A treatise on the cause and nature of vital heat / by William Parker.

A TREATISE

ON THE

CAUSE AND NATURE OF

VITAL HEAT.

BY

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CHAP. I.

THE following remarks have been the result of study in search of a knowledge of Vital Heat, and of the practical uses to be derived from imparting and regulating this circulating medium, in the restoration and preservation of health. Heat is the basis of life, the tenure on which the vital spark exists. Heat and life cease together. We are thus led to enquire, what is heat? (1)Our best philosophers agree, that its source and nature are but little understood. Lavoisier's theory of respiration is allowed to be altogether hypothetical, and received as such, in the absence of a better system. In proof of these assertions it

may be necessary from time to time to append some quotations which point out [2]"that a new theory is therefore required to account for the chemical production of heat": that the present system is "a fallacy," and that instead of being "satisfied" with the present state of knowledge, these admissions lay open reasons why other views may be propounded. Should these deductions from experience and analogy bring any shadow of discovery into light, a field of great results will appear in prospect.

Physicians until of late years, imagined they knew the nature of disease; but cholera has been allowed by them to have baffled their skill. The following transcript from the lips of a divine of such high authority in science as Dr. Whewell, recorded in the pages of the most popular medical organ of the present day, affords no insignificant testimony in support of this assertion. (*See Lancet, Dec. 8th,* 1849.) "The Rev. William Whewell, D. D., Master of Trinity College, said in his admirable sermon, preached before the University of Cambridge, on the day of the general

thanksgiving, Nov. 15th, 1849, "We "may remark further, that this visitation "was specially fitted to break down any "conceit which we may entertain of the "great skill of our time, in matters "which concern the health of the body. "For now, after this pestilence has twice "stalked through the land, the wisest of "our physicians presume not to say, that "they know more of its nature and ori- "gin, or of the means of resisting its "invasions, and healing where it smites, "than they knew when first it appeared "among us. Of all these things they "are ignorant now, as they were igno- "rant then. And thus, while men were "loudly boasting of their knowledge of "the human frame, and of the laws of "life, and of the means of directing the "vital powers, so as to cast off disease, "and procrastinate death, the very first "event which occurs, deviating from the "common and familiar course of things, "is utterly beyond the circuit of the "field to which this knowledge extends, "and puts to complete shame their self- "complacent boasting. Is it then too "much to say, that the infliction, which

"has fallen upon us, and which we here "assembled acknowledge for a judg- "ment of God, was fitted to teach us "humility in our estimate of ourselves, "and was the more fitted for this end in "proportion as we had more need of "the lesson."

In every climate the treatment of cholera has exemplified a great deficiency of the knowledge of the disease. It may be fairly asked from what cause has this deficiency arisen? The admitted ignorance of the cause and nature of heat, may be replied.

(3)The concentration of heat, we style fire. This mysterious element God has been pleased to employ in many of the manifestations of his power. The sacred volume affords abundant evidence of his miracles by fire. In its ordinary usefulness it stands pre-eminent to all other of our Creator's gifts of nature, in which he has revealed to us its wonderful effects, while the secret of its laws is still a mystery that science has yet to unravel. From whence then is derived the supply of this universal agent of heat? Sir Isaac Newton sup-

posed an ethereal and universal medium to exist throughout our planetary system, and every succeeding age bears testimony to the belief of some quality in nature, imponderable, invisible, operative, and unknown in all the phenomena of nature, in some analagous form, under denominations according to various modifications, as electric, galvanic, mesmeric, vital stimulus, animal spirits, nitrous spirit, specific heat, fluid heat, primitive heat, latent heat, animal heat, original heat, proper heat.

(4)Heat has been styled the soul of the universe: that nitrogen can be identified, as this essence in all these forenamed principles, is attempted to be illustrated in the following pages. It may appear less presumptuous, before these views be insisted on, to refer the reader to the conflicting opinions of our writers on nitrogen, in the subjoined quotations, (5,6,7,8) This most expansive element of nature has been named by various physiologists "a mere diluent," "an unvital air." But the wise architect of this fair world, has given to nitrogen no less power than space. It per-

vades our earth, our air, our water; the organs of animal life, as also of vegetable growth, all confess its presence; nor is it there in vain. Our want of knowledge stimulates our search to catch some twilight glimmerings of his designs, while we still confess we cannot "find out the Almighty unto perfection."[a]

In tracing the principle of heat to its source, we may view it with nitrogen, from the lowest latent or specific heat of bodies in every degree, to the grandest phenomena of the most explosive combustion, as is seen in the quadrochloride of nitrogen, iodate of nitrogen, and phosphoretted hydrogen gas. (9,10)These are combinations of nitrogen, and there are no bodies of such explosive power known. We find nitrogen to occupy about eighty in every 100 portions of atmospheric air, extending throughout forty to forty-five miles in height, surrounding our globe, and impregnating all nature, both animate and inanimate, with its presence, and penetrating beneath, to the centre of the earth, as far

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[a] Job, Chap. 11, verse 7.

as geologists can fathom. What agent in nature is alike magnificent as nitrogen, to be the centre of all those universal and inexhaustible resources, from whence the vital heat is supplied: and where, likewise, is the electric spark kindled but from nitrogen?

Nitrogen in combination, effects by its presence, these phenomena that are exhibited in the most explosive compounds: and no inflammable body may be said to be devoid of nitrogen, in some suitable combination with other bodies. The following table will supply some expositions of these observations, that identify the presence of nitrogen with heat, in some of its varied forms, and their results.

From the chemical properties of nitrogen therein exhibited, we would lead the reader in the succeeding chapters, to consider this great agent in nature under its remedial forms, in its life giving stimulus of warmth to the human frame.

1.	NITROGEN GAS (inhaled)	Vivid ideas.
2.	CAFFEINE, THEINE, ASPARAGINE, THEOBROMINE (identity of taurine in each)	Diet.
3.	MORPHIA, QUININE, CHLORIDE OF AMMONIA	Medicinal
4.	STRYCHNINE, PRUSSIC ACID, immediate poisonous effects on the brain	Medicinal.
5.	Action of boy's pop-gun, rubbing the hands together, rubbing one's sleeve, the use of the thermometer in mines	Production of heat by pressure.
6.	NITRATE OF SILVER, LIQUID AMMONIA, NITRIC ACID	Caustic.
7.	Action of piston on German tinder, beating of soft iron rod, rubbing two dry sticks together, striking flint with steel	Production of fire by pressure.

