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ANNEX

Section, Chemistry

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OUTLINES

OF

CHEMICO-HYGIENE AND MEDICINE;

OR

THE APPLICATION OF CHEMICAL RESULTS

TO THE

PRESERVATION OF HEALTH,

AND

CURE OF DISEASE;

BY

A. DALLAS, C. H., C. M.

"Quæmadmodum sanitas omnium rerum pretium excedit, omnisque felicitatis fundamentum est, ita scientia vitæ ac sanitatis tuendæ omnium nobilissima, omnibusque hominibus commendatissima esse debet."—HOFFMAN.

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CONTENTS.

CHAP. I.—Identity, p. 23.

Elements of the Food, of the Organs, and of the Excretions, p. 26.

The Ultimate Compounds of Organized bodies, p. 33.

Nutrition, p. 35.

Waste, p. 41.

CHAP. II.—Equilibrium, p. 50.

Oxidation, p. 53.

Ventilation, p. 62.

Temperature, p. 72.

CHAP. III.—Displacement, p. 82.

CHAP. IV.—Concluding Remarks, p. 100.

INTRODUCTION.

The progress of modern improvement is distinguished, in a particular manner, by the strictly scientific character of every department of human industry. To satisfy the reason, is as imperative, in these days of freedom of thought and of speech, as to satisfy the conscience. Men do not now rest contented with the naked formula, which has been handed down from a preceding generation; but are prone to question every one of its purposes and adaptations, in the true spirit of the Baconian philosophy, and with a perseverance and exactitude that would astonish the older and most devout followers of Aristotle. It matters not, in which one of the many avenues of industrial life, we choose to cast an enquiring glance; whether it be the modeling of the optical lens, or the construction of a suspension bridge; the same studious observance of natural principles, as a rule and as a guide, is manifested in every individual act of the expert mechanician.

The fine arts too, and also the more intellectual traits of certain professions, participate in this advancement. In particular departments, much, no doubt, has been handed down, to us, from a remote antiquity, that is perfect both in the conception of true principles and the design of construction. Such, for example, are those oldest Grecian types of the male and female forms, which indicate corresponding mental characteristics. Among the voluminous and diversified treasures of ancient learning, there is nothing to be compared with the truthfulness of the conception of the human figure, possessed by the earlier Greeks; a truthfulness consisting, in the exact correspondence of the productions of art, with the real objects in nature that they were intended to represent. Our sculptors and painters have received from them the rules of art, so perfect as to be beyond the reach of criticism. The contrast between the sexes, the opposition of the masculine and feminine, is beautifully exemplified in the correspondence of their corporeal with their mental aspects. In stature, the male being large, the female small; the breadth of chest and shoulders of the first, their narrowness in the second; the narrow

pelvis of the one, its breadth in the other; the large bones, large muscles, large head and feet of the stronger sex, while the corresponding members of the weaker are small;—on the one hand, the angular and coarsely developed, but symmetrical limbs of the male body; on the other, the smooth and rounded outline of every feature of the female;—and finally, the stern, resolute and unflinching countenance of the masculine type, indicating a sense of duty and the responsibilities of manhood; contrasted with which, the half-opened mouth and involuntary smile of female beauty, the wistful look, and yet retiring attitude, as if conscious of her feminine nature, denote the most tender emotions, sensitiveness and dependence. When Zeuxis was applied to by the Crotonians for a fine painting, to adorn the temple of Juno, and he proposed a picture of Helen to be painted from the finest specimens of the Crotonian women, they brought to the artist five of their most beautiful virgins, so that he might select the one most perfectly formed, from which to copy. Zeuxis, however, retained the whole five; because, as he stated, the Helenic type of female beauty was not represented in any one, individually; and would therefore have to be made up from the finer points of each, selected by the artist himself.* In this we perceive the exquisite nicety of Grecian art. It is not sufficient that the living copy be the finest and most beautiful that Crotona could produce; it must come up to the conception, in the mind of the artist, of what beauty really consists. And then this conception is in accordance, not with the caprices of the human imagination, but with the principles of the natural law; and expresses the natural requisites of female beauty. For notwithstanding that, in rare and exceptional cases, a concentration of perfect parts may possibly exist in one subject; still, as the most symmetrical tree does not always bear the choicest fruit; and excellence, in many of the more important requisites, is seldom found unalloyed with properties that detract from the unexceptionableness of the whole; so the province of art is to select and combine, from natural varieties, those parts only which represent the hardness or softness of the psychical life which they envelope; at the same time that it rejects every external feature that does not harmonize with its natural standard of correspondence.

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* Neque enim putavit, omnia, quae quaereret ad venustatem, uno in corpore se reperire posse; ideo quod nihil simplici in genere omnibus ex partibus perfectum natura expolivit. Itaque, tanquam caeteris non sit habitura quod largiatur, si uni cuncta concesserit, aliud alii commodi aliquo adjuncto incommodo muneratur.—*Cicero. Proœm Lib. II. De Inventione.*

But notwithstanding such excellence, attained in particular and isolated departments of art, in the civilization of the Greeks, of which the preceding is one example; and also among the modern Italians, who, by colonization, are the legitimate inheritors of Grecian genius; the distinguishing feature of the present age, compared with those artistic achievements, is the universal application of science to every industrial pursuit. It is no longer to sculpture, to painting, to the mathematics, to metaphysics, to rhetoric, to conquest and civil polity, that the unsatisfied activity of living masses of human beings is now exclusively directed. Every process in the factory, in the print-field, in the bleaching and dye house, in the machine shop, in glass and porcelain manufacture, in ship building, and in mining, has a scientific reason to justify its use. The mathematics and Euclid, hydrostatics and aerostatics, have much to do in the construction and working of machinery; chemistry also, in most of our manufactures. Even in the making of a needle or a thimble, the knowledge of chemical principles is indispensable. The maleability of the metal and its subsequent hardening, are both chemical processes. The superintending workman must have a knowledge of the natural law, necessary to be observed, in preserving the purity of maleable iron; and also that for its subsequent conversion into a carburet. So intimately is success, in a mechanical or manufacturing occupation, dependent on the scientific application of means, that we find the managing head of every manufacturing establishment, more or less, a scientific personage, who is able to explain the natural principles which constitute the basis of his scientific skill.

The same proficiency might reasonably be looked for in the department of medicine; for no satisfactory cause can be adduced, to justify a contrary result. With respect to scholastic acquirements, and the prestige of social position, the medical profession has possessed advantages of no ordinary kind; and why it should constitute an exception to the general rule is, in some sense, difficult to understand. Yet, its more eminent and distinguished members have not been backward, in expressing their dissatisfaction with the actual state of medicine. It would be superfluous to cite quotations, to prove the candid avowals of old and respectable practitioners. Indeed there is scarcely a medical writer of any repute, who has not expressed sentiments of derision, mingled with regret, at the anomalous condition of the healing art. Great difficulty seems to have been experienced, in accounting for the cause; which, however, can be easily perceived, if we only compare the method of

procedure, in medicine, with the method pursued, in the industrial departments already noticed. Here, the widest contrast is perceptible, in one particular; namely, the rule of guidance. The glass manufacturer knows the invariable chemical properties of the materials, on which he is to operate. He knows the proportions in which the silicates of potash and soda, exposed to a red heat, combine to form glass in a state of fusion;—and also that if the alkali predominates, the glass is exceedingly soluble in water; whereas, if the acid is in excess, the glass is then insoluble. In like manner, the soap-boiler comprehends, beforehand, the scientific principles of his profession. Without this preconceived, or previously acquired knowledge, of the affinity of caustic alkalies for fatty matters, and their exact combining proportions, he would not be able to practise his calling with success.

Now, the practice of medicine does not pretend to take this scientific course. The medical practitioner does not assume a knowledge of the affinity which exists between quinine, arsenic, or calomel, and the constituents of the blood or of any secretion of the human body. But, notwithstanding this absence of the necessary scientific data, he proceeds to administer these substances, depending on chance for the results. Need we wonder then, that the designation of science is denied to medicine; and that medical men themselves admit the justice of the verdict.

It is evident, that if the glass manufacturer or the soap boiler should attempt, thus, to act independently of the natural laws of chemical affinity, his labors would be futile, and bankruptcy would soon determine his fate; for, there is, in glass making and soap boiling, no professional monopoly, to compel the public to pay for bad glass and bad soap, as they have to do, equally, for good or bad medical treatment.

A professional monopoly, resting on no scientific foundation, may well be considered a stumbling block and impediment to the progressive improvement of the profession itself. Relying too much on an exclusive privilege of little comparative value, men of education and genius have neglected to exert their talents, in the way that a free competition would have rendered imperative. It besides affords no real protection either to the respectability or emoluments of that class of practitioners, whose claims to public confidence and credentials of competency, are founded on the thoroughness of their scholastic curriculum, as well as on an extensive hospital and clinical practice. For, if we regard, on the one hand, the numbers who claim

to be licentiates, and who constitute a large and increasing majority of mere empyrics; and, on the other, the swarm of illiterate patent medicine doctors; there is certainly little cause to congratulate the profession, on having secured that efficiency and respectability, contemplated by the legislative acts of incorporation.

The real cause why medicine occupies a position so low, is, that it possesses no scientific basis. Had chemistry received that attention and support which have been accorded to anatomy and physiology, the result which is so much to be regretted could not, in all probability, have occurred; for the study of organic chemistry must, in that case, have become a necessity; and must have been prosecuted with a success equal, at least, to that which has been attained in the field of surgery. What organic chemistry is accomplishing now, would have been achieved before. There is no doubt whatever, that the backward state of medicine has been caused entirely, by its neglect of organic chemistry. Important as surgery must ever continue to be, as one branch of the healing art, it is incapable of rendering any service, either to promote or retard the change of the tissues, or even to modify the nature of a secretion. And with respect to pharmacy, when, by the application of an intended medicinal agent, a secretion becomes changed, the collateral effects produced are not appreciable; are therefore not perceived; and may, in all likelihood, be more injurious ultimately to the patient, than if the original disorder which it was intended to remove, had been allowed to continue.

The importance of organic chemistry is now, however, fully admitted by the leading physicians both in Europe and America. Wherever a disinclination has been shown to make an open and candid avowal of its necessity, the reason may be easily traced, to the apparent difficulty, of incorporating a new system with an old established practice. On this head, however, there exists a good deal of misapprehension. The advice of Mr. Wakely and others, to medical students, given without qualification, has had some share in exciting this feeling. As far back as 1844, during the publication of Liebig's lectures in the *Lancet*, Mr. Wakely recommended in very impressive terms, the importance of organic chemistry to medicine; but, apparently, not perceiving the facility with which the results of the new discoveries, in chemistry, could be used by the old practitioners, his advice was directed exclusively to young students. Such advice, without qualification, was virtually to ostracise the whole existing body of practitioners. In this sense, it seems to have been received; and, notwithstanding that no demurrer was ostensibly

made, on their part, it has continued to stand in the way, and to prevent that countenance to organic chemistry, by the medical profession, that otherwise would have been practically manifested.

The importance of organic chemistry being admitted, it does not necessarily follow that, before it can be made available for the cure of disease, the medical practitioner must enter the laboratory and serve an apprenticeship to a new art. This would be a discouraging position to assume. The discoveries that have been made are too recent, to be generally applicable to the institution of an appropriate curriculum of chemical study, for medical practice. Such a curriculum will undoubtedly be established, so soon as the mode of experimenting, now in progess, shall have been sufficiently matured, and the results be available, as a guide, to the requirements of a course of chemico-medical study. Even then, however, it is not to be supposed, that the exact calculations of the practised chemist will not continue to take precedence, in all medical formulæ. Many experiments, particularly in organic chemistry, are of a complicated and tedious nature, for which the general practitioner could neither find time nor convenience. In such cases, he must be satisfied to borrow the ascertained facts of the professional chemist; for the purpose of using them in his medical practice. If so, there is no reason why these ascertained facts should not be made available now, as well as afterwards. It is a great mistake, to think, that nothing can be done to place medicine on a scientific basis, before that a new generation of practitioners, with chemical certificates, shall have taken the place of the present. It is a misfortune that such a misunderstanding should have occurred; the more so, on account of its universal prevalence. If viewed in a proper light, the erroneous impression, thus formed, could be easily removed. And the sooner this is done the better it will be for the credit of the profession.

There is little comfort, in being reminded, by every circumstance connected with the administration of physic, that the man of education who can boast of fellowship with one or more chartered Faculties, is, after all, to a certain extent, on a par with the vendor of patent nostrums; and that the *pilula hydrargyri*, as a specific, is susceptible of no more satisfactory explanation, than the universal draught, which is warranted to be infallibly efficacious, in every possible case of disease, without distinction. It is mortifying to reflect, that a noble art should, thus, be degraded to a level with the vilest system of deception and commercial dealing. But there is no use continuing to expose defects and to express regrets, unless suitable means

be suggested and simultaneously adopted, to remedy the evil complained of. It is well to understand, at the same time, the full import of the difficulties which surround the whole question; because it is only by becoming sensible of the magnitude of the obstacles which oppose a beginning to the progress of medical reform, that the proper means, by which to remove them, can be devised and successfully undertaken. In regard to the prejudices of many of the old practitioners, and also of the more numerous body, whose chief qualification consists, in being able to follow unscrupulously and to the letter, the empyrical routine of the existing schools, it is reasonable to assume that they could be easily overcome, by the example of those more gifted medical authorities who, by their writings, determine the law and give a shape and tone to the popular medical tenets of the day. It is evident, that the general belief imputes to established and deep rooted prejudice, the difficulty of innovation on the present system. And this prejudice certainly exists. But if properly regarded, cannot be considered to stand in the way of a reformatory change. If, from the presentation of the subject in its proper light, the conviction can once be produced, of the disparaging contrast, between a system of practice having a scientific foundation, and that, at present existing, which has no theory, and is incapable of being defended, the issue will soon be determined. The chief point is, to set forth prominently the radical cause of the evil—that which underlies and constitutes its substratum. The conviction must be brought home to the mind of every member of the profession, that it is the exclusively empirical character of medicine which constitutes its radical defect; in which empiricism there exists not only a want of correspondence, but *an actual opposition between professional practice and natural principles.* The presentation of this fact, the proofs of its truth, and the illustrations requisite to impress it deeply and permanently on the good sense of the great body of medical practitioners, are, in my opinion, all that are wanted, to secure an immediate recognition of the claims of science, and an abandonment of the unsatisfactory foundation on which medicine has hitherto rested. The time has besides arrived, when a change of system has become unavoidable; and can no longer be delayed, despite of the disposition to concede or withhold what the circumstances so urgently demand. The principles of organic chemistry, affirmed by the most ample experimental proofs, within the last twenty years, are directly opposed to the system of medication now in general use. Those principles, as has been before stated,

are now recognized by leading physicians who have turned their attention to the subject; and the reader of medical periodical publications, cannot fail, to observe, a growing tendency, to subordinate the rules of medicine to the principles of chemistry. The perfect and systematic application of the latter to the former, must no doubt be a work of time; as organic chemistry is only yet in its primary and germinating state. Enough, however, has been accomplished to define the relation of chemistry to medicine; and to satisfy the most competent professional authorities, that it is only under the guidance of chemical tests, that anything can be known, of the nature of the secretions and the change of the fluids; or that the action of medicaments can be definitely ascertained.

So far, the importance of organic chemistry has been admitted; and, as a consequence, its principles are already applied, though partially in both private and hospital practice. The way, however, which has been taken to make chemistry serviceable to medicine, is by no means likely to be attended with success. On the contrary, it will appear, on examination, to be really objectionable; and, moreover, that it is not in accordance with those principles of secience which ought, in all cases, to be our standard of authority. I make this admission with considerable reluctance; because I owe what knowledge I possess, on this subject, to the writings of some of the principal actors in the great work of chemico-medical reform; know the value of their discoveries; and can foresee the amount of good which society is about to derive, from their labors. The occasion, however, is one which concerns the future prospects of medicine, as a science; and the right or wrong principles acted on, now that a change is in progress, will assuredly decide the shape which the transitional system will assume, for a considerable time to come; during one epoch, at least, of its future history. I, therefore, feel less reserve, in stating my views, of what I consider the right application of the principles of organic chemistry; at the same time that I wish it to be understood, and as I shall endeavor to show, that my application of those principles, is in unison with the theory and doctrines of Liebig, as a whole; and is the only legitimate mode by which, consistently with those doctrines, they can be practically enforced.

In studying organic chemistry, much depends on the direction and scope which is conceived, at the outset, with regard to the comprehensiveness of the subject. It will not do to follow the restricted curriculum of the old regimen, for the detection, by analysis, of gases, acids and poisons, even with the addition of the organic

elements; for this would be only dealing with the dry bones and subsidiary manipulations of what properly constitutes the science. Neither should it be supposed, that the object is to form an extended and intimate acquaintance with the use of pharmaceutical reagents, and the changes they produce on the living tissues. Yet I am sorry to confess that, with the exception of a more rigid observance of the old rules of hygiene, the whole bent of the new chemico-medicinal practice, is confined to this reactionary application of external substances. We have a recent example of this, in Dr. Churchill's specific of hypophosphates of lime and soda for tuberculosis; which is more remarkable, in consequence of its having been officially and favorably reported upon, in Paris, by a committee of the Académie de Médecine. A reference to the current medical reports will show, what appears very strange, that this system of practice has been gaining ground, wherever it has been attempted to make organic chemistry the basis of medicine. The cause of this error may be imputed, and no doubt is due, to some suggestions by Prof. Liebig, while experimenting on the action, within the body, of alloxan,* iron, phosphates of lime, and other substances; and, on the conversion of benzoic into hippuric acid. † Since these suggestions were first made, we have witnessed the preparation, from the stomach of the ox, of a compound called pepsin; and more recently, of a compound of iron, under the name of blood-food; besides many other preparations equally irrational. Dr. Churchill's is, however, a more conspicuous example of the tendency to which I have referred, for two reasons; first, because it has received the official sanction of a corporate body of eminent savans; and second, because it is of recent occurrence.

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* "It would be most interesting to investigate the action of alloxan on the human body. Two or three drachms, in crystals, had no injurious action on rabbits, to which it was given. In man, a large dose appeared to act only on the kidneys. In certain diseases of the liver, alloxan would very probably be found a most powerful remedy."—*Animal Chemistry.*

† "To the evidence produced by A. Ure, of the conversion of benzoic acid into hippuric acid, in the human body, M. Keller has added some very decisive proofs, which I append to this work, on account of their physiological importance. The experiments of M Keller were made in the laboratory of Professor Wöhler, at Gottingen; and they place beyond all doubt the fact that a non-azotized substance taken in the food can take a share, by means of its elements, in the act of transformation of the animal tissues, and in the formation of a secretion. This fact throws a clear light on the mode of action of the greater number of remedies; and if the influence of caffeine on the formation of urea or uric acid should admit of being demonstrated in a similar way, we shall then possess the key to the action of quinine, and of the other vegetable alkalies."—*Animal Chemistry.*

Professor Liebig did no more than simply recommend the performance of isolated experiments, for the purpose of testing the truth or falsehood of certain opinions, which could not be satisfactorily determined in any other way. And it matters not whether we consider these suggestions at varience with his general theory or not. It was necessary that disputed questions should be settled by tangible experiments, and by this means be settled forever; for experiments are the only proofs of the validity of theories. But, to assume that suggestions to experiment amounted to an approval of a certain course of practice, is a very grave error. We cannot conceive, that there is any other way, of accounting for the prevalent tendency of distinguished members of the profession, thus, to misapply chemistry. Every attempt to graft the old routine of medical practice on organic chemistry, is only an additional proof that the principles of science are misapprehended. In place of continuing to look into the human body, for the reactionary changes, produced by the administration of foreign substances, this system of procedure must be abandoned *in toto*. It has been too long tried; and has resulted in nothing but discredit; because it is a system of guessing. It proceeds on no preascertained data; and, further than an experiment to demonstrate its falacy, should be altogether discountenanced.

The groundwork, and in fact the whole scope of chemico-medicine, lies in a clear perception of the analogy between the nutritive and healing processes in man, compared with those of the lower animals and of plants. The limitation of our observations to the action of this or that individual substance, and the mere classification of results, is a narrow and discreditable employment of our faculties. The worm which crawls on the ground can discriminate, by actual contact, which one, of many substances, is best adapted to suit its immediate wants; but, for man, whose Promethean spirit is able to draw down fire from heaven, to be engrossed only with considerations that ascend no higher than the sensuous perception of the material objects which lie directly in his path, is unworthy of a being gifted with reason, and endowed with faculties that, if properly directed, should enable him to fathom the occult causes and scan the purposes and intentions of all earthly phenomena. The analogy of the elemental functions, in the animal and vegetable kingdoms, between plants and animals, and between the lower animals and man, is the fulcrum on which the truth of chemico-medicine ultimately rests. Without analogy, no generalization can be formed; and without a process of generalization, the truth, in this as in all parallel cases,

must ever continue to be a mystery. In this analogy of the functions of the elements, what, in the first place, is chiefly to be observed, is the unalterable character of each class of primary elements, under all circumstances, whether in or out of the organism; and, in the second, our ability to trace it, and to demonstrate its identity, whatever forms it may assume, or under whatever arrangement it may appear, first, in the air or in the soil, second, in plants, third, in animals, and, finally, after passing from the organism through the process of eremacausis or decomposition, appearing again in the air or soil. As the human body is a congeries of primary elements, having different forms of arrangement, and derived from vegetable and animal organizations, it is only by tracing, in this manner, the elemental functions, that we can arrive at a correct knowledge of the nature of a secretion; and as our ability to change a secretion must in all cases depend on a knowledge of the conditions of change, therefore is it necessary that an acquaintance with the conditions of change should take precedence of any attempt to act upon a secretory organ. This, it will be observed, is a controversion of the mode of procedure commonly adopted. A knowledge of the *rationale* of the process of change, is made to take precedence of any attempt to perform the act;—that is, in professional practice; for, as I have already stated, isolated experimental attempts merely, are always required to test the validity of theoretical conclusions.

What constitutes science is the conception of the *modus operandi* of the natural law. Nothing can be scientific which has not its foundation in a principle of nature. When Denys and Emerez, as related by Magendi, transfused the blood of a calf into the veins of an idiot, and reported that the idiot seemed to recover his reason, the proceeding was contrary to the dictates of science; because at variance, with that law of nature, which associates certain functions with specific structures of the organs. The exercise of reason, could not be predicated, where the organ of reason was wanting; and on that ground alone, the experiment was uncalled for and absurd; a conclusion which is borne out by the fact that, on subsequent repetitions of the same experiment, the idiot first became frantic, and afterwards died.

The curing of symptoms, though an error of a different class from that committed by Drs. Denys and Emerez, is equally irrational and unscientific. There can be no greater proof of the obliquity of mental vision, than to imagine that by cutting off our means of knowledge, the thing known may cease to exist. Yet this is exactly

what takes place, when a practitioner is satisfied if he can only succeed in obliterating the external signs by which an internal disease is made apparent. For quick pulse, accompanied with pain in the region of the chest, Dr. A. abstracts blood. The pulse is reduced, and the pain has ceased. Thereon, the patient and the doctor congratulate each other, on the efficacy of the treatment. But soon after, the pain returns, and also the quick pulse; and because the former bleeding had operated to dispel both symptoms, it is resorted to again, and another volume of blood is abstracted. A temporary relief, as before, may follow the second operation; and sometimes even the third; till, gradually, the returning symptoms become alarming, and the patient has become too weak to submit again to the same operation. Other treatment is then employed, by physicing; directed still, however, to allay the pain and reduce the pulse; that is, to cure the symptoms. Again, Dr. B. has got a patient who is affected with dropsy; that is, with water lodged in the cellular tissues, as anasarca; or in the cavity of the chest, as hydrothorax; or in the cavity of the abdomen, as ascites. Of course, the kidneys do not perform their accustomed functions; therefore, the kidneys must be acted on; and, for this purpose, diuretics are administered. But the fluid still remaining in the cellular tissue or cavities of the body, and increasing in quantity, hydragogues are then added to the diuretics, and an additional action is thereby excited in the alimentary canal. Here also, all that is aimed at by the treatment is to draw off the liquid. But the accumulation of liquid is not the disease; it is only a symptom of derangement of certain secreting organs;—therefore, to cure dropsy, Dr. B., in place of grappling with phantoms, ought to have directed his attention to the cure of the diseased organs. But, how seldom is the proper method even thought of! The fashion is, by diuretics and hydragogues, to attack the symptoms; that is, the water lodged in the body.

As a systematic mode of treatment, the curing of symptoms is particularly conspicuous in what is called homœopathic practice. The peculiar system of this medical school prescribes a different specific for every variety of symptoms. Though the internal disease is the same, each external indication is visited with a different treatment. An example from Dr. J. H. Pulte's book, which is acknowledged as a standard authority, will illustrate this. The disease which takes the first place in the "Homœopathic Domestic Physician," is rheumatism. Under this head, are comprised no less than nineteen classes of symptoms; each of which has a specific treatment, different

from the others. Aconite is applied to the symptoms of one class, bryonia to those in another; and so on with belladona, chamomile, arnica, nuxvomica, pulsatilla, mercury, dulcamara, rhus, ignatia, thuja, china, veratrum, arsenic, phosphorus, caustic, sulphur, sepia. Now, rheumatism proper, is an affection of the muscles and joints, chiefly of the shoulders, hips and knees. The pains are the same in all cases; differing only in intensity; and being either temporary and shifting, or permanent. A difference of intensity, or of temporary or permanent continuance of pain, is a difference only of symptoms. These symptoms are not the disease, and therefore should not constitute the object of treatment. Yet, Dr. Pulte prescribes for each symptom, as for a separate disorder. As a climax, he adds a provision that overturns the whole fabric of specifics, reared with such a degree of minuteness. It is as follows: "After a remedy has been tried for ten or fourteen days, another may be chosen, if no improvement has appeared."

The question that arises here, is this: Which other is to be chosen? If aconite has been tried for ten or fourteen days, and has failed, what other specific will answer the symptoms for which aconite has been prescribed? Will any of the other eighteen do? If so, and if the same liberty is allowed in the other eighteen cases, when, in a similar way, each specific fails to cure the symptoms to which it is said to be specifically applicable, what use can there be in assigning one specific to one class of symptoms more than to another? Why not allow these specifics to be guessed at, in the first instance, as well as afterwards? If aconite has failed, and belladona is next to be tried, what is the reason that belladona is not prescribed first; or, in other words, why is aconite made to take precedence of belladona? That provision is a virtual acknowledgment that the finely adjusted arrangement of symptoms and their specifics, is fallacious and deceptive. One addition only is wanting, to place the homœopathic system of curing symytoms in its true light. But Dr. Pulte, less candid than the famous chronothermalist, Dr. Dickson, suppresses what Dr. Dickson, under similar circumstances, frankly admits. Writing also under the head "rheumatism," Dr. Dickson says:

"Like the gout, it is a remittent disorder; and Dr. Haygarth, long ago, wrote a work illustrative of the value of bark in its treatment. My own practise is to premise an emetic; this I follow up with a combination of quinine and colchicum. If that mode of treatment fail, I have recourse to opium, arsenic, guiaic, mercury, silver, turpentine, copaiba, arnica montana, aconite or sulphur, or combinations of them; all of which remedies have succeeded and failed, in ague as well as rheumatism. In most instances of

acute rheumatism, the first combination will be found to answer perfectly, though in cases of long standing you may have to run from one medicine to another, before being able to bring about this desirable termination; and it is my duty to confess to you that, in some cases, particularly where either much depletion, or much mercury, or both, have been employed—as I grieve to say they too often are in the primary treatment—you may fail with every means you may devise."

It would be futile to ask the homœopathist or chronothermalist, what chemical relation there is between aconite or mercury and the symptoms of rheumatism; for there is not one sentence in either Dr. Pulte's or Dr. Dickson's book, to indicate, that either of them ever thought, that chemistry has anything to do with curing rheumatism or any other disease;—so completely is science excluded from those two systems of practice also.

