HODG: CHOLERA MALIGNA

ESSAY

ON THE

PATHOLOGY AND THERAPEUTICS

OF

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BY

HUGH L. HODGE, M. D.

MEMBER OF THE AMERICAN PHILOSOPHICAL SOCIETY, &c.

[Extracted from the American Journal of the Medical Sciences, for August, 1833.]

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PREFACE.

"A PUBLICATION is not rendered improper or needless, because works of a similar nature have preceded it. Little would ever issue from the press if this principle were admitted." Thus writes an eminent and modest author, whose works have proved of great utility. So much however has been written on epidemic cholera, that the subject seems to be exhausted, and the public mind to be almost satiated. The fact, nevertheless, must be acknowledged, that although this disease has been investigated by the most eminent physicians in Asia, Europe, and America, and although it has been treated by every conceivable variety of empyrical effort, yet the pathology of cholera, and of course the principles of treatment, are not established.

This being the case, publications should be multiplied. Every individual who, by observation or reflexion, has attained a result, even on one point of pathology or practice, satisfactory to himself, should cast such result before the public to assist, if possible, in elucidating the pathology and therapeutics of an epidemic, which in its desolating course from east to west—from the Ganges to the Mississippi—has set at nought, not only the dogmas of the schools, but also much that was venerated and trusted in medical science. The charge of vanity, or of the affectation of superiority, should not therefore be urged against any new recorder of facts or opinions. The minds of men differ as much as their physiognomies, and every man who is capable of independent reflexion will stamp the character of his own mind on his writings, and may thus facilitate the onward path of science.

Under the influence of these opinions, I would publish, even on so trite a subject as cholera maligna, the result of personal observations on this epidemic. The chief object will be, by analyzing the incipient and confirmed symptoms of the disease, to determine the true pathology of cholera maligna, so denominated, and thence to deduce scientific principles for its management. "Experientia docet"—experience must be the test of all pathological doctrines. To say that the pathology is true, but the practice necessarily resulting is injurious, is absurd—as such admission would destroy the very object of pathology, and paralyze the efforts of every medical philosopher: for what advantage can accrue should the nature of a disease be firmly established by the laborious investigation of the anatomical arrangements

and physiological state and functions of the part affected—of the symptoms which characterize its morbid state, and the changes evinced by the knife of the dissector, if, after all, the therapeutical precepts deduced from it cannot be conveyed to the bed-side? On the contrary, if the principles resulting from such scientific investigations will stand the test of experience, the advantages resulting to the profession and to the public, are immense. Not only will a suitable class of remedies be designated, but the appropriate time and circumstances under which each agent should be employed will appear, while the circumscribed boundaries of mere experimental knowledge will be almost indefinitely enlarged. One principle is worth a thousand facts. A principle is indeed nothing more than a general fact, which, resulting itself from individual facts, is the prolific parent of an innumerable progeny.

My opportunities for observing cholera have been as varied as that of most practitioners of this city. In the spring of 1819, I had charge of several cases of the disease in Calcutta, India, among the native Hindoos and the American sailors, being the vestiges of the desolating epidemic of 1817–18. On the breaking out of the epidemic in this city, I prescribed for the first cases at the Alms-house Infirmary with every facility for post mortem examinations, which were always made. Subsequently I took charge of the City Cholera Hospital, No. 4, and was during the whole epidemic constantly and actively engaged in private practice. From these sources, the varieties of the disease, arising from location, natural temperaments, morbid predispositions, depraved habits, and complications with other disorders, have been often observed, and thus sufficient data been afforded for analyzing the symptoms of cholera, and separating those which are peculiar, from those which it has in common with other complaints. In giving this analysis and its results, no claim is made for strict originality, but the hope is entertained, that truth will, in some respects, be elicited, and the cause of humanity benefited. Believing that this disease essentially resembles many with which the profession are familiar, and that it can be managed in a rational scientific manner, with as much prospect of success as any analogous complaint of a malignant aspect, no just reason can be discovered for abandoning the principles of medicine, or for confiding in the wild and contradictory assertions of empiricism.

ESSAY, *&c.*

AS the object of this essay is to indicate principles for the treatment of cholera, deduced from its *pathology;* and as its pathology must be established by a careful examination of its characteristic symptoms, and of its effects as exhibited by post mortem investigations, a detail of facts becomes necessary as a basis of subsequent reasoning. But certain general propositions must be previously stated respecting disease in general, that the following observations may be at least understood, even if they should not be approved or adopted.

It may be proper to disclaim all belief in *ontology*, as it has been termed by the BROUSSAIS school, that is, in the idea that disease is an *entity*—a being—a something added to the system. This is a notion which, I doubt, few physicians of respectability have ever entertained, although it has of late years been the subject of severe sarcasm. On the contrary, disease is virtually disorder, an alteration of the natural state or actions of the tissues or organs of the economy. A knowledge, therefore, of the natural state or actions of parts, in other words, of physiology, is requisite for understanding their morbid condition. Physiology demands a minute acquaintance with the structure of the body. Anatomy and physiology are therefore the true foundation upon which pathology can alone rest. Unfortunately, these sciences, especially physiology, are still imperfect, and hence there are various and honest differences as to subjects of fundamental importance.