8.	Phosphorus (burns with flame at 100 degrees) Potassium may be said to burn with suitable combination of nitrogen and water	Burn with flame.
9.	Gun Powder, Gun Cotton, Nitre, White Powder	Explosive by fire
10.	Gold, Silver, Platinum (when combined with nitrogen)	Fulminating by pressure.
11.	Chlorine Gas (when combined with nitrogen)	Excessive explosion.
12.	Iodine, (when combined with nitrogen) Phosphoretted Hydrogen Gas	Excessive explosion by spontaneous action.

NOTES FOR THE FIRST CHAPTER.

(1) Brande's Lectures. Lancet, Nov. 10th, 1827-8, page 214. "We know nothing of the nature or cause of heat."

(2) Turner's Chemistry, 7 edition, by Liebig and Gregory, page 190. "Chemical action is very often accompanied by increase of temperature, and the heat evolved during combustion is only a particular instance of it. Any theory, therefore, by which it is proposed to account for the production of heat in some cases, ought to be applicable to all."

"It is a well known fact, that increase of temperature frequently attends chemical action, though the products contain much more insensible heat, than the substances from which they were formed. This happens remarkably in the explosion of gun powder, which is attended by intense heat; and yet its materials, in passing from the solid to the gaseous state, expand to at least 250 times their volume, and consequently render latent a large quantity of heat. These circumstances leave no doubt, that the evolution of heat during chemical action is owing to some cause quite unconnected with that assigned by Lavoisier: and if this cause operates so powerfully in some cases, it is fair to infer, that part of the effect must be owing to it on those occasions, when the phenomena appear to depend on change of specific heat alone. A new theory is

therefore required to account for the chemical production of heat. But it is easier to perceive the fallacies of one doctrine, than to substitute another which shall be faultless : and it appears to me, that chemists must for the present be satisfied with the simple statement, that energetic chemical action does of itself give rise to increase of temperature."

(3) Dr. Arnot's Elements of Physics, vol. 2, page 137. "Fire being in truth but a concentration of the element of heat, which in its tranquil, or invisible diffusion, we have already contemplated, as the beneficial life or soul of the universe."

(4) Domestic Gardener, page 45. "Boerhaave represents fire as a peculiar substance, *sui generis*, unalterable in its nature, and incapable of being produced, or destroyed; naturally existing in equal quantities in all places, imperceptible to our senses, and only discoverable by its effects, when, by various causes, it is collected for a time in a less space than that which otherwise it would occupy. This matter of fire is not supposed to be derived from the sun; the solar rays, whether direct or reflected, being of use only as they impel the particles of fire in parallel directions."

(5) Dr. Whewell's History of the Inductive Sciences, 2 edition, vol. 3, page 147. Hooke and Mayow had entertained the opinion, that the air contains a nitrous spirit, which is the supporter of combustion."

(6) Dr. Arnot's Elements of Physics, vol. 2, page 145. "Nitrogen which does not aid the combustion."

(7) Turner's Chemistry, page 210. "It was supposed to act as "a mere diluent" to the oxy-

gen, but it most probably serves some useful purpose in the economy of animals, the exact nature of which has not been discovered." "The uses of nitrogen are in a great measure unknown."

(8) Dr. Whewell's History of the Inductive Sciences, vol. 3, page 146. "Lavoisier showed that the atmospheric air consists of pure or vital air, and of an *unvital* air, which he thence called *azot*."

(9) Turner's Chemistry, page 288, 7 edition. "Quadrochloride of nitrogen was discovered by Dulong, in 1811; it is one of the most explosive compounds yet known, having been the cause of serious accidents both to its discoverer and to Davy."

(10) Brande's Lectures. Lancet, Dec. 22nd, 1827-8, page 461. "Iodate of nitrogen, it must be managed with the greatest care, as it can scarcely be handled or moved from one place to another, without exploding. It shall be shown in the next lecture, as I see that what I had ordered to be prepared of it has exploded in the night."

Turner's Chemistry, page 288. Nitrogen,— "it does not congeal in the intense cold produced by a mixture of snow and salt."

CHAP. II.

THE conflicting opinions of physiological writers, in accounting for generating heat in the respiration, have left room for discussion. Conjectures, therefore, propounded on elementary enquiry, may be worthy of investigation, where knowledge is now admitted to be imperfect. (11)Statements (in the notes added) giving, as they do, contradictory results from the experiments of scientific men of deep research, alike in quest of truth, shew that the uses of nitrogen are still but little understood, or valued. A practical investigation of its properties, in conducing to the due regulation of vital heat, adapted to the preservation and restoration of health, is herein attempted, on the experience of its usefulness in controlling disease, and of its being also the essence and source of heat in the nervous system. As a constituent in our food it is abundant, in various modifica-

tions of medicine it affords means of imparting energy to those vital organs that cannot subsist in a normal state without a due supply of its renovating powers.(12)

Nitrogen, in its simple state, imparts food to the brain and blood, it circulates in the blood, and nerves, from the first moment that God "breathed into his nostrils the breath of life." The heart obeys the impetus then given, and its mighty piston rises and falls obedient to the laws of its great Creator. The cause of heat has been attributed to motion. The origin of motion has been sought in vain, and ascribed to the immutability of the Deity, leaving this law of his will undefined. The perfect mechanism of nature, adapted for muscular power in the human frame, has been in some measure explained: but the prime mover is wanting in the exposition of physiologists.

In observing the process of boiling, in a flask over a lamp, bubbles will first arise, and the motion be seen to commence from the bottom of the flask, where the heat has been the strongest, consequently the heat has caused the first

movement. The respiratory system, imparting heat to the whole body, imputed to the effects of combustion in the lungs, has been shewn to be a fallacy.(13) That oxygen, because necessary to support life, is not the sole supporter of heat, will be evident when the uses of the mighty element of nitrogen shall be well considered and comprehended. It is a matter of no small surprize that nitrogen should have been so thoroughly put out of consideration, when the gases are treated of, in the respiratory process; and that oxygen alone should be suspected of all vital efficacy.(14)

In inflating the lungs of still born infants, or for resuscitating drowned persons, the mere mechanical effect of setting the lungs into motion is not all that is needful to kindle the vital spark. To inject atmospheric air, by means of some instrument, is found to be more productive of good effects than when communicated by the human breath. The reason appears to me to proceed from the supply of nitrogen thus carried into the lungs, instead of the carbonic acid.(15)

An egg possesses a vital specific heat, as soon as laid, which is probably derived from nitrogen. The shell is known to be pervious to atmospheric air, and the temperature of ninety-six degrees to be necessary for the growth of the vital process. On the due supply of these, the development of the embryo depends. A chick may be heard to emit a sound before it has left the shell, on being put into warm water. The constituent of heat is still essential to its new existence; in other words nitrogen sustains the warmth within it and around it, previous to its having acquired any mechanical movement to aid its vitality. Should a mechanical power be supposed to exist in the chick in the egg, it could only arise from the continuance of incubation, having brought invisible life into positive existence, and through heat imparting the source of motion: from this heat also, do seeds germinate, and burst their cortex. The incubation of the hen, the warmth of the nest, or the heat of the sand to the egg of the ostrich or tortoise, alike tends to supply the due proportion of heat for the growth of the

incipient life of the young. Nor is the element of nitrogen less important in its after life, in sustaining the temperature of its internal frame, when more development takes place, and more capacity is required in the universal atmosphere, for its change of existence.