In connection with the bearings of science on the sanatory condition of society and the health of individuals, it would scarcely be doing justice to our subject, if we neglected its moral considerations. These are comprised, in the obligation, imposed on each of us, in the first place, to know, and, after knowing, to conform to the laws ordained for the government of our material being. However necessary it is that medical institutions should form part of our social system, individuals are not thereby released from the obligation to study and to understand the precepts of natural revealation. For, inasmuch, as intelligence or the power of reasoning is a constituent part of man's nature, therefore, is the exercise of that reasoning power a duty, which cannot be disregarded without, at the same time, discountenancing the purpose for which it is given. What chiefly distinguishes the highest from the lower animals, and one man from another, is the capacity to comprehend, either by intuition or induction, the occult causes of the nature of things. "Omnis homines, qui sese student praestare ceteris animalibus, summa ope niti decet vitam silentio ne transeant, veluti pecora, quae natura prona, atque ventri obedientia, finxit. Sed nostra omnis vis in animo et corpore sita: animi imperio, corporis servitio magis utimur: alterum nobis cum dis, alterum cum belluis commune est."* He who is able, is, in duty, bound to exercise his faculties, for his own good and for that of his fellow creatures. With the proper exercise of those faculties, it is impossible not to perceive the wisdom of the arrangement which associates, with good or bad bodily functions, corresponding consequences. The moral influence capable of being

* Sallust.

exercised, through the knowledge of the fact that no indulgence in excesses of any kind can take place, without being followed immediately by consequences of a penal nature, can scarcely be over-estimated. It is customary, however, at the present day, to impute, to the divine dispensation, all bodily infirmities and domestic afflictions, without regard to the separate application which distinguishes the natural dispensation from the christian. In the prospect of a future state of happiness or misery, the public mind is, thus, made to lose sight of the measure of good or evil which every individual, by his particular conduct, causes to himself, in this world. The two dispensations are so blended, by official authority both secular and religious, that the distinction between them, if not completely obliterated, is, at least, scarcely discernible. Indeed, I know of no cause more calculated to produce individual omissions of personal and domestic duty, than the belief that the penalty is distant and uncertain. But no two things can be more distinct, in their consequences, than the natural and christian dispensations; for while the one relates exclusively to material concerns, to good and bad works; the other refers to a spiritual life alone, to the faith and disbelief from which good and bad works emanate. It is therefore palpable, that whatever has a material design is, necessarily, in its consequences material; and, accordingly, that, under the natural dispensation, misdeeds of omission or commission, carry with them, an immediate corresponding punishment in this life. For daily acts, punishment in a future state seems too remote; and is, therefore, inoperative on the fears and consciences of most people. Repentance, though late, gives hope; and procrastinates the resolution to reform. That faith or disbelief which shapes a man's general conduct, and is the primary source of his good or bad acts, is undoubtedly what merits an award in a future life; and this is the true interpretation of the scriptural doctrine. But the moral tendency of individual acts, is dependent on their being followed, by immediate corresponding consequences; and accordingly, if we interpret the natural revelation aright, we shall find that there are few examples, in which the happiness and misery we experience, are not of our own creation. In illustrating this, it is not necessary to go beyond the limits of hygiene and medicine. The consequences of crimes and offences against persons and property are, however, no exceptions to the general rule. But as our subject, properly comprises, only the conditions of body consequent on the knowledge or ignorance of its hygienic and medicinal requirements, it would be irrelevant to introduce what does not come under this head.

It is a popular opinion, derived from experience, that persons who indulge freely at table are generally short-lived. But the knowledge of this fact does not prevent the practice of said indulgence. The actual pleasure preponderates over the remote evil consequence. Death, however soon it may come, has no terrors for one who does not think it is immediate. The same thing happens in cases of indulgence exclusively in strong drink, in the use of drugs, in venereal and other excesses, in too close an adherence to the counting-house desk, and in many other ways, which are all violations of the natural rules of life. The parent who, regardless of the eternal consequences to himself, pursues a course which he knows must entail misery if not disgrace on his family, as well as bodily disease on his offspring, is yet a more forcible example of the little influence which a remote prospect of punishment has, in deterring persons from doing what they know is wrong. With a large portion of society, the moral influence, in this respect, is virtually dead; and the reason why propriety is disregarded, and a deaf ear turned to the voice of conscience, is, because the penalty is supposed to be uncertain and remote. The old Pythagorian basis of morality, which consists in the conventional habits of life, however well adapted to certain social conditions, loses a great part of its force in the midst of a commercial civilization, wherein men change their habits, customs and religious belief, with as much facility and unconcern as they change their dress. Something more is required, in this state of things, than dogmatical precepts, to preserve the moral framework of society. With the relaxation of the reins of civil and ecclesiastical government, the imagination can no longer be influenced, to the same extent, as could have been done under other circumstances. Nothing less than conviction will satisfy the minds of the enquiring masses. The reason must now be addressed. What appeals are made to the conscience, must be through the understanding. He who cannot perceive this, and, in ignorance, pursues the old course of dogmatical inculcation, is a real empiricist, and may justly be compared to empty brass or a tinkling symbol.

Present to an accessible and enquiring mind (and every mind is such, if approached in the proper way) the mode in which alcohol affects the body—that it immediately retards the change of matter, and thereby destroys the state of equilibrium between waste and supply—and an argument is offered which carries more force than all the total-abstinence lectures that ever were delivered. But observe, that the internal process must be illustrated, so as to be

understood; which is a simple matter. Telling, or lecturing, or preaching that such is the fact, will not accomplish the desired end. It may strike the imaginations of some, and make temporary adherents of many; but nothing less, than a scientific appeal to the judgment, can produce a deep and permanent conviction. What is more common than defective house drainage and bad ventilation, notwithstanding the admonitions on the subject which have gone forth in every conceivable shape? Gluttony in eating, one of the most common forms of intemperance, is not diminished, and never can be, by stale homilies on the advantages of moderation; for pickles and spices, which are used for the purpose of enabling the gourmand or dyspeptic, to cram into his carcase, more food than the natural appetite will admit, must continue to be fashionable so long as the understanding remains unenlightened, concerning the immediate chemical changes consequent on such indulgence. In vain, therefore, does the moralist inveigh against evil habits, if he does not adopt the proper means to attain his object; for it is evident that one fact, impressed on the mind by a process of conviction, is of more value than a thousand precepts, picked up by hearsay, and floating loosely in the fancy.

The time is not far distant, when the responsibilities of individuals and of society, under the natural revelation, will form, as they should do, the theme of pulpit eloquence. Why, in our style of preaching, one revelation only should be recognised, while the other is tacitly and virtually excluded, will cause, at some future day, no small share of amazement.

In the mean time, as an apostle and minister, under one department of the natural revelation, the duty of the medician is to expound the principles and take charge of the practice of the sanatory and healing art, strictly in accordance with that revelation. While organic chemistry puts him in possession of the conditions of health, chemico-medicine instructs him that the proper means of cure are those which exist in the healthy conditions.

He arrives at this knowledge, not by studying the human organism and functions alone; but through the analogy of the processes in plants and the lower animals, compared with those in man. That analogy, independent of what is said under the two heads, identity and equilibrium, is perceptible in those principles of hydrostatics and pneumatics which explain the porosity of woody fibre and animal membranes; their permeability by fluids; the ascent of the sap of trees; and the circulation of the fluids of the animal body, by virtue

of the evaporation from the surface and the pressure of the atmosphere; and the molecular and other conditions, necessary to overcome the force of capillary attraction, and the attraction of the parietes of vessels and duets. These ought properly to form parts of the curriculum of study, for chemico-hygiene and medicine. They unfold the conjoint mechanical and chemical causes, by which the juices of plants and fluids of animal bodies are moved in the circulation, and also in the process of endosmosis. Like many collateral branches of science, hydrostatics and pneumatics are indispensable to the student of chemico-medicine. In this department, Professor Liebig has done great service, no less to general philosophy than to chemistry, by his treatise on the analogy of the causes of the motion of the sap in plants, and the fluids in animal bodies. These hydrostatic and pneumatic branches open up a new and wide field, from the further cultivation of which the most important results may be anticipated. They are too comprehensive, however, for a work like this, which is designed to give simply an outline of the leading principles of the chemistry of health and disease; and, therefore, are not included in the present treatise.

The analogy between the chemistry of plants and of animals, which is more immediately indispensable to the elucidation of our subject, relates to the unchangeableness of the primary elements, and the equilibrium of the chemical functions of organized bodies. Under the two heads, identity and equilibrium, what is said in the following pages has reference, accordingly, as much to the vegetable as to the animal kingdom. The additional chapter, on displacement, as it relates to the action of the nerves exclusively, is applicable only to animals.

CHAPTER I.

IDENTITY.

The word "identity" denotes the sameness or unaltered state of a thing, under different circumstances and relations. When a living person becomes drowned, and a dead body is afterwards found in the water, the proof that the body so found is the same as of the person who was known to have been alive, is said to be the proof of its identity. Or, the identity may be of whole species; as, in gathering apples from the trees in an orchard, the pippins, russets, snows and crabs, may be mixed in one heap, and each species be afterwards identified, as having been taken from trees of that species. The identity of the elements or ultimate constituent parts of organized bodies, under various circumstances, forms the starting point of the chemico-medicinal system of practice. It assumes that each element which forms part of the food of a plant or animal, preserves the same size, the same shape, and the same chemical affinities, in every situation in which it may be placed. For example, a particle of carbon is of the same size and form, whether existing in carbonic acid, in alcohol, in the fat of the body, or in the diamond; consequently, the elements of the food preserve their elementary characteristics in the stomach, blood, tissues, excretions, and, finally, in the soil or air. On this view is founded the objection to all substances as medicaments, whose constituent elements are different from those of the food; as well as of all substances, as food, whose constituents are different from those of the body. Seeing the important bearing which this principle of the identity of the elements exercises, on both hygiene and medicine, it therefore claims a minute and careful exposition.

To the contrary and prevalent belief, that the elements of the food become changed in the body, by the vital force, is to be imputed the erroneous views which have been entertained, with respect to the use of the deleterious and poisonous preparations of the pharmacopoeia. The nature of the changes which have, thus, been supposed

to take place being inexplicable, no rule, having a universal application, has ever been known to obtain. The belief that the elements of the food, as of vegetables and milk, become changed in their essential properties, before that bone, flesh and brain can be produced, has precluded the idea of tracing these elementary constituents; for to identify the carbon of milk in the blood or tissues, could not have been conceived to be possible, while the impression existed that the carbon lost its purely carbonaceous properties by digestion and assimilation. Not only medicine, but hygiene, came thus to be established also on a purely empirical foundation. The comparative usefulness of gluten and starch could not be perceived. The different purposes of albumen and fat were as little known as if these substances themselves were beyond our cognizance. Even at the present day, there is no stronger proof of the false empirical notions, with respect to diet, than is evidenced in the rules for using butcher meat, vegetables, alcoholic beverages, &c. Though these rules are various, and notwithstanding the progress which has been made in organic chemistry, it seems not to be known that beef has a specific use altogether distinct from vegetables, and serves a separate purpose in the animal economy. There are thus erroneous and indefinite rules for hygiene, as there are contradictory modes of practice in medicine,—inconsistencies that are altogether attributable to the notion, so generally prevalent, that, in the processes of digestion and assimilation, the elementary constituents of the food lose their original properties.

In considering the subject of identity, it would be improper to overlook the doctrines of ancient philosophers and modern thinkers, in relation to it. These doctrines will be recognized under the appellation of the atomic theory. So early as the fifth century before the Christian era, two philosophical schools or sects flourished in the Greek colonies of Ionia, in Asia Minor. They were distinguished chiefly by the notions, which they respectively held, concerning the unchangeableness of the primary elements, or, what they termed, the atoms of matter. One sect, being necessarily pantheistic in its views of creation, held the belief that the universe existed by virtue of a power within itself, which was forthforming and progressive; and consequently, as there was no motive power distinct from matter, that the power of motion and generation was possessed by each atom; the aggregate power of the whole being a unity, comprising the powers of the several parts. Each atom was therefore supposed to have a power within itself of generation and mutability,

by the action of which the properties of the atom were continually undergoing change. On account of placing the power of motion in the material atoms, the members of this sect, the most prominent of whom were Thales, Anaximenes, Diogenes and Heraclitus, were called Dynamicists, from δύναμις, which signifies force or power. The other sect, of whom Anaxagoras was the most perfect type, distinguished between the moved matter of the universe and the moving power; that is, between God and the creation. It was maintained by this sect that each atom of matter had been impressed, at its original creation, with a certain form, certain size, and certain combining properties; and was not capable of acting in any other way, or of assuming any other form, than what was peculiar to it at its original inception. As the atoms were thus supposed to perform mechanical functions, in obedience to a power impressed on them from without, the members of this other sect were known under the appellation of Mechanicists.

About the same time, the atomic theory was inculcated by another school of Grecian philosophers, called Sophists, at Abdera, in Thrace. The most prominent of this school was Democritus; and the chief peculiarity of its doctrine, was the existence of a vacuum, surrounding every atom of matter.

Coming down to the beginning of the last century, Boscovitch, an Italian mathematician, advanced the hypothesis, that the primary atoms are mathematical points, without extension, but possessed of the properties of attraction and repulsion. This singular doctrine found an advocate, no later than 1844, in the person of Dr. Faraday.

The atomic theory has, however, received its most complete development from the English chemist and mathematician Dalton; whose views, may be said, to be generally predominant among European and American scholars, at the present day. Dalton assumed, that each atom is surrounded by a space or atmosphere; and that, in a composite body, which is an aggregation of atoms and their surrounding spaces, contraction and expansion are simply a diminution and increase of the intervening spaces:—for example, that in the freezing of water, the spaces become smaller; and when water evaporates, the spaces become larger; at the same time, that the atoms of hydrogen and oxygen, of which water is composed, retain their original sizes, being themselves incapable of increase or diminution.

Now, in tracing the identity of the elements of the food, as they appear consecutively in the fluids, solids and secretions of an organ-

ized body, all that concerns us, is the ability to distinguish one class of elements from another, without regard to the intervening spaces, or the divisibility of what are considered as atoms. These latter are debatable points, and fortunately, it happens, they are not comprehended in the researches of chemico-medicine. All that we have to do with, is the identity of the elements—the proof of their unchangeableness under every variety of circumstances. Whether each element of a compound has or has not a surrounding space, capable of contraction and expansion, and is capable or incapable of division, are questions altogether irrelevant to our subject. Therefore, we readily set aside the views of Democritus, Boscovitch and Dalton. With Anaxagoras, however, the case is different. His doctrine contains nothing which is not demonstrable, by the ordinary methods of proof; and, moreover, corresponds with the doctrine of identity as it is understood by the modern organic chemist. Accordingly, we find that Anaxagoras, reasoning from the premises that the primary elements, whether in the organism or out of the organism, are identical in shape and size, and are in no way whatever changed, inferred that all the parts of an organized being must have existed previously in its food.* He promulgated this inference; but, in that age, it did not admit of proof, for experimental science was then in its earliest infancy. Its verification was not possible, before that chemistry should have become so far advanced as to be applicable to the analysis of organized bodies. It is remarkable, notwithstanding, that in the long interval of two thousand two hundred years since his time, the important truth comprehended in this inference, should not only have borne no fruit, but should have lain concealed among the hidden treasures of the past, as the relict of a dead and obsolete philosophy.

ELEMENTS OF THE FOOD, OF THE ORGANS, AND OF THE EXCRETIONS.

What are meant by elements are the different classes of simple substances, which are respectively composed of homogenous parts. An element, in this sense, is different from an atom which denotes

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* Plut. de Pl. Ph. 1, 3. Καὶ ἐκ ταύτης τῆς τροφῆς τρέφεται θριξ, Φλέψ, ἀρτηρία, νεῦρα, ὀστᾶ, καὶ τὰ λοιπὰ μόρια. τούτων οὖν γινομένων ὁμολογητέων ἐστίν, ὅτι ἐν τῇ τροφῇ τῇ προσφερομένῃ πάντα ἐστὶ τὰ ὄντα.—Arist. de Gen. Anim. I. 18.—Simpl. Phys. fol. 106 a.

something that cannot be divided. When we treat of carbon, as an element, what is understood is the substance carbon, without reference to the quantity, whether a minute particle or large volume. So likewise of the other elements, it is the homogenous quality which is implied.

The number of elements, comprised in the food of plants and animals is fourteen. They are divided into two classes; principal elements, and elements of the ashes.

Principal elements, are so called, because they make up most part of the bulk of organic substances. They are distinguished besides, from the other elements, by the property of separating in a volatile state, when a substance is calcined; or decomposes, by the natural process of decay and putrefaction.

The elements of the ashes, on the other hand, after the process of calcination or decomposition has been completed, are the residue or what remain in a pulverized or solid state; and from this circumstance they derive their name.

The large proportion of the principal elements, compared with those of the ashes, is much the same in all organic substances. The following substances, dried respectively at 212° and 230° Fahrenheit, yield, by calcination or decomposition, the proportions per cent., of volatilized and residual elements here stated:

	VOLATILIZED BY CALCINATION.	RESIDUAL, AFTER CALCINATION.	AUTHORITY.
Wheat, 230°	97.6	2.4	Boussingault.
Rye, do.	97.7	2.3	"
Peas, do.	96.9	3.1	"
Beans, do.	96.9	3.1	"
Lentils, do.	96.9	3.1	"
Oats, do.	96.	4.	"
Potato, do.	96.	4.	"
Flesh (beef) 212°	95.77	4.23	Playfair & Boeckmann.
Ox blood, do.	95.58	4.42	"
Oats straw, do.	95.58	4.42	Liebig.
Turnips, 230°	92.4	7.6	Boussingault.
Barley straw 212°	91.46	8.54	Schrader.
Hay, do.	91.	9.	Liebig.
Wheat straw, do.	84.5	15.5	H. Davy.

It will be seen by this, that the great difference in the quantity, of the two classes of elements, justifies our applying the term *principal elements*, to carbon, hydrogen, nitrogen and oxygen. And, on

the other hand, the circumstance of the other ten being a residue in all cases of incineration and decomposition, makes *elements of the ashes*, an appropriate appellation. The following, are the two classes of elements:

PRINCIPAL ELEMENTS.	ELEMENTS OF THE ASHES.	
1. Carbon.	5. Phosphorus.	11. Calcium.
2. Hydrogen.	6. Sulphur.	12. Potassium.
3. Nitrogen.	7. Iron.	12. Magnesium.
4. Oxygen.	8. Chlorine.	13. Fluorine.
	9. Sodium.	14. Silicon.

These are the elements of all organized bodies; of plants as well as of animals. As whatever constitutes the elements of the food, constitutes also the elements of the organs and of the excrements; so, we find, that the fourteen elements mentioned here, exist in all three of these different circumstances or forms.

First, in plants, which derive their food from the air and the soil. The last ten of the above fourteen elements, being found in the soil, in the form of salts. And the first four, partly in the air and partly in the soil, in the form of carbonic acid and ammonia.

Second, in the graminivora, which subsist exclusively on plants, such as hay, clover, grasses and herbs; the constituents of which are exactly the fourteen elements here enumerated. Boussingault's analysis of oats, dried at 212 F., gives 50.7 per cent. carbon, 6.4 hydrogen, 2.2 nitrogen, 36.7 oxygen, and 4. ashes. By the analysis of Dr. Will, oaten straw which is eaten readily by cattle, yielded, when dried at 212° F., 46.3 carbon, 5.68 hydrogen, 43.93 oxygen, and 4.02 ashes. These ashes, by Berthier's analysis, contained, in 100 parts, the following:

Carbonic acid	a trace.
Sulphuric do.	1.
Phosphoric do.	.60
Muriatic do.	6.50
Silica	55.
Lime	2.90
Oxide of iron and charcoal	5.
Potash and soda	29.
	100.

Third, in the carnivora, which feed on the bodies of the graminivora; and, therefore, consume and appropriate the same fourteen elements. The following analyses of the chief parts of the ox, which are eaten as food will exemplify this:

OX BLOOD. (*Boeckmann.*)		OX FLESH. (*Boeckmann.*)		BONE. (*Berzelius.*)	
Carbon	51.96	Carbon	51.89	Cartilage	32.17
Hydrogen	7.33	Hydrogen	7.59	Blood vessels	1.13
Nitrogen	15.08	Nitrogen	15.05	Phosphate of lime	51.04
Oxygen	21.21	Oxygen	21.24	Carbonate do.	11.30
Ashes	4.42	Ashes	4.23	Fluate do.	2.
	100.		100.	Phos. of Magnecia	1.16
				Soda, Chloride of Sodium	1.20
					100.

The bodies of the carnivora, in their constituent elements, are necessarily the same as those of the graminivora. The above analysis of the blood, flesh and bone of the ox, are also those of the same parts of the carnivora.

Fourth, in man, who is said to be omnivorous, on account of his varied appetite, for the numerous products of both the vegetable and animal kingdoms. But, notwithstanding the many and divers sources from which he draws his food, its constituent elements do not exceed, in number or variety, those which are common to the food of plants and the lower animals: a proof of the identity of the constituents of the food of every thing which has life. For the human body itself, either in life or when, after death, it is decomposed, presents no other constituents than of the fourteen elements already enumerated.

Of the animal substances, besides the flesh of the ox, which supply nutriment to the human body, eggs and milk may be noticed, as among the principal; from the circumstance also, that they form the only nutriment of many species of animals, during the earlier periods of their existence. Eggs, by the analyses of Jones and Scherer, contain, carbon, hydrogen, nitrogen, sulphur, phosphorus, chlorine; potash, soda and their carbonates; and lime and magnesia, and their carbonates. By the analasis of Schwartz, cow's milk contains, besides carbon, hydrogen, nitrogen and oxygen, also soda combined with lactic acid, chloride of potassium, and the phosphates of soda, lime, magnesia and iron.

Among fish, Morin furnishes an analysis of the flesh of the smelt; by which we find that, besides the principal constituents it contains sal ammoniac, phosphates of potash, lime, iron and magnesia, chloride of potassium, carbonate of lime, and lactate of soda.

The food of plants and animals is, thus, seen to be derived from the soil and atmosphere; and to consist of fourteen elements, all of

which are traced in the various forms of vegetable and animal organization. These analyses are a verification of the *a fortiori* argument of Anaxagoras, that all the parts of an organized being must have existed previously in its food. It may seem superfluous, to undertake the proof of what is self-evident the moment it is presented to our reason; for, we cannot conceive of any other source or means, by which an organized body can become possessed of any part of its substance, than through its food. And if the truth of the *a fortiori* proposition was all that was intended to be proved, there might be some reasonable ground for seeming to think that these analyses are unnecessary. They serve an important purpose, however, which, it is proper, we should clearly understand. The value of the experiments which have been made consists, in their furnishing the proof, that the elements of the animal body are the same that existed previously in plants; and that the elements of plants are the same that existed formerly in the air and soil. The purpose which these analyses serve is, therefore, the proof of identity; a most important object, when we consider that the prevalent belief imputes, to the vital force, the power of generating, in the organism, elements not primarily derived from the food. It is to demonstrate the falsity of this prevalent belief, and thereby to do away with the evil consequences attending it, in hygiene and medicine, that the proof of identity requires to be firmly and indisputably established. When it is proved that, under no circumstances whatever, does antimony, iodine, calomel or arsenic exist in the normal state of the organism of a plant or animal, an argument is adduced why neither of these substances should ever be administered artificially to a plant or animal. The argument is conclusive, unless we are prepared to find fault with the order of nature, and presume to set the artifices of man above it. Following still, the natural indications, there is no such thing as plants and the lower animals being supplied with powerful stimulants and narcotics. The constituents of plants and of the bodies of the lower animals are definitely known, and it is therefore an ascertainnd fact, that they do not contain such powerful substances, which are never supplied in their natural food. But the constituents of the human body are no less definitely ascertained; and, as under no normal conditions, do they comprise stimulants or narcotics, the natural law forbids in this case also, the administration of such substances. Let it be observed that the rule is derived from a knowledge of the natural constituents of the food, of the body, and of the excrements. And that the proof of identity of the

constituents, is a proof that stimulants and narcotics, &c. &c. &c., are foreign substances, whose presence in plants and in the bodies of the lower animals and man, is unnatural; and, therefore, injurious. The settlement of the question of identity is, therefore, intended not only to eradicate from medicine the employment of deleterious substances; but likewise to restrain, from general hygiene, the use of unwholesome articles of diet.

The chain of identity, through animals and vegetables, to the air and soil, is implied, though not expressed, in the proposition of Anaxagoras. For, if the parts of an organized being existed previously in its food; and plants are the food of animals; and constituents of the air and soil are the food of plants; therefore, the parts of an animal are the same parts which existed formerly in the air and soil. Keeping in view, that the atomic elements of the mechanical philosophy were incapable of transmutation, either of size or form or chemical affinities, this is the legitimate conclusion, from the proposition of Anaxagoras, inductively carried out.

The fourteen elements are identified in the excretions. Human excrements consist of the faeces, urine, breath and perspiration. Whatever enters the body, as food, passes from it afterwards in one or other of these forms; and in the same quantity, as in the food received. Faeces, besides the principal elements, contains, by the analysis of Playfair, 13.58 per cent. of ashes; according to Berzelius, 15 per cent. The variation is accounted for by the difference in the degree of concentration of the food. The following analyses of one thousand parts of human urine, and one hundred parts of guano, will convey an idea of the elementary constituents of liquid and solid excrements:

HUMAN URINE.

(*Berzelius.*)

Urea	30.10
Free lactic acid, lactate of ammonia, and animal matter not separable from them	17.14
Uric acid	1.
Mucus of the bladder	.32
Sulphate of potash	3.71
Sulphate of soda	3.16
Phosphate of soda	2.94
Phosphate of ammonia	1.65
Chloride of sodium	4.45
Muriate of ammonia	1.50
Phos. of magnesia and lime	1.
Siliceous earth	.03
Water	933.
	1000.

GUANO.

(*Volckel.*)

Urate of ammonia	9.
Oxalate of ammonia	10.6
Oxalate of lime	7.
Phosphate of ammonia	6.
Phos. magnesia and ammonia.	2.6
Sulphate of potash	5.5
Sulphate of soda	3.8
Sal-ammoniac	4.2
Phosphate of lime	14.3
Clay and sand	4.7
Organic substances not estimated, containing 12 per cent. of matter not soluble in water. Soluble salts of iron in small quantity.	
Water	32.3
	100.

Analyses are, often, not perfect; because those made, by different chemists, do not exactly correspond. If the methods of experimenting were not defective, each operator should be able to detect, in each secretion, all the elements which properly belong to it, and which are present in it. Sometimes one or more elements may be overlooked, by one experimenter, that may be detected by another. Or the quantity of each class of elements may not be equally the same. These variations may be occasioned by dissimilar articles of diet, as well as by defects or differences in the methods of experimenting. Under these circumstances, the proper course is to take the averages of all properly authenticated reports; and, in this way, we are satisfied that the analytical reports, furnished from different sources, however incomplete they may be in their details, are, upon the whole, perfectly reliable. For example, in the above analysis of urine, twelve only of the fourteen elements are stated. Fluorine and iron are wanting. An oxide of iron appears in the perspiration. But it should appear also in the urine. Fluorine also, which is a constituent of the bones, should appear in the urine. Again, the difference between 13.58, the per centage of Playfair, and 15, the per centage of Berzelius, in one hundred parts of faeces, does not affect the accuracy of either analysis. They are supposed to be both correct. Finally, the poisonous substance picrotoxine, a constituent of cocculus indicus was, at first, supposed to contain no nitrogen; because, in all the experiments that had been made, nitrogen had not been detected; though it was discovered afterwards, that nitrogen is a constituent of cocculus indicus. The error, in the previous analyses, was occasioned by the smallness of the quantity of nitrogen, and consequently, its inappreciableness, by the tests employed. Taking, however, the averages, the reports show that the fourteen elements are detected in the excrements which pass from the body; that is, in the faeces, urine, breath and perspiration.

They are also identified afterwards in the air and soil. This is the case with the excrements of all animals; and also with the decomposed constituents of their bodies after death. As has been stated, when wood, flesh and solid excrements are burned thoroughly, their principal elements become volatile and ascend. The residue, consisting of the ten elements of the ashes, remains on the ground. And so it is also, with plants and animal bodies, when in place of being burnt, they become dissolved by the natural process of decomposition.

Thus, we perceive, that what were derived from the air and the soil, in the first instance, to form and nourish the bodies of plants

and animals, return finally to the air and soil again, after having served the purposes of organized life: A beautiful example of the simplicity and exactitude of the order of creation; by which a few elements appear successively under the most different aspects; and move in a circle, from the inanimate soil and atmosphere, through every phase of organized vitality, back again to the soil and air; thence to repeat, through thousands of generations, and throughout all time, the same invariable routine.

THE ULTIMATE COMPOUNDS OF ORGANIZED BODIES.

Though, as we have seen, by what has been said in the preceding section, that the fourteen elements are capable of being traced and identified in their different organic forms; still they are not found existing, severally, in a state of isolation from each other; but, on the contrary, are met with as compounds. It is in their compound forms that they are recognized; first, in the air and soil; afterwards, in the structure of plants and animals; and finally, in the excrements, and in bodies undergoing decomposition. It is observable that, in the capacity of compounds, limited in number, they perform a circuit similar to what has been already described.

The four principal elements exist, in their compound states, as carbonic acid, ammonia and water. The first of these compounds, carbonic acid, is composed of one part, by weight, of carbon, and two of oxygen. It is accordingly represented by the symbol C O_2. The second compound, ammonia, comprises one part, by weight, of nitrogen and three of hydrogen. Its symbol is accordingly N H_3. The third, water, has one part hydrogen and one oxygen; its symbol being H O.

On the other hand, the ten elements of the ashes are compounded among themselves, with oxygen, variously; and the compounds are named after their constituent elements; as, phosphate of lime (phosphoric acid and the oxide of calcium; or phosphorus and oxygen and calcium and oxygen). In like manner, phosphates of magnesia, soda and ammonia; sulphates of lime, ammonia, soda and potash; fluoride of calcium; chloride of sodium; and silicates of potash and lime.