That the expressions hereafter employed may be understood in the precise sense intended, I would remark, that, agreeably to BICHAT'S arrangement, the body is regarded as composed of organs, and these of tissues. The nervous, vascular, and absorbent tissues may be called general tissues, as entering into the composition of all organized portions of the body—the nervous being of two kinds, ganglionic and cerebro-spinal, each distinct and peculiar, but intimately connected by communicating branches. It is believed, that there is but one vital property, viz. *irritability*, or the capability of receiving impressions, of being acted on; and that the evidences or manifestations of this property vary in different tissues—some presenting the phenomena of contraction, as the muscles; others of expansion, as the iris, nipple, &c.; and others, of sensation, as the nerves; hence we

speak of contractility, expansibility, and sensibility, which are merely irritability modified by tissue.

Every tissue maintains its own peculiar vital susceptibilities in all its various combinations in the different organs; a remark peculiarly applicable to the general tissues, necessary for organization, as nerves, blood-vessels, and absorbents. Hence irritations of these tissues present analogous phenomena in all the organs; when severe they often involve the whole economy, forming what are termed general or constitutional diseases, as contradistinguished from similar affections, involving but a portion, often a minute portion of a tissue; thus we observe *general*, as well as local, nervous or vascular diseases.

There is great truth and value in the division of life, as it regards its phenomena, (for of life we know nothing,) into *organic* and *animal*, as has been happily conceived by Bichat. Organic life, as it is summarily termed, having respect to the changes which occur alike in all animated beings, vegetables and animals, such as circulation, respiration, nutrition, secretion, and absorption; while animal life, or the life of relation, is peculiar to animals, and distinguishes them from vegetables: its phenomena are those of sensation, perception, motion, volition, &c. The phenomena of animal life depend solely on the cerebro-spinal system of nerves; those of organic life on the vascular system, (perhaps on the ganglionic system of nerves;) hence every part of the body, not excepting the brain and nerves, is the subject of organic life and its peculiar diseases, while the brain and its dependencies alone manifest the disorders of animal life.

The functions of the two lives are, from the anatomical arrangements of the nerves and blood-vessels, necessarily most intimately connected—as any disturbance of the circulation in the brain must affect the medullary mass; and nervous excitations or depressions have more or less influence over the vascular system, as the experience of every individual can testify. Hence these general systems—the nervous and vascular tissues—the representatives of organic and animal life—are usually simultaneously and similarly deranged. In many cases, however, they are observed in very opposite conditions; great depression of organic life, with a natural or excited condition of animal life, and sometimes dulness, stupor even of the brain when the general and local circulation is apparently undisturbed. This singular fact, evincing the partial independence of the brain and nerves on the vascular system occurs, there is reason to believe, very frequently, but has been exceedingly overlooked by pathologists. It no doubt will aid exceedingly in reconciling many apparent contradictions in the reports of experienced physicians respecting the treatment of diseases. The circumstances under which these opposite

conditions of the nervous and vascular apparatuses occur, have not been accurately pointed out, nor their causes detailed, but they are frequently seen in all the variety of neurotic diseases, are almost essential to the existence of mania a potu, and, I have no doubt, form one of the leading peculiarities of cholera maligna, attention to which is of the utmost importance, and the neglect of which has been the cause of much of the disappointment and failure so generally experienced in its management, as will hereafter be exemplified.

The tissues thus endowed with irritability can be acted on by external or internal causes, which may be arranged under two general divisions—*irritants* and *sedatives*, or those agents which excite, and those which depress vital phenomena. Irritants acting on the irritability of a tissue cause irritation; sedatives cause sedation; the former being of course a state of excitation, the latter a state of depression; and hence directly opposed to each other.

Irritation and sedation should always, when possible, be distinguished from two other conditions with which they are almost universally confounded; viz. strength and weakness.* Strength and weakness have reference to an increase or diminution of power; irritation and sedation to similar changes of excitement or action. Irritation often exists where there is great debility, and sedation is continually noticed where the strength is very great. An individual greatly debilitated by hæmorrhage may have a high fever; a strong man may be torpid from exposure to cold.

Another remark is of importance, that states of irritation or sedation, owing to peculiar laws of the economy, are often secondary, not directly resulting from the original cause; thus febrile irritation does sometimes succeed great abstinence or profuse hæmorrhages; reäction after these depressing causes. On the contrary, great torpor, *i. e.* extreme sedation, is often induced by excessive excitement; thus gangrene may follow inflammation; prostration may be the consequence of fever. Analogous to this, is immediate depression or sedation from an overwhelming irritant, as the prostration which results from extensive burns, from gun-shot wounds, or other severe contusions.

Irritation or sedation of the blood-vessels necessarily involves changes in the circulation; of themselves important and at the same time aggravating existing phenomena.