(16)The mal-conformation of the heart in the blue disease, is proved not to be an obstacle to life; but it is an impediment to the development and symmetry of those parts necessary to health.

(17)Of what is the atmospheric air composed, that gives the breath of life? One of its constituents is nitrogen, which supplies food to the blood, and through the lungs imparts an impetus to the heart, accompanied by those other elements of oxygen and hydrogen, that are said to decarbonize the blood. Liebig computes, that the amount of oxygen inspired is, in quantity, in exact correspondence to produce the respired carbonic acid that ensues: that "no part of this oxygen remains in the system, but it is given out again in the form of a compound of carbon, or of hydrogen." (*See Liebig's Animal Chemistry, 2 edition, page* 13.) Is it

to be concluded, that nitrogen, so abundant in our atmosphere, is never taken into the lungs by respiration? It is allowed that our means of testing, may not be adequate to detect precisely the amount of nitrogen, but a loss of nitrogen has been acknowledged to have ensued after respiration, although the admission be at variance with Liebig's remark, that "no nitrogen is absorbed from the atmosphere in the vital process," page 43. He admits in the same page, that "no part of an organ which possesses motion and life is destitute of nitrogen." Also, that "the chief ingredients of the blood contain nearly seventeen per cent of nitrogen, and no part of an organ contains less than seventeen per cent of nitrogen."(18) After the respiration of nitrogen, it has been observed to be somewhat diminished; that inhaling it in a pure state, it exhilarates, without leaving a subsequent exhaustion, though it cannot, without oxygen, long sustain life.

Elliotson's, Blumenbach's Physiology, page 165. "A host of circumstances shew that our temperature depends upon respiration, and therefore upon chemical

changes." We will shew that our temperature does not depend upon respiration, although respiration supplies two material agents for the production of heat, viz. nitrogen and impetus. The disengagement of carbonic acid gas is allowed to pass off from the lungs: as to heat being generated, to any extent, is questionable, although no doubt, that the carbon from the blood is carried off in this way, as well as through other channels.

Oxygen is vivifying, and will change the color of the blood for circulating through the arterial system. Can there be any example shewn of its producing heat, like that of nitrogen, when mixed with iodine? (*See page* 11, *No.* 12)

The temperature falling in the admixture of an effervescing draught, causing the evolution of carbonic acid gas, is a strong proof against the principle of its generating heat during respiration, by the oxygen of the atmosphere mixing with the carbon of the blood; an act of combustion, as some will have it. Dr. Leeson, at a conversazione, at St. Thomas' Hospital, is referred to as follows:—(*See Lancet, Feb. 2nd,* 1850, *page* 161) 'After

various considerations respecting animal and vegetable life in a chemical point of view, the solid carbonic acid was exhibited, and was made to produce intense cold, by passing first from the solid to the liquid state, and then from the latter to the gaseous state, a lump of solid mercury was thus produced." These examples expose the fallacy of the present theory of heat being generated in the lungs by the disengagement of carbonic acid gas.

To render this principle of vital heat understood, as communicated to the circulation by the arteries and veins. It is admitted that by rubbing the hands over the coat sleeves heat is generated, both the coat and hand are increased in temperature. The animate and inanimate alike have their temperatures increased by the pressure of the particles of atmosphere between the hand and coat. The pressure in the piston produces fire on the tinder, which is evidence of the concentration of heat; if the coat be gently rubbed, a less degree of temperature is produced, if a continuous pressure, the heat will be continuous, in

proportion to the pressure applied, so as to keep up an agreeable or normal degree of temperature, as in the arteries and veins.

The impression, that nitrogen is the cause and source of heat in the human frame, is the result of long contemplation: and that it should exert such remedial control, with skilful combination, is accounted for, from its being so intimately a part of our nature, and from its ministering food to our vital organs, with its relation to heat, by which our life is sustained.

In the Physiological and Scientific Treatise on Cholera, the practice therein detailed resulted from previous experience of the beneficial principle, and is more fully developed in these succeeding remarks on vital heat, as applying to disease in general. The study of sixteen years has confirmed the thoughts which sprung from theory and hypothesis. Success in its practice has urged me to pen these views, believing they may be useful in other hands, and in hopes of drawing attention to this subject, and making it available to the highest sources of enjoyment derivable from human science.

NOTES FOR THE SECOND CHAPTER.

(11) Bell's Anatomy of the Human Body. Vol. 1, page 503. "Of the heat of the blood. The next effect of respiration is the communication of heat to the body. There are some who pretend to say, that when they draw in vital air, they feel a genial warmth in the breast, diffusing itself over all the body; but it is easy to feel in this way, or any way, when a favorite doctrine is at stake, while those who know nothing about doctrines, breathe the vital air without any peculiar feeling which they can explain. To suppose but for a moment, that all the heat which warms the whole body emanates from the lungs, were a gross error in philosophy. It were to suppose an accumulation of heat in the lungs equal to this vast effect of heating the whole body. But were it so, we should feel a burning heat in the centre, a mortal coldness at the extremities, and marked differences in the heat of each part, in proportion to its distance from the lungs. In fevers we should feel only the intense heat of the centre; we should be distressed, not with the heat in the soles of the feet, or palms of the hands, or in the mouth and tongue, we should feel only the heat of the lungs. When the limbs alone were cold, would the lungs warm them? How could it warm them up to the right temperature, without over-heating the whole body? When a part were inflamed, how could the heat

go from the lungs, particularly to that point and rest there? It is a law of nature, to which, as far as we know, no exception is found, that a body, while it passes from an aërial to a fluid form, or from a fluid to a solid form, gives out heat. So it might be said, what is the whole business of the living system but a continual assimilation of new parts, making them continually pass from fluid into a solid form? but this would be an erroneous view of the matter."——"This is a subject of much difficulty, as may be readily conceived, when we consider, that for its elucidation, we require to measure the air, and estimate, not the temperature of that air, but the degree of heat it is capable of producing: we are consequently engaged with chemical processes of great delicacy."

