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ASIATIC CHOLERA;

ITS

CAUSE AND CURE,

DISCOVERED AND DEMONSTRATED.

BY

THOMAS HARVEY, ESQ.

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The following pages were written with a view to the delivery of a Lecture on the Cause and Cure of Cholera; but personal affliction prevented their publication in that manner,—and they now appear in their original form, without alteration.

THOMAS HARVEY.

4, *Grove, Hackney,*
London, 15*th Nov.*, 1853.

ASIATIC CHOLERA,

ITS CAUSE, AND CURE.

From the first irruption of Cholera into Great Britain in the year 1832, down to the present period, when this devastating pestilence has again visited our shores, although upwards of twenty years have elapsed, I fear it will be but too readily admitted, that little progress has been made towards obtaining an accurate knowledge of the peculiar characteristics of the disease, or even of any uniform and successful mode of treatment, of those affected with it.

Were it not that medical men have unquestionably declined to indicate by any authoritative proceeding, their general or individual opinions, on the probable cause of this insidious disease, which opinions might be subjected to the ordeal of public scrutiny, it would be more presumptuous on my part than it may at present

appear, for a non-medical man,—a member of a different profession, to obtrude a theory of his own, on a subject so peculiar and of such deep and vital interest to every member of the community. I feel, therefore, that I may claim a measure of indulgence in the attempt which I now make, to throw some light on this hitherto deeply mysterious and art-baffling disease; and should I convince your judgment that I have arraigned the true cause, and indicated the rational cure of Cholera, and, as a pioneer in clearing the wilderness of obscurity surrounding the fatal track of this destroyer, succeeded to any extent, in ameliorating the condition of the helpless and the diseased, I shall derive therefrom great and permanent satisfaction.

With me, the enunciation of my views has become a positive duty, from which I dare not shrink without incurring self-reproach, or I should have hesitated to place myself in a position so liable to hostile criticism by a body of men highly educated and intelligent, as are those of the medical profession of the metropolis; to this I am conscious I subject myself by this discussion, and probably by the freedom of my observations; but truth only is my object, and if the result aimed at be secured, that truth is vital and concerns not one, but all; not the present only, but future generations.

My treatment of this subject will be popular, not scientific, except so far as the mere use of chemical terms and quantities, by way of illustration and explanation, may make it so; and thus I hope to render myself intelligible to all.

It is not necessary for me to revert to the periodically destructive agency of Cholera in the East, or to its rapidly recurring blast across the continents of Asia and Europe to the isolated shores of our own isles, and thence over the populous cities and trackless wastes of America, unchecked and uncontrolled; neither need I recur to the desolation of hearths and homes in the burning East, or in the swampy and fever-stricken cities of the Southern States of America, to bespeak your sympathies or awaken your deepest interest in this subject, for among us all, "who hath not lost a friend" by the same fell destroyer.

Prior to the year 1832, when Cholera for the first time passed the limits of its eastern domain, to which it was deemed indigenous, and invaded the temperate regions of the British Islse, it was believed that there were physical conditions existing which rendered its location in this country impossible; but the fact of its actual presence and fatal tendency, soon disabused our minds of all preconceived notions of this nature; and it must have at once be-

come obvious to the thoughtful and the instructed, that a new disease, dependent on altered physical conditions, had to be encountered; and as no phase of the disease could be recognized by the medical world, causes hitherto unknown, must have been called into activity to produce the results exhibited.

Through the most extended experience of the oldest medical practitioner, no parallel could be traced; and from the widest sphere of his observation, no certain corollary could be deduced. From the first decided evidences of the presence of the disease, through all its rapid and varying stages, it was too fearfully palpable that a potent, and hitherto unknown influence had prostrated the vital energies of the system, and that this influence, unless promptly counteracted, would speedily prevail over the struggling efforts of nature.

Amid all the varied features of the disease, one remarkable characteristic was ever present —a pervading sensation of coldness; the natural warmth of the body had suddenly departed, and all the concomitants of extreme cold—cramp, and depression of the surface, or in its more matured stages, what is ordinarily called collapse supervened, accompanied by a leaden hue and complete prostration of all nervous energy.

Medical men who were required to combat this new and formidable antagonist, availed themselves of all ordinary means to restore warmth to the body, and employed the usual sedatives to counteract the effects of violent cramps in the bowels and extremities, and in some cases these remedies, although as I conceive indirect in their operation, were successful; —but notwithstanding some modes of treatment succeeded in one case, and others highly dissimilar in others; and although all aimed at one definite object—the restoration of heat and circulation to the surface of the body—I have been unable to discover that this practice was the result of a correct appreciation of the causes which had produced such unprecedented effects; and *in the absence of any rational theory of the cause of Cholera,* it must be obvious to the least initiated that the remedies sought out and applied were mere experiments upon a most insidious disease, guided solely by the judgment of different practitioners, according to the varying phases exhibited in its rapid progress.

As the disease was new to the medical profession of this country, it was obvious that a new and distinct cause was superadded to the catalogue of active agencies, periodically prevalent and fatally operative under favorable conditions; and upon the medical world was cast the responsibility of determining at the earliest

moment what were the altered physical conditions, and what the probable cause; for I may safely predicate that an accurate knowledge of causes is the best preparation for, and preventive of, a recurrence of any calamity whatever.

But it may be questioned whether we are not too prone to be content with a superficial knowledge of effects, with reference to subjects of the deepest interest and importance, and in the matter of diseases to rest satisfied with the results of certain palliatives or restoratives, which are sometimes, but not always, successfully administered, instead of directing our minds to a searching investigation into the probable causes and the first altered conditions of the body— the precursors of the actual visible disease.