"*Ubi irritatio ibi affluxus*" is now an axiom in medicine, and always true if irritation be restricted to organic life, but if extended to the organs of animal life will very frequently prove deceptive. Irrita-

* Vide American Journal of Medical Sciences, Vol. X. p. 93, for the author's views on this subject.

tion increases not only the flow of blood to a part, but also its transit and exit from the same part. There is every evidence of increased circulation derived from the bright arterial colour, the heat, the increased secretions, the enlargement of the supplying vessels, and also of the veins carrying away the blood.*

On the contrary, sedation is marked by decided evidence of a diminished circulation; the part becomes cold, blue, or livid; the vasa afferentia and vasa efferentia are diminished in size and activity, and there is a diminution or suppression of the natural secretions. As a certain degree of tension and firmness exist where there is irritation and a rapid circulation, so sedation and a diminished circulation render a part soft, doughy, inelastic. Should the sedation occur suddenly, some blood may be arrested in the smaller vessels, at least for a time, increasing the lividity of the surface; but this is comparatively rare externally. Internally this collection of blood is common; the veins especially become turgid with dark grumous blood, sometimes to an enormous degree, oppressing the already torpid organs, and often preventing their natural efforts to reäct. These are *passive congestions* of blood, in which the fluid is arrested *in* a part, and not actively determined *to* a part, as in the case of irritations; for in these last, the blood would be bright, well arterialized; the pulse active; the organic actions increased, &c. These are *active congestions*. The consequences of active congestions are well known, but those of passive congestion have been less noticed, and of course less understood. We usually observe serous or bloody effusions, (not secretions,) venous hæmorrhages or complete stagnation of the blood, and consequent death. Examples are numerous in the influence of severe cold on the internal viscera; in gangrene; in the cold stage of intermittents; in malignant forms of fever, indeed in malignant diseases generally; in many convulsive affections, &c. In all cases there is diminution of vital heat, a livid condition of the parts, diminution of force and frequency of pulse, and a partial or complete stagnation of the circulating fluid.

There is also a remarkable contrast in the condition of the blood in active and passive congestions, (a very positive proof of their essential opposition.) Active determination of fluids to a part is almost universally accompanied by a florid, highly arterialized, or vitalized state of the blood, which, when effused, coagulates firmly; the coagulum retaining the red globules, and expressing an abundant and pure serum. In well-marked cases, the phenomena characterizing inflammatory blood are noticed, such as the firm coagulum, its cupped form, adapted to the shape of the vessel, the buffy coat, &c. Passive con-

* Vide North American Medical and Surgical Journal, Vol. VI. p. 23 and 34.

gestions present us a dark-livid "venous" blood. In some cases, this blood, when effused, forms a soft coagulum of large size; the coagulum retaining much of the serum, but often suffering the red globules to escape, so as to give the whole separated serum a reddish tinge. It sometimes happens that the coagulation hardly occurs; the blood is excessively black; little separation occurs between the constituent parts; the serous or thinner portions being livid or black, from retaining the colouring matter of the blood, while this colouring matter itself no longer consists of *globules*, for these seem to be broken down or destroyed. This constitutes the "dissolved blood" of authors.

One important remark should be subjoined, which explains why the state of sedation and congestion has been so frequently denied to exist, and all its phenomena referred to irritation, viz.—the complication of active and passive congestion in the same case. It not unfrequently happens that when a passive congestion is induced, irritants are subsequently applied to portions of a tissue so circumstanced; or even prior local irritations may exist, by which blood is determined actively to the same tissue, greatly enhancing the dangers of the case, and demanding the most energetic measures for the safety of the patient. Examples we shall have occasion to give, but would now mention the cold stage of fever complicated with abdominal inflammations; passive congestion of the lungs complicated with bronchitis, or pneumonia, as often seen in asthma; convulsions with passive congestion, aggravated by the administration of stimuli, &c. *Post mortem* examinations will evince the alterations from inflammation, while the indications of passive congestion have often disappeared; hence the morbid anatomists seem justified in referring the phenomena, during life, to active, rather than passive congestion, without reflecting on the severity of the preceding disease, and the comparatively trifling evidences of inflammation.

The above views may seem trite to many, and novel to others; by some they would no doubt be disputed, but on appeal to clinical observation, I think they will be found substantially correct, and also in accordance with the common experience of the profession. Should this be the case, there will be a solid foundation for the division of diseases into two great classes—those caused by irritants and those by sedatives—diseases of *irritation* and those of *sedation*. Each of these may be complicated with each other, be modified by the innumerable variety of causes, (for no two agents produce precisely the same effects,) by temperaments, constitutions, habits, strength, age,

sex, climate, locations, and various other general agents, and especially by the organs and tissues primarily or secondarily affected. Divisions and subdivisions may hence be greatly multiplied; nevertheless, a careful philosophical analysis will, I believe, lead us to the above simplification of diseased actions.

