, and the regular succession in which they are produced, that even in our climate we can be supplied with some kind or other of delicious and wholesome fruit, fresh from the bosom of nature, almost the whole year round; and the apple can by proper care be kept in its natural state through the winter and spring, till a new year brings us fresh supplies. And then there is a great variety of nuts which are admirably fitted for the winter's use, and which are very delicious and perfectly wholesome to the vegetable-eater whose general regimen is correct. Moreover, the apple, pear, peach, cherry, plum, strawberry, raspberry, and a great number of other fruits, may be preserved by drying, so as to furnish us with a rich variety of delicacies during the whole winter. The good ripe peach and other kinds of fruit, when well dried in the autumn, may be stewed in some water with a little sugar, and make a delicious dish of sauce to eat with our bread in the

winter and early spring. Besides this, the fruits may be preserved in their own inspissated juices, so as to make exceedingly delightful substitutes for fruit in its natural and recent state. Thus, if a quantity of choice rich sweet apples be gathered and made clean, and ground in a clean mill, and the juice immediately pressed out and filtered through washed sea-sand and pulverized charcoal, and then put into a proper vessel over a slow fire, and the water evaporated till the juice becomes a thick syrup, and if in the mean time some mildly acid apples be divested of the skin and core and put into this syrup, till they are cooked through, a delightful sauce will be produced, which will serve instead of the ordinary use of butter with our bread through the whole winter. Peaches, strawberries, and other fruit, may also be preserved in the same simple manner.

1407. But here again I must repeat, that every species of artificial preparation opens the way to evil, principally from four grand sources. First, the want of the proper exercise of the teeth (709), and consequent insalivation and complete trituration of the food before it is swallowed (717); second, eating too fast and too much (416); third, improper concentrations (1312) and combinations (1313); and fourth, improper temperature (1311). All four of these sources of evil must therefore be constantly guarded against; and the utmost pains should habitually be taken to cultivate fruit of every variety to the highest perfection and in the greatest abundance, in order that our tables should be at all times furnished as far as possible with that which will be delicious and wholesome in its natural state.

1408. But it should always be remembered that fruit of every description, if eaten at all, should be eaten as food, and not as mere pastime or merely for the sake of gustatory enjoyment; and therefore it should, as a general rule, be eaten at the table, or constitute a portion of the regular meal. I do not mean as the dessert of flesh-eaters, after they have eaten already enough of other food; but I mean as a portion of the regular meal of vegetable-eaters, taken with their bread, instead of flesh and butter; for their breakfast and their dinner; but more sparingly at their third meal or supper, especially if the third meal be taken late in the day. The truth is, that all cooked food, even under the best regulations, impairs in some degree the power of the stomach to digest uncooked substances, and, therefore, so long as we are accustomed to cooked food of any kind, we must be somewhat more careful in regard to the times when we eat fruit and other substances in their natural state. The digestive organs always in health partake of the general vigor and freshness of the body, and always share with it also in its weariness and exhaustion. Hence, as a general rule, so long as we are accustomed to cooked food, the stomach will always digest fruit and other substances in their natural state better in the early than in the latter part of the day. Moreover, it is a truth of considerable importance, that fruit and other substances in the natural state are digested with more ease and comfort when taken alone, at a regular meal time, than when taken with any kind of cooked food, except good bread. While, therefore, human beings, and especially in civilized life, wholly disregard these physiological principles, and eat fruit with any thing and every thing else, and at all hours of the day and night, they ought not to be surprised, and still less should they complain, if they suffer from their erroneous habits. But nothing is more certain then that, if human beings will in a reasonable degree conform to the physiological laws of their nature, they

may eat almost every variety of esculent fruits which the vegetable kingdom produces, with entire safety and comfort.

1409. Be it understood that I do not pretend to name all the products of the vegetable kingdom proper for human aliment. It is my object to teach general principles in regard to life, health, and regimen, rather than to give particular dietetic prescriptions or formula. There are doubtless many excellent fruits and vegetables of our own climate which I have not spoken of and many of other climates which are wholesome and delicious. As a general rule, however, the fruits of other climates which are gathered before they are perfectly ripe are to be avoided as unwholesome and unsafe. With the great physiological principles before him which I have presented and shall present in these lectures, every intelligent individual can guide himself in the details of practical application, and therefore it is enough for me to say in general terms, that if the dietetic and other habits of man were true to the laws of his nature, he might safely partake of most or all of the esculent products of the vegetable kingdom, and he might easily cultivate the richest and most bountiful variety of fruits and vegetables of every description for his enjoyment, and extend his gustatory pleasures far beyond anything that is or can be experienced by the flesh-eating epicure (702). But this will not, it *cannot* be done, while flesh continues to be so important an article in the diet of human beings in our country (858).

1410. In conclusion of the whole matter, in relation to kinds and qualities of food, then, I will summarily recapitulate, that those who *will* eat flesh, should use but a small quantity of the healthy lean fibre (1271) once a day, prepared in the manner I have named (1279), and accompanied with good bread, and one or two kinds of vegetables at most, simply prepared, and eaten plain; but while they continue to eat flesh, let them be careful how they indulge in fruits and vegetables in their natural state (1299). While, on the other hand, they who subsist wholly on a pure diet of vegetable food and water, under a correct general regimen—and particularly those who are accustomed to such diet from childhood—may partake with safety and enjoyment of every esculent fruit and vegetable that the wide earth produces or can be made to produce; provided always that every such article is of a healthy growth, and properly matured before it is plucked or gathered, and eaten as a portion of the regular meal, at proper times and in proper quantities. The vegetable-eater also, by the help of fire, can prepare many green vegetables, such as peas, beans, corn, and other products of the garden, which, although they are far from being most perfectly adapted to his physiological wants and interests, yet when prepared in the best manner (1405), and eaten plain, with good bread, and in temperate quantities, are comparatively harmless, and give a pleasant variety to our diet.

1411. Finally, let it ever be remembered as a matter of the utmost importance, that whatever constitutes the food of man, it should always be of the very best quality. Serious attention should be given that the wheat and all other kinds of grain and every kind of fruit and vegetables that he employs for food, are of the most perfect character, and that they are prepared—so far as artificial preparation of any kind is necessary—in the most perfect manner. The bread should be the best that can be made; the potatoes and other vegetables should be cooked in the best possible manner (1405), but in great simplicity; every thing, in short, should be done with care, aiming at perfection. It is surprising what a difference

can be made in these things. Some women will prepare a plain vegetable dinner in such a manner that almost any man in the civilized world would feel it a privilege to partake of it, while others will get it up in such a way as to render its very appearance disgusting. Order, neatness, good taste, and a sound judgment, should be diligently cultivated by all who attempt a practical exemplification of the principles inculcated in these lectures.

LECTURE XXII.

Physiological principles in regard to times of eating—Different theories of hunger—Beaumont's theory—The true physiology of hunger—Natural regularity and periodicity of vital action—Hunger naturally recurs at regular periods, and becomes an established physiological habitude—Flesh-meat increases the urgency of hunger; the pure stimulants still more—The more stimulating the diet, the more frequent and importunate will hunger be, and the more will it demand stimulation rather than alimentation—The vegetable-eater fasts longer than the flesh-eater without distress—Five general inductions in regard to hunger as an indication of the alimentary wants of the system—The practical application of these principles—The number of meals in a day, and the proper duration of time between meals—If three meals are taken in a day, the last should be light, and not too near the sleeping hour—The importance of great regularity in the times of eating—Never eat between meals—Late suppers very mischievous—Dietetic regularity of children and aged people.

1412. In regard to the proper times of eating, physiology does not teach us precisely at what hours nor how frequently we shall take our meals; but it does determinately establish for us certain general principles or great way-marks by which we are led to conclusions sufficiently exact and determinate for our purpose.

1413. I have frequently spoken of hunger as a special sense (247, 589, 595), and in part already explained its physiology (757, 1192); but a correct understanding of the physiological character and laws of this sense is of so much practical importance that I shall now enter into a more full explanation and illustration of them. It would hardly be a profitable employment of time to recite the various opinions which have been entertained on this subject during the last twenty-five hundred years. It is enough to say that the theory of hunger has always corresponded with that of digestion (431). After Spallanzani had established the doctrine of a solvent gastric fluid, he advanced the idea that hunger was caused by the action of that fluid on the inner coat of the empty stomach; and this notion was very generally received, and has continued in vogue to the present time. The recent experiments and observations of Dr. Beaumont, of which I have spoken (431), have however fully proved that notion to be incorrect; for he has ascertained by the most careful experiments and observations, continued for nearly eight years, that no gastric juice is ever found in an empty stomach, or one which contains no food or chyme, but that always, when the food is chymified and passes from the stomach, that organ is left entirely empty and clean, and contracts upon itself and remains in this state till some alimentary or other substance is introduced into it, to excite its secretion and muscular contraction. Dr. Beaumont has therefore attempted another explanation of hunger. 'My impression, says he, 'is, that hunger is produced by a *distention* of the gastric vessels, or that apparatus, whether vascular or glandular, which secretes the

gastric juice—a distention by the gastric juice of a particular set of vessels or glands which constitute in part the erectile tissue of the villous coat of the stomach. The sensation varies according to the different degrees or states of distention, from the simplest desire to the most painful sense of hunger, and is allayed or increased in proportion to the application or refusal of alimentary stimulus to the excretory vessels; the greater the distention of the vessels, the more acute will be the pain; hence the difference between a short and a protracted fast. It almost amounts to demonstration,' continues the doctor, 'that a large quantity of gastric juice must be contained in appropriate vessels during a fast, ready to obey the call of aliment; and the quiescence and relief from the unpleasant sensation, which are experienced as soon as the vessels are emptied, are, I think, additional proofs of my opinion.'

1414. But this theory of Dr. Beaumont's is quite as untenable as that of Spallanzani's. If hunger be a sensation produced by the distention of the vessels containing the gastric juice, how is it that that sensation which occurs from physiological habitude at regular periods, according to the individual's customary hour of eating, will subside and totally disappear if that time is permitted to pass by without any food being received?—unless, indeed, the wants of the system for nourishment are real and pressing; and even then the same thing will take place to some extent. Will it be said that there is a re-absorption of the gastric juice, and a consequent abatement of hunger? This is wholly an assumption, of the truth of which there is no proof; while many things go to prove the contrary. But again, if simple distention of the gastric vessels causes the sensation of hunger, how is morbid appetite to be accounted for? We know that in certain states of the stomach, resulting from improper dietetic habits, hunger is much more craving and distressing than in a healthier condition of the stomach; and in such a state of things also, hunger is no true indication of the alimentary wants of the system (757), for it often supervenes with painful energy when fasting would actually be much better for the system than feeding. We know too, that the same individual feels hunger much more powerfully when he is in the habit of eating flesh freely, and still more if he uses stimulating condiments, than when he subsists entirely on vegetable food, and abstains from all such condiments. Can these facts be satisfactorily accounted for on the principle of simple mechanical distention? Certainly not. But there are other facts in point not more easily got over. Here are several individuals assembled around a table loaded with sumptuous fare; their hunger is powerful; they contemplate the repast with eager desire; their appetite is exceedingly keen; the savory viands are smoking on their plates, and now they are just about to commence their meal. At this moment several letters are thrown upon the table; one reads that a steamboat has burst her boilers, and that his beloved wife or child, whom he was hourly expecting home, is scalded to death: his hunger is entirely gone in an instant. Another reads an insulting communication, which throws him into a violent fit of anger, and his appetite is all gone. Another reads that a dreadful pestilence has broken out and is committing awful ravages in the neighbourhood; a paroxysm of fear at once destroys his hunger. Another reads that his ship, which he believed to have been captured by pirates, has just entered the harbor with a rich freight; a transport of joy annihilates his hunger. Another takes a pinch of snuff, and his

hunger is gone. Another puts a piece of tobacco into his mouth, and his hunger is destroyed. Another rubs his gums smartly with a little salt, and his hunger is subdued. Another dissolves some tartar emetic, stirs it up, and contemplates swallowing it; and his hunger disappears. Now these are not merely fanciful suppositions; they are real cases which have happened thousands of times. But how are such cases explained by Dr. Beaumont's theory of distention? Is the gastric juice re-absorbed in an instant, or does it instantaneously gush from its distended vessels into the stomach? Neither! It is not possible either for re-absorption or disemboguement to take place so instantaneously. What then becomes of the sense of distention in the vessels containing the gastric juice, which constitutes the feeling of hunger, according to Dr. Beaumont's theory? It is evident that the theory is wholly at fault. Indeed the assumed facts on which this theory is founded are all merely things of the imagination. There is no such thing in reality as 'the large quantity of gastric juice,' which Dr. B. is so confident of, 'contained in appropriate vessels, during a fast, ready to obey the call of aliment.' Not a particle of gastric juice is formed until the stomach is excited to physiological action by the ingestion of food, and then it is poured into the gastric cavity as fast as it is secreted. The function of gastric digestion is purely physiological, and every step and peculiarity of the process is the result of vital power and action (494).

1415. We have seen that the stomach is a primary organ of external relation (688), constructed to receive the external substance designed for the nourishment of the body; that it does not perform its function for itself alone (687), but receives and digests food for the whole assemblage of organs constituting the single system; and therefore it holds an important relation to the whole organic domain (298), and is accordingly connected in its anatomical structure and physiological endowments most intimately and powerfully with the common centre of organic life (231); and, depending on the voluntary powers for the supplies of that aliment which it receives and digests for the nourishment of the whole system, it is also powerfully connected in anatomical structure and sympathetic relation with the centre of animal perception and action (245). Hence, therefore, when the physiological economy of the system requires a supply of food, it indicates its want in the organ designed to receive that food, and this indication is perceived by the centre which presides over the voluntary functions (280).

1416. In the perfect health and integrity of the system, when a supply of nourishment is required, the vital economy brings the stomach into a particular physiological condition, preparatory to the reception and digestion of that nourishment. This condition consists in a concentration of vital energy in the tissues of the organ (313); the nerves of organic life distributed to the stomach (231) receive an increase of vital stimulus, the vessels become somewhat more injected with blood (393), exalting the vital properties of all the other tissues, and preparatory to the secretion of the gastric juice; the temperature of the stomach is slightly elevated (434), and the whole organ becomes more red, and has something of an excited appearance. The whole may therefore be called a state of vital exaltation; and in this state the stomach is specially prepared for the performance of its functions; in this state it possesses its greatest functional power, and can digest any alimentary substance with the greatest ease, and most perfectly.

1417. But all this might take place without the consciousness of the animal (228), and therefore without serving in any measure to excite the voluntary powers to furnish the requisite supply of food, were it not for the particular connexion established between the stomach and the centre of animal perception (280), by means of the pneumogastric nerve (245). This nerve being one of the internal *feelers* of the animal centre (590), is so associated with the nerves of organic life in the stomach, that it sympathizes with them, or feels their condition, and communicates this feeling to the centre of animal perception; and this perception of the physiological state of the stomach by the animal centre is the special sense of hunger (589), which is a demand of the organic domain on the voluntary powers for a proper supply of food, and naturally excites those powers to satisfy its wants (595). In the perfect health and integrity of the system, therefore, the special sense of hunger informs us with utmost accuracy both when food is wanted and when the stomach is in the best state to receive and digest it.

1418. Every thing in creation is subject to law (144), and every thing in nature that has motion or action naturally observes the strictest regularity. From the revolutions of planetary systems, down to the physiological actions of the simplest vegetable, every thing, when undisturbed, and left to obey its own constitutional laws, is strictly regular and exactly periodical in the recurrence of its phenomena; and in living bodies, every disturbance of this regularity and periodicity is in some measure a violation of their laws and an injury to their constitution. This is emphatically true of the human system If the physiological actions of our bodies were left to obey their own constitutional laws, without the least disturbance from our voluntary actions or any other cause, every vital phenomena of the system would recur at regular periods, with the exactness of a most perfect chronometer; and although the human constitution possesses a wonderful power of sustaining the disturbances of irregularity without immediate destruction, so that many human beings, by virtue of great natural vigor, attain to fifty, seventy, and in some extremely rare instances even to a hundred years, in spite of many and sometimes great irregularities, yet nothing is more true than that the greatest possible longevity and the highest possible well-being of the human system can only be secured by the most perfect physiological regularity and periodicity; and therefore every interruption or disturbance of the physiological regularity of our systems, by our voluntary irregularities or other causes, is always and inevitably in some measure injurious to the constitution, impairs health and shortens life. Indeed, such is the importance of physiological regularity to the welfare of the body, that when it is properly observed, it will enable the system to endure other evils with astonishing power, and often for a wonderful length of time. Thus, let an individual whose voluntary habits are systematic, and which conform in a good measure to the natural regularity and periodicity of the physiological actions of his system, accustom himself to the use of tobacco, opium, alcohol, arsenic, or any other poison, and always take the same quantity at regular periods, and it is surprising how soon the system will accommodate itself to the pernicious substance (728), and how perfectly the habit will insert itself into the physiological economy, and become as it were a harmonizing element of action, with which the system will work on with little apparent inconvenience, though always and inevitably with more or less detriment, for forty, sixty, or eighty

years. But let another individual of general irregularity of habits, accustom himself to the use of the same poison, taking it at irregular times and in irregular quantities, and though he do not consume more in a year than the man of regular habits, yet his system will be incomparably more disturbed by it, and if he perseveres in the use of it, much more certainly will it bring on disease, and in a much greater measure abbreviate life, than in the other case.

1419. The physiological reason for this difference is easily given. We have seen that the discriminating sensibilities of the nerves of organic life are soon destroyed by the use of improper substances (728), so that the organs acted on by such substances become as it were isolated in their sympathies, in a measure corresponding with the quantity and energy of the deleterious substance habitually used, and have no longer the power to give alarm to the general centre of action (228), and rally the vital forces in powerful resistance to the offending cause, and consequently the system suffers comparatively little from sympathetic disturbances (948 *et seq.*). We have seen also that there is in the system a conservative and renovating economy which is continually busy in repairing the injuries which result from our voluntary improprieties and other causes (314). In the first case, then, the general regularity of the individual gives greater physiological power to his whole system; the regularity, as to time, with which he takes his poison, enables the system always to be prepared to receive and dispose of it, with the least possible disturbance and injury; the regular quantity which he takes is always adapted to the state of accommodation in the system, so that little sympathetic disturbance is produced beyond the part immediately acted on (950), and the whole regularity enables the conservative and renovating economy of the system to keep pace with the depredation; so that, though the constitution always and inevitably wears out the sooner for the poison, yet it perhaps never actually breaks down with disease in consequence of it. In the second case, the contrary of all this is true. The general irregularities of the individual impair all the physiological powers of the system; his irregularity as to time and quantity in the use of his poison generally takes the system, as it were, by surprise—continually produces extensive disturbances in the physiological actions,—often exceeds the conservative and renovating economy of the organic domain, and consequently brings on disease and breaks down the constitution perhaps long before it is worn out. All dietetic and other irregularities by which the physiological regularity and periodicity are disturbed, are therefore always and necessarily more or less injurious to the human constitution, and serve in some measure to impair health and abbreviate life.

1420. Some individuals, as we have seen (1418), by virtue of an iron constitution, will attain to advanced life with many improper habits: but if there be one rule in which remarkable cases of longevity agree more invariably than in any other, it is in that general regularity of voluntary habits and circumstances, which in a good measure conforms to the physiological regularity and periodicity natural to all living bodies; and it is owing mainly, if not wholly, to the greater regularity of the voluntary habits and circumstances, that health becomes more uniform and better established in many people in the latter part of life than during the middle period. Many who claim to be wise in this

matter tell us it is better to be somewhat irregular than to be too precise and punctilious in our habits. It is undoubtedly true that a continual mental anxiety in regard to the regulation of our habits often does more harm than any consequent regularity of habits does good. Nevertheless, it is beyond all controversy, true, that when our regularity is the result of correct and systematic education or training, and is a thoroughly established habit, the more perfect it is, the better it will be for all the physiological interests of our nature. Nay more; it may be laid down as a general law, that those individuals whose alimentary habits are in point of regularity most in conformity with the physiological regularity of their bodies, will not only with greatest certainty secure health and longevity, but will also with greatest certainty secure prosperity in their vocations and pursuits of life.

1421. In the perfect health and integrity of the system, if the voluntary habits are in strict accordance with the physiological laws of the body, hunger will recur with the utmost regularity and integrity, as an indication of the alimentary wants of the vital economy; and this recurrence will constitute a physiological habitude of the system, harmonizing perfectly with all the other operations of the organic domain. But when the voluntary habits are very irregular, and the general periodicity of the vital actions of the system is disturbed, the regularity of the recurrence of the physiological condition of the stomach, the perception of which by the animal centre constitutes the sense of hunger, will be commensurately affected. In savage life, when the dietetic and other habits of the individual are simple and pure, and where the individual has no regular meal-times or stated times of eating, but procures his food and eats only when prompted by hunger, and greatly varies in his quantity, there will be no regular recurrence of that sensation at particular periods, but it will take place only when the vital economy really requires that a fresh supply of food should be introduced into the gastric cavity, and the frequency of its recurrence in such a case will always correspond with the quantity and quality of the food received at a meal, and the amount of active exercise which the individual takes. But in civilized life, which is evidently the more natural state of man (764), the very structure and economy of society, as well as the interests and convenience of the individual, make it necessary that all the voluntary habits of man should be more regular and systematic, and therefore, if not unnecessarily artificial, more in conformity with the natural regularity and periodicity of the physiological actions of his body (1418), which are not only greatly influenced by, but also in turn very greatly influence, these voluntary habits. Indeed, the physiological periodicity and habitudes of the human body are infinitely more concerned in making man 'the creature of habit,' as he is called, than he has probably ever been aware of.

1422. If, therefore, an individual in civic life, with a perfectly healthy and undepraved system, regularly eats at stated periods his three meals a day, of pure simple vegetable food, and uniformly takes about the same amount of exercise, and at each meal eats just about that quantity of food which the alimentary wants of the vital economy really demand, the physiological condition of the stomach indicated by the sense of hunger will become a fixed habitude, and hunger will recur at his regular periods of eating with utmost exactness and precision. But if

at any time he takes considerably more nourishment into the stomach than the real alimentary wants of the vital economy require, or omits his customary exercise or labor, hunger will not recur precisely at his next stated period of eating; and if he eats at that time, he will oppress and irritate the stomach, and trespass on the general physiological interests of his body, and by habitually continuing such transgressions, he will inevitably so affect the condition of his stomach as to bring on a preternatural appetite, which will eagerly receive food as often as his meal-time comes, and perhaps even more frequently, whether his system really requires alimentation or not, and which will never be satisfied with such a quantity of food as the vital economy of his system can dispose of without embarrassment and oppression Such an appetite, therefore, is something very different from that natural and healthy hunger which is a physiological manifestation of the real alimentary wants of the body; and it is of the utmost importance that this distinction should ever be kept in view when we are reasoning on the dietetic habits of man; for such an appetite is no safer guide for us in regard to eating—as to time, quantity, or quality—than the drunkard's thirst is in regard to drinking.

1423. But again; if a member of civic life, with a healthy and undepraved system, suffers flesh-meat to enter freely into his diet, all that I have just said of the vegetable-eater will be true of him under the same circumstances, except that all the effects and manifestations will be more energetic and distinct (909). While he observes a proper regimen as to times of eating, quantity of food, and amount of active exercise, hunger will always recur at stated periods, but it will be considerably more powerful and importunate and impatient and much more tormenting if the customary supply of food is withheld at the regular periods of eating (911); and if he transgresses in the manner which I have described in the case of the vegetable-eater (1422), the morbid appetite which he will produce will be more tyrannous, vehement, and voracious, and much more likely to excite all the more exclusively selfish propensities and passions (1213). In either of these cases, if the individual adds stimulating and heating condiments to his food (1202), he will necessarily increase the despotic energy and urgency of his appetite, which will always recur as soon as the increased exhaustion of his system demands a renewed stimulation, whether there be a need of alimentation or not. And if his stimulants are of a narcotic or poisonous character, the morbid craving, will be be still more distressing, violent, and imperious. In such cases, therefore, where the individual is regular in his times of eating, hunger will not only recur with energy as often as his stated times of eating recur, but it will habitually come on before the stated time of eating arrives, and be very impatient and perhaps tormenting until it is either satisfied or exhausted. For in all cases when hunger at a particular time is more the effect of physiological habitude (1422) than the manifestation of the real and pressing need of the system for alimentation, if that time be permitted to pass by without the individual's taking any food, the hunger will subside; and this will also take place for a single time when the system is in a state to receive food with advantage, and especially when the diet is simple and unstimulating.

1424. This is a beautiful illustration of the systematic regularity of

the physiological operations of our organic economy. The stomach is regularly brought into a physiological condition, preparatory for the performance of its function (1416); and whether that function is performed or not, that peculiar condition in due time passes away, and the vital energy which was accumulated in the gastric centre is distributed to other parts, to sustain other organs in the performance of their functions. This peculiar condition of the stomach will pass away much sooner and with much less uncomfortableness of feeling in the pure vegetable-eater of regular habits, when the ordinary meal is omitted, than in the flesh-eater; and he who makes a free use of stimulating condiments with his food, experiences still more inconvenience and distress at the loss of a meal, than he who eats flesh simply and plainly prepared. Hence the pure vegetable-eater loses a meal with great indifference, fasts twenty-four hours with little inconvenience or diminution of strength, and goes without food several days in succession without suffering any thing like intolerable distress from hunger. The flesh-eater always suffers much more from fasting (911), and experiences a more rapid decline of his muscular power;* and he who seasons his food highly with stimulating condiments, feels the loss of a single meal severely; a fast of twenty-four hours almost unmans him; and three or four days' abstinence from food completely prostrates him, if he is cut off from all stimulants as well as aliment.

1425. From the explanation before us, then, we perceive—1st, that the sense of hunger is produced by a *vital stimulation* of the nerves of the stomach, which is attended with an increase of blood in the vessels of that organ, an elevation of its temperature, and a considerable concentration of vital energy in the gastric centre, preparatory to the performance of the function of digestion (1416); and hence, a violent fit of anger, grief, fear, joy, or any other passion, or intense excitement of the mind (1414), or a free use of tobacco, opium, coffee, tea, or any other narcotic substance, or alcholic liquors, or any other means by which the vital stimulation or exaltation of the stomach is suddenly counteracted, will instantly destroy hunger, and subdue all desire for food. By these same means also, hunger may be completely prevented. Thus, an individual may be kept under such a state of mental excitement, that his meal-time will arrive, and he will sit down at his table without feeling any hunger or appetite for his food. A free use of alcoholic and narcotic and other stimulants will have the same effect; and for this reason the Mahomedans and Jews and other oriental religionists generally make a free use of opium, tobacco, coffee, etc., during their long fasts. In certain states of the system, however, when an individual comes to his table without any sense of hunger or desire for food, a glass of wine, if he is accustomed to it, or a little brandy and water, will serve to excite an appetite; while a more powerful stimulation of the same kind will be sure to produce the contrary effect; and in all cases the use of such means impairs the physiological integrity of hunger and the functional power of the stomach. For reasons now assigned, intense mental excitement, violent anger, grief, fear, joy, etc., violent muscular exercise, and all other causes which serve to prevent or destroy hunger, also serve to retard or prevent digestion (444).

* It has been asserted by some writers on physiology, that carnivorous animals will fast longer without serious inconvenience than herbivorous animals, but this is erroneous; the contrary is true.

1426. We perceive—2nd, that that concentration of vital energy in the stomach of which we have cognizance in the sense of hunger, brings the stomach into the best state for the reception and digestion of food (1416); and if aliment be then received, the organ will perform its function with more ease and perfectness than at any other time; but if food be entirely withheld, and the customary hour of eating be suffered to pass by without alimentation, this vital stimulation will subside, the sense of hunger will die away, and the vital energy accumulated in the gastric centre will be diffused over the system, or directed to some other particular organ or organs, to sustain it or them in the discharge of functional duty; and hence, after our customary meal-time has passed by an hour or two without our taking any food, and hunger has wholly subsided, if we then sit down and eat a hearty meal, the stomach will be embarrassed and oppressed and irritated; and if our digestive powers are not very strong, and our system generally in vigorous health, a general sympathetic irritation of the nervous system will be produced (297), resulting in a disturbed action of the vascular system (312), and more or less disturbance of all the physiological functions of the body, attended perhaps with a burning sensation in the eyes and face, and in the palms of the hands and soles of the feet, a heaviness and dull pain of the head, general langor and lassitude, and commonly very considerable thirst; and followed by a foulness of the tongue, fetidness of the breath, and a disagreeable taste of the mouth.

1427. We perceive—3rd, that when the body is in a perfectly normal, healthy, and undepraved state, and the dietetic and other voluntary habits in strict accordance with the physiological laws of the system, hunger is a true instinctive indication of the alimentary wants of the vital economy; but habitual over-eating and over-distention of the stomach causes oppression and irritation and debility of that organ, impairs the integrity of the sense of hunger as an indication of the alimentary wants of the system, and creates a preternatural appetite which is never satisfied with such a quantity of food as the vital economy can easily and healthfully dispose of, but is continually excessive and tormenting in its demands, and if not habitually restrained, impels to that constant gluttony which inevitably brings on disease that is attended with great distress of body and mind, and often with excruciating pains, and generally cuts off life at an early period.

1428. We perceive—4th, that precisely in proportion as the stimulating quality of our food exceeds what is necessary to the most perfect chymification of its nutrient properties (1423), the energy and importunity of hunger is increased; and precisely in proportion as the organic sensibilities (301) and sympathies of the stomach and other organs associated with it in the general function of nutrition are depraved by the use of stimulating and narcotic substances in our diet, the integrity of hunger as an indication of the alimentary wants of the system is impaired, and the sense becomes a physiological affection, which recurs with more or less regularity, according to the voluntary habits of the individual, and often with a highly morbid and tormenting energy, and without any true regard to the real state of the system as to its need of nourishment, but almost entirely with regard to the demand of the gastric centre for accustomed stimulation; and hence, a morbid appetite or craving for food is often felt when the system not only does not need it, but would actually be injured by a fresh or new supply of food to the gastric cavity. It may therefore be laid down as a general law, that the more stimulating and heating the

diet is, the more powerful and urgent will be the sense of hunger, and the more distressing and painful also when the food is withheld. Hence, as we have seen (1423), hunger is more keen and urgent in the same individual when he is accustomed to eat flesh freely, than it is when he subsists wholly on pure vegetable food; and still more so when with his flesh-meat he freely uses stimulating condiments or seasonings. It may also be laid down as a general law, that in proportion as the stimulating properties of our customary diet prevail over its nutrient properties, the energy and urgency of hunger will be an indication of the demand of the stomach and of the general domain of organic life for accustomed stimulation, rather than of the real alimentary wants of the system. Hence, the use of pure stimulants (733) with our food, renders the sense of hunger more powerful and vehement and distressing (1423), and commensurately impairs its integrity as an indication of the alimentary wants of the vital economy, and degenerates it into a demand for stimulation. All dietetic error, therefore, by which the nerves of organic life are irritated, and their vital properties impaired, and morbid irritability and sympathy induced, always increases the unhealthy energy and despotism of the sense of hunger, and proportionately impairs its integrity as an indication of the alimentary wants of the vital economy, and renders it a totally blind and exceedingly dangerous guide in regard to times of eating and quantity of food.

1429. We perceive—5th, that in the perfect health and integrity of the system, if the voluntary habits are in conformity with the natural regularity and periodicity of the physiological action of the organic domain, that peculiar condition of the stomach which is indicated by the sense of hunger, and which specially prepares it for the reception and digestion of food, will recur at our stated meal-times with great exactness and regularity, and this regular recurrence at particular times will soon become an established physiological habitude, and thus the ingestion of our food, or the reception of our meals, will always take place precisely when our digestive organs are prepared to perform their functions in the easiest and best manner. But as it is a law of the vital economy always to endeavor to accommodate itself to circumstances (854), and still adhere as far as possible to its natural regularity and periodicity, so, if one who is accustomed to take his dinner at twelve o'clock, is induced to change his hour for a single occasion, and dine at eleven o'clock, the next day at eleven the vital economy will bring the stomach into something of that physiological condition which is indicated by hunger; and if the individual continues to eat at this hour, and his other habits correspond, the physiological condition of his stomach will soon fully and regularly recur at that hour, and become a regular habitude. But if the individual dine one day at twelve o'clock, the next at eleven, the next at one, the next at two, the next at twelve, etc., he will soon entirely break up the physiological habitude of his stomach, and compel that organ to perform its functions to great disadvantage, and under great embarrassments; and however powerful his constitution and vigorous his health may be at the commencement of his irregularity, if he continues in such a course he will inevitably and soon break down his digestive powers, and induce the most serious and distressing disorders. It is true that the savage eats at greatly irregular periods, and probably without often being troubled with dyspepsy in consequence. But the cases are very different; the civilized man who is irregular in his meal-times, eats at one time or another, according to particular circumstances or en-

gagements, and generally with little or no regard either to the real alimentary wants of his system or the condition of his stomach, and consequently he is even more likely to take his food at a time when his system does not require it, and his stomach is not prepared to receive it, than otherwise; but the savage, as a general rule, eats only when he is really hungry, and when his stomach is keen for the performance of its function; besides, the savage, with all his irregularity, seldom brings his meals too near together, which is the most common fault of civilized life. It must also be remembered that there are numerous other causes co-operating to impair the digestive powers of man in civic life, which the savage is free from. Yet, after all, the savage suffers exceedingly from his dietetic irregularities. Indeed, this is one of those features of savage life which are most at variance with the physiological laws of the human constitution, and render the savage state unnatural to man (764), and greatly abbreviate the duration of life. For nothing is more true than that the highest welfare of the human constitution requires the utmost regularity and periodicity in all the physiological actions of the system; and therefore, man is constitutionally adapted to that state in which all his habits are regular and systematic, and in which his food is, as a general rule, taken at stated periods; for the more perfectly regular and correct the voluntary habits of man are, the more regular and uniform will his physiological habitudes be, and, if I may so speak, the less friction and jarring will there be in the vital operations of his organic economy (1418).