Take a well-known instance of the discovery and world-wide recognition of a fact which has immortalised the illustrious man whose name I have the honor to bear.

Harvey discovered, and published to the Court and the world, the great fact of the Circulation of the Blood, and demonstrated the truth of the theory he had propounded. His theory was at first scorned and contemned by his contemporaries, but at length justice was rendered to his genius by the universal recognition of its truth. But although he revealed the wonderful effects of a still more mysterious

cause,—to him and the men of his day, that cause remained a sealed book ; they, too, rested satisfied with the discovery that the blood circulated continuously through the system ; the cause of its circulation—beyond the impulse of the heart and the blood-vessels—was apparently to them a mystery too great to be approached ; and even to this day I am led to conclude that but little comparatively is known of the actual motive power—the primary and permanent cause of the circulation of the blood.

In investigating this subject I have adopted the conclusion, that the circulation of the blood is primarily dependent on the mechanical pressure of the atmosphere in the lungs, and that it is maintained by this pressure and the vital influence of oxygen ; and in my judgment that circulation cannot be perpetuated by any other natural cause, and is not, as some medical authorities have supposed, to be attributed to the contraction of the heart, or to some muscular power in the blood-vessels—the one the cylinder of the engine, and the other the distributing channels—each totally inadequate to produce or perpetuate such motion, the cause of which, I believe, was imparted to the first man who was made of the dust of the ground, perfect in his organisation, but inanimate, when God " breathed into his nostrils the breath of " life, and man became a living soul."

With such instances before us of the deficiency of popular information at least, whatever be the condition of medical knowledge, on subjects of so much interest and practical importance to all, subjects which have afforded opportunity for investigation from the creation of the first man down to the present moment, it will probably be conceded, that a spirit of inquiry into the causes of many of the familiar phenomena of nature, and especially into those which derange its ordinary functions, is not a distinguishing characteristic of the present age.

To an exposition of *the probable cause of Cholera*, and *the rational mode of cure*, I propose now to direct your attention, feeling assured that a correct appreciation of the specific cause of this subtle disease will be calculated to allay much unreasonable apprehension, and lay the foundation for a more rational and successful mode of treatment.

During the prevalence of Cholera in London, in 1849, I witnessed in every direction the ravages of the disease, which carried off many whom I knew; I then felt deeply interested in the solution of the question, which I am now about to discuss, and lamented day by day that no efforts appeared to be made by competent scientific or medical men to solve the question.

Specifics for the cure of Cholera were proffered on every side, but few or none ventured to predicate anything respecting the *modus operandi* of the proposed remedies, and the most opposite modes of treatment were as confidently advocated by different practitioners.

I did not hesitate to subscribe to the opinion expressed by one medical man of this metropolis, in his letter published in the *Times* newspaper at that period, that *Cholera is not produced by a specific poison in the atmosphere* —but I regret he did not communicate something of a positive character respecting the origin of the disease, and state at least to what specific causes he attributed the incipient stages of Cholera.

Regarding the disturbance of the equilibrium, or what I may call the natural condition of the atmosphere, as the primary cause of the disease, I concluded that a deficiency of oxygen had probably destroyed that equilibrium, and if such deficiency were discovered, I thought I could clearly trace the direct and immediate connexion between such a cause and the effects produced in every case of true Asiatic Cholera; and it is now my intention to endeavour to demonstrate the fact, that *nothing but a deficiency of oxygen in the atmosphere can produce Cholera in its true type;* and if I succeed in the proof of this proposition, the

remedy which I have to propose will I hope be as readily understood and appreciated as the cause of the calamity will be obvious.

Shortly after I had arrived at these conclusions I obtained a knowledge of the attested fact, that there had been, during the prevalence of Cholera in London in that year, a deficiency of ozone in the atmosphere, and that some experiments made both at St. Petersburgh and in Paris, during the prevalence of Cholera, had exhibited like results.

Dr. Faraday considers ozone to be "oxygen in an allotropic state—that is, with a capability of immediate and ready action impressed upon it." He also considers "electricity to be the agent by which oxygen is converted into ozone, or rendered more energetic in its action."

Dr. Schönbein, of the University of Bâle, is the discoverer of ozone; and Dr. Drew, of Southampton, who is in communication with the discoverer, relative to a series of experiments on the subject, has recently stated that "ozone combines energetically with the deleterious gases which arise from the decomposition of animal and vegetable matter, and neutralises their effects." Schönbein has proved by experiments that "air containing $\frac{1}{6000}$ of ozone can disinfect 540 times its volume of air produced from highly putrid meat, that is to say, such a fœtid atmosphere may be com-

pletely purified by a quantity of ozone equal to $\frac{1}{3,240,000}$ of its volume;" and Dr. Faraday, in a lecture recently delivered by him on the subject, stated, "we cannot doubt that ozone exerts an important influence on the atmosphere, and therefore on the health of animals and vegetables." Whatever may be the process or agent by which this concentration of oxygen takes place, in order to produce what is here called "ozone," which is described as possessing such remarkable properties, there seems no reason to question the fact, that it is still but oxygen, by some process or other rendered more energetic in its action, and that it may not inaptly be called the spirit of oxygen.

Thus far, by the proved absence of ozone or oxygen from the atmosphere, I was strengthened in my opinion as to the existence of the cause which I had previously determined was sufficient to produce the disease; but I could discover no evidence that a scientific investigation into its mysteries was being pursued, or that any mind was especially directed to the full development of this deeply-interesting subject.