Diseases of irritation (of organic life) involve active determination of fluids to a part, or induce general vascular excitement; hence active hæmorrhages, acute dropsies, inflammations, febrile affections, &c.

Diseases of *sedation* are accompanied by passive collections of blood, (the retention of fluids in a part;) hence passive hæmorrhages and effusions, the various congestive forms of disease, and all the varieties of malignant diseases. But, as already intimated, we seldom in practice meet with simple forms of disease; diseases of irritation and sedation are continually complicated, one with the other, and modified by various circumstances. Still the essential predominance of one class of actions can be almost always detected, affording a foundation for appropriate treatment, to be regulated according to the peculiarities of the case.

The treatment of diseases of irritation is by sedative measures—those which diminish action, whether by a direct or indirect influence on the part concerned. They need not be particularized, as they are recognised by every one under the title of antiphlogistic remedies.

The treatment of diseases of sedation is by stimuli, local or general. These, by exciting the organic actions, not only counteract the causes of depression, but also the disposition to passive congestion with its unpleasant consequences. Should stimuli alone not be adequate for this purpose, much science and judgment will be demanded in endeavouring, by more direct methods, to unload the congested vessels that reäction may ensue. Hence in moderate cases, little difficulty is experienced, but in the severer forms of sedative and congestive diseases, the most judicious and experienced practitioner, regulated by the best medical principles, cannot always command success; nevertheless he will often triumph under the most untoward circumstances, as changes of structure and disorganization seldom occur in diseases of sedation unless complicated with irritation in particular tissues. The details of this practice will be given when speaking of the management of cholera maligna; a disease which, I shall endeavour to prove, is essentially one of sedation of organic life, with irritation of the cerebro-spinal system of nerves, (animal life.)

In the preceding observations having stated, without intending at present to defend the pathological principles involved in the follow-

ing investigation, a statement of the phenomena of cholera maligna, as observed by the author, will be made as the foundation of future reasoning.

Respecting the *causes* of cholera maligna, I have few observations to make. They may, for practical purposes, be divided into general and local; the former embracing the epidemic influences which are essential to its prevalence, the latter the peculiar circumstances which facilitate its development in certain places and in particular individuals.

Of the essential or epidemic cause we know very little respecting its source, nature, or modus operandi. From its history, which has been so frequently detailed, we may assert that it does not exist as an ingredient or component part of the atmosphere, but as a separate and independent agent. Its influences, however they may have been modified, have not been controlled by the heats of Hindostan, or the rigors of a Russian winter, nor successfully opposed by the seasons of the year—by winds, however regular or powerful, by forests, mountains, deserts, or oceans. They have defied, not only these natural barriers to the progress of pestilence, but every restraint suggested by science or presented by experience. The independence of this agent on the atmosphere has been exhibited, not only by the history of its progress from country to country, but by its apparent fickleness in every district it has invaded, not affecting all portions at once, or in regular succession, as the atmospherical variations of temperature, but like the thunder-storm or the whirlwind, pouring its destructive influences on devoted spots, while all around may be tranquil and safe. When prevalent in a given place, few escape its influence, but experience demonstrates, that *local* causes greatly favour its appearance and its ravages. These local or particular causes have reference to external circumstances, and also to the peculiar temperaments, constitutions, habits, &c. of individuals. They need not now be particularized, as they are noticed by most of the writers on cholera maligna, and are the foundation of all the sanatary measures for cities and individuals, which have been so successfully employed in most districts of our country. "Avoid exciting causes" has been the universal and important admonition under the supposition that all were predisposed by the general cause which gave character to the subsequent affection.

Although thus ignorant of the origin of the epidemic, and of the laws regulating its progress, we may determine to which of the two great classes of causes, irritants or sedatives, it belongs, by examining its effects on the animal system. To accomplish this object most

effectually, the influence of the epidemic must be detected as early as possible, and be traced through the different stages of the complaint to recovery or death; thus, light may be thrown not only on the character of the cause, but on the nature or pathology of cholera.

The influence of the epidemic cause on the animal system may be advantageously considered under five general heads; the 1st, including the precursory symptoms; the 2d, the symptoms of the first or active stage; 3d, those of the second, or collapsed stage; 4th, those of reäction, constituting the third stage; and 5th, the appearances on dissection.

1st. *The precursory symptoms* vary exceedingly in different individuals, whose temperaments, constitutions, and habits, do not correspond. In general, they are those of oppression, with some nervous disturbance. The individual is easily fatigued; he complains of a general unpleasant feeling, (malaise,) with sensations of fulness about the head, chest, but especially of the abdomen, which seems to be enlarged. A little exertion may induce a palpitation of the heart, or oppression of breathing; there is often giddiness, dulness of intellectual faculties; appetite is impaired, and food taken oppresses and disturbs the viscera. Bowels are torpid; frequently a diarrhœa or dysentery supervene; the discharges, although often containing feculent matter, are of a light colour, sometimes pale-yellow, grayish, or even whitish at this early period. The surface of the body is paler, but of a darker hue than natural, as also the lips and tongue; there is less urine secreted; there is a coolness and clamminess of the skin, and some slight sensations of rigors, at least these are easily excited by a draught of air, and by placing the feet on a cold surface. The pulse is almost always slow, sometimes soft and full, at other times contracted and slightly tense, forming the oppressed pulse of authors. Should blood be drawn, it will be observed darker than on ordinary occasions; the coagulum will be large, soft, and the apparent proportion of serum small. The patient has often irregular pains in the back and limbs, but complains especially at night of occasional cramps in the extremities, particularly in the calves of the legs; the parts remaining tender on pressure. He is easily agitated or alarmed.