(12) Elliotson's, Blumenbach's Physiology. page 168. "Mr. Brodie removed the brain of animals and continued respiration artificially. The usual chemical changes of the blood continued in the lungs, yet the temperature of the animals diminished, and even more rapidly than if the respiration had not been continued, owing it is said to the succession of cool air sent into the lungs. He therefore concludes, that animal heat depends much more upon the nervous energy than upon the chemical changes of the blood."

(13) Dr. Whewell's History of the Inductive Sciences, vol. 3, page 443. "We may observe further, that though Harvey's glory, in the case now before us, rested upon his having proved the reality of certain mechanical movements and actions in the blood, this discovery, and all other physiological truths, necessarily involved the assumption of some peculiar agency belonging to living things, different both from mechanical

agency, and from chemical; and, in short, something *vital*, and not physical merely. For when it was seen that the pulsation of the heart, its *systole* and *diastole*, caused the circulation of the blood, it might still be asked, what force caused this constantly recurring contraction and expansion. And again, circulation is closely connected with respiration; the blood is by the circulation carried to the lungs, and is there, according to the expression of Columbus and Harvey, mixed with air. But by what mechanism does this mixture take place, and what is the real nature of it? And when succeeding researches had enabled physiologists to give an answer to this question, as far as chemical relations go, and to say, that the change consists in the abstraction of the carbon from the blood, by means of the oxygen of the atmosphere, they were still only led to ask further, how this chemical change was effected, and how such a change of the blood, fitted it for its uses. Every function of which we explain the course, the mechanism, or the chemistry, is connected with other functions, is subservient to them, and they to it: and all together are parts of the general vital system of the animal, ministering to its life, but deriving their activity from the life. Life is not a collection of forces, or polarities, or affinities, such as any of the physical or chemical sciences contemplate: it has powers of its own, which often supersede those subordinate relations: and in the cases where men have traced such agents in the animal frame, they have always seen, and usually acknowledged, that these agents were ministerial to higher agency, more difficult to trace than these, but more truly the cause of the phenomena. The discovery of the mechanical and

chemical conditions of the vital functions, as a step in physiology, may be compared to the discovery of the laws of phenomena in the heavens by Kepler and his predecessors, while the discovery of the force by which they were produced was still reserved in mystery, for Newton to bring to light.

(14) Dr. Arnot's Elements of Physics, vol. 2, page 163. "It was at one time the favorite explanation of this, that animal heat was produced in the lungs during respiration, from the oxygen then admitted. This oxygen combines with carbon from the blood, and becomes carbonic acid, as in combustion, and was supposed to give out a portion of its latent heat, as in actual combustion; which heat, being then spread over the body by the circulating blood, maintained the temperature. We now know, that if such a process exist, which it probably does, for the animal heat has generally a relation to the quantity of oxygen required in any particular case, and when an animal, being already much heated, needs no increase, very little oxygen disappears, still much of the effect is dependent on the influence of the nerves, either directly or indirectly, through the vital functions governed by them.

(15) Müller's Physiology, page 92. After commenting on the theory and experiments of respiration by Lavoisier, Laplace, Dulong, and Despretz. "From these experiments, it results that even if the chemical theory of respiration is adopted, there must be still some other source of animal heat." "Besides it is at present merely an hypothesis, that the oxygen of the atmosphere unites with the carbon in the lungs, to form carbonic acid." "This is an interesting problem for chemical enquiry."

(16) Elliotson's, Blumenbach's Physiology. page 155, note. "Hence the constant coldness of those wretched beings, who labour under the *blue disease*, (Cæruleans,) which arises from a mal-conformation of the heart. Sometimes the septa of the heart are imperfect; sometimes the aorta arises with the pulmonary artery from the right ventricle, as in the tortoise. In such instances the chemical changes can take place in the lungs but imperfectly."

(17) Pereira's Materia Medica, vol. 1, page 11. "Physiological effects of calor. All living beings, but especially the animals denominated warm blooded, generate heat. To all a certain temperature, which differs in different individuals, is essential to the maintenance of life, and hence caloric, or heat, is a vital stimulus, increased beyond a certain degree it ceases to be vivifying, it may cause inflammation, or apoplexy; it may exhaust by its prolonged stimulant operation, or when its action is very violent it may decompose the organized tissues, by its chemical influence." *See page* 10, *No.* 1.

(18) Müller's Physiology, page 326. Sir H. Davy states "that in his experiments, an absorption of nitrogen took place to the amount of one-seventeenth of the volume of the oxygen, which disappeared from the atmosphere, so that in twenty-four hours the quantity of nitrogen absorbed was as much as 2,246 grains. Pfaff also observed a diminution in the quantity of nitrogen, and estimated it at from one-hundred and seventh to one-eightieth of the volume of the air inspired."

Turner's Chemistry, 7 edition, page 217. "Davy discovered that it (nitrogen) may be taken into the lungs with safety, and that it supports respiration for a few minutes. He breathed

nine quarts of it, contained in a silk bag, for three minutes, and twelve quarts for rather more than four, but no quantity could enable him to bear the privation of atmospheric air for a longer period. Its action on the system, when inspired, is very remarkable. A few deep inspirations are followed by most agreeable feelings of excitement, similar to the earlier stages of intoxication. This is shewn by a strong propensity to laughter, by a rapid flow of vivid ideas, and an unusual disposition to muscular exertion. These feelings however soon subside, and the person returns to his usual state, without experiencing the langour, or depression which so universally follows intoxication from spirituous liquors. Its effects however on different persons are various; and in individuals of a plethoric habit, it sometimes produces giddiness, head-ache and other disagreeable symptoms. *See page* 10, *No.* 1.

CHAP. III.

God, "hath made of one blood, all nations of men for to dwell on all the face of the earth:" so has he constituted the temperature of the blood to be the same in all climates. Interruption of the due equilibrium of the normal state we call blood heat, is the usual forerunner of disease. Hence the supreme importance of sustaining and regulating the temperature of the system. As human blood is alike in all situations, why should it not have the same remedial agent in all disease? These considerations impel the wish to throw some further light on this subject, whereby a more scientific and just treatment of disease may be pursued.