1430. The important positions, therefore, which physiology determinately establishes in relation to the question before us, and by which our reasonings and conclusions must be governed, are these: viz., 1st, the sense of hunger is a true instinctive indication of the alimentary wants of the vital economy, and is a safe guide in regard to times of eating and quantity of food only while the system is in a perfectly healthy and undepraved state; but all deviations from a strictly natural diet, and all habitual excesses in quantity, necessarily to a greater or less extent impair the integrity of the sense, and render it a treacherous and a dangerous guide; and such deviations and excesses are nearly universal in the human species, and especially in civilized life; and therefore, as a general rule, little dependence is to be placed on the sense of hunger as an indication of the alimentary wants of the system, and particularly in relation to quantity. 2d Our meals should not be taken so irregularly as greatly to disturb the natural periodicity of the physiological actions of the organic economy, and prevent the regular recurrence of that condition of the stomach which is indicated by hunger, and which specially prepares the organ for the performance of its function (1416). 3d. Our meals should not be so seldom or so far apart as to require an over-distention of the stomach when we do eat, in order to receive food enough to answer the alimentary wants of the system. 4th. Our meals should not be so frequent or so near together, as that the food received into the gastric cavity at one time is not fully digested before another portion is taken.

1431. With these well ascertained positions to govern our reasoning, we can arrive at particular conclusions in regard to times of eating, with all the accuracy and certainty that the physiological welfare of the human body requires. Some portions of the human family eat but once in twenty-four hours; and where the habits and circumstances are in all other respects simple and favorable to health, and the food is nourishing

and unstimulating, the digestive organs will readily adapt themselves, in capacity and power to such a habit (338); so that man in a simple state of society, where there is little regular and systematic employment of the voluntary powers, and where the intellectual faculties are little cultivated or exercised, will enjoy more uniform health and attain to greater age than he would in a more cultivated and artificial state of society, if he took his meals too frequently. But in civilized life, where the constitution and relations of society demand of every member some regular employment of his voluntary powers, and a considerable cultivation and exercise of his intellectual and moral faculties, one meal a day would require too large an appropriation of the physiological powers of the body to the gastric function during the process of digestion, and too protracted an interruption of voluntary employment and intellectual exercise, to be compatible with the individual and social interests of man; and if by continued voluntary employment and intellectual exercise the appropriations of vital energy to the stomach should be diminished, the functional power of that organ would soon be broken down. It is fully evident, therefore, that the regular habit of taking but one meal in twenty-four hours is not best adapted to the physiological and psychological interests of man. Hence, it may be considered as a general rule inductively established on physiological principles, that man cannot take less than two regular meals a day, consistently with the highest permanent physiological and psychological welfare of the human constitution.

1432. We have seen (439) that some kinds of food pass through the stomach much more slowly than other kinds, and that the stomach of one individual differs from that of another in regard to the time employed in the process of gastric digestion, and even the same stomach varies in this respect very considerably with the varying circumstances and conditions of the individual. We have seen also (910) that in the true physiological sense of the terms, the ease or difficulty with which a particular kind of food is digested is in no measure determined by the time in which that kind of food is passing through the process of the stomach; for, although some kinds of food pass through the stomach much more rapidly than others (911), yet the chymification of them actually causes a greater expenditure of vital power and waste of organized substance than the digestion of other kinds of food which are much longer in undergoing the same process. Again, we have seen (320) that the grand function of the alimentary cavity, as a whole, is the converting of the food into that partially assimilated substance called chyme, and presenting the chyme to those organs (388) which elaborate the chyle from it, and conveying the fæcal matter from the body; and the chymifying process is continued through the whole length of the small intestine (446), and perhaps to some extent in the large; and therefore, that the most perfect performance of the functions of the small intestine, including both chymification and chylification, requires that the stomach should not be actively employed at the same time with a fresh supply of food; or, in other words, the physiological welfare of the system requires that the entire alimentary cavity should complete its chymifying process on one portion of food before another meal is received. Moreover, the stomach requires a time to rest and to recruit its energies after it has completed its function, which should be of greater or less duration according to the degree of exhaustion which it has suffered from the performance of its function.

Mild, unstimulating, vegetable food, passes through the stomach slowly, and leaves the organ comparatively little exhausted from the performance of its function (1015); while flesh-meat, as we have seen (910), passes through more rapidly, and leaves the organ much more exhausted: and consequently the stomach really requires a longer time to rest after the digestion of flesh-meat than after the digestion of farinaceous food. Yet as flesh-meat works the vital machinery more rapidly (909), and is much more stimulating in proportion to the quantity of nourishment which it actually affords the system, hunger returns at shorter periods and more vehemently (911) in the flesh-eater than in the vegetable-eater, and the flesh-eater can habitually take his meals more frequently than the vegetable-eater, without serious inconvenience to his digestive organs in particular; but the general increased action of his vital economy will wear out his constitution in a shorter time (915). So that, all things considered, whether man subsists on one kind of food or another, the permanent physiological welfare of his system requires that about the same length of time should come between his regular meals.

1433. Where farinaceous vegetable food, however, constitutes a considerable proportion of the diet, and man is not stinted in the quantity of his aliment, the digestive organs must have their proper time for the performance of their function, or serious disturbances and disorders will soon result. And, as a general rule, when an ordinary meal is taken, the stomach cannot perform its function in the best manner for itself and the whole system, and have sufficient time to rest, and also allow the small intestine a proper opportunity to carry forward its assimilating processes without disturbance, in less than *six hours*. I speak with all the authority of indubitable truth, therefore, when I say that man cannot habitually take his meals more frequently than once in six hours, without serious detriment to his constitution—without necessarily shortening his life,—without inevitably afflicting himself with disease of some form or other, sooner or later. It is true that civilized man habitually violates this rule, and it is true he experiences the bitter consequences.

1434. I know that many naturally vigorous constitutions will bear up under this oppression, in some cases for many years, in the enjoyment of what the world calls health; but however powerful the constitution and however long it endures such oppressions without actually breaking down, the existence of nature is not more certain than that the habitual taking of food more frequently than once in six hours is injurious to health and destructive to life. Be it remembered, however, that this is stated as a general rule, in regard to man in ordinary health, and who is not stinted in his alimentary supplies, or who takes as much food as his system requires at each meal. It is also equally certain, as we shall see hereafter (1440), that we cannot habitually take food at a very late hour in the day without encroaching upon our proper sleeping hours, and thereby inevitably impairing the soundness of our sleep and preventing its refreshing and invigorating effect. Hence, it may be considered as a general rule, inductively established on physiological principles, that man cannot habitually take more than three meals a day, consistently with the highest permanent physiological and psychologieal interests of the human constitution.

1435. Many portions of the human family have from the earliest times been accustomed to take but two regular meals a day; and this was the habit of some of the wisest philosophers of antiquity. Indeed, Socrates

used to teach his disciples that they who ate more than twice a day were barbarians. It was the prevailing custom of the most civilized nations in the days of Greece and Rome, to take a light and simple meal in the fore part of the day, and to make the principal meal or supper near the close of the afternoon, after the cares and duties of the day were completed; and from supper till the hour of sleep the time was devoted to relaxation, social enjoyment, and amusements.

1436. This regulation is far more conducive to health and longevity than our modern custom of crowding everything together, and compelling the digestive organs, the voluntary muscles, and the brain, all to perform their functions at the same time, and thus embarrass and worry each, and prematurely break down the whole. It is incomparably better to eat but two meals a day, than either to eat more frequently than once in six hours, or to hurry from the active employments of mind and body to our meals, and from our meals back to our active employments; and this is particularly true of those members of civic life whose employments are attended with much exercise and excitement of the mind (303, 510).

1437. Merchants and others whose labors are more mental than physical, and draw more largely on the energies of the nervous than the muscular system, would be immensely the gainers in every respect if they would, as a general regulation, close up the business of the day punctually at three o'clock in the afternoon, lay all their cares aside, and suffer the vital energies which have been accumulated in the brain to be diffused throughout the system, or concentrated in the gastric centre, and thus by a conformity of their voluntary habits to the physiological laws of their bodies (1418), suffer their stomachs to prepare themselves for the performance of their function (1416), and sit down to their principal meal at four o'clock, and eat slowly and with cheerfulness, and devote the remainder of the evening to relaxation, to social enjoyment, to reading, and to the light avocations pertaining to domestic and social life; and at eight o'clock in the morning, breakfast on plain, simple, and nourishing, but unstimulating food.

1438. To those who are accustomed to take their three regular meals, and their lunch at eleven o'clock, such a regulation as I now propose undoubtedly appears intolerable; and it certainly would be intolerable to them if they continued the same diet that they are now accustomed to. But let them lay aside all their stimulating meats and drinks and condiments, and accustom themselves to subsist mostly or entirely on a plain nourishing diet of farinaceous substances and fruits, and in a few months if their habits are in other respects correct, they will with utmost certainty find that they can go from their eight o'clock breakfast to their four o'clock supper with infinitely less '*sinking*' and *gnawing* of the stomach and teasing of the appetite than they now experience, and that they can perform the duties of the day, however laborious, with vastly less fatigue and exhaustion of body and mind than they suffer at present. Besides, with such a regulation properly carried out, they would not only enjoy themselves much better while acquiring their wealth, and with much greater certainty succeed in their pursuits of life, but—what is of no small consideration in this age of wealthy dyspeptics and hypochondriacs—they would with much greater certainty be able to enjoy their wealth after they had acquired it.

1439. Agriculturists, mechanics, and others, whose employments draw more largely on the muscular than on the sensorial powers of the body

have generally more vigorous digestive organs, and do not by their employments detract from the energies of the stomach so much as the class of men I have just spoken of. Besides, as a general rule, their active muscular exercise is more conducive to the decomposing (314) and eliminating functions of the body (499); and therefore they can take more food, and suffer their meals to come somewhat nearer together, without injury. But the hardest laboring farmer or mechanic ought not, as a general habit, to eat more frequently than once in six hours; and then he will be far more likely to take too much than too little nourishment. In this country, as a general fact, laboring people impair their muscular powers and break themselves down more frequently by eating too often and too much than by any other means (795).

1440. If due regard be paid to the physiological principles which should govern our sleeping hours (1434), we ought certainly, as a general habit, not to take a meal later in the day than six o'clock p.m.; and taking this for an established point, if we make three meals a-day, it will fix our regular periods at six o'clock a.m., twelve a.m., and six p.m.; and these are undoubtedly the very best periods that can be fixed on if we take three meals a-day. If we would regularly rise at four o'clock in the morning, breakfast at six, dine at twelve, and sup at six, and always be moderate in our quantity, and never suffer the mental anxieties and nervous excitements of our business or vocation to trouble our meal times nor interfere with our digestive power, it would probably be best for us—and especially if our habits are active—to take three regular meals a-day; or, in other words, it would probably be better for us to take a sufficient quantity of food to sustain our bodies at three meals six hours apart, than to take the same quantity at two meals eight hours apart.

1441. But if we cannot make our three meals a-day without eating oftener than once in six hours, and without encroaching too much upon our proper time of sleeping, and without being obliged to hurry from the excitements of business to our dinner, and from our dinner to the excitements of business, it is incomparably better to limit ourselves to two meals a-day. I speak with great earnestness on this subject, because it is of immense importance to the welfare of mankind! The evils which result—the sufferings which are produced by eating too frequently—by bringing our meal-times too near together, are actually incalculable! I am confident that this is one of the greatest sources of affliction to civilized man. By the habitual ingestion of one portion of food into the stomach before the previous portion is fully disposed of, the digestive organs are embarrassed, their functions are disturbed, the whole system is worried and debilitated, all the assimilating processes of the body are deteriorated, indigestion with all its train of distressing symptoms is induced, and diseases of every type and character are caused. Nor should we, for the sake of securing our three meals a-day, and keeping them at a proper distance from each other, be induced to suffer one third meal habitually to come nearer to our sleeping hour than six o'clock. Some writers on hygeine have indeed insisted with much force that we ought not to eat later in the day than five o'clock; and were this to be the principal meal, as in early times (1435), the position would undoubtedly be correct.

1442. But where three meals are taken in a day the third one should always be very light and simple, and the food should be mild and unexciting, and in this case six o'clock would be sufficiently early to allow the digestive organs time to advance, so far in the performance of their function before the regular hour of retirement arrived, as not to impair the perfect soundness and refreshing effect of sleep.

1443. I know that thousands of people in civic life are in the habit of eating hearty suppers just before they retire to rest; and I know too that by virtue of powerful constitutions and perhaps much active out-door exercise, there is occasionally an individual among such people who enjoys a tolerable share of health, and attains to seventy or eighty years of age; but I also know that ninety-nine in a hundred of those who indulge in this practice are broken down and afflicted with chronic disease, before they reach fifty years, and a large majority of them are in their graves before they are forty years old. I am aware also of the objection raised by some, that the lower animals, usually fill their stomachs, and then lie down to rest: there is a vast difference, however, between lying down to rest in the manner of the lower animals, and going to sleep as man does Few animals sleep immediately after lying down The ruminating animals, we know, remain hours in a wakeful state after lying down; and although carnivorous animals are much more stupified by what may almost be called the narcotic effects of their food, yet there is reason to believe that they rarely if ever sleep soundly during the first stages of gastric digestion. Moreover, it should be remembered that no strict analogy can be instituted between the lower animals in a state of nature, and man in civic life; for, as we have seen (1252), nearly all the circumstances and habits of civic life serve to impair the physiological powers of the human body, and particularly to debilitate its digestive organs and to produce and keep up an unhealthy irritability in the nerves of organic life (228) and a preternatural sympathy between the digestive organs and the brain

1444. If man were in a truly natural and healthy state and always subsisted temperately on a mild unirritating and unexciting diet, and preserved the nerves of organic life in a perfectly healthy condition, and never over-excited and over-worked the brain, he might undoubtedly, like the young infant, go to sleep on a full stomach, with comparatively little physiological disadvantage to his system. But in civic life, where a high degree of sympathetic irritability universally exists between the brain and stomach, the case is very different, and renders it impossible for man to habituate himself to such a practice without seriously embarrassing the functions of the vital economy and increasing greatly his liability to disease and untimely death.

1445. On the whole, then, it appears very evident that if we take three meals a day, six o'clock in the morning, twelve at noon, and six in the evening, are the very best periods we can fix on for our meal-times; and if we regularly rise at four, and never later than five o'clock in the morning, and avoid having the toil and cares and anxieties and excitements of our business or vocation encroach too nearly on the dinner hour, it is probably as a general rule, better to take three moderate meals a day—and especially if our habits are active—than to take the same quantity at two meals. But if we cannot take three meals a day without bringing them nearer together than six hours, or if we

cannot take three meals a day without being obliged to hurry from the bodily and mental toil and excitements of business to our dinner, and eat with great rapidity, and hurry back to the bodily and mental toil and excitements of business, we had infinitely better take but two meals a day, under the regulations which I have named (1437). At all events, if we are wise, we will, as a general habit, keep our meal-times at least six hours apart. This is so important a regulation, it can hardly be too much insisted on.

1446. But whether we take two or three meals a day, or whatever hours we fix on as our stated times of eating, it is of great importance to our welfare as individuals and as members of society, that we should regularly and punctually take our food at those hours, and, as a general rule, with as little variation as possible; for by so doing, if our habits are in other respects correct, we shall soon establish such a healthy physiological habitude of the digestive organs as will always secure to us a good appetite for our food, and that condition of our stomach in which it is best prepared for the performance of its function (1416).

1447. If by any means, however, we are on some occasions obliged to pass by our regular meal-time without any food, till our hunger has subsided and the attendant physiological condition of the stomach has passed away, it is, as a general rule, far better to defer eating till the next regular meal-time arrives, and our hunger again recurs. But in such a case it is important to remember that we ought not, at our next meal, to make up for the one which we have lost, by eating a quantity sufficient for two meals at once. Nothing, perhaps, is more common, when an individual in health has by any means been detained from his dinner, than for him to sit down to the supper, or, as it is commonly called, the *tea*-table, and eat his dinner and supper both at once; and then, in due time, he retires to rest, and rises in the morning, and wonders why he has had such a poor night's rest, and why he feels so little refreshed from sleep, and why so languid, and why his eyes are red, and his tongue coated, and his breath foul, and why his mouth tastes bad, and why his head aches. Such an individual, and every body else, should know that all these unpleasant symptoms result from the oppression and irritation of the system caused by the improper quantity of food taken at supper.

1448. Every body should understand and remember that the digestive organs partake in a considerable measure of the general fatigue and weariness of the body, and have less functional vigor in the latter part of the day than in the earlier part of it; and therefore, when the dinner has been lost, the supper had better be lighter than usual, rather than heartier; and then the night's rest will be sweet and refreshing, and in the morning the body will be vigorous and elastic, and the spirits cheerful. And as a general rule, in all cases when a meal is lost, the next meal should not be more full, but on the contrary rather lighter; and then the occasional loss of a meal will perhaps in every instance prove beneficial, or at least not injurious.

1449. In these remarks, however, I only contemplate those members of civic life who have abundance of food, and who habitually eat full as much as the alimentary wants of the vital economy demand; those who from poverty or other causes are compelled to be extremely abstemious and never exceed and rarely satisfy their alimentary wants, cannot be

benefited by losing a meal. Yet even in such extreme cases, the loss of one meal would be very ill repaired by the reception of such a quantity of food at the next meal-time as would oppress and embarrass and irritate the stomach, and through it the whole system. When the regular recurrence of hunger distinctly indicates that physiological condition of the stomach, which is a manifestation of the alimentary wants of the system, and which prepares the organ to receive and digest the proper supply of food, it is probably always true, except in a decidedly morbid condition of the stomach, that the loss of a customary meal results in more or less of indirect debility of the digestive organs; and hence, when hunger again recurs at the next succeeding meal-time, the stomach requires a lighter rather than a heavier task than usual.

1450. When the regular meal is made and finished, then the stomach should always be left to perform its function without any disturbance or embarrassment. In strict propriety, not another mouthful of food of any kind should be swallowed till this is done. Many people are in the habit of eating but little at the regular meal-times, and of taking a few mouthfuls every hour or two between meals; and I believe that such people almost invariably complain of ill health, and most of them are dyspeptic; and well they may be, for there are few practices which serve more directly and powerfully to irritate and vex and bring down the stomach, than that of disturbing and interrupting its function by constantly introducing small quantities of food into it at all hours of the day and with the utmost irregularity. By such means they inevitably disturb and finally break up the regular physiological habitude of the stomach (1421), and by taking food when that organ is not in a proper condition to receive it, they harrass and irritate not only the stomach itself, but also, to a greater or less extent, every other organ in the system (511).

1451. Men of vigorous health and good digestive powers may indulge in this injurious practice for a while, without being conscious of any evil effects, but they greatly deceive themselves if they think to indulge in this irregularity with impunity. For powerful indeed are the digestive organs of that individual who can long continue in such a practice without finding himself seriously afflicted with dyspepsy or some other form of chronic disease. Hence it is often found, as Dr. Paris justly observes, that distressing cases of dyspepsy may be entirely cured by no other remedial means than a regular and strict observance of stated periods of eating. Nor let it be supposed that I draw my rules from experience of dyspeptics, and that therefore my reasonings on this point are only applicable to dyspeptics and other invalids; all my reasonings are founded on general physiological principles established in human nature, and therefore they are applicable to all mankind, except in so far as I avowedly accommodate them to man in civic life; and even in this, I am always guided by physiological principles; and consequently, though every one in the same general predicament may not have the evidence of precisely the same symptoms in his own experience to corroborate my statements, still my principles and reasonings are none the less true in relation to all.

1452. If by reason of having taken too much food at the previous meal-time, or in consequence of neglecting the customary exercise, or from any other cause, a regular meal-time arrives without the recur-

rence of hunger, and without any evidence of that physiological condition of the stomach which indicates the alimentary wants of the system (1416), and especially if there be reasons to believe that the stomach has not entirely disposed of the previously ingested food,—it is best, by all means, in such a state of things, to abstain from eating, and take no more food till the next regular meal-time arrives; for by taking food in such a case we shall only irritate and debilitate the stomach, and worry the whole system; and by persevering in such a course, we shall soon be visited with acidity, and other symptoms of indigestion. If, by any means, they who live on a simple diet experience acidity and other symptoms which indicate functional embarrassments and derangements of the stomach, and which are most frequently caused by eating too often, too fast, and too much, the most certain as well as the safest remedy is to lose a meal, or perhaps fast a day, and then return to the regular meals more guardedly, making them considerably lighter at first; for it should ever be remembered as a most important physiological law, that a fast should never be broken by a very full meal, but the first one, two, or three meals after a fast—and always in proportion to the duration and severity of the fast—should be lighter than usual.

DIETETIC REGULARITY OF CHILDREN.

1453. In the management of children, it is of the utmost importance that strict regularity and punctuality should be observed in regard to the times of eating. Because the springs of life are so elastic in them, and they seem to recover so promptly from the little ailments with which they are occasionally afflicted, parents generally having no conception of the evils which result to the constitutions of their offspring from those habitual transgressions of the physiological laws of their system, in very early life, which are attended with no immediate and strongly marked manifestations of suffering or disease. But there is a deep delusion on this subject pervading the whole human family. In all cases, perhaps, when mankind observe an effect, they look for an immediate cause, and generally fix on something whose proximity to the effect is such as to satisfy them of the immediate relation of the one to the other; and here they generally leave the matter, without any farther investigation. This same mode of reasoning is universally applied to those physiological and pathological phenomena or symptoms which mankind take cognizance of. If a person experiences any ailment, he immediately looks around him for some fact, event, or circumstance, which he may fix upon as the cause of his indisposition; and accordingly, while he experiences no ailment, he confidently concludes that no cause of indisposition exists in the circumstances or habits or events of his life; and hence, in pursuance of this same mode of reasoning, while children are able to eat and drink, without any regulation as to the quality or quantity of their food or their times of receiving it, and do not manifest those immediate and unequivocal symptoms of disease which compel their parents to see the relation between them and their dietetic habits, the parents will not be convinced that anything in their dietetic habits is wrong.

1454. But if the truth were universally and clearly understood, that except in cases of direct violence, almost every instance of disease and suffering in the human family is gradually and slowly brought on, not by the action of any one cause for a single time, but either by the constant

and continued action of some one cause, or by the continued action of many causes for a considerable time, and probably in most cases for a great number of years, before those symptoms are perceived which are generally regarded as the first evidences of a disease, or at least a disordered state of the system, then parents and others would know that many causes in the dietetic and other habits of children may be operating to impair and to destroy their constitutions, while they are able to perceive no symptoms of disease in their little bodies; and then also would people know that those distressing symptoms which they suffer in later periods of life are far less the effects of those immediate causes to which they attribute them, than of those causes which have been operating perhaps from the very hour of their birth.

1455. Everything in the state of the human system in early childhood renders it peculiarly liable to be injured in such a manner as permanently to affect the constitution, by every cause that disturbs the functions of, or produces irritations in, the growing body; and parents therefore can hardly be too careful in the regulation of the dietetic habits of their offspring, nor too precise and punctual in their times of eating.

1456. The error which prevails on this point is so universal and so inveterate, it is necessary that I should speak of it in strong terms of disapprobation. In most families in our country, children, from their birth till they go from under maternal care and misguided fondness, are permitted to take food into their stomachs at any and every hour of the day, just as a wayward fancy or nervous restlessness or capricious appetite shall dictate. But this is all wrong, decidedly and cruelly wrong. Every particle of aliment taken into their stomachs must be digested, as well as that received into the stomachs of adults; and their tender and delicately susceptible organs, even more than those of adults, require their proper time for the undisturbed performance of their functions and their proper time for repose (1432); and to perform their functions healthfully and vigorously, and with least exhaustion to themselves, those little organs require that every physiological advantage which nature has provided for them, or can supply them, should be possessed; and we have seen how beautifully and benevolently God has ordained that peculiar physiological condition of the stomach, of which we have cognizance in the special sense of hunger, and which indicates the alimentary wants of the vital economy, ane prepares the stomach to receive and digest the proper supply of food (1416, 1417).

1457. Now then, if in the fully developed and vigorous body of an adult it is of great importance that strict regard should always be had to this physiological condition of the stomach in the reception of our food and times of eating, of how much more importance is it that these things should be attended to in the management of children, whose delicate systems are easily disturbed, and every disturbance of which modifies in some degree the very elements of their constitution and the development of their bodies? Depend upon it, it is not easy to overstate the importance of the strictest and most punctual regularity in the times of children's receiving their food.

1458. From the first hour of life, this matter is of the highest importance, in rearing and educating our children. If they be nursed or fed whenever they are restless, or whenever an ignorant nurse or mother takes a notion that they require it, or be supplied with food as often as

they choose to ask for it, and be permitted to be swallowing something that requires digestion at all hours of the day, without the least regard to order or regularity as to times of eating or the condition of the stomach, how can their digestive organs perform their functions without continual disturbance and irritation? and how can their stomachs become established in that regular physiological habitude (1421) which is so essential to the most vigorous and perfect performance of their function and permanent interests of the vital economy? And if such oppressions and irritations of their tender and susceptible organs be continually kept up, can it be surprising that they should be restless and fretful and frequently indisposed? or that they should often be afflicted with those distressing and violent complaints which in so many instances and so suddenly send them to the grave, in the very budding of their existence?

1459. They who have never tried the experiment of strictly regulating their children in their times of eating, can have no just conception of the salutary and happy effects of such a regulation. I repeat that it should commence from the very first hour of life, and continue so long as our children are under our care; and we ought to endeavor to establish their habits so firmly in childhood, that they will not afterwards depart from them.

1460. In the earliest stage of infancy, children undoubtedly require nourishment more frequently than full-grown people. Yet it is in no degree less important that they should be nourished at regular and stated times. How often a young infant needs to be nourished, is a question about which there is some difference of opinion among writers. But there is no reason to believe that their little stomachs will dispose of a suitable portion of their appropriate food in a much shorter time than is required for the stomach of an older child to digest the same kind of aliment; and hence I am confident that I am perfectly safe in saying that, as a general rule, once in three hours is as often as an infant should be nourished. And mothers and nurses that are truly wise and humane, will fix the hours of nursing with great precision, and observe them with great punctuality, and they will be sure to receive their reward in the quietness and health and cheerfulness of their children. But to nurse them every half hour or every hour, till their little stomachs become oppressed and irritated, and they throw up their food, which is often in a state of acidity, and worry and cry from the irritation and distress thus caused, and then to nurse them again to stop their crying, is cruel beyond measure, for it not only distresses them for the present, but it is blending with the very elements of the constitution the principles of disease for after-life.

1461. When children are old enough to receive solid food, they should either eat four regular meals a-day at stated periods, from four to five hours apart, or, like adults, eat three regular meals a-day at stated periods, six hours apart; and with the same regularity and precision, be permitted to take a little plain simple food, or good ripe fruit of a proper kind, just mid-way between their regular meals. This practice may be continued till they are four or five years old, if they take considerable active exercise in the open air, and if their regular meals be light. But if their habits are inactive and sedentary and studious, more caution must be used both in regard to quantity and frequency of eating. Still, however, the grand point which I now wish to make most prominent is, that whether they eat at a greater or less number of times, they should, as a general rule, only

eat at those stated and precise times, and never be allowed to take a morsel of food at any other time. If this rule were strictly observed, and the meal-times of children properly regulated as to frequency, according to their age, activity, vigor, etc., it would save childhood, as well as after-life, from an immense amount of evil and suffering.

1462. Every one who has the care of children ought to know that if they be permitted to eat very frequently and with great irregularity, they will very soon be habitually tormented with a craving appetite, which, like the drunkard's thirst, is the more importunate and distressing the more it is indulged. Children of such habits are always far more unhappy and fretful and ill-tempered and unmanageable and liable to disease, than they would be if their dietetic habits were properly regulated. Some few of them, with good natural constitutions, by virtue of much active exercise in the open air, survive the perils of such a childhood, and perhaps never realize the bitter consequences of their early transgressions, till they have attained to adult age, and possibly not till they have reached the middle period of life; but a large majority of them are cut off by disease in some form or other before they are ten years old. It is therefore not kindness, but abiding cruelty, in parents to beget and pamper such an unhealthy and mischievous appetite, which, like the consumption, seldom fails to destroy its victim, and which children of well-regulated habits never know.

DIETETIC REGULARITY OF AGED PEOPLE.

1463. Systematic regularity and punctuality in regard to times of eating are hardly less important for aged people than for children. As old age advances, there is even in the best ordered life a gradual abatement of the physiological powers of the system (678); the digestive organs, with equal pace, diminish in functional vigor; and there is a corresponding diminution in the alimentary wants of the vital economy; and all the vital processes of the system take place with slowly decreasing energy and rapidity. The necessary consequence is, that as man becomes old, his system is less able to endure sudden and violent changes of any kind, and less able to maintain a general regularity of physiological functions, when there is considerable irregularity of voluntary habits. The stomach whose functional energies are impaired by age, requires all the advantages which the best condition and circumstances of the system to which it belongs can afford it, in order to perform its function in such a manner as will best sustain the interests of that system; and hence it may almost be asserted as a general law, that great regularity of the voluntary habits is essential to the continuance of life in old age; and amongst the voluntary habits, there are few of more importance to the physiological interests of the body and the comfort of the individual in old age, than systematic regularity and punctuality in times of eating. Indeed, as I have said (1420) there is reason to believe that a principal cause why health is generally so much less fluctuating after certain periods of life than before, is that the physiological habitudes of the body are so much less disturbed by the irregularities of the voluntary habits, and especially those connected with alimentation.

1464. They who love their parents, then, and who count it one of the richest blessings of this life to have those beloved parents long continue with them in the enjoyment of health, the objects of their gratitude and

affectionate duty, should study to do all in their power to secure the utmost regularity to their voluntary, and especially their dietetic habits.

LECTURE XXIII.

Quantity of food necessary to sustain the human body—Excessive alimentation may be sustained in high health at the imminent hazard of life, during the whole growth of the body—An uncommonly powerful constitution may maintain health in excessive alimentation for seventy or eighty years without actually breaking down with disease; but it always shortens life, predisposes to disease, and almost invariably produces it, even in the soundest bodies, and inevitably where there is a natural predisposition to it—Particular effects of excessive alimentation—Excessive alimentation the greatest source of evil to man—Gluttonous propensity and practice of man—Difficulty of controlling it—Difficulty of laying down general rules as to quantity—The only safe general rule that can be given—Appetite a blind guide—Quantity of food for children and for aged people—General conclusions in regard to food—Drink, why required, and what kind, and how best supplied—Thirst, how far a true indication of the want of the vital economy—Morbid thirst, how produced, and what it indicates—Excessive drinking of water or any other liquid; the effects—Effects of impure water—Mineral waters, etc.—How to secure good water—Pure stimulants; salt, pepper, mustard, etc., tea, coffee, alcoholic liquors, tobacco, opium, etc.—Their effects on the system, and the general delusion concerning them.

QUANTITY OF FOOD.

1465. In regard to the quantity of food which the human body requires, there appears to be far more truth in the speculative opinions than correctness in the practices of the civilized portions of the human race. It is a common saying, that it is comparatively unimportant *what* a man eats or drinks, so that he is strictly temperate in his *quantity;* and the principal objection to this proverb is, that it is almost universally made to justify an indiscriminate indulgence of appetite, rather than to prevent or discountenance excesses in quantity.

1466. We have seen (314) that the matter of which our bodies are composed does not remain permanently in its organic arrangement during our corporeal existence, but by the two great vital processes of composition and decomposition, particle by particle of new matter is continually added to the several structures and substances of the body, and particle by particle of old matter is continually abstracted from the several structures and substances, and ultimately eliminated from the vital domain (506). It is to sustain this great process of composition, or general function of nutrition, that food is required by the vital economy, and is constantly introduced into the alimentary cavity, and by the vital processes of assimilation converted into chyme, chyle, blood, etc.; and it is to sustain the great processes of decomposition and elimination that certain voluntary and involuntary actions are constantly required.

1467. By the varying circumstances and habits of individuals, the relative activity and vigor of the two great processes of composition and decomposition are correspondingly affected to a certain extent; so that the general bulk of the adult individual may be several pounds more or less, at different times, consistently with the general integrity of function in the system. And as it is a physiological law of living bodies, that each part is nourished and sustained according to its duties and its healthy action (376, 393), so particular members or parts of the system may be

considerably more developed at one time than at another (1019); but as a general law of the vital economy, the two great processes must necessarily balance each other, within certain limits, or integrity of function is destroyed, health impaired, and life abbreviated (499).

1468. During the healthy growth of the body, the great process of composition or general function of nutrition is necessarily somewhat in excess of the processes of decomposition; yet even at this time, the relative activity of the two great processes is strictly determined by the physiological integrity of the system, according to fixed and precise constitutional laws; so that no considerable permanent deviation can take place without injuring the constitution, impairing health, and abbreviating life. The process of composition may be too rapid or too languid for the welfare of the constitution. When the constitution is vigorous, however, excessive nutrition may take place through the whole period of growth, without any distressing symptoms of such excess; and the individual may be regarded as the personification of health, while at the same time the whole course of his life runs fearfully close to the line of active and violent disease (639), and he is, with the certainty of necessity, abridging the period of his earthly existence, and generating the elements of disease, which will sooner or later manifest themselves with more or less of violence and pain according to his subsequent habits of life.

1469. After the body has attained to its full size, or ceased to grow, there must be a general equilibrium or balance of action between the great process of composition and decomposition, of incorporation and elimination, of ingestion and evacuation, or all the physiological interests of the system must suffer, health must be jeoparded, and life shortened. The bulk and weight of the body, as I have said (1467), may vary with varying circumstances, to a very limited extent, consistently with the general integrity of function in the vital economy; but no considerable variation of this kind can take place while the proper balance of action is maintained in the system; and, therefore, whenever the general bulk or weight of the body is either considerably increased or diminished from the perfectly normal standard, it is an infallible evidence of unbalanced and unhealthy action in the system, and cannot long be continued without serious detriment to the constitution and hazard of life.