These precursory symptoms, known by the term "cholerine," vary in duration from a few hours to several days; often they are never observed; the decided symptoms of cholera appearing at once—no dysentery or diarrhœa even preceding the attack. Hundreds, indeed thousands have been affected by them without any further evidence of disease, and it perhaps may be safely asserted, that ordinary prudence with judicious directions will usually prevent the

development of the complaint. But this is not always exercised, hence we often have—

2d. The symptoms of the *first stage of cholera.*—The attack of cholera is usually sudden, and varies, as to what is apparently the first symptom, in different individuals. Perhaps in most cases, there is a profuse discharge of a grayish or whitish fluid from the rectum; the patient is much distressed without positive pain, and has often nausea and sometimes vomiting. The first evacuations per rectum, are often mingled with feculent matter, but still of a light colour; afterwards they become thinner, having the appearance usually of oat-meal gruel, consisting of a serous fluid filled with a flocculent matter of some slight consistence. Afterwards the discharge becomes more watery, and seems, in many instances, to consist of pure serum. The vomiting is first of the contents of the stomach, should any ingesta be present: afterwards of a light-coloured fluid, with few flocculi, more like serum, or the drink which may be given.

In other cases, the patient complains almost exclusively of the nausea and vomiting, discharging every thing taken into the stomach almost immediately, while the bowels are but slightly and sometimes not at all disturbed.

Again, I have seen cases in which there was no vomiting or purging, the patient complaining perhaps of some nausea and feelings of oppression and malaise, but would hardly regard himself as seriously indisposed, were he not suffering from cramps in the muscles of voluntary motion, particularly of the legs, to him the first and only indication of disease.

Purging of light-coloured fluids, vomiting or cramps appear therefore to be the primary symptoms, and are so indeed to the patient, and to the inexperienced physician; but on attentive examination, the whole physiognomy of the patient, and all his vital actions as far as can be judged, will be found more or less deranged prior to the occurrence of purging, vomiting or even spasms. There is often a wild, anxious, timid expression of the countenance; the features are contracted; the eyes sunken; the secretion of tears diminished; the colour of the skin is dark, sometimes bronze-like, with a purplish appearance of the lips, tongue, mouth and fauces; the skin and mucous membrane of the mouth are cool; the extremities often cold; the hands and feet contracted; the nails purplish, with an inelastic condition of the surface generally, which with the mouth and tongue remains moist. The mind of the patient is not materially affected; there is at this stage usually anxiety and restlessness; sometimes giddiness, or sense of fulness or enlargement of the head; the respiration is

slow, marked by sighing, and a feeling of oppression referred to the lower portion of the chest, especially about the heart.

The breath of the patient is usually remarked as being less warm than natural.

The pulse I have found in this stage to be *oppressed*, sometimes it is weak and tremulous when the vital functions are still active, but usually the pulse is small, contracted, and slow; often with considerable tension, analogous to the apoplectic pulse of authors, but having seldom the same degree of force. As the symptoms advance, the pulse becomes softer, smaller and weaker, prior to the actual occurrence of the second stage.

In the abdomen there are perhaps more unpleasant sensations, referred chiefly to the epigastric region. These sensations are those of stricture, of weight, of fulness, rendering the patient very restless, and aggravating the disposition to full inhalation. In most cases, there is no complaint of abdominal pain, or of any sensation of heat or burning; and when interrogated, such feelings are seldom acknowledged, unless there is a collection of undigested food, or of acrid matters. There is seldom tension of the abdomen, even when there is much sense of fulness; but this cavity is soft and can be even forcibly pressed and moved without disturbing the patient. Very generally he will affirm that he has no pain in any of the cavities of the body.

The vomiting and purging are usually without much effort or straining; the quantity of fluid evacuated is sometimes enormous; again, and even in bad cases, very trifling, and, as above intimated, in some cases, there is no evacuation by the mouth or rectum. No evidence of the secretion of bile is afforded; the partial appearance occurring during the precursory diarrhœa now entirely vanishes. So also the urine is diminished in quantity, and sometimes is suppressed, the bladder being empty. No tears are secreted. Profuse evacuations often occur from the surface of the body, especially if much heat be applied; the skin becoming more cold and livid, and the capillary circulation slower.

Should the blood be examined, it will be found darker than during the preceding or precursory state, the coagulum softer, and the serum less in quantity, and more red.