It is not sufficient to determine the existence of any unusual phenomenon in nature, and attribute to its influence any remarkable variation in the physical world, coincident with such a phenomenon; but we must clearly understand the power and properties of the one, and

be enabled to identify its operation on, and connection with, the other, before we can pronounce that towards each other they stand in the relative positions of cause and effect.

It will be necessary, for the proper consideration of the subject, to take a hasty glance *at the properties of oxygen, and its influence on organized beings;* we shall then be better able to understand the manner in which its abstraction, or sensible diminution, can, and *really does, produce that hitherto almost uncontrolled disease—spasmodic Cholera.*

A remarkable and most interesting discovery has recently been made by Professor Faraday, which greatly strengthens my opinion that oxygen will be found deficient wherever Cholera prevails:—the fact discovered is, that oxygen is magnetic. I believe this discovery may lead to a change of some popular opinions, among others, one generally received as to the mode of purification, or what is usually termed the oxygenation of the blood in the lungs; and that this important process will resolve itself simply into a question of electrical affinities. The discovery that *oxygen is magnetic,* may ultimately be found to have a material bearing on this subject.

During the prevalence of Cholera at St. Petersburg, in 1849, it is stated that a large magnet which would ordinarily suspend a

weight of 84lbs, actually sustained during that period such a diminution of its power, that it was incapable of lifting above 15lbs; and I believe a similar result was observed in Paris in the same year. Faraday's discovery is a recent one, but not the less important—clearly evidencing to my mind the fact, that a deficiency of oxygen occasions a loss of electrical power, and that in every place where Cholera prevails, both these phenomena will be found concurrent.

Mr. J. Mather, of South Shields, has just published a letter to show that the prevalence of Cholera is invariably attended by marked electrical derangements in the atmosphere, and that when electricity is negative, vitality is depressed —and when positive, it is excited. This is proved by the fact that when the Cholera was so prevalent at Paris in 1849, the deaths rapidly increased till the 8th of June, on which day they numbered 623. On that evening a great thunder-storm shook the city nearly to its foundations. Next day the Cholera began to decrease—in ten days there were little more than 100 deaths a day, and in twenty days little more than thirty. "In the same year," says Mr. Mather, "when Cholera of a very fatal character was in this district, I made daily observations, sometimes twice a day, with a magnet, which in its normal condition carried about 2lbs. 10 oz. When the atmospheric indications were

at the worst, and Cholera most fatal, the magnet could only sustain 1 lb. 10 oz., varying with the virulence of the disease. My hygrometer indicated at the same time an atmosphere nearly saturated with moisture." Mr. Mather adds that in the north, where the Cholera has lately been so very prevalent, the old Cholera atmosphere has been as marked as it was in 1832 and 1849.

I have lately read in a London Newspaper, an article on the exemption from Cholera of the workmen engaged in certain metal manufactories in France; and it is also stated, as indicating the effect of atmospheric influence, that "all the coach springs manufactured in France during the former prevalence of Cholera were found defective in quality."

Assuming the statement to be correct, that oxygen is magnetic, and that during the period of its proved deficiencies such results as have been mentioned are produced on inorganic substances, it may confidently be affirmed that the human body is, if not in a much higher degree susceptible of such influences, certainly not less obedient to the laws of nature, and that under the dominion of such disturbing agencies, great changes will be produced in the conditions essential to the maintenance of health.

Athough however these facts and opinions may, and unquestionably do, tend to strengthen the views which I am about to submit, I may

add that the non-establishment of the magnetic properties of oxygen, or its influence on inorganic bodies as an electrical agent, does not in any degree militate against the theory which I shall propound, and which will mainly have reference *to oxygen as an universal and recognized supporter of combustion and animal life,* without regard to its magnetic character, notwithstanding the obvious truth, that the other properties assigned to it are both important and interesting.

Atmospheric air is principally composed of two kinds of elastic fluid—the one discovered by Dr. Priestly in 1774, and then called by him dephlogisticated air, now known as oxygen gas; and about the same period, or rather anterior, Dr. Rutherford demonstrated the existence of an elastic fluid in atmospheric air, extinguishing flame and unfit for respiration; this is now known as azotic, or more recently, nitrogen gas. Small portions of hydrogen and carbonic acid gases, are also found, but these are minute in quantity, and may rather be regarded as accidents than essentials to its composition.

Oxygen gas is acknowledged to be the great agent in respiration and combustion; without it neither one process nor the other can be supported, and upon the existence of a proper proportion of this vital air depends the purity of the atmosphere and the maintenance of the health of mankind.

Azote or nitrogen gas is, on the contrary, incapable of supporting combustion, and rapidly destroys animal life. The proportions in which these gases unite, to form atmospheric air, is about 27 parts of oxygen to 73 of nitrogen or azotic gas by weight, and about 21 to 79 by bulk, or about *four fifths of nitrogen to one-fifth of oxygen by measure.* Thus, then, it will be perceived, that only one-fifth in quantity of what we call atmospheric air, is composed of the vital life-sustaining principle, and that four-fifths of the atmosphere consists of nitrogen, or the life-destroying principle.

These proportions however of two gases possessing such antagonist properties, compose the pure and balmy air which we breathe, the general effect of which is health; the diminution of the vital principle, or an admixture of noxious exhalations, such as carbonic acid or sulphuretted hydrogen gas, with the atmosphere, produces disease.

Oxygen and nitrogen do not combine chemically, but merely mechanically, each probably existing in its own perfect globule, each atom possessed of nearly the same specific gravity and bulk, though differing in proportions.