These two classes of compounds; the one, of the principal elements; and the other, of the elements of the ashes; are called ultimate compounds. Because all other compound forms, whether

of the stem, juices or fruit of plants, or of the blood, tissues, bile or urine of the animal body, are reduced to these; as, originally, they are derived from them. And, as carbonic acid $C O_2$, ammonia $N H_3$, and water $H O$, are the only three forms in which the principal elements, as ultimate organic compounds, exist, primarily in the air; and are also the only three forms, in which they return to the air again, after having served in the living organism; so, it is *their* identity that we are now concerned in tracing, throughout their various transpositions, in vegetables and animals.

The compounds, as they exist in the fluids and tissues, are, however, more complicated than these. For example, albumen, which has the formula $C_{48} H_{36} N_6 O_{14}$, is the principal compound of nutritive food, and also of blood. But, inasmuch as it is reducible to the ultimate compounds, by the addition of oxygen, which is always present in the air; and inasmuch as it is ultimately resolved into these three compound forms by decomposition; they are for these reasons, the proper criteria for the proof of identity. The following, will show how albumen is reducible, to the three ultimate compounds, by the addition of oxygen:

Albumen	$C_{48} H_{36} N_6 O_{14}$	48 part.	Car. Acid,	$C O_2$	$= C_{48}$	O_{96}
Add	O_{100}	6 "	Ammonia,	$N H_3$	$= H_{18} N_6$	
		18 "	Water,	$H O$	$= H_{18}$	O_{18}
	$C_{48} H_{36} N_6 O_{114}$					$C_{48} H_{36} N_6 O_{114}$

Albumen is here converted into carbonic acid, ammonia, and water, by simply adding 100 equivalents of oxygen—an addition which takes place in the ordinary process of respiration, when a person inhales pure air. This change takes place also when albumen, in a state of putrefaction, is exposed to the air. For the work of oxidation then goes on most vigorously; the oxygen of the atmosphere, with the conditions of warmth and moisture, being the only agent, which produces the decomposition. In a similar manner, the other more complicated compounds of organized bodies, are all convertible, into these ultimate compounds. Blood and flesh, if the ten elements of the ashes are excepted, are, with the addition of oxygen, composed exclusively of carbonic acid, ammonia, and water. In short, these ultimate compounds, originally of the atmosphere, interveningly of all plants and animals, as well as of their excrements and decomposed bodies, and finally of the atmosphere again, are what we are able to trace; and, in tracing which, are able to identify, as the last products of the decomposition of all organized substances.

NUTRITION.

The nutriment taken by a plant, is intended, to supply it with the constituents of its stem, branches, leaves and fruit. An animal takes food also, for the purpose of furnishing its body with the elements necessary to form bones, membranes, flesh, cerebral and other matters which enter into its composition.

The way to find out what food is proper for any particular species of organized being, such as an oak tree or an ox, is to ascertain the constituents of its body. Therefore, when we know that the roots, stem, branches, leaves and juices of an oak tree are composed of carbon, water and certain organic salts, we possess a knowledge of the constituents of which its food should consist. The food of an oak tree is, accordingly, carbon, water and certain organic salts. No other nutriment is required; no other would answer; and should any other be substituted, in its stead, the tree would wither and die. Animals similarly circumstanced would share the same fate. The body of an ox consists of nitrogen, carbon, water and certain organic salts. Its proper food is, thereby indicated, to be exactly these same constituents; which, moreover, should be compounded, in the exact proportions, in which they exist in the tissues of the animal. Any deviation from their natural combining proportions, cannot take place without being followed by an equal amount of detriment, which is soon perceptible in the condition of its body.

The simplest way to determine the constituent elements and their proportions in the solids of the body, would be by examining the fluids; for the solid parts of a tree are formed from its juices, as are all the solid parts of an animal from its blood. But this is not practicable; because our means of experimenting, by chemical analysis, are not sufficiently refined to enable us to detect, in the fluids, the proportions of the minuter constituents. The custom, therefore, is to analyze each of the solid parts separately. This round about method, however clumsy it may seem, is necessary under the circumstances.

Substances which are used, by animals, as food, are distinguished by the presence or absence of nitrogen. Those containing nitrogen, are the most nutritious; such as the seeds of grass and corn, leguminous seeds, fruits, vegetables, fish and the flesh of animals. Non-nitrogenous substances, are such as sugar, starch and fat. The former exist in the body, as compounds of nitrogen, the latter as compounds of carbon.

The nutritious compounds of nitroginized food, are known as albumen, fibrine and caseine. Each of these compounds contains the same elements, and in the same proportions; with the exception of the elements of the ashes, phosphorus and sulphur, which vary in quantity. This will be seen, by comparing their formulæ:

Albumen, $C_{48}\ H_{36}\ N_6\ O_{14} + S_2 + Ph.$
Fibrine, $C_{48}\ H_{36}\ N_6\ O_{14} + S + Ph.$
Caseine, $C_{48}\ H_{36}\ N_0\ O_{14} + S$

Mulder, who made the discovery that albumen, fibrine and caseine, contain the same principal elements and in the same proportions, discovered also that there is no difference between the vegetable and animal forms of these compounds. To the formula of the principal constituents, which is the same in all three, he gave the name protein (from *προτεινω*, I hold before, or I hold the first place). He also adopted the following formulæ, which are more convenient:

VEGETABLE.	ANIMAL.
Albumen = Protein + S_2+Ph.	Albumen = Protein + S_2+Ph.
Fibrine = Protein + S+Ph.	Fibrine = Protein + S+Ph.
Caseine = Protein + S	Caseine = Protein + S

Articles of diet, which contain the principal elements, in the proportions in which they exist in protein, are the most nutritious; provided they contain also the elements of the ashes, which are indispensable. All nutritious substances, such as butchers' meat, fowl, fish, grain and vegetables, in short, all nitrogenous products, intended for our food, existing in a natural state, and used by us, contain protein and the necessary elements of the ashes. That is, they contain albumen, fibrine or caseine. When it is required to ascertain the nutritive properties of an article of food, enquiry is directed to the quantity of protein and the elements of the ashes, or of albumen, fibrine or caseine. The amount of nutrition, is in the direct ratio, of the quantity of either of these.

With respect to the propriety of using butchers' meat, or animal flesh of any kind, there has been a difference of opinion. A comparatively few maintaining that, by the indications of nature, it was designed that the human species should subsist on vegetables alone. This question admits of two lines of argument. A physiological, in favor of vegetable diet only; and a chemical, in favor of both vegetable and animal food. If the structure of the teeth and lower jaw alone, is considered, it would seem that, analogically, they are designed to macerate granular snbstances only. The double verti-

cal and horizontal action of the lower jaw, and the molar structure, of the lateral teeth, clearly demonstrate this purpose. And if, from the structure, the rule permits us to infer the functions, then is it evident that man does not belong to the beef-eating species, and is not a carnivorous animal. So far, the argument is conclusive, on one side. But, on the other, organic chemistry demonstrates, just as conclusively, that the muscular tissue of beef and pork and other animal meats, when used as food by man, becomes assimilated in his body as muscular tissue also. And, moreover, that these meats contain, severally, the same constituent elements, and in the same proportions; that they exist in the human body. Not only are the blood and muscle of man composed of elements the same as those of the lower animals which constitute his food, and in the same proportions, but the constituents of his blood and muscle correspond, qualitatively and proportionately, even with the elements of the plants on which those lower animals subsist. Animal and vegetable fibrine, albumen and caseine, containing the same classes of elements and in the same proportions.

Practically, the preponderance of a beef diet, as among the English; or of vegetable food, as with the Chinese, is dependent for its suitableness, in each separate case, more on climate and the amount of bodily labor, than on any abstract principle, applicable unconditionally to the whole human species. Health and longevity are not peculiar to the Chinese, who feed on rice, more than to the North American Indians, who live almost exclusively on the flesh of the deer; or of the Esquimaux, who subsist on flesh and blubber, and never taste vegetable food. Rice exclusively, is wholesome and appropriate food, in a tropical climate; but, the Esquimaux would not survive long, on such diet. So, with the inhabitants of China, a constant diet of the flesh of the deer or walrus, could sustain life, only for a comparatively short time. These facts clearly demonstrate, that animal and vegetable diet are both proper; and that the proportions in which they should preponderate, is determined by the temperature of the climate, and the amount of waste, by labor, which the body is accustomed to undergo.

Vegetable fibrine is the gelatinous precipitate observable, when the juice of a plant is pressed out, and allowed to stand for a short time. It is not soluble in water. In the soluble liquid which remains, when heated to the boiling point, is found a coagulated mass, which is vegetable albumen. Vegetable caseine, is obtained chiefly from the expressed juice of leguminous seeds, such as peas, beans, and

lentils. It is soluble in water, but not coagulable by heat. It is coagulable however by the action of an acid; and, when heated, a skin forms on its surface, such as takes place on milk that has been boiled. These are the forms, in which the nutritive constituents exist in all nitrogenous nutritious plants.

Animal fibrine exists in blood, lymph and chyle. It is the crassamentum or clot that forms in blood, when drawn from the body. The lean of beef is chiefly fibrine. It is insoluble in water. Animal albumen is the floculent substance which appears in the serum of blood or the white of egg, when neutralized by ascetic acid, with the addition of a sufficient supply of water. The watery or serous part of blood, and the white of egg are both, therefore, albuminous substances. Like vegetable albumen they are soluble in water. Animal caseine, is the curd of milk, neutralized by an acid. In the milk, it preserves its solubility, by means of the potash which milk contains. It is not soluble in water. The nitrogenous nutritious parts of animal substances, consist, thus, of animal albumen, fibrine and caseine.

The non-nitrogenous compounds which are used as food, such as sugar, starch, butter, fat and oil, are composed exclusively of three of the principal elements; namely, carbon, nitrogen and oxygen. They do not contain any of the elements of the ashes. The difference between them is occasioned by the different proportions in which the same elements are combined. This will be seen in the following formulæ of equivalents:

CANE SUGAR.	STARCH FROM THE LEGUNINAE.	MUTTON FAT.	OIL OF BITTER ALMONDS.
(*Berzelius.*)	(*Strecker.*)	(*Chevreul.*)	(*Liebig.*)
$C_{12}\ H_{11}\ O_{11}$	$C_{12}\ H_{10}\ O_{10}$	$C_{11}\ H_{10}\ O$	$C_{14}\ H_{6}\ O_{2}$

Or calculated by the per centage, by weight, the formulae will stand thus:

CANE SUGAR.	STARCH FROM THE LEGUNINAE.	MUTTON FAT.	OIL OF BITTER ALMONDS.
(*Berzelius.*)	(*Strecker.*)	(*Chevreul.*)	(*Liebig.*)
Carbon..... 42 225	Carbon ... 44.91	Carbon..... 78.996	Carbon..... 79.56
Hydrogen. 6.600	Hydrogen 6.11	Hydrogen. 11.700	Hydrogen... 5.56
Oxygen.... 51.175	Oxygen... 48.98	Oxygen.... 9.304	Oxygen..... 14.88
100.	100.	100.	100.

As with the nitrogenous compounds, it was shown at page 34, they are reducible, by the addition of oxygen which is always present, to their ultimate compounds, namely, carbonic acid, ammonia and water; so, with these non-nitrogenous substances, the addition

of oxygen makes them yield the ultimate compounds, carbonic acid and water. The following is an example:

Cane sugar	C_{12} H_{11} O_{11}	12 eq. of carb. acid	CO_2	=	C_{12}	O_{24}
Add	O_{24}	11 " water.....		=	H_{11}	O_{11}
	C_{12} H_{11} O_{35}				C_{12} H_{11}	O_{35}

These two classes of compounds, nitrogenous and non-nitrogenous, serve two distinct purposes, in plants and animals. The former, exist, in nutritious fruits and seeds, and in fleshy tissues and muscle. The latter, in ligneous or woody fibre, and in fat and oleagenous formations. In the selection of food, attention should be paid to the purpose which it is intended to serve. If the object is to produce seeds or fruits, or muscular tissue, care must be taken that nitrogenous substances are supplied. But if the intention is to produce woody fibre,* sugar, starch or animal fat, the proper food is the non-nitrogenous. The agriculturist who neglects this distinction, will be sure to meet with constantly recurring disappointments, in the unproductiveness and failure of his crops. And the breeder of cattle, who is ignorant of the rule, cannot expect any other fate than the loss and waste of the means, which otherwise could be made productive, to the fullest extent.

Keeping in view the comparison, between the analized constituents of organized bodies and the analized constituents of their food, let us now consider the process of nutrition. Plants draw in their nutriment by two different channels. Their carbon, as carbonic acid, is absorbed, by the leaves, from the air. Their nitrogen, in the form of ammonia, together with organic salts and water, are imbibed from the soil. The carbonic acid enters the leaves chiefly during the night, at which time they become perfectly saturated with the gas. So soon, however, as the sun's rays strike on the plant, in the morning; and in the day time also, during the action of the solar rays; the carbonic acid becomes decomposed. The carbon, in combination with the salts obtained from the soil by the roots, becomes assimilated, as woody fibre, and forms a permanent deposit. At the same time, the oxygen is eliminated by the leaves, as an excrement; and is returned to the air, to serve afterwards for the respiration of animals and for combustion. The deposition of woody fibre, necessarily presupposes two continuous currents, in the stem and branches of a plant, one descending the other ascending, for the conveyance of the

* See Liebig on Forest Culture.—*Agricultural Chemistry.*

soluble nutriment to all parts, from the leaves and roots; and for the carrying away of substances, to be expelled, as excrementitious. The ammonia enters by the roots, together with the organic salts and water. This ammonia is one of the volatilized products of putrefaction. When, for example, vegetable or animal substances, containing nitrogen, become decomposed, by rotting, their nitrogen combines with the hydrogen of water; and, in this state, the combination of nitrogen with hydrogen, in the proportions of one equivalent of the former to three of the latter, forms ammonia, which evaporates and passes off into the air. But, unlike carbonic acid, it does not remain there. It returns to the earth, in every shower of rain and snow; and is the source, whence the cereals of grass and corn, the fruits of trees and leguminous seeds receive their nitrogen. In the process of nutrition, this nitrogen, imbibed as ammonia along with the organic salts and water, is carried from the roots to the heads of corn and grass, and to the buds of fruit trees; and is there deposited, in albuminous or other compound forms.

The process, in animals, may be summed up in a few words. From the mouth, where it is mascerated, the food passes along the oesophagus into the stomach; in which, acted on by the hydrochloric solvent of that organ, it becomes digested. From the stomach, it passes, as a chymous mass, into the intestines; mixes there with the bile and panereatic juice; is constantly turned and compressed, in a vermicular manner, so that its soluble parts may be brought in contact with the parietes or sides of the intestinal canal; and thereby become absorbed, by the innumerable absorbent vessels which open into it, at every point. A separation, however, takes place in the intestinal canal, between the soluble and insoluble parts of the food. The insoluble parts are borne along and straightway expelled from the body. On the other hand, the soluble portion is taken up, by the small vessels referred to, which communicate with the interior surface of the intestines. These vessels are called lacteals, from the Latin *lac*, which signifies milk; because the soluble food absorbed, and with which they are filled, is white like milk. The lacteals, in their course, after leaving the intestinal canal and ram fying the secretory glands of the mesentery, converge and terminate in the thoracic duct, which receives all this white soluble food. It is then carried by the thoracic duct up to the left side of the neck, and emptied into the large vein leading directly to the heart. The nutritious part of the food has now entered the general circulation, and is mixed with the venous blood. So mixed, it enters the right divi-

sion of the heart; which, acting as a force-pump, sends it to the lungs. From the lungs it is returned to the left division of the heart, forming now red arterial blood; and is now prepared and fitted to perform its destined purpose; that is, to form new parts of living organs. By the contraction of the left division of the heart, it is forced into the arteries, which carry it to all parts of the body; ramifying the minutest structures. When it reaches the hairlike extremities of the arteries, called the capillaries, the work of deposition begins. The fibrine and albumen which, as food, entered the body, in the form of bread, butchers' meat, fish and vegetables, after having passed into the state of blood, are now deposited as the fibrine and albumen of living organs; that is, they form now parts of the body itself. So too, the carbon and hydrogen of non-nitrogenized food, passing, through the same process, into the blood, are now deposited as cellular fat.

The discovery of Mulder, that vegetable and animal fibrine contain exactly the same constituents, and in the same proportions, and do not vary in any respect whatever; and that the same equality exists between vegetable and animal albumen; enables us to identify the proteinaceous compounds of the food, in the chymous mass, as it leaves the stomach; thence, in the lacteals and thoracic duct, next in the blood, and finally in the living tissues, as vital compounds of fibrine and albumen.

WASTE.

Under this head, are understood all decompositions, and secretions of the tissues, which are expelled from the body. The agent which effects this waste, is the oxygen of the air. Oxygen, the most abundant element in nature, is a universal solvent. It exerts the most powerful affinity for most of the other elements; whereby they are loosened from the compounds in which they occur, and are set free. A simple and familiar form, in which this affinity is visible, is the action of oxygen on the carbon of coal or dry wood, when ignited. The compound of coal or wood becomes completely dissolved, leaving no visible product of the combustion, except a few ashes. What carbon and hydrogen it contained, have gone off as carbonic acid and water. The dissolution of the compound is, thus, most thoroughly effected, by means of the oxygen. A similar action takes place, in the animal body, through the processes of decomposi-

tion and secretion. The oxygen, employed in performing these changes, enters the body by the lungs, which communicate with the external air. All the blood, in the body, passes through the lungs; and by means of its iron globules becomes saturated with the oxygen of the inspired air. This oxidized iron, called peroxide, because in its highest state of oxidation, being carried to the capillaries, gives off its oxygen, in consequence of the more powerful affinity which the oxygen has for the carbon and hydrogen of the effete tissues, than for the iron. The compounds of the effete tissues are thereby immediately dissolved; and, carried along in the venous blood, proceed to the proper secretory organs, for the purpose of being expelled from the body. Now these compounds are the fibrinous and albuminous deposits, and also the non-nitrogenous cellular fatty deposits, which, under the head of nutrition, in a preceding page, were stated to be formed in the capillaries. They are, therefore, dissolved nitrogenous and non-nitrogenous compounds. As such, they have separate means of egress from the body. Their carbon, in combination with oxygen, as carbonic acid, reaches the lungs, from which it is expelled. The nitrogenous compound, including the organic salts, is conveyed to the kidneys; is there separated from the blood, and carried away to the bladder; to be thence thrown out from the system. The lungs and the kidneys are the two principal outlets, for the debris of the effete tissues. The lungs send off the ultimate gaseous compound, carbonic acid. The kidneys part with the other ultimate compounds, ammonia, carbonic acid, water, and soluble selts.

By the analysis of urine at page 31, the products yielded are those mentioned above. Besides the soluble salts and water, urine is composed of urea, lactic acid, lactate of ammonia, and uric acid. The sum of the constituents of which, it will be seen, by the following calculation, with 30 equivalents of oxygen, represent the ultimate compounds, carbonic acid and ammonia.

Urea,	C_2	H_4	N_2	O_2	24 eq. Carb. acid,	C_{24}			O_{48}
Lactic Acid,	C_6	H_5		O_5	7 " Ammonia,		H_{21}	N_7	
Lactate of Am.	C_6	H_8	N	O_5					
Uric Acid,	C_{10}	H_4	N_4	O_6					$C_{24}\ H_{21}\ N_7\ O_{48}$
Add,				O_{30}					
	C_{24}	H_{21}	N_7	O_{48}					

Liebig gives the mean of two analyses of the composition of the chief constituents of the urine of man and the lower animals; one by himself and the other by Mitscherlich, at $C_{10}\ H_4\ N_4\ O_6$. The dif-

ference, between it and the product of the above statement, besides the proportions of each compound which they have included, lies in the different forms of the compounds found in the urine of the lower animals. As, in either case, the product is reducible to carbonic acid and ammonia exclusively, it does not signify what proportions we assume or comprehend in our calculations. The object aimed at, being simply to show, that the ultimate principal compounds are, in this case, carbonic acid and ammonia.

In the vegetable kingdom, the sources and modes of admission of carbon and nitrogen, are the same in all plants. The carbon enters by the leaves, as carbonic acid; and the nitrogen, by the roots, in the form of ammonia. They are, both, the products of the decomposition of vegetable and animal bodies. They formed, previously, the constituents of living organs; but afterwards, during decay and decomposition, they return to the air and to the soil, to become again, in a new generation, constituents of similar living organs. The carbon performs a circuit. From the air, as carbonic acid, we trace it to the organism of the living plant; then to the decayed plant, combining with oxygen; and finally, to the air again, as carbonic acid. The nitrogen, likewise, we find, existing, as ammonia, in the atmosphere; next, in the soil, having descended, with rain and snow; then in the cereals and fruits; afterwards in decayed cereals and fruits, combining with hydrogen to form ammonia; and lastly, as ammonia, existing again in the atmosphere. Now throughout all their combining and decomposing processes, whether in the air, in the soil, in the living or decayed plant, the proportions in which carbon and oxygen form carbonic acid, and nitrogen and hydrogen form ammonia, are the same and invariable. All other compounds of vegetable substances, hold their constituents also, in definite and invariable quantities. When these compounds are chemically separated, the determinate quantity of each separated class of elements, is exactly the same as existed in the compound. And notwithstanding that in the compound forms, the elemental distinctions seem to be lost, such is not the case; for by analysis, the proportions of the elements are identical with those brought together, in the first instance, to form the compound. In the case of more varied compounds, the chemist obtains the same result, as in the minor one of carbonic acid. One atom of carbon and two of oxygen, brought together, form carbonic acid. Then, by analysis, the carbonic acid is separated, into one atom of carbon and two of oxygen. The quantities of the elements separated, are equal to

what they were before being combined, and during their state of combination; and have undergone no change. And this takes place equally, in more complex bodies, as in those which are less so. In the wheat plant, we know precisely the quantity of each class of elements; we know that they are all imbibed from the soil and the air; we know that they existed in the soil and the air before they entered the plant; and finally, we know that the proportions in which they exist in the plant, are the identical proportions, which the air and the soil shall again receive, from its perfect decomposition.

Turning to the animal kingdom, the experiments made, have produced results, corresponding with those obtained from the analysis of plants. The constituents of every part of the human body have, in a similar manner, been identified in its food. The nitrogenized constituents, of which all the organs are composed, having been first identified in the food, have then been traced as forming part of the blood; next, as forming the organs and tissues of the body; afterwards, when they had served their purpose in the organism, they are found passing through the kidneys and bladder, for expulsion. Similarly, the carbon of the food is seen, successively, in the blood, in the tissues and organs; in the liver, undergoing secretion; and, ultimately, passing from the lungs in combination with oxygen, as carbonic acid. The iron of the blood, the phosphates and sulphates, &c., of the organs are all identified, first in the food, and afterwards in the excretions. And, as in vegetables, in whatever combinations their constituents are found, they exist, governed, at all times, by the same chemical affinities, and possessing the same forms and dimensions.

This proof of the unchangeableness of the elements, under all circumstances, whether in a separate or organized state, establishes conclusively, the truth of the mechanical theory of atoms; and thereby, supplies a scientific basis for the culture of both vegetable and animal physiology. This basis had been entirely wanting; for, while the dynamical theory prevailed, the belief that the elements in an organic body lost their original properties, through the action of the vital force, precluded all data on which to calculate the law of their operation. It was only by determining the mechanical action of the elements in all circumstances, that the law by which they operate could be ascertained. Previous to the discovery of that law, the relation between the constituents of the plant and the constituents of the soil, was unknown. The practice of agriculture

was exceedingly defective. All kinds of manures, without discrimination, were heaped on every description of soil. And the farmer depended upon the rotation of crops, to get from the soil and the manure what virtue they might possess. The practice of agriculture was entirely carried on, without a scientific theory as its basis. It was, in short, a system of guessing. The wrong seed, the wrong manure, and the wrong soil were most often brought together. And when they happened to be right, it was purely by chance. The benefit conferred on agriculture, by the discovery of the mechanical action of atoms, is indeed incalculable. With the aid of this discovery, when a farmer now sets about to grow wheat, he selects a soil containing the organic salts contained in wheat; namely, silicate of potash, and phosphates of magnesia, lime and ammonia. If the soil does not contain them, he knows in what kind of manure they are contained; and accordingly supplies it to the land, together with manures containing the principal constituent, nitrogen, such as night soil. But, on the other hand, beans, peas and lentils require scarcely any silicate of potash or phosphates. They want, however, a large supply of nitrogen. Then again, potatoes, turnips and cabbage, are different. While they require scarcely any silicate of potash, the quantity of nitrogen required is also very small. What soil and manure plants require, are ascertained, in all cases, by knowing the elements of which they, the plants, are composed. Agriculture is, thus, reduced to a science. Its theory is perfect. And the practice, founded on that theory, is evidenced, in the comparatively immense returns realized from land, as it is now scientifically treated, in Great Britain and on the continent of Europe.

The application of science to the raising, fattening and dairy properties of cattle, since the proof of the mechanical theory of atoms, has been equally successful. But, to the culture of the human body, little of a practical nature has, as yet, been accomplished; notwithstanding, that the definite laws of the chemical organization of the human body, are as correctly ascertained, as those of plants. Cottages for working men, and public baths and wash-houses for the poorer classes, are steps in the right direction, certainly. But the theory and practice of chemico-hygiene, though applied to the growth of plants and the raising of cattle are, as yet, almost unrecognized, in their application to the human subject.

When a plant is stinted or droops, the gardener imputes the cause to a want of some necessary condition of its normal state. It may

be too much shaded from the sun. It may want watering, in consequence of the absence of rain, during a dry season. Or, the soil may be stiff, so as to exclude oxygen, which is necessary, for the decomposition and solution of various substances surrounding the roots, and required for nutrition. In either case, *he looks to the normal state of growth, for the rule on which he is to act.* If it is too much shading, he removes the cause. If it is the want of water, he supplies it. Or, if it is the exclusion of oxygen from the roots, and from the nutritive compounds surrounding them, he digs round the plant and loosens the earth; so as to admit oxygen, and allow the decomposition to proceed. He knows the chemical constituents of the plant, and of the soil and atmosphere; and, in seeking and applying a remedy, he supplies that which is wanting, and which, he knows, other plants of the same kind, in a healthy state, have. The rule being, invariably, *that nothing is to be applied which does not constitute its food,* or does not act like light or heat to decompose and assimilate its juices. If, for example, it is water it wants, the water applied must not be hot water, nor salt water. The reason of this exclusion is, that neither hot nor salt water is its natural food. For the same reason, when the plant is in its early stage, just shooting above the ground, and its vegetation appears slow, the scientific gardener would never think of administering paragoric, or Mrs. Winslow's soothing syrup, for the purpose of assisting its development. Nor, when it attained larger dimensions, without, at the same time, bearing the indications of a completely healthy condition, would he smear the outside bark with unguentum potassii iodidi, or with Perry Davis's Pain Killer. A deficiency of leaves would not justify the use of either quinine or Blood Food. Neither would its want of the absorbing function, as in dry weather, indicate the propriety of calomel, or of Dr. Churchill's hypophosphates of lime and soda.

The time was, when equally irrational proceedings were common, in the rearing of vegetable products. But, among professional agriculturists, this is no longer the case. In this department of human industry and of art, science now reigns preëminent. But if such a barbarous system has been discarded from the culture of plants, and the management of cattle, how does it happen that this same system is still retained, in the treatment of the human body? Why is science employed in vegetation and the breeding of live stock, and not in the preservation of the health and lives of mankind? The laws of chemistry, which regulate the birth, life and death of a plant,

are the same laws which regulate the birth, life and death of a human being.

In order to exemplify this equality of subordination to the mechanical operation of the chemical law of nature, let us compare the facts and exhibit the parallelism. The germ in the cereal is said to be in embryo. After the seed is sown, and while germinating, its nutriment is derived from the constituents of the seed itself. The seed contains all that is required to produce the young sprout, and to sustain it till it puts forth fibrous roots, and, at length, appears above the surface of the ground. So soon as the roots are formed, a new source of nourishment is obtained; for the roots imbibe the constituents of the soil. And, when the sprout finds its way above ground, it begins to perform a new function. It breathes. It respires. It inspires and expires air, in the same way as the human lungs; and continues afterwards to do so during the whole period of its life. In like manner, the chick, in the egg, is nourished by the contents of the egg itself. The egg contains the constituents of the flesh, the bones, the brain, the feathers, the claws, &c. Every part of the chick exists within the shell. As with the cereal, the chick no sooner leaves the shell, than it begins to receive nourishment from a different source. It begins to pick solid food, from the ground, and to drink water. The respiratory organs, likewise, commence to act; inhaling oxygen, from the air, and giving out, carbonic acid. So, with the human embryo, and its appendage the placenta; which latter holds within itself, derived from the blood and constantly renewable, every constituent of the human body. The placenta, in this respect, contains the substance of the bones, the brain, the muscles and tissues, the hair, nails, &c. So soon as the infant is born, it also draws its nourishment from another source. It feeds then on milk. Milk is its only food, for some time. At birth, the lungs too become inflated; and the process of respiration commences.