1470 In a healthy body, the general processes of decomposition and elimination take place more or less rapidly and freely, according as the individual is more or less active and athletic in his habits; and as a general law, the assimilating organs correspond in functional vigor and activity; and hence, as we have seen (1439), the robust active laborer requires more food than the sedentary man, and can receive and digest more with ease and comfort. But in all cases, if more food is taken into the alimentary cavity than is just sufficient to answer the real alimentary wants of the vital economy and balance the ease and healthy action of the decomposing and eliminating organs, injury is inevitably done to the system.

1471. In a vigorous body, where all the organs are well-balanced, and no one of them his predisposed to any particular disease, the vital economy as a whole, applies its power according to the general or particular demands of the system, and this aggregate power of the vital economy always corresponds with the average power of the several organs composing the system (1095). If, therefore, in such a state of the system, more

nourishment is received into the vital domain than is really demanded by the alimentary wants of the vital economy, the decomposing and eliminating organs will be excited to proportionably increased action, so as to preserve the general balance between the two great processes of composition and decomposition; and if the constitution is uncommonly vigorous, and the several organs well developed and wholly free from particular predispositions to disease, and the general habits of the individual are active and invigorating, and mainly favorable to physiological power and health, excessive alimentation may habitually take place for forty, sixty, or eighty years, and perhaps even longer, and the general balance between the two great processes be so perfectly preserved by the corresponding over-working of the decomposing and eliminating organs that no consequent morbid results will ever be experienced, which will determinately indicate their true cause, or unequivocally denote an excessive alimentation.

1472 Hence, it is almost universally believed that so long as an individual enjoys health, he is not injured by habitually eating more than is really necessary for the healthy nourishment of his body (1245;) but this opinion is utterly and dangerously false. It is, indeed, one of the most mischievous errors entertained by the human mind. For there is nothing in nature more true, more certain, than these propositions—viz.: 1st, every human being comes into existence with a determinate amount of constitutional stamina, an unreplenishable fund of life (877). This fund cannot, by any possible earthly means, be made to meet the necessary expenditures of vital action, beyond a certain period; but it can be profligately squandered in one-fourth or one-tenth part of the time which it might be made to last: 2d, all vital action is necessarily attended with some expenditure of vital power and waste of organized substance (376), draws something from the ultimate and unreplenishable fund of life; and therefore all excessive vital action, all *intensity* of vital action (1099), increases the expenditure of vital power, and necessarily abbreviates the duration of life; and consequently, however long the vital economy of any human body may be able to preserve the general balance of action between the composing and decomposing organs, and maintain the general health of the system under excessive alimentation, yet nothing is more certain than that just in proportion as the alimentation has exceeded the real healthy wants of the vital economy, and thus caused an unnecessary expenditure of vital power in the composition and decomposition of that excessive matter, life has been abbreviated, even though the individual die in what is called old age, without a single violent symptom of disease. The error of opinion on this subject is so general and so mischievous, that I feel anxious to present the truth in the strongest possible light.

1473. But we have as yet only contemplated the subject in its most favorable view. The case I have presented is a very extraordinary one. It is truly wonderful with what power, and how long, the vital economy of a vigorous and well-organized body will sustain and resist the habitual depredations it is made to endure from the voluntary errors of man; but it is an extremely rare case that there is such a balance of power between the several organs, and such a general vigor of the system as will enable the human body, in any circumstances, to maintain health under excessive alimentation till the constitution is prematurely worn out, and death results from the exhaustion of the vital powers, in what we call old age. For it is a necessary law of living bodies, that always in proportion to the excess

of vital action is the danger of disease; and, therefore, even the best constituted and almost vigorous bodies not only hasten the expenditure of the vital powers of the constitution by excessive alimentation, and thus tend to an untimely exhaustion of the fund of life, but always of necessity proportionately increase the danger of disease and of breaking down and destroying the constitution by violence, even long before its natural energies are exhausted Hence, millions of human beings perish by disease, in all periods of life, from excessive alimentation and other causes, where one man is enabled to maintain health under the action of such causes, till he dies from the exhaustion of his vital powers.

1474. Moreover, it is a very important consideration that in the present state of things, few human beings come into existence with all their organs equally well developed and free from predispositions of every kind. On the contrary, there is in almost every individual some inequality of development and physiological power in the organs of his system, some hereditary taint, some unhappy predispositions to disease. In all such cases, of necessity, the aggregate power of the vital economy as a whole, to bear up under habitual oppressions and depredations, corresponds not with the vigor of the strongest organ, but with the physiological ability of the weakest organ in the system. Thus, if an individual has a very vigorous stomach and very weak lungs, the power of his vital economy as a whole to maintain health under excessive alimentation, is not equal to an average of the physiological ability of his stomach, but to an average of that of his lungs; and if he goes beyond this he will inevitably break down and destroy his lungs, and thus his life (511). Hence, it is a general physiological law of the human body, that the power of the vital economy to maintain health under excessive alimentation, and all other excesses and causes that act on the system in the same general manner, always corresponds with the physiological ability of the weakest organ in the system (1095).

1475. Excessive alimentation, then, always and inevitably shortens life and tends to produce disease. If the general organization and constitutional power of the system and the voluntary habits of the individual are such as to enable the vital economy to keep up the general balance of action and maintain health under habitually excessive alimentation, so that no distressing symptoms are experienced, still, as we have seen (1472), it is always and necessarily true that the vital powers of the constitution are expended with a rapidity proportionate to the excess, and life is correspondingly abbreviated (877). But this, we have seen (1473), cannot take place without commensurately increasing the liability to disease. Excessive alimentation causes an overworking of all the organs concerned in the general function of nutrition, as well as those employed in the general function of decomposition and elimination, and consequently every organ concerned in the general economy of organic life is over-taxed, and kept, as it were, in a state of preternatural action. The whole vascular system, including all the blood-vessels (313) and lymphatics (385), is overdistended, and made to perform excessive labor.

1476. If all the organs of the body are equally well developed and well balanced in physiological power, which is extremely rare (1474), the system will hold on in health with wonderful energy, till some other cause supervenes to break down some particular organ, or produce morbid action in some particular part. A sudden exposure to cold when the vessels of the

lungs are all over-distended, may cause such a reduction of the power of those vessels as will render them unable to press on their contents, and engorgement will ensue; this will cause a rallying of the vital forces to relieve the parts; increased action and temperature will take place, and there will be extreme danger of inflammation, change of structure, and fatal pulmonary consumption. Or perhaps, instead of the lungs, the pleura (176) or pericardium (368) or liver or some other internal organ may become the seat of disease. And instead of exposure to cold, some excess in voluntary action, some violent effort, excessive labor, etc., may affect some particular part more than the rest of the body, and thus determine the locality and character of the disease. Or excessive mental action, anxiety, despondency, grief, anger, fear, or some other passion, may be sufficient in such an over-taxed state of the system to induce local or general disease. But if no adventitious cause comes in to induce sudden and violent disease, either local or general, the continual over-working of the system will almost inevitably exhaust, debilitate, and relax some particular organ or apparatus of organs, so as to destroy the balance of action in the vital economy, and thus gradually lead to chronic and perhaps acute disease. The vessels of the brain may become relaxed and enlarged, and this may result in apoplexy or dropsy of the brain; or by the same means, pulmonary apoplexy may take place; or the kidneys, liver, or some other gland may break down; or a general debility and atony of the decomposing and eliminating organs may result; and the vital economy, finding itself unable to keep up the balance of action in the system, by healthfully disposing of the excessive aliment as fast as it is received, may resort to the last temporary expedient in its power for the present preservation of life and health, and deposite its excessive matter in a partially assimilated state in the loose cellular tissue, in the manner we have already contemplated (498—501), and thus, as it were, create a great swamp or morass of crude, fatty, and watery matter, for the common drainage and common safety of the vital domain.

1477. This diseased action may lead to general corpulence and obesity, and keep up the functional power and activity of the digestive organs, at the continual and imminent risk of sudden death from congestion or apoplexy in the brain or some other important organ; or it may result in local or general dropsy, and thus terminate life. Or if the decomposing and eliminating organs hold out and keep pace in function with the excesses of alimentation, the digestive or some other of the assimilating organs will sooner or later almost certainly break down, and thus chronic or acute disease of the most distressing kind will be induced.

1478. But when, as is almost universally the case in the present state of the human race (1474), the organs are not equally developed and powerful, but the brain, stomach, lungs, liver, kidneys, or some other organ or part of the system is constitutionally weak and predisposed to disease, then, unless the particular circumstances and habits of the individual are such as to cause a special morbid determination to some other part, habitually excessive alimentation will inevitably, sooner or later, break down the organ or part which is naturally the most feeble, and develop its predisposition into active disease; and when any organ is thus broken down and brought into a morbid condition, the standard of excess in regard to alimentation is altered. Instead of being more than the general vigor of the healthy system requires, it is now more than the diseased

organ can bear (1095). For when disease is once established in such an organ by such a cause, so long as the alimentary matter received into the digestive organs is more than the good of the diseased organ requires, that organ will be kept in a diseased state by excessive alimentation, unless indeed a more active disease should be induced in some other organ. Thus, by excessive alimentation, chronic disease, and often of the most distressing kind, is produced and kept up for years in the brain, eyes, ears, nose, mouth, throat, lungs, stomach, intestines, liver, kidneys, skin, nerves, muscles, bones, or some other organ or part, and perhaps finally terminates in premature death; and all the time the deluded sufferer is resorting to every conceivable remedy but the true one, and dosing himself with every species of drugs and medicines that human science and ingenuity can devise and that empiricism can employ, and as continually cherishing his disease and perpetuating his sufferings by excessive alimentation or by over-eating.

1479. It is therefore beyond all question true, that in all countries where human aliment is abundant and easily procured, gluttony or excessive alimentation is decidedly the greatest source of disease and suffering and premature death to man! 'Excess in *drinking*,' said Hippocrates, more than two thousand years ago, 'is almost as bad as excess in *eating*,' and the statement has remained true from that day to the present,—nay, from the first transgression in Eden to this hour! Intoxicating liquors and substances, with all their fearful energy to destroy, and all the tremendous evils they have done—and surely they are great, terribly great!—have still caused less disease and pain and untimely death in the human family than errors in the *quantity* and quality of food! A drunkard *sometimes*, though very rarely, reaches old age; a glutton *never* does (1316).

1480. If man were in all respects as strictly obedient to the physiological laws of his nature as other animals in a truly natural state, he would be no more gluttonously inclined, but would be safely guided and governed by his instincts in regard to kinds and quantities of food (1417). But physiologically depraved as man universally is, if he leaves himself to the guidance and control of appetite (1422), he will almost inevitably run into excess; and hence the universal fact, that where man has the means of alimentary indulgence, he habitually takes more food than is consistent with the highest physiological and psychological interests of his nature,—more than is compatible with the greatest vigor and sprightliness and longevity of body, or with the greatest serenity and happiness of mind, or with the greatest degree of intellectual activity and power, or the most exalted moral purity and goodness.

1481. In the present state of the world, a large portion of the human family are restrained by necessity from habitual gluttony; yet the most ill-fed inhabitants of Europe or of Asia needs but the means and opportunity to prove that he is in this respect a human being. In our country, therefore, where there is an almost unlimited abundance of human aliment, and where every one of correct habits can be bountifully supplied, nothing but self-restraint can keep the people from gluttonous excess. But hitherto they have not been sufficiently aware of the importance of such self-restraint, and consequently they have run to great excess. The people of the United States, as a body, probably eat twice as much food as is consistent with the highest well-being of their nature; and it is pro-

bably true, as I have before observed (795), that the people of New England, as a general fact, are habitually more gluttonous than any other portion of the human family, because they have the means, the opportunities, and the greatest temptations to be so.

1482. Still the evil itself is not greater than the difficulty of regulating the dietetic habits of man in regard to the quantity of his food. In the first place, it is impossible to ascertain the precise quantity which man, in all the diversities of human circumstances and conditions, requires; and in the second place, it is almost equally impossible to induce him to govern himself by any well-ascertained principles in relation to this point, with sufficient integrity to be habitually temperate in the quantity of his food.

1483. Some writers on diet have laid down precise rules, and given the exact weight and measure by which man should govern himself in regard to quantity. But this I shall not attempt to do. I can only say, as I have said, that the universal and powerful propensity of man is always to excess; and more especially in civic life, where artificial preparations of food serve both to create and to provoke a morbid appetite (1407); and that excessive alimentation, or over-eating, is beyond all question decidedly the greatest source of disease and suffering and untimely death to man, in every portion of the world where the alimentary supplies are abundant (1497). And hence it is of the utmost importance for every one to guard continually and rigorously against this propensity. However correct the quality of our food may be, if we habitually over-eat, our whole nature is injured, and always in proportion to our excess. Indeed it is, as a general rule, strictly true, that *a correct quantity of a less wholesome aliment is better for man, than an excessively small or an excessively large quantity of a more wholesome aliment.* So far as health and longevity are considered, therefore, it is incomparably better for man to subsist on *a correct quantity* of vegetable and animal food, properly prepared, than habitually to indulge in an excessive quantity of pure vegetable food of the best kind, and prepared in the best manner; and the difference is still greater if the vegetable food is viciously prepared. And it is solely from the want of a proper regard to the important truth, that many have been unsuccessful in their experiment who have attempted to live exclusively on vegetable food.

1484. In fact, the propensity to over-eat is far the most incorrigible evil with which we have to grapple in attempting to reform the dietetic habits of the human race. Because it is so difficult, in the first place, to convince mankind of the importance of it; and because it is yet more difficult, in the second place, for man when fully convinced to govern himself according to his own conviction, while surrounded by continual temptations and impelled by a treacherous appetite. But it is in vain, utterly in vain to hope for any considerable improvement in the condition of man, unless some means can be adopted by which he can be induced, as a free moral agent, habitually to restrain himself from excessive alimentation.

QUANTITY OF FOOD.

1485. It is, however, impossible to state any particular *quantity* of food which would be best for every one, of every age and situation and

condition. The active, vigorous, laboring man of middle age requires more food than a child or an old man, and more than a sedentary or studious or feeble man of the same age; and the same individual requires more food under some circumstances than under others. As a general rule, the quantity of our food should, within certain limits, be proportionate to the amount of our active exercise (1439); yet the most athletic and active laboring man is, in our country, constantly in danger of taking too much food. Indeed it is unquestionably true, that at least ninety-nine of the farmers and other laboring men of New England are prematurely worn out and broken down by over-eating, where one is thus affected by excessive labor or hard work (795). A very small quantity of good farinaceous food is sufficient to supply the alimentary wants of the vital economy even of the most robust body of an active laborer; and all that exceeds the proper supply of those wants necessarily oppresses the organs, diminishes the muscular power, and serves to impair and wear out and break down all the energies of the system. The laboring class, however, probably suffer less than the other portions of society from excessive alimentation.

1486. The only general rule I can give in regard to the quantity of food proper for man, therefore, is this:—Let every one consider that excessive alimentation is one of the greatest sources of evil to the human family in civic life (1479); and that every member of society has a continual and powerful tendency to this excess (1480); and, therefore, that *every individual should, as a general rule, restrain himself to the smallest quantity which he finds from careful investigation and enlightened experience and observation will fully meet the alimentary wants of the vital economy of his system, knowing that whatsoever is more than this is evil!* and let every one remember also, that, as a general rule in civic life, *there cannot be a blinder guide, in regard to quantity of food, than appetite,* And he that follows it will surely be led into excess; *for the most athletic and active laborer cannot habitually eat artificially prepared food, even of the simplest and plainest kind, till his appetite is perfectly satisfied, without sooner or later experiencing serious evils from excessive alimentation!* And if this is true of the robust active laborer, to a much greater extent it is true of the inactive and sedentary and studious and feeble.

1487. It is a humiliating truth, that much the greatest, and indeed almost the only real, difficulty experienced by those who, after having grown up in the gluttonous habits of society, and perhaps destroyed their health mainly by over-eating, as a last resort adopt the mode of living inculcated in my lectures, is that of resisting the propensity to eat more than is compatible with the welfare of their nature (1484). The sense of taste being greatly redeemed from its depravity (701) and restored to much of its natural purity and delicate susceptibility (698), and the food being simple and such as is best adapted not only to supply the alimentary wants of the body (750), but also to afford the highest gustatory enjoyment (703), they relish it so well and enjoy it so much, that it requires the most perfect self-control to be able at all times to refrain from overstepping the bounds of temperance in quantity; and hence it is the most insurmountable obstacle in the way of the practical success of the dietetic principles which I teach, and especially in their application to adults, or those whose habits have been established in the ordinary mode of living. Thus far in the great experiment it is certain that excessive alimentation or over-eating has been the grand

cause of failure with a large majority of those who have been unsuccessful adventurers in the dietetic system which I advocate.

1488. I say again, therefore, (1486), that it is not possible for me to lay down a more perfect general rule for all persons in all circumstances and conditions, than that *every individual should restrain himself to the smallest quantity of food which he finds from careful investigation and enlightened experience and observation will fully meet the alimentary wants of the vital economy of his system;* and in ascertaining this point, he is not to be governed by his *feelings* during a few of the first days or even weeks of his experiment, nor yet by the testimony of the scales or steelyards; for it will often happen that a regimen under which an individual will feel very uncomfortable for a while at first, and lose several pounds in weight, will in the end, after his system has become accustomed to it, not only remove all of his uncomfortable feelings and restore his former weight, but in every respect greatly improve his health and strength and the condition of all his faculties.

1489. In some cases of disease it will often be found necessary for the invalid to limit himself to the smallest quantity of food that will prevent actual starvation. 'The more you nourish a diseased body,' said Hippocrates, 'the worse you make it;' and this, in almost every instance, is strictly true. Yet when such a retrenchment is first commenced, the patient will often feel exceedingly uncomfortable, and perhaps imagine that all his symptoms are really becoming more violent and dangerous. But such things should by no means discourage him, if he is following the advice of a truly enlightened physician.

1490. If at any time, however, an individual, in any condition and circumstances, finds that he has indulged to excess in the quantity of his food, let him take warning from the first indications, and immediately retrench; or if he has already gone so far as to have brought on unpleasant symptoms of indigestion or other difficulties (1452), such as acidity of the stomach, eructations, headache, or pain in any other part, or a general langor and disquietude, let him lose a meal, or even fast a day, and always after such a fast return to his usual meals with great caution, eating very lightly for a day or two; and in this manner, with proper exercise, he will throw of every unpleasant symptom, and prevent disease. Acidity of stomach may always be completely relieved in this way; and so may almost every other disagreeable and painful feeling and disorder, if taken in proper time.

QUANTTTY OF FOOD PROPER FOR CHILDREN.

1491. Children in civic life, even when their diet is of the simplest and plainest kind, are always strongly inclined to take more food than is good for them; and when they are allowed to indulge in all the variety of culinary preparations, they are sure to run into great excess, and thus either cut themselves off in very early life, or lay the foundations for distressing chronic disease in future years. While their bodies are growing, it is true that they require more aliment than they otherwise would (1468); still, however, they are in constant danger of excess, and therefore continual restraint is necessary; for, as I have already stated (1453), though convulsions or other distressing symptoms may not immediately follow every instance of dietetic error, yet the effects of these errors are none the less certain; and though judg-

ment is not visited immediately upon the transgressor, it will inevitably come, sooner or later.

1492. While children nurse (1458), they should, as a general rule, be confined, at least till near the time they are weaned, to the natural food which the mother and nurse affords. And if from any cause, other food be found necessary before that time, the very best substitute for the mother's nourishment is thus prepared. Take some good wheat and wash it clean and dry it, and let it be finely ground without bolting; then, with about a table-spoonful of this meal and a pint of pure water, make a thin gruel, which should be boiled about fifteen minutes, and then about a pint of good new milk fresh from the cow should be added; and this milk should if possible be always from the same young healthy cow, which is kept on good hay or grass (1296). The food thus prepared and taken in moderate quantities after the child is three months old, will have the happiest effect on its little body, and may be continued till it is old enough to take regular meals of solid aliment. Pap ma of superfine flour, sago, arrowroot, etc., is decidedly less wholesome.

1493. When children are weaned (1294), good coarse wheaten bread and a portion of good new milk diluted with about half as much boiling water or pure soft water, together with a proper supply of good ripe fruit in its season, should mainly constitute their diet. Rice, Indian corn, rye, peas, beans, potatoes, and other vegetables, plainly and simply prepared, so as to secure as far as possible full mastication, may also be allowed them as their years increase; but every judicious measure should be taken to cause them, with the least possible appearance of authoritative restraint, to limit themselves to such a quantity of food at each meal as is compatible with the permanent welfare of their whole nature. Every thing stimulating and heating, both in their food and drink, should be carefully avoided. Children should on no account, except from necessity to avoid actual starvation, be allowed to taste of flesh (1253); and still more carefully should they be guarded against alcoholic and narcotic stimulants of every kind. Their only drink should be water; and that, as far as possible, should always be pure and perfectly soft. They will however require very little drink, if all their dietetic habits are correct.

1494. If these and other directions which I have given and shall give concerning children are properly observed, parents will never have reason to complain of the evil effects of an exclusively vegetable diet (1254), nor have occasion to resort to the unnatural and monstrous practice of feeding their children with flesh and wine and other stimulating and poisonous substances in order to '*invigorate their systems.*' And it is most certain that parents cannot well be too careful about the dietetic habits of their children. Their prosperity and happiness during their whole existence, here and hereafter, are intimately connected with these things; and the christian mother who makes the table a snare to her offspring, is in reality far more cruel than the benighted hea hen mother who buries her children alive, and with her own feet treads down the smothering earth upon them in their graves.

1495. Parents! if you truly desire that your children should live and be permanently healthy and useful and happy in life, and blessed for ever, see tha their food be of a proper quality, and plainly and simply prepared; and that they be regular in their times of eating, and eat no

more than the healthy nourishment, and growth of their bodies require; and in regulating these points, always keep in view their age and circumstances, their habits of active exercise, of study, confinement, etc.

QUANTITY OF FOOD PROPER FOR AGED PEOPLE.

1496. I have said (1463) that in the best ordered life, the physiological powers of the body gradually decline as old age advances, and that the functional energies of the digestive organs and the alimentary wants of the vital economy suffer a correspondent diminution. Consequently, man requires less food in old age than in the meridian of life, and it is more immediately essential to his health and comfort that his food should be plain and simple and unstimulating. Nothing can be more false than the abominable proverb that '*wine is the old man's milk.*' It is always the bane of every man that drinks it; and the old man has less vital power to resist and repair its deleterious effects, than one in the vigor of meridian days; hence, if a man has used it ever so long, when he begins to approach old age, if he would prolong his life in health and serenity, and the possession of all his faculties, and have his last days his best days, he must entirely abandon every intoxicating drink and substance, and with great regularity in regard to times of eating, confine himself wholly to a plain simple vegetable diet, gradually diminishing his quantity of food as the physiological powers of his body slowly decline. He who regularly and wisely pursues such a course, will never sink into that miserable dotage in which the soul, with all its faculties, seems to become extinct or completely sepulchred in the living body, and in which even the animal instinct are so nearly obliterated that they are no longer capable of discharging their duties to the domain of organic life; but the surviving carcass, like a monster born without a brain, is left to the care of impatient and loathsome offspring, or the hireling and hear less attention and service of others; but his will be 'a green old age,' healthful and serene and intelligent and cheerful, and capable of natural and intellectual and moral enjoyment to the last (678). And when his constitutional fund of life is expended, he will calmly expire without an agony or struggle, like one who falls asleep in the sweet tranquility of his soul.

1497. O ye whose pious hearts are ardent in your love for your aged parents, who feel it one of the most grateful privileges of your lives that you may be permitted to return to them something of the attention and kindness you have received from them, and who fervently desire that they may long continue to enjoy your dutifulness and to bless your board and household by their patriarchial presence and influence and ripened council, I solemnly charge you not to destroy them and afflict yourselves by a luxurious table, but spare no pains to provide for them a plain and simple diet of the very best and most wholesome quality, and to secure the greatest regularity to all their habits, and be assured you will not lose your reward.

1498. On the whole, then, the food of man should always be plain and simple, and all the artificial preparations should be made as consistent as possible with the laws of constitution and relation established in his nature, or with his organization and physiological properties and powers (1310, *et seq.*).

1499. The quantity of his aliment should never exceed the real wants

of his vital economy, and his meals should always be taken at regular and stated periods; and when at any time he perceives the symptoms of excessive alimentation, he should either immediately retrench in quantity, or omit a meal, or fast a day, and then return with great moderation to his regular meals.

1500. He should always be careful to masticate or chew his food very fully, and completely reduce it to fine particles in the mouth, and mix it freely with the salivary fluid before he swallows it; for all masses of unchewed food in the stomach very slowly digest, and always tend to worry and irritate that organ and disturb its function, and in many instances they produce very serious effects both on the physiological and psychological powers. Cramps, colics, convulsions, delirium, etc., have frequently resulted from such causes (436).

1501. The meal ought never to be made in a hurry, but the food should be slowly swallowed (1310, Note); for if it is too rapidly introduced into the stomach, it always oppresses and irritates that organ, impairs its functional power, and serves to bring on dyspepsy and innumerable other evils (717). Hence the table should always be made the scene of social enjoyment and cheerfulness. Interesting conversation and pleasantry and wit are peculiarly appropriate to the hour of eating, that every individual may feel that mere sensual gratification is not the only nor the highest enjoyment of the table, and that by such means the food may be more slowly introduced into the stomach, and consequently a less quantity eaten. 'If you would live long and enjoy life,' said Lord Bacon, 'be cheerful at your meals and on going to bed.' This is an admirable precept.

1502. In conclusion of my dietetic remarks, it is important that I should repeat that, as a general rule, no one in health should make great dietetic changes very suddenly In some cases of disease, extremes are sometimes necessary, and the physician may be obliged to cut a man off at once from a full diet, and put him on an extremely abstemious regimen. But ordinarily, dietetic changes should take place more gradually; not that there is really so much danger in changing suddenly from a worse to a better diet, as is generally supposed, but that the uncomfortable feelings which at first attend such sudden changes are such as are almost certain to drive most people back to their old habits. And therefore, as Moses, under the direction of the Lord, did not attempt to lead the Jews by the shortest way from Egypt to the promised land, lest the difficulties of that way should induce them to return to Egypt, so I for the same reasons advise those who are disposed to conform to the principles which I have advanced, not to act precipitately and with more zeal than judgment, but carefully to examine the way before them, and proceed intelligently and wisely. And let none expect to find himself in an elysium in a few days or weeks or months after he enters upon his experiment. The effects of the course which I point out are not like those of the way which embraces an abundance of intoxicating substances and other means of sensual excitement and indulgence. However wholesome a pure vegetable diet may be, it causes no paroxysms of rapturous excitement; however delicious a draught of pure water may be to an undepraved palate, it produces no transports of delirious ecstasy. But the real encouragement of the course which I recommend are, in general terms, exemption

from disease and pain, permanent and uniform health, and temperate enjoyment of body, a serene and contented and cheerful mind, and clear and active intellectual and moral powers; and it promises not only to afford us these blessings in the early part and the meridian of life, but to continue them to us unimpaired as at that period of our existence when, in the ordinary habits of life, mankind experience the rapid decline of all their powers, and the accumulation of those infirmities of age which render longevity hardly desirable (681); and it promises to sustain us in the enjoyment of these blessings without any change in their quality, and with but little abatement in their degree (678), almost to the last pulse of a protracted life; and thus, in the most eminent manner, fit us for the greatest usefulness in the present state of being, and, as the mightiest auxiliary to the true religion of the soul, qualify us for the greatest enjoyment in our future existence; and finally, it promises to compose our bodies at last in the dreamless sleep of death without a struggle, without a pain. No one, therefore, ought to consider that he has made even a fair beginning of this great experiment in less than one year's time of honest conformity to the principles which I teach, and five years of such conformity is the shortest time that can be considered a fair trial of the system. I say to all, then, act rationally and wisely! Honestly and diligently seek after truth, and cordially embrace and obey it when you find it; and be assured that '*Wisdom's ways are ways of pleasantness, and all her paths are peace!*'

THE NATURAL DRINK OF MAN.

1503. We have seen that the human body is composed of solids and fluids (124); that the blood, from which all the other substances of the body are formed (118), consists of innumerable animal molecules or globules of animalized matter, and an aqueous menstruum called the serum (482). The serum, in a perfectly healthy state of the system, consists almost entirely of water. The saline and other properties found in it varying so considerably with the varying habits of the individual and conditions of the system, that it is impossible in the present state of things to determine with any certainty how far they are truly normal and how far they are adventitious. We have seen also that water and the aqueous juices of fruits, when received into the stomach, are absorbed by the radicles of the portal system (440, 442) and mingled with the blood of that system, and finally pass into the general circulation, and become the serum of the blood, without undergoing any assimilating change. From the serum of the blood are produced all the serous exhalations by which the internal parts are continually moistened, and the aqueous portions of all the secretions of the system (497); and also the exhalations of the lungs and skin, and nearly if not entirely the secretion or excretion of the kidneys (448, 450). Furthermore, it is a well-ascertained physiological truth, that if perfectly pure water of a proper temperature be brought in direct contact with the most delicate and highly susceptible living tissue of the body, no disturbance is produced, no physiological excitement or vital reaction takes place. This completely demonstrates the perfect adaptation of pure water to the vital properties of all the tissues of the body (312), and shows not only that under the healthy

regulations of the vital economy it may be diffused over the whole system and penetrate even the most delicate medullary (162) and other substances with perfect safety, but that it is as necessary to the organic functions and offects of the system as the alimentary matter from which the animalized corpuscles of the blood are formed.*

1504. There is no evidence that water ever undergoes any assimilating change in the system, or is in any measure appropriated to the formation of the animal solids. In people of corpulent habits, where there is a strong predisposition to the accumulation of adipose matter in the loose cellular tissue (498), if large quantities of water be habitually drunk, it will sometimes lead to a species of dropsy in the adipose tissue, and thus considerably increase the bulk and weight of the body. In this manner people of such habits sometimes increase their weight from fifteen to thirty pounds during the summer when they drink water very freely, and lose it again in the winter when they drink less, even though they actually consume less aliment in the summer than in the winter. It is true also, that an individual can sustain life considerably longer without food if he continues to use water, than he can if he abstains both from food and drink; but neither these facts, nor any other yet known, afford any evidence that water is ever assimilated and appropriated to the purposes of nourishment in the system; and therefore it may be considered as certain that it enters the vital domain (287) as an unchanged substance, and serves all the purposes of the vital economy for which it is introduced into the system, and is finally eliminated from the body without undergoing any assimilating change.

1505. The normal purposes, therefore, for which water is required in the living animal body, are—1st, to serve as a menstruum to the animalized or assimilated matter of the blood, in order to give it sufficient fluidity to enable the vital economy to effect the general purposes of circulation and nutrition—or, in other words, in order to make it sufficiently thin to pass freely through all the arteries and veins, and all the minute vessels of the system, in which the principal changes take place (384), and which are concerned in nourishing the several structures, and forming the several secretions of the body (374); 2d, to supply the aqueous portion of the secretions of the system (1503); 3d, to be the source of all the serous exhalations by which the internal organs and parts are continually moistened (407); and, 4th, to dilute, and as it were to flood off, in the form of pulmonary exhalation, cutaneous perspiration, renal secretion, etc., the worn-out or decomposed matter of the system (506), and whatever foreign and impure substances may be absorbed in the vital domain (484); and also when necessary to afford a serous excretion to the mucous surface of the alimentary cavity, to dilute and flood any irritating or disturbing substance that may by any means find its way into the stomach or intestines.

1506. It is now a perfectly well-ascertained physiological truth, that no other fluid but pure water will answer these purposes of the vital economy. Every other substance in nature or that can be produced by art, which is either a fluid itself, or capable of being kept in a fluid state by aqueous solution or mixture, if introduced unchanged into the general circulation of the animal body, is more or less a cause of excite-

* The blood, by chemical decomposition, affords about ninety per cent. of water, and the brain nearly an equal proportion.

ment, irritation, and disturbance to the living tissues and organs with which it comes in contact, and therefore always more or less injurious to the physiological interests of the system. Hence, as we have seen (448), a special economy is established for the protection of the vital domain, as far as possible, from all such foreign and unfriendly substances. If any digestible matter is received into the stomach in aqueous solution or mixture, it is retained in the alimentary cavity and digested before it is permitted to pass into the vital domain, and the water only is absorbed in its unchanged state; but if, in the general integrity of the system, indigestible mineral or vegetable substances are received into the stomach in aqueous solution, they are either rejected by vomiting or evacuated from the alimentary cavity by the bowels, or absorbed into the portal veins unchanged (440, 442), and as hastily as possible sent off to the liver, lungs, kidneys, and skin, and eliminated from the body (450); and by these means the water is filtered and purified from all foreign and improper substances before it is permitted to enter the general circulation and become the menstruum of the living blood (482, 484). But when by long-continued depraving habits, the nice physiological integrity of the system is greatly impaired, these substances are permitted to pass more and more freely into the general circulation, and to pervade every part, and thus the whole system is made to feel their immediate presence and to suffer from their pernicious properties (443, 448).

1507. With the most precise and determinate relation to the specific physiological want, then, the special sense of thirst (595, 757) is established in the organic economy; and in the perfect health and integrity of the system, its demand is always specific and determinate. It asks for pure water, and only for pure water; and no other production of nature nor of art can healthfully answer its demands. Whatever be the beverage used by man, therefore, when true healthy thirst is experienced, it is only the purely aqueous portion of the beverage that satisfies the want and answers the physiological purposes of the vital economy.

1508. The sense of thirst is instinctively referred to the fauces or the throat, but careful and accurate experiment has proved that if water be introduced into the stomach without being swallowed (431, Note), thirst is fully satisfied. From this and many other corroborating facts in relation to this point, it is very certain that thirst, like hunger (1415), consists in the animal perception of a certain physiological condition of the stomach (1416); and in this condition the stomach is prepared to receive water and absorb it with much greater ease and rapidity than at any other time.