These symptoms characterize the condition of the organic life of the patient during this first stage of cholera; the organs of *animal life* are also disturbed. The nervous irritability of the patient is more marked. There is more alarm, and the senses are often exceedingly acute; noises are sometimes agonizing; the sense of thirst is always

great and peculiar, often excessive; patients affirm that prior to this disease, they hardly know what was the sensation of thirst—and this too, when the tongue is moist and comparatively cold. So also the *sensibility of the skin* is excessive; patients complain of a degree of heat and of stimulation, which healthy individuals would bear without inconvenience, when the circulation in the skin is almost or altogether stagnant, when this tissue is contracted, purple, and actually colder than after death. Great complaints are almost universally made of hot applications and of sinapisms, and other rubefacients.

But this disorder of the nervous system is more especially manifested by the neuralgic pains in different portions of the body, and by violent tetanic spasms in the voluntary muscles. These spasms are most frequent in the gastrocnemii muscles; they affect the other muscles of the legs and feet, also those of the thighs, arms, back, and abdomen; occasionally those of the chest and throat, very seldom of the face. The pain is excessive—sometimes recurring at long intervals, often every few seconds, and sometimes there is apparently little intermission—the patient being agonized under a universal tetanic contraction, exciting the most heart-rending exclamations of suffering, increasing the cold perspirations, and prostrating still more the vital powers. They constitute the chief suffering of patients—indeed, the only pain to which they are ordinarily subjected.

Their occurrence is very irregular; in some cases they constitute almost the only urgent symptom, there being no vomiting or purging; while in others of a severe grade, they are very trifling, or are altogether absent. As the disease advances they often disappear, and cannot therefore be regarded as among the essential symptoms of the disease, although they evince a morbid state of the nerves.

3d. Should relief not be afforded, *the second stage, or that of collapse*, as it is significantly termed, ensues; in virulent cases it occurs almost instantaneously, there being no perceptible forming stage. The coldness of the skin now increases—becoming greater than that of surrounding objects; little warmth is perceptible even on the epigastric; the cutaneous discharge is augmented; the lividity is usually more intense, so that the whole aspect of the patient is altered as in cases of asphyxia, or as if he had been dusted with charcoal; the skin is contracted—on the hands and feet it is corrugated or shrivelled; the lips, tongue and mouth generally are also livid and cold, the thermometer in the mouth frequently not rising above 88° or 89°, and the parts *feeling* still colder to the examiner; the features are pinched and contracted; eyes sunken, with an anxious

expression, the conjunctiva being pale or livid; the respiration is slow; the breath is colder than natural; the sense of oppression increases, often becomes very great, and united with præcordial distress, it produces the most unremitting and exhausting jactitation, depriving the patient of all the solace and refreshment which sleep might afford. The pulse now is at best small, tremulous, vermicular, but in most instances, disappears entirely in the smaller arteries for hours before death ensues, and sometimes in the protracted cases even for days. In the larger vessels, and in the heart itself, the pulsations are exceedingly feeble. The vomiting of serous fluids continues, and is sometimes very constant, without much nausea or retching; the purging generally diminishes, and often disappears, but sometimes a serous fluid continues to flow, pleno rivo, per rectum, without effort or consciousness on the part of the patient. No urine or bile is excreted, and the secretion of tears is suppressed.

Such is the condition of the organic life during this sinking or collapsed stage of the disease. The organs of animal life being the subject of organic life must suffer in a similar manner, but their partial independence is most wonderfully manifested. The patient's intellectual powers—his memory—perception—and even judgment, are preserved in a remarkable degree, considering the depression of his organic actions. His mind and feelings are however more quiet than during the first stage, and he seldom manifests much interest in his own safety or the welfare of others. This listlessness increases, and in some few cases partial stupor precedes death, even when there is no decided symptoms of congested brain.

The peculiar excitability of the nerves of sense and motion continues, and is in some respects often augmented, notwithstanding the increasing weakness of the circulation, the greater coldness and lividity of the surface. The sensation of thirst is agonizing—usually absorbing all the desires and interests of patients; the susceptibility of the cutaneous surface is so great, that all rubefacients, and even moderate heat, are intolerable; the patient often will not bear the covering of a blanket, and will petition with moaning accents for the removal of every means of irritation, when the pulse is no longer discernible, and life nearly extinct.

The spasms, as already intimated, often disappear, but sometimes they increase in severity, and continue almost to the last instant of life, the termination of which they seem to accelerate. Indeed, after death—that is, of the organic life, this irritability of the nerves is often manifested by the movements of the fingers, toes, and even of

the limbs, continuing from a few minutes to two or three hours, and in all cases, the muscles universally become unusually contracted and rigid.