There is, thus, we perceive, a parallelism established, between the nutrition and respiration of plants and animals. The germ in the grain of wheat, the chick in the egg, and the human embryo with its appendage the placenta, all take their first nourishment from within. When, afterwards, they come forth into the world, the source of their nourishment is changed; and, at the same time, they begin to breathe. These three distinct processes are common to all organized beings, in both the vegetable and animal kingdoms. It is not the grain of wheat, the egg, and human embryo, alone, that exhibit this parallelism. It is observable in every thing that has

life; and, therefore, is evidence of a universal law, which brings down the chemistry of the human body, to a level with that of a vegetable product; and, verifying the mechanical theory of atoms, demonstrates that the human body is governed, in its inception, birth, growth, maturity, decay and death, by the chemical relation existing between the constituents of itself, and the constituents of the external elements. In fact, that the body itself is a chemical compound; that all its changes are chemical changes, performed, at all times and all places, and under all circumstances, in strict conformity with the ordinary chemical laws, as they are understood by the professional chemist.

But the parallelism does not stop here. A comparison of the food of the germ of wheat, of the chick in the egg, and of the human embryo, has led to the important discovery, that its nutritive constituents are the same in all three. That is, the wheat contains the same principal constituents as the egg; and each of these the same as the human embryo and placenta. As has been stated the merit of this discovery is due to Mulder of Utrechet, one of the most eminent chemists of the present day. It has already been shown, that while the carbon absorbed by the leaves, from the air, forms the woody fibre of trees, and of corn and grass, the nitrogenous compounds imbibed by the roots, go to form the fruit. Now the cereals of wheat are the fruit, and consequently are nitrogenous compounds. Mulder discovered that the elements of these nitrogenous compounds exist, in certain invariable proportions, in vegetables and animals. That these elements and their proportions are, according to the formula given by Liebig, $C_{48}\ H_{36}\ N_6\ O_{14}$. And, on account of the universal presence of this compound, in these proportions, in all nitrogenous substances which serve as food, he gave it the name protein. Vegetable protein being the same as animal protein, we expect to find it existing, under different circumstances, with similar characteristics. Such is the case. And herein, is another of the most beautiful provisions, in the order of creation. The cereals of wheat, barley, or oats, whose principal nutritive constituents consist of protein, are eaten by the barn fowl; the flesh of which, and the eggs also, are composed of protein. In its turn, the barn fowl constitutes the food of man; whose blood and flesh, and the organs of whose body, are composed of protein. The ox, in the pasture, consumes protein; which goes to form the lean or fleshy part of beef; which is itself protein. And, when man eats the flesh of the ox, he eats protein; the very same substance of which his body is

composed. If we go a step farther, and add a connecting link to the two extreme ends of the series; man dies; his body becomes decomposed by the chemical action of the external elements; the nitrogen and hydrogen of the protein of his body form ammonia; the carbon and oxygen of the same protein, with additional oxygen from the air, forming carbonic acid; which ammonia and carbonic acid, are imbibed by the roots, and absorbed by the leaves of succeeding grasses and herbs. The process of nutrition is, thus, in a circle. Vegetable and animal nutrition, being mutual and equally dependent upon each other.

> "All are but parts of one stupendous whole,
> Whose body nature is, and God the soul;
> That, changed through all, and yet in all the same;
> Great in the earth, as in the ethereal frame;
> Warms in the sun, refreshes in the breeze,
> Glows in the stars, and blossoms in the trees,
> Lives through all life, extends through all extent;
> Spreads undivided, operates unspent;
> Breathes in our soul, informs our mortal part,
> As full, as perfect, in a hair as heart."

Now the facts enumerated, and which have been established of late years, by the discoveries in organic chemistry, constitute the primary data of the law of identity; from which we deduce chemico-hygiene and the practice of chemico-medicine. These primary data are, as follows: First, that all the constituents of an organized being existed previously in its food. Second, that the particles of each class of elements have, individually, the same form, dimensions, and chemical properties, in the body, that they had previously, in the food; their arrangement only being different. Third, that the proper food of every organized being, is matter containing constituents similar to those of its own body. And fourth, as nothing enters the body of a plant, which is not identical with the constituents of the plant; and nothing enters the body of an ox, or inferior animal, which is not identical with the constituents of its body; so, nothing should be allowed to enter the body of a human being, either as a nutriment or medicament, which is not a constituent of the human body.

CHAPTER II.

EQUILIBRIUM.

Having, in the preceding chapter, under the head of "Identity," explained the processes of nutrition and waste, we have now to consider the necessity of maintaining these two processes, in a state of equilibrium. The taking of food and the reception of oxygen, have a reciprocal bearing on each other. They are both conditions of vitality. A laboring man, who works during the day in the open air, and is supplied with a sufficient amount of wholesome food, cannot be otherwise than generally healthy. The waste of his body, and the supply of food for the purpose of restoring what has been wasted, are a constant renewal of the conditions of the equilibrium; and consequently, of the conditions of health. On the other hand, an excess of nutrition or of waste, if continued, is a cause of disease. And, accordingly, we find, that, while among the poor, a great amount of mortality is occasioned by the excess of waste over nutriment; the reverse is the case with the rich; who suffer most from excess of nutriment and deficiency of waste. The extent to which the disproportion between waste and supply, is a cause of disease and mortality, is not appreciated. Most of the diseases, which are imputed to other causes, can be easily shown to have their inception, in the disproportion here referred to.

Disease, in general, is referable to two causes; one, a disproportion, between the supply of nutriment and the waste of the body; the other, a disproportion, between the temperature of the external surface of the body and the internal viscera. This limitation of disease to two causes, may occasion some surprise, to those who have been accustomed to consider the subject, from a non-chemical point of view. But, with the aid of organic chemistry, and the explanations thereby furnished of the *modus operandi* of the natural law, this limitation, may be considered, to be unquestionably established. As, therefore, a cause of disease is a deviation from a known cause of health, the remedy must be sought in the known healthy conditions. The treatment of a simple case of gastric derangement, or of consti-

pation of the bowels, occasioned by excessive indulgence, or by the nature of the food, is an example of this. The conditions of a healthy state of the stomach, *caeteris paribus*, are moderation in the quantity and quality of the food, and the avoidance of all articles of diet which are of a decidedly stimulating nature. Therefore, for gastric derangement, the remedy should consist of the conditions of health; which, we know, are temperance and moderation in the use of food, and abstinence from whatever has a stimulating tendency. This is the natural course, recommended by our knowledge of the conditions of the natural law. It is not, however, the course which is generally followed. Sulphate of magnesia, effervessing bicarbonate of soda with brandy, or brandy alone, is more commonly employed; and, sometimes, aromatics. Again, we know that the softness of the mass which is passing along the intestines, is a condition of their healthy functions; and that the consistency of this mass is regulated, by the degree of concentration of the food. Therefore, to remove a state of constipation, the natural and proper means is, to modify the articles of diet. A cathartic will empty the intestinal canal; and thereby produce a depleting effect; which may seem to benefit the whole system. But, however customary its adoption, it is an artificial and clumsy way of doing that which can be done better by natural means; setting aside the consequences, under a bad habit thus contracted, of repeatedly recurring to a practice which, like all other unnatural practises, cannot fail to produce ultimately pernicious effects.

These are simple cases, in which the causes and effects are readily visible; and, on this account, may be considered exceptions to the generality of cases requiring medical treatment. Such is not, however, the fact. The reason why, in many diseases, the intimate connection between their causes and effects, are not perceived is, because their *rationale* is not understood. This is exemplified by, what may be supposed, an abstruse case. Tuberculosis is a disease, of which the cause, is presumed, to be involved in mystery; and, in accordance with this impression, the treatment is not determinate, so as to exclude contradictory modes of practice. By some, it is said to be a peculiar morbid growth in the lungs. Others consider it, as the development of a scrofulous constitution. While, not a few, make it hereditary; tracing it, from the children to consumptive parents. When, however, the constitutional effects of imperfect oxidation, and the local developments arising therefrom, are fully perceived, tubercles will then be seen, to be a consequence of a con-

tinued putrescent condition of the blood of the effete tissues, which have been decomposed, but cannot find egress from the lungs. Prolonged congestion, occasioned by improper treatment, is also a frequent cause of the formation of ulcers in the lungs. But the small granular formations, which receive the name of tubercles, have their beginning in an imperfect oxidation of the blood, and a consequent deficiency of that process of elimination, by which the products of the effete tissues are carried out of the body. When the nature of oxidation is, thus, properly understood, the means for the prevention of tubercles at once becomes apparent; not only this, but the remedy, for their removal is, at the same time, plainly indicated.

In the exercise of either prevention or cure, the first requisite is a knowledge of the normal conditions of health. The healthy conditions are the guide. We can only measure the degree of departure from the rule, by first knowing the rule itself. When this knowledge is acquired, the remedy indicated is manifestly the adoption of the rule, or a return to the normal conditions. In tubercles, the preventive rule is oxidation. Therefore, the remedy is oxidation. Collateral agencies or aids are, of course, requisite; the chief of which, when tubercles have been formed, is displacement, by the revulsive agency of cold water. This last is the most effective means for the removal of pus and ulcerous deposits, from their lodgment in the cellular tissue. The principal remedial agent, however, is the oxygen of the atmosphere; because the disease has occurred in consequence of the absence of sufficient oxidation, and not in consequence of the absence of the process of displacement. Remedies take rank, in accordance with their rank, as normal conditions of a healthy state. Food, exercise, and rest are all necessary conditions of health; but, inasmuch, as the absence of neither of these, is the cause of tubercles, they, therefore, take inferior rank, as remedies; precedence being given to oxidation; the chief healthy condition; the chief preventive condition; and therefore, the chief remedial condition.

By this, it will be seen, that medicine is dependent on hygiene, for its rule of procedure. Just as a mechanic, who undertakes to repair a steam engine, is obliged to keep in his mind a vivid impression of the requisites of a perfect machine, and strives that his repairs shall conform to the structure of the perfect type; so is it obligatory that the medical practitioner should keep constantly before him, a just conception of the healthy structure, the healthy functions, and the conditions of their preservation; and strive, at all times, in his labors of reparation, to copy from the natural type; and

to subordinate his views, to the unvarying dictates of this, the only true standard of authority, in medical science. He should always remember, that the formation of new tissues, from the assimilation of the nutritious matters of the food, and the destruction of the effete tissues by oxidation, are both processes of healthy transformation; that the state in which the amount of new tissues so formed, equals the amount of effete tissues so carried away, is a state of healthy equilibrium between the amount of supply and the amount of waste; that the continuance of the equilibrium, is a continuation of the conditions on which health is dependent; that every cause of the disturbance of the equilibrium is a cause of disease; and that the explanation of the transformations and of the equilibrium, is an explanation of the rules to be observed, both for the preservation of health and its restoration when impaired. Hygiene and medicine rest, in short, on the same scientific basis. The requisites for a proper understanding of the one, being identically those which are required for a right apprehension of the other. On this account, they cannot well be treated separately; which will appear, in what is contained, under the three following important heads, of Oxidation, Ventilation, and Temperature.

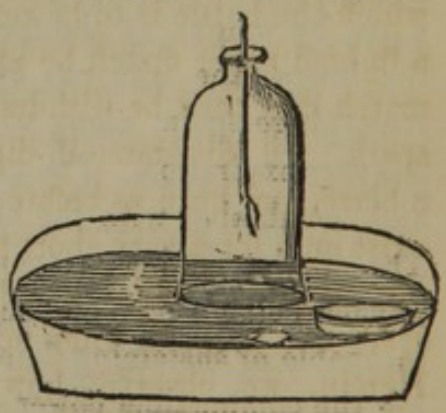
OXIDATION.

The air which enters the trachea in respiration, is composed of two gases; nitrogen gas, and oxygen gas; in the proportions of two parts, by weight, of the former, to one of the latter. On reaching the lungs, the nitrogen is rejected, and is thrown out into the atmosphere again, along with the carbonic acid which is eliminated at every expiration. The oxygen, on the contrary, enters the lungs; and, combining with the blood, is carried to all parts of the body. The distinguishing properties of the two gases, consists in the oxygen being a powerful supporter of combustion; while nitrogen is incapable of sustaining flame, for one moment. But, notwithstanding the combustible power of oxygen, it is not able, in a pure state, to sustain life. Neither is nitrogen. But when the two are mixed, in the proportions above stated, the quantity of oxygen contained in the volume of air which reaches the lungs, is such, as can be received with benefit. Any other proportions of these two gases would be injurious. An increase of oxygen, would occasion more

of that element to enter the blood, at each inspiration, than the proper quantity. And, on the other hand, a decrease of the amount, would deprive the blood of the quantity required for the due performance of the vital functions. The proportions in which they are combined in the atmosphere, are exactly such as are adapted to our wants. A few experiments, to illustrate this, will be more impressive, than a mere verbal treatment of the subject; at the same time, that a vivid and lasting impression, so produced, is better calculated to waken the mind, to the importance, of conforming to the simple indications of nature.

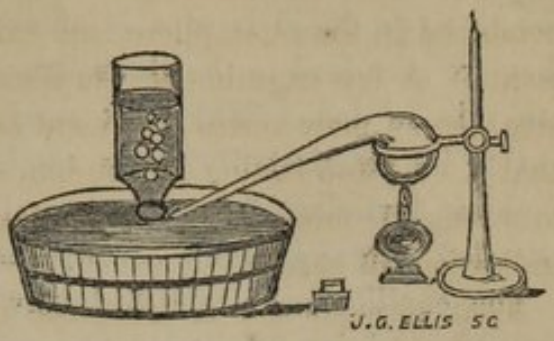
That nitrogen gas is incapable of sustaining life, may be illustrated by the following experiment: Take a deep dinner plate, and put as much water in it as will float a small saucer; into which put a piece of phosphorus about the size of a pea. The phosphorus is then to be ignited, by touching it with a piece of wire heated to redness. It will burn freely, emitting a clear light. It is now to be covered with a stoppered bell glass; which will extinguish the light, as soon as the air in the glass becomes completely neutralized, by the union of its oxygen with the phosphorus. This new combination of oxygen and phosphorus is phosphoric acid; which appears as a white fume, at first, but soon settles down and dissolves in the water, leaving nothing in the glass except invisible nitrogen gas.

The plate, with its contents, is then to be lifted and placed in a shallow tub containing some water. Keeping the bottom part of the bell glass under water, detach the plate and saucer from it; and sink it, till the height of the water in the glass corresponds with that on the outside. The stopper may now be removed, and a light be introduced, which will be instantly extinguished. A fly or a mouse, being put in, would expire in one moment. Showing that one of the elements of the atmosphere, that which is not admitted within the lungs, is incapable of supporting life.



The other element of the atmosphere, namely, the oxygen, may be artificially produced, in the following manner. Put one ounce

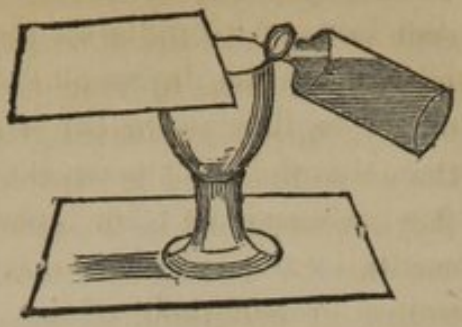
of the binoxide of mercury (red precipitate) into the bulb of a two ounce green glass retort; which is to be fixed in a stand, and having a spirit lamp below. The beak of the retort is to dip into a tub of water, as in the annexed sketch. The heat, from the spirit lamp, causes bubbles to pass along the beak of the retort, and into the water. They will very soon, however, cease. Other bubbles will be seen escaping, when the retort becomes more heated, and a grey film will be observed adhering to the arch or large part of the neck; which are signs that oxygen gas has begun to be generated. A pint glass bottle, with a ground stopper, which is to be taken out and laid aside, is then to be filled with water; and, inverted, is to be held over the beak of the retort, to receive the bubbles of oxygen gas which, passing along the beak, ascend into the bottle; while the water, in it, descends gradually into the tub. The bulb of the retort must now be kept nearly red hot. The grey film adhering to its arch, will increase and run down into the tub, in the form of bright globules of mercury. In this way, the binoxide of mercury, being decomposed by intense heat, its mercury descends into the tub, while its oxygen passes up into the bottle.



Keeping the neck of the bottle still under water, the stopper, which should be rubbed with pomatum, may be now inserted; after which the bottle is to be removed. If the stopper be taken out and a lighted paper match be plunged in, it will burn brilliantly. The match may then be withdrawn and extinguished, leaving only a red spark. In this state, if dipped in again, the spark will kindle into a blaze, and burn as before. An insect, placed in the bottle, could exist only for a very short time. Pure oxygen alone is, therefore, not capable of supporting life; however admirably adapted it is to serve this purpose, when mixed with nitrogen, as in the atmosphere. Herein, we observe, how nicely the nitrogen and oxygen are adjusted, with the design of establishing a state of harmony, between the gaseous compound and beings possessed of life They form a compound, in which, each element is neutral in its effects. That is, the non-vital or inimical properties of nitrogen and oxygen, in their separated state, are completely neutralized. The object could not

be accomplished, by mixing them in any other proportions. Air, such as exists in the atmosphere, can easily be produced by simply mixing two parts by weight, or four volumes of nitrogen, with one of oxygen, in a graduated glass bottle. By this synthetical method, the air so produced is capable of supporting life and flame, just as they are sustained in the atmosphere. But, in no other proportions can this be done. The most carefully conducted experiments for testing its practicability, have resulted in the conviction, that the slightest deviation, from the natural proportions of the mixture, is attended with appreciable consequences of an unfavourable nature.

The equilibrium established between the elements, for the purpose of sustaining life, may be beautifully illustrated by the burning of a wax candle; in which, the flame may be supposed to represent vitality; the wax, the nutriment; and the oxygen of the air, the agent by which the waste is produced. Wax is a compound of carbon, hydrogen and oxygen, in the proportions, by weight, of 81 per cent. carbon, 13 hydrogen, and 5 oxygen. As the oxygen of the atmosphere exerts a strong affinity for the carbon and hydrogen, the candle will continue to burn so long as the nutriment is supplied, by the wax, and the agent of waste by the external air. On examining a lighted candle, with a microscope, it will be seen, that as the wax melts, it ascends from all sides to the top of the wick; while a chemical action, is observed, going on in all that part of the wick which is enveloped in flame. This action is the union of the oxygen with the carbon, producing carbonic acid; and, of the oxygen with the hydrogen, producing vapor; both of which pass off into the air unperceived. There are several methods by which these products can be detected and measured. The most simple, however, is to hold a cold deep tumbler, inverted, over the flame of the candle, as here represented. The ascending carbonic acid being lighter than air, when heated, as in this case, will displace the air and fill the tumbler; at the same time that the vapor will condense into water on its interior surface. The tumbler may be now removed; and if the carbonic acid be prevented from escaping, by placing a thick soft card tightly across the mouth of the tumbler, it may then be turned, mouth upwards, in its usual position.



The test for carbonic acid is now to be applied. Push the card aside, as here shown, and pour in a little clear lime water.* Then place the card tightly over the mouth of the tumbler as before. Shake it gently so as to mix the carbonic acid with the lime water, which will become white, like milk. On standing for a short time, a precipitate will show itself, at the bottom of the tumbler. This is carbonate of lime.

The products of waste by the burning of a wax candle are, therefore, carbonic acid and water. The cold tumbler is the test for the water; and the lime water, that for the carbonic acid. The flame can be kept alive, so long as it is supplied with the means of nutriment from the candle, and of waste from the air; but no longer. If either of these means of supply and waste is defective, or is not in exact equilibrium, the flame will not burn so bright. To exemplify this, reduce the amount of nutriment by paring the wax off the candle, all round, till little more is left than about the thickness of the wick itself, as in the annexed sketch. The flame will be long, thick and dim; because the smoke of the burning wick preponderates over the amount of the burning carbon and hydrogen of the wax. The wick will burn down quickly, through the action of the oxygen which is as powerful as ever; but the flame will not be bright. On the other hand, lower the tumbler a little, over the candle, as in experiment page 56. The flame will then become more dim, for an opposite reason, namely, the deficiency of oxygen. The equilibrium is again impaired, by the excess of nutrition over the amount of waste. And the effect is, a dark flame, as if struggling to keep itself in existence.

Now, what we observe in these experiments, is precisely what takes place in the human body, by a series of chemical actions of the same kind. For the vital force in a human being is as much

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* Lime water may be prepared, by pouring water gently on about two ounces of quick lime, till it crumbles down into a powder; when it is to be placed in a quart bottle, and well shaken. The bottle is then to be allowed to stand, till the lime settles at the bottom, and the water appears perfectly clear. Then pour the clear lime water into another bottle, carefully; and cork it well.

dependent on a supply of nutriment and on waste, for its existence, as the flame of a candle on the supply of wax and oxygen. Not only this, but the degree of derangement, occasioned by variations from the equilibrium, is the same, in each case. It makes no difference, that the one process is carried on within an organized body, in life; whereas the other is the independent action of the natural elements in the open air. Oxygen and carbon, and oxygen and hydrogen, retain their affinity for each other, as forcibly, in the organism, as out of it. And what takes place, as we have seen, between the oxygen of the air, and the carbon and hydrogen of the wax candle, corresponds, in every respect, with the action of the inspired oxygen, on the carbon and hydrogen of the effete tissues within the human body. The decomposition of the effete tissues, may properly be regarded as a process of combustion. Heat is given off, while it goes on; at the same time, that carbonic acid and water are formed in large quantity.

The manner, in which the tissues become decomposed, is this: Being in a worn out state, in consequence of having performed their destined functions in the body, their carbon and hydrogen bearing a powerful attraction for the oxygen of the inspired air, which has been carried in the iron globules to the capillaries, combine with it, on the first contact. This chemical combination, causes the entire resolution of the tissues into a liquid mass; by which their nitrogen and organic salts are liberated. On new formed tissues the oxygen exercises no influence, so long as there is old tissue to be acted on. In like manner, if there is an excess of concentrated carbon and hydrogen introduced to the blood, through the use of alcohol or fat, the oxygen will combine with them first, before combining with the elements of the tissues. The dissolution of the tissues is then prevented or retarded; the waste of matter does not take place; and the equilibrium becomes interrupted. The constant tendency of alcohol and fat meats is to prevent waste. And setting aside, in the mean time, the enervating effects of alcohol; its interruption of the necessary change of the tissues, should be a sufficient reason of itself, against the use of that pernicious stimulant. But when the oxygen is permitted to act freely on the old tissues, their constituents become as completely dissolved and carried away, as the constituents of the wax candle, in the preceding experiments. In both cases, the waste is effected by the oxygen of the air acting on similar classes of elements, for which it has an affinity.

An equally familiar illustration of the manner in which the effete

tissues are decomposed, is furnished, when a piece of beef is exposed to a warm and moist atmosphere. There is this additional advantage, in this illustration, that nitrogen is present and also the organic salts; constituting all the elements comprised in the effete tissues of the living body. A piece of ox flesh is composed of exactly similar constituents to human flesh. The change which takes place in a piece of beef, when exposed to moisture and warmth, is one of rapid decomposition. The new compounds formed during the process, are the ultimate products into which all organized bodies are reduced, after vitality has become extinct. They are carbonic acid, ammonia, water, and organic salts. As the carbon of the piece of beef, combining with the atmospheric oxygen, passes into the air; and its hydrogen, uniting, in like manner with oxygen escapes as vapor; the fibre of the beef gradually loosens; and, as this last change advances, the nitrogen combines with hydrogen and also passes off. The chemical action going on, in the mean time, is intense; and continues so, till nothing is left, except the ashes.

Now the equilibrium between the supply and waste, in the candle, in the piece of beef, and in the tissue of the human body, is the state best adapted for the exercise of the normal functions. As the candle burns dimly, when the wax is deficient, as in experiment page 57, or when the oxygen is deficient, as in experiment page 65, so is the state of the vital powers in man, influenced disadvantageously by either the deficiency of food or deficiency of oxidation. It may safely be said that, at least, one half of the diseases of mankind is occasioned by these two causes; but more particularly, by the latter. It is scarcely possible to estimate the number of disorders which spring from the latter cause alone. Yet the connection between cause and effect, in this case, is a thing which is virtually excluded from the mind, and therefore is very rarely perceived. Indeed, there is an insensibility and absolute unconsciousness regarding the value of pure air; and still more so as to the fearful amount of mortality, and widely spread devastation, to the health and happiness of millions, in consequence of its neglect.

Let us suppose that the oxygen is not sufficient. The waste carbon cannot then be carried off; nor can the waste salts of the nitrogenous compound be kept in a state of solution. The venous blood, in passing through the lungs, is not then properly oxidized; and, consequently, the arterial blood partakes of a venous character. The equilibrium is so far lost; and the function of the organs becomes, in a certain measure, impaired. This cannot continue,

for any length of time, without producing more serious effects. Certain symptoms soon become manifest; such as head-ache, loss of appetite, and constipation; and a person so affected is said to be bilious. A couple of what are called anti-bilious (calomel) pills, acting on the bowels, may remove the symptoms. A recurrence of similar symptoms, and their removal by similar treatment, may take place successively, without much apparent inconvenience. But, though the latent effects are not immediately perceptible, they exist notwithstanding. By and by, in consequence of the frequent repetition of this artificial practice, it is found, that the stomach cannot perform its work without the aid of stimulants; and the organ itself is then said to be affected. The bile accumulates in the system, invariably in such a case; and jaundice may supervene. The liver may become congested, or probably, may be the seat of biliary calculi. The salts which, with sufficient oxygen, would have passed through the kidneys in a soluble state, may form concretions, known as urinary calculi. The lungs, saturated with retained venous blood, in a state of decomposition verging on putridity, may become affected in their texture, and asthma or tubercules, or both, may follow. A person, affected in either of these ways, is at a loss to account for his disorder. He is satisfied, within his own mind, that he has been living a regular life, and that he has regularly taken the prescribed medicines, and in sufficient quantity; and expresses surprise that he should, notwithstanding, be the subject of disease. Yet how many do we not meet with, every day, who are placed in this exact position.

Imperfect oxidation in the violation of a natural law. It cannot be violated with impunity. No artificial expedients can compensate for our ignorance of a law which it is our duty to understand; and understanding which, we are bound to obey. Its observance, is attended with health. Its non-observance, with a complication of diseases. It produces, as remarked, dyspepsia, jaundice, liver complaint, biliary and urinary calculi, asthma, consumption, and an endless variety of other affections, which are commonly imputed to other causes. These do not all appear in the same subject, at one and the same time; though many do in complicated forms of disease. A great deal depends on constitutional peculiarities; and, where calculus may develope itself, in one case, dyspepsia or consumption may do so, in another. Most commonly, affections arising from defective oxidation, are insidious in their progress; and become rooted in the constitution, without exciting suspicion that there is anything mate-

rially wrong. A person may complain of occasional indigestion or want of appetite, slight headaches and bilious sensations; which are not usually regarded in any other light, than natural casualties, from which no one is supposed to be exempted, whatever may be the precautions used, to avoid them. Years may elapse in this way, and an advanced stage of life may be even reached, before that the indications are considered sufficient to excite apprehension of what is going on. But the crisis is sure to come. The longer it is delayed, the worse it will be when it does arrive; for the slower and more continuous the progress of a disorder, the more extended its operation, and the more deeply rooted its hold on the general constitution. From being, in its first stages, nothing more than local derangement of some particular function, it gets to be a complication of bodily infirmities, that sets at defiance all remedial means, when, at last and too late, such are applied, in unlimited profusion and corresponding variety.

In adjusting the equilibrium between the food and the waste, it is necessary to keep in view the mode of life, and the climate or season of the year. In a cold climate or season, the air is dense, and, consequently, there is a large amount of oxygen in a comparatively small space. On the other hand, the air is rarified when the climate or season is warm; and a small amount of oxygen has, therefore, a comparatively large volume. Now, the character of the food stands in a direct ratio to the climate or season of the year. Concentrated food is proper in a cold or concentrated atmosphere; and food that is not concentrated is best, when the air is warm and therefore is not concentrated. This rule is in conformity with the equilibrium of waste and supply. As the carbon of the food, after having served its purpose in the body, passes off by the lungs, and a dense atmosphere consumes more carbon than a rarified atmosphere, it is, therefore, necessary, in winter, to make use of food containing concentrated carbon, such as the fat of bacon. Where there is exposure to the air, there is no food so wholesome or so serviceable, in winter, as fat pork or bacon. Chemically, it produces a large amount of animal heat, and, thereby, protects the body from the increased action of the oxygen of the air. In summer, on the contrary, the oxygen being less operative, on account of its great rarity, food containing non-concentrated carbon, such as potatoes, rice, fish, gelatinous parts of butcher's meat, such as shanks of veal and calf's head, and vegetables, and ripe fruit of all kinds, are what ought to be chiefly eaten.