1509. If water were only employed as a menstruum to the animalized matter of the blood (483), its waste would be exceedingly small, and the vital economy would rarely require a fresh supply; and as that portion of the serum which is exhaled from the moistening of the internal organs and parts is continually re-absorbed by appropriate vessels (441) and returned to the circulation, even this employment of the water received into the vital domain would cause but a very slow expenditure, and but seldom require a replenishment. It is therefore almost exclusively the employment of the serum to dilute and flood away the effete matter and impurities of blood (461) in the vapor of

the lungs, the perspiration of the skin, and secretions of the kidneys, liver, etc. (506), that causes the continual waste of the aqueous portion of the fluids of the system, and renders a frequent replenishment necessary.

1510. In a perfectly normal, healthy, and undepraved state of the system, therefore, thirst is a true instinctive demand of the vital economy for a supply of pure water (1507); and when such a demand is made, a draught of pure water is always exceedingly grateful and highly salutary. But the special sense of thirst, like that of hunger (1423), may be so excessively depraved, and its integrity so entirely destroyed, that its demands may be wholly at variance with the real wants of the vital domain, and it may be irresistibly importunate for drink at a time when the vital economy would be injured by the introduction of any fluid into the stomach; and it may also be vehement and despotic in its demands for both quantities and qualities of drink which would be extremely detrimental to the system.

1511. If the dietetic and all other habits and circumstances of man were truly natural and in strict accordance with the laws of his nature, he would very seldom require drink, and therefore very rarely experience thirst. The fruits and succulent vegetables which entered into his diet would afford all the aqueous matter that his vital economy requires, and this would always be of the purest and most salutary kind. Besides, being introduced in such a form, the stomach would never be inundated by a flood of water at once, but would receive it more gradually, and in a manner better adapted to the action of its absorbent and receiving vessels (442). So that, by this means, the system would be secured from improper quantities and qualities of fluid, and the sense of thirst would never be depraved nor its integrity impaired. Many individuals in the United States, who have adopted the diet and general regimen advocated in these lectures, have so regulated their dietetic habits as to be able to live without taking any kind of drink, or feeling thirst, for the space of three, four, and six months; and these have invariably found that their health was in every respect more perfect at such times, than when they frequently experienced thirst, and drank even pure water. By deviations from the strict line of physiological rectitude, however, in the quantity and quality of food and drink, and other errors of voluntary habits, the actual demand of the vital economy for pure water is increased, and the integrity of thirst as a natural instinct is always more or less impaired.

1512. We have seen (376) that all vital action is attended with an expenditure of vital power and waste of organized substance, and (687) that every organ in the system, in the performance of its particular function in the general economy, necessarily to some extent exhausts its vital powers and wastes its substance; and, therefore, it is always and necessarily true, that in proportion as any one organ is over-tasked or made to do more than is requisite for the health and integrity of the system in its perfectly normal state (1060), the organ itself is injured and the whole system suffers (297, 298); and hence as in regard to excessive alimentation (1471), so in regard to excessive imbibition or drinking, when a larger quantity of fluid is received into the stomach than is demanded by the immediate wants of the vital economy, it must be disposed of in some way or other. The absorbents (442) are made

to perform unnecessary labor in taking it up, and then it cannot be permitted to enter into the general circulation and remain there, but must as speedily as possible be expelled from the vital domain; and therefore, all the organs employed in the performance of this work (506), are also made to do unnecessary duty; and when excesses of this kind are habitual, both the organs employed in receiving the fluid into, and those employed in expelling it from, the vital domain, are overtasked, debilitated, and relaxed, and often brought into a morbid condition, and not unfrequently involve the whole system in fatal disease, attended perhaps with a morbid and most distressing thirst, the gratification of which only increases the evil, and renders the thirst itself more vehement and tormenting. Thus habitual over-drinking may break down the kidneys and bring on diabetes, or, like excessive alimentation (1476), so debilitate, relax, and prostrate the absorbing and eliminating organs, as to bring on a general dropsy; and although neither of these distressing complaints may result from habitual overdrinking, yet most inevitably the practice is injurious to the system, and always in proportion to the excess in the quantity and error in the quality of the liquids drunk.

1513. The principal physiological cause of the necessity for a constant supply of aqueous matter to the vital domain in a truly healthy and proper state of the system, we have seen (1509), is the expenditure of the serum of the blood, in the vapor of the lungs, the perspiration of the skin, and the secretion of the kidneys; and this, we have seen (1511), if man's habits and circumstances were in all respects correct, would require no greater supply than would be afforded in the juices of the fruits and succulent vegetables that entered into his diet; and consequently, in such a case, man would very rarely experience thirst, indeed never, unless the healthy action of his system was in some measure disturbed. But the voluntary habits and circumstances of man are so continually infringing the physiological laws of his nature, that the vital operations of his organic economy are almost incessantly disturbed, and the integrity of all his physiological powers and instincts more or less impaired.

1514. The quantity of water exhaled from the lungs (469) varies with circumstances, but it is much more uniform than that which passes off through the skin and kidneys (507). Yet even the cutaneous perspiration and renal secretion would vary much less than they usually do, if the voluntary habits and circumstances of man were always in conformity to the constitutional laws of his nature. As a general rule, however, the copiousness of the cutaneous perspiration corresponds with the degree of muscular exercise. If the latter is unusually energetic and continued, the former often becomes so free that it passes from the insensible to the sensible form, and instead of escaping from the body in a state of vapor, it exudes in liquid drops, and sometimes gushes as it were from the whole external surface in a drenching flood. This, of course, rapidly diminishes the quantity of aqueous matter in the body, and unless there was a considerable excess of it previously in the system, it will cause such a sudden expenditure of the serum of the blood as will require a prompt and free replenishment; and consequently the sense of thirst will be felt with a degree of intensity corresponding with the urgency of the want, and will hardly be satisfied with any

thing less than a copious draught of water. In this manner, laboring people whose dietetic habits are not most favorable to the physiological interests of their bodies, will perspire very profusely, and especially in hot weather, and of course they drink as freely as they perspire; and indeed it is a common opinion with this class of people, that it is a benefit to them to perspire freely, and that they labor the more easily for it. But this is a great and mischievous error. Every rational being ought to know that it can be of no possible benefit to his vital powers to filter several quarts of water through his body daily, and laborers who drink much and perspire much, actually do this, to the decided diminution of their strength and detriment of all their powers; for they are not in the least degree nourishing or sustaining their bodies by their free drinking, but are taking large quantities of aqueous matter into the stomach to be received into the vital domain by the absorbents, and then as speedily as possible to be expelled from that domain by another set of organs, and principally through the skin; and thereby, as we have seen (1512), they are compelling both the absorbing and the eliminating organs to do a very great deal of unnecessary duty, by which they are exhausted, debilitated, and relaxed, and perhaps actually and permanently diseased, even if the drink is always pure water.

1515. Copious perspiration, therefore, as a general law, is decidedly debilitating to the body, and where it is habitual or continued it is otherwise detrimental. The strength of the laboring man is always diminished by it, and he is necessarily more fatigued and exhausted at the close of a day's labor in consequence of it. If the dietetic and other habits of man were in accordance with the physiological laws of his nature, it would be a very extraordinary thing for him, while in health, to perspire profusely,—and never, except in extraordinary circumstances. The laboring man, while actively engaged in his customary employment, would have a pleasant moisture upon the skin, and nothing more; and this would rarely cause such a rapid exhaustion of the serum of his blood as to require a very prompt and copiously supply of water as a drink, and consequently he would rarely experience thirst,—or seldom more than would be fully satisfied at his meal-times with the succulent or juicy portions of his food. In such a case, the laboring man would go through the toils of the day with much less fatigue and exhaustion than he who drinks much and perspires much. This is no fanciful theorising, it is a perfectly well ascertained physiological truth, and has been fully demonstrated by hundreds in the United States within the last eight years. Every laborer—and there have been many such—who has so regulated his dietetic habits as to require little or no drink (1511), has found that he could perform more labor, with little sensible perspiration, and much less fatigue and exhaustion. Indeed it is, in almost every instance, a matter of surprise with such individuals, that they can perform so much more labor in a day than formerly, and yet find themselves at the close of the day with so little sense of weariness, and with so great a degree of freshness, elasticity, and sprightliness. Surely, then, it is a matter of no small importance to the laboring man to know how he may, as it were, diminish the friction of labor, and thus husband his strength and in every respect promote his comfort and prosperity.

1516. When, by any means, a general fever is induced in the system (1087), attended by great thirst, it is an instinctive demand of the vital economy for water, as a medicine, to reduce the temperature of the body, to subdue the excessive action, and probably also to flood away whatever morbific impurities may have found their way into the circulation (486). Cold water taken freely into the stomach in such a state of the system, is absorbed with astonishing rapidity, and is very soon diffused over the whole organic domain, and is finally evacuated by the skin, lungs, etc., and thus greatly reduces the febrile temperature and action of the system; and if the water is perfectly pure, it has in every respect the most salutary effect. Indeed, if there be any one thing in nature of which it may more truly be said than of any other, that it is a universal catholicon, it it pure cold water. In such cases, therefore, the instinctive demand of the vital economy should always and freely be gratified. Nay more,—pure cold water should not only be drunk as freely as the thirst requires it, but in most cases of high fever, the free application of water to the whole external surface, till the skin feels cool and moist as in health, is a natural and powerful and safe means of subduing the disease. I am entirely confident—and I speak from no ordinary experience in this matter—that the introduction of cold water into the stomach, and judicious application of it to the skin, will in most casas subdue a high fever more rapidly, more safely, and more certainly, than any other means that can be employed. I have seen the most wonderful success from such treatment, and in the most extreme and desperate cases, when all other remedial means employed in regular practice had proved ineffectual. But even pure water can be made the instrument of empiricism, and when injudiciously employed may do far more harm than good. Wisdom and skill are always requisite in the use of even the simplest remedial means (1068),

1517. When, therefore, pure water is required by the healthy body to serve the purposes of the vital economy as a menstruum of the blood, etc. (1505), and when it is required by the diseased body as a remedial means, the thirst which demands it is a truly natural instinct, and should always be obeyed; but if we can so regulate our habits and control our circumstances as to prevent the occurrence of thirst for either of these purposes, we shall certainly do wisely; and yet far more wisely if we can wholly prevent the thirst which is ordinarily experienced by man, and especially in civilized life, and which induces him habitually to drink all sorts of beverages, and at times when the vital economy neither requires the supply of aqueous matter nor can receive it without injury.

1518. In regard to thirst, as of hunger, the natural regularity and periodicity of the vital actions of the body (1418) always tend to establish a habitude; so that if an individual whose habits are in other respects correct, drinks nothing but pure water, and takes that only at a particular hour, his system will soon establish a physiological habitude corresponding with this practice, and his thirst will regularly recur at the stated hour, whether his vital economy really requires a supply of water or not, and he will rarely if ever feel thirsty at any other time, unless in other respects he deviates considerably from his ordinary habits. In this manner we form the habit of drinking at our meal-

times, or at stated hours between our meals, and thus from mere force of habit, millions of gallons of different kinds of drink are daily poured down human throats, to drench and debilitate the stomach, and to be filtered through the delicate organs of the living body (1506, 1512). Yet the mere thirst of habit is by no means the most common and the most urgent thirst which impels human beings to drink, to the injury of their bodies and their whole nature.

1519. It is a general physiological law of the system, that the more exciting the food, the more frequent and intense will be the thirst; hence they who eat animal food of any kind, and more especially flesh (909), are always—in proportion to the freedom with which they use it—more thirsty and drink more than they who subsist on vegetable food, other things being equal. Again, whatever produces irritation in the alimentary canal, or by any means causes a preternatural heat in the mucous membrane of that canal (338), will also superinduce thirst, the intensity of which will always correspond with the degree of irritation and feverish heat. Hence, therefore, however simple our diet, and however correct its quality, if we neglect to masticate our food in a proper manner (426), and swallow it too rapidly, it will cause more or less irritation in the stomach (716), which will produce an unhealthy degree of heat in that organ, and thus occasion thirst; or if food is taken at an unusual and improper time, when the stomach is not in a condition to receive it (1426), more or less of gastric irritation will be caused, and thirst will be an almost inevitable consequence; or if more food is taken at a meal than the stomach can receive and manage with ease, gastric irritation will be caused, producing a feverish degree of heat and a commensurate intensity of thirst; and if the stomach is somewhat debilitated and is considerably embarrassed in the performance of its function, the thirst thus caused will be exceedingly urgent and distressing. If the food is crude, and such as is digested with great difficulty, it will almost certainly cause gastric irritation and thirst, and sometimes in a very painful degree. The animal fats or oils always tend to produce gastric irritation and thirst (1268), and most especially when mixed with other substances, as in pastry, etc. If salt, pepper, mustard, and other purely stimulating substances (733) are used with the food, gastric excitement and irritation will be produced, corresponding in degree with the freedom with which those substances are used, and with the potency and deleteriousness of their properties, and a commensurate intensity of thirst will be caused; and if stimulating and intoxicating drinks are used, thirst will be rendered still more frequent, vehement, and irresistible.

1520. The thirst produced by all these causes is strictly speaking a morbid thirst, and, as a general fact, is in no measure a true indication that the vital economy really requires a supply of water; on the contrary, this thirst is often most importunate and tormenting, and at times actually irresistible, when drink is not really needed for any of the physiological purposes of the vital economy, and when fluids cannot be received into the stomach without decided and perhaps very great injury to that organ, and through it to the whole system. Thus it not unfrequently happens, and especially in civic life, that when the digestive powers of an individual are considerably impaired and he becomes dyspeptic, about an hour after eating, and more usually after

dinner, he begins to feel an intensely importunate and distressing thirst. I have seen cases which actually amounted to a species of insanity, and in which the sufferer had no power to resist the morbid craving, but against the most entire convictions that he ought not to drink, and against the most urgent entreaties and remonstrances of friends and physicians, would rush to a vessel of water, if he could get at it, and drink with all the terrible avidity of self-destroying madness. This tormenting thirst is caused by gastric irritation, which is the effect of acidity, and generally also of the indigestible and irritating substances which he has taken with or for his dinner; and the morbid thirst demands water to dilute and flood away those acrid and irritating substances; but water or any other liquid received into the stomach at such a time only serves to convert the contents of that organ into a mere wash, and thus interrupt the feeble process of digestion, and every way enhance the difficulty and increase the suffering.

1521. But when thirst, by whatever cause produced, is not the true instinctive demand of the vital economy for water, it is never so well satisfied with water as with some stimulating beverage; and when such beverages are used, the sense of thirst is still more depraved; and in exact proportion to the stimulating and intoxicating power of those beverages, and the freedom with which they are used, it becomes more and more exclusively a demand for accustomed stimulus, and correspondently more frequent and more despotic So long as the dietetic habits of mankind are greatly at variance with the physiological laws of his human system, therefore, nothing but necessity arising from the want of means, or the most powerful moral restraint continually imposed and enforced, can keep the race from universal drunkenness; and hence the melancholy fact, that from the earliest history of the species until now, with the occasional exception of a limited and brief paroxysm of reform, the human world has staggered with inebriation; and so long as the fixed constitutional laws of nature shall remain, in spite of all the efforts that have been made or that *can be made* to choke man off from his intoxicating cup, the human world will continue to stagger on, unless the reformation goes beyond the cup, and removes the deep depravity of thirst (768).

1522. From the argument before us we perceive that man naturally seldom requires drink, and that the thirst which most frequently induces him to drink is not the true demand of the vital economy for water, and that even pure water is decidedly hurtful if taken when not necessary for the physiological purposes of the system (1505), or more freely than those purposes require (1509). But it were well for man if *excesses in quantity* were the only evil he experiences from the use of water as a drink. With too few exceptions, and especially in civic life, the water employed for this purpose is charged with those mineral and vegetable and animal impurities which render it exceedingly injurious to the vital organism of the human body. True, the human species is perpetuated from generation to generation, and society presents what is considered a fair proportion of health and longevity even in the cities of New York and Boston, where the water is extremely impure; and it is also true that other portions of the human family will inhabit regions where the atmosphere is almost continually loaded with the impurities that arise from the decomposition of dead animal and vegetable matter,

and live on from generation to generation without those evidences of '*experience*' which *compel* them to know that health is impaired and disease created and life destroyed by the poisonous atmosphere which they breathe. But if *experience* of this kind is to be taken as a proof of the healthfulness of our habits and circumstances, then there is no such thing as a poison in creation, and no region on earth that is not healthy. For we know that the vital economy of the human body will so accommodate itself to circumstances, that the deadliest poisons may be habitually taken, and slowly destroy the constitution and cause untimely death (510), without producing any symptoms which are so determinate and unequivocal as to compel the sufferer to know that he is injured by those poisons (950). Nothing therefore can well be more erroneous and delusive than this general *experience* of society. But correct physiological science teaches us the indubitable and irrefragable truth that the living tissues of the human body cannot be continually irritated, and the functions of the vital economy habitually disturbed, without impairing health, creating disease, and shortening the duration of life.

1523. We have seen (1503) that when water is introduced into the stomach, it is taken up by the absorbents and received into the portal veins unchanged (1506), and that if it holds in solution any indigestible substances, these are also absorbed with it, and at first the special economy of the portal system, as far as possible, purifies the water by a kind of filtration, before it is permitted to enter into the general circulation and become the serum of the blood. But if water containing such impurities be habitually used, the physiological integrity of the purifying organs becomes impaired, and by degrees the impurities are suffered more and more freely to pass into the general circulation, and to pervade the whole system (448). All mineral substances held in aqueous solution are in this manner absorbed, unchanged, and when the water containing them is habitually used, they become as common in the general circulation as the serum of the blood itself. And can any rational creature suppose that these substances can be continually passing through the exceedingly minute vessels of the glands (334), of the brain itself, and of every other part of the system, without decidedly injuring the delicate tissues on which they act? It is well known that if hard water be habitually used for washing the hands, even for a short time, the skin on which it acts soon loses its natural softness and smoothness, and becomes dry and rough, and often cracks and becomes painfully diseased. And can any one believe that a fluid which produces such an effect on the external skin, that is protected by a horny epidermis or cuticle (287), can continually come in contact with the most delicate nervous and other tissues of the vital domain, and not injure them? It is passing strange that a thing so plain as this should be considered so questionable, and that civilized communities like the citizens of New York and Boston and other places in our country should, either from carelessness or parsimony, continue from year to year and from generation to generation to harass and lacerate the delicate vessels and tissues of their bodies with the mineral impurities of the water which they drink! Depend upon it, there is no uncertainty in this matter. The stomach, the liver, and every other gland (333, 334), and every capillary vessel of the system (374)—in short, every

organ and tissue and substance of the body, necessarily suffers from the use of such water; and though possibly no one organ may become the seat of active disease during life in consequence of it, yet the functional power of each particular organ is impaired, and the general physiological powers of the system are diminished by it, and every part is rendered more liable to disease, and life is always and inevitably shortened (877). Pulmonary consumption, scrofulous affections, indurations, cancers, and other diseases of the glands, and diseases of the skin and mucous membrane, are caused by it Indeed, it is most true that functional disturbances and derangements, and structural diseases of every description and of every part, are either increased or aggravated by the use of impure water; and in every kind of chronic ailment, the recovery of health is greatly retarded if not wholly prevented by the use of such water.

1524. The use of water impregnated with mineral substances as a remedial means, or as a medicine, is therefore, in almost every conceivable case, injurious to the human body. It is true that a solution of common salt, or Glauber or Epsom salt, will, by its powerful irritation, cause such a vital reaction (300, 950) as to produce a free evacuation of the stomach and bowels, which in certain cases of disease, and for a single time, may, on the whole, be greatly beneficial in the result; yet in every instance the direct and immediate effect of the mineral on the living tissues of the organs, is detrimental, and if continued, cannot fail to exhaust, debilitate, and disease the parts on which it acts. Thousands of human beings have seriously impaired their digestive organs, and otherwise injured their constitution, by an ill-advised dozing with salts, and other mineral substances, under the mistaken notion that by so doing they were '*purifying their blood.*' And many thousands have done themselves irreparable injury by the use of the mineral waters of public watering-places. Universally gluttonous as human beings are where they have the means to be so (1480), almost every member of society is more or less troubled with some of the multitudinous ailments which result from habitual over-eating, and of course, if they resort to public watering-places, and daily swallow quarts or gallons of water strongly impregnated with mineral substances, it will cause such copious and continued evacuations of the body as will in most cases at least temporarily remove or mitigate the symptoms of repletion; and in some instances, the new disease caused by the mineral water will, on the principle of counter-irritation (1052), subdue the symptoms of chronic disorders, and thus perhaps remove the morbid affections of the skin and other parts, and lead the deluded invalid to believe that he is really recovering health, when it fact he is only exchanging one form of disease for another, and by these means making the new disease more active than the old one. In such cases, if the ailment is simply symptomatic, from over-eating or other dietetic errors, and no particular organ is actually diseased, the powerful drenching and evacuation will remove the symptoms for the time, and the individual may return home believing himself to be restored to health; and if afterwards he becomes more temperate and otherwise correct in his dietetic habits, he may never have a return of those symptoms, but if he continues in his old habits, he will inevitably have a return of them or others more distressing, and he is always the more

liable to a return of them in proportion to the effect which the mineral waters had on his system. But if the individual is actually laboring under chronic disease, however completely the drenching may for the time subdue the symptoms, if he does not afterward avoid the causes by which his disease was originated or perpetuated, it will, with the certainty of death, come back upon him greatly increased by the effect of the mineral water, or else some new disease will supervene, more painful and more incurable than the first, and which is either caused or greatly modified by the means used to remove the first. So that, in every instance—I repeat it solemnly!—*in every instance the direct and immediate effect of mineral waters on the human body is injurious;* and where such waters are freely used for any considerable time, the injury is serious and permanent. The digestive organs are always debilitated, and sometimes completely prostrated; indeed, the whole tone and energy of the system are impaired; and where one individual is benefited in the result, thousands are greatly injured! The delusion is deep and broad on this subject, and I have no hope of dispelling it; but I must speak the truth from the fulness of my heart, even though it may never be heeded.

1525. The only drink that God has made for man, therefore, and the only drink that man can ever use in perfect accordance with the vital properties and laws of his nature, is PURE WATER (1503, 1506); and this is best supplied by the juices of such fruits and succulent vegetables as compose a part of the natural food of man (1501): and they pursue the wisest course of life whose dietetic and other habits are such that the aqueous matter which the vital economy of their system requires is abundantly furnished by their regular food. Yet if by any means water in its separate form is rendered necessary as a drink, and indeed for any other application to the human body, and for the preparation of food, it is of exceedingly great importance that it should be as pure as possible. Some families are greatly blessed with a well or spring which furnishes them with excellent water; some bring it from a distance in aqueducts, and some cities and towns are supplied by rivers or large streams or ponds. In all these ways, if the aqueducts are of a proper kind and construction, water may be furnished which is very good, and especially if it be filtered before used. Some take the pains to distil all the water that they use; and if the water which they put into their kettles is wholly free from any vegetable and animal matter, they will obtain the most perfectly pure water in this way; but if the water which they put into their kettles contains any vegetable or animal substances, some of their properties will rise with the vapor, and qualify the water which is received from the still. So that, on the whole, they who cannot otherwise be well furnished, will probably do best to depend on the cistern and the clouds. For rain-water, when it is pure, is the most delicious and wholesome that can possibly be procured. To secure such water, some have two stone or brick cisterns so constructed that water will filter from one into the other. Others have two, and receive the first of the rain into one, till the atmosphere and the roof are cleansed, and then receive it into the other for drinking and culinary purposes. Others, again, have one good stone or brick cistern, with pipes so constructed and arranged that every heavy rain will wholly drive out the water previously contained in the cistern, and fill it with a fresh supply.

In either of these ways, with proper care, excellent water may be had the year around; but every family that uses rain or river water should be furnished with a first rate filter, through which all their water should pass before they use it; and those who cannot procure such a filter from New York or Boston or elsewhere, can easily construct one for themselves with gravel and sand and charcoal, which will be far better than none. But they who have a good cistern, well supplied with water from the clouds, and a good filter to purify it for their use, can have the most delicious and healthful drink that human beings need or can enjoy; and they who can by any reasonable pains and expense provide such drink, are bound by every consideration of health and morality to do so. By adding to their cistern a good ice-house, they may have their drink as cool during the warm weather as they wish. But I repeat that they are wisest who so live as to require little drink of any kind.

TIMES OF DRINKING.

1526. If man were as simple and as true to the laws and instincts of his nature as the lower animals, it would be of comparatively little importance at what time he drank, so that it was always in obedience to the truly instinctive demand of his vital economy. But in civic life, where many causes are co-operating to depress the physiological powers of the human body, and particularly to debilitate the digestive organs, it becomes of much importance that the times of drinking should be properly regulated. In regard to alimentation, we have seen (426, 716) that the best interests of the system require that the food should be perfectly masticated and mixed with the salivary fluid before it is swallowed. We have seen also (429) that when food is received into the gastric cavity in a proper condition, the stomach secretes a solvent fluid which, by the muscular action of the organ, is thoroughly mixed with the food for the purpose of digestion, and that (440) when the food is received in a fluid state, containing considerable aqueous matter, the water is first absorbed, and then the gastric secretion and digestion commence (1281); because if the gastric juice were to mix with the water, it would be so much diluted that its solvent power would be wholly destroyed. Hence, if in the midst of a meal, or after a meal is completed, a portion of water or other drink is received into a vigorous stomach, and more particularly if true thirst is felt (1507), the organ suddenly and powerfully contracts upon the food, and presses it into the pyloric or small end (341), and by the contraction of a number of the circular fibres of the muscular coat (347), which gives the stomach somewhat the appearance of an hour-glass, the food is held there till the fluid which is received into the splenic or large end (382) is absorbed, which is done as rapidly as possible, and then the circular fibres relax, and the regular function of the stomach goes on with little interruption or embarrassment. But if, instead of properly chewing our food, and mixing it with the fluid of the mouth we continually wash it down with some liquid, or between every two or three mouthfuls of food take a small portion of drink, the fluid and solid ingesta are so thoroughly mixed together that the process of digestion cannot commence till the meal is completed and all the liquid removed by absorption (442); and this leaves the alimentary contents of the gastric cavity

much more dry and compact than if no drink had been taken (1281); and thus we greatly retard and embarrass the function of the stomach, and serve to debilitate, relax, and break down that organ. Yet while the stomach continues to be vigorous and active, all this may be done without any appreciable symptoms of gastric embarrassment, but never without more or less real detriment to the organ and its function. In that state of gastric debility, however, which is almost universal in civic life, the case is very different; the fluid received into the stomach during the ingestion of food is very slowly and with great difficulty absorbed; and if the food, with little mastication and insalivation, is continually washed down with some kind of drink, the process of digestion, instead of commencing immediately, as it ought to do, will be delayed for half an hour or an hour, and sometimes even longer, till the relaxed and debilitated absorbents can remove the fluid and bring the food into a consistence proper for the action of the gastric juice (1281); and now the food, instead of being properly mixed with saliva (426), and thoroughly saturated with healthy gastric juice as it came into the stomach mouthful by mouthful (429), lies in an oppressive and almost impenetrable mass, and the already wearied organ must, if possible, in its relaxation and lassitude, secrete a sufficient quantity of solvent fluid to digest it. But in this state the stomach is poorly fitted to secrete a healthy and energetic fluid; and, therefore, it is not surprising that under such embarrassments the vital powers of the debilitated and worried organ are not able to control the inorganic affinities (131), but suffer them to become active in the formation of gases and acids, which by their acrid and irritating properties, create a morbid and intense thirst, which vehemently asks for some liquid to dilute those acrid substances (1520), and almost irresistibly compels us to drink. If, however, in this state of things, we yield to the morbid demand, and take a quantity of water or any other liquid into the gastric cavity, the feeble organ cannot, like the vigorous stomach, contract upon its contents, and save them from the inundation, but the flood will come down and sweep over the entire mass, and reduce it to a more unmanageable wash than it was at first; and then will follow a distressing sense of distention, attended frequently with eructations and belchings, and often a part of the crude contents of the stomach are spasmodically thrown up, and a part perhaps ejected in o the intestines, to produce irritations, flatulence, colic, etc. (436). This is a true description of what every day takes place in civic life, in hundreds of individuals; and if all who indulge in the mischievous practice of washing down their food with liquids of any kind, do not experience all these evil consequences, they may be assured the practice always tends to such results.

1527. If the use of even pure cold water with our food in the manner I have described is incompatible with the physiological interests of our bodies, and the cause of functional disturbance and organic debility, much more is that water objectionable when it is habitually used hot for the same purposes and in the same manner. As with our food (1311) so with our drink, every thing taken into the mouth and stomach in a higher temperature than our blood is relaxing and debilitating to the parts on which it acts, and through them to the whole system. The teeth and every other organ and part in the oral cavity are injured by hot

drinks (714); the throat and œsophagus and stomach are relaxed and debilitated by them. In short, as we have seen (1311), every part of the system is in some measure relaxed and debilitated and rendered more liable to disease by the dietetic use of any thing in an elevated temperature; and if, instead of hot water or milk and water, we use tea or coffee or chocolate or any other made beverage, the mischievous effects on our digestive organs are still greater, and always in proportion as the qualities of those beverages are more or less unfriendly to the vital powers of our bodies. Tea and coffee and wine and all other narcotic and alcoholic beverages are exceedingly deleterious; but as I shall have occasion to speak of them more particularly in another place, it is not necessary to say more concerning them now.

1528. On the whole, then, in regard to the drink of man, it were best and most truly natural if his dietetic and other habits were such that the demand of his vital economy for water were fully answered by the aqueous juices of the fruits and vegetables which properly composed a portion of his food (1511). But if he *must* have drink, every law and property of his nature unequivocally declares that it should be the most perfectly pure water, and that he should not drink it warmer than his blood, and as a general rule it is better that it should be considerably cooler. It can be too cold, but with people in health and of good habits there is very little danger in this direction. It is also fully evident that, as a general rule, drink should not be taken with the food, nor too soon after eating. It is far better, if one is thirsty, to take a draught of pure cold water some twenty or thirty minutes before eating, or three or four hours after the meal; and they who are regular in their habits can regulate their thirst with perfect ease and comfort. An individual whose dietetic habits are tolerably correct, may soon accustom himself to take a glass of water in the evening or morning, or at any other hour in the day he chooses, and only at that one hour; and he will feel his thirst return regularly at that period, and never trouble him at any other time, unless occasioned by something extraordinary (1518). They who are tormented by a morbid thirst produced by gastric irritation from too much or from improper food (1519), had far better take active exercise in the open air, than drink. The cool fresh air upon their skin will greatly abate the fever of their stomach (291), and thus alleviate their thirst; and exercise will increase the action of the stomach, and enable it to digest or to reject its contents; and then, let them be more careful to avoid transgression.

SEASONINGS, CONDIMENTS, AND STIMULANTS.

1529. The human body, we have seen (106, *et seq.*), is composed of the common matter of the world, converted into animal arrangement and structure by vital forces, which overcome and subdue the more primitive affinities of organic matter (107, *et seq.*). We have seen also (314) that the matter of our bodies is not permanent in its organic arrangement, but particle by particle is continually escaping from the vital structure, and returning to inorganic forms (117); and hence the necessity for constant supplies of new matter to replace that which is eliminated from the vital domain (1466). Our bodies, therefore, consist of an assemblage of organs (121) so constructed and adjusted as

to form of the whole a single system (314, *et seq.*), and each of these organs performs its particular function—not for itself *alone*, but for the whole—as a constituent part of the one system (687, *et seq.*); and the associated functions of all the organs constitute the single vital economy of the system (312), by which the body is nourished and sustained in all its physiological properties and powers. The organic wants of our bodies, and consequently the purposes for which their organs were constructed, require vital power and action in the organs; and vital action requires that the living organs should be susceptible of being excited by appropriate stimuli (305); and hence, as we have seen (312), every organ in which vital action is required, is furnished with tissues whose vital properties endow it with the necessary powers for the performance of its function; and thus every acting organ in the system is constituted with vital sensibilities that fit it to be excited by those substances which it was constructed to receive and act upon (296). A certain degree of action in the several organs is therefore necessary for the sustenance of the body and the maintenance of life; and such is the general sympathy of every organ with each other in the whole assemblage, and all with each (230, 296—305), that no one organ can greatly fall short nor greatly exceed its proper rate and tone of action, without in some measure involving the whole system, and causing a correspondent disturbance in the general economy of the vital domain. And although, as we have seen (294), the animal centre of perception has in the ordinary state of the system no cognizance of the particular actions and conditions of the several organs in the domain of organic life, yet the cerebro-spinal system (228) sympathizing directly and powerfully with that domain in all its affections and conditions (293—305), the animal is conscious of satisfaction and enjoyment, or depression and disquietude, according as the general tone of the organic economy comes up to or falls short of the usual healthy standard. And consequently, as we have seen (305), when the system is in perfect health, and each organ is healthfully acting under the influence of its appropriate stimulus, the physiological wants of the organic economy are satisfied, a grateful communion of sympathy pervades the whole system, and mental tranquillity or perhaps delight is the natural result (565). If by any means to which the system is adapted and accustomed the stimulation is somewhat increased and the general tone elevated, the sympathetic mental consciousness or feeling amounts to exhilaration and perhaps high enjoyment; and, on the other hand, if by any means the general tone be depressed, the sympathetic mental consciousness or feeling is commensurately unpleasant and distressing, and the individual feels a corresponding degree of dissatisfaction and disquietude, which is promptly removed and satisfaction afforded by the requisite degree of stimulation. Hence it may be said that there is in man and all animals A NATURAL LOVE OF STIMULATION.

1530. But the vital sensibilities by which our organs are rendered susceptible to the action of appropriate stimuli, also render them susceptible to the action of other and improper stimuli. In the natural constitution of man, all the animal and organic sensibilites (292, *et seq.*) are established with precise and determinate relations to the physiological interests of the body, and to the nature and qualities of the substances designed to act on the living tissues of the organs (689, *et seq.*),

Thus, as we have seen (300, 950), the organic sensibilities of the stomach not only render that organ capable of being excited to action by appropriate stimuli, but they render it capable of being excited to even the most powerful and violent action by improper and offending and pernicious substances.