We can, therefore, the more readily understand the great facility with which oxygen may be abstracted from the atmosphere by any attractive influence, without any process of

decomposition of the atmosphere itself. The knowledge of this fact may greatly simplify the present inquiry; and the beauty and wisdom of such an arrangement of the Creator as that, by which so small a proportion of vital air, as one-fifth of the ambient atmosphere, is made to subserve all the ordinary purposes of man, will, I trust, be made conclusively evident before the close of this lecture.

Combustion has been defined "to be a process by which certain substances decompose oxygen gas, and suffer its caloric to escape in the state of sensible heat;" and Dr. Ure describes it as "the disengagement of heat and light which accompanies chemical combustion." The term combustible may be applied to all bodies capable of being burnt in atmospheric air or oxygen gas, and which, during the process of combustion, unite with oxygen, and thereby evolve caloric or heat—of these the principal are carbon and hydrogen. Common coal contains both these substances; its combustion, in the ordinary way, will therefore serve as a familiar illustration of the process adverted to.

The evolution of heat from a coal fire depends solely on a continuous supply of oxygen from the atmosphere; and although four-fifths of the whole amount of atmospheric air which enters an ordinary fire, is incapable, in an uncombined state, of aiding combustion;

yet such are the power and vitality of the remaining one-fifth of oxygen, and such its avidity for carbon, that no limit can, under ordinary circumstances, be assigned to the process which we call burning, but such as a deficiency of carbon, or other combustible matter may present.

By this process of burning, it may be observed, nothing whatever is really lost, but new modifications of the same ingredients take place; and the result of the union of oxygen and carbon, during combustion, is the production of carbonic acid gas, the natural food of plants, but speedily destructive of animal life.

Respiration, on which human life depends, will be found to exhibit in its process and results, *phenomena identical with those presented to us by ordinary combustion.* The same agents are in active operation, the same chemical changes and combinations are effected, and the same effects are produced.

Respiration commences with our existence, and cannot be suspended for any lengthened period during life. I have already noticed the composition of the atmosphere we breathe, and referred to the comparatively limited quantity of vital air or oxygen which it contains. I shall now point out more particularly *the functions which oxygen performs in relation to human life, and*

the manner, in which a sensible diminution of its quantity, directly operates to produce Asiatic Cholera.

It has been calculated that 48,000 cubic inches of air enter and pass out of the lungs in an hour, or 1,152,000 cubic inches in 24 hours. An adult makes about 20 inspirations in a minute, at each of which he inhales about 40 cubic inches of atmospheric air, and consumes about 32 *cubic inches of oxygen* in the same period, or in 24 hours about 46,080 cubic inches.

The surface of the lungs is said to be equal to the entire surface of the human body; but as only a limited quantity of the air which enters the lungs can, at one inspiration, come into contact with the surface, a large portion being required for inflation and its concomitant mechanical purposes, it will be obvious that a very minute quantity of oxygen, which is only one-fifth of its volume, can, at the moment of inspiration, perform the vital functions assigned to it.

Prior to the discovery of the circulation by Harvey, the motion of the blood was all that was known; and even on that subject nothing satisfactory could be advanced; and but for the light afforded by the facts which he revealed, I should not, in all probability, have been able to connect—with any degree of certainty, in relation to this subject—cause and effect.

It is now well known, that the blood, which has been carried by the arterial system from the heart to the extremities, and which has been returned to the heart by the veins, is thence again projected through the great pulmonary arteries into the lungs, there to undergo that change, and receive that propulsive power and vital influence, which are calculated to maintain the circulation, and sustain life and health.

The blood in the body of an adult is variously estimated—by a low computation it is supposed to weigh 28lbs., and about two ounces are said to be transmitted at each contraction of the ventricle into the pulmonary artery, to be subjected in the lungs to the revivifying influence of oxygen. The entire quantity of blood will therefore have to undergo this process between *twenty and thirty times at least every hour.* From this statement, the vast importance of a regular and abundant supply of the renewing and vital principle, on which the purification of the blood depends, will be self-evident, and require from me but little argument to enforce.

The blood which has traversed the system, and which acts as a medium of sustenance to the body, circulating incessantly to every part in succession, and conveying from one extremity to the other the nutriment extracted

from the food, is returned to the lungs loaded with, what I may call, its excrementitious matter, carbon and hydrogen; there, at every pulsation of the heart, and every inspiration of the atmosphere, to undergo a complete change of condition, by means of a chemical combination, or in other words, combustion.

I cannot readily adopt the opinion, that oxygen is actually taken up by the blood, for with the blood itself it does not come into contact, being always separated from it by a thin film. Haller estimates the thickness of the parietes of the air cells at about the thousandth part of an inch, the extreme ramifications of the pulmonary vessels being distributed on these parietes, so that the blood is almost in immediate contact. I am inclined to the belief, that oxygen acts on the blood, by instantaneously communicating to it that electrical power which it is said to possess, and which communicates vital heat and energy to the system.

Dr. Menzies ascertained that the blood, every time it passes through the lungs, gains more heat than is equivalent to one degree of Fahrenheit's thermometer; and Dr. Crawford, in the course of a series of experiments, found that blood contains a much greater quantity of absolute heat than the elementary substances of which it is composed. The heat thus obtained

by the decomposition of oxygen, is carried by the extreme vessels over the whole body, and *is the source of the uniform temperature so essential to health.*

The oxygen, which by contact with the thin pellicle covering the blood vessels, over the extensive surface of the lungs, has parted with its caloric, latent heat or electricity, to the blood, and which has in an instant, converted the dark venous blood into a brilliant red, will be found also to have combined with the carbon excreted by the lungs, and carbonic acid gas will be expired in proportion to the oxygen which has disappeared, furnishing incontrovertible evidence that perfect combustion has taken place, by the union of oxygen with the carbon of the blood.