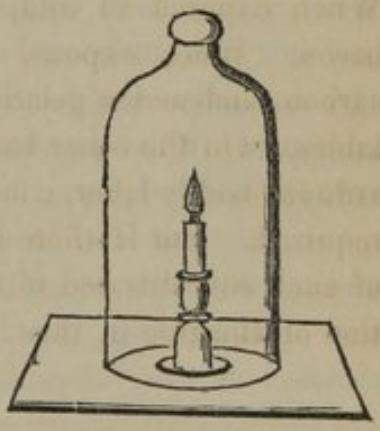
The use of beef and the lean of other meats, known as concentrated nitrogenized food, has less relation to the climate or season of the year, than to the nature of the employment. The rule which prescribes the circumstances, under which, beef and the lean of butcher's meat generally, are to be used, should be carefully noted by the hygienist and medician. A man who is employed ten hours of the day, at arduous bodily labour, as a carpenter, a mason, a miner or common laborer, and whose body undergoes emaciation by waste, requires such food as can be converted, in the shortest space of time, into the tissues of his own body. Such food is known as concentrated nitrogenized compounds; of which, none is more concentrated than the fleshy or lean part of beef. And, therefore, beef is suitable food for a man, whose employment occasions great waste of the body. A small quantity of beef will compensate, where a large and inconvenient bulk of non-nitrogenous food, such as potatoes or rice, would be required. On the other hand, persons employed within doors, and not exposed to waste of body, should eat very little animal food, and indeed little concentrated food of any kind, whether compounds of nitrogen or carbon. The rule, for diet, is easily applied, if we keep in view the equilibrium of waste and supply, between the two processes of nutrition and oxidation which are constantly going on. When exposed to cold, we want concentrated carbon, such as fat bacon. When exposed to heat, we want then non-concentrated carbon, such as the gelatinous parts of butcher's meat, rice and vegetables. On the other hand, if the body suffers inordinate waste by arduous bodily labor, concentrated nitrogenized food, such as beef, is required. But if there is no such inordinate waste, then very little of such concentrated nitrogenized food is to be used. The application of the rule is, thus, very simple and very easy.

VENTILATION.

The ventilation of houses, is the means employed for the purpose of admitting pure air. In hygiene, there is nothing which demands so much care and attention. Yet, of all the devices for the preservation of health, there is not one which is less regarded than this. People chink up every crevice, in winter, to exclude the external air. In summer, when oxidation is difficult, in consequence of the rarity of the atmosphere, they lie down in closed rooms, with the windows and doors securely fastened; breathing during the whole

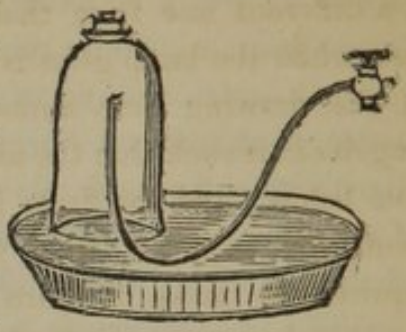
night, the unwholesome emanations of their own bodies. Our public buildings exhibit no better arrangement; for the mode of ventilation generally practised, has more regard to the supplying of hot air, than to the facilities for its escape after it has become contaminated. It does not seem to be understood that the capacity of the oxidizing process bears a definite relation to the amount of oxygen comprised within a given volume of air; otherwise, in ventilating a court of justice, a church, an hospital or asylum, the proportion of oxygen introduced and of carbonic acid carried out, would be more an object of attention, than simply the generation of hot air and its confinement afterwards within the building. As an important accessory of both hygiene and medicine, it is desirable that the true principles of ventilation should be fully explained, in such a shape as to convey a suitable impression of the good and bad consequences arising from its observance and neglect. The best method of accomplishing this, is to employ such simple and familiar experiments, as any one can readily comprehend; and also perform, in the domestic circle, without either danger, inconvenience or expense.

In the former experiments, with the wax candle, the flame was compared to the principle of vitality in animals; and the modifications of the vital power were shown to correspond with the preservation or disturbance of the equilibrium, between the supply of wax and of oxygen. Let us now, in the first place, observe the effect, when the supply of oxygen is entirely cut off. Light the candle, and notice the brightness of the flame. Then take a bell glass (a common large tumbler will answer), and place it, as here shown, over the candle. The flame will continue to burn, while there is oxygen to feed it; as, in a similar manner, our life is preserved, so long as a sufficient amount of oxygen exists in the air which we breathe. As the oxygen becomes consumed, the flame gradually gets dim; till finally it is completely extinguished, or, may be said, to have died for want of air, or, what is not less appropriate, to have been suffocated. A small animal, placed under a similar glass, would share exactly the same fate; the only difference would be, that a longer time would intervene before that life would become extinct; because the flame of the candle consumes the oxygen quicker, than could be done by the respiratory process of a small

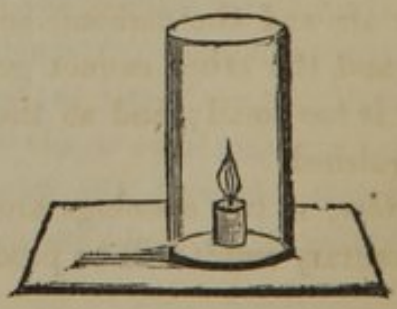


animal. This is, in miniature, what would take place, to a person, shut up in a very small room.

The evil effects of sleeping in a small and confined room, will be more instructively illustrated, in the following experiment: Place a stoppered bell glass, on a shelf, in a shallow tub; the water being an inch or so above the shelf. Place the end of a small bent metal pipe or tube, about half an inch in diameter into, and near to the top of the bell glass; the other end, which is provided with a stop-cock, is to be supported with the hand. Then applying the lips to the end of the pipe, draw the air from the glass into the lungs; and force it back into the glass again. After this has been repeated three or four times, the stop-cock is to be closed, and the tube to be withdrawn. The glass is then to be moved from the shelf, on to the bottom of the tub. If the stopper of the glass is now taken out, and a lighted taper is dipped into the glass, it will not burn; but is immediately extinguished. The reason of this is, that the lungs have absorbed all the oxygen from the air in the glass, and returned its nitrogen, along with carbonic acid from the blood; with both of which latter gases the glass is now filled. In a small and close bedroom, life would soon become extinct; for, similarly, the lungs would soon absorb all its oxygen, and fill it with impure gases. What prevents death from taking place, are the crevises about the window, door, floor and chimney; which are usually found to exist, more or less, in every sleeping apartment. But, notwithstanding that this result does not occur, during the six or eight hours that a person lies in bed, in such an apartment; defective oxidation or the inhalation of impure air, never fails to leave its mark on the constitution; and, gradually, to develope those insideous forms of disease, whose cause or origin neither the patient nor the doctor can account for.

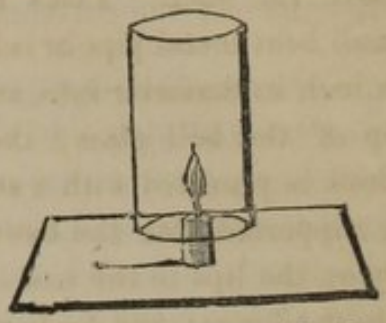


An example of defective ventilation may be furnished, by placing the cylindrical glass of a lamp or a glass shade, over the wax candle, in the manner here represented. The flame will continue; but as there is only one opening, which has to serve both for the admission of air and escape of carbonic acid, a struggle takes place between the two. The one, for admission; the other, for exit. And, as the air cannot



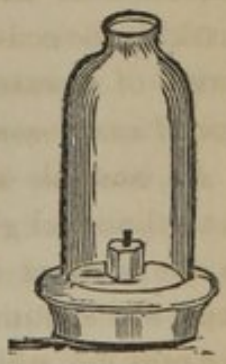
reach the flame without being mixed with the carbonic acid, the light is dim; and continues so, while the candle is kept burning.

The advantage of having two openings, so that the air can enter at a different one from that by which the carbonic acid escapes, is seen when the lamp glass is raised a short distance from the table. In the drawing here annexed, the arrangement is such that the air has ingress from below; and the flame is, therefore, plentifully supplied with the element required to make it burn brilliantly. We have here an example of the arrangement required, in our dwellings; and of the principle which ought to govern all devices, for ventillating either private or public buildings.



But the secret of ventilation does not consist, in creating a current; but, in regulating the current of air, in such a manner, that while it is continually going on, it is unperceived, and produces no sensible effect on the temperature of the external surface of the body. In the first place, a current is indispensable. In the second, it must be so contrived that no draft can be perceived.

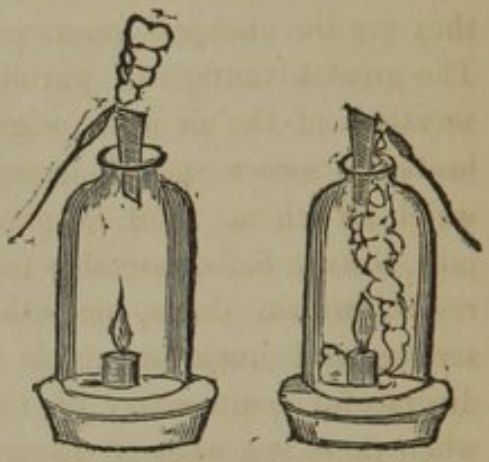
Some circumstances require that the cold air should enter from below; and, in summer or, in a warm climate, this is particularly desirable; and, in short, is the right plan to adopt. But, in the winter of northern latitudes, a cold ground current, is objectionable; and, for this reason, a different arrangement becomes necessary. The cold air, in this case, should enter from above. We have seen, in the preceding page, that the light continues to burn, notwithstanding there is no current, because the opening at the top of the glass is wide. If the aperture is narrow, say about an inch, the flame will expire. The accompanying drawing, exhibits a glass shade, somewhat like a quart bottle, with an opening at the top, about an inch in diameter. Being placed over the lighted candle, the struggle soon commences betwen the air and the carbonic acid. The one cannot get in, and the other cannot get out, because the opening is too small; and so the light becomes soon extinguished.



Now, if two openings are provided at the top, in place of one, a contrary result will be produced. In the aperture, as here repre-

sented, place a piece of smooth pasteboard, cut so that the edges will fit the sides of the opening exactly. The candle will then burn as brightly as if placed in the open air. Because, the cold air enters at one of the apertures, while the carbonic acid passes out by the other. The two arrows, point to the different directions of the currents.

The two opposite currents are seen, when a smoking taper is held alternately at each side of the pasteboard, as here represented. The smoke, is seen, to descend, on one side; and, to ascend, on the other. The arrangement for ventilation, in this plan, is the most judicious, when the weather is cold, and where artificial machinery is required. The regulation of the currents, is that part of the arrangement, in which the chief merit consists. And this depends altogether on the proper adjustment of the registers, which are placed at the two openings above.



Most commonly, when no double sashes are used to keep out the cold, and there is no chinking of crevices, additional means of ventilation may be unnecessary. But no house, if not warmed by other means, should be without a hall stove, in winter; on the top of which a tin or iron basin should be constantly kept, containing water. And the doors of all the rooms should be left wide open, during the day, so that the temperature may be equalized in all parts of the house. To pass, occasionally, from a warm room into a cold one, is neither agreeable nor safe; and to a delicate constitution is extremely hazardous.

The warming of public buildings and private dwellings, with hot air, cannot be too strongly condemned. The least acquaintance with the nature of the change produced on the air within doors, by the generation of hot air, might have been sufficient to dissuade the inventor of the hot air apparatus from the completion of his plan; or, at least, should have deterred others, differently situated, from adopting an invention, the use of which is to change pure air, by depriving it of its oxygen, into a gas that is highly deleterious. The steam from the hot water tank, intended to compensate for the

lost oxygen and to neutralize the effect of the poisonous carbonic acid, is a defective substitute; and, under no circumstances, can it generate the vital element which the hot air apparatus completely destroys, and which is indispensable to healthy respiration.

Heating, by hot water or steam pipes, is the plan which promises to supersede all others. On the score of health, it possesses all the requisites desired; and affects the air, in no other respect, than simply to warm it. The hot water pipes or steam pipes, for a private dwelling, are expensive, in the first instance; but ultimately they are the cheapest, on account of the small consumption of fuel. The great advantage of warming by hot water or steam, is the preservation of the air in its original purity. The air of a building so heated is sweet and wholesome; a consideration that should outweigh all others. For hospitals, asylums, churches, court houses, jails, lecture halls, assembly rooms, theatres, and all places of public resort, within doors, no other plan is fitted, or is free from serious and unsurmountable objections And, moreover, it is a disgraceful commentary on the management of such institutions, when there is a want of discernment, in a matter, that concerns, to such an extent, the sanatory condition of their permanent inmates, or those who occasionally frequent them.

Proper ventilation is one of the most important requirements of health. More so, during the night, than in the day time. For, during the night, there is none of the opening and shutting of doors and windows, that take place during the day, and by which the air in the house is, more or less, changed The chief reason, however, for attending more particularly to night ventilation, is on account of the thorough manner in which its good effects can be immediately realized. In a close room, it is utterly impossible, that the heavy breathing of a person asleep can receive the necessary amount of vital air; because such air does not exist in a confined room. When asleep, during the night, the respiration goes on undisturbed. It is heavy, measured, and in large volume. The muscles and blood vessels are then perfectly relaxed; and, therefore, the state of the body is better adapted to receive the full complement of the oxygen required. Such is not the case during the day; for, when occupied with business, there is a constriction of the muscles and vessels; the breathing is interrupted by every accident; and attention directed to the most trifling concern, such as the reading of a letter or newspaper, reduces the process of respiration to the lowest limit. For these reasons, the best time for oxidation is during the night.

But, independent of the more thorough manner, in which it can be effected during the night, it is, besides, more convenient. Many employments cannot be carried on comfortably, without the presence of a considerable degree of warmth. A book-keeper sitting in a counting-room, in winter, requires the air of the room to be of a pretty high temperature. He would not be able to perform his duties properly, if exposed to a cold air. Likewise in stores and shops. And also, in dwelling houses. There would be no comfort unless the apartments were so warmed as to indicate, on the thermometer, the degree of temperate. But apartments so warmed, by artificial means, are not wholesome, unless the effects are counteracted, at intervals, by natural ventilation. When so counteracted, however, the comfort of warm apartments may be indulged, not only with the most perfect impunity, but with effects highly conducive to general health. There are various ways of ventilating a room. Two apertures or openings are, however, necessary. For night ventilation of a sleeping apartment, the most ready mode is, to lift the bottom sash of a window, and lower the top one. My own practice, from which I have uniformly experienced the best effects, during the last ten years, is, in winter, to open from one to six inches at the top, and the same at the bottom, according to the degree of cold, just before stepping into bed; at which time, the room is warm and comfortable. A cooling process immediately commences. Pure cold air enters at the lower aperture, and passes through and around the room. While the warm or impure air, from the combustion of wood or coal, in the hall stove, from respiration, and other causes, escapes at the upper aperture. When the room is thoroughly ventilated and perfectly cool, the window may be closed. My own practice is, not to close it till about an hour before day-light, when I open the bed room door about one fourth of its range, for the purpose of admitting warm air from the hall stove, which is generally lighted about half an hour before the time of getting out of bed. The room, then, is comfortable while dressing. By adopting this practice, the sleep is sound. No tossing and rolling in bed. The body keeps one position, instinctively, even when asleep. This is natural. Rolling in bed takes place only when the room is overheated, and, when the body suffering from the consequent oppression, seeks relief, even during sleep, in a change of posture.

The chemical changes effected, in the mean time, in the venous blood, by which it has become arterialized, is visible, in the absence

of bad breath, and more particularly in the large quantity, and perfect transparency, of the urine which has been voided during the night. These are the immediate criteria by which we judge of the extent to which the oxidation has been effected. The feeling of vigor, and appetite for breakfast, are accompanying indications that a salutary change has taken place. That change is, in the first instance, the complete transformation of the tissues, by which the process of waste is accomplished. And, in the second, the carrying away and expulsion of the matters, thus transformed. All the transformed carbon of the venous blood has gone off, during the night, in the breath; and all the nitrogen in the urinary secretion. All the fat of bacon or beef which had been eaten, has escaped, in this manner, by the lungs. All the lean, by the kidneys. The appetite for breakfast, is the sensible indication that the waste has been completed, and that the process of supply should commence. With fresh nutriment, the assimilation, for the purpose of forming new organs must, under these conditions, go on with vigor, and be conducted under the most favourable circumstances.

In summer, it is desirable to have two windows in a bed-room, if possible. One opposite the other, or, at least, on a different side of the apartment. One window, with a chimney besides or an opening for a stove pipe, may answer, however. The object of this is to create a current of a more direct kind, without which the room will not be sufficiently cool, in warm weather. The current of air should be made to pass over the bed. There need be no fear of bad consequences, from the draught striking on the head. There is a foolish apprehension, in almost every person's mind, respecting the effect of air currents. All that is required, while lying in bed, or at any other time, is to avoid whatever is calculated to produce perspiration. Where there is no sensible perspiration, no bad consequences are to be feared. And perspiration can be easily avoided by avoiding feather beds, which are the deadly enemies of human life, whether used in summer or winter. I know of nothing more grateful or more salutary, than a current of fresh air, striking on the face or bare head, while asleep. The liability to take colds and coughs, does not arise from habitual exposure to the weather; but from people accustoming themselves to be cooped up in close and confined rooms, and shunning the natural atmosphere; in wrapping the neck round with furs or large cravats; and covering the head, so that there is no egress for vapor or ingress for the external air. Persons who act thus, are affected with every change of wind; and, if of sedentary habits, will be visited frequently with febrile attacks.

The benefit which ventilation renders to the reproductive powers, during rest and sleep, cannot be overestimated; and yet there seems to be no appreciation of this fact. It is customary to go to bed at night, for the purpose of taking rest; and it is also customary to think that this rest is obtained, and that the object of sleep is secured, if a certain number of hours is spent in bed. Nothing can be more deceptive or fallacious. And herein we have an example of the evil effects of a blind credulity, in controlling the habits; at the same time, that the facts, necessary to expose it, lie at the surface, and yet are not perceived; while the moment these facts are stated, the instant they are submitted to our judgment, we see their force, and unconditionally acquiesce in their truthfulness. Now the object of going to rest and remaining in bed during the night, is to enable the body to recover the waste which has been produced, during the active business hours of the day. It is, in short, to restore the equilibrium between waste and supply. From the time we rise in the morning, till we retire at night to bed, the body and mind are both actively employed; and, all this time, this activity occasions a diminution of muscular flesh, and a consequent decrease of bodily strength. So that, as night approaches, the body becomes more or less enervated, according to the amount of labor endured. The enervation, instinctively, leads us to take repose. But the rest so obtained, is only a collateral effect with the increase of muscle which, in the mean time, has taken place; the latter being the real object of nocturnal rest and sleep. Once this object is perceived, it becomes obvious, that what has to be attended to chiefly, in order to secure its attainment, is an observance of the general conditions of nutrition, along with ventilation. Proper food and proper digestion are requisite; along with sufficient oxidation, for carrying off the products of waste, by the proper channels, and in the proper forms. By lying down in a room, cool and well aired, after having observed the conditions of nutrition which have been explained, under the appropriate head, the chemical changes that ensue, during sleep, are sure to reproduce all the muscle which had been expended on the preceding day; and one indication of this is the feeling or consciousness of renewed strength, experienced on the following morning, on rising out of bed. The feeling of strength, is a symptom, of the increase of muscle.

But the object of nocturnal rest and sleep is not to produce muscle only. It is also, for the production of cerebral and nervous matter. The brain and nerves are supplied largely with arteries and veins; and are formed, like the other tissues of the body, from arterial

blood. They are, therefore, dependent, like all other parts of the body, on the proper regulation of the secretions; and consequently on the equilibrium of waste and supply. The brain and nerves are material organs, that participate, with the cognate organs of the general system, in whatever increases or diminishes their capacity. The assimilation or decomposition of new cerebral and nervous matter, takes place, contemporaneously, with the assimilation or destruction of the muscular tissues. So that whatever strengthens or debilitates the muscular tissues, strengthens or debilitates, at the same time, those organs of thought and sense. Liebig makes use of very significant language, when he says: "In regard to the nature and essence of the vital force, we can hardly deceive ourselves, when we reflect, that it behaves, in all its manifestations, exactly like other natural forces; that it is devoid of consciousness or volition, and is subject to the action of a blister." * The subordination of the mental functions, to the ordinary chemical laws of the material elements, is visible in the correspondence of the results. In sickness generally, and in insanity of the mind, this fact is not to be overlooked. It applies with great force, in what is said, under the head of "displacement," in the third chapter of this treatise. In the mean time, it is sufficient to observe, that the object of rest and sleep, is as much to increase the cerebral and nervous matter, as the muscular; and that the mind, and nerves of sense and volition, are influenced directly and in the most immediate way, for good or for evil, by the nature of the sleep and the extent of the noctural oxidation.

A person, on the contrary, who lies down in a warm room, and rolls and tosses in bed during the night, or, by stimulants or narcotics, procures a heavy and continuous sleep, cannot experience this refreshing vigor. It is impossible that he can; for, though his body may have been duly supplied with food before retiring to rest, the accompanying circumstance of the warm room, precludes the chemical changes, on which the formation of new muscle depends. And, consequently, the symptom, next morning, in place of being that of vigor, is one of lassitude; and, getting out of bed, is an act performed with a considerable degree of reluctance. Going to bed, then, resting and sleeping, may all take place, and yet the object of doing so may not be attained. And, in this, we observe the importance of undeastanding aright, the chemical relations of the body to

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* *Animal Chemistry.*

its food, its atmosphere, and the other agencies which chemically affect it.

TEMPERATURE.

Most chemical changes are operative, only, under circumstances, in which a certain measure of heat or cold is present. Water cannot be converted to steam or ice, without a very great modification of its temperature. But, on the other hand, to preserve the actual state of a body, its natural temperature must not be changed; or, at least, there must not be any great or extreme change. If it is desired, to keep a candle from melting, it must not be taken into a very warm room, or the dissolving process will soon begin. A glass decanter of cold spring water, perfectly dry on the outside, when placed on the table in a warm room, will soon become covered with a thick moisture, which is the air of the room condensed by the cold of the decanter. That part of the air which comes in contact with the cold decanter, is turned into water, because the decanter is so much colder than the air of the room. Therefore, to proserve the actual state of a body, it is necessary to preserve the natural temperature of that state.

While life continues and food is in sufficient quantity, the temperature of the blood of animals is not affected by climate or seasons. It preserves the same temperature in the arctic region and in the tropics. The inhabitants of Greenland have a temperature of blood the same as the Brazilians, notwithstanding that the two climates are so extremely opposite. And the blood of a citizen of the State of New York is as warm, in winter, as in summer. It might seem, from this, that the law of transfusion of heat and cold, from one body to another, is different in organized bodies, from what it is in inorganic substances; but such is not the case. The former give off, and receive, heat and cold, as much, and as continuously, as the latter; but, in consequence of the constant process of combustion going on in the animal body, the heat generated being a constant quantity, regulated by the quantity and quality of the food or fuel, which corresponds with the temperature of the external atmosphere, an equilibrium of temperature of the blood and viscera is uniformly maintained. Those who advocate the views of the Dynamical philosophy, and consequently believe that all the chemical changes of the animal tissues are produced and regulated, by what is called

the vital force, assume that the law of transfusion of heat and cold is not the same in organic bodies and inorganic substances. They assume, that while a piece of iron or wood becomes heated or cooled by the ordinary laws of chemistry, the temperature of the animal body is dependent on, and is regulated by, the vital force. That is, they admit two different and antagonistic laws of temperature. One, consisting of the chemical affinities of lifeless substances, for each other. A second, consisting of an unknown power, called the vital force, which acts absolutely and independently of all chemical affinities.

If the impregnation of vitality be regarded in its proper acceptation as, in plants, the controlling power of the conformation of parts; and, in animals, to the controlling power of the conformation of parts, a superaddition of the controlling power of the conformation of cerebral functions; then, the compatibility of its existence, in an organism, whose material elements combine and separate by the same law that regulates their combinations and separations in a lifeless substance, is perfectly reconcilable. On this head, there is nothing advanced which can be construed to be suppositious; for the facts of animal chemistry, demonstrate the mechanical functions of the elements. So far as the truth of the mechanical theory of the elements is capable of proof, all the experiments and observations of the most competent chemists agree, that the universal law of elementary affinities, as it is understood in the practice of the laboratory, is not superseded nor contravened, in the organism, by the action of the vital force.

The equilibrium of temperature is not dependent on climate or season, but on the chemical process known as the oxidation of carbon and hydrogen, which is carried on more vigorously in a cold than in a warm atmosphere. If the Esquimaux could not provide themselves with food consisting of concentrated carbon and hydrogen, to neutralize the concentrated oxygen of the climate in which they live, the warmth of their blood could not be preserved. The blubber and oil which they eat, is burnt in their bodies by the oxygen of the air which they inspire; and the process for the formation of carbonic acid and water, is accompanied, in the body, as in all cases out of the body, with the generation of heat. It is the heat so produced that keeps up the temperature of the body. Such a consumption of carbon is not required in warm countries; and consequently it does not take place. But in the winter season of a temperate climate, it is necessary; though not to the same extent as in the arctic regions; and, accordingly, we find, that a large propor-

tion of concentrated carbon constitutes the food of the inhabitants of such a climate.

The transmission of heat or cold from one substance to another, commences on the surface. As in the example of a candle, brought into a warm room, the melting process begins on the surface, so is it with the cooling of the animal body. The temperature, at the surface, becomes first affected. A cow without shelter, and exposed to the wintry frost and wind, is cold all over the surface. This coldness increases or diminishes, with the increase or diminution of her food, as well as with the variations of exposure to the inclemency of the weather. And, if the food is deficient, the cold will penetrate below the surface. The resistance offered to the cold atmosphere, is produced, internally, by the chemical process of oxidation, which is continually generating heat. Hence the conditional temperature of the skin depends upon the state of equilibrium, or on the preponderance of one or other of the antagonistic forces, namely, the process of oxidation and that of ssimilation.

The human body, which possesses no external covering of hair, is delicately sensitive to atmospheric changes. In the normal state, or that state which exhibits a healthy condition of its functions, the heat of the surface and of the deeply seated viscera is equal. And, therefore, it is a natural law, that the temperature of the blood is the natural temperature of the surface. The good and bad effects, occasioned by the maintenance and disturbance of the equilibrium between the temperature of the blood and that of the surface, are invariably preceded by the conversion, the one into the other, of two important secretions. Perspiration and urination go on, in their natural healthy state, when the two antagonistic forces, referred to, are equally balanced. But, if that balance is disturbed, a portion of the constituents of one secretion is diverted into the other. Cold, applied to the surface, occasions what would otherwise pass off as perspiration, to seek a channel of exit by the kidneys. That is, the substance of the perspiration is converted into urine. On the other hand, great warmth of the surface diverts part of the constituents of what otherwise would form urine, from the kidneys, their natural channel, to the skin, from which it exudes as perspiration. This conversion of the constituents of perspiration into urine, and of those of urine into perspiration, is in accordance with the common chemical process, by which steam is converted into water, or water into steam. The following experiment will explain this.

A glass shade, about four inches wide and eight deep, perforated with holes at the top, is to be warmed and placed over the lighted

wax candle, as here represented. The vapor formed by the combustion of the wax, will pass off through the holes at the top; in the same way that perspiration escapes by the pores of the skin. And, if the external air is cool, the vapor will condense and fall down on the outer surface of the shade, as in sweat.

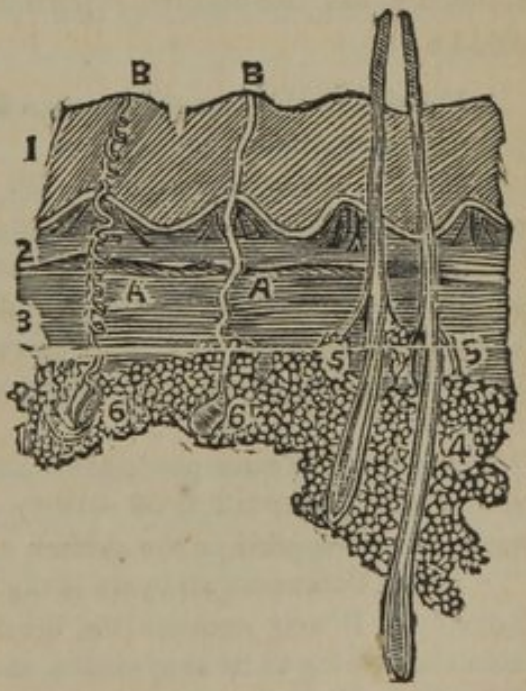
But, if the glass is perfectly cold, when set over the candle, the vapor in place of passing out at the holes, will condense on the internal surface and form water, and trickle down the sides in drops, just as the urine trickles into the pelvic cavities of the kidneys.

This experiment affords a tolerably good illustration of the excretory process by the skin; and, at the same time, of the liquifying process which takes place, when the perspiration is checked, by cold. An examination of the structure of the skin, and of the mode in which the secretions go on, will exemplify one of the most beautiful adaptations of an apparatus, to serve one or other, alternately, of two different purposes, contingent on the external temperature.

The skin or outer covering of the body is composed of two layers, the epidermis and derma. The epidermis is the outmost layer, and is a horny and homogenous substance, without blood vessels or any vascular structure, except the passages of the sudoriparous pores, and the follicles of the hairs.

The derma or true skin is that portion, in which the blood vessels, nerves and glands are situated. Both the papillary division and the corium represent a vast areolar network of vascular tissues, the interstices of which, called areolae, are filled with adipose or fatty matter.