1531. In the perfectly healthy and undepraved state of the stomach, its sensibilities enable it with the nicest and most discriminating accuracy to perceive and appreciate both *the quality of the stimulus* and *the degree of stimulation* (286, 726, 727, 950); but the habitual introduction of improper substances into the gastric cavity so depraves its sensibilities that it often wholly *loses its discriminating power to perceive the quality of the stimulus, and only retains the ability to appreciate the degree of stimulation* (728). By the same means, also, its delicate susceptibility to the action of its natural and appropriate stimuli is so impaired, that the latter fail to excite sufficient action in the organ to keep up its proper tone and to satisfy the demands of the organic economy; and the consequence is, that a physiological depression of the organ results (1180, Note), which involves the whole domain of organic life; and the sympathy of the cerebro-spinal system with this depression (228) becomes a mental consciousness of dissatisfaction, disquietude, and distress, which must either be borne till the vital economy recovers the stomach from its depravity, and restores it to its healthy susceptibility, or be removed by the use of the stimulus by which the depravity has been produced, or by some other stimulus equally powerful. Thus, while the stomach is healthy and undepraved, the simplest and plainest food excites it to the vigorous performance of its function; and there is no want of tone in the organ, and no physiological dissatisfaction is felt in the system, and no mental disquietude results. If, in this state of things, a sufficient quantity of tobacco or any other poison is introduced into the gastric cavity to endanger life very imminently, its poisonous property is instantly perceived, and the sympathetic alarm is promptly given to the whole domain of organic life (225), and, as we have seen (300, 950), the most violent vital reaction takes place; but if a very small portion of tobacco be introduced at first—not enough to endanger life, nor greatly to disturb the function of the stomach—very little or no alarm will be given to the organic domain at large, but the stomach will, as it were, endeavour to keep its little troubles to itself, and by its own special economy (1541), protect itself and the vital domain as far as possible from its deleterious qualities. Yet always and inevitably, just in proportion to the pernicious quality and energy of the tobacco, the discriminating sensibility of the stomach is impaired, and the organ is commensurately less susceptible to the action of plain and simple aliment, and less nice to perceive the poisonous properties of the tobacco.

1532. If the effect is small, and no more tobacco is introduced into the gastric cavity, the vital economy will soon recover the organ from the injury, and restore it to its healthy sensibility. But if, before this is effected, a little larger quantity of tobacco is taken, the stomach, having less power to perceive its poisonous properties, will give no more alarm than it did before with the less quantity; and if this course be followed up for a short time, gradually increasing the quantity of the tobacco, the discriminating sensibility of the stomach will be so much depraved that it will no longer be able to perceive the quality of

the stimulus, and only able to appreciate the degree of stimulation (728); and this discriminating sensibility of the stomach being destroyed, there remains no other instinctive means by which the poisonous character of the tobacco can be detected in the gastric cavity. If now the tobacco be entirely withheld, and the depraved stomach be left to its own resources and the action of its natural and appropriate stimuli, these will wholly fail to keep up the tone of the organ, and the necessary consequence will be a physiological depression corresponding with the depth and extent of the depravity, and involving the whole domain of organic life (228), and sympathetically producing a proportionate degree of mental disquiet and distress.

1533. But the mind cannot be conscious that the tobacco has produced its distress, nor that it is suffering from the want of physiological tone in the stomach or any other organ (305). It is only conscious of its own distress, which it naturally attributes to some purely mental or moral cause acting directly on itself (565). The depraved stomach, however, craves its accustomed stimulus, with a vehemence equal to the depth of its depravity and the degree of its physiological depression; and if the requisite quantity of tobacco be introduced into it, immediately its tone is restored, the physiological depression removed, and the mental disquietude dispelled. But the mind cannot be conscious that it derives its relief from the action of a poisonous substance on the stomach, nor that it is in any measure affected by the condition of any bodily organ (576). The stomach no longer perceives the poisonous quality of the tobacco; it only appreciates the degree of stimulation which the tobacco produces; and *in that degree of stimulation* the stomach blindly rejoices, and the whole organic domain sympathetically rejoices with it (227); and in this general physiological exhilaration the mind rejoices also, though utterly unconscious of the source of its delight (577). But the mind, not from its consciousness, but from the exercise of its reasoning powers, will soon discover that its disquietude follows the abstraction of the tobacco, and its satisfaction or delight follows the use of it; and, judging, not from any knowledge of the physiological powers and laws of the body and of the properties of the tobacco, but wholly from its own consciousness of disquietude when the tobacco is withheld and satisfaction when it is used, it naturally and necessarily comes to the conclusion that the tobacco is not only innoxious but highly salutary; and thus man is brought to the full belief that tobacco is greatly conducive to his health and comfort, and feels himself fully confirmed in his opinion by the very best and most infallible means of knowledge—*his own experience.*

1534. This same reasoning strictly applies to the physiological and psychological effect of all other pure stimulants on the human system (879). In every case, by so much as they increase vital action, they cause the vital expenditure (376) to be in excess of the immediate vital replenishment (881); and the necessary consequence is a commensurate physiological depression, or 'indirect debility,' as it is called in medical works. In every case also, in proportion to the deleteriousness of the substance used, the vital sensibility of the organ on which it acts, is impaired and depraved; and the organ loses the power to perceive the quality of the stimulus, and only retains the ability to appreciate the degree of stimulation. Moreover, in exact proportion as any organ

becomes depraved by any particular kind of stimulus, it loses its susceptibility to the stimulating properties of other substances (701), and becomes dependent on that particular kind for a satisfactory degree of stimulation, and is depressed and dissatisfied if that accustomed stimulus is withheld ; and in its depression involves to some extent, as we have seen (1532), all the physiological and psychological powers of the system. This constitutes the power of such acquired appetites, and renders it exceedingly difficult to subdue and remove them. And always, when the system has become habituated to any stimulating substance, the depth of the depravity caused by its use, the depression and dissatisfaction experienced if it is withheld, and the difficulty of subduing the appetite for it, are in proportion to the deleteriousness of the substance, and the natural and instinctive antipathy of the pure and healthy vital powers to its poisonous properties.

1535. But as the discriminating sensibility by which any organ is enabled to perceive the poisonous properties of substances which act upon it are soon destroyed by the habitual use of such substances (696), and as the degree of stimulation is all that is appreciated by the general organic economy and all that affects the mental consciousness, so the physiological satisfaction and the mental enjoyment and delight always correspond with *the degree of stimulation*, without any regard to the *quality* of the stimulus. And as the most deleterious substances cause the deepest depravity of the organs on which they act, and as their stimulation is attended with the greatest expenditure of the vital powers, and is consequently followed by the greatest degree of physiological depression and mental disquietude, so the depraved appetite formed by the use of such substances is most importunate and despotic, and most exclusive in its demand for the particular kind of substance by which it was formed, and that particular kind of substance becomes most exclusively essential to the production of the requisite degree of stimulation. And hence, in proportion to the deleteriousness of any substance on which the system has become dependent for stimulation, the mind, judging from its own consciousness (1533), regards that substance as essential to its own comfort and enjoyment, and to the welfare of the body ; and as such substances, when the system is deeply depraved by them, are always used in gratification of the most importunate appetite, and as their stimulation removes the most distressing physiological depression, caused by their own depraving and exhausting influence, so their stimulation is regarded as the most grateful and delightful of all the enjoyments of life, and the substances themselves often become of more importance, in the estimation of the mind, than any thing else affecting human existence.

1536 The explanation of these physiological principles fully discloses to us the philosophy of the universal and deeply melancholy fact of man's propensity to indulge exclusively in the use of stimulating and intoxicating substances (768). By over exertion of the body, or overaction of the mind, or by dietetic errors in the quan ity or quality of food, or by some other cause (510), the nice balance of the physiological actions of the body is disturbed, a corresponding physiological depression is produced, and a commensurate disquietude is felt. If, in this state of things, man fully understood himself, and were wise, he would patiently bear the light and momentary disquietude, till the renovating

powers of his vital economy restored the balance of action, and thus removed his distress (1419). But unhappily, man knows not himself! and, what is yet more his fault than his misfortune, he seeks not with proper diligence and in a proper manner to know himself. And in his ignorance, if by any means he experiences a physiological depression and consequent disquietude he is at once impatient to be relieved, and eagerly avails himself of any thing that promises the most speedy alleviation. Purely by accident at first he discovers that certain substances, if taken into his stomach, exhilarate him and remove his depression (880); but upon what prinbiple he has no idea (1533), nor does he give himself any care to ascertain. It is enough for him to know that when he is fatigued or in any manner depressed, if he takes the substances in suitable quantities, he is relieved and perhpas made happy. The olfactory and gustatory (690, *et seq.*) and organic sensibilities (296, 727) alone can perceive and appreciate the qualities of the substances with reference to the physiological interests of the body; and these, we have seen, are soon depraved by the action of those substances, and the system only retains the ability to appreciate the degree of stimulation, and that is the very thing that affords the satisfaction and delight; while at the same time its effects upon the system destroy the physiological and mental ability of the individual to be satisfied with the action of the natural and appropriate stimuli (1531), and cause a more and more frequent and distressing physiological depression and consequent demand for stimulation. But man in his ignorance, and in the blindness of his sensuality, knows nothing of the physiological philosophy of all this. He neither knows nor suspects that the frequency and depth of his disquietude are caused in any measure by the substances which he uses to remove that disquietude. He only knows from his *experience* (37), whose integrity he can no more doubt than he can doubt his existence (1533), that whenever he feels depressed and disquieted, the use of those substances affords him relief and satisfaction and enjoyment; and, therefore, he fully believes them to be salutary cordials which do him good, and only good.

1537. Thus man in his blindness and delusion goes on from the occasional to the habitual use of his stimulants, till he brings his system into such a state of general physiological depravity, and renders it so subject to physiological depression, that its natural and appropriate stimuli (305) no longer serve to keep up its tone in any respect, nor to satisfy its demands for stimulation (1531); and the result is, that nothing simple and unexciting in his food or drink satisfies his depraved appetite and morbid craving for stimulation; and, therefore, he blindly multiplies the kinds of his stimulants and increases the quantity, with the increasing depravity and demand of his system, without knowing or suspecting the consequences, till every thing in his diet, every thing he swallows, is, either of its own nature or by the addition of other substances, pungent and exciting; and this inevitably soon brings the system into a condition in which its exhaustion is so rapid and its consequent depression so deep and distressing, that it can no longer be satisfied with the mere dietetic use of stimulants, but must be kept continually under their influence; and as the more freely such substances are used the more rapidly and powerfully they exhaust and destroy the susceptibilities of the system even to their own influence, so the infatuated self-destroyer

is driven on to the use of more and more powerful and pernicious substances, till he exhausts the resources of nature and of human ingenuity, in making himself a miserable and yet utterly deluded drunkard and degraded sot! And from the beginning to the end of this career of self-destruction, man is compelled along his course by a necessity which he voluntary generates as he proceeds, and at every step he is ready, in the full sincerity of his soul, to swear by all in earth and heaven that his own *experience*, which is the most infallible criterion of truth that man can have, fully demonstrates the correctness of his habits, and proves not only that his stimulants are innoxious, but that they are salutary and necessary for his comfort and for the continuance of his life.

1538. There is, therefore, in man a natural aptitude and powerful tendency to become a drunkard, and to destroy himself by the use of stimulating and intoxicating substances Hence, in all periods of time and all portions of the world, it has been universally true of the human species, that the means of stimulation and intoxication have been among the first discoveries and inventions of the earliest stages of society; and nearly every tribe and nation have indulged in the use of those means, without suspecting the consequences, till almost universal drunkenness was the result; and when, by enlarged experience, and by the sagacious observation of the more intelligent and philanthropic members of society, the relation between such excesses and their evil effects has been discovered, the depraved appetite of the body and the delusion of the mind (576, 598) have proved too mighty for the restraints of civil law, or at most the excesses have only been restrained in a very small measure by the severest exercise of civil power. Among the bloodiest and most terrible laws to be found in the codes of nearly every nation that has inhabited the earth, are those which in the earliest stages of their civilizatien were enacted and enforced against excesses in the use of intoxicating substances. And yet, where such laws have been most sanguinary and most terrible, the nations, after having risen to what is considered the highest state of refinement in civilization, have, mainly through excesses of this kind, declined and perished in general drunkenness. Ancient Greece and Rome are in this respect but striking illustrations of the general history of the human race. Indeed all means, both human and divine, have hitherto failed to restrain mankind from excessive indulgence in stimulating and intoxicating substances. The general diffusion of that knowledge which leads to self-restraint has ever been, and from the nature of things must ever be, the only means which can in any measure reclaim man from this deep and universal depravity and delusion. So fast as the people of any state or nation have become sufficiently intelligent to perceive and understand the consequences of an excessive indulgence in the use of stimulating and intoxicating substances, they have as a general fact restrained themselves within narrower and narrower limits of indulgence, in proportion to their intelligence and the truth and extent of their convictions. But where the depravity is universal, and the appetite for stimulating and intoxicating substances is engrafted as it were upon the very constitution by hereditary influence and perpetual habit, (1418). it is a most difficult thing to produce the conviction that such indulgences, are incompatible with human happiness and health

and life and sound morality and true religion. Hence, even in the most enlightened state or nation upon earth, the people have as yet only become sufficiently intelligent to understand the relation between the excessive use of the most powerful intoxicating substances and their most violent effects; and in proportion to the fulness of this conviction they restrain themselves from actual drunkenness; but they do not perceive and understand the relation between the use of all intoxicating, all purely stimulating substances, and their immediate and ultimate physiological and pathological effects upon the human body; and, therefore, while they perhaps restrain themselves entirely from the use of certain intoxicating substances whose ruinous effects have become too well known to be denied or doubted, they indulge themselves with little or no restraint in almost every other kind of stimulating and intoxicating substances whose mischievous effects they have not yet been *forced* to perceive and understand; and hence the universal fact, that human beings, even in the most enlightened portions of the world, habitually and almost continually indulge in the use of a great variety of stimulating and intoxicating substances, to render their diet gratifying to a depraved appetite (702), and to keep up a satisfactory degree of stimulation in their systems.

1539. All stimulants, I have said (884), increase the vital action of parts with which they come in contact; and when they are powerful, and the quantity considerable, and the organ or part on which they act an important one, such as their stomach, their local effect is sympathetically felt by the whole organic domain (298), and the whole system is thrown into an increased action by sympathetic excitement or irritation. Substances that act in this manner are called *local stimulants.* Others are rapidly taken up by the absorbents (442) and diffused throughout the body, exciting every part to increased action by their immediate presence. These are called *diffusable stimulants.* But while the stimulation produced by these different substances, when the system is accustomed to them, is identified in the mental consciousness (1533) with that which is produced by the natural and appropriate stimuli, giving a sense of satisfaction and increased vigor and enjoyment (1535) yet the physiological action which they cause is of a very different character. The natural and appropriate stimuli of the system (305) always excite the parts on which they act to the performance of their function, and the stimulation which they produce increases the functional energy of the organ. But the action caused by those foreign substances which are used purely for their stimulating effect, is the action of vital resistence (300), or what is called vital reaction (950)—a rallying of the vital forces to resist and repel and expel the offending and disturbing cause. This stimulation, therefore, while it lasts, though it increases the feeling of strength, and to some extent the muscular power of voluntary action (880), yet it never in any case increases the functional energy of any of the organs concerned in assimilation and nutrition, but, on the contrary, always diminishes the functional power of those organs, and retards their functions and deteriorates their functional results. On this important point medical men have fallen into an exceedingly great error of opinion, which has been the source of incalculable mischief in medical practice and dietetic regimen.

SALT.

1540. SALT has probably been more universally employed as an article of diet by mankind, from the primitive ages to the present day, than any other pure stimulant or substances which is used simply for its exciting property. It can hardly be considered remarkable, therefore, that at a very early period in the history of the human family this substance came to be considered as essential to the comfort and the health of man, nor even that in later times the opinion should be very generally entertained by those nations who use salt, that an entire and protracted abstinence from it would inevitably destroy life. But it is somewhat remarkable that scientific men, and particularly those who have given their attention to physiology, chemistry, medicine, etc., have not long before this discovered and disclosed the error of such opinions.

1541. Salt is a mineral substance, and is wholly innutritious and indigestible. If a table spoonful of it be dissolved in half a pint of water, and introduced into the human stomach, it is immediately perceived by the organic sensibilisies of that organ (296) as an offending or disturbing substance; great irritation is produced; the vital forces, if not exceedingly impaired (950), react with energy; mucous and serous secretions are rapidly increased in the gastric cavity, to protect the mucous membrane (338) from its acrid and irritating qualities; much distress is experienced by the individual, and nausea and vomiting generally succeed, as an instinctive means of expelling the offending cause from the vital domain; and in all cases, considerable portions of it are driven through the pyloric orifice (341) in the intestines, where great irritation is also produced by it, and it is soon expelled from the bowels, with large quantities of serum secreted from the blood to dilute and flood away the irritating substance, and thus protect the living parts on which it acts, and the vital interests of the system generally, from its pernicious effects (1505). When salt is taken into the stomach in small quantities with food, the result is somewhat different. If the stomach is perfectly healthy in all its properties and powers (312), however small the quantity of salt, it is immediately detected by the undepraved sensibilities of the organ, and a vital reaction takes place corresponding in energy and extensiveness with the quantity and strength of the offending substances (300), and by the mucous and serous secretions which are promptly produced, the parts are protected, and the salt is so diluted as to be rendered no longer very dangerous to the delicate vital properties of the tissues on which it may act. It is therefore not expelled from the alimentary cavity by vomiting nor purging, but is taken up in a state of solution by the absorbents of the stomach (442), and mingled with the blood of the portal veins (448): not in any case nor degree, however, to supply the wants of the vital economy, but to be expelled from the vital domain through the kidneys, lungs, skin, and other depurating organs of the system, as a foreign substance (506). By the long and habitual use of this substance, however, the organic sensibilities of the stomach, and of all the other parts of the system, becomes so much impaired by its qualities, that they no longer make so energetic a resistance to it as when they are healthy and undepraved, and the salt is gradually permitted to pass more and more freely into the general circulation, and be diffused througout the

whole vital domain (448), pervading the minute vessels of the glands and other parts, and becoming so permanently a quality of the serum of the blood as to be regarded by many as an evidence of the necessity for its dietetic use.

1542. The facts in regard to the dietetic use of salt then are these:—1. Salt is wholly innutritious—it affords no nourishment to any structure or substance of the human body. 2. It is utterly indigestible—it enters the body as a mineral substance—it is absorbed unchanged as a mineral substance—it goes the rounds of the general circulation as an unassimilated mineral substance—and is finally eliminated from the body through the kidneys lungs, skin, etc., as an unassimilated mineral substance. 3. Its acrid quality is offensive to the vital sensibilities of the organs, always causing vital reaction or resistance, and *this vital reaction constitutes the only stimulation ever produced by salt*, and is therefore always attended with a commensurate degree of irritation and vital expenditure, and followed by a correspondent degree of indirect debility and atony; and consequently it always and inevitably tends to produce chronic debility, preternatural irritability, and disease; the stomach, intestines, absorbents, veins, heart, arteries, and all the other organs of the system, are always irritated, exhausted, and debilitated by its presence. 4 It never in any measure promotes digestion nor any of the assimilating functions of the system; on the contrary it always retards those functions, and is unfavorable to all the vital changes (1282). Where a stomach has been greatly debauched and its energies prostrated, the sudden and entire abstraction of salt and all other stimulants from the food would undoubtedly leave that organ in a temporary state of atony or depression, which would unfit it for the performance of its function. But it is entirely certain that, in a stomach whose powers and sensibilities are unimpaired and healthy, salt always retards digestion and embarrasses the function and diminishes the functional powers of the organ; and the impaired stomach receives tone from it only upon a principle which is always and inevitably unfriendly to its own physiological interests and to those of the system in general (879). And this is all true of every other assimilating function and process of the vital economy; and hence it is a well ascertained truth in the science of physiology, that the dietetic use of salt is unfriendly to all the processes of assimilation, nutrition, and secretion, in the vital economy. 5. It always, in proportion to the freedom with which it is used, diminishes gustatory enjoyment (701). It is true that there are some substances eaten by man, whose qualities are such that they are rendered more tolerable by the use of salt than they would be without it; but it is nevertheless true that the use of salt with those substances always and necessarily impairs the nicely discriminating power of the organ of taste, and takes away the delicate perception of the agreeable qualities of more proper food (698), and thereby on the whole immeasurably diminishes the amount of gustatory enjoyment in the course of an ordinary life. Incredible as this may appear to many, every intelligent individual may demonstrate its truth by three months' fair experiment.

1543. But we are told of the great abundance of salt in nature—of the instinct of some of the lower animals, which prompts them to go a great distance to procure it—of its necessity to preserve the lives of

some of the domesticated animals, and of the Scripture authority for its use in human diet. All these points I have carefully examined, and from the examination am the more fully convinced that salt is not a necessary nor a proper article for the dietetic use of man. Its great abundance in nature affords no evidence either for or against the propriety of man's using it as an article of diet. As to the instinct of the lower animals, it is not true that there is any animal in nature, whose natural history is known to man, which instinctively makes a dietetic use of salt. It is true that some herbivorous animals, such as the deer, when they are diseased by worms, grubs, or bots, in the alimentary cavity, will instinctively go in pursuit of salt, not as an article of diet, but as a seasoning to their food, but purely as a medicine to destroy the animals in their stomachs; and they never instinctively use it at any other time nor for any other purposes. It is true also that domesticated animals are subject to diseases for which salt is perhaps the best and most natural medicine in the world; but it is not true that they require it for any other purpose, nor is it true that they will be less healthy if they are not regularly fed with salt. In regard to the Scripture authority, it amounts to this, and nothing more: salt, when good, is an antiseptic, and preserves those substances on which it acts from putrefaction; and good men have a similar effect upon the moral world; —but when salt has lost its antiseptic property, it is good for nothing; and when men who profess to be good, exert no *antiseptic* influence on the moral world around them, they are like salt that has lost its savor.

1544. It is a little remarkable that some have contended for the necessity of salt as an article in the diet of man, to counteract the putrescent tendency of animal food or flesh-meat, when there is not a carnivorous animal in nature that even uses a particle of it, and few if any of the purely flesh-eating portions of the human family ever use it in any measure or manner (777, 1012), and most portions of the human family who subsist mostly on vegetable food wholly abstain from it. In man, as in some of the lower animals, salt is undoubtedly an excellent medicine for worms in the alimentary cavity; yet so far is the dietetic or habitual use of salt from preventing the generation of worms in the alimentary organs, that, on the contrary, it tends directly by its irritating and debilitating effects (1542), to produce that state of the bowels most favourable to the generation of worms; for while the alimentary organs of man are healthy and vigorous, and perform their functions well, they are never infested with worms. It is only when they are debilitated and relaxed and sluggish that they are thus annoyed and the habitual and free use of salt tends directly to produce this state of things,

1545. On the whole, then, it is most evident that the best and most permanent health of the human body does not require the dietetic use of salt, but, on the contrary, the free use of it is decidedly detrimental to the human system. It is well known that sailors and others, when confined for a considerable time to salted food, become afflicted with scurvy, which is always a very distressing and often a very fatal disease. And from my own extended and careful observations during the last eight years, I have been strongly pressed to the conclusion that the dietetic use of salt is largely concerned in the production of cancers and other glandular diseases of the human

system (1523); and I am entirely certain that it exceedingly aggravates many chronic diseases, and have little doubt that it increases the liability of the body to diseases of every kind; that it is directly conducive to scrofulous, pulmonary, and cutaneous affections, and disorders of the mucous membrane;—in short, there is very reason to believe that it not only serves to predispose the human body to every form of disease, but also serves to aggravate and perpetuate every species of disease, when actually induced (1524), and that it serves to hasten on a premature old age, by rendering the solids dry and rigid and inelastic (681). I am therefore prepared to affirm with great confidence, that the well-being of the human body does not require the dietetic use of salt; that the free use of it is decidedly and often seriously injurious; and therefore, if it is used at all, it should be very sparingly, and always the less the better.

SPICES.

1546. In regard to other stimulants used as seasonings with food, such as mustard, pepper, ginger,—in short all stimulating and heating spices and condiments, they are not only unnecessary, but they are decidedly mischevious in their effects on the alimentary organs, and through them on the whole system (1534.) They always, according to their stimulating power, increase the vital exhaustion of the parts on which they act, and produce a commensurate degree of physiological depression of indirect debility (1539); and when habitually and freely used, they produce chronic debility and preternatural irritability not only of the digestive organs but of the whole system. When first received into a healthy stomach, the vital reaction (950) is so great that it always produced an inflamed aspect of the mucous membrane of that organ (338), arising from the engorgement of its blood-vessels (393) in the effort of the stomach to protect its delicate tissues (287) from the irritating properties of the offending substances (1541); but when the habitual use of them has greatly impaired, to the healthy and discriminating sensibilties of the organ (1532), the vital reaction is less powerful, and the engorgements less excessive, while at the same time the stomach is commensuratoly less susceptible to the action of its own natural and appropriate stimuli (1531), and suffers a physiological depression and want of tone if the customary stimulants are withheld (1542); and this has led to the common but utterly fallacious notion that these spicy seasonings promote gastric digestion. The truth is, that every one of the pure stimulants (733) actually retards digestion, diminishes the functional power of the digestive organs, and deteriorates their functional result (444). Some, it is true, are much less mischievous than others, but none of them is salutary nor wholly innoxious. Dr. Beaumont (431, Note) found, from repeated and careful experiments, that when precisely the same kinds of food were taken at the same hour on successive days, and in almost exactly similar conditions of the stomach, the food which was dressed with a liberal quantity of strong mustard and vinegar was three-quarters of an hour longer in digesting than that which was taken without any condiments. And this difference, it will be recollected, was in the same stomach, which was accustomed to the use of such condiments, and therefore could not perform its function on pure unstimulating

aliment with the full tone and vigor of a perfectly healthy stomach which had never been thus depraved. Dr. Beaumont also found that when mustard and pepper were taken with the food, they remained in the gastric cavity till all the food was digested, and continued to emit a strong aromatic odor to the last; and that the mucous surface of the stomach presented a slight morbid appearance towards the close of chymification.

1547. It is true, as we have seen (1542), that when the stomach has been greatly impaired and debilitated by the habitual and free use of pure stimulants, and lost its power to be healthfully and vigorously excited by plain and simple food (1531), the sudden abstraction of all seasonings from the diet will leave the stomach in a relaxed and depressed state, which wholly unfits it for the performance of its function. But it is also true, that so long as the stimulants are used, the functional powers of the stomach will always be impaired, and its functional results more or less deteriorated; and the more freely they are used, the greater will be these effects; whereas, if the stimulants are wholly abandoned, and a severely abstemious diet is adopted for a short time, with a proper regimen in other respects, the stomach will soon recover its healthy sensibilities and natural tone, and be able to digest the plainest and simplest food with perfect ease and comfort.

1548. These are, therefore, well ascertained general principles in physiology;—1st, that mustard, pepper, and all other stimulating and heating spices and condiments, afford no appreciable nourishment to the body (733); 2nd, that they do not assist the stomach and other assimilating organs in the performance of their functions; 3rd, that they considerably retard the process of digestion, and render it less complete and perfect, and often, by greatly increasing the muscular action of the stomach, hurry the contents of the gastric cavity into the small intestine in a comparatively crude state (436); 4th, that the use of them, even for a single time, never fails to cause irritation and produce some degree of indirect debility of the stomach, and the habitual use of them always causes more or less chronic debility and morbid irritability of the alimentary organs, and through them of the whole system,—developing a general morbid irritability in the nerves of organic life, causing irregularity in the actions of the heart and blood-vessels, and leading to debility and disease in those organs,—debilitating the brain and cerebro-spinal system generally (228), inducing chronic inflammation in the mucous membrane of the alimentary and respiratory cavities and other parts, causing physiological depression, and creating an unhealthy hunger and thirst (1433, 1599), which lead to gluttony and the use of stimulating and intoxicating drinks and other substances. In short, the habitual use of these substances always and inevitably causes more or less irritation and exhaustion and debility in the whole system, predisposes it to disease of every kind, actually induces many diseases, and aggravates every disease with which the human body is afflicted; while, on the other hand, it in no measure ministers to the real comforts of man. It diminishes his gustatory enjoyment (702), impairs his bodily elasticity and strength and his animal vivacity, takes away his mental tranquillity, subjects him to frequent depressions of mind and painful despondency, and increases his liability to insanity. Red pepper, mustard, ginger, and cinnamon, are somewhat less irritating than black pepper, allspice, cloves, and nutmegs; but they are all

highly exciting and exhausting, and when habitually and freely used, they are all decidely and seriously mischievious. The stern truth is, that no purely stimulating substances of any kind (735) can be habitually used by man, without injury to the whole nature.

NARCOTICS.

1549. But the narcotic substances which are almost universally employed by mankind purely for stimulating and intoxicating purposes, are far more deleterious in their nature, and when used with equal freedom are much more pernicious in their effects on the human system, than salt, spices, and other pungent substances ordinarily used as seasonings and condiments with food. The narcotic or intoxicating substances which have been used as means of stimulation by different portions of the human family, are somewhat numerous; but the most common in the civilized world, and especially in our country, are tea, coffee, tobacco, opium, and alcohol (768). Alcohol, though not commonly considered a narcotic, is nevertheless properly classed with those substances, for its effects on the living body are essentially the same. It is produced, as we have seen (1365), not by any formative process of nature, but by a process of decay, or the decomposition of the saccharine matter of organized bodies. The grand characteristic of all narcotic substances is their *anti-vital* or life-destroying property. When they are not so highly concentrated or energetic as to destroy life instantly, they produce the most powerful and often the most violent and distressing vital reaction (300, 697), which causes a correspondent degree of exhaustion (881), depression, and prostration (1531); and they often destroy life, purely by vital exhaustion in this violent and continued vital reaction (950). But when the discriminating sensibilities of the system (1532) have been depraved by the habitual use of these substances, and its powers of giving a sympathetic alarm greatly impaired, these same substances, even the most deadly in nature, if the quantity be only commensurate with the degree of physiological depravity, may be habitually introduced into the stomach, and even received into the general circulation (448), and diffused over the whole system, and slowly but surely destroys the constitution, and always greatly increase the liability to disease, and almost certainly create it, and invariably aggravate it, without any of those symptoms which are ordinarily considered as the evidence of the action of a poison on the living body; but, on the contrary, their stimulation is attended with that pleasurable feeling (1533) and agreeable mental consciousness (1535) which lead the mind to the strongest confidence in their salutary nature and effect. Hence, there is not a poison in the vegetable or mineral kingdom which the human body cannot, by careful training, become so accustomed to, that it will receive into the stomach, at a single dose, without any immediate evidences of its deleterious effects, a quantity sufficient to kill, in a very few minutes six men who have never used it. Arsenic may be taken with food as a seasoning, as freely as table salt, with as little immediate evidence of its poisonous character; and even prussic acid, which kills instantaneously like lightning, where the body is wholly unaccustomed to its action, may with proper care be gradually brought to act upon the human system,

till it can be used with considerable freedom as a means of exhilaration and intoxication.

1550. This wonderful capability of the living body to adapt itself by physiological depravity to the action of poisons of every kind, has not only led the infatuated human race to the excessive use of such substances as means of intoxication, but, almost as a necessary consequence (1534), has also led them to the full belief that those substances are innoxious and salutary. Accordingly we find in every period of human history, in every portion of the world, that not only the ignorant multitude, but also the more intelligent, and to a great extent even the members of the medical profession itself, have stoutly denied the poisonous character of those deleterious substances which they employed as means of habitual stimulation and intoxication, on the ground that they could be habitually and freely used without producing immediate death, or any of the distressing symptoms which indicate the action of a poison ; but, on the contrary, so far as the *feelings* can appreciate their effects (1535), they act on the system as grateful cordials. From an *experience* of this kind, the poisonous character of tea, coffee, tobacco, opium, alcohol, and all other narcotic substances, has been boldly, boisterously, and vehemently denied, by those who habitually use them as means of stimulation and intoxication. Even in our own land of boasted intelligence, in the middle of the nineteenth century of the Christian era, and in our very colleges of learning, the idea that alcohol is a poison has been treated with ridicule and contempt, as too absurd for any but a visionary fanatic to believe ; and yet there is no truth in science more perfectly demonstrable than that alcohol is one of the most energetic and fatal poisons known to man ; and with equal certainty can it be proved that tea, coffee, tobacco, and opium, are powerful poisons to the human body.

1551. But this point is not in any measure to be determined by what is called *experience*, or the fact that these substances can be habitually used as means of agreeable stimulation without producing the immediate symptoms of the action of deadly poisons ; for, as we have seen (1522), if this be our criterion, we are forced to the fallacious conclusion that there is no such thing as a poison in nature. We have seen (167, 312) that the solids of the human body consist of three general tissues or forms of organic structure ; that each of these tissues is endowed with peculiar vital properties ; that these tissues compose the several organs, and their vital properties, together with the vital affinities, which are under the control of the nervous power (204), constitute the vital forces of the organic economy, and the functional powers of the organs. Now then, whatever substance, by the action of its own intrinsic qualities, is immediately destructive to the vital properties and vital constitution of these tissues, is as certainly a poison as that two and two make four. If a real poison, in a very small quantity or very diluted form, be brought to act on a living organ composed of these several tissues—as the stomach, for instance—the organ may, by its own peculiar economy of vital reaction (1541), and by the co-operation of the associated organs in the general vital economy (300), so far protect itself and the system from the pernicious properties of the poison, as only to suffer considerable exhaustion of its vital powers and depravity of its organic sensibilities (296). From this state the

organ may be recovered by the renovating economy of the system (1419). But if the poison be at first received in a highly concentrated form of large quantity, it will either arrest the functions of life at once, by paralyzing the nervous power (17), or it will produce a violent reaction, and in the terrible conflict utterly exhaust the vital properties and destroy the vital constitution of tissues, and death will be the result! This is, therefore, the only true mode of ascertaining the properties of substances in relation to the physiological powers of the human body; and it is a matter which has been repeatedly and fully demonstrated, that all the substances which I have named contain a strong *anti-vital* quality,—or in other words, their effect on the living body is to destroy the vital properties and vital constitution of the tissues which compose the organs.