High testimony has been herein referred to, in the subjoined notes, to shew the acknowledged ignorance of the subject: and in practice, it has been exemplified in cholera. A treatise on this

subject of cholera, brought before the public a few months since, contained a specific, which experience had proved to be curative in every case where I had the opportunity of using it, amounting to 111 cases. It is there assumed, that nitrogen is probably the life of the blood. I am persuaded the more closely the subject shall be contemplated, the more fully it will be recognized as the life-giving stimulus; and will be allowed to supply an answer to those pertinent queries, (*see note* 13, *chap.* 2,) advanced by Dr. Whewell at page 443, vol 3, History of the Inductive Sciences; that nitrogen has the force therein sought for, and which the progress of this essay explains.

The remedy prescribed is on the same elementary principle of therapeutics that is herein advocated.

Cholera, by its malignity and rapidly fatal termination, is peculiarly adapted to exhibit the effects of any medicine that should control its power; and is a palpable instance for exemplifying a system which the author's experience has proved to him, to operate in a reme-

dial form, over every class of curable disease. M. Louis has suggested, that the slight difference in individual cases of cholera should make no essential difference in the treatment: that it was one and the same disease. This opinion bears out the conclusions to which the practice of years has given weight; amounting to identify all disease in some measure as analogous, inasmuch as that, if closely studied, all complaints originate in a rigor or coldness, thereby acting on the circulation of the blood and capillary system, oftentimes sensibly experienced. The duration of the cold stage, before reaction takes place, often points out the severity of the impending illness.

Variety of conditions induces diversity of complaints; also peculiarities and irregularities in different individuals in the same disease. In all, it is the same machinery that requires to be put in the normal state of health. Exposure to the same casualty will often occasion various results to different individuals.

External means are only secondary in combating any internal disturbance of

the animal frame. Whatever applications may be resorted to, for relief, the chief endeavour to restore regularity of the circulation to those functions, which the chill had interrupted, should be borne in mind.

To carry the analogy further, we may remark, that apples have a specific character and variety: also that each apple of the same kind on a branch, may individually slightly differ in degrees of flavor, color, size, and time of ripening. As they are all apples, they have much in common; they all possess malic acid: and blood may be considered in some measure, as analogous to malic acid: each supplies an essential quality to their respective bodies. The structure of all sorts of apples is alike; which is supported by similarly constituted organs in every kind, and the same culture will in general be desirable for the whole orchard; so also in the various ailments to which the human family is liable; as long as the due regulation of heat in the blood can maintain the circulating process, it will feed the lamp, and keep bright the last spark of life.

In admitting coincidences, usual in disease, and the first principle of therapeutics to be kept in view, the peculiar symptoms of each individual disease will afford abundant scope for discrimination, and modification of treatment. Among the various treatments prescribed by homœopathists, hydropathists, and mesmerists, each has attained popularity, although based only on hypothetical views, and on the imputed merits of empirical results. The confidence thus acquired must be mutable; as much alternation of success, cannot fail to attend practice, not grounded on scientific views.

The present theory of respiration being defective, the treatment of disease in general, is devoid of an established system: consequently a knowledge of this complicated machinery of respiration, acting on the lungs and heart, must involve the constituents of the blood, and its circulation through the body.

In the process of circulation after birth, the secondary impetus or shock is caused by inhalation, which must produce mechanically a simultaneous effect

on the heart. I believe that in the process of respiration, the nitrogen is carried into the lungs, and absorbed by the blood, to give the specific heat to the blood, this nitrogen being supplied in due proportion, it is operated upon by the action of the heart, causing the impetus, or stroke, which keeps up the temperature of the blood in the arteries; this temperature is found to be lessened, as the blood passes into the venous system.

The capillaries receiving the blood from the arteries, convey it without any perceivable impulse, or oscillation, in a continuous unvarying stream; as has been noticed in a frog's foot.(19,20) The blood is collected in the veins by degrees; they receive it with open mouths, and convey it into larger veins, like tributary rivulets into their larger streams; at each of these junctions, there is a ripple, or oscillation produced. As the veins increase in size, so is the supply of blood greater, and the oscillation increased. These oscillations, from time to time, increase or renew the temperature, which would, without this action, be diminished, as the surrounding bodies

absorb heat, and the circulation of the blood is slower in the capillaries and veins, consequently not so warm by $1\frac{1}{2}$ degrees, as in the arteries.

Hence will be apparent the great importance of attention to the capillary system, to keep up a due degree of heat on the surface of the skin, and to shew the liability of injurious consequences that may result from a chill; and why coldness is a precursor of disease; and will thus point to remedial agencies through heat.

Ingredients containing the constituents of heat, afford the best means for generating the vital stimulus that has been lost. Tea has been long universally esteemed a luxury, although not supposed to afford nourishment, the refreshment it imparted was admitted, while the constituents of the panacea were unknown. Recent discoveries of chemists find it to contain constituents of the bile, having nitrogen in suitable combination, and it is now acknowledged to be as beneficial as agreeable. Coffee also possesses the same identity of principle, in taurine.

The experience of sailors who have substituted coffee (which contains nitrogen) for grog, that contains no nitrogen, give it the preference. It is accounted for, by the warmth and exhilaration imparted by the nitrogen, not leaving those exhausting sensations so often experienced after alcohol. Cacao has also nitrogen, in suitable combination for nutritious diet.

In recommending the universal use of nitrogen, in suitable combination, is because I regard it as the generator and source of vital heat, and an essential stimulant of the human frame: and to regulate its due circulation through all the ramifications of the nervous system, the best expedient for the removal of disease, whether it be local, functional, or organic.

It is the blood which repairs all injuries, as wounds, broken or decayed bones, inflammations, as well as complaints of a chronic character, as consumption, paralysis, scrofula, scurvy, lunacy, &c. Outward applications are auxiliaries, in adapting parts together, and disposing the pores of the body to be acted on more

freely by the circulating fluid; and this to be in an energetic state, to dispense health through its entire course, needs a constant supply of its component parts, of which so large a proportion is nitrogen.

Mechanical means for producing heat, by rubbing, exercise, warm clothing, radiation from fire, or hot bodies, call the latent nitrogen into active heat.

In warm climates, where the atmosphere is at 98°, or at a higher degree, hot air, or hot applications cannot be of much service in the treatment of cholera. The principal remedy relied on has been calomel, which we know increases the hardness of the pulse, if not the frequency also, and thereby causing an impetus on the arterial system, and an increase of vital heat, as instanced by the circulation.

(21)Heat has been described as a fluid in a gaseous form: and we may reflect that on the degrees of heat, depend those of motion, as when heat is intense, gases are thrown off, incandescence takes place, or in water, ebullition is produced.

The action, and vibration, attendant on heat, testify the importance of the

knowledge of this property: and thence the debateable question of the nature of heat should be fully discussed: when its laws shall be ascertained and acknowledged, they will afford the best superstructure for the basis of medical treatment; far superior to that on which the pivot of health is at present regulated.