The sebiparous and sudoriparous glands, are the organs which secret the perspiration or sweat. These glands, like those of the serous and mucous membranes, are supplied with arteries and veins. The perspiratory secretion is effected, from the capillaries of the arteries, in the



SECTION OF THE SKIN.

1. Epidermis. 2. Papillary division of the derma. 3. Corium. 4. Adipose cells. 5. Sebiparous glands. 6. Sudoriparous glands.

gland, before the blood reaches the veins, and is carried by the efferent ducts A A to the pores B B, where it leaves the body, as vapor, or lies on the surface, as sweat. The secretion from the arteries of the glands into the efferent ducts, can only take place, however, when the surface is sufficiently warm. If the skin is cold, the glands will be contracted, the secretion will cease, and the albuminous and fatty constituents which, under ordinary circumstances, find an outlet by the skin, will pass on, in the general circulation, to the kidneys.

By this, it is evident, that, when the perspiration is checked, no secretion can take place in the sebiparous and sudoriparous glands. The arterial blood, in place of being secreted at the surface, undergoes no change there; but travels on to the urinary secreting apparatus. Albumen and fat, what properly ought to be the secreted constituents from the glands of the derma, are then visible in the urine, in large quantity. Such a diversion, from the ruling mode of procedure of an important secretion, cannot occur without entailing equally important consequences, on the condition of the functions. Accordingly, the derangements that follow are often characterized by the most complicated and alarming symptoms. Dr. Fourcault, of Paris, established this fact, by a series of experiments, undertaken for the purpose of determining what share the condition of the skin might have in producing the disease, known as albuminuria. The following are the results, reported to the Académie des Sciences, in 1844:

"First. The skin is only an organ of secretion, and the products of transpiration are not found in its tissue.

"Second. An animal preserves its temperature, even if its skin is taken off. Albuminuria does not follow this operation.

"Third. When cutaneous perspiration is entirely suppressed, five series of phenomena manifest themselves: deep alteration of the blood; considerable fall in temperature; super-secretions and effusions of various kinds local lesions; alteration in the composition of the urine; and, lastly, albuminuria.

"Fourth. The same phenomena, more especially the last, manifest themselves, when, after taking off entirely or partially the skin of an animal, the varnishes are applied on the surface which it covers.

"Fifth. Cutaneous asphyxia is the result of complete suspension of perspiration. It may occasion the death of man as well as that of inferior animals. Owing to its suppression, the blood acquires to a maximum degree the refrigerant and stupifying properties of venous blood.

"Sixth. When the suppression is partial or incomplete, it occasions the general phenomena which are observed in fevers and in inflammation."

Soon after the publication of Dr. Fourcault's report, considerable attention was excited, in England, to ascertain to what extent, filthy personal habits might form the primary cause of much of the disease existing among the laboring and poorer classes. The result of these enquiries, was the establishment of cheap baths and wash-houses. The necessity and exceeding usefulness of this provision, in a sanatory point of view, cannot be questioned. But the introduction of the warm water baths, may be said to have neutralized much of the good, which it was expected the public would derive from the practice of daily ablution. The effects of using the tepid bath will be found at page 94.

The reason why clothes are necessary and become worn, is to equalize the temperature between the surface and the deeply seated viscera; that is, to establish an equilibrium of the heat of the blood, in the different parts of the body. This equilibrium is indispensable to a state of health. It is absolutely necessary that the blood should be as warm immediately beneath the skin, which forms the outer covering, as in the heart itself. Unless this balance is preserved, the velocity of the blood decreases on approaching the extremities or the surface of the body. A cold surface throws the blood inwards; and, if continued, may produce congestion or inflammation of one or other of the internal organs. This frequently happens, and is attended by febrile symptoms or shivering; and the individual sufferer is said to have "caught cold," and to have inflammation of the pleura, termed pleurisy; or of the lungs or kidneys. These inflammatory complaints are very common; and are caused, as I have said, by derangement of the equilibrium of heat, and the overcooling of the surface. A damp, cold atmosphere will produce no injurious consequences, if the body is properly protected with suitable clothing, and the muscles are kept in a state of action. But, privation, on the one hand, and neglect, on the other, of those necessary precautions, may be said, to occasion, at least, one half of the mortality, reported in the official returns.

There seems to be two primary causes, to which, may safely be imputed, the catalogue of human bodily ailments. One, is defective oxidation; the other, derangement of the secretive functions of the skin. Sickness and disease originate, generally, in one or other of these two causes. Invalids do not perceive that there is a consecutive connection, between the various maladies, under which they suffer. Each affection may contain, in embryo, the germs of another, which will appear at some future time. Each case of erro-

neous treatment, is the precursor of worse forms to follow. This is scarcely ever recognized. In sickness, one point occupies, exclusively, the attention; and that is how to get rid of the existing symptoms. The agency which effects this with most speed, is held to be the most curative, and best entitled to confidence. How few ever imagine that the seeds of consumption, which occur in after life, were planted in the constitution during childhood or youth—during the medical treatment, administered for a simple cough or eruptive fever. A correct apprehension of the extent, to which, the customary medical treatment is the initiatory stage of subsequent complications of disease, would undoubtedly lead to a more careful discrimination of the proper means of cure. But these means would still remain a desideratum, unless the derangements, to which they might be considered applicable, could be chemically explained. We have seen, that the proper course, for derangements arising from defective oxidation, such as accumulations of bile, tubercles and calculi, is to supply that which is deficient, namely, oxygen. In the same way, we must proceed, in treating disorders occasioned by disturbance of the cutaneous secretions; we must establish the proper function of the skin. A cough, the croup, pneumonia and pleurisy, are only so many different seats of the same disease. They are all cases of inflammation; proceed from the same cause; and require the same treatment. This treatment consists of the application of heat to the surface; by which a double function is produced. The inflamed or congested part, situated internally and beneath the warm application, expands and allows the fluids to pass through it freely; at the same time, that the current of blood, passing on to that part, is diverted partially to the surface. It has been stated before, that heat applied to the surface expands the organs exactly beneath; and that cold, so applied, produces a contraction of these organs. We have an excellent example of this, in the common practice of applying a warming plaster to the lumbar region of the back, in lumbago, and also in inflammation. The difference in the curative effect of the same treatment, arises from the facility or difficulty of reaching the seat of the disease. For example, the inflammation of the mucous membrane of the large branches of the windpipe, constituting what is known as a common cold, is popularly cured by tying a stocking round the neck when going to bed. Here the seat of inflamation is easily affected, by the warmth around the neck; and the relief is, accordingly, soon experienced. Croup, which is a swelling of the mucous membrane of the larynx and windpipe, is also accessible;

and when attended, in time, can be easily relieved, by the simple application of warmth. If the inflamation is allowed to progress, great danger arises, from the closing of the aperture, through which the respiration is carried on.

The annexed sketch represents the two conditions of the *rima glotidis* or opening in the larynx of a child, through which the air passes to and from the lungs. No. 1, is the natural size; and No. 2, that in which croup is present. If the opening is diminished, though slightly, from the size in figure 2, the case generally proves fatal. The reason of the great mortality among children, from croup, is, in the first place, the neglect to take timely means to check the progress of the inflammation; and, secondly, the application, eventually, of every kind of means but the right kind. This complaint is common, in bleak, cold and damp weather; when the function of the skin is most susceptible of derangement. Too much soft, fleecy clothing has a tendency to keep up a free perspiration; which, in cold and inclement weather, is not without danger; notwithstanding that the child may be, all the time, within doors. But the danger is still greater if, in this state, it should be exposed to a cold current. With the first appearance of croup, which may be known by the shrill sound of the air in the windpipe, or the husky cough, with a deep red colour of the inside of the throat, no time should be lost, in hastening to bathe the child's feet in warm water, and wrapping the neck round with two or three folds of fleecy hosiery or fine flannel. Or a warming plaster may be applied round the neck; or a blistering plaster between the shoulders; at the same time, keeping the body warm and promoting a moderate perspiration. The efficacy of the means depends, mostly, on the quickness with which they are applied. If delayed, the same treatment may be altogether inefficacious; and the danger, from the closing of the aperture, will then be imminent.

In bronchitis, or inflammation of the small air-passages or bronchii of the lungs, the disease is farther remoued from the influence of external applications; and, for this reason, its treatment is rendered more difficult. The same remark is applicable to the inflammation of the substance of the lungs, termed pneumonia; and also the inflammation of the lining membrane of the lungs and chest, called pleurisy. Notwithstanding, however, this disparity, in the means of reaching the seat of the disease, the remedy, if possible, ought still to be the same. But, in most cases, the seat of the inflamed organs

or membranes cannot be easily reached. The proper course then is to reduce the quantity of blood in the system; and thereby, relieve the congested organs. But this must not be done, either by the lancet or with leeches. The amount of blood can be considerably reduced, by abstinence from concentrated food, and the free use of unconcentrated substances. And rest, in a reclining posture, in bed, by relaxing the tension of the muscles and removing the causes of irritation, incident to the exercise of the muscular functions, will accomplish all that is required, to restore the diseased parts to their usual healthy state.

As in croup, all inflammatory disorders, occasioned by derangement of the function of the skin, may be prevented, by adopting the necessary precautions, at the first indication of their symptoms. They begin, with stiffness and langour; and, as they proceed, alternate sensations of cold and heat are experienced. When these indications are observed, the feet, of the person affected, should be bathed in warm water; he should go, at once, to bed; and the body and feet should be well covered, so as to promote a free perspiration. If the bowels have been constipated, something should be taken to relax them. The symptoms generally disappear, on rising from bed next morning; in which case, the flannel shirt must be changed for a dry one, before getting out of bed. But if it should so happen that the precautionary treatment has not been applied in time, the langour and febrile symptoms may continue next morning. The person affected must then continue in bed; discontinue the perspiration by lightening the bedclothes; abstain from food; eating only stale brown bread toasted, porridge, or any simple article that is calculated to keep up a free motion from the intestinal canal. The drink should be water or gruel, or anything else that is neither stimulating, astringent nor constipative. Rest and quiet and abstinence, the natural remedies for sickness among the lower animals, whom we would do well to imitate, in this particular, are generally all that are required to restore the healthy conditions in this class of diseases, when the precautionary means have not been adopted in time. In most cases, however, it will be found, that, in the derangement of the function of the skin, the consequent congestion and inflammation of the interior organs will be relieved, by diverting the current of the fluids to the surface.

But, however well clothes are adapted to preserve an equanimity of the temperature, care must be taken that they be not used in excess; for the danger, from overheating the surface, is just as great

as from the opposite extreme. In order to balance the temperature properly—for this is the sole and only object why clothes become necessary, nothing should be worn which is not of a loose and open texture, capable of transmitting the effluvia from the body and the external air to it. At the same time, the amount of covering should be such, as not to occasion sensible perspiration. The chief point to be aimed at is to keep the surface of the body warm, but, at the same time dry and free from moisture. When clothing, either from the nature of the fabric, or from the quantity worn, produces and keeps up a sensible perspiration, the consequences cannot help being injurious. In one way, by debilitating the system. And, in another, by exposing it, in this state, to cold chills. What is here stated is applicable, however, only to cold seasons. In the hot weather of summer, free perspiration is desirable, and is then a necessary excretion. But, it is not then produced, by clothing. It is the result of natural warmth, peculiar to that season of the year. These remarks apply also to the coverings which should be used, when in bed. These coverings should, likewise, permit air to pass freely to and from the body. The head should not be covered, during sleep. It should be kept cool; particularly of one whose brain is active. The great quantity of blood which goes to the brain, indicates that the head should be kept uncovered, so as to preserve the equilibrium between it and the other extremities. On the other hand, because less blood goes to the feet, there being no separate organ to supply in these lower extremities, they ought to be well covered. And all this is required, to preserve an equilibrium of temperature, in the several parts of the body. Above all things, a feather bed should be avoided. Its warmth, I would repeat, debilitates, by the constant perspiration attending its use. By its means, a foul vapour encompases the body while in bed. A hair mattress, however thin, laid on another of straw, is, without exception, the best form of bed that can be used.

CHAPTER III.

DISPLACEMENT.

Hitherto, our attention has been confined to purely chemical functions. We come now to consider another branch of chemico-hygiene and medicine, somewhat different in its character, from the circumstance that the action produced is chiefly mechanical. What is understood by displacement, is the moving of the matter contained in a secreting duct, or existing as a cellular deposit, from one place to another, by mechanical means. The agent employed, for this purpose, is the cold bath; which is, without exception, one of the best hygienic and curative agencies known. It is a misfortune that, in so simple a matter as the use of cold water, there should prevail a great deal of misapprehension. Either as a source of health or a means of cure, its use is, indeed, inestimable. But though this truth may be freely admitted, still, if its *rationale* is not understood, comparatively little good can result from the use of cold water.

A great deal is said about cold water cures, and the public mind has been held in suspense, regarding the merits of what is known as Hydropathy. River and sea water bathing also, though indulged and generally approved of, is attended with a very small share of benefit, compared with what might be derived from it, if its real purpose, and its action within, were known. Now, what changes, within the body, are produced by the application of cold water to the surface? What change takes place in the heart, in the lungs, in the liver, in the kidneys, in the pancreas, in the spleen, in the arteries, in the veins, in the several glands, in the celular tissues and the membranes? Great changes take place in all these organs. But what these changes are, is what requires to be understood. We are told that cold water bathing is good, just as we are informed that bathing in tepid water or riding on horseback is good. If we question or demand the how and the wherefore of their goodness, no rational nor scientific answer is given. I will say nothing of the recommendation, to consumptive persons, to ride on horseback; because, I think, the jolting and fatigue, consequent on such exercise, are too much for a weakly constitution; because I have seen it tried, and discontinued on this account; and because it is not capable of a rational explanation on scientific grounds. But cold, as well as tepid water bathing, is as often injurious as it is beneficial. Of the many persons who resort yearly to sea bathing, a great number return

without benefit; while not a few consider themselves worse, from having used the salt water. In lake and river bathing, it is too much the case, that little good is derived from the practice; and even in the use of the domestic bath, injury is often inflicted which is not immediately perceptible.

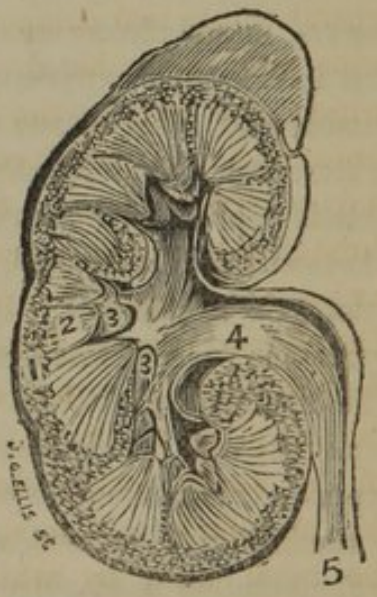
There is a scientific reason for bathing, just as there is a scientific reason for any other useful act. But, unless the reason is known, the chances are that, in its performance, the act may be abused, and most frequently injury may proceed from it. Therefore, it is proper that the changes which take place internally, should be minutely explained.

The human body possesses what is called a nervous system. These nerves traverse every part of the trunk, head, legs and arms. They communicate, between the surface of the body and the internal viscera. They are divided into two classes; nerves of sensation and nerves of motion. Nerves of sensation, with which we have more immediately to do, as the term implies, perform a function similar to that of telegraph wires. They convey impressions, from one part, to another. What impressions are received at the points of the fingers, in examining an external object, are conveyed to the mind. But impressions experienced on the surface of the trunk, or on the outside of the leg or any other member, are also conveyed inwardly to the parts seated directly beneath. This is the case, when cold or heat is applied to the surface. The nerves of sensation, at the part where the cold is applied, convey the impression inwardly, with the velocity of lightning.

As has been before observed, heat expands, while cold contracts. The application of heat to the surface, makes the deeper seated parts expand. This is the principle on which, as has already been explained, inflammation or congestion of a deeply seated organ, such as the kidney, is treated, when a heating plaster is laid over the part, or fomentation is employed. The warmth of the surface expands the organ beneath, and keeps it so expanded; and, by this means, the obstruction to the urinary secretion and to the free passage of the blood, produced by the congestion, is removed. What takes place, when cold is applied, is the opposite of this. The kidney then becomes contracted; and if allowed to remain so for any length of time, very serious consequences may follow. It is a common occurrence, when a child engaged at play has a bleeding at the nose, that the mother takes the cold iron key from the lock of the door, and places it on the back of the child's neck, directly over the spine;

and the bleeding immediately ceases. The stoppage of the blood is caused by the contraction of the ruptured vessel. The edges of the rupture are brought together by the contraction; and being so compressed, the blood is prevented from escaping. If the key is taken away instantaneously, after the bleeding has been stopped, the blood will flow out again. But if the key is kept on for a little, the edges of the rupture will adhere, and the bleeding will not afterwards return. Hemorrhages generally may be arrested, or, at least, mitigated, by a similar application of cold to the spine. In what are called hemorrhoids or bleeding piles, it is the only effectual remedy; care being taken, at the same time, that the evacuation of the bowels is regular, by diet alone, and not by drugs.

Now, the object of using the cold water bath is to produce this contraction; but not to continue it. The judicious use of the bath consists in effecting an instantaneous contraction, to be succeeded by an immediate expansion of all the internal organs and viscera. When an organ is so compressed, its contents are squeezed out, just as, in squeezing an orange, the juice is expelled from it. In the section of the kidney here shown, the structure is such that it admits of being compressed into a much smaller compass than its ordinary size. There is a large pelvis or cavity (4) for the reception of the urinary secretion, which enters it from the papillary projections (3 3) surrounding its interior surface. The cortical and medulary substance of which the body of the kidney is composed, is exceedingly vascular, and therefore, compressible. When, in the regular process of displacement, it is compressed, the urinary secretion contained in the cortical and medulary substance, and which is trickling slowly into the cavity (4), is squeezed into that cavity at once. This, it will be observed, is a mechanical action; effected suddenly, through the instrumentality of the nerves, which convey the shock received at the surface.



SECTION OF THE KIDNEY.

1. Cortical substance. 2. Medulary substance. 3 3. Papillae, from which the urine exudes. 4. Pelvis, or receptacle of the exuded urine. 5. Ureter, carrying the urine to the bladder.

At the same time, that the shock is received, the blood contained in the blood vessels of the kidney, is pressed onwards through the

veins. Then, so soon as the cold is withdrawn from the surface of the body, and, by quick drying the surface becomes warm, a rush of fresh arterial blood takes place into the arteries, and thence into the veins of the kidney, completely filling its whole parenchyma.

The apparatus in which this process is carried on, is more minutely represented in the accompanying sketch. The arterial blood having entered the kidney by the renal artery, passes along the branch of the artery 1—2; giving off the branches marked A, A. From these latter, the afferent arteries proceed to the malpighian glands B, B, in which the secretion of urine from arterial blood takes place. Within their substance, the arterial blood is separated into two compounds, urine and venous blood. The urine leaves them by the uriniferous ducts L, L; which enlarge and converge, in their course through the medulary or tubular portion, towards the pelvis. The efferent veins F, F, leaving close to where the artery enters the malpighian glands, carry off the venous blood, through the medulary substance, into the renal vein, by which it leaves the kidney.

Each malpighian body communicates with an artery, vein and uriniferous duct. The two former enter, close to each other, on one side. The latter opens, on the side directly opposite.

A malpighian body or gland, with its accompanying vessels,

PLAN OF THE STRUCTURE OF THE KIDNEY; AFTER KOLLIKER.

I. Cortical substance, containing the secreting apparatus. 2. Medulary substance; containing the veins; and tubes or ducts, which carry the secreted urine to the pelvis, 4. 1, 2, Branch of an artery. A, A. Smaller branches, giving off twigs to the malpighian secreting glands, B, B. F, F. Efferent veins. L, L. Uriniferous ducts.

if examined separately, will exhibit with more minuteness still, the arrangement of the secreting machinery. The twig, coming from the branch *a*, of the artery, after entering the malpighian body B, separates into five, six, seven or eight branches; each of which divides again into a bunch of capillaries. It is from these capillaries, during the passage of the arterial blood through them, that the urine is secreted into the minute uriniferous ducts which converge and form the uriniferous tube L, L, which takes a winding course in the direction of the pelvis. Alongside of the afferent twig, the efferent vein F, is seen emerging. It convolutes and forms a plexus around the uriniferous tube, terminating in the renal vein V.

PLAN OF THE RENAL CIRCULATION; AFTER BOWMAN.

a. Small branch of an artery. 1. Malpighian body. L L, Uriniferous duct. F, F. Efferent veins leading to V, the large venal vein.

With reference to the structure of the arteries and veins, which structure directs the course of the blood in the kidneys when they are compressed, it is necessary to remark that arteries have no valves; whereas the veins have. The reason of this arrangement is, that arterial blood, the blood which flows in the arteries, being pure and in composition the same as the oxidized blood issuing from the left division of the heart, produces no injurious effect, when it recedes in the arteries by regurgitation. On the other hand, venous blood, being in great part the refuse of the decomposed tissues, intended for expulsion from the system, could not flow back into the arteries without, at the same time, altering the condition of the arterial blood, and, accordingly, doing mischief. To prevent this, the veins are found to have valves, in all those parts, where they are required. These valves are so constructed, that they prevent the venous blood from going back into the arteries; and it is, therefore, forced to take a direct course onwards.

In the capillaries and small veins, no valves are perceptible; but there is a provision which answers the same purpose. They possess longitudinal and projecting formations, called nuclei; some of which are placed transversely, in such positions as require that the absence of valves should be compensated by structures capable of serving the

same purpose. In the annexed representation, the transverse nuclei are placed in the minute artery 1, just at its point of connection with the capillary 2; so that the arterial blood, which becomes changed in the capillary, cannot return into the minute artery; being prevented from doing so by these transverse nuclei; and must, therefore, move on through the capillary; the elongated nuclei also acting as valves, to arrest the return of the blood.

TRANSITION OF A MINUTE ARTERY INTO CAPILLARY VESSELS, FROM THE BRAIN; AFTER KOLLIKER

1. Minute artery. 2. Transitional capilary. 3, 3. Coarse capillaries. 4, 4. Fine capillaries, containing elongated nuclei. *a.* Transverse nuclei.

It is manifest, that the compression of the kidney must affect most forcibly the external cortical substance, in which the malpighian bodies are situated, so as to move their urinary contents inwards, through the efferent vessels and ducts, in the direction of the pelvic cavity; their blood being forced, simultaneously, into the renal vein. That this effect is produced, is demonstrated by the quantity of the secreted fluid which passes into the bladder when, by means of the cold bath, the kidney is made to contract in the way described. This is an experiment which any one can try upon himself, in order to become convinced of the truth of the fact which has been stated. The way to proceed, is, first, to empty the bladder of its contents, just before applying the cold water; taking care that the body is comfortably warm, when stepping into the bath. If a sponge bath, the water is to be applied freely to the spine. The process of bathing may not occupy more than one minute, or two minutes. At the expiry of which short period of time, and before leaving the bath, there will be experienced an urgent disposition to pass urine. And, if the feeling is gratified, the quantity evacuated will equal, on an average, the full of an ordinary sized wine glass. Under usual circumstances, the passage of urine into the bladder is a slow process; proceeding from the ureters drop by drop; and no desire for evacuation is felt, before that a large quantity of urine is accumulated. The urgent desire to evacuate, before leaving the bath, is caused by the irritation produced on the mucous membrane of the bladder, in consequence of the quantity of urine thrown in, at one time, and suddenly.

The kidneys have been selected to illustrate the nature of the change, by dislodgement, which takes place, when the nerves of the surface are made to transmit their shock to these urinary organs. A similar change, however, occurs simultaneously in every other secreting gland; and, moreover, in every membrane, tissue and cell of the human body. The contractile effect, on the surface, is communicated to the whole vascular system. No part, whatever, is exempted. The larger organs, such as the lungs and liver, equally with the minute glands of the serous and mucous membranes, and the albuminous cells of the areolar tissue, participate, to the full extent, in the contractile function, and also in that of displacement of their contents. So universal is the influence produced, that not only are the immediate effects perceived to be of a constitutional nature, but the subsequent manifestations indicate the mutual support which, constitutionally, the separate parts render to each other.

The mechanical process of displacement, which is a result of the shock occasioned by the cold water, has the hygienic effect of accellerating the change of matter, or waste; and thereby making room for an increase in the amount of nutrition required. The equilibrium being preserved, assimilation proceeds under the most favorable conditions; and the maximum of nutritious and assimilative conditions produces a maximum of vitality. It is in this way, that the body acquires additional power, when the progress of displacement is continuously prosecuted.

But it is not the body only, which benefits by this continuous revulsive action. The mind also participates, to an equal extent, in the amount of vigor which is imparted, by this means. It is necessary to remember that the brain, the organ of the mind, is material; and that it possesses a vascular structure, for the purpose of nutrition and waste, similar to what exists in other members of the animal body. It has arteries and veins that perform the same functions, and serve a purpose similar to that of the arteries and veins of the muscular tissues. And in this respect, there is no difference between the brain of a quadruped and that of a human being. Nutrition and waste being alike essential, to the one and to the other. And this resemblance is not limited to their structures and functions, for the purpose of nutrition and waste. The vital manifestations have a direct relation to those structures and functions. Being most powerful, *caeteris paribus*, under the greatest acceleration of assimilation and oxidation, in which the equilibrium of the two processes is preserved; and *vice versa*, or proportionately imbecile, when these

processes go on slowly, and are not in equilibrium. There is, in short, no agency whatever, that imparts strength or weakness to the muscular tissues, that does not influence similarly, and to an equal extent, the brain and nervous system, and their manifestations.

From the lowest reptile, up to man, vital development is the result purely, of assimilation and oxidation carried on, under the conditions of the equilibrium. To satisfy ourselves of the reality of this general law, we need look no farther than to the domesticated animals; such as the horse, ox, cow, dog and cat. Neither of these animals, in a fat or lean condition, possesses equal strength of muscle, or exhibits so much animation, as when fed and exercised, so as to maintain the natural conditions of the equilibrium. A fat or lean dog is, in an abnormal state, when there is a preponderance of one or other of the conditions of nutrition and waste. The fatness is then a cause of enervation, as much as the leanness. For the fat dog not only wants animation; but his want of strength, is made conspicuous, the moment he comes in hostile contact with a more normally conditioned, but lighter dog, of the same particular breed. It requires no argument, to prove, that a corpulent man, cannot possess strength or the capacity of endurance. The strength of the body, and also of the mind, in a state of health, depends, to a considerable extent, on the proportion of muscular fibre, relatively to the amount of fat. The rule being, that when the muscle is well developed, the mind will be found to be proportionably powerful; it being always understood, of course, that all other conditions are the same.

Sensation and perception are common, to us, with the inferior animals. In many respects, our powers of sensation and perception are inferior to theirs. In relation to the dependence of the vital energy and mental vigor, on the state of the muscular fibre, man has no advantage over other animals. And, in this respect, is not superior to them. What constitutes his superiority, is the superaddition of the power of reason; or of that faculty, in which the reason is seated. And here even, this rational faculty is found to be vegetative. To grow with the body; mature with the body; and to be developed, with its development. Sympathizing, in all its vicissitudes; and losing its force and vigor, as old age impairs the force and vigor of the muscles.

As the brain and nerves, the seat of intellect and organs of sensation, have arteries and veins, and, therefore, possess the usual apparatus of nutrition and waste; and are, in consequence, so intimately related, in their growth and development, with the growth and

development of the other structures of the body, the reasonable and legitimate inference is, that, in the processes of assimilation and oxidation, and also of displacement, the organ of the mind, and the mind itself, are as much influenced, as the muscular tissues. The benefits, therefore, conferred on the nervous system, by assimilation, oxidation, and displacement, are facts of vast importance to both hygiene and medicine.

The sensation experienced by a healthy person, after a bath performed in the proper way, is that of great vigor. The strength seems renewed, and the body seems capable of undertaking some Herculean feat.

But suppose the individual has been afflicted with a diseased state of the liver; or with tubercles in the lungs; or with ulcers in the neck or on the legs; or the formation of pus or concealed humors, in any part of the body; the compression, occasioned by the application of cold water to the surface of the body, pushes the diseased matter, wherever it may be, forwards, in a direction to empel it, through the secretions of the venous blood. The onward movement is, from the arteries, into the veins. By the valvular construction of the veins, when the compression takes place, the valves prevent the diseased matter from going back. It can only go forwards. Consequently, it goes, in a direction, to be removed from the place in which it has been formed, and to be expelled.

Therefore, in cold bathing, in order to effect this onward movement of the fluids and humours, and, at the same time, to aid the sudden rush of fresh arterial blood, the bathing must be done quickly, and also the subsequent dry rubbing. The degree of compression is in proportion to the coldness of the water. If the constitution is able to bear the shock, a person having tumors to be removed, or chronic derangement to be overcome, should make use of the coldest water.

Displacement, moves the diseased matter, from the place in which it hae been formed or located. Oxidation, carries it out of the body. The repetition of the first process, and its continuance, are necessary to move the morbid matter of a constitutional or local disorder. And the length of time during which these processes must be carried on, to effect a perfect cure, is proportioned to the stage of the disease, and the collateral circumstances attending it.