1552. Tobacco is not only one of the most powerful, but one of the most loathsome poisons in the vegetable kingdom; and therefore, as we have seen (1534), when any human being has succeeded in overcoming the strongest instinctive antipathies of his nature, and formed an appetite for this filthy weed, that appetite is extremely despotic in its power, and will not be appeased by any other stimulant, and is more difficult to overcome than almost any other depravity of the human body. I have already so fully explained the manner in which this abominable poison affects the human system (444, 696, 697, 701, 768, 902, 951, 1418, 1531, 1532), that it is not necessary I should say more concerning it. If what has been said will not convince man of the folly and madness of using tobacco in any form as a means of stimulation, no human testimony will; and I have little hope that any thing I can say will have much effect in removing so deep and so universal a depravity (768). Opium is in all respects so essentially like tobacco, that what is true of one, in regard to its effects on the human system, is in general true of the other; except that opium, being more commonly taken into the stomach, more immediately impairs the digestive organs (444), and diffuses its mischievous influence more rapidly and extensively throughout the whole system, causing a correspondent degree of physiological prostration and morbid irritablity, and consequently increasing the frequency and despotic energy of the demand for stimulation, and leading to greater excess in quantity, and proportionately more ruinous effects on the animal, intellectual, and moral nature of man; rendering him extensively diseased, and—except when under the direct stimulation of his drug—stupid, sottish, and extremely miserable. Alcohol, being a more rapidly diffusable and a more fiery stimulant (1539), seems almost instantaneously to pervade the whole system, and to make a direct assault on every part of the living body at once. A very few drops of pure alchohol introduced into the human stomach unaccustomed to it, will destroy life nearly as quick as prussic acid (1549); and a small quantity of the common spirits of wine of the shops will destroy life in a few minutes; yet by commencing the use of it in a very diluted form and in small quantities, and gradually increasing the strength and quantity, the human body, we know from most melancholy facts, may, through physiological depravity (1532), be so accustomed to this deadly poison, that it will receive it in large quantities, and in some rare instances be as it were saturated with it for many years, and still live on (484, 1649). Yet alcohol, whether in the

form of distilled liquors or fermented, whether in wine or beer or cider, *is always an anti-vital principle*,—always acts on the human body to disturb and impair its physiological functions, and to destroy its physiological powers. When first taken into the stomach, it highly inflames that organ, and by the strong vital reaction, is expelled from the gastric cavity into the small intestine, and extends its inflammation through the whole length of that canal. It has been supposed to promote digestion, and has formerly been prescribed to dyspeptics by physicians generally; but it is now a matter of perfect certainty that it always retards chymification (1378), and renders the process less perfect, and always diminishes the functional power of the stomach; in short, its effect is always, and in the nature of things, of necessity, to destroy the vital properties and the vital constitution of the tissues of the body (1551), and always to disturb every vital function, to deteriorate every functional result, and to impair and destroy every physiological and psychological power of the human system. It cannot therefore be used as a stimulant in any quantity without some degree of injury to the whole nature of man; and when habitually and freely used, it always does great mischief, and almost inevitably leads to the most ruinous consequences in body and mind; and nothing but the blindest infatuation growing out of sensual depravity (576) could induce human beings to cling to and vindicate the use of such a destructive poison as a means of stimulation (1550).

TEA AND COFFEE.

1553. But probably the most general and unbroken, and I might almost add the most mischievous, delusion of the civilized world at the present day, in relation to intoxicating substances, is that which leads to the nearly universal use of tea and coffee as common beverages, by male and female, old and young, vigorous and feeble, healthy and sickly, rich and poor,—by all habitually as articles of diet, and by most excessively as means of intoxicating exhilaration. The other poisons of which I have spoken (1249—1552) have produced such manifest effects of evil in the general experience and history of the human family, that multitudes have been convinced of their deleterious character. But with a very few individual exceptions, there is a universal belief in all parts of the world, where tea and coffee are used as beverages, that they are not only perfectly innoxious, but positively salutary. The fundamental principles on which this delusion rests have already been explained (1529, *et seq.*): viz., 1st, the physiological capability of the human body to adapt itself, by depravity, so perfectly to the action of the most baneful substances, that it will manifest no immediate symptoms of the poisonous effects of such substances; 2nd, the stimulation produced by even the most deadly poisons to which the system is accustomed, is identified in the mental consciousness (1533) with the natural and healthy physiological stimulation of the body, and is enjoyed in proportion to the physiological depression which it removes and the agreeable exhilaration which it causes; 3d, the use of tea and coffee is commenced at so early a period in life,—they are at first used in such small quantities, and so gradually increased, and the physiological powers of the body are depraved by such imperceptible degrees,—that those violent and distressing symp-

toms which indicate the immediate actions of a powerful poison very rarely if ever result from the habitual use of these substances (870). The consequence is, that the depraved appetite which they create, the physiological depression and demand for stimulation which they cause, and the grateful exhilaration which they produce, make all who use them love them in proportion to the freedom with which they are used, and with equal confidence believe that they are perfectly salutary cordials, and indispensably necessary to comfort and to health. But if, instead of commencing the use of these substances in very small quantities, a full cup of strong tea or coffee were taken at the first time, either by a youth or a full grown person of a healthy and undepraved body, the violent and distressing symptoms which would inevitably result in every case would leave no doubt of the poisonous character of these substances.

1554. A notion has prevailed quite extensively that green tea is more hurtful than black, on account of the former being cured on copper; but this is wholly incorrect. Green and black teas are varieties of the same plant, and the only reason why green is a somewhat more active and powerful poison than black is, that its natural properties are less impaired by the process of curing.* We are informed, however, that since 1832, a large proportion of the green tea imported into the United States has been manufactured from damaged black tea, by a process in which a small quantity of prussian blue is used; yet with this addition, the tea thus manufactured is not more poisonous than the genuine green tea of the best quality. But in regard to tea and coffee, as of all other intoxicating substances which human beings use as means of habitual stimulation, there is a blind determination on the part of those who thus employ them to defend their character, and to ascribe whatever evils may seem to be connected with the use to something besides the intrinsic properties of the substances themselves. Yet considering how early in life tea and coffee are introduced into the diet of children, and how universally and freely they are used by both sexes of every age, it is greatly to be doubted whether they are not at present actually doing more injury to the human constitution, and in a greater measure destroying human health, life, and happiness, than any other intoxicating substance used in Christendom.† Besides the injury done to the body by the very high temperature in which they are usually drunk (1311), their strong narcotic property, in proportion to the freedom with which they are used, has the same deleterious effect as tobacco, opium, and alcohol (1531, 1552),—impairing and serving to destroy all the physiological and psychological powers of the human system. The appreciable morbid effects which they produce are of course modified by the different degrees of constitutional power in different individuals (658), and by all the varieties of situations, circumstances, conditions, and habits in life; but in all cases they impair the functional powers of all the assimilating, circulating, and other organs concerned in the general office of nutrition, cause more or less of unhealthy irritability

* Mr Brande, the distinguished analytical chemist, of England, by a series of careful experiments made in 1821, proved that there is no appreciate difference between green and black teas.

† There are now more than ten millions of pounds of tea, and fifty millions of pounds of coffee, consumed in the United States annually, and the quantity is rapidly increasing

in the nerves of organic life, debilitate the brain and the whole cerebro-spinal system (228), diminish the muscular power, in every respect predispose the body to disease, always aggravate disease when induced, because frequent and distressing physiological depression and mental disquietude and despondency, and strongly tend to delirium and confirmed insanity.* The feeble and the sedentary suffer more from the effects of tea and coffee than the vigorous and the active, and, as a general statement, woman more than man; indeed the sufferings of woman are very greatly multiplied and enhanced by these treacherous beverages, which she regards as indispensable to her comfort.

1555. It is most evident then, that tea, coffee, tobacco, opium, alcohol, and all other narcotic and intoxicating substances, are poisonous to the human body, and cannot be employed by man as means of stimulation without decided detriment to his whole nature; and when they are habitually and freely used, the injury is always great and often very calamitous. Besides the evils already mentioned, the habitual use of narcotics serve powerfully to diminish the size of the human body from generation to generation, and otherwise to impair its symmetry (963), and greatly to deform it (962.) Employed as medicine, these substances often do great mischief; and it is certain that as a general fact, the medical use of them has been incalculably more injurious than beneficial to the human family. In short, as a general rule, the less man has to do with them, as stimulants or as medicine, the better will be his health, and the more uniform his enjoyment; and the less he has to do with all kinds of purely stimulating substances, as seasonings to his food or means of stimulation, the more certainly will he be blessed with good health, long life, and happiness, if his habits are in other respects correct. Even the camphor and cologne bottles are far more frequently the sources of evil than of good to those who employ them; and the infusions or teas made of pungent and exciting herbs should be used with great caution, and especially as drinks or medicine for children. Both for internal and external application, in health and in sickness, pure water is, as a general rule, the most salutary liquid that can be used (1516).

LECTURE XXIV.

SLEEP—The physiological necessity for sleep—The restorative effects of sleep—Causes of unsound sleep, and of dreams, somnambulism, etc.—Dreaming not compatible with the most refreshing sleep—How far physiology determined our hours of sleeping—Sleep in relation to longevity—Neither too much nor too little sleep consistent with sound health—Vegetable-eaters can do with less sleep than flesh-eaters—Sleep of children—Improper means to cause children to sleep—Sleep of aged people—The proper time of sleeping—How much time required for sleep—BEDS and bedding—Feather beds objectionable; why—Hard beds best—Best kinds of bed-clothing—Bed-rooms should be large—Night garments—Entire change of clothing at night—Night and day clothes should be aired—Bed-rooms and everything in them should be kept clean—Beds, etc. of children and aged people—Ventilation of bed-rooms—BATHING—Importance of cleanliness—Different modes of bathing, and

*Tea and coffee will produce delirium tremens quite as quickly as ardent spirit, if they are used to the same excess.

proper times—Importance of the bath to children and aged people—Its great value as a remedial means - Shaving, cutting the hair, etc.—AIR---Pure air indispensable to perfect health---The physiological reasons—Causes of impure air---Great importance of pure air to children and the aged—CLOTHING - All clothing in itself an evil—How far necessary, and for what purpose—The proper regulation of clothing—EXERCISE—Its indispensable importance to health—Different kinds of exercise adapted to civic life—Great efficacy of proper exercise as a remedial means for the feeble—Its great importance to the young and the aged---General conclusions and remarks.

1556. HAVING fully ascertained the natural dietetic character of man, and pointed out the general rules which should govern him in his dietetic habits, we are next led to consider what regulations are necessary in regard to sleeping, bathing, air, clothing and exercise.

1557. We have seen (121—137, 207, 208, 314) that in many of its properties and functions, the human body resembles a tree or plant. With the exception of mastication (426, *et seq.*) and gastric digestion or chymification, nearly or quite all the processes in the general function of nutrition are very similar in the animal and in the plant; and hence that system of nerves in the human body which presides over the general function of nutrition is called the system of vegetative or organic life (218—228), and all those organs which are immediately concerned in this general function are said to belong to the domain of organic life, and in health perform their particular functions without the violation (302, 303) and without the consciousness of the animal (294). But the food of the animal being separated from it, and requiring perceptive and locomotive and prehensive and voluntary powers, in order to furnish the digestive organs with the necessary supply of aliment (209), it is provided with organs of external relation adapted in anatomical structure and physiological endowment to the properties of external things and to the internal wants of the organic system (210, 316). These organs of external relation in man (688) consist of the brain and spinal marrow, with all their nervous cords, branches, fibres and filaments, and of the various muscles of voluntary motion, together with the bones, cartilages, ligaments, tendons, etc., connected with those muscles, and acted on and moved by them (233). We have seen also (875) that the performance of every function in the living body is attended with some expenditure of the vital properties and organized substances of the organs which perform them, and that it is the constant business of the general function of nutrition to replenish and repair the exhaustion and waste thus produced (393, 493).

1558. In the domain of organic life, God has wisely and benevolently so ordered things that the replenishing and repairing economy of the system, as a general fact, keep pace with the expenditure of power and waste of substance in the performance of the vital functions (376, 377); so that the heart, with only the momentary rest that one part enjoys while another is in action, as the ventricles and auricles alternately contract (372), is able to continue its operations without interruption from the commencement of our being to the termination of our earthly existence; and the lungs, with only the brief repose which follows each expiration (469), are able to continue on their exercise incessantly through life; and all the other organs of involuntary motion and vegetative function are sustained in the constant performance of their duties in the vital economy of the system, with no other rest, while

the body exists, than the very short repose which may intervene between the regular performance of their functions (1432) or their regular actions. But in the domain of phrenic or animal life (229), where action is voluntary, the same balance between the exhausting and replenishing economy is not kept up (377). In the contraction of every voluntary muscle, in the exercise of every nerve belonging to this domain, the expenditure of vital power and waste of substance, as a general fact, somewhat exceed the immediate replenishment and repair effected by the general function of nutrition (493); this excess, we have seen (909), is greater in the flesh-eater than in those who subsist on a pure vegetable diet, and still greater in those who use pure stimulants with their food (1556), and far the greatest in those who act under the influence of intoxicating substances (1549). But even in those of the purest and simplest habits, whose diet and general regimen are the most perfectly adapted to the physiological and psychological interests of human nature, the continued exercise of any voluntary organ, or of any part within the exclusive domain of animal life, always causes an expenditure of vital power and waste of organized substance, which in some measure exceeds the immediate replenishment and repair effected by the general function of nutrition; and when that exercise is severe and long continued, the excess is very considerable, causing a sense of weariness, and sometimes of distress. And as the brain and the organs of special sense (396, *et seq.*) and the nerves of animal life generally (228, 232—307) are continually exercised in the operations of the mind and the voluntary motions of the body, they largely share in the general exhaustion and weariness of the domain.

1559. It is evident, therefore, that if the exercise of the organs in the domain of animal life were to be continued too long without interruption and repose, their exhaustion would become so great as completely to destroy their functional powers, and throw the organs into a state of painful and ruinous disease. Regular periods of rest are therefore indispensably necessary to the health and functional integrity of all these organs and parts; and our benevolent Creator has wisely ordained such periods of rest, and placed those organs whose unceasing functions are essential to our bodily existence so entirely independent of the powers of animal life (302, 303), that these latter may be hushed in death-like repose for several hours in succession without the least interruption to the action of the former (567).

1560. SLEEP, then, is the repose of the organs of animal life, in order to afford the vital economy an opportunity to replenish and repair the exhaustion and waste and injury which they have sustained from previous exercise, and perhaps abuse (1419). How beautifully, therefore, is man in this respect adapted to the natural world in which he lives! While light surrounds him, he has organs adapted to perceive it, and by its aid to perceive the visual properties of things (689, *et seq.*); and while, with this advantage, he is able to direct his course whithersoever he may choose, and to whatever object he may desire, he has organs adapted to the audible and olfactory and gustatory and tangible properties of things, by which he can hear and smell and taste and touch (294, 556); and he has powers (520, *et seq.*) by which he can think, reflect, and reason, and judge, and will, and act, and thus fulfil the functions and the final causes of his organs of external relation,

and supply the wants of the internal domain (233). But when the light fades away and darkness gathers round him like the pall of death (18), his vision is blotted out, and he no longer needs the exercise of any of his special senses, nor of any of the powers of animal life; and when these all naturally require repose, then nature with a bland and soothing influence gently seals his senses, and draws the shroud of oblivion over his consciousness, and leaves him to rest in the temporary death of all his moral and intellectual and voluntary powers (571); while the vital economy over which the nerves of organic life preside (288), unceasingly and industriously carries forward its replenishing and repairing and renovating operations, in order that he may wake as by a resurrection to a new existence, refreshed and vigorous, and full of health and happiness in every part.

1561. O! man knows not, nor even dreams, how constantly the goodness of his Creator is acting to redeem him from the effects of his trangression!—how, when the day is spent in continual abuses of his body, in the habitual violation of the laws of life: and when night comes, and he is lost in sleep, and ceases from his sins, the hand of God in unremitting kindness and parental mercy directs and urges on those renovating processes of the vital powers (1419), by which the injuries his system has received from his pernicious practices are so nearly repaired, that when he awakes and rises to another day, and feels as fresh and vigorous as at yester-morn, he *will not* believe that the tobacco and alcohol and other poisonous and improper substances which he indulged in yesterday did him any harm; and thus, for the benevolence of God, who watches over him with unceasing care, and by every means which can be brought to act upon his moral susceptibilities endeavors to reclaim him from his sins, he only returns that strange perverseness which, in disobeying God, destroys himself.

1562. In a perfectly healthy and undepraved state of the system, sleep is, as it always should be, an entire suspension of all the powers of animal life (567); every sense is completely locked up, every thought is hushed, and not the sligtest consciousness of existence remains; and in such a state of the system, this death-like sleep is so profound, that it is not easily disturbed by any external cause. But when continued errors of diet and other infractions of the laws of life (683, *et seq.*) have considerably impaired the healthy properties of the nervous system, and especially the nerves of organic life, and produced in them an increased irritability approaching to, or actually possessing, a morbid character (296 *et seq.*), sleep becomes less death-like in its profoundness, and is more easily broken by external causes, and almost continually disturbed by internal irritations. While Caspar Hauser (1131) continued to subsist exclusively on his simple vegetable food and water, and to sleep on his bed of straw, 'his sleep,' says his biographer, 'was sound and dreamless, and it was extremely difficult to wake him; and it was not till after he went to live with Professor Daumer, and was furnished with a proper bed,' continues the learned writer, 'that he began to have dreams.' This statement naturally leads to the inference that the change from the bed of straw to the '*proper bed*' was the principal cause of Caspar's sleeping less soundly, and of his dreaming. But no one, being acquainted with correct physiological and psychological principles, can for a moment give credit to such a

notion. If by a '*proper bed*' the writer means a bed of feathers and a great abundance of warm clothing, it is undoubtedly true that such a bed served to debilitate his system and to diminish his phy-iological powers, and in some measure obstruct the freedom of pulmonary and cutaneous respiration (506), and thus to increase the injurious effects of other causes; but sleeping on a proper bed could have no direct tendency to make him dream. It is, beyond all question, certain that the chief, if not the exclusive, cause of Caspars' sleep becoming less sound, and of his dreaming, was the irritation produced in the domain of organic life by the change in his dietetic habits, and sympathetically involving the brain (299, 567).

1563. When there has been so intense and so protracted an over-action of the brain, or of any part of it, as to destroy the healthy condition of the part, and induce in it a highly morbid irritability, then such a state of cerebral disease may be the immediate cause of dreaming; yet this state, as a general fact, cannot take place without deeply involving the condition of the nerves of organic life in the stomach, and to some extent throughout the whole domain (586), so as to produce a morbid reaction on the cerebral part, either as an exciting or aggravating cause of dreams (305). Again; if there has been such an exercise of the brain by the continued action of the mind on some particular subject, as to produce great cerebral exhaustion or weariness, without actually inducing morbid condition, irritation in the domain of organic life will be exceedingly apt to cause dreams on the same subject on which the mind has been employed in the waking hours (1196). But in all cases when there is no irritation in the domain of organic life, cerebral exercise, which stops short of inducing morbid condition, instead of being in any degree a cause of dreaming, is on the contrary a most powerful final cause of the more profound and dreamless sleep; and even when there is actually a morbid state of any part or parts of the brain, there will seldom if ever be dreams without irritation in the domain of organic life (218. *et seq*).

1564. Irritation in the domain of organic life, therefore (571), may be considered the grand cause of unsoundness of sleep, and of dreams in all their varieties, from the most shadowy and vague conceptions of things, to the most strongly marked and extraordinary cases of somnambulism; and it will always be found that the removal of this irritation is the most certain and speedy way of preventing such effects The principles upon which this irritation produces dreams I have fully explained when treating on the functions of the brain (550, *et seq*), and it is not necessary that I should repeat them here. The alimentary canal, including the stomach and intestinal tube, is the ordinary seat of this irritation (567); but the liver, kidneys, and indeed each particular organ in the domain of organic life, may be the special seat of it (299). Nevertheless, even in cases of this kind, the originating causes are generally such as act on the alimentary canal, and induce a morbid condition of particular organs by continued sympathetic irritation (511).

1565. It may therefore be asserted as a general fact, that dietetic errors are the originating, and generally the immediate, causes of unsoundness of sleep and of dreaming in all its varieties (567). Many other causes co-operate with these, to aggravate their effects and render

sleep less refreshing, which however would of themselves seldom if ever cause dreaming; and it should be remembered that *dreaming is always to be considered as unfavourable to the welfare of the human system*, inasmuch as it is a demonstration of some disturbance in the system, causing unsoundness of sleep and some degree of action in the brain when its repose should be perfect.

1566. To enumerate particularly all the dietetic errors by which the soundness of sleep is impaired, and dreaming in all its varieties is caused, would be to repeat much that I have said in the proceeding lectures. It is sufficient therefore to say, that every violation in our dietetic habits of the laws of constitution and relation established in our nature (683, *et seq.*), tends to produce these effects; or, in other words, every thing in the quality, quantity, and condition of those substances that we use for nourishment, drink, or stimulation, which irritates the stomach and intestines, and increases the irritability of the nervous system, serves to render sleep less sound and refreshing, and tends to excite dreams. All alcoholic and narcotic substances, all pure stimulants (1202). all improper culinary preparations of food, all improper concentrations and combinations of alimentary substances (1310, *et seq.*), imperfect mastication, too rapid deglutition or swallowing, eating to much, eating at improper times, etc, (1434), are among the most prominent causes which impair the soundness of sleep and excite every variety of dreams. Lewd and licentious habits of every kind by producing similiar effects on the nervous system, serve also in the most powerful manner to impair the soundness of sleep and to increase the liability to dreams. Yet I have found that in bodies much disordered by these last-named causes, dreams may generally if not always be prevented by strictly avoiding dietetic errors, and shunning every thing which will produce irritation in the alimentary canal.

1567. The sleep of young infants and of children generally is much impaired by over-feeding and other dietetic errors (1453, *et seq.*); and the evil habit of stuffing them full just before they are put to sleep, and of nursing them frequently during the night, is by no means the least of those errors. As a general rule, the digestive organs of human beings, and most especially in civic life, should have little to do during the hours of sleep (1444); and this applies to people of all ages and circumstances, and particularly to the young and old, and feeble and infirm. And hence, it were unquestionably better for every one in civic life, as a general rule, to take no food nearer than four or at the shortest three, hours before retiring to rest (1440); and as a general rule also, every one, diseased or well, should avoid sleeping immediately after a meal in the day-time; for though this habit may not seem to be immediately attended with injurious effects, yet it is most certain that such effects do result sooner or later, in some form or other (1443). Gentle and pleasant exercise, and cheerful conversation, and innocent amusement, are infinitely better after a full meal than sluggish rest or sleeping (1501).

1568. As I have stated (1412, *et seq.*) concerning the times of eating, so I must say in regard to sleeping, physiology does not determinately point out the precise hours at which we should go to sleep, and at which we should arise, nor tell us exactly how long our sleep should be. Yet, without doubt, if man were in all respects perfectly obe-

dient to the laws of constitution and relation established in his nature, the instinctive physiological powers of his system would regularly lay him down to sleep, and rouse him up again, at stated hours, with all the punctuality of undisturbed physiological habitude (1418).

1569. It is an interesting fact, that Caspar Hauser, for some time after he was set at liberty, 'regularly commenced and ended his sleep with the setting and the rising sun.' And when it is considered how long he was confined in his dark dungeon, where day and night were alike to him, and where the perfect simplicity and uniformity of his habits and circumstances were all peculiarly adapted to favor those physiological habitudes which naturally belong to the undisturbed economy of the vital domain, this fact seems to be the most distinct and unequivocal testimony of nature on this point that has ever been afforded us, or of which we have any knowledge. It is true we have been accustomed to think that man requires less sleep than this fact would seem to justify, and it is probably also true that we have not properly appreciated the importance of perfectly sound sleep as one of the principal means in the economy of nature by which health is preserved, and still more, by which life is prolonged. Certain it is, however, that, as a general rule, men who have been most remarkable for their extraordinary longevity, have been long and sound sleepers.

1570. But sleep, to be most favourable to health and longevity, must be perfectly natural and sound; the broken dreamy sleep which is too generally experienced by members of civic life is better than none, but far from being best. Nor is it by any means compatible with health or length of life for any one to endeavour to prolong his rest in bed a greater length of time than he can sleep with tolerable soundness A sluggish drowsiness too long continued always serves to debilitate the system, to relax the solids, impair the functional powers of the organs, and to produce general languor and stupidity. While, on the other hand, excessive wakefulness, or too little sleep, causes excessive exhaustion of the vital energies, particularly in the domain of animal life (228), debilitates the brain and all the organs of the special senses, and impairs their functional powers, relaxes the muscles, and finally debilitates the whole system, and abbreviates the period of life. And if sleep is too long prevented, derangement of the mind, and of the general functions of the system, and death, speedily ensue.

1571. It is important to remark that those who temperately subsist on a pure diet of vegetable food and water can endure protracted wakefulness much longer without serious injury than those who subsist principally on animal food; and those who freely use stimulating condiments with their food are still less able to bear continued watchfulness; and those who freely use intoxicating substances will suffer the soonest and most of all from this cause (1549, *et seq.*).

SLEEP OF CHILDREN AND AGED PEOPLE.

1572. Young children require more sleep than adults or youth; but all artificial means of protracting their sleep are decidedly objectionable, and many of them exceedingly injurious. If the quality and quantity of their food (1491, *et seq.*) and their times of receiving nourishment

(1453, *et seq.*) are properly regulated, and if they are correctly managed in other respects, they will require no cradle to secure their sleep, and still less will they require opiates of any kind, either through the mother (1294) or administered directly to themselves. As a general fact, rocking children in a cradle has a bad effect upon their health, and none but the most gentle motion of this kind should ever be allowed; and the habits of mothers and nurses, of drinking gin or brandy toddy or porter or ale or any other alcoholic or narcotic liquor,* or of giving any of these, or any paregorics or carminatives, to children, to make them quiet and to cause them to sleep, is exceedingly bad, not to say very wicked and cruel. Well-managed children will sleep full as much as the good of their little bodies requires without the use of any such means, and it is infinitely better that they should occasionally cry and exercise their lungs, than that they should be kept continually in a state of sluggish quietness by stupifiying and deleterious substances. Even the herb teas of domestic preparation (1555) should be used with great caution and very sparingly. If nursing children are restive and fretful, examine their dietetic habits, and the dietetic habits of the mothers or nurses, and the cause may generally be very readily found. It is more cruel than the grave for the mother or the nurse to be constantly indulging in those kinds of food and drink which inevitably produce irritation in the delicate little bodies of children (1294), and then to endeavour to allay that irritation by anodynes. It will be almost a miracle if such children do not either die before they get through teething, or become afflicted with chronic disease before they are twenty years old. I repeat, then, that no artificial means should be used to cause children to sleep; and the utmost care should be taken to avoid everything relating to their diet, clothing, cleanliness, etc., which may serve to impair or abridge the natural soundness and duration of their sleep. A great want of cleanliness of their bodies is exceedingly unfavorable to the sound and healthful sleep of children.

1573. Old people require less sleep than the young and growing, and less than the middle aged (1496). But it is of great importance that the sleep of the aged should be as sound and as long as it can possibly be rendered by *natural and proper means* (1567); and it is perfectly certain that where such means are strictly observed their sleep which will be much more sound, refreshing, and protracted, than is ordinarily enjoyed by those who are advanced in years.

THE PROPER TIME AND DURATION OF SLEEP.

1574. Some have contended that it is of little importance whether we sleep in the night or in the day-time, so that we sleep a proper length of time. But every indication of nature and all experience are opposed to such a notion, and to a properly enlightened mind there cannot be the least ground of doubt that the night is the natural time to sleep (1560); that is, in all parts of the globe where the twenty-four hours are regularly divided into day and night (18). And all experience in civilized life has proved also, that, other things being equal, those who get a considerable portion of their sleep before midnight, are, as a

* Many a nursing infant has been intoxicated and stupified by the substance swallowed by the mothers (1294).

general fact, the most healthy and long-lived. In that state which in all respects is most perfectly adapted to the constitutional nature of man, therefore (644), there is every reason to believe that he would retire to rest soon after daylight disappears in the evening, and rise with the first gleam of light in the morning. But in the present artificial state of civic life, there are so many things to disturb and break up the natural physiological habitudes of the human system (1418), that even the sleep of man is exceedingly affected by circumstances; so that it is impossible to lay down a general rule which will be equally suited to every individual. The best *general rule*, therefore, which I can lay down for all people in our climate, and indeed in all climates where the day and night are nearly of the same length as ours, is, that they should retire to rest as soon as they can after daylight disappears, and rise as soon as their sound and refreshing sleep is at an end, and certainly as soon as the earliest dawn of the morning appears. But if mankind will not listen to this general rule, which is undoubtedly the best that can be given to them, then I will give them another which is an extreme concession to human perverseness of habit; and say that, as a general rule, the *very latest hour* at which any human being should be kept from sleep is ten o'clock at night, and none should be in bed after the sun is risen. We have been told of individuals who habitually took but four hours sleep; and undoubtedly some, by virtue of good habits in other respects, or a powerful constitution, may hold out many years in this way; but it always and inevitably shortens life, by an undue expenditure of the vital energies of the constitution in maintaining the animal and sensorial powers and functions. Six hours are probably the shortest time that man can habitually devote to sleep, consistently with the permanent welfare of his system; and perhaps eight hours of sound sleep are as many as any one can secure or enjoy to advantage in the present state of things. An average of seven hours, therefore, is probably the nearest we can come to exactness in a general rule for man in civic life.

BEDS, BED-CLOTHES, BED-ROOMS, ETC.

1575. Concerning beds, I cannot speak the whole truth without greatly reprobating a strongly cherished custom of society, for I am compelled to declare that *feather-beds* are in every respect objectionable, and that they possess not one redeeming quality, not a solitary virtue to save them from the general bonfire to which they ought immediately to be consigned.

1576. Is it claimed that they are 'soft and warm,' and therefore conducive to human comfort? It is true that feather-beds are absolutely softer than straw, hay, moss, or hair mattresses; and it is true that they do not so rapidly conduct the heat from our bodies, and therefore are considered warmer; but it is also true that they so relax and debilitate our bodies, and so affect our nervous systems and our caloric function (489), that we *feel* our feather beds to be harder, and to be less conducive to the healthy and comfortable regulation of our bodily temperature, than our beds of straw or moss. And hence, when we become fully accustomed to hard beds, if our habits are in other respects correct, we do not require so much clothing by night nor by

day, in cold weather, as when we are accustomed to sleep on feathers.

1577. We have seen (287—299, 330, 337) that there are the most intimate and important anatomical connections and functional and sympathetic relations between the external skin of the body and the mucous membrane which lines the alimentary and respiratory cavities, etc. (338, 353), and that through these and other media the external skin holds very direct and powerful relations with all the internal organs and functions of the system. In consequence of these relations (687), feather-beds not only relax and debilitate the external skin and impair all its functional powers, and make it more susceptible to cold and to all the changes of weather (490), and to the action of all insalubrious causes and influences, but they also relax and debilitate the whole system, and serve to impair every one of its physiological powers and interests (299). The lungs and digestive organs are powerfully affected by every thing which is detrimental to the general condition of the external skin (291). So that, by habitually sleeping on feather-beds, we are more predisposed to dyspepsy, with all its train of evils, and to pulmonary diseases of every description. Indeed there is probably not a single disease with which the human system has ever been afflicted, that we are not more strongly predisposed to, and which, when actually existing, is not in some measure aggravated by the use of feather-beds. I repeat, therefore, that they have not one redeeming quality, and ought, with as little delay as possible, to be utterly and for ever discarded by every human being. They cause many more evils than it is convenient or even proper for me to enumerate on this occasion; while, on the other hand, they do not in reality minister to the comfort of mankind in any manner.

1578. We have seen (506) that the whole external skin of the human body is in some measure a breathing organ, and that it is continually exhaling a vapor loaded with various excrementitious matters, and held in an aeriform state by the heat which passes with it from the body (129, 130). Feathers being non-conductors, not only retain much of this heat about the surface of the body, but also retain so much of the gaseous and other perspired substances as to keep the body surrounded by a very impure atmosphere while in bed. This impure atmosphere penetrates into every part of the bed; and besides this, there is always more or less of dead animal matter belonging to the feathers, which is continually undergoing decomposition, and forming unwholesome gases and offensive odors. So that a feather-bed, if the utmost pains are not taken to prevent it, soon becomes so completely saturated with its own impurities and those received from the human body, that it will give to the whole room, and even to the whole house, a very disagreeable and unhealthy odor; and when the bedroom is small and not well ventilated nor properly cleansed, the very walls become in a few months so deeply tainted with the impurities, that it is almost impossible by repeated cleansing and whitewashing to destroy the offensive smell, even in years. And where every measure is taken to keep a bedroom clean and sweet, if it contains a feather bed it will always have a disagreeable smell to those who have a pure olfactory sense. In every respect, therefore, feather-beds are unworthy of a place in the habitations of civilized beings.

1579. Mattresses made of hair, if the hair has been thoroughly cleansed, are incomparably more favorable to health and purity and comfort than feather-beds. Mattresses made of moss, manilla grass husks, straw, hay, palm leaf, etc., are still more conducive to the highest and most permanent well being of the human body. For it should ever be remembered that, always and of necessity, in proportion as we, by the artificial means and circumstances of civic life, bring our bodies into that condition which renders soft beds indispensable to our immediate comfort, we diminish our physiological powers, increase the uncertainty of health, and abbreviate the duration of life; and the evil is always increased by an indulgence in the thing for which we thus create a demand (725, 1307). Bodily development, symmetry (937), vivacity, agility and vigor, and mental cheerfulness, activity, clearness, and power, and moral purity and elevation and happiness, are all best promoted by a hard bed.