From what has been stated, the vast importance of oxygen in the economy of human life will admit of no dispute, whether viewed as a simple agent in the ordinary process of combustion, or as the sole means of purifying and revivifying the corrupted and exhausted stream of life; but when, in addition to these uses, we discover that it contains the principle of vital heat or electricity, which is probably the life-giving and life-sustaining principle in man, then only do we begin to appreciate its almost illimitable power and wonderful adaptation to our wants.

The manner in which a deficiency of oxygen in the atmosphere may be occasioned, it is not necessary for me specifically to determine; but viewing this subject in relation to recent discoveries, it seems far from improbable that it arises from the earth becoming positively electrified, or possessing more than its natural quantity of electricity, and from the atmosphere containing less than its natural quantity, when it is said to be negatively electrified; and that oxygen, or its vital principle, disappears in the same proportion from the lower portion of the atmosphere surrounding the earth.

Since writing the preceding paragraph, I have seen a report of a lecture on the "Progress of Science," by Mr. Robert Hunt, of the Museum of Economic Geology, from which I extract the following statement, proving the magnetic intensity of the earth to be at its maximum in the present year:—

"In immediate connection with the physics of the solar disc, we have a somewhat remarkable proof, this year, of a speculation ventured by Sir William Herschel in 1801. Sir W. Herschel paid great attention to the dark spots on the sun's disc; and he was led to infer that those spots had some very close connection with the temperature of the earth. Struvé and several other continental astronomers have found by repeated observations, that the spots on the sun move in cycles of ten years; and that they reach their maximum and sink to their minimum in periods, respectively, of five years. And we also find that the mean

annual temperature of the earth is highest when the number of spots on the sun is at its maximum, and *vice versa*. In the present year *the number of spots on the sun is at its minimum;* and in our own climate the temperature has been below the average of our summers.—It is by means of Mr. Fox's dipping needle deflector that it has been determined, that the variations in the earth's magnetic force follow in direct relation to the number of spots on the sun's face:—that when the *number of spots is* greatest, then the *magnetic intensity is least;* and when it is at its *minimum*, then *the magnetic intensity of the earth is greatest.*"

Be the cause what it may, a sensible diminution of oxygen will have a direct tendency to retard combustion, which becomes slow and imperfect; and under its continued influence, a change will imperceptibly take place in the human body, which I venture to suggest as the first altered condition and true type of Asiatic Cholera, namely, *the loss of vital heat in the blood.*

In addition to the direct effects produced by such a deficiency, I am strongly inclined to believe, that as the atmosphere loses its oxygen it loses its electricity, and that gradually and insensibly, vital heat or electricity passes away from the surface of the body; and that under the depressing influence of this loss, many persons become prepared for the energetic action of the disease.

It would be erroneous, however, to suppose

that before such effects can be produced on the human system, the preceding causes must have been readily appreciable by their magnitude and universality,—precisely the contrary will be found to be the fact; and hence the fatal character of this insidious disease, which is heralded by causes unseen and unfelt, and therefore unheeded.

Taking the proportion of oxygen in the atmosphere at 21, and nitrogen at 79, it has been found by experiments that a candle begins to burn dimly when the proportion of oxygen is diminished from 21 per cent. to 18, and will be extinguished when the proportion falls to 16—and that consequences serious, if not instantly fatal, to animal life, may be produced by the loss of even this apparently inconsiderable proportion of vital air.

I conceive that what we call Asiatic Cholera may more properly be termed an altered condition of the body, resulting from the loss of vital heat in the blood, than what we usually denominate disease. This loss of vital heat in the blood I conclude to be the first change which takes place in the system, and which produces all the other unusual phenomena which have hitherto puzzled the medical world; indeed I may assert, without hesitation, that *but for the loss of vital heat in the blood, the distinguishing characteristics of Asiatic Cholera could not be*

exhibited; and it has long occasioned me surprise, that the observation of this fact did not induce a course of reasoning which should infallibly lead to the discovery of the cause.

I feel that had no experiments been instituted into the state of the atmosphere, and had no deficiency of oxygen been either proved, or suspected, to influence its condition, the discovery that *the blood had lost its vital heat and fluidity*—that the fire was nearly extinguished in the lungs, the furnace of the human body, and that *a dissolution* of the *constituents* of the *blood had taken place,* should have determined the pre-existent fact of a *deficiency of oxygen* as certainly as the perturbations of Uranus enabled my own countryman, Adams, to affirm the existence and position of the planet Neptune, before its actual presence in space had been demonstrated by the observations of the French astronomer Leverrier.

It is now generally known that the vomiting and purging, which prevail in cases of true Cholera, are occasioned by the saline and earthy constituents of the blood,which are contained in the serum or watery portion of the vital fluid, having exuded through the attenuated surface, or escaped from the minute terminations of the blood vessels into the stomach and intestines. The presence of such unfriendly agents in these regions is quite sufficient to account for the

violent efforts of nature to expel them; but no evidence is afforded, as we are informed, on *post mortem* examinations, of the presence of any active malignant poison, or even intestinal irritation, sufficient to account for death.