It would be foreign to the object of this paper to dwell upon the almost innumerable modifications of these symptoms which result from the various exciting causes, the temperaments, habits, constitutions, and diseases of the individuals, and the circumstances in which they are placed, or the treatment to which they have been subjected. It will be sufficient to observe, that these variations are more numerous in the first than in the second stage of the disease—among the precursory symptoms than among those which precede dissolution. In the closing scene there is a melancholy uniformity in the manifestations of this most terrible malady; the cold and livid, the moist and shrivelled surface—the shrunken features—the husky voice—the constant jactitation—the pulseless arteries—the oppressed respiration—too surely and uniformly indicate approaching dissolution, although the mind, as if determined to manifest its independence on organized matter, preserves to the last much of its wonted energies, and occasionally exhibits traits of its pristine activity.

4th. It however does not always happen, especially when medical assistance is afforded, that death terminates the second or collapsed stage of cholera maligna. In some cases *reäction* ensues; the pulse becomes perceptible at the wrist: soon a little fulness and distinctness are recognised; there is a greater warmth of the body first, then of the limbs; the effusion from the skin and bowels ceases; the lividity of the skin is less intense, and there is less jactitation: soon the warmth of the surface is decided; the corrugation of the hands and feet disappears; the colour is more natural, and all the phenomena of life are gradually reïnstated. Among these should be noticed as very favourable the return of the urinary and biliary excretions; the bile being manifested by vomiting or purging of this fluid, usually mingled with mucous matters. The tongue becomes clean and pale; the appetite is restored; the thirst disappears, and convalescence is fully and rapidly established. This is the most favourable, but unfortunately, not the usual form of reäction, for in many cases, the patient's danger continues exceedingly great, so that a very large number perish during apparent convalescence. The symptoms now manifested are so various, that it would be tedious and useless to enter into a detail, but for establishing suitable practical indications, those which I have witnessed may be arranged under three general divisions.

In many, during the reäction of the organic life, as above described, high excitement of the cerebro-spinal system is manifested. The patient becomes really maniacal, being impetuous in his actions; refusing all advice; wandering about his room or the house, and quarrelling with his attendants by day and night, until he is exhausted by his efforts; all relief from sleep being denied him. He suffers as patients maniacal from drink. Such cases are often observed in the intemperate, and those of a nervous temperament.

Another form in which reäction occurs in a dangerous manner, is where some organs are oppressed, and even overwhelmed by the severity of the organic actions. Such cases were common; symptoms of passive and active congestion being combined; the pulse often remaining weak; the extremities even cold; the bowels torpid, but the surface being generally warm, especially over the affected organ, and the natural colour being partially or completely restored. The brain suffered most frequently, but occasionally the lungs, stomach, bowels, or liver were the seats of this reäction and congestion, by which their functions were impaired, the reëstablishment of healthy action in other organs prevented, and thus the life of the patient jeopardized or destroyed.

A third variety of morbid reäction was observed, accompanied with febrile symptoms; hot, dry skin; frequent, but weak pulse; dry tongue, where no organ suffered so intensely as in the former cases from congestion, but where reäction was nevertheless inordinate, with symptoms of irritation in one or more of the viscera. The patients suffered as in typhoid fever.

5th. The last source of facts, from which the pathology of cholera maligna must be deduced, arises from the condition of the solids and fluids, observed chiefly on *post mortem examinations.*

Much has been said and written on the condition of the fluids in this disease, and statements have frequently been made directly opposed to each other. Much of this discrepancy has arisen from a want of careful observation, and also from the imperfection of animal chemistry. The latest and best observations have been made by M. L. R. Lecanu, of Paris, who was rewarded by a gold medal of the Académie de Medicine, July 12th, 1831, and by W. B. O'Shaughnessy, M. D. who made an official report to the Central Body of Health of London on the 7th of January, 1832.

1st. The blood is always altered in appearance, being both in the arteries and veins much darker than natural; it is less fluid; the coagulum is soft, and large, and black; often there is no proper coagulum, and no separation of the serum; the blood resembling

"tar" in colour and consistence; the red globules, O'Shaughnessy affirms, remain unaltered, they are often diffused in the serum, not being retained by the imperfect coagulum. In the subjoined table from O'Shaughnessy, will be seen the changes effected in the serum of the blood from cholera patients, as far as ascertained by the most careful analysis. The specific gravity of the serum of healthy blood is estimated at an average at 1.28; that of cholera blood at 1.45. The proportion of serum to crassamentum in health being as 57 to 43; that of cholera blood as 43 to 57.

"The crassamentum was found normal in the proportion of its ingredients, so that the addition of a certain quantity of water would have restored it to its usual density, proportions, &c. For this reason I have not included the crassamentum in the tabular statement of the analysis."*

"The dense, clotted, tarry mixture consists of dense, though fluid albumen, fibrine in a semi-coagulated state, colouring matter and small traces of the usual saline ingredients."†

Comparative Analysis of Serum in Health, Malignant Cholera, and Bilious Diarrhœa, by Dr. O'Shaughnessy, of London.