Vital heat I attribute to nitrogen in suitable combination; in exemplification of the *en bon point* of life, as essential to our existence, and in due proportion, as a necessary concomitant of health.

Symptoms of the deficiency of nitrogen, if considerable, are speedily marked in the system by a depression of different organs of the brain; as sight, or hearing, or those more under the influence of the spinal marrow, the heart, lungs, stomach, liver, &c.

In its highest order it is here intended to exhibit nitrogen as subservient to the amelioration and enjoyment of life, in the promotion of health; the best blessing of our natural existence.

(22)By perspiration a large quantity of nitrogen is thrown off, and perspiration may be considered a safety valve, in carrying off an excess of heat.

In maintaining a due proportion of heat, nitrogen has been found to supply the deficiency of that quality which is evolved in disease, and marked by its first symptom, viz. rigor. The longer this symptom continues, the greater is the severity of the attack, whatever organ the disease may fall on, and the proportionate prostration after the attack is over, if nitrogenous medicine, be not continued to the convalescence.

In cold climates the inhabitants depend chiefly on animal food, by which vital heat is best sustained. The use of the cod liver oil in this country, probably derives its virtues from its nitrogenous constituent.

We are told that the theory of respiration, in producing heat, is not satisfactorily understood: how palpable then the deficiency. Can a professor of medicine teach that which he does not know?

To lead to a successful practice of medicine, whether medical or surgical, the knowledge of heat would afford an universal guide.

In accidents, or sudden interruption to the circulation, as well as in chronic cases, the most important point is to re-

store a normal state to the functions of the system.

The assumption that nitrogen is the most powerful agent in producing this result, is propounded from a careful scrutiny of its experience, through a series of years. Whether the theoretical views be received or neglected by the professors of medicine, the strength of its efficacy in practice is conclusive of its merits; and as several patients, who have benefitted from my treatment have repeatedly advised me to make my views more extensively known, I have at length from undeviating perseverance and examples, both encouraging and numerous, through so long a period, acquired confidence in the means, and have been induced to diffuse them in this public form, considering how circumscribed individual practice, under favorable circumstances, must be, and that life and health, are alike transient.

My success in the treatment of cholera, has imparted great importance to those views of vital heat, and conviction in my mind of their being founded on a

correct basis, in addition to the results of disease in general.

My experience has been in a rural district, and country town, with enough leisure and opportunity to contemplate, with close attention, individual cases; and though they have been, for the most part, in obscure life, they warrant a diffusion of the principle of their treatment, as founded on a close adherence to the views herein stated.

What has been the case with many travellers in cold weather? some have been induced to lie down, because a sleepiness had come over them, and have died from the effects of cold; whereas others have been encouraged to walk, when the pressure on the arteries and veins has been kept up, and consequently a genial or normal temperature produced, and life preserved. In either case no assistance from food had been procured; and we may infer that pressure alone had produced the happy result.

A natural way of increasing heat by pressure is admitted by philosophers, "that pressure produces heat." The

pressure of the atmosphere in mines is another great example of the natural mode of generating heat.

The case of a medical man reported in the Lancet, who had an attack of cholera, and had occasion to visit a patient some miles from his house: he, at once, hastened off on foot, and got into perspiration, thereby restored the *normal heat*; by such determination, he cured himself. Although he is reported to have given the case of himself, he does not assign the cause of the cure.

Some cholera patients have been rubbed briskly by nurses, with an irritating application, as turpentine or mustard; the patients have done well, upon this same principle as the surgeon's case, without regard to the internal use of medicine or food, as in the cases of cold weather.

The blue disease may be also adduced; the heat being lower than in other persons, owing to the heart not being symmetrically formed, thereby the impetus is lessened, and pressure diminished, consequently, heat is diminished.

Hœmorrhage from flooding, or other

causes, in like manner will produce excessive cold; because the system has been robbed suddenly (as in cholera) of some important quality of the blood: a diminution of nitrogen we presume is the result, where there is no organic disease.

A shock on the nervous system, by a gun-shot, often produces death, not from the loss of blood; a fright, also, will produce similar fatal effects, and an analagous state of coldness, requiring similar treatment.

The remedies usually employed, tending to increase heat in the treatment of all these cases, are ammonia, coffee, tea, hot air bath, warm water bath, turpentine, mustard, bottles of hot water, &c. Brandy is not generally esteemed so much as other remedies, for fear of inflammation being produced, on the return of heat. The effluvium from carbonate of ammonia, or liquid ammonia, produces good effects through the nostrils by the absorption of nitrogen, when the patient is too far gone to swallow.

The agriculturist and the florist have discovered the virtues of ammoniacal

water, which is strongly impregnated with nitrogen; they find it fertilizes all vegetation, in the germination of the seed, growth of the plant, and the development of the flower and fruit: all are best attained through its agency.

In contemplating the immense importance of this gas in the economy of the workings of the universe, we are led not only to wonder and admire those mysteries of providence, while we partake of, and enjoy the blessings its influence bestows around us, in beautifying nature, and lending its aid to our artificial luxuries in health: but also, to seek its use, in renovating the cold and languor of old age and sickness; that its effects may be imparted, without the attendant evils that succeed to some other stimulants.

The constituents of the air, as regards the gases, oxygen and nitrogen, at all times, and in all climates, are in the same proportion, consequently, miasma, odorous, or other effluvia, must make their entrance between the interstices of the particles of the elements of the air, and exert their power through the nervous

system. Those vapours, often destructive of health, and even of life, are most readily imbibed when the animal powers are weakest, where the stimulus of heat is soonest interrupted from defective circulation.

No atmosphere or climate is exempt from sickness, or from the intrusion of those varied poisons which circulate in all spots of habitable life; but while we sustain the genial warmth, and regulate its power, we check the destroying influence, and avert the venomed dart.

NOTES FOR THE THIRD CHAPTER.

(19) Elliotson's, Blumenbach's Physiology. note, page 107. "Dr. Hastings, when observing the circulation in the frog's foot under the microscope, saw that the blood moved faster in the arteries than in the veins, and in the veins than in the capillaries."

(20) Elliotson's, Blumenbach's Physiology, page 104. "Indeed we have ocular proof, that the capillaries do not contract on the blood in the ordinary state of things, for the blood in them, as well as in the arteries and veins, may be seen for an hour together in the frog's foot, under the microscope, to move in a stream unvarying, neither becoming finer alternately, nor experiencing impulses."