Diseased humors, which pass from the body in this manner, can pass out by three channels only; namely, by the kidneys, by the lungs, and by the skin. Tubercles, and similar diseased formations, can be

effectually removed, only in this way. In place of washing a common ulcer on the leg with milk and water, as is commonly done, the most speedy and effectual way to heal the sore, is to wash and rub down the whole body, in the manner described.

Rheumatism, a painful disorder of the joints and muscles, though caused by the action of cold and damp on the surface, is unlike the inflammation of mucous or serous membranes, which are produced by the same cause, in this respect, that it progresses slowly, gradually becomes confirmed in certain parts of the system, and, in most cases, remains afterwards, as a lifelong inheritance, occasioning severe pain and annoyance in old age. Acute rheumatism may easily be cured, in such a manner, that its eradication shall be thorough and complete. With chronic rheumatism, the case is different. Like all diseases, confirmed by long continuance, it takes deep root; becomes, in a sense, ingrained; and has to be mitigated rather than cured. It is capable of being treated, however, so as to exclude permanently the occurrence of pain. By observing the manner in which the maximum of vitality is produced, it will be perceived that the cure takes place, through displacement and the consequent accelerating process of waste and assimilation, which are the most forcible conditions of the equilibrium. The parts rheumatically diseased, when made to undergo a continual process of displacements, become renewed. The renewals are not those which occur under ordinary circumstances. They are the accumulative and concentrated amounts of muscular energy, produced by the accelerated means of assimilation.

In treating for rheumatism, the cold water bath is to be used, in the morning, on getting out of bed. The body should be comfortably warm, at the time of commencing the bath. The cold water is to be applied to the whole body, commencing with the head; and more particularly to the parts affected. And those parts should be well rubbed, subsequently, with a coarse dry cloth, finishing with a second cloth of the same kind. Flannel must be worn next the skin; and if the disorder has progressed for any length of time, so as to have taken hold of the system, it will be necessary to sew patches or stripes of chamois leather, on the outside of the flannel shirt, and directly over the parts where the pain is felt. These patches must be made to cover only the parts so pained. It is common with some to wear a chamois under-jacket; but this is highly objectionable. If other parts are equally covered, those affected will not benefit by the covering. In all cases of rheumatism, either incipient or confirmed, sensible perspiration is to be avoided, during both day and

night. Out-door exercise is to be freely indulged. The skin should be kept dry; and this can be managed easily, by the general treatment recommended. It is proper to observe, that, in many cases, it may happen, that no relief is experienced till the cold bathing has been continued daily for some time; and therefore, the patient is not to discontinue the bath, because he may fancy that its good effects ought to be manifested at first.

All healing processes have one mode of action. Diseased matter is carried away in the venous blood; and healthy deposits, to fill its place, are formed from the succeeding influx of arterial blood. The chief object of the healing art, is to remove whatever does not properly belong to the healthy body. The healthy condition is the standard on all occasions. It is the model to which the medical practitioner should always look for his rule of action. In removing diseased accumulations, the rule, we are to follow, is that of displacement, by compressing the organs or tissues wherein the accumulated matter is lodged; and as this can be effectually done only by a constitutional mode of treatment, we, therefore, plunge the whole body in cold water; or apply the water to the whole surface, by means of a shower bath, or with a sponge. It does not signify by which means, so long as the double revulsion is produced by the cold shock, and the rubbing down is equally and thoroughly executed. In winter the room should be warm, or, at least, not very cold, in which the bath is taken.

In regard to what is called hydropathy, its leading feature, or indeed the fundamental principle on which its pretensions are founded, is that of sweating out the disease. It is this getting rid of disease, by sweating it out, that is assumed to constitute the process of cure in hydropathy. Therefore, in examining its pretensions, all that is required, is to ascertain whether the sweating promotes the natural course of the secretions, or diverts them so as to derange the equilibrium of the natural functions. The object of enquiry is the determination simply of a matter of fact, cognizable on scientific data. The assumptions of Priestnitz may have originated in honesty of intention and integrity of purpose; but Priestnitz was an uneducated person, at the time he originated hydropathy, and is so still. He knew nothing of the anatomy of the human frame, and, consequently, much less of the nature and constituent elements of the various secretions. How he could, thus circumstanced, have originated a scientific theory, is not conceivable. And what grounds his followers assume, for their adoption of a system conceived, thus, in

ignorance, and which practically violates a fundamental principle of science, may be left to themselves to consider.

The principal glandular secretions, are the urine, the breath, and the perspiration. In health, they have their separate channels of exit. The urea and uric acid, are found invariably, in the urine; the carbonic acid, principally in the breath; and the muriates of soda and potash, in the perspiration. It never occurs, in a state of health, that either of these secretions is diverted from its natural channel. And, therefore, if we are to look to the normal state for the rule by which we are to be guided, in the treatment of the sick, it will be found, that the very first condition to be observed is the limitation, exclusively, of each secretion to its natural channel. There is no controverting this truth. We cannot falsify the natural law.

In the hygienic and medicinal process of displacement, no such diversion occurs; nor is it possible. It is to guard against this, that the process is limited, in duration of time. One minute, or, at the utmost, three minutes in the bath, cannot be exceeded, with advantage. And in that time the sebiparous and sudoriparous secretions cannot be diverted to the kidneys, nor the urine to the cutaneous surface. The suddenness of the impression or shock, merely displaces the matter of the glands and ducts; moving the venous blood and the secretions from the arterial blood, onwards; at the same time that a temporary revulsive action, to a very small extent, scarcely appreciable, takes place in the arteries of the glands.

When the cold or warm bath is used improperly; that is, when a person remains too long a time in it; or remains so long as to allow time for a secretion to become diverted, certain constituents of the urine are then found in the perspiration, or those of the perspiration in the urine. As has been stated, it is to guard against this result, that a restriction is placed on the time in which the bathing operation should be completed.

As a general rule, sensible perspiration or sweating is to be avoided, at all times, except during the heat of summer; or, when, by artificial means, warmth is applied to the surface, for the purpose of removing internal congestion. And in proportion to the extent to which it is possible, by light clothing and other suitable precautions, to diminish the amount of perspiration in the heat of summer, is the corresponding advantage to the constitution. Insensible perspiration, is a normal condition of the equilibrium. But sweating, is one of two abnormal extremes; the other of which, is suppressed perspiration. Similarly, neither a lax nor a constipative state of the

bowels, is a normal state. Nor is excessive nor suppressed urination. Every departure from the equilibrium, is a departure from the rule to be observed, and which should in all cases prevail.

Now, the practice, in hydropathy, of sweating the patient in sheets, coverlets or blankets, for two or three hours, till the perspiration changes its color, becomes viscid and of a strong odor, and the urine and the breath also become offensive; is not only a derangement of the equilibrium; but is a transferring of urinous qualities to the perspiration, by a violent ordeal. The idea of sweating out the disease originated, in the presumption that all parts of the body are accessible through the pores of the skin; otherwise, it would be a contradiction, to sweat for an abscess of the lungs or liver, if the matter formed in the abscess could not be brought to the surface of the body, by the hydropathic ordeal. But there is no way whatever, by which diseased matter can be transferred from either of these organs to the skin. It is impossible that it can be so tsansferred, under any circumstances; for the venous blood of the general circulation passing through them, and also that of their *vasa vasorum*, take a direction to the heart. The proper channels of outlet for the matter of abscess, and also for all other diseased matter, are the lungs and kidneys. They are the principal outlets, because all the blood of the body passes through them, for secretion. Which is not the case with the sebiparous and sudoriparous glands; for these glands receive and secrete only the blood that reaches the surface. Except by the hydropathic ordeal, the amount of matter perspired is trifling, compared with what finds an exit through the lungs and kidneys. And, even under that ordeal, though the amount of blood brought to the surface is comparatively much greater than when that ordeal is not applied, still, the amount is small, compared with the amount in the whole body. Upon the whole, then, the quantity of blood capable of being secreted by the sebiparous and sudoriparous glands, even under the hydropathic ordeal, is small compared with the quantity secreted from the lungs and kidneys. These facts conclusively show, that the hydropathic system is at variance with the simple truths of anatomy and physiology. *

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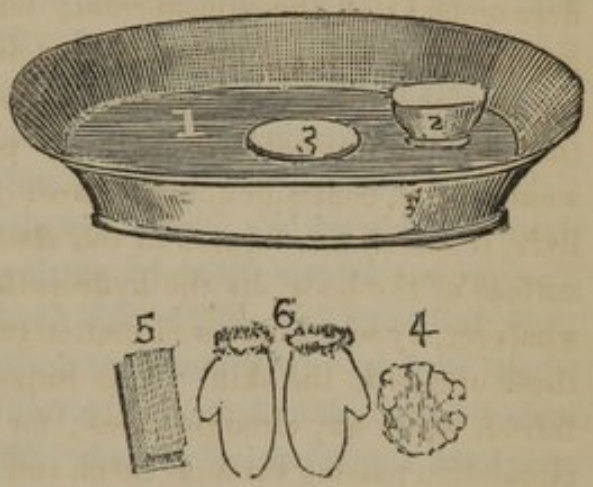
* As the name of Liebig has been employed, in the writings of hydropathists and homœopathists, for the purpose, evidently, of imposing on the credulous public, I consider that I am performing a double duty in making known the recorded opinions of that great man. Germany being the land in which Priestnitz and Hanhemann originated and matured their respective systems, and in which their systems have been most extensively practised, the testimony of a profound scholar, shrewd observer, and the most distinguished

The plunge bath is certainly a great luxury; but it is not every one who can aford the expense which attends it. The most convenient bath, and one equally efficacious, is a hand basin filled with cold rain water, and a wide and shallow tin pan to stand in. The tin pan is portable, and may be carried from one bedroom to another, so that all the inmates of a house may use it, consecutively, every morning. The annexed sketch of the pan, basin, and other necessary accompaniments may be useful to those who desire information on the subject. A common wash tub will answer the purpose; but for general use, it is comparatively clumsy and heavy, and not wide enough to protect the carpet from being wet. The pan is light, and easily handled, and may be set standing upright, on its edge, against the wall of the room, when not required for use.



1. Tin pan, 42 inches across the mouth; 36 inches across the bottom; and 4 inches deep. 2. Hand basin. 3. Thin circular board to stand on, to protect the soles of the feet from the coldness of the tin. 4. Sponge. 5. Hard scrub-brush, 6 inches long. 6. Coarse hard worsted mits.

The best way to proceed, is to place the basin in the pan, and, while standing on the floor, to lean over the basin and wash the head first. Soap it very lightly on the crown. Then, with the brush, scrub it well all over, using as little water as possible, so as not to wash the soap off. When this is done, then stand erect on the floor; and rubbing the palms of the hands over the head, in order to soap them, apply the hands so partially soaped to the face, shoulders, armpits, loins, and between the thighs. As soon as this

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chemist of the age, familiar with both systems, must carry great weight. Commenting on the abuses of medicine, in his lectures, published in 1844, Professor Liebig expresses himself as follows:

"The existence of hydropathic institutions, those dens of covetous and rapacious gamblers, where the wretched invalid resorts, to throw the dice for health and life; the rise and progress of the homœopathic system, which treats truth with scorn, and bids defiance to common sense, loudly proclaim the need which exists for the adoption of settled principles, definite methods of research, and a systematic arrangement to guarantee their attainment and retention." * * * "Can we wonder that men wholly ignorant of physiology and chemistry, although in other respects rational, should adopt the absurd notions of Hanhemann, that his doctrines should prevail in Germany, and find disciples in all countries?"—*Lancet*, Nos. 1 & 15 for 1844.

is done, place the circular board in the centre of the tin pan; get in and stand on it; and squeeze the sponge, filled with water, once on the crown of the head. Then distribute the water, which is flowing off mixed with the soap, over the body by rubbing the parts all over. The remainder of the water may then be applied freely with the sponge, squeezing it over the head; and rubbing down at each application of the sponge, till the basin is emptied; care being taken that some portion is applied freely to the back of the neck and spine, so as to influence the spinal cord. If bearable, cold spring or well water, in summer, is best, where the object is to displace the morbid matter of constitutional disease, or local ulcers.

Having finished the bathing, and stepped out of the pan; rub down quickly with a coarse dry cloth, and follow with a second. The process is completed by putting on the mits, and rubbing the arms, body and legs till, by the friction, a warmth is felt over the whole surface. In winter the clothes must be hurried on, to promote the warmth and secure the full influx of arterial blood, which completes the revulsive process. The water in the tin pan is then to be emptied into the basin; and the pan, being wiped with the sponge, may be set up against the wall or otherwise disposed of until required. The basin, with the water, is to be placed in the basin stand. By attending to these particulars, in the order in which they are here stated, a habit of method and regularity is acquired, which makes the bathing operation expeditious and convenient to the person engaged in it; and precludes annoyance to others, and complaint on the part of the attendants, who have the cleaning and setting of the room in order, afterwards.

If the body feels warm immediately after the dry rubbing, it is an indication that the effect is beneficial. But to secure this result, it must be comfortably warm before commencing to apply the cold water. On no account should a bath be taken while the body is cold. When the plunge bath is used, the head should be wet first, before going into the bath; because it is better for the blood to rush from, than to the head; a transition that invariably takes place on the application of cold.

With this knowledge of the *rationale* of the bath, it is easy to conceive why little benefit is derived from it, in consequence of the way in which it is generally made use of. Young persons invariably remain too long in the water. Older ones frequently do the same. The common practice is to go into the lake, river or sea; that is, nto cold water, with the sun's rays striking directly on the head.

And, to make the case worse, many females will not allow the head to be wet, on any account. Then again, in the plunge bath, the time for continuing in it is too long, and the head is generally the last that partakes of the water.

The objection to warm or tepid water bathing, may be inferred from the contrary inward action attending it. No doubt it is more agreeable to the feelings, to go into a warm than a cold bath; and this may be the reason why the warm bath is generally used. But what is most pleasing to our taste, is not always the best suited to our bodily and mental requirements; and if the extent of the debility and corresponding infirmities, attendant on the use of the tepid bath, could be adequately impressed on the public mind, much good might be done, so as to lead to its discontinuance. A warm bath, taken in warm weather or in summer, produces no displacement, and is followed by no revulsion. And, if taken in winter, is succeeded by a sensation of cold, which is a reverting of the order in which the revulsion should occur. The permanent temperature of the surface, after the revulsion, should be that of warmth; and this is what takes place when the cold bath is used. But, after a warm bath, the surface is more sensitive to cold; and the cold is then the permanent after state; and, as such, the body becomes exposed, in a most imminent degree, to internal congestion.

The general use of the warm or tepid bath in our hospitals, precludes the process of displacement. The best agency, for the removal of the morbid matter of the circulation and secretions, or of ulcers, is thus neglected. Is not such a procedure in direct violation of a principle of science? What a reflection, on the prevalent system of physicing, that the natural indications are not perceived; and that a practice the most vicious, should take the place of a means of cure, which, in a general hospital, should, above all others, be most highly valued! The warm water bath should not only be discouraged, but ought to be absolutely prohibited, in every medical institution.

Its use, by the mentally insane, is still more objectionable. Yet it is a melancholy truth that, in the management of lunatic asylums, the warm bath, as a means of cleanliness, if for no other purpose, is considered a valuable adjunct in the general arrangements. Now, it may not be generally known, but it is a fact nevertheless, as has been noticed, that whatever gives stamina to the muscles, has a corresponding effect on the nervous system. For the brain and nerves are supplied with arteries and veins, for their nourishment, the same as all other parts of the body. And, on the other hand, that any per-

manent cause of stimulation or excitement of the blood and tissues, produces a permanent state of the nerves, precisely of the same stimulating and exciting character. Of this we have a practical exemplification, in the training of pugilists and pedestrians. When a person is about to engage in a pugilistic encounter, or to undertake a fete of walking a given distance in a given time, he requires qualities of endurance and coolness, for the execution of his purpose; must be sound in wind, and possess, what is called, good bottom. These qualities are all acquired by the rational system of training universally adopted. He is restricted in his diet to coarse and plain articles, such as coarse stale bread, vegetables; and water to drink; exercise in a cold and bracing atmosphere; and the constant use of the cold bath, and dry towel rubbing. The muscles of the arms, chest and legs become thereby, fully developed; and he acquires a measure of strength which, in the exercise, is of long continuance, and is long before it is exhausted. The solidity thus imparted to the body, is visible also in the mind. He is cool and collected. He goes to work, not by fits and starts; but with a settled purpose, resolution and firmness, that imparts dignity to his acts.

Now, the chief means in producing this state of the muscular and nervous systems, is displacement. The theory of the process has been explained. It consists in the acceleration of the change of matter, or waste; and the consequent accelerative process, by which new tissue is formed. The rapidity of the processes of waste and supply, being thus continued for a period of time without intermission, generates not only an increase of bulk, but, what is more appreciable, a consistence, and firmness of fibre in which the nervous system invariably participates. By a continuous persistence in the use of cold water, so as to produce displacement every time it is used, it is in the power of any person to give firmness and solidity to his muscles and nerves. And moreover, it is within the reach of every one afflicted with cutaneous or organic constitutional or local disorders, to rid himself of the same by this very simple means.

On the other hand, a person fed on beef and fine bread, and who drinks ale, and makes use of the tepid bath, may be fleshy, and acquire what the French call *embonpoint*. But his flesh is of the wrong kind. He will be more excitable; and will be readier to fight, or walk, or undertake any other fete; in the execution of which, however, he is almost sure to be beaten.

These are practical truths, that have a scientific explanation. They ought to be of great value in the treatment of the insane.

Displacement should be regarded and employed as the chief medicament in every lunatic asylum. No treatment of the insane can be generally effective in which cold water revulsions are excluded, or are not made the primary means of cure. An objection may be started, as to the difficulty of getting patients to use the cold bath. But such is not tenable. If it be made a rule, in an asylum, that the bath is indispensable; and patients be given to understand that reliance is placed on it, more than on any other means; and if, at the same time, the bath room is comfortable; in winter being warmed; there is no reason to suppose that the patients could not be induced to accustom themselves to cold bathing. Like everything else, to succeed in persuading them, it would require to be gone about in the proper way. Besides having the bath room attractive, the bathing should be commenced during the heat of summer, at which time no persuasion would be required, as a cold bath is then a universal luxury. Patients, commencing to take the bath in winter, should have rain water; and the female and more delicate male patients, should be supplied with rain water during the whole year, as it is soft and grateful to the feelings. After the custom has been generally introduced, during the summer, of taking a cold bath every morning, a continuance of the practice, in winter, could be easily secured, by a little address and management; and, if need be, by some additional allowance, privilege or reward. By whatever means accomplished, however, the cold bath should be made a *sine qua non*, in the treatment of the mentally insane; and should hold the highest rank as a medicament, in every lunatic asylum.

Before leaving this part of our subject, I would impress on every one, young and old, the advantage of taking a cold bath every morning, during the whole year round; in winter as well as in summer. With many, it will require no inconsiderable amount of resolution to commence the practice; for habit is so difficult to overcome that, without some strong motive, the attempt might be considered almost impracticable. But few, who can bring themselves to use the cold bath, daily, for two or three weeks, without intermission, and in the proper manner, will feel disposed to renounce it afterwards. The benefit experienced is so palpable as to be itself the strongest motive for the continuance of the practice. On this point, there can be no deception. The truth of the fact is easily tested.

In place of washing the face and hands only, because the face and hands only are seen, this partial washing should be abandoned; and a basin of water, applied to the whole body, should be adopted in its

stead. Gentlemen might as well dispense with the shirt altogether, because it is not seen, and wear only a collar and a dicky. And, for the same reason, the ladies might remove some concealed appendage of comfort and health. There is no reason but fashion, arising out a slovenly if not a filthy habit, why this privation should exist only in the one case. And it cannot be denied, however humiliating it may be to our sense of propriety, that the reason why we wash only the face and hands is because, as has been said, they are the only parts which are visible.

Fashion, in this respect, has altered very much for the worse, since the age of the Æsculapian temples. The free and constant use of the cold bath, was the chief means of purification, and the grand medicament to which the sick and the maimed were all alike subjected. Amid the orgies and priestly devices which characterized the treatment of disease, in the early age to which reference is here made, the bath stands out as a useful remedial institution, to which, in our own boasted days of therapeutic science, we can furnish no parallel.

CHAPTER IV.

CONCLUDING REMARKS.

Reviewing the substance of what has been said, in the preceding pages; and, in the first place, with reference to the peculiarities which distinguish the scientific medician from the mere empiric; it is worthy of remark, that the more competent a physician is to comprehend the irreconcilableness of the principles of his practice, the less dogmatical are his assumptions, in regard to the virtues of his prescriptions. It is observable, that an active or passive constitution of mind, generally determines the aspect in which it views a proposition, or the relative bearings of external objects. While one takes on impressions, and retains them, indelibly, in the same way that this paper has been impressed with types and ink; they are received,

by another, only as postulates; and, as such, are retained for the purpose of being digested afterwards; and to be either cancelled or confirmed, as circumstances may justify, on some future occasions. In a rational point of view, and as already has been remarked, the distinction between man and brutes, and between one man and another, consists in this active or passive constitution of mind. It is no less peculiar to medicine, than to other professional avocations. The fine arts, or the rude employments of manual labor, present no exception to the rule. In the studio and pulpit, at the bar, in the laboratory, surgery, and last, though not least, in the druggery, we find, one class of men, prosecuting their labors by the light of their own genius; making use of the inherited materials of former generations, only in so far as they are in consonance with the eternal rules of right, and consequently with the laws of the Creator; probing for first principles; and scrutinizing the occult causes of the nature of things. Another class, by far the more numerous, are the exoterici of Pythagoras; mere machines; the slaves of early training, good or bad; who band together instinctively, for the promotion of their peculiar interests, or the protection of their respective crafts; and, are found, on all occasions, resisting the progress of enquiry and science, as leading to innovation.

As the respect due to a licentiate, does not arise from his having a legal appendage to his name, irrespective of other considerations; neither can a charter, to a corporate body, protect it from contempt, if such charter is known to have been improperly awarded and unworthily obtained. Something else is required, besides the legal title. And that something, is the merit on which titles should rest, and from which they should emanate. Had it so happened that, like surgery, any particular school of physic could show scientific claims to sustain its pretensions, there could exist no objection to its enjoying the special patronage and protection of the law.

It is for the interest of every respectable practitioner, to look at the subject in this light. For the question is not now, as it used to be formerly, how far the law is available to protect only one school, to the exclusion of all others. Surgery will continue to be so protected, and very properly; for it has a purely scientific foundation; and arduous, and assiduous, and continuous labor is required, to attain proficiency. But, as to physic, or the mixing and administering of drugs, no license and no law can protect it from abuse and from ridicule; for the reason, that no two schools, or no two members of the same school, can be found to agree in practice. The fact

is, that in consequence of the dissatisfaction in the public mind, with respect to this disagreement, and the professional ignorance from which it is assumed to proceed, many people constitute themselves their own doctors. And this is a necessity forced on their reasonable convictions, from the contempt in which they hold the entire physicing system. Not only this, but any incompetent person may compound and vend physic, under the cover of a legal patent, without let or hindrance, notwithstanding that such person may not be able to read or write. So low is the profession of the physician degraded, in practice, as well as in public estimation, and so crowded is it with a class of members who are mere traders in drugs, that its emoluments, except to a fortunate few, are barely sufficient to provide, in each individual case, the ordinary comforts of a family.

If medicine is to be rescued from its present condition, and is to establish a just claim to be legally protected, it must combine chemistry wit[illegible]omy and physiology; and, in doing so, care must be taken not to [illegible] into the error of thinking to graft chemistry on the old drugging system of practice. The art of medicine consists, properly, of two branches or departments; namely, surgery and organic chemistry. The one comprehends every thing connected with the structure and the mechanical functions; the other, every thing pertaining to the constituent elements, and their chemical functions. In regard to structure, there is no difficulty. Surgeons do not disagree, concerning the principles of surgery, or the methods of operation. They may not always coincide, with respect to the proper time, at which an operation should be performed, or that it should be performed at all; as in the case of an amputation. But here the difference ends. On fundamental principles, there can be no disagreement; because every act is, either a process of scientific investigation, or is performed in accordance with an established scientific formula. Why not, in the same way, adopt scientific data, in the chemical department of medicine, and, thereby, establish its reputation and claims, on a basis, equally secure against public contempt, and equally entitled to legal protection? Till this is done, and until a proper curriculum of organic chemistry be introduced, the practice of the physician cannot fail to be regarded otherwise than on a par with that of the patent medicine doctor; for, in the present practice of physicing, the one is just as little competent to explain, scientifically, the *modus operandi* of his prescription as the other.

So soon, however, as the scientific facts of organic chemistry shall

have superseded the physicing system, it will be generally perceived that the law of chemical combinations is of universal application; is the same in a plant and animal, as in an inorganic substance; and that, therefore, as in surgery, or mechanics, so also in chemico-medicine, the principles of the science are universal, cognizable and determinate; and such as they have been described in the preceding pages.

In regard to the prospective changes which medicine is destined to encounter, before that it can be recognized as reliable and trustworthy, and entitled to public confidence, much can be said that is suggestive of encouragement. If people could only be taught to live as they ought to do, medication would be almost unnecessary. But the habits of civilized life are such as to enervate and debilitate the body; exposing it, on almost every occasion, to derangement of some kind or other. And, notwithstanding that many, who have acquired some knowledge of anatomy and physiology by means of natural or scholastic study, are able to prescribe for and treat themselves when sick, the masses are not so circumstanced. And, as civilization progresses, the probability is, that enervation and debility will progress in an equal ratio; giving occasion for an increase of medical practice, and consequently to an extension of the medical profession.

How to live, so as to be able to avoid the endless multiplicity of circumstances, that bring sickness and misery in their train, is what every person should understand. Few, nevertheless, terminate their earthly career, without having occasion to look back in amazement and with sorrow, on the rocks and quicksands among which they had been navigating without chart or compass. And fewer still, can be found, who have completed their term of mortal existence, without exhibiting the scars of disease in their shattered constitutions. We come into the world, surrounded on all sides, by natural and artificial agencies, which continue to act on our bodies during every moment of our lives. In the cradle; and afterwards, while under the paternal roof; notwithstanding the solicitude, the watchfulness and ministrations manifested, to protect children against the common disorders to which they are all more or less exposed, it unfortunately happens that, in most cases, all this care, in consequence of being misdirected, fails in accomplishing its praiseworthy purpose. Nor, can it be said, that there is much improvement, in the condition of young persons who have attained the years of manhood. Nor yet, of those, more advanced in life, who look forward with anxiety to

the accumulative ailments of old age. Our lot, in short, seems to be a liability to disease, during every moment of our lives; from our first coming into the world, till our final exit. Reference might be made to the bills of mortality which are periodically published, for evidence of the premature age at which most people die. But this would be an exceedingly partial means of ascertaining the extent of the evil. For, the evil is not confined to the numbers who die prematurely; but, is more particularly evidenced, in the numbers who live in a perpetual state of disease. We meet with few, who are not afflicted with bodily complaints of some kind or other. In passing along our thoroughfares, irrespective of the crowds who exhibit on their countenances the unmistakable ravages of disease, we meet, at every step, the apparently comfortable and well dressed denizen, whose exterior betokens unimpaired health and a long period of years. But, alas! how deceptive are the outward habiliments, and the accessories of ease and pecuniary means! There lurks beneath, concealed from the busy throng, the canker worm, which, incidiously, but with sure and unaverted purpose, is hastening the final crisis, when he too, must become numbered among the hosts of unconscious victims who prematurely, thus, quit the scene of their mortal existence. So universally, is disease the inheritance of the rich and the poor, the educated and the ignorant, without distinction. Those who are so afflicted, get physiced professionally, or they physic themselves. In either case, the disease, and, too often, the treatment also, are the precursors, because they lay the foundation of other disorders to follow, at longer or shorter intervals; for it is an acknowledged fact, in the practise of physic, that derangement of the organs, or their functions, is seldom unattended with latent effects, to be developed at some future time.