Now, it will be readily admitted by medical men, and easily understood by others, that no separation of the serum from the crassamentum, of the watery from the fibrin or cruor of the blood, can take place till the blood has been deprived of its usual standard of temperature.

Take an ordinary case of blood-letting from the arm. When the blood is first drawn, whatever may be its condition, it will be usually of the same colour and consistence, more or less red or purple, but uniform throughout, and shewing no tendency to the separation of its constituents. Mark its appearance during the process of cooling;—a thin yellowish fluid—the serum or watery part of the blood—covers the surface of the vessel, the coagulum—the crassamentum of the blood—by its greater specific gravity, descends to the bottom. Pour off the serum from the vessel, and you will perceive that the residuum is in a condition much better calculated to make an elastic ball, or to serve as a base for a pigment, than to circulate through the beautiful, elaborate, and minute blood vessels of the human body; in fact it will be obvious that it is reduced to a condition which renders it utterly impossible

for it to subserve those beneficent purposes in the human economy which the circulation of the blood in man was intended to effect.

Almost identical will be the effects produced by Asiatic Cholera, except that in Cholera the fibrinous portion of the blood remaining in the veins, will be in a far worse and more unhealthy condition than I have supposed in the other case, because, for *want of a due supply of oxygen*, not only will the blood not have carried back from the lungs *the vital heat requisite to the maintenance of its fluidity*, but it will be returned by each pulsation with its carbon unconsumed, its venous character unchanged, and vitiating, instead of purifying, in its progress through the system.

The blood having, from the causes I have indicated, *lost its vital heat*, the minute vessels, those channels of distribution which have their termination in the stomach and intestines, lose their elasticity and contractile power, the surface of those vessels becomes relaxed, the mouths dilate, and the watery portion of the vital current passes away, leaving nothing but the highly deteriorated and thickened crassamentum. How often do we hear that pulsation had nearly ceased in the patient when medical aid came? It is much more difficult to comprehend how, under the unparalleled circumstances of such a case, pulsation could continue; the rice water

evacuations having drained the blood vessels of the fluid portion of the blood, and left in them only a deposit of stagnant coagulated matter.

The other obvious symptoms of true Cholera usually presented were the cold breath, the cramped bowels and extremities, the leaden hue, and the cold collapsed surface.

The whole of these effects, are, I conceive, perfectly reconcileable with the theory of the cause which I have advanced, and the leaden hue and collapsed surface may be easily explained.

While the serum of the blood is gradually oozing away into the intestines, a drain is occasioned on the blood vessels extending throughout every part of the body, which become gradually emptied of that portion of *the blood which has become fluid, as I have explained, by loss of heat;* this exhaustion takes place beyond the reach of atmospheric influence, and by this unnatural secretion a partial vacuum will be formed in the blood vessels, which the pressure of the atmosphere speedily overcomes; the vessels with the purple venous blood become thereby more prominent and distinct, and in contrast with the pallor of the icy surface, presents a general leaden hue. Unless these fearful symptoms be promptly and vigorously counteracted, death must ensue from mere congestion, and the gradual suspension of all the functions of life.

I am aware that, in some severe cases of Cholera, there is great and sudden prostration of nervous energy, and that some medical men are of opinion that the brain is therefore the primary seat of the attack; but may not the same results be produced by the operation of the causes I have referred to—producing stagnation of the blood, even where no vomiting or purging have appeared, and as a natural consequence the suspension or prostration of the functions of the nervous system, as certainly, and almost as rapidly, as though life itself were extinguished?

May not Cholera, therefore, be more rationally accounted for upon the principle I have suggested, than by referring its cause to some subtle poison or mysterious agency, the action of which upon the human system is unknown, and thus leaving its mode of treatment to be determined by the caprice or temerity of the practitioner?

If I have succeeded in convincing you that the *separation and loss of the serum of the blood is the result of the loss of vital heat in the blood; that such loss of vital heat is occasioned by slow and imperfect combustion, arising from a deficiency of oxygen in the atmosphere, and that such deficiency has been proved to exist;* then I shall have accomplished all I anticipated on this part of the subject, and have determined the first important question which I had proposed to discuss—*The probable Cause of Cholera.*

That the visitation may be, as some suppose, a direct infliction of Providence upon the nation, no one can question; but the infliction, on these hypotheses, is not the result of an insidious poison disseminated throughout the atmosphere, but the effect of withholding from us a portion of that vital principle which gives food to our lungs, and is requisite to support the fluidity of the blood, and the heat of the body.

Regarded in this light, it may be easily understood why the ravages of Cholera are first and so severely manifested in filthy, ill-drained, crowded, and ill-ventilated courts and alleys, without referring its production or propagation to any subtle poison or mysterious agency. The unfortunate inhabitants of such localities constantly breathe an atmosphere seldom diluted by a pure stream of the balmy air, which alone can maintain us in robust health, and surrounded by offensive vapours, reeking exhalations, and noxious gases, which rapidly deteriorate the diminished stock of vital air, fall ready victims to a disease which destroys thousands of lives in other walks of life, where such active auxiliaries are not in visible operation.

Having determined in my own mind the probable cause of Cholera, I come next to the consideration of the still more important question—*The probable Cure!*

I could not fail to perceive, that a disease, which often terminated fatally in a few hours, was not to be controlled by any ordinary and experimental mode of treatment,—that a multitude of cases baffled all the resources of medical skill; and that frequently before medicines administered by the mouth,could,in the ordinary course, produce any effect upon the system, death had closed the scene.

In many cases, too, medicine could only produce the effects intended by diffusion through the system by the agency of certain absorbents; and it is quite obvious that the absorbent power had often ceased before medicines could be administered, and all the remaining energies of nature were insufficient to stay the rapid ebb of the vital current.