(21) Dr. Arnot's Elements of Physics, vol. 2. page 161. "A soft iron nail laid upon an anvil, and receiving in rapid succession three or four powerful blows of a hammer, becomes hot enough to light a match, and if longer hammered will become incandescent, or red-hot,—partly from the diminished volume, or condensation of the iron, on the principle already explained, and partly from the percussion or friction, in a way not yet well understood, but probably electrical."

(22) Dr. Arnot's Elements of Physics, vol. 2, page 163. "Perspiration, both from the skin, and internal surface of the lungs, occurs generally in proportion to the excess of heat. Dogs and other animals when much heated, as they cannot throw off or diminish their natural covering, increase the evaporating surface by protruding a long humid tongue."

CHAP. IV.

"THE question has been much discussed, whether the oxygen and nitrogen gases of the atmosphere are simply intermixed, or chemically combined with each other."(23,24)

As the property of heat diffuses an equality of temperature in a room, or in any confined space, and presuming nitrogen to be the inherent basis of heat, it follows, that a due proportion of nitrogen will imbue the whole volume of atmospheric air, under any natural circumstances, independent of mechanical action, or of the laws of gravitation; which, if no other influence intervened, would cause it to rise above the oxygen, leaving the oxygen at the bottom, from its superior weight, compared with that of nitrogen. The nitrogen being four to one of oxygen, is sufficient to surround the particles of oxygen, and to support them, and also to preserve their particles from contact, by the influence of the universal medium of heat.

Sir H. Davy says, "a piece of iron made red-hot by hammering, cannot be strongly heated a second time by the same means, unless it has been previously introduced into a fire. This fact has been explained by supposing, that the fluid of heat has been pressed out of it by the percussion, which is recovered in the fire; but this is a very rude mechanical idea." If we grant the property of heat to exist in nitrogen, this problem will be more clearly accounted for, by the fire again expanding the iron to its former dimensions, when it takes in its due portion of atmospheric air, containing nitrogen, which the hammering had expelled, and in which the property of heat existed; and thus the subsequent hammering produced incandescence, through the constituent aid of nitrogen.

Friction is one of the accustomed means of causing heat. Does not the pressure, caused by friction impel the nitrous spirit into action, whether when rubbing two sticks together we produce fire, or by compression of the nitrogen in an air piston we ignite tinder? *as seen page* 10, Nos. 5 and 7.

Nitrogen is alike abundant from the

equator to the poles, in the atmosphere, whether dense or rare: in all altitudes and climates, it is found to possess the usual proportions of twenty per cent of oxygen, and eighty of nitrogen.

Within our atmosphere, the theory of pressure is evident, by the various degrees of heat in the same latitudes of our globe, at different elevations.

The snow on the Alps and on the Andes is accounted for, by the consideration of their height encountering so much less weight of atmosphere, and the air becoming more rare according to the elevations: the nitrogen of the air is, consequently, not so forcibly pressed, nor is heat developed, and thus, even in the torrid zone, we find that snow covers the tops of mountains.

On those mountains of the moon, under the equator, which are covered with snow, the sun's rays dissolve portions of it in the summer: these are supposed to cause the overflowings of the Nile, at a distance of some thousands of miles.

(25)It is computed, that heat from the sun does not penetrate beyond a few feet under the surface of the earth: still

an increase of temperature, amounting to one degree every forty yards in descending, is discovered to the greatest depth that has been measured, and thus approximating to the central heat, which, by the same reasoning, is accounted for: as, by pressure, we should understand, that the weight of atmosphere upon every square inch of surface is calculated at fifteen pounds.

Under the surface of the globe of the earth the oscillations are lost. The atmosphere is a non-conductor of heat, as is shewn by an orangery at Versailles, where the windows and doors are double, at about four feet apart. So no cold or heat can be communicated to the volume of air in a mine, from the sun; which had been supposed to have had some effect; but that notion has vanished, leaving the source of heat to be accounted for, by some other natural cause.

(26)Concluding the thermometer to continue to rise towards the centre of the globe, a distance of 4000 miles, the presence of fire would be the result; as it is conjectured is the case.

(27)In reference to the supposed tem-

perature being now cooler, than in distant periods of our earth's history, and also, that the dimension of the crust of our globe has not diminished,[28] it may be suggested, that the subterranean fires have occasioned larger caverns in the bowels of the earth, and these the elasticity of the air having filled, its expansion into increased volume has taken place; and therefore, it has become rarer, and consequently, colder.

[29,30]The supposition that stars, so distant as they are, should have an influence sufficient to heat the atmosphere surrounding the planets of our system, is surely an assumption far less credible than, that the solar spaces of our atmosphere, possessing in nitrogen, all the appliances, and properties of heat, should educe the temperature supposed to attend on the motion of the planets.

What more ethereal, universal, or active agent is there, to cause those vibratory undulations, supposed to occupy and extend throughout all our planetary space, than nitrogen? it is flexible to any extent, and combustible in powerful grandeur! *See page* 11, *No.* 12.

The atmospheric air preserves all inanimate nature in due equilibrium from immediate contact of its particles, while heat is insensible: but when the nitrogen is brought into activity, through the effect of pressure, every degree of warmth, even unto incandescence, may be occasioned. *See page* 10, *Nos.* 5 *and* 7.

The knowledge of so diffusive a property as heat, must be interesting, as regards external circumstances, as well as in the constitution of our internal frame: and doubtless the temperature of our atmosphere, exercises a strong influence on our bodily and mental faculties; whether derived from a solar, or an ethereal source.

At present we seem to have no clue, to unravel the laws, by which the different proportions of nitrogen combine with various bodies, in producing explosions; or to define, why nitrogen should create other sensations than the other elements.

Chemical results demonstrate the facts, and we make the uses and actions

of nitrogen available to our service, in a chemical point of view. Their relative proportions may be styled suitable combinations, for the effects resulting from them, and seem to point to the law of nature, implying a specific heat. The circumstance, that water does not admit of a higher temperature than boiling, shews the degree and limit of the specific heat it will absorb: encrease of fire does not augment the heat, but dissipates the water. This law can only be overcome in an apparatus of immense strength, excluding atmospheric air.

In conclusion, I must express the sincere respect I entertain, for those enquirers into nature, whose opinions have been herein quoted; their philosophical and chemical results have elicited much to interest the student, and to encourage further investigation, throughout the various phases under which the workings of the Creator's laws may be regarded.

The focus at which these operations are viewed in the preceding pages, brings the subject of them under inspection,

in the nearest light that human interest can regard them, especially, as they relate to our mental and bodily health.