Then the extent to which, commercially, the drugging system is carried on, is such, that without personal experience, it is impossible to form an adequate conception of it. Not only this, but the systematic manner in which people make it a practise to use these drugs, and the implicit confidence placed in their efficacy, are a melancholy proof of the prevalence of a social mischief of no ordinary magnitude. The first time I had my attention directed particulnrly to this point, was about twenty-eight years ago, while resident in Glasgow. Morrison, of London, the great pill manufaeturer, had entrusted the agency of his business, in Scotland, to a Dr. Greer, who, it happened, had instituted an action for libel against one of the city newspapers; and, on account of some connection I myself had with the press,

Dr. Greer called on me for the purpose of influencing me in his behalf. And, in order to satisfy me of his claim to the gratitude of the public, I was invited to accompany him to his dwelling, so that I might have an opportunity of examining the documents to that effect in his possession. I accepted the invitation, but not with the view of becoming the advocate of a cause so repulsive to every sentiment of honor and propriety; and for the first time, in my life, witnessed the evidences of an amount of credulity, which, except on the evidence of my senses, I never could have believed was possible. On opening a large sideboard drawer, some four feet in length, and proportional in its other dimensions, I found it filled with original letters; many of them, bearing heraldic seals; and all of them, having the genuine post-office marks, on the outside of the sheets; for envelopes had not then been introduced. Their purport was, unqualified approval of the pills; with remarks on the great benefit derived from using them; expressions of gratitude to Dr. Morrison, as a benefactor of mankind; and, concluding, with orders for fresh supplies. These letters, were not from persons in humble life; nor from ignorant persons, who might be supposed to be the dupes of Dr. Morrison's or Dr. Greer's artifices. They were chiefly from persons of distinction; some of them noblemen, residing in different parts of the country. From my own personal knowledge, I have testimony, that patent medicines are liberally patronized, and in general use, among the more intelligent portion of tne Canadian people. And, with reference to the United States, it would be superfluous to undertake the proof of what is palpable to every person of observation; that their use, among the more wealthy and better informed classes, is reduced to something like an indispensable national custom. Now, if this is the case, with those who should be supposed the slowest to become the victims of this species of medical deception, to what extent, may we calculate, is the practise adopted by the masses; who are not expected to have the same amount of acquired sagacity; who lack the corresponding advantages of comfort; and whose necessities constrain them to resort to, what they consider, the cheapest form of medication? The consequence is, that the drugging system has got to be a most gigantic institution; and public opinion has settled down into a belief, that to get sick, and to take patent medicines, are the unavoidable appendages of human existence.

There is no prospect that the masses can ever be instructed to live properly; and this being the case, it would be preposterous to assume

that they can be made to have a knowledge of medicine. The medical profession is, therefore, destined to be a permanent and useful profession. In view of this fact, its usefulness should be secured by the most unequivocal criteria. It should occupy a place in the social fabric, far above the vulgarities of the drugging routine; such as would challenge the scrutiny of every lover of scientific research. How this can be done, is not a question about which there is much uncertainty. On the one hand, the drugging practice, to a man of education, is disreputable. He feels it to be such; for he is conscious that it is not capable of being defended. A corporation cannot, therefore, expect to be held in esteem, on the score of professional errors, of which the more enlightened of its individual members are ashamed. On the other hand, however simple the chemico-medicinal mode of treatment may seem, at first sight; and to whatever extent it may thereby be calculated to induce the prevalence of self-medication, and consequently to curtail professional practice, the conjectures on this head are far from being correct. The combinations of circumstances, in chemico-medicine, require a knowledge of anatomy, physiology, chemistry, hydrostatics and aerostatics; which, it must be admitted, cannot be matured without considerable professional application.

But assuming, for the profession, higher ground, it may be suggested that organic chemistry should be grafted on the present practice of surgery. This would not only eradicate empiricism, root and branch, but would place medicine, as a whole, on a solid and permanent scientific foundation. So constituted, the incorporation of the Faculty, by the Legislature, would be acceptable to the public, because of the scientific guarantee. Associated with surgery, which is a science, would be organic chemistry, which also is a science. This twofold organization, in one system of practice, by virtue of its completeness and efficiency, could easily acquire an exclusive jurisdiction over every thing connected with the practise of the healing art. And the security to the public, would be a satisfaction, for which, as a return, no corporate privileges would be considered too great. Surgery and organic chemistry are the two branches of medicine. They comprise the whole medical art. Their union, exclusive entirely of physic or drugs of every description, may not take place so early as it is desirable it should do. But, sooner or later, it is a union that must occur. And, when it shall happen, medical practice shall then have assumed its most perfect and unexceptionable form.

In the meantime, as a pioneer in the work of reform, with a view of bringing about an event so much to be desired, it is the duty of every enlightened practitioner to stand forward, and manfully denounce the anomalous condition of the profession of which he is a member. If he is a qualified surgeon, he should at once place himself in a new attitude, and repudiate the whole *farago medendi* of the drugging system. He ought to take up a dignified position, such as becomes one who is conscious that his vocation possesses intrinsic merit; and cast off, as an incubus, that which detracts from his standing in society. No enlightened member of the profession can shut out from his mind the fact, that the practice of physic, in the way in which it is carried on, is discreditable; and reflects on the reputation and standing of every one connected with it, irrespective of merit or professional attainments.

Turning now to what has been said on organic chemistry, as a summary of chemico-hygiene and medicine, it will be observed, that the whole subject is comprised under the three heads, Identity, Equilibrium, and Displacement. The latter is a hygienic and medicinal process; but as it is produced mechanically, it may not seem to come properly under the chemical head. It is, however, an acceleration of the chemical changes. It produces the rapid transmission of the secretions; increases their quantity in a given time; and, thereby, removing a larger quantity of the debris of the effete tissues, it changes and improves the character of the fluids which remain. So that, though its first impulse is produced mechanically, it is followed by important chemical changes; and, therefore, may properly be admitted into the hygienic and medicinal department of organic chemistry. Identity determines the unchangeableness of the properties of the elements. Equilibrium, on the other hand, is the correspondence of opposite functions, existing in concert.

The proof that the chemical affinities of oxygen, carbon, hydrogen and nitrogen, the four principal constituents of organized bodies, are the same out of the organism as in it, is the ground on which the internal transformations are predicated. Without this basis of identity, chemico-hygiene would have nothing to rest on; and chemico-medicine would be little better than a dream. And, for this reason, more space has been taken up, and more anxiety evinced, to explain it properly, than, by some, might seem to be required. But this part of our subject must not be undervalued. And no one need think to comprehend the principles of chemico-medicine, who does not fully understand the mechanical character of the elementary functions.

The equilibrium, is the normal state; that state, in which the healthy conditions are equally balanced. It is the equilibrium either of nutrition and waste, or of temperature. When the amount of oxidation is equivalent to the amount of nutriment; and the heat of the surface of the body, immediately below the skin, is the same as the heat of the deeper organs, without excess or diminution of the amount, one way or the other; the general constitutional result is health, or the proper hygienic state. This state will continue, *caeteris paribus*, so long as the corresponding amounts preserve their balance. And, even after the balance is disturbed, the derangement must continue some time, before that permanent bad effects can take hold of the system, and become perceived. Thus, perspiration may go on freely for a considerable time, and be followed by no other result than emaciation. And, if checked suddenly, by cold, the restoration of the perspiratory process, if not too long delayed, will prevent the occurrence of permanent bad consequences. In the same manner, gluttony developes its effects after it has been continued for a time; and the inhalation of impure air leaves no appreciable marks, before that it has exceeded certain limits.

As disease is a derangement of the equilibrium, it is so in one or other of these two ways. It is a derangement of the balance of nutriment and waste; or it is a disturbance of the balance of the temperature. To whichever of these two classes of derangement a disease is imputed, the remedy is first to be sought in the equilibrium of the disturbed conditions. The remedy may be applied too late, and after the derangement may have become complicated, and may have affected other organs and functions than those primarily implicated. This is commonly the case, and the process of cure is then correspondingly tedious. The delay, here referred to, may take place in different ways. There may be personal negligence, in taking heed to the indications of lassitude, &c., which mark the commencement of almost all disorders. It may proceed from a privation of the necessary means; as when a person is, from home, travelling; is exposed, by the nature of his employment; or, his condition of life and pecuniary circumstances, are not such, as to afford the expense required. Frequently, however, the delay is occasioned by the time spent by the physician, in order to determine first the character of the disease. This latter is the source of great and widespread mischief. A few bread pills, or a harmless powder, is administered daily, for one or three days, to give time for the disease to develope itself; so that the physician may not mistake one

disease for another, and may not run the risk of deviating from the specific treatment prescribed in the pharmacopœia; which latter would be a heinous professional crime. This giving time for the disorder to develope itself, is virtually fostering and rooting in the constitution what could altogether be overcome, at the outset, by the most simple and rational treatment. It should be deeply impressed on the mind of every practitioner, that every moment of delay is an aggravation of the complaint, and increases the difficulty of the treatment; at the same time, that it prolongs the period, within which, it is possible to effect a cure. The reason why delay is generally practised, is the fear of mistaking the complaint, and applying the wrong specifics. Nature is not supposed to exercise any power in either preventing or curing. It is the reliance, exclusively, on the physic, that is the origin of the whole mischief. The pharmaceutical specific is to do everything. If, after the disease is encouraged to take firm hold, the first specific of the pharmacopœia fails, the physician then tries the second. If it too fails, he tries the third, and so on; till such violation of nature enervates the patient for life, or generates new and complicated chronic ailments, if it do not consign him to an early grave.

If the complaint is occasioned by deficient oxidation, the first thing to be done is to supply the defect. If, from too much concentrated nutriment, the quantity must be reduced. Let it be observed, however, that what is meant by diminution or excess, is what is under or above the corresponding equipoise. If, on the contrary, an increase of the amount of concentrated food is accompanied by a corresponding increase of oxidation, the equilibrium will not be disturbed, and consequently the healthy conditions will continue. It is the disproportion of the corresponding amounts, of what ought to be equal, that gives rise to derangement of the functions.

The checking of the perspiration may produce a cold, or, what is the same thing, a congestion or inflammation. The first thing, in such case, is to provoke a return of the perspiration as speedily as possible. No time should be lost, in doing this. Delay is dangerous. It may be effected generally, over the whole body, by natural means; or by local applications; or both; as the circumstances may require. If accomplished too late, to be productive of immediate good, the course to be adopted afterwards, is to abstain from nutritive and stimulating food; to rest; keep quiet; and see to the evacuations, that they are regular. We should take a lesson, in this respect, from the lower animals. When they are sick, they lie down, abstain, and

get well. My cow turned unwell about two months since. She would not eat, and would not drink, for about four days; was all the time disposed to lie down, sometimes in one place and sometimes in another. Nothing was done for her, except that she received an extra quantity of bedding at night; and she got well at the end of the four days. If a cow-doctor, had been called in, it is difficult to tell what might have been the consequence. Several boluses and clysters might have been administered; and if it should so have happened that the cow was not killed; she might still, by the power of nature to overcome the treatment, have got better on the said fourth day; when, no doubt, the boluses and clysters would have got the credit of the cure. The reason why I did not employ a cow physician, is the very simple one, that the lower animals do not require such; it being contrary to their natural mode of life, as it ought to be equally to our civilized condition, to practise capriciously what is inimical to health, and to the prolongation of existence.

In the general treatment, chemico-medicinally, of disease, the chemical condition of the secretions, and their equilibrium, should be the chief points requiring attention. Whatever medicaments are administered, should be those which are natural. And the practitioner should regard his interference, in no other light, than as a help to the enforcement of the natural tendencies. It is always to be assumed, that if nature is allowed an opportunity, the cure can be effected by natural means. And that medical skill is only required, in so far as it can be judiciously employed to aid the natural effort. The outward indications or symptoms are, of course, to be carefully noticed; but their misinterpretation should be also guarded against.

The first appearance of sickness of most kinds, is commonly marked by a similarity of symptoms. It is, therefore, often difficult to know, for two or three days, what is the nature of the complaint. But this is of little consequence; for the primary treatment being, in almost all cases, the same, no error can occur from following, as a general rule, the method prescribed for febrile symptoms. All diseases, with very few exceptions, commence with fever as their general type; accompanied by lassitude, disinclination to move, alternate chilliness and heat, yawning and stretching. When these symptoms are apparent, however different the diseases may be, the treatment is the same, in all cases. So it is in measles, small pox, jaundice, pleurisy, eresipelas, scarlet fever, influenza, and in intermittent, remittent, continued, bilious, inflammatory and putrid fevers.

As fever is an indication of constitutional derangement, the treat-

ment must be constitutional. That is, it must not be applied to produce a local effect, such as to remove headache or pain located in any particular part of the body; but to produce an equal effect on every part of the body, at the same time. If taken at the commencement, a disease may be cured at once; and, under any circumstances, if it continue, the after stages are rendered more tractable by timely attention.

The object to be attained, by the medical treatment, is the removal of the occult cause of the fever. That occult or hidden cause, may be the cause of measles, of jaundice, or of anything else. It does not signify what the cause is; for we are able to judge only by the external symptoms; and these, as I have stated, are, primarily, common to most diseases. It is necessary, that the treatment should be such as to embrace the greatest scope of action; so that, whatever the cause may be, or wherever it may be located, it may be reached by the method which we adopt. If promptly and properly adopted, it will carry off, at the commencement, what would otherwise keep the patient in bed or confined to the house for weeks.

If, however, the symptoms should continue on the second day, the patient should keep in bed; should be kept comfortably warm, but not too warm; the room should be ventilated at all times, night and day; whatever weak drinks are asked for, should be given, as they are wanted, either hot or cold; and the body should be kept gently open. It commonly happens that there is no desire for food; and, in this case, none should be offered. But should there be a desire to eat, any light farinaceous preparation will be sufficient.

On the third or fourth day, the particular nature of the disease may be determined. It may be small pox, or scarlet fever, or some other disease having the febrile type. Whichever it may be, on no account is the treatment to be changed. The reason of this is, that in all constitutional disorders, the treatment must be constitutional. And, as variety of symptoms only indicates diversity of species, that is no reason to suppose that the febrile symptoms are anything more than a general type of one kind of disease; and, therefore, amenable to one mode of treatment. This is the rock, on which the empiricist is continually foundering. He is perpetually assailing the varieties of symptoms. If one specific does not answer, he tries another, and a third, and a fourth, consecutively; and, thus heaps dose upon dose, until he either forces a change of symptoms for the worse, and creates a new and more aggravated disease; or, the strength of the constitution and the vital force, resisting all those pernicious appli-

ances, the patient recovers, at the end of the period when he would have recovered, had nature been allowed to take her own course. Let it always be borne in mind that, the symptoms of a disease, and the disease itself, are two different things. And, therefore, never attempt to check a disease, and thereby throw it inwards, by forcing a change of symptoms. I have known persons who resided near marshy ground, not far from Toronto, being constantly victims to ague. They have come into the city, and purchased quart bottles of quinine mixture, with which they checked the complaint. But it was generally not long before it returned again; and the quart bottles had to be refilled. They foolishly imagined, all the time, that every check was a cure. The same persons, having afterwards removed to a different part of the country, became free from these attacks. No doubt the neighbourhood of a marsh is not the most healthy situation; but, in this case, which I have described, had the ague been permitted to run its course, and not been checked, it would have been got rid of, and would not have returned for a considerable period of time. The error was in checking it, by means of quinine. This is a common error, however; and takes place, too often, under other symptoms than those of ague.

When the disease, which commenced with the febrile type, continues, the whole attention must be paid to good nursing. Be patient. Do not be in too great a hurry to effect a cure. You cannot force nature, with impunity. Let the patient rest quietly in bed; let him have light food; cooling, acidulated or other drinks; be kept clean; and the bowels be kept gently open. Let the room be well ventilated with pure air from out doors. And, if it be winter, or cold spring or fall winds prevail, nothing is more cheerful or more healthful, in a sick chamber, than a wood fire in the open chimney. It has a charm, and possesses a wonderful medicinal effect. In due time, this course of procedure will bring about a natural change for the better, and leave no bad consequences. So potent are the simplest means, when employed at the proper time, and in the right manner, as adjuncts to assist nature.

These directions are applicable to the treatment of all such cases as have a febrile type; namely, measles, small pox, jaundice, pleurisy, eresipelas, scarlet fever, influenza, and remittent, intermittent, continued, bilious, inflammatory and putrid fevers. But there are other affections, such as inflammation of the lungs, disease of the heart, dropsy, coughs, &c., which have a local habitation, and are different from those mentioned above, which are constitutional. To these,

external applications are admissible, and are often proper; but no substance, of whatever kind, should be thrown into the circulation, for the purpose of producing a local effect. On this point, I wish to remark, emphatically, that wherever this practise is adopted, it cannot fail to be attended with the worst results. The swallowing of any deadly poison, such as prussic acid, strychnine, arsenic, creosote, or iodine, for the purpose of acting on a particular organ, seems absurd; and it really is so; for this reason, that once it gets into the circulation, every part of the system is as much exposed to its action as the particular organ which it is intended to influence. On the contrary, except in so far as external applications are proper, local diseases should be treated exactly in the same way as those having the febrile type. A person afflicted with consumption, can never benefit by taking strong poisons; but if the tubercles have not proceeded too far, the constitutional and rational course, if managed properly, will be sure to bring about a cure. In all cases, then, look well to the system of nursing; see that the natural wants are supplied, the evacuations are regular, and that attention is paid to the natural indications throughout the different stages of sickness. Let nature take her course, and all will come well in the end.

Taken as a whole, then, we perceive that chemico-medicine is a system of treating disease, exclusively by natural means. That the food, the clothing, the air, the bath, &c., are agencies that produce chemical changes in the body; which changes are specific and measurable, in the same way that other chemical changes are definitely measured in the experiments of the laboratory. We know what these changes are; we understand the principles on which they take place; are able to trace them through their primary, medial and final stages; and we have a perfect insight into the conditions on which healthy and diseased states of body are dependent; and, therefore, have it in our power to control the external causes, by which those healthy and diseased states are produced.

In excluding the use of drugs, this exclusion is justifiable, on the ground, that there is no analogy for their use, in any other class of animals, or in plants. But some will say: How can a disease be cured without physic? I have been met, with this question, too often. And I admit that it is a natural question, when put by those who do not understand the system which I have been explaining. But, no one who comprehends its principles, could allow such a question to occupy his mind for one moment. These means, as we have seen, admit of a scientific explanation. There is no guessing at results;

no conjecturing what may be the issue of any particular course. Because there is but one course. Because the process of cure is, in all cases, the same; consisting, as I have stated, of a transformation of diseased parts, and a reproduction of new parts, by the natural agencies which have been enumerated. As, in a deeply seated abscess, the matter formed may be carried out of the system, through the two natural excretory channels, by means of oxidation and the revulsive agency of cold water; so, in biles, ulcers, scurvy, and eruptive diseases that develope themselves on the external surface, the application of the same means is attended with equal success. A great improvement has taken place, recently, in the treatment of eruptive diseases, with respect to the necessity of ventilation, cold drinks, and cold sponging; a treatment the contrary of what had been formerly pursued. For it was more common before, to shut up the patient in a warm room, to administer warm drinks, and apply tepid washes, for the purpose, it was supposed, of bringing out the eruption. The cold plunge bath has been now recommended, even for scarlet fever. I know of no case, however, in which, for scarlet fever, it has been tried; though I have no doubt whatever of its propriety, if properly used.

Most complaints are aggravated, at the commencement, by the impatience to do something quickly, which will put a stop, at once, to the disorder. And it uniformly happens, in consequence, that prescriptions follow each other so rapidly, that they either neutralize each other, or they produce a combination of contrary actions, different from what was intended. Not only is nature not assisted, but every natural effort is obstructed. We have an example of this, in the treatment of rheumatism, one of the most tractable forms of disease. There is no end to the prescriptions; such as nitre, cynara, emetics, bleeding, quinine, arsenic, &c., in this complaint. But the most pernicious, and the one which aggravates the disorder most, is the one which is most commonly recommended. That is sweating, by means of Dover's Powders or other sudorifics, while in bed. Now, sweating is not only debilitating to the constitution, but, like the warm bath, it renders the patient more susceptible to the changes of temperature of the atmosphere. The desideratum, on the contrary, is to fortify the system against these. But no artificial application can ever do this.

It is equally necessary to guard against an error of an opposite character. There is nothing more common, in the practice of hygiene, than for persons to imagine that they have fulfilled all its

conditions, when they have, really, only acted on one or more of its obvious requirements. In chemico-medicine, this error is still more common. One patient observes, strictly, the rules for oxidation and displacement; but neglects those for nutrition; in consequence of which neglect, the food may be concentrated and stimulating, or may be such as to produce a constipated state of the bowels. Another, while conforming to the directions for oxidation, displacement and nutrition, is irregular in his other habits; such as keeping late hours, and indulgence in excesses of other kinds. A third, may be circumspect, in his observance of the prescribed rules; but, in consequence of misunderstanding the principle of identity, may be prone to apply to a physician or patent medicine doctor; and, thus, be the recipient of foreign substances, that undo all the good otherwise produced by the appliance of natural medicine. The modes are various, by which the object, aimed at, may fail of being attained, in consequence of the misapplication of the means employed.

It is the same in medicine, as in other practical departments of science and art. The conditions of success are definite. The neglect of one, is appreciable in the result; and may completely defeat the object of the operator. The making of a loaf of bread proceeds, on definite known conditions. A certain amount of flour, salt, yeast and water, constitute the ingredients. The kneading of them, into dough, has a method. The fermentation of the mass, is a nice process, that requires some skill. And finally, the making up of the dough, into loaves; the heating of the oven, and the subsequent baking, are not without rules, that require to be scrupulously observed. The best loaf, is that, in the making of which all the requisite conditions have been comprehended. The worst, that, in which the greater number have been neglected. Omit either one of these conditions, and observe the result. Is it not the same in every other kind of domestic work, and in all departments of mechanical labor and appliances of art?

The intention to observe the conditions of hygiene and medicine, but actual performance of what contravenes those conditions, is not the way to proceed, in order to be successful. The error may be one of commission or omission. Extraneous agencies may be employed; or those which are essential may be overlooked, and, therefore, not be comprised in the treatment. In such cases, the good results anticipated, will not be realized.

As, in the making of a loaf of bread, if the oven be not sufficiently heated, the leaven will fall; and in place of a raised loaf, the pro-

duct from the oven will be a lump of soddened dough; so, all the conditions of nutrition and displacement may be implemented; but, if oxidation is omitted, their medicinal properties will fail to produce their effect.

A contrast between the chemico-medicinal method, and that which relies on the administration of drugs, cannot fail to be instructive. Independent, however, of what can be said; either, on the one side, or, on the other; those who advocate and prescribe mineral and vegetable specifics, entirely different from the constituents of the body, are bound to explain their chemical action in the organism. With Socrates, we hold, that unless they are able to give this explanation, the necessary inference is, that they do not understand the doctrine or system which they profess and practice. Now, the explanation of the internal chemical action of a substance, different from what constitutes the substance of the body, has never been attempted. We are told, indeed, that mercury will cure one disease, and that arsenic will cure another; but the way in which it is done, the chemical combinations and reactions internally, no one has yet attempted to expound. On the contrary, and herein consists the fallaciousness of the drugging system, that for every one who maintains the efficacy of mercury or arsenic, or any other article of the pharmacopœia, you will get as many of the same school to condemn it, as not only useless, but injurious, in the same class of diseases for which it is prescribed. Chemico-medicine presents no such contradiction. Its purpose is to understand and explain the reasons for each natural change; to reveal the working of natural principles; and to perceive the object and design of the Creator, in His wonderful works.

INDEX.

Agriculture, improvement of, pp. 44–46.
Air, its composition, p. 53 ; its effects, pp. 53–71.
Albuminuria, Dr. Fourcault's experiments in, p. 76.
Albumen, animal and vegetable, pp. 34, 36, 38.
Alcohol prevents the transformation of the tissues, pp. 20, 58.
Anaxagoras, his mechanical theory of the elements and nutrition, pp. 25, 26, 31.
Animals, their nutritive functions, pp. 40, 41 ; the waste of their tissues, pp. 42, 44.
Atomic theories, pp. 24–26.
Bath, changes produced by the cold, pp. 82–88, 90, 92, 97, 98, 99 ; in rheumatism, page 91 ; in hydropathy, p. 92–94. How to bathe, pp. 95, 96. The warm bath, injurious, p. 97.
Beef, when proper to be used, pp. 36, 37, 38 ; Analysis of, p. 29.
Boscovitch, his atomic theory, p. 25.
Brain and Nerves, produced, like muscular tissue, from the blood ; and dependent, for their volume and power, on the same causes as the muscles, pp. 71, 88.
Bronchitis is a common inflammation ; treatment of, pp. 78, 80.
Carbonic acid, experiment with, pp. 56, 57.
Caseine, animal and vegetable the same, pp. 36–38.
Churchill's, Dr., hydrophosphates of lime and soda, pp. 13, 46.
Clothing, its object, and rules for, pp. 77, 80, 81.
Cough or a cold, is a common inflammation ; treatment of, 78, 80.
Croup is a common inflammation ; treatment of, pp. 78, 79.
Curing of symptoms, pp. 15, 16, 17.
Dalton, his atomic theory, p. 25.
Denys and Emerez, their transfusion of the blood of a calf into the veins of an idiot, p. 15.
Dickson, Dr. confession of, p. 17.
Diet, general rules for, p. 62.
Disease, limitation of to two causes, pp. 50, 77 ; general treatment of, pp. 110–113.
Drugging System, its extent, pp. 104–105.
Dynamicists, their doctrine of the elements, p. 25.
Eggs, analysis of, p. 29.
Elements, definition of, pp. 26, 27 ; principal elements, and elements of the ashes of organized bodies, p. 27.
Fat, prevents the transformation of the tissues, p. 58.

Fever, nature and treatment of, pp. 110–112.
Fibrine, animal and vegetable the same in composition, pp. 36, 38.
Fourcault, Dr., on the cause of Albuminaria; his experiments on the skin, p. 76.
Gas, nitrogen, experiments with, p. 54; oxygen, p. 55; carbonic acid, p. 57.
Greeks, their artistic excellence, pp. 5, 6.
Guano, analysis of, p. 31.
Homœopathy, professes to cure symptoms only, pp. 16–18.
Hot air apparatus, for warming buildings, objectionable, p. 66. Hot water or steam pipes, most approved, p. 67.
Hydrostatics and Pneumatics, importance of, in chemico-medicine, pp. 21, 22.
Hydropathy, examination of, pp. 92–94.
Insanity, treatment of, pp. 97–99.
Kidneys, secrete the nitrogenous compounds and organic salts of the effete tissues, p. 42; their seereting function increased by oxidation, p. 69; how influenced, by change of temperature of the surface of the body, p. 74; structure and functions of, pp. 84–86.
Liebig, on the action of alloxan; and the conversion of benzoic into hippuric acid, pp. 13, 14; on the analogy of the motion of the sap in plants, and the fluids in animal bodies, p. 22; on hydropathy and homœopathy, pp. 94, 95.
Lime water, how to prepare, p. 57.
Lungs, their office, p. 42; principal outlet of the carbon, as carbonic acid, of the effete tissues, p. 42.
Medical profession, anomalous on account of its neglect of organic chemistry, pp. 14, 100–107.
Medicine, dependent on hygiene for its rule of procedure, p. 52; limited, in its application, to aid the efforts of nature, p. 110.
Mechanicists, their doctrine of the elements, pp. 25–44.
Milk, analysis of, p. 29.
Natural revelation tacitly ignored; the moral consequences therefrom, pp. 18–21.
Nervous system, produced like muscular tissue, from the blood; and dependent for its volume and power on the same causes as the muscles, p. 71; their functions, p. 83.
Nitrogen gas, experiment with, p. 54.
Oats, analysis of, p. 28.
Organic Chemistry, misapplied in medical practice, p. 18.
Ox, analysis of the constitnents of its body, pp. 29, 35.
Oxygen gas, experiment with, pp. 54, 55.
Patent Medicines, pp. 102, 104, 105.
Perspiration, experiment on, p. 75; how influenced by change of temperature, p. 76; rule concerning, pp. 81, 93, 94, 109.
Plants, their internal chemical functions, pp. 39, 40; their treatment, pp. 45, 46.
Pleurisy, is a common inflammation; treatment of, pp. 78, 80.
Pneumatics and Hydrostatics, importance of, in chemico-medicine, pp. 21, 22.
Pneumonia is a common inflammation; treatment of, pp. 78, 80.

Protein, pp. 36, 48.
Pulte, Dr., his homœopathic treatment of symptoms, pp. 16–18.
Pus and ulcerus matter, how disposed of, p. 90; their channels of exit, pp. 90, 94.
Revelation, the natural, tacitly ignored; the moral consequences therefrom, pp. 18-21.
Rheumatism, Dr. Pulte's homœopathic treatment of, p. 16; Dr. Dickson's chronothermal treatment of, p. 17; nature and proper treatment of, pp. 91, 114.
Riding, injurious to consumptive persons, p. 82.
Science, necessary in medicine as in other professions, pp. 7, 8.
Skin, its structure and functions, pp. 75–77; how influenced by changes of temperature, p. 76.
Smelt, analysis of the constituents of its body, p. 29.
Sophists, their atomic doctrine, p. 25.
Symptoms, curing of, pp. 15–17.
Temperature, the law of, the same in animate and inanimate bodies, p. 74.
Tubercles, p. 51; new removed, p. 90.
Ulcers, how cured, by displacement and oxidation, pp. 90, 92, 94.
Urine, increase of, by oxidation, p. 69; how diverted to the surface of the body, p. 74; increased by displacement. p. 87; how secreted, p. 84–86. Human urine, analysis of, p. 31.
Valves of the veins, disposition and structure of, pp. 86–87.
Vegetable food, when proper to be used, p. 37.
Vegetable fibrine, albumen and caseine, pp. 36–38.
Ventilation, experiments on, p. 63–66; best during sleep, p. 67; of a bed-room how effected, pp. 69, 71.
Wax Candle, composition of and experiments with, p. 56.

ERRATA.

For "empyrics," at page 9, read *empirics;* and for "empyrical," at page 11, read *empirical.*

For "venal vein," at page 86, read *renal vein.*