1580. It is of much importance that the clothes of the bed should be properly regulated as to quantity and quality. Too many bed-clothes render sleep less sound and refreshing, and serve to relax and debilitate the body, and in every respect to impair the physiological powers of the system; while, on the other hand, the want of sufficient clothing in cold nights, by suffering too great an abstraction of animal heat from the surface of the body (489, 491), impairs the soundness of sleep, and renders it much less refreshing and invigorating; and where the want is great and continued, the evil consequences are often very serious. Be it remembered, however, that all my remarks concerning beds, bed clothes, etc., are made with reference to man as a member of civic life, and as an inhabitant of a climate which renders the use of artificial means necessary for the proper regulation of the temperature of his body. For undoubtedly, if clothing were not necessary for the regulation of the temperature of his body, sleep would be more perfect and refreshing and invigorating without any, than with it (720).

1581. There is a kind of bed-clothing becoming very common in our country, which ought never to be used except from necessity, where other kinds cannot be had; I mean those articles made principally of cotton-batting or wadding, and called *comfortables*—a very great misnomer, for they are in reality very *uncomfortable* things. They have much the same effect on the body that feather beds do (1577), relaxing and debilitating the whole system. Indeed, people in delicate health can generally soon tell by their *feelings* when they are lying under one of these articles; for they render respiration less free, and cause a general sense of oppression and weariness, which often amounts to a painful sense of lassitude; and hence, as a general fact, sleep is less sound and refreshing, and more disurbed by unpleasant dreams, when this kind of clothing is used. Woollen blankets are incomparably better articles of clothing for beds than such *uncomfortable comfortables*; for while blankets are sufficiently non-conductors to retain the heat, they are not so utterly impervious to the air and to the exhalations of the body, yet, for reasons which I shall give when come to speak of bodily garments, it is better as a general rule that the woollen bed-clothing should not come in immediate contact with the skin. In cold weather, cotton sheets are probably the best that can be used, and in hot weather linen sheets are preferable.

1582. From what I have said (288, 289, 831 506, 1578) concerning the functions of the external skin, it must be evident that an impure atmosphere is continually formed around the surface of the body while we are in bed and enveloped in clothes, which completely prevent any thing like a current of air, or the atmospheric motion which, during the day, is consequently produced by our voluntary action and other causes. This impure atmosphere, as I have stated (1578), penetrates into the bed and into all the bed-clothes, and, as it were, completely saturates them. If we go from the fresh morning air into a sleeping-room at the moment when an individual is rising, we shall have a very strong olfactory preception of the impurities which issue from the bed; and if that bed be soon made without airing, and the room be not freely ventilated, the very walls of the room, as we have seen, will in a short time become strongly and deeply tainted with the offensive and unwholesome odor.

1583. When we rise in the morning, therefore, the bed should be thrown open, and, as soon as may be, the bed-clothes should all be taken off and thrown over clothes-horses or chairs, and the bed shaken up and the windows open, so that the whole may be thoroughly aired before the bed is made; and they who persist in using feather-beds, should very frequently lay them out in the open air and hot sun, that the impurities, which are constantly accumulating in them (1578) may be fully driven off; and it will be still better if, as often as once in four or five years, the feathers be subjected to the cleansing process of baking.

1584. On retiring to rest at night, every thing worn during the day should be taken off, and hung up on pegs, on clothes-horses, or on the backs of chairs or elsewhere, so that they can be well aired during the night, and give off the impurities they have received from our bodies in the day-time. *Not a single article of clothing worn by day* should be kept on during the night; but flannels, and all other under-clothes, should be taken off and hung up; and after the whole surface of the body has been briskly rubbed with the flesh brush, a course towel, or the hand, a loose flowing bed-garment should be put on, so that the body and limbs shall be entirely free from all ligatures and compressions, and there shall be nothing to preveut the most perfect freedom of respiration, circulation, and voluntary motion. This bed-garment may be made of cheap cotton, and therefore can be afforded by every one. When this garment is taken off in the morning, it should always be hung up where it can be well aired.

1585. Besides thus freely airing the bed-garment and bed-clothes every morning, they should be frequently changed and washed, that they may by all means be kept as clean and sweet as possible. The beadstead should also be kept perfectly clean in every part, and free from every impure thing, animate and inanimate. The floor of the bedroom should be washed frequently; and as often as twice in a year the walls should be whitewashed or cleansed with hot soap-suds. They who neglect these things cannot reasonably expect to enjoy the best of health, nor need they be surprised if they are occasionally visited with typhus and other fevers and complaints.

1586. It is exceedingly desirable that all bedrooms should be large, and so situated and constructed that they can be well ventilated, and

most especially the family room, or that in which the parents and small children sleep. Opposite opinions are entertained by different writers on hygiene, in regard to the propriety of sleeping with the bed room windows open. Some think it a salutary practice, and others think the contrary. One thing is certain, however: open chambers, where the house is merely clapboarded on the outside, and not ceiled nor plastered on the inside, are far more healthy bedrooms than those which are closely ceiled or plastered. Indeed it should always be understood and remembered, that both when we are sleeping and when awake, the pure air cannot have too free an access to our whole bodies, provided we are kept sufficiently warm, and are not exposed to too strong a current (1580). If bedroom windows are open during the night, therefore, a screen should always be placed before them so that the sleeper is never exposed to a current of air. Where the bedrooms of a house open into a common hall, it is perhaps better to open the windows of the hall and the bedroom door, than to open the windows of the sleeping-room. It is very desirable that there should be a fire-place in every sleeping-room for the purpose of ventilation, but not for fire, except in sickness; for it is exceedingly unfavorable to health to sleep in a room where a fire is kept during the day, unless it is well ventilated before we retire to rest, and during the night.

BEDS, ETC., OF CHILDREN AND AGED PEOPLE.

1587. It is of very great importance that all these circumstances should be strictly attended to in relaltion to the sleep of children and youth. They who desire to have the bodies of their children fully and vigorously developed, without distortion, without disproportion, without feebleness, in any part, must not suffer them to sleep on feather beds, nor in unclean bedding, nor in confined and ill-ventilated rooms. Let their beds be hard, and every thing about them clean and sweet. Feather pillows should also be avoided. Pillows made of moss or fine hay, or even straw, are incomparably better for children than feathers. Parents need not fear that such beds will feel hard to their children. When they become accustomed to them, they will never desire softer couches, and they will sleep upon them with most refreshing and invigorating soundness. But if their bodies are buried up in feathers every night, they will be enfeebled, their nervous excitability will be increased, they will be far more likely to take cold, they will be more predisposed to disease of the spine, rickets, etc.; their lungs, digestive organs, and in short their whole systems, will be debilitated and rendered more liable to become diseased. Too many children ought not to be put to sleep in the same bed nor in the same room, nor is it well to accustom children to sleep with old people. In strict physiological truth, it is decidedly best not only for children but for adults, for every body in civilized life, or where beds or bed-clothing are used, to sleep alone, or but one in a bed.

1588. Great care should be taken to keep the bedding and bedrooms of aged people as clean and sweet as possible. As the vital powers of their bodies suffer an abatement of energy, it is the more important that every thing unfriendly to life should be avoided, and that every circumstance in which they are placed should be salutary (1496),

It is desirable, therefore, that for these as well as all other classes of people, the bedrooms should be large and airy.

BATHING.

1589. When we consider that the whole external skin is in some measure a breathing organ (1578); that it is continually discharging impurities from the body (1582); that it is the medium through which a large portion of the effete or worn-out matter of the system passes off (506); and that in its anatomical structure and functional character it holds very near and powerful relations to the lungs, stomach, and other internal organs (287, 291, 330, 337), we must feel convinced of the great importance of preserving its healthy condition, and of securing the vigorous performance of its functions. In order to this, few things are more indispensable than cleanliness; and hence, bathing should never be neglected.

1590. In all civilized communities, every house should be constructed with conveniences for bathing, so that each member of the family can readily pass from the sleeping-room to the bath. Where this has been neglected, however, and such conveniences cannot readily be had, every one, even in the humblest condition of life, can easily make such arrangements as will enable him to bathe his whole body daily, with very little trouble and expense. A portable bath may be placed in every sleeping room; and if this cannot be afforded, an ordinary wash-stand and bowl, or even a pail of water, with a good sponge or coarse towel, will answer the purpose. If to these can be added a tub to stand in, surrounded by a screen made of cheap cotton cloth, nailed upon a frame like a clothes-horse, every thing necessary is supplied. Pure soft water, if it can be had, should always be used for bathing and cleansing the skin.

1591. On rising in the morning, the bed garment should be laid off, and water applied very freely to the face and neck; and if the hair is short, the whole head may be plunged into the water. A little mild soap may be used with advantage about the face and ears and neck, to make every part perfectly clean. When thoroughly washed, these parts should be wiped dry, with a towel which is sufficiently coarse to give action to the skin. This done, if the individual has a tub or something else to stand in which will hold water, let him take a tumbler or some other vessel, and pour water freely upon his shoulders with one hand, and with the other wash himself briskly in every part. This is an exceedingly great luxury where it can be enjoyed, in every season of the year. If, however, the individual has nothing to stand in which will keep the water from the floor or carpet, then let him take a good large sponge or coarse towel, and make it as wet as it can be without dripping, and beginning at the back of the neck, pass briskly over the whole surface of the body and limbs; and then dip it again into the water, and wring it as dry as possible, and rub the whole surface more freely and vigorously; and then immediately take a coarse dry towel, and in a brisk manner wipe every part perfectly dry. This operation should be followed in the same manner with a flesh-brush, as stiff as the skin can comfortably bear, applying it freely to the spine and limbs, and indeed every part. Where the brush cannot

be nad, use the coarse towel or the ha Ad alone. If from free perspiration or any other cause the skin is more than usually foul, a little mild soap should be applied with the sponge, to the whole surface.

1592. By such operations as these, the skin is cleansed and invigorated, and the whole system healthfully exercised. Those who are dyspeptic, and inclined to sluggishness and constipation of the bowels, should take this opportunity to exercise the abdomen (175) with the hands or handle of the flesh-brush, placing it against the lower part of the abdomen, and passing it quickly up to the stomach, and repeating the motion many times in rapid succession. Where circumstances admit, this is also an excellent opportunity for a free exercise of all the limbs and muscles, by leaping, swinging the arms, and throwing the body into various attitudes.

1593. They who have never practised this mode of bathing can have no just notion of the comfort which it affords. When, from almost any cause, one rises from his bed in the morning, languid and dull, and perhaps with a heavy feeling of the head and foul taste of the mouth, such a bath followed by the exercise I have named, refreshes him astonishingly, and makes him feel like a new man. Indeed, any one who has been long accustomed to this kind of bathing, would hardly be willing to dispense with it for a single morning, even to save his breakfast. It may with perfect comfort and safety be continued through the whole year. Even on the coldest mornings of winter it is exceedingly refreshing and grateful. After this ablution is performed, and the body is partially clothed, a tooth brush should be freely applied to the teeth with a little clean water, taking care to pass the brush over all the teeth, both on the inner and outer side of them, so that the teeth, gums, and mouth, may be well cleansed. It would be well to repeat this operation after every meal.

1594. Besides the sponge bathing, there are various other modes of bathing or ablution which may be very advantageously used under proper circumstances. The cold shower bath is exceedingly invigorating to every one who is able to bear it, and is greatly beneficial to most dyspeptics and others who are labouriug under chronic debility not connected with organic disease. Those who are much debilitated from excesses in sensuality are generally very much benefitted by this bath. There is perhaps no better time for the shower bath than immediately after rising in the morning; and in some cases it is highly useful to repeat this bath as a remedial means just before going to bed at night.

1595. The tepid bath, varying from eighty to ninety-five degrees, Fah., according to the age, vigor, etc., of those who use it, may, under proper regulations, be employed with great advantage by all classes of people. The robust and active, when fatigued and exhausted with the toils of the day, will find the tepid bath exceedingly refreshing. The feeble and infirm and those who are laboring under chronic diseases, such as pulmonary consumption, etc., are also much refreshed and benefitted by the proper use of the tepid bath, and the frequent use of it by aged people is highly salutary. The diseased, the feeble, and the old, will probably find the best time for taking the tepid bath to be about eleven o'clock in the forenoon. But at whatever time any bath is taken by any person, it ought always to be remembered that no one should bathe soon after eating; three hours at least should elapse after

a hearty meal, before a bath is taken, when it will be found most invigorating.

1596. The vapor bath, as a remedial means, when properly employed is highly grateful and salutary. The medicated vapor baths, as managed by Mr. Whitlaw and his followers, often proves exceedingly beneficial to those who are laboring under certain chronic diseases, and it is rarely injurious to any. I am inclined to think that sufficient attention has not been given to this means of cure, by physicians in general. By these remarks, however, I intend to give no countenance to the indiscriminate steaming which has become so extensive an instrument of presumptuous and impudent quackery at the present day.

1597. Swimming, if well-timed and properly regulated, as an agreeable and healthy mode of bathing combined with exercise, for the young and vigorous. But boys who are allowed to indulge in this kind of bathing at pleasure, and especially boys of the city, are exceedingly apt to go into the water too frequently, and to remain in quite too long, and thereby very much impair their health, and often bring on violent disease, which soon terminates in death. As a general rule, those who cannot swim ought not to remain in the cold bath over five minutes, and those who do swim should not exceed thirty-minutes. After, taking any kind of bath, exercise which promotes respiration and circulation and general determination to the surface, is very beneficial.

1598. Much care should be given to the cleanliness of young children. Their bodies should be regularly washed all over every day, with soft water and a very little good castile soap; and the skin should be wiped perfectly dry, and then exercised a little, either with the hand alone, or a piece of soft flannel. The tepid bath is of great service to children when labouring under diarrhœa, dysentery, and many other complaints. But the bath should never be administered when their stomachs are full, or soon after eating. Not only children, but persons at every period of life, may be astonishingly benefited by the proper use of the tepid sponge bath, in certain stages of fever, when the pulse is full and quick, the tongue dry, the thirst great, and the skin hot, without a sense of chilliness. I have seen effects almost miraculous produced by sponging the body in such conditions, with tepid water containing a little soap or pearlash; but much knowledge and sound judgement are necessary to govern such operations with safety, as an indiscriminate bathing in any mode may do great mischief.

1599. In the use of the cold bath in any manner, if the individual, after rubbing himself off briskly and clothing himself, finds that he is disagreeably chilly, unless he is concious of having been in the water too long, he should avoid that kind of bathing, and perhaps confine himself to the tepid bath two or three times a week, or to the sponge bath, if he finds it pleasant and refreshing to him.

1600. In concluding my remarks on bathing, I must repeat it is exceedingly desirable to have every dwelling house furnished with a good bathing room and apparatus; and the expence of these things bears no proportion to the health and comfort they afford, and the money which they save in a family in the course of a few years. It is wonderful that mankind at the present day, claiming as they do to be so much more enlightened in science and useful knowledge than the ancients, should yet be so far behind them in matters of this kind In the

Mosaic dispensation, the most rigorous regard was paid to bathing, and cleanliness in every thing. One of the highest luxuries of ancient Rome was bathing. The Mahomedans, the Hindoos, and many other portions of the human family, perform their daily ablutions, as a religious duty. Yet the most intelligent portions of Christendom neglect it.

1601. Shaving of the beard is one of the evils which civic life has subjected man to; and we have now become so accustomed to it, that we regard the wearing of a long beard as a very strong evidence of a man's insanity, or at least of very great eccentricity. And yet, if a new edition of the Bible were to come out with elegant engravings, representing the patriarchs and prophets and our Saviour and the Evangelists without a beard, we should all be much shocked at the seeming sacrilege. Every intelligent mind that reflects on the subject must soon be convinced, that the true and full dignity of the male form in the human species requires the presence of the full-grown beard, and no physiologist can doubt that the habitual shaving of the beard serves in some measure to diminish the physiological powers of man, and to abbreviate the period of his existence. Yet since custom compels us either to shave or to suffer banishment from society, it is desirable to know how we can do the former with the most comfort. I have tried every expedient, and have learned both from science and experience that they who would shave with the greatest comfort should always use cold soft water in making their lather. If the beard is hard and the skin tender, lather it well, and then wash off the soap in cold water, and then lather the beard thoroughly again, and shave with a sharp razor; and when this is done, let cold water be applied freely to the face and neck, and then let the parts be wiped dry. The use of hot water in making a lather, and of cologne or any other heating wash after shaving, always serves to debilitate the skin and make it very tender, and to cause the face to bleed and smart during and after the operation. If any one will follow my advice six months, he will never return to the use of hot water in making his lather, nor to the use of cologne or spirits as a wash after shaving. If, however, any one finds it necessary to use hard water, it may be heated to make the lather, which should be suffered to become cool before it is applied to the face. Dipping the razor in hot water certainly makes it cut better.

1602. What I have said of the beard is unquestionably true of the hair of the head. The angel who announced the birth of Sampson, declared that he should be a Nazarite from his birth; and consequently that neither his beard nor his hair should ever be cut. Whether the sudden loss of Sampson's wonderful strength on the cutting of his hair was designed to teach mankind the natural relation between the hair and the strength—or, in other words, to teach us that the cutting of the hair serves to diminish the powers of the body and abridge the period of life—I will not presume to say; but certain it is, that such is in some measure the effect. This effect, however, is probably small, both in regard to the hair and the beard, when compared with most others concerned in debilitating the human body and shortening the life of man; and there can be no question but that many of the artificial modes in which females dress their hair are far more injurious than the frequent cutting of it. Various causes operate in civic life to destroy the hair, but probably the most numerous and efficient of them operate through the stomach (421). When by any means, howeve

the hair is diseased and baldness is threatened, the only remedy in nature is to pay strict attention to the diet and general regimen; cut the hair often and very short, and wash the head frequently all over in cold water, using occasionally a little mild soap, and follow the bathing with the brisk application of a good clean stiff hair-brush. If this course honestly pursued for several months, does not restore the hair to vigorous health, nothing will. No dependence can be placed on the specifics that are advertised for improving the hair, and many of them do mischief. All kinds of oil and perfumery for the hair should be avoided. The natural oil secreted by the appropriate vessels of the skin (333) is all the hair requires, and the application of any other oil to it always serves to suppress the natural secretion, and to leave the hair drier in the end. They who would improve the hair or any other part of their system, must pursue such a course as will improve the general health of the body, and make no other local applications than are consistent with the vital economy of the part and the general physiological interests of the system (423).

AIR.

1603. We have seen (463, *et seq.*) that in the function of respiration or breathing, a vital process is continually going on, by which a portion of the air received into the lungs is digested and incoporated with the blood, not as oxygen, but as a vitally assimilated principle of the living blood (472), and that by this function of the lungs the grand process of digestion is completed (459), and the arterial fluid is fitted for all the purposes of the system in the great function of nutrition (474, 475). We have seen also (721, *et seq.*) that pure air is composed of twenty parts of oxygen and eight parts of azote, by volume or measure, and that the lungs, as living organs, are constitutionally adapted to air consisting of precisely these proportions; and consequently every deviation from this point towards an excess either of azote or oxygen, is injurious to the lungs and to the physiological interests of the body. Hence it is of the utmost importance that the lungs should be constantly supplied with pure air, not only for the preservation of their own health, but for the preservation of the integrity of their function, the health of their blood, and the general welfare of the system. But we have seen (720) that the whole external skin performs a function which in many respects closely resembles that of the lungs, and that it not only appears to consume a portion of the oxygen of the air but also like the lungs is continually eliminating the excreted impurities of the blood (506), among which the chemist detects a considerable quantity of carbonic acid gas (143), which, when received into the lungs without a mixture of atmospheric air, is almost instantly destructive to life, causing an immediate suspension of all the powers of animal life; and if relief is not promptly afforded, organic life is very soon destroyed (469). Carbonic acid gas is formed in considerable quantities by decaying vegetable matter. Living vegetables also give it off during the night but consume it during the day. Much the greatest source of it, however, is animal respiration and perspiration. Hence, crowded assemblies in churches, theatres, hospitals, prisons, etc., rapidly consume the oxygen of the air, and produce carbonic acid

gas; and consequently, if such places are not well ventilated, the air will soon become impure, causing difficulty of breathing, vertigo or dizziness of the head, nausea, faintness, trembling, relaxation of the voluntary muscles, slow and feeble pulse, spasms, asphyxia, and death. In this manner the lives of many have been destroyed; but a vastly greater number has been cut off by plagues, and putrid and typhus and other fevers, brought on or excessively aggravated by impure air. And it is principally owing to the effect which a dense population has on the atmosphere, and to the want of proper ventilation, that cities are less healthy than the country.

1604. We see, therefore, that it is of very great importance that our habitations should be so situated and so constructed as to admit of perfect ventilation in every part, and that our bed-rooms in particular should be large and airy (1586), and that too many persons should not sleep in the same room (1587). We perceive also that it is of great importance that every person should have frequent and free access to the pure open air (1603), and it is equally important that at such times every one should be capable of drinking in the sweet breath of heaven without the least restraint; of inflating the lungs fully and deeply, and freely expanding the chest without any artificial restriction whatever.

1605. The effect of such a respiration of pure air is truly wonderful. When the careful mother has been shut up in her nursery or confined to her house for a number of days in succession, diligently attending to maternal duties or domestic concerns, till she begins to feel a nervous oppression and a dull headache coming upon her, if she breaks away from her confinement, and walks or rides in the pure open air, even for a few minutes, she feels a new life and a new spirit entering into her blood, and diffusing itself throughout her whole system; her languor and depression and headache are dispelled, her eye becomes bright and sparkling, her countenance animated, her form more erect and stately, and her step more elastic and graceful; and she returns to her domestic empire and household duties almost a new creature, and seems to carry with her into that empire and through all those duties a new and salubrious atmosphere; and if she is a nursing mother, her babe will be almost equally benefitted by the consequent improvement of its natural food. Nor are such advantages confined to the mother. Every female and every studious and sedentary person, and every invalid that is able to move or to be moved in the open air, should endeavour to be abroad in it as frequently as propriety and duty will admit.

1606. The air bath, as Dr. Franklin calls it, is exceedingly salutary to every one in health, and to almost every invalid. If the whole skin may be considered a breathing organ (1589), then should it not only be kept clean, but for its own health and vigor, and the health and vigor of the whole system, it should be permitted to receive the full and free embraces of the pure air at least twice in the twenty-four hours. Every morning and evening the whole body should be exposed freely to the air, and the skin exercised with the flesh-brush, a coarse towel, or with the hand (1584, 1591); and five or ten minutes spent in such exposure and exercise in the morning will prove very salutary to every one who is not too far gone in disease to bear it. Let it always be remembered that man was made for the open air; it is his natural

dwelling place, and the habit of cooping up in ceiled houses is always in some measure detrimental to the physiological interests of the human constitution.

1607. If there be one class of human beings to whom pure air is more essential than any other, it is young children; they soon droop and become puny and diseased if they are confined to impure air; and on the other hand, few things serve so much to impart health and vigor to sickly and puny children as free access to the pure open air of heaven. Nurseries ought therefore to be thoroughly ventilated every day, and kept perfectly sweet and clean, and the air of them should not be consumed by too many lungs; and infants should be carried abroad as early and as freely as prudence will allow. And when children become old enough to run alone, they should be daily taken into the open air when the weather is pleasant.

1608. Aged people also require great purity of air; and strict attention should be paid to the thorough ventilation of their rooms; and so long as they are able to walk or ride abroad, they should, when the weather is not too inclement, daily visit the open air; and when they can no longer do this, their habitations should be the more frequently ventilated.

1609. In regard to the benefit to be derived from a change of climate, there is probably much popular error of opinion. Invalids, trusting too exclusively to the salubriousness of the country or sea air, or of a mild climate, wholly or mostly neglect to attend to their diet and regimen in general, and consequently a large portion of those who travel in pursuit of health, either die abroad, or return home little or no better than they went; whereas, if they would avail themselves of the advantages of a correct regimen throughout, as well as of pure air and a mild climate, they would far more generally recover health. As a general rule, therefore, the air and climate of any portion of the United States, under a strictly correct general regimen, are much better for invalids of every description, than any other climate in the world with an entire disregard to regimen.

CLOTHING.

1610. Concerning clothing I deem it necessary to say but little, and that little for the most part in general terms. It is entirely certain that no kind of clothing is strictly natural to man; or, in other words, if man, inhabited that climate to which his constitution is most perfectly adapted (1239), his body would be more symmetrically and completely developed, and more elastic, agile, and vigorous, and more perfectly and uniformly healthy,—his life would be longer, his intellectual faculties would be more active and powerful, his moral character would be more pure and virtuous,*—in short, all the physiological and psychological properties, powers, and interests of the human constitu-

* 'The Zulus,' says the Rev. Mr. Grout (1168), 'depend on the products of the soil for subsistence, and go entirely naked. Licentiousness is wholly unknown among them. I have been among them for three years, seen them on all occasions, have many a time seen hundreds of males and females huddled together in perfect nakedness but never once saw the least manifestation of licentious feeling, and they are as remarkable for their intellectual activity and aptitude as for their chastity.'

tion would be better sustained, as a permanent fact, from generation to generation, by entire nudity, than by the use of any kind of clothing. Strictly speaking, therefore, all clothing is, in itself considered, in some measure an evil. In passing into climates much colder than that to which he is constitutionally adapted, however, man finds it necessary to employ clothing to a greater or less extent, for the purpose of preserving the proper temperature of his body (129). In such a situation, therefore, clothing becomes *a necessary evil;* and in so far as man suffers less from the injurious effects of clothing in such a situation than he would from cold without it, it is a comparative good; that is, it prevents a greater evil than it causes. Nevertheless, as it cannot serve to adapt man so perfectly to such a situation as to make it equally conducive to the highest well-being of the human constitution with his natural climate without clothing (1240), it remains true as a general proposition, that clothing is in some measure detrimental to the physiological interests of the human body.

1611. But I hope I shall not be misunderstood in this reasoning. My object is not to advocate bodily nudity in society; though I cannot doubt that morality would be greatly improved by it, in the course of two or three generations, if in all other respects mankind conformed to the true laws of their nature; but my sole object is so to explain the laws of constitution and relation established in the nature of man as will enable him to regulate those artificial habits and customs which society makes necessary, in such a manner as that they shall be in the least possible degree injurious.

1612. If man were always to go entirely naked, the external skin, the anatomical structure and functional character and relations of which we have fully contemplated (1577, 1582), would be preserved in a more healthy and vigorous state, and perform its functions more perfectly, and thereby the whole human system in all its properties, powers, and interests, would be benefitted; the circulation, and particularly the venous circulation which is near the surface (475), would be more free and unobstructed; respiration or breathing (463, *et seq.*) would also be more free, full and perfect; voluntary action would be more unrestrained and easy; the bones would be less liable to disease and distortion; all the muscles of voluntary motion (194) would be better developed and more powerful; in short, the anatomical developed and symmetrical proportion, and the physiological power, and functions of every part in the whole system, would be more perfect; and, as a natural consequence the sensual appetites would be more purely instinctive, and exert a less energetic and despotic influence on the mental and moral faculties (598), and the imagination would be deprived of its greatest power to do evil.

1613. Clothing, then, is an evil so far as it prevents a free circulation of pure air over the whole surface of the body, or in any manner relaxes and debilitates the skin, and increases its susceptibility to be unhealthily affected by changes of weather and by the action of morbific agents (1577); it is an evil so far as, by compression or otherwise, it prevent a free and equal circulation and return of the blood; it is an evil so far as it prevents the free action of the chest and lungs, or in any manner or measure restricts respiration; it is an evil so far as it interferes in any degree with the digestive organs; it is an evil so far as

t prevents the most perfect freedom of voluntary action, and ease and grace of motion and attitude, or prevents the full development of any part of the system, or serves, by the substitution of artificial means for natural powers (1307), to relax and to debilitate the muscles, or render the tendons, ligaments, cartilages, and boxes, less healthy and powerful or in any measure to abridge the control of the WILL over any organ of voluntary motion; it is an evil so far as it serves to increase the peculiar sensibility of any organ of animal instinct, and to augment the power of that instinct on the intellectual and moral faculties; it is an evil so far as it serves to enfeeble the intellectual faculties, and render the mind sluggish and sensual; and it is an evil so far as it serves to excite an unchaste imagination, and cause the sexes to act towards each other more from the impulse of animal feeling than from the dictate of sound reason.

1614. The application of these general principles to the regulation of clothing is perfectly easy, and cannot lead any intelligent mind into error. It requires—1st, that whatever climate man may inhabit, he should endeavor to preserve that state of general health and vigor of body which will render the least quantity of clothing necessary for the preservation of a healthy temperature; 2nd, that the materials used for clothing should, as far as consistent with the proper temperature of the body, be such as serve in the least degree to relax and debilitate the skin, and through it the whole system; 3d, that the clothing should be so adjusted as in the greatest possible measure consistent with the proper temperature of the body, to admit of a free access of air to the whole surface, and of the most perfect freedom of circulation, respiration, and voluntary action, and attitude; and 4th, that the fashion of the clothing should be such as in the least possible degree to excite an impure imagination.

1615. After having so fully laid down the general principles in regard to clothing, it is hardly necessary that I should say that corsets, stays, garters, and every kind of ligature or compression, and all kinds of tight dresses, should be avoided, and especially by the young and growing, whose bodies are very easily and almost inevitably diseased, deformed, and distorted, to a greater or less extent, by such unnatural means. The growing body should be as free as the air. The flowing robes of the ancients were incomparably more favorable to health and more graceful than modern dresses.

1616. Much has been said by certain writers on hygiene, in favor of wearing flannels next to the skin; and undoubtedly there are particular cases in which the habit being formed, had better be continued, than too suddenly abandoned. Yet it is certain that woollen serves to excite, relax, and debilitate the skin, and through it the whole system, and thereby to increase the very evils which it is worn to prevent, more than cotton, linen, and silk (1581). While, therefore, I leave invalids and other individuals to govern themselves on this point according to their particular circumstances and state of health, I lay it down as a general rule, with reference to the permanent interests of the human constitution, that it is better not to wear woollen next to the skin, when cotton, linen, or silk under garments can be had.

1617. What I have said concerning the regulation of the temperature of the body by means of clothing, is true in regard to the use of fire

(1307). In all cases it relaxes and debilitates the system, and diminishes the power of the body to regulate its own temperature (130, 490), and, therefore, the physiological interests of our bodies require that we should, as far as possible, keep them warm by their own healthy and vigorous calorific function (489), and only use fire as a necessary evil, and under such regulations as will not expose us to greatly unequal temperatures at the same time, or to powerful heat on one side and severe cold on the other. Our rooms should be so warmed as to be of mild and equal temperature in every part.

EXERCISES.

1618. We have seen (308—511) that the human body consist mainly of an assemblage of tubes formed into a system of organs, and for the most part filled with fluids of different qualities. The arteries, veins, and capillary vessels, including the lympatics (367—390) compose a very large proportion of the whole bulk of the solids of the body; and all these, even the most minute, are ducts for some kind of fluid; so that the fluids of the body form by far the greatest part of its weight; probably not varying much from nine-tenths in a healthy adult body of middle age. These fluids are, or should be, continually in motion, and, as well as the solids, constantly undergoing changes in their constituent particles (314). The food received into the stomach is digested into chyme (129, *et seq.*); from this is elaborated (463, *et seq.*); and from the blood all the solids of the body are formed (493, *et seq.*), and the salivary and gastric and pancreatic and all other fluids employed in the operations of the vital economy are secreted (497), and all those fluids and substances are excreted which are eliminated from the body in its depurating or cleansing functions (506).

1619. To keep up this grand vital circulation, and to give to all the vital functions and perfectness to all the vital changes, and to secure a proper supply of blood to every part, and maintain the general health and energy of the system, EXERCISE or voluntary action is of the utmost importance. It greatly promotes circulation (475), and particularly in the capillary system, or the myriads of minute vessels which are so numerously distributed to every part of the body (375); it equally promotes respiration, causing full and deep inspirations of air, and a vigorous action of the lungs (463, *et seq.*); and serves to impart vigor and activity to all the organs, and to secure the healthful integrity and energy of all the functions, and the symmetrical development and constitutional power of the whole system; and gives strength and agility and elasticity and grace to the body, and energy and activity to the intellectual and moral faculties. Indeed, exercise may truly be considered the most important natural *tonic* of the body. If it is wholly neglected, the body will become feeble, and all its physiological powers will be diminished; but if it is regularly and properly attended to, the whole system will be invigorated, and fitted for usefulness and enjoyment,

1620. We have seen (192, 376) that every contraction of the muscles serves to exhaust their vital properties; and to replenish their exhaustion, a constant supply of fresh arterial blood is diffused throughout the muscular tissue in great abundance (393); and the more vigorously

any part is exercised, the more rapidly and abundantly that part is supplied with arterial blood; and hence, the habitual, healthy, and vigorous exercise of any part, always serves to produce and maintain a full development of that part, and to give it greater power (1009). Thus, if one arm is constantly and vigorously exercised, and the other remains wholly unemployed, the muscles of the former will soon be much more largely developed and far more powerful than those of the latter. Hence, the welfare of the whole system requires that each part should be duly exercised, and most especially in young and growing bodies, which are easily deformed and even dreadfully distorted by a neglect of voluntary action.

1621. We see, then, that as exercise promotes and invigorates all the vital functions of the body, and considerably increases the insensible evacuations, it is important that a certain relation should always be observed between the quantity of food received and the amount of exercise taken (1439). They who are employed in active labor in the open air, require more food than persons of sedentary and inactive habits; though, as I have stated (1485), the most active and robust laborer should never take more food than is really needed by the vital economy of his body; and they who neglect exercise, and 'feed themselves without fear,' will certainly cause either a reaction, upon the digestive organs, inducing dyspepsy and perhaps organic disease in the stomach or intestinal tube, or general or local congestion resulting in fever, or local disease of some kind or other (1476). Moreover, such people will inevitably impair their intellectual and moral powers, causing mental dullness and stupidity, and blunting the moral sensibilities and increasing the relative influence of the more exclusively selfish propensities and passions (1242). We see also that exercise, in order to be the most salutary, should be as much as possible in the pure open air (1605), and the body and limbs should be perfectly free and unrestrained by any thing that is calculated to prevent the full expansion of the chest, the deep inspiration of air, the free circulation of the blood, the vigorous functions of the skin, and the easy and natural motion of every part (1614).