If these applications do not admit of mathematical demonstrations, the deductions are explained, by reasonings based on elementary principles, wherein the premises have been borne out by experience of very general success in them: these have far exceeded the expectations the author had at first anticipated. Such considerations it is trusted, will palliate the criticisms to which the opinions urged, may be subjected.

NOTES FOR THE FOURTH CHAPTER.

(23) Turner's Chemistry, page 211. "The knowledge of the composition of the air, and of the importance of oxygen to the life of animals, naturally give rise to the notion, that the healthiness of the air, at different times, and in different places, depends on the relative quantity of this gas. It was therefore supposed that the purity of the atmosphere, or its fitness for communicating health and vigour, might be discovered by determining the proportion of oxygen."—"But this opinion, though at first supported by the discordant results of the earlier analysts, was soon proved to be fallacious."—"On the contrary, the composition of the air is not only constant in the same place, but is the same in all regions of the earth, and at all altitudes. Air collected at the summit of the highest mountains, such as Mount Blanc, and Chimborazo, contains the same proportion of oxygen, as that of the lowest valleys. The air of Egypt was found by Berthollet to be similar to that of France. The air which Gay-Lussac brought from an altitude of 21,735 feet above the earth, had the same composition as that collected at a short distance from its surface. Even the miasms of marshes, and the effluvia of infected places, owe their noxious qualities to some principle of too subtile a nature to be detected by chemical means, and not to a deficiency of oxygen. Seguin examined the

infectious atmosphere of an hospital, the odour of which was almost intolerable, and could discover no appreciable deficiency of oxygen, or other peculiarity of composition. The question has been much discussed, whether the oxygen and nitrogen gases of the atmosphere are simply intermixed, or chemically combined with each other. Appearances are at first view greatly in favour of the latter opinion. Oxygen and nitrogen gases differ in density, and therefore it might be expected, were they merely mixed together, that the oxygen, as the heavier gas, ought, in obedience to the force of gravity, to collect in the lower regions of the air: while the nitrogen should have a tendency to occupy the higher. But this has no where been observed. If air be confined in a long tube, preserved at perfect rest, its upper part will contain just as much oxygen as the lower, even after an interval of many months, nay if the lower part of it be filled with oxygen, and the upper with nitrogen, these gases will be found, in the course of a few hours, to have mixed intimately with one another. The constituents of the air are also in the exact proportion for combining. By measure they are nearly in the simple ratio of one to four, which agrees with the law of combination, by volume and by weight, they are as eight to twenty-eight, which corresponds to one *eq.* of oxygen, and two of nitrogen."

(24) Turner's Chemistry, page 212. "Since the elements of the air cannot be regarded as in a state of actual combination, it is necessary to account for the steadiness of their proportion on some other principle. It has been conceived that the affinity of oxygen and nitrogen for one another, though insufficient to cause their combination when mixed together at ordinary tem-

peratures, might still operate in such a manner as to prevent their separation."—"That a certain degree of attraction is even then exerted between them, which is able to counteract the tendency of gravity."

(25) Dr. Arnot's Elements of Physics, vol. 2, page 135. "In the operations of mining, the deeper men go, the higher they find the temperature to be, at the rate of a degree for about 200 feet of descent, which fact, as heat tends to equable diffusion, proves both that the central heat of our earth must have had another source, than a radiation from the sun of the present intensity."

(26) Dr. Whewell's History of the Inductive Sciences, vol. 2, page 535. "Fourier gave in the bulletin of the Philomathic Society, a summary of his results, as far as they bore on this point. His conclusion was, that such an increase of temperature in proceeding towards the centre of the earth, can arise from nothing but the remains of a *primitive heat:* that the heat which the sun's action would communicate, would in its final and permanent state, be uniform in the same vertical line, as soon as we get beyond the influence of the superficial oscillations, of which we have spoken; and that before the distribution of temperature reaches this limit, it will decrease, not increase in descending."

(27) Dr. Arnot's Elements of Physics, vol. 2, page 134. "Of one fact there can be no doubt, namely, that the present temperature of the surface of the earth is much lower than the temperature in remote past time."

(28) Dr. Whewell's History of the Inductive Sciences, page 534, vol. 2. "The temperature of the interior of the earth." "The question of the temperature of the interior of the earth

has excited great interest, in consequence of its bearing on other branches of knowledge. The various facts which have been supposed to indicate the fluidity of the central parts of the terrestrial globe, belong in general to geological science, but so far as they require the light of thermotical calculations, in order to be rightly reasoned upon, they properly come under our notice here. The principal problem of this kind which has been treated of is this,—If in the globe of the earth there be a certain original heat, resulting from its earlier condition, and independent of the action of the sun, to what results will this give rise? and how far do the observed temperatures of points, below the surface, lead us to such a supposition? It has for instance been asserted, that in many parts of the world the temperature, as observed in mines, and other excavations increases, in descending, at the rate of one degree (centesimal) in about forty yards. What inference does this justify?"

(29) Dr. Whewell's History of the Inductive Sciences, page 536, vol. 2. "Heat of the planetary spaces. In the same manner this portion of science is appealed to for information concerning parts of space, which are utterly inaccessible to observation. The doctrine of heat leads to conclusions concerning the temperatures of the spaces which surround the earth, and in which the planets of the solar system revolve. In his memoir, published in 1827, Fourier states, that he conceives it to follow from his principles, that these planetary spaces are not absolutely cold, but have a *proper heat*, independent of the sun, and of the planets. If there were not such a heat, the cold of the polar regions would be much more intense than it is, and the alternations of cold and warmth, arising from the influence of the

sun, would be far more extreme and sudden than we find them. As the cause of this heat in the planetary spaces, he assigns the radiation of the innumerable stars which are scattered through the universe." Fourier says, "we conclude from these various remarks, and principally from the mathematical examination of the question, "that this is so." I am not aware that the mathematical calculation, which bears peculiarly upon this point, has any where been published. But it is worth notice, that Svanberg has been led to the opinion of the same temperature in these spaces, which Fourier had adopted (fifty centigrade below zero) by an entirely different course of reasoning, founded on the relation of the atmosphere to heat."

(30) Dr. Whewell's History of the Inductive Sciences, 2 edition, vol. 3, page 609. "Again the supposition of a central heat of the earth, considered as the effects of a more ancient state of its mass, appeared to indicate, that its cooling must still be going on. But if this were so, the earth might contract, as most bodies do when they cool, and this contraction might lead to mechanical results, as the shortening of the day. Laplace satisfied himself by reference to ancient astronomical records, that no such alteration in the length of the day had taken place, even to the amount of one two-hundreth of a second, and thus there was here no confirmation of the hypothesis of a primitive heat of the earth."

FINIS.

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