I speedily arrived at the conclusion, that except in the incipient stage of Cholera, before the disease has actually developed its fearful characteristics, medicines introduced into the stomach were useless. I became disinclined to regard Cholera as a question solely within the purview of the medical world. I believedthen, as I believe now, that *the cure is a question purely of chemical combination*—I felt that the disease, if disease it must be called, was one which has its main origin in the lungs, and that the remedy, to be effective and permanent, must be applied to the expanded surface of these organs, and

not to the contracted coats of the stomach; and that any remedy, worthy of the name, must be rapid, if not instantaneous, in its operation.

Now, I hope, will be seen the beneficence and wisdom of the Creator, to which I have before adverted, in that remarkable arrangement by which one-fifth of oxygen, diluted with four-fifths of nitrogen or poison, is made to subserve all the purposes of animal life, and constitutes the atmosphere we breathe. Were the atmosphere composed wholly of oxygen, and man capable of constantly breathing such an exciting fluid, we should have been deprived of those reserved forces which are now available in great emergencies; and the stimuli which are required to counteract disease, and restore the otherwise weakened or exhausted organs to a state of health, would not have been within our reach.

Combustion in the lungs, in Cholera, will be found, as I have stated, to have become slow and imperfect, from an inadequate supply of the vital air necessary to its support—diminished quantities of vital heat will be evolved; the carbon and hydrogen will have returned to the heart unchanged, until in the later stages of the disease, in common phraseology, "the fire goes out," and the patient dies.

It will be obvious that in such cases of rapid exhaustion of vital energy, the fire of life must be speedily rekindled, or the last lingering

spark will have expired. Now there is not a power in nature which can accomplish this object with the same certainty, and as instantaneously, as oxygen gas.

Conceive for an instant the effect of a full inspiration of oxygen gas into the lungs of a Cholera patient in a state of partial collapse—40 cubic inches of oxygen displacing 40 cubic inches of atmospheric air, which atmospheric air, in a state of purity, contained only eight cubic inches of oxygen, but in its deteriorated state not sufficient to support animal life;—conceive then, I say, the effect of a dose of oxygen presented to the immense surface of the lungs—a surface, as I have stated, equal to the entire surface of the human body; and imagine that there are passing under its influence through the minute vessels, almost in immediate contact, only about two ounces of blood, at each pulsation, spread over this great surface, and that that blood contains, in superabundance, matter of the most inflammable kind—carbon and hydrogen—*needing nothing for its instantaneous combustion but the presence of that oxygen;* and you will be led to conclude that the fire will be instantly rekindled—that the circulation of the blood will be vigorously renewed, and that vital heat will once more, as with a lightning flash, pervade the system.

Pure oxygen gas, "which possesses the property of accelerating the circulation of all the

animal fluids—which occasions the most rapid combustion of all combustible substances, and which is the most energetic and powerful agent with which we are acquainted," *is the remedy which I propose for Asiatic Cholera !*

Oxygen gas may be inhaled for a considerable period with perfect impunity, even by a person in health ; the only effect being to rapidly increase the pulse and of course the circulation. This could not be continued for an indefinite period, because carbon and hydrogen would not be extracted from our food in sufficient quantities to keep up the excessive combustion, and nature would sink for lack of combustible material ; for such are the extraordinary power and energy of oxygen gas, that if a lighted candle be immersed in it, the splendour is greater than the eye can endure.

Dr. James Mackintosh, of St. Olave's Infirmary, Southwark, in a letter on the subject of Cholera, published in the *Times* on the 7th of October, 1853, states—

"In cases of deep collapse it appears to me that the circulation is so feeble and the blood in such a viscid state that the process of nutrition fails ; and as a consequence that substances introduced into the alimentary canal are neither taken up by the lacteals nor veins ; and if they are, it is in such small quantities as to be attended by no good result.

"It is an important fact to observe that the blood has been found viscid in a state resembling tar in consistence.

and appearance, in all *post mortem* examinations of fatal cases of Cholera. A condition of the blood of such general occurrence must be of the highest importance in the treatment of Cholera, for until this anomalous state of the nutritive fluid is corrected, it is reasonable to suppose that remedies introduced into the alimentary canal must prove inert.

"The extraordinary results obtained by the introduction of saline solutions into the veins in cases of collapse, serve to support this view of the treatment of Cholera as a reasonable one; for while all remedies introduced into the alimentary canal had signally failed in bringing about reaction in the deepest cases of collapse, this almost invariably succeeded in doing so; but unfortunately, this favourable result was not permanent, the patient generally relapsing into his former state of collapse after a certain time.

"The problem then, that remains to be solved, is how to make the reaction thus obtained permanent."

Is it possible to read language of greater interest, or in truth of deeper despondency, from medical authority, than this?—the same routine of experiment upon experiment, and the same confession of the utter hopelessness of all known modes of treatment in extreme cases. If, as the writer states, "the problem that remains to be solved, is how to make the reaction permanent," then I confidently reply, administer the essential principle of life, oxygen gas, and the reaction will be obtained, and that reaction will be permanent. Does not the condition of the blood, described as resembling tar

in consistence and appearance, unquestionably demonstrate the existence of unconsumed carbon and hydrogen, returned to the heart, and ultimately choking up the avenues of life?