1622. A certain amount of exercise or labor is therefore as essential to the highest welfare of man, as food or air. By a rigidly abstemious diet he may live on, with an exemption from actual disease, and perhaps attain to what we call old age, with very little active exercise. But in such a life he can never know that vigor of body and mind, that perfectness of health, that vivacity and buoyancy of spirit, that habitual serenity and cheerfulness and high enjoyment, of which his nature is capable. But we have seen (376) that every vital action is attended with an expenditure of vital power and waste of organized substance, and (376) that every vital function necessarily draws something from the ultimate and unreplenishable fund of life. Hence, so far as voluntary exercise or labor is necessary to the most healthy condition and perfect functions of the human system, it is a blessing; and beyond that, it is in some measure an evil; for in proportion to the excess, life is always shortened, and the body predisposed to disease (1473).

1623. From constitutional necessity, therefore, if man takes too little voluntary exercise, he suffers; and if his voluntary exercise is exces-

sive, he suffers. But happily for the race, the sufferings from excessive labor bear no proportion to those which result from inactivity. A man may greatly abbreviate his life by over toiling, and yet through the whole of his earthly existence enjoy comparatively good health, sweet sleep and a cheerful mind; but he who suffers from want of exercise —and especially if with that is connected excessive alimentation and other dietetic errors—experience the bitterest and most intolerable of human misery.

1624. Beyond all question, the natural employment of man, so far as labor is considered, is the cultivation of the soil; and it is equally certain that if all the circumstances and habits of man were in accordance with the laws of his nature, four hours a day of productive labor would amply sustain the human family; and this is just about the amount of labor which the highest good of every one requires. But if some fall greatly short of this amount of productive labor, others proportionably exceed it; and thus both classes become sufferers. This is the present state of things in the human world. Multitudes are living without productive labour, and great multitudes are consequently compelled to labour to excess. But let not the laborer envy the drone; for toil and poverty with health and cheerfulness are rich blessings when compared with the miseries which are endured by nearly all who live without active labor.

1625. In the present state of things, however, the structure of society in civil life requires that many should be devoted to persuits which are less favorable to health than the calling of the husbandman; and a large majority of these pursuits are of a nature which does not admit of sufficient active bodily exercise for health and comfort. To all such, therefore, exercise becomes a necessary part of regimen, and must be regularly attended to, or they must suffer. And yet, where it is mere matter of regimen, attended to because it cannot be neglected without suffering, it loses more than half its virtue. Exercise, in order to be most beneficial, must be enjoyed. The mind must enter into it with interest, and if possible with delight, losing the idea of labor in that of pleasure; and hence, exercise connected with social amusements which are favorable to health and strictly compatible with sound morality is peculiarly beneficial. Walking, which is one of the most natural and healthful modes of exercise, is doubly salutary when it can be connected with social enjoyment and hearty cheerfulness, and varied with occasional running, leaping etc., according to the strength and agility of the individual. Riding on horseback, which in the present artificial state of things is the most salutary and efficient kind of exercise known in civic life for those invalids who are unable to take a more active kind, though always beneficial, is more than doubly so when the idea of riding for health is wholly lost in the pleasure of the ride, or engrossed in some pleasing interest of the occasion. And so of all kinds of salutary and well-regulated exercise, the more completely all considerations of health-seeking are lost in the enjoyment and pleasure of the occasion, the more healthful will be the effect. Even the varied exercises of the gymnasium, which are admirably adapted to develop and invigorate every part of the body, are rendered far more beneficial by being performed with spirit and ambition and vivacity and cheerfulness.

1626. The salutary influence of animating music, connected with exercise, is very great; in fact, it may almost be said to be medicinal, for it actually has the most healthful effect on all the vital functions of the body; and hence, dancing, when properly regulated, is one of the most salutary kinds of social enjoyment ever practised in civic life, and every enlightened philanthropist must regret to see it give place to any other kind of amusement. The religious prejudice against dancing is altogether ill founded; for it is entirely certain that this kind of social enjoyment, when properly regulated, is more favorable to good health, sound morality, and true religion, than perhaps any other known in society. It is infinitely better that people should come together to sing and dance, in the healthful exhilaration of their spirits, than that they should come together to eat and drink, or to seek enjoyment in almost any of the modes of social entertainments in civic life, or that they should endure a miserable existence in moping melancholy, for want of proper exercise and relaxation.

1627. Let me not be misunderstood, however; I do not intend to encourage the assembling of young people together at public taverns and hotels, and spending the night in dancing, eating, drinking, and other improprieties (682); but I would have this kind of exercise mostly confined to the domestic and social circles. Vocal music ought to be as universal a branch of education as reading and writing, and instrumental music should be almost as extensively cultivated. If I could have my wish, the Violin—the best musical instrument ever invented—should be played in every family in the civilized world; and every evening, when the duties and the cares of the day were completed, the whole domestic circle,—parents and grand-parents, children and grand-children, all that could move with comfort,—should have an opportunity to join in the dance. Even those who had been engaged in active labor through the day, would be refreshed by it; and those who had been confined by sedentary employment would be exceedingly benefited: the old would be made younger, and the young would be invigorated; the social feelings would be improved; sleep would be more sound and refreshing; and all would be made more healthy, more happy, and more virtuous. For true health and true virtue are more nearly allied than is generally supposed. 'How can they addict themselves to the practice of virtue and to the service of God,' says Plato, 'who are ever caring for their own miserable bodies?'

1628. If music, marching, and dancing constituted a part of the regular exercise of all our colleges, theological seminaries, and other literary and scientific institutions, immense benefits would result, not only to those institutions, but to society at large. Thousands who now pass from the place of learning to years of misery, and an untimely grave, would be preserved in health, and live to be blessed and to bless mankind by their usefulness.

1269. It is hardly necessary to say that children and youths of both sexes requires much exercise in the open air, for the healthful and symmetrical development of their bodies, and for the establishment of a vigorous constitution (1255, 1494, 1587, 1607, 1620). Children, as we have seen (671, 677), are instinctively inclined to action; even before they can stand or sit alone they love to keep their little limbs

almost continually in motion while they are awake; and as soon as they are able to run alone, they delight to be constantly in action; and when they are old enough to be abroad in the open air, they find their greatest enjoyment in those amusements and sports which are of the most active kind. Action is therefore as instinctively natural to children as breathing, and it is unnatural and improper to restrain them from it, and to keep them in a state of confinement or inaction for any considerable time. Their little bodies become painfully weary if they are compelled to remain in one position for half-an-hour at a time, and it is cruel to repress their instinctive desire for action, beyond what is necessary for their proper discipline. Girls should be allowed as much freedom of action in childhood as boys, and they should be encouraged to exercise freely in the open air while their bodies are growing. Not only their own individual welfare requires this, but the good of the race demands it.

1630. Aged people, after they have retired from the active employments of life, must keep up their regular exercise, or they will soon become feeble and infirm. It is impossible for the vigor and activity of the body to be long preserved without exercise. Walking and horseback-riding are among the best modes of exercise for the aged. Riding in easy carriages will do for very feeble persons who are able to take an airing, but it affords little exercise to the body; plain waggons without springs are far more beneficial as means of exercise to those who cannot bear them. With the aged, as with all others, exercise is most salutary when accompanied with cheerfulness. Occasional hilarity and a hearty laugh healthfully exhilarate and exercise the whole system. It should also be remembered by the aged, as a most important truth, that the regular exercise of the mind is not only the necessary means of preventing the rapid decline of the intellectual powers in advanced years, but that it also serves in no small measure to prolong life and enjoyment.

1631. The importance of exercise as the *natural tonic* of the body is greatly overlooked and exceedingly neglected in the treatment of chronic diseases of every kind (1619); and irritating and deleterious stimulants (1529, *et seq.*) are employed to produce those effects in the system which can healthfully result only from proper exercise and pure air. Dyspeptic and other chronic invalids ought never to hope for health by any means without exercise. The beneficial effects of horseback-riding, to those who are laboring under pulmonary consumption, are often truly astonishing. I have known invalids afflicted with this dreadful disease, when they were too feeble to mount the horse without help, by riding a short distance the first time, and gradually increasing the length of the ride daily, become able, in the course of two weeks, to ride twenty miles without stopping by the way, and feel more vigorous at the end of the journey than at the beginning; and I have known instances in which such individuals have made journeys on horseback of several hundred miles, and returned to their homes and friends almost perfectly restored to health. Indeed I am entirely confident that if strict simplicity and propriety of diet, and riding on horseback to the full extent of the patient's ability, will not cure pulmonary consumption, no earthly means can cure it; and I am very certain that most other means employed in modern times, while they may perhaps seem

to alleviate the symptons, really aggravate the disease, and hasten the patient to the grave.

VOLUNTARY EVACUATIONS.

1632. The regular action of the bowels is of the utmost importance to health. The evils, both bodily and mental, resulting from habitual costiveness, are incalculable; and yet there is reason to believe that this habit of body is exceedingly common in civic life (1345), and particularly with young females. Mothers, and all who have the care of children and youths of both sexes, ought to pay great attention to this matter; for they may be assured that it cannot be neglected without much hazard to the health and life of the young. Habitual costiveness predisposes to dyspepsy, pulmonary consumption, nervous disorders, headache, insanity, and indeed almost every distressing form of disease that flesh is heir to; and when it does not actually develop disease in youth, it lays a deep and immoveable foundation for it in after life. Everybody should have a regular and free action of the bowels once in twenty-four hours; and the dietetic and other habits should be so regulated as to secure this.

APPENDIX.

NOTE A.

The mucous coat of the alimentary canal, in a healthy state, and successfully injected, appears to consist almost entirely of a cribiform texture of veins; these veins being commonly empty at death, present themselves as a soft spongy structure, which gives rise to the ordinary description of its sensible condition as a velvety layer. The most minute injection of the arteries scarcely makes itself visible among these veins when they are properly injected, a straggling branch only here and there exhibiting itself. The aborescence of the arteries is confined to the level beneath the venous intexture, and is there developed to an extreme degree of minuteness, being intermixed with corresponding venous ramuscles, generally larger and more numerous than the arteries themselves. The fine venous trunks of these deeper layers have their originating extremities bent vertically towards the cavity of the gut, and by that means receive the blood of the first venous intertexture or layer. The meshes of the first venous intertexture are exceedingly minute, and vary in a characteristic manner in the stomach, small intestines, and colon. This intertexture is very different in its looks from a common vascular anastomosis, and produces in the colon an appearance resembling a plate of metal pierced with round holes closely bordering upon each other: these holes constitute in fact follicles or gaping orifices, the edges of which are rounded off, and their depth is that of the thickness of the venous anastomosis, being bounded below by the arterial venous layer, and by the cellular coat of the part.

Ordinary modes of examing give no evidence of the existence, in the alimentary canal, from the cardiac orifice of the stomach to near the anus, of an epidermis; on the contrary, they rather lead to a belief of its being absent, in consequence of the softness, tenuity, and transparency of the mucous membrane; but that it is really present may be proved by the following process. Tear off the peritoneal coat, invert the part, and inflate it to an emphysematous condition; the epidermus will then be raised as a very thin pellicle, and may be dried in that state; but as this pellicle retains the air, we hence infer that it lines the follicles, and is uninterrupted by any perforations. This epidermis, if the part be previously injected perfectly, shows dots of injecting matter, but no aborescence if it be inflated up from the veins. In so doing the villi disappear are in fact unfolded.

The villi cannot be seen to any advantage except they be erected by an injunction, in which case, those of the upper part of the small intestines are found to run into each other very much like the convolutions of the cerebrum, and to press upon each other's sides in the same way. Some of them, however, are merely semi-oval plates, the transverse diameter of which exceeds the length. At the lower end of the small intestines they become simply conical projections, somewhat curved, with the edges bent in, and they retain this mechanism until they entirely disappear near the ileo-cœcal valve. In the whole length

of intestine there is, however, every variety of shape, from oblong curved and serpentine ridges, to the flattened cone standing on its base; the first condition changing gradually to the last in the descent of the bowels.

Conformably to this definition of villi, none exist either in the stomach or colon, for there we have only the venous meshes. The villi of the jejunum are about the thirtieth of an inch high, and those of the ileum about one sixtieth.

The superficial venous layer has great regularity in the ileum, and the conical villi stand out beautifully from its partitions, or, in equivalent language, from the divisions of the follicles. In the upper part of the small intestine the follicles are in equal number to what they are in the ileum; the regularity of their arrangement being interrupted by the long serpentine and oval villi; but invariably the same venous intertexture exists, and forms in both the chief bulk of the villi by passing into them.

In the stomach the *follicles* vary much in size, and there is an arrangement whereby many of the smaller ones are seen to open into the larger. On an average about 225 are found upon every eighth of an inch square, which would give, of course, to an inch square, sixty-four times that amount, or 14,400 follicles; and conceding the whole stomach to present an area of 90 inches, which is probably below the mark when this organ is moderately distended, as exhibited in the preparation upon which this calculation is founded, the entire number of follicles is *one million two hundred and ninety six thousand.*

The greater uniformity of size of these follicles in the colon, and its even surface, enable us to count them with more certainty, and they appear to exist at the beginning of this gut, at the rate of about 400 for every eighth of an inch square; and in the sigmoid flexure at the rate of about 200 to the same area; they become in fact both smaller and less numerous in descending towards the anus.

Admitting the entire area of the colon to be 500 inches, and 19,200 of these follicles, on an average, to exist on every square inch, the aggregate number will be *nine millions six hundred thousand.*

Again, estimating the whole area of the mucous coat of the small intestines at 1440 inches, and allowing for interruption occasioned by villi, about twenty-five thousand follicles are found upon every square inch, and the two numbers multiplied produce *thirty-six millions.*

The entire number of follicles in the whole alimentary canal is, by the preceding estimate, *forty-six millions eigh hundred and ninety-six thousand.* I am very far from pretending to have counted them all, but have made an approximation to the actual number by observing sections of different portions of the subject, and verifying observations upon other subjects. The external surface of the cutis vera presents, as it were in outline, the same arrangement; the venous reticular intertexture appearing broader, not quite so perfect, and more shallow, and forming the papillæ; but as additional experiments are wanting, it may be passed over with this transient notice; perhaps indeed a more skilful hand in adopting the hint may perfect the details.

In the stomach, the largest of these follicles is about one ninety-eighth of an inch in diameter, and the smallest about one four-hundred-ninetieth. In the colon the largest is about one two-hundred-and-forty-

fifth of an inch in diameter, and the smallest about one four-hundred-and ninetieth. In the small intestines their size varies in about the same ratio as in the colon, but they are much more irregular in shape, being scattered more in groups in consequence of the villi intervening. Some of them penetrate obliquely towards the fo ndations of the villi; hence, when examined from the exterior, their distribution is more regular, and they are seen lodged in the cellular coat of the gut.

I have endeavored to keep the estimate of the number of follicles below what other calculators would make it upon an observation of my preparations and a fair measurement of the area of the alimentary canal, lest the number should seem excessive and incredible. I have therefore the most reasonable assurance of being within bounds on that point. I may now ask their use. Is it to secrete or absorb? * * * * * * For my own part, I am much inclined to adopt the opinion of their absorbing faculties.

Notwithstanding the facility with which I can detect these follicles, I have failed entirely under various means of examination, in finding any orifices to Peyer's glands, in the dried intestines; they appear to be merely small lenticular excavations in its substance, and wherever, a cluster of them exists, it disturbs the arrangement of the villi, and gives to them a scattering, unequal distribution. I would also suggest very respectfully to anatomists whether our knowledge in regard to them is sufficiently exact to render further inquiry useless. For my own part, it appears that this subject requires some additional attention.

[*Remarks on the Structure of the Mucous Coat of the Alimentary Canal;* by W. E. Horner, M.D., *Professor of Anatomy in the University of Pennsylvania.*]

NOTE A, REFERRED TO IN 1165, 1255.

The Orphan Asylum of Albany, N. Y., was founded in December, 1829. Orphans and other destitute children of the city were gathered into it, to the number of from seventy to a hundred and thirty. The house at first occupied was too small for the good accommodation of so large a number, but great pains were taken to keep it clean and well ventilated. One room was set apart for a nursery or sick room, and a woman, with sometimes one or two assistants, employed to nurse the sick and feeble. Drs. James and Green were the attending physicians. Great attention was paid to the personal cleanliness of the children, and their regimen generally as to bathing, clothing, air, exercise, etc., was intended to preserve and promote health. Their diet consisted of fine bread, rice, Italian puddings, potatoes, and other vegetables and fruit, with milk; and to these was added flesh or flesh soup once a day.

A large and commodious house having been built for the purpose, the children were removed to it in April, 1833. In September, 1833, a change was commenced in the diet of the children, and in the course of three months they were brought fully in o what is popularly called 'the Graham system of living.' In August 1836, the following account of the institution was published:

"It is now more than six years since this institution was established, and about three since the new regimen was adopted, so that the time has been nearly equally divided between the regimen which embraced animal food and that which excluded it. From the commencement to the present time, new inmates have been occasionally received into the asylum from the almshouse and the city, and most of these children have been in very poor health, and some of them exceedingly diseased. During the whole period, also, children have from time to time been placed out in families, when they had arrived at a proper age.

"The average number of children in the asylum has been about eighty. During the first three years the changes were somewhat more frequent than they have been during the last, but during the last three years there has been a large proportion of very small children. Under the first regimen the children were washed all over once in two or three weeks; under the new regimen they have been washed all over every morning in the summer, and three times a week in the winter. Under the new regimen the house has been much larger and more airy and convenient than that which was occupied most of the time while under the old regimen. Now then, let us look at the general results. During the first three years, or while the first regimen was observed, from four to six children were continually upon the sick list in the nursery, and a nurse constantly employed to take care of them, and sometimes the number of the sick was greatly increased, and one or two assistant nurses necessary. The attendance of a physician was found necessary once, twice, or three times a week uniformly, and deaths were frequent. In the summer of 1832, the epidemic cholera made its appearance among the children of the asylum, and carried off six or eight of them; and let it be observed, that during the cholera season, the proportion of flesh and flesh soups was considerably increased in the diet of the children. During the whole period of the first three there were twenty-eight deaths.

"The new regimen, it has been stated, was gradually introduced at the close of 1833. While this change was taking place a child was received into the asylum diseased with scald head. This disease, when once introduced into such an institution, is rarely arrested till every inmate has had it, and it sometimes takes years to expel it; but in this instance it was so promptly and vigorously met by a salutary regimen, that it was wholly arrested and driven from the institution before it had extended to half of the children. The nursery was soon entirely vacated, and the services of the nurse and physician no longer needed; and for more than two years following, no case of death nor of sickness took place in the asylum. Within the last twelve months there have been three deaths in the institution. One of them was an idiot child received some months before from the almshouse; this child was of extremely imperfect organization, and low order of vitality; its bones were soft and flexible, and in all respects it was so miserable a mass of organic existence, when brought to the asylum, that no one expected it would long survive. It however continued to live on for several months, and then died suddenly. The second case was also an idiot child received from the almshouse in a bad state of disease, and died soon after it was brought to the asylum. The third case was a child which likewise came from the almshouse in an advanced stage of disease, and died very soon after it was received into the asylum. At the same time two or three other children were received from the almshouse wretchedly diseased, but they have been restored to health.

"We see, therefore, that excepting the scald head brought into the asylum at the very commencement of its new regimen, and the few cases of disease imported from the almshouse within the last year, and excepting the death of the two idiots and one other child, all of which came to the institution with the grasp of death upon them, there has been no case of death nor of disease in the asylum during the last three years, or since the new regimen has been adopted. And, therefore, it is speaking truth most strictly to say that not a single case of death nor of disease has taken place in the institution within the last three years, from causes existing in the asylum, on the contrary (to use the language of the Report of the Board of Managers)—'under this system of dietetics the health of the children has not only been preserved, but those who came to the asylum sickly and weak have become healthy and strong: and greatly increased in activity, in cheerfulness, and in happiness.' It may be said by some that most of this remarkable improvement is attributable mainly if not wholly to the change of situation; but let it be remembered that the old regimen was continued five months after the children were removed to the new house which they have since occupied, and that but little apparent improvement in the health of the children took place before the new regimen was adopted; up to the very period at which the change was commenced, the nursery was continued, and on the day when they began to adopt the new regimen there were six children on the sick list. But almost from that very day there began to be a manifest improvement in the health of the children, and in a short time the nursery was wholly vacated, and has ever

since been entirely unoccupied, except temporarily by the few cases of imported disease already mentioned.

"Miss Grimwood, the superintendent, and Miss Clark, the principal teacher, state that since the new regimen has been fully adopted, there has been a remarkable increase of health, strength, activity, vivacity, cheerfulness, and contentment, among the children. Indeed they appear uniformly to be perfectly healthy and happy, and the strength and activity which they exhibit are truly surprising.

"That an airy situation and a clean and well ventilated house are of prime importance to the health of such an institution no one who understands the subject can entertain a doubt; but in order to arrive at correct conclusions in matters of this kind every particular and circumstance should be carefully examined and justly estimated. In the case before us, it is fully evident that the change of situation was neither the sole nor the principal cause of the astonishing improvement in the health of the children. Nor can we justly consider the substitution of the coarse for the fine bread, nor the abandonment of animal food, the sole cause of such an improvement; but the improvement resulted from the co-operation of all these causes; it was the effect of a correct regimen throughout, embracing the diet, sleeping, bathing, clothing, exercise, and intellectual and moral discipline. And such a regimen, adapted to the physiological laws of human nature, constitutes what is called 'the Graham system.'

"Miss Grimwood and Miss Clark also state that the change in the temper and disposition of the children since they have adopted their new regimen is very great; they have become less turbulent and irritable and peevish and discontented, and far more manageable and gentle and peaceable and kind to each other; and this, say the superintendents, is not the result of a want of spirit and energy, but of a healthy state of the whole system—a general serenity—an absence of morbid irritation.

"'The effect of the new regimen on the intellectual powers of the children,' says Miss Clark,' 'has been too obvious and too striking to be doubted. There has been a great increase in their mental activity and power; the quickness and acumen of their perception, the vigor of their apprehension, the discriminating energy of their comprehension, and the power of their retention, daily astonish me!'"

From August, 1836, at which time the foregoing account was written, until November following, the children of the asylum all continued in excellent health. In November two of them were somewhat indisposed for two or three days, and then recovered their usual health, and all continued well until March, 1837. In the second week of March the small pox appeared in the asylum, and in twenty-four hours six of the children exhibited symptoms of that disease; or, as the event proved, three of them had the genuine small pox, and three of them the varioloid. These children were from three to twelve years of age. Alarming as this disease is considered, it was here nearly stripped of its terrors; for it was so mild as scarcely to interrupt the regular proceedings of the institution. One little girl was remarkably full of the genuine small pox, yet she was scarcely ill at all, and did not complain in the least, nor did she take any medicine. All she wanted was brown bread. Indeed this was the only thing that any of them seemed to crave while the disease was upon them. A little boy four years of age, who had been about nine months in the asylum, and who came there in a very full habit, and had evidently been accustomed to gross living, and was from the first much afflicted with worms, had the small pox far more severely than any other child, and the disease left him much more exhausted than it did any of the others. This little fellow had scarcely thrown off the small pox before he was taken, in his feebleness and exhaustion, with the hooping cough, and in spite of every care, sunk under his complicated difficulties, and died. Another little boy had the small pox very full, but he hardly seemed to mind it at all, and soon threw off the disease as a light and harmless thing. By an untimely accident, however, he was exceedingly exposed at the moment he began to recover, and took a violent cold: the lung fever set in, and after four or five days' sickness he died. The three children

which had the varioloid were so lightly affected that their indisposition was scarcely perceptible. In fact, except in the case of the little boy troubled with worms, the disease was to light and mild in all the children, that it hardly made any change in their diet, studies, or amusements, and play; and the disease did not seem to impair their constitution in the least; they rose from it at once, and went on as if they had not been sick.

Almost immediately after the small pox had left the asylum, the hooping cough made its appearance there, and eight or ten of the small children had it. Excepting the little boy already named, whom it found afflicted with worms and extremely exhausted from small pox, none of them minded this last disease at all. They continued in school as usual, ate and played as usual. They occasioned no trouble during the night; nothing was given them but their food and drink, and nothing extra was done for them. Their cough was very light and easy, and none of them complained.

After the hooping cough had left the asylum, all its inmates remained in good health for about six weeks or two months.

About the first of June, 1837, wheat being very scarce and high-priced, and those who provided for the asylum not being aware of the importance of the children's being supplied with unbolted wheat meal bread, furnished the institution with fine flour made of foreign wheat, which had been a little heated during the passage. When the children commenced eating bread made of this flour they were all in fine health, but they had not continued to eat it more than four weeks before about fifteen or twenty of them began to have sore eyes, and in the course of three or four weeks more there were thirty cases of scarlet fever, and of these two terminated in death. Still, however, this disease was so modified by the general regimen of the institution, that not more than three or four out of the thirty subject to it were confined to their beds by it, nor did they require much extra attention.

That there was a very close relation as to cause between the sore eyes and the scarlet fever, was at least strongly indicated by the fact that no child which had sore eyes had the scarlet fever.

About the first of September the asylum was again furnished with a small supply of unbolted wheat meal, and from this time till the first of January, 1838, all the inmates of the institution enjoyed excellent health. At the commencement of the present year some change took place in the board of managers, and a new caterer was appointed, who supplied the institution with fine flour of second quality, but sweet and good. In the course of three or four weeks from the time the children commenced eating the bread made of fine flour, a number of them began to have sore eyes again. The superintendent now feeling confident of the cause of this complaint, stated her convictions to some of the managers, and told them that the children must have the coarse wheat meal bread, or their health could not be preserved. In the mean time she endeavored to make the evil as light as possible, by giving the children very little of the fine bread, and sustaining them principally on good potatoes and apples. Very soon after this, however, a full supply of the coarse flour came, and from that time to the present—now about five months—the health of all the inmates of the asylum has been excellent and uninterrupted.

Albany, June 12, 1838.

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VOCABULARY, OR DEFINITIONS.

Abnormal—irregular, deformed, out of the truly natural state, condition, order, or manner.

Acute disease—disease which come on suddenly, with violent symptoms, and soon comes to a crisis.

Alimentary canal—the stomach and intestines; the cavity which receives and digests the food, 317.

Albuminous—partaking of albumen, or a substance like the white of an egg.

Anastomosis—properly the communication of one vessel with another; when applied to other tissues it means to unite, to join, to run one into another.

Anus—mouth of the rectum thro' which the fæces are discharged.

Aorta—the great arterial or principal blood-vessel leading from the heart, 374.

Aperient—opening, laxative.

Asphyxia—a suspension of the action of the heart and arteries, as in swooning, fainting.

Atony—relaxation, debility, want of tone, 1180, Note.

Auricle—(a little ear); applied to the two upper cavities of the heart, which resemble an ear, 368.

Bronchia—the branches of the wind-pipe in the lungs

Cachectic—a vitiated state of the solids and fluids; a general want of health and tone.

Calculi (plural of calculus)—concretions. stone-like substances formed in the bladder, kidneys, gall-bladder, etc.

Caliber—the diameter of a body, the capacity of a tube.

Caloric—producing heat, 489.

Capillary—very small, hair-size.

Cerebrum—the brain, 265.

Cerebellum—the little brain, 264.

Cerebro-spinal—the brain and spinal marrow taken together, 229.

Cervicle—belonging to the neck, 180.

Chronic Disease—disease of long standing, which comes on by imperceptible degrees.

Chyle—the fluid formed from the chyme, and from which the blood is formed, 153, 456.

Chylopoietic—having the power to form chyle.

Chyme—the digested food in the alimentary cavity, 435

Cineritious—having the color of ashes.

Cœcum—a portion of the large intestine, 346.

Colon—the main portion of the large intestine, 338, 346.

Congestion—an accumulation of blood in a part, an over fulness of the vessels.

Corpora quadrigemina—four small ganglions lying at the top of the medulla oblongata, 250.

Corpus callosum—the great commissure of the brain, 267, 271.

Corpuscle—an extremely small body, a minute particle.

Crassamentum—the clot, or thick red part of the blood which separates from the serum, 482.

Cribiform—resembling a sieve or riddle, perforated with holes.

Cutis vera—the true skin.

Diaphragm—the membranous partition which divides the body into two large cavities, 175, 363.

Diabetes—disease of the kidneys, producing an excessive quantity of urine.

Depuration—cleansing, purifying.

Duodenum—the first twelve inches of the small intestines, 338.

Emphysematous—inflated, blown up, distended with air.

Encephalic—within the skull, the contents of the cranium.

Epigastric—round about the stomach.

Epiglottis—the little valve that closes the top of the wind-pipe in the act of swallowing, 340.

Et Seq.—(et sequitur), and the following.

Facial—pertaining to the face.

Fascicle—a little bundle.

Fauces—the throat, the cavity behind the tongue.

Fibro-cartillage—cartillaginous structure with porous arrangement.

Filamentary—thread-like.

Final cause—purpose or end for which a thing is made, or exists.

Follicle—a little glandular sac. 333.

Foramen—a hole an opening.

Function—the office of an organ:—thus, digestion is the function of the stomach.

Functional—pertaining to function.

Functional result—the effect of function:—thus, chyme is the functional result of digestion.

Ganglion—a knot, bulbous enlargement of the nervous substance.

Gastric—belonging to the stomach.

Glosso-pharangeal—belonging to the tongue and pharynx.

Glottis—the opening or mouth at the top of the windpipe, 354.
Hepatic—belonging to the liver.
Humoral pathology—disease as connected with the humours or fluids of the body
Hypoglossal—under the tongue.
Idiopathic disease—an original disease of some particular part, one that is not sympathetic, does not spring from another.
Idiosyncracy—a peculiar temperament or predisposition.
Ileo cæcal—pertaining to the ileum and cæcum, 346.
Ingesta—the contents of the stomach after a meal is made.
Inorganic—not being arranged into organs, or by organs; stones and all substances not vegetable nor animal are inorganic.
Inosculate—to unite, the mouth of one vessel opening into another.
Jejunum—the second portion of the small intestine, so called because mostly found empty, 388.
Lacteals—small vessels that form the chyle and convey it to the thoracic duct, 887,
Lamina—plates of sheets.
Larynx—the top of the wind-pipe, 353,354.
Lymphatics—small vessels that form the lymph and convey it to the blood-vessels, 385.
Medulla oblongata—the head of the spinal marrow, 244.
Menstruum—a dissolvent, a fluid holding other substances in a liquid state, 482.
Meso-colon—the membrane which as a curtain holds the colon in its place, 350.
Mesentery—the curtain of the small intestine, 350.
Molecular—pertaining to molecules or minute atoms.
Morbid—diseased, unhealthy.
Mucous membrane—the membrane which lines the stomach, lungs, etc. 289.
Nasal fossæ—the canals of the nose.
Normal—truly natural and proper state, form, condition, action.
Œsophagus—the meat-pipe, 338.
Olivary bodies—portions of the medulla oblongata, 244.
Omenta—the caul or the fatty curtains that cover the bowels, 350.
Ophthalmic—pertaining to the eye.
Organic—having organs, or being organized, any vegetable or animal body, or any solid substance belonging to such bodies.
Osseous—bony. **Ossification**—formation of bone.
Papulæ—the little velvety tufts or eminences formed by the fine terminations of nerves and vessels, 287.
Pancras—a gland lying behind the stomach, 343.
Pathology—the science of disease, everything pertaining to disease
Pelvis—the basin formed by the hip bones and others at the lower part of the trunk.
Pericardinum—the membranous sac that surround the heart, 368.
Periostium—the fibrous membrane that surrounds the bones, 169.
Peristaltic—the worm-like motion of the intestines, 445.
Peritoneum—the outer coat of the stomach and intestines, 350.
Pharynx—the funnel-shaped muscular bag at the top of the meat-pipe, 338, 347.
Phrenitis—delirium or frensy from imflammation of the brain, etc.
Physiology—the science of life, comprehending all the vital properties, powers, functions, and laws of living bodies.
Physiological depression—a state of exhaustion, and relaxation, and want of tone or energy, 1180.
Physiologico-psychological science—intellectual and moral physiology; or the science of man's intellectual and moral nature as connected with the organs and functions of the living body.
Pleura—the membrane that lines the chest, etc., 361.
Plexus—a net-work of nerves or vessels.
Pneumo-gastric—pertaining to the lungs and stomach.
Preternatural—more than is natural or consistent with sound health.
Prophylactic—preserving health, conducive to health.
Psychology—the doctrine of the soul, including all the properties, powers, functions and laws of the intellectual and moral nature of man.
Puerperal—pertaining to child-bearing.
Pulmonary—belonging to the lungs.
Pylorus—the muscular ring at the lower orifice of the stomach.
Ramuscles—minute branches.
Rectum—the lower part of the large intestine. 338.
Renal—pertaining to the kidneys.
Rugæ—the wrinkles or small folds of the stomach, 349.
Saponaceous—having the quality of soap.
Scirous—indurated, hard knotty.
Sebacious follicles—producing an oily or fatty substance.
Secernent—secreting, as follicles and glands, 333.
Semilunar ganlion—the central brain of organic life, 226.
Serous fibrous—partaking of the character of the serous and fibrous structure.
Serous—thin, watery; like whey;
Serous membrane—the membrane which lines the closed cavities, and exhales a thin watery fluid or vapor, 176, 353.

Serum—the watery part of the blood, 482.
Solar plexus—the great central nervous plexus of the body, 226.
Stamina—the fundamental powers of the constitution.
Tissue, cellular, muscular and nervous—the three general forms of structure in the body, 312.
Tissue—a particular arrangement of fibres or filaments in an organ.
Therapeutics—the discovery and application of remedies in curing disease.
Trachia—the windpipe.
Trifacial nerve—the nerve of sensation, etc, with three branches distributed to the face, etc., 254, et seq.
Trisplanchnic nerve—see 220.
Turgescence—swollen, enlarged.
Vascular—consisting of vessels, see 313.
Vasculo-nervous—consisting of vessels and nerves, 287.
Vena-cava—the great venous trunk, see 378
Vena-porta—a particular apparatus of veins connecting the alimentary canal and liver, see, 381.
Venous blood—the dark purple blood of the veins.
Villi—the velvety pile of the mucous membrane, 287.
Viscera—the internal organs, see 313.
Vulnerary—adapted to heal wounds.

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