There may be cases which require injection into the blood-vessels, in order to give the patient a chance of recovery, where the disease has nearly run its course; this is not a question for me to determine; but the rapid combustion which would take place in the lungs, in the earlier or later stages of the disease, by the inhalation of pure oxygen gas, would speedily restore the fluidity of the blood, and in my opinion, in most cases, render such accessories as saline injections totally unnecessary.

Probably by this time the inquiry, "How are we to obtain oxygen gas?" is ready to be made by some who have followed me through the course of these observations. There is no difficulty in procuring the remedy to any extent, and at little cost; large stores of oxygen having been provided by nature, combined with other substances. It is found in great abundance in manganese and in nitre, but the black oxide of manganese approaches nearest to a perfect oxide of any substance with which we are acquainted, and contains about 57 parts of oxygen to every 100 of manganese. It is only necessary to pulverise the manganese and heat it to a white heat in an iron retort; the gas in great

quantity may be collected in gas holders, or any appropriate vessels, and secured in bladders. One pound of manganese will furnish about ten gallons of this gas, and if strong sulphuric acid be used with the manganese during the process, less heat will be required to produce the gas. Manufacturing chemists will, however, readily supply any quantity of oxygen gas which can possibly be required.

I have now exhibited what I consider to be the true cause and rational cure of Cholera, and I may add, that *I am not without evidence of the efficiency of the means of cure recommended*; but I desire to have the theory I have propounded tested by the validity of the reasoning, and not supported merely by the adventitious aid of incidental cases.

A word or two, before I conclude, on remedial measures and preventive agencies; and first I would observe, that as during the prevalence of Cholera much of our *vital heat, or electricity*, probably passes away from the body insensibly—and we thus become unconsciously liable to, and prepared for, the full development of the disease—substances which are known to be non-conductors of heat and electricity, such as flannel or silk, should be worn as the article of clothing next the skin.

In illustration of the value of such protective means, I may state, it was re-

marked as a circumstance of interest, that among the numerous victims of Cholera in the City of Constantinople, during the prevalence of the epidemic there, one class of labourers, the oil porters, experienced entire immunity from the disease, not a single death having occurred among them. This result was attributed to the complete saturation of their clothes with oil, which rendered their garments non-conductors of heat and electricity.

The question of food I leave to the medical profession to regulate, except to recommend the most nutritious food, and richest in hydrogen; and that all cold, watery, and indigestible food should be avoided.

I am pleased to observe that some medical men, instead of prohibiting the use of cold water by their patients, as they too frequently have done, now permit its use "*ad libitum.*" Were anything wanting to satisfy my own mind that a deficiency of oxygen, and incomplete combustion resulting therefrom, is the cause of Cholera, I should find that theory amply confirmed by the evidence of recovery from collapse in Cholera, in many cases, by the simple agency of cold water alone, drunk in excessive quantities.

A member of the Society of Friends informed me, a few weeks since, that a person at Exeter, who had a very severe attack of Cholera

during the epidemic, in 1849, resolutely determined to allay his intense thirst by drinking cold water,—that he drank 32 gallons, and was speedily restored to health. A similar case in the same year occurred at Modbury, in Devonshire. The following I have extracted from the Registrar's Report in the *Times* Newspaper of the 12th October in the present year—

"Bermondsey, St. James."

"Mr. Martin, the Registrar," having mentioned a particular case, stated—"In the same house I attended a woman this day fortnight; she was collapsed for some hours—during the day, she drank 16 quarts of cold water, and is now quite well."

In neither of these cases does the obvious cause of the recovery appear to have been discerned by the narrator. Nature herself had indicated the means of recovering that vital heat, which could no longer be obtained from the deteriorated atmosphere, although by a process far less direct. Water, which contains nearly nine-tenths of oxygen and about one-tenth of hydrogen, might not only, to a great degree, compensate the loss of the serum by gradual absorption, but as long as the system retained sufficient power to decompose it, would yield the largest amount of vital heat in the form of oxgyen to be obtained from any fluid, as well as a supply of hydrogen necessary to support combustion. The great value of pure water, as a remedial

agent, will therefore be readily understood; and additional evidence is thus furnished of the power of oxygen, in every form, as a remedy for Asiatic Cholera.

The vapour bath would doubtless be of great efficacy in many cases, if readily available, where oxygen gas is not at hand, but not as it is too frequently administered, to the surface of the body only; let the patient, while the body is immersed, breathe no other atmosphere than the vapour of water at a temperature varying from 100 to 110 degrees of Fahrenheit, and the rapidly increased pulsation will speedily give evidence of renewed vigour in the circulation.

I fear too much stress is laid on the value of the washing and purifying processes, adopted frequently in localities where misery, filth, and disease are found; and that in some cases the disease intended to be averted, is actually invited and disseminated. I conceive that fire will be found a much more valuable auxiliary, in the process of purification, than water, in a multitude of instances; and wherever Cholera appears, I should recommend a fire to be kindled in every apartment; not only pure, but all impure air and noxious gases, will rush into the vacuum which the burning produces, and a fresh atmosphere will be the result.

In crowded courts and alleys, where the disease prevails, fires might be made in the street,

or in the adjoining yards, and all the doors and windows of the surrounding houses should be thrown open, to exhaust the polluted, and obtain a renewed atmosphere. Oxygen gas might also be introduced into the apartments of the sick.

Although there is no specific poison of Cholera, this important fact should constantly be borne in mind—that impurities, of any and every kind, generate gases which diminish the vital influence in the atmosphere with which we are surrounded, and tend directly to the propagation of Cholera, or whatever other disease is epidemic. And it should also *be remembered—at all times, and under all circumstances—that health depends much less on what we eat, than on what we breathe.*

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