Ingredients.	Healthy Standard of Lecanu.	Malignant Cholera.		Bilious Diarrhœa.
		Barras.	Dewar.	
Water - - - - - -	906.00	854.00	866.80	921.00
Albumen - - - - -	78.00	133.00	124.00	61.85
Urea - - - - - -	0.00	1.40	0.00	0.00
Organic, soluble in alcohol and water	1.69	4.80	4.00	5.20
Albumen combined with soda	2.20			
Fatty matter				
Crystalline - - - -	1.20	1.40	1.23	1.90
Oily - - - - - -	1.00			
Muriat soda potassa - -	6.00	4.00	2.17	5.00
Carbonate soda		0.00		
Phosphate do. - -	2.10		0.5	2.30
Sulphate do.				
Carbonate lime magnesia				
Phosphate lime magnesia iron -	0.91	1.60	0.70	1.10
Loss - - - - - - -	1.00	0.60	1.5	0.90
Total - -	1000.00	1000.00	1000.00	1000.00

* O'Shaughnessy, p. 35. † Ibid. p. 62.

The result of the experiments is, that the water and the salts of the blood are diminished in cholera maligna, and the albumen is apparently increased; the serum was devoid of the least action on litmus or turmeric papers, not therefore being acid as was supposed. The consistency of the whole mass was greater from the deficiency of the serous portion, but the crassamentum was chemically unaltered.

2d. The evacuations from the skin, although profuse, have not, I believe, been collected and analyzed; they apparently consist of serous fluid only. The discharges from the bowels and the stomach are so peculiar, as to be remarked as pathognomonic signs. They are usually very abundant, and vary somewhat in appearance during the progress of the complaint. No traces of bilious matter, and rarely any of fæces can be detected; sometimes the first discharges per rectum have a feculent smell; they are always of a light colour, as in cases of jaundice, being compared to that of oat-meal gruel or rice water; at first consisting of two portions, separating when at rest; one is a serous fluid, the other consists of light flocculi, being apparently an altered mucus. In the collapsed stage of the complaint, very frequently the serous portion is alone perceived; in one case I have noticed it precisely as pure as the serum of the blood. On chemical analysis, Dr. O'Shaughnessy found that the liquid portion consists of water, mucus, albumen in small quantity, and muriate, acetate, and carbonate of soda. The flaky matter in the case of DEWAR, he is disposed to believe, was principally composed of fibrine, but "all practical chemists," he adds, "are aware of the extreme difficulty of distinguishing this substance, in a solid state, from coagulated albumen." Neither the blood, nor serum, nor evacuations were acid; the latter gave decided proofs of being alkaline.

These facts, collected during the prevalence of the epidemic at Newcastle on the Tyne, England, are confirmed by the analyses made by MM. ROSE and WITTFLOCK, at Berlin, Prussia, and by subsequent analysis made by Dr. O'S. at London. The dejections at Berlin were strongly alkaline and contained albumen. "In the case of Dewar, they contained the most remarkable of the principles deficient in his blood."* A glance at the table will show, that similar alterations in the blood did not occur in bilious diarrhœa, and "in all cases of ordinary diarrhœa, the blood preserved its normal proportions. Of more than one hundred cases of ordinary diarrhœa,

* O'Shaughnessy, p. 66.

the *dejections presented no single property of cholera evacuation.*"**** "I am entitled to conclude," says Dr. O'Shaughnessy, after alluding to his experiments, "that the *exudation* of the colourless parts of the blood constitutes one of the chief diagnostic characters of the malignant cholera."*

Respecting the condition of the organs and tissues post mortem in cholera maligna, little need be said, for it is manifest that a disease so rapid in its progress, will leave few or no alterations of structure, and the distribution of fluids during life will be but imperfectly manifested by the appearances which remain after death.

The skin remains more or less livid, but for several hours is warmer than before death; the voluntary muscles are rigid, and of a darker red; the arteries of the extremities are very small, and often contain soft, imperfect coagula, so also the veins.

The brain and spinal marrow are unaltered; the veins of the pia mater are usually preternaturally loaded, and there is some serous deposition under the arachnoid, and sometimes in the ventricles; there is also some turgescence of the vessels of the spinal marrow.

The lungs are remarkably healthy, especially as to colour and texture; sometimes they are emphysematous; the mucous membrane of the bronchi is of a dark-red colour generally, but the large vessels of these organs are not distended.

The heart is not enlarged; the right side contains portions of the dark, soft coagula, with some fluid blood; the left side is generally empty, or nearly so; there are sometimes slight serous depositions in the pericardium.

In the abdomen, the peritoneum is often preternaturally dry and adhesive; the liver unaltered, its vessels not usually distended; no bile in the pori biliarii, or ducts of the liver.

The gall-bladder usually contains bile, of a dark-green colour.

The stomach, small and large intestines, manifest a dark-red appearance on opening the abdominal cavity, which evidently depends on an injection of the blood-vessels under the peritoneum, as can be clearly demonstrated by dissection.

The mucous membrane of the alimentary canal varies much at the different stages of the disease: if death had occurred speedily before much or any serous effusion, it is often of a deep-red colour, (brick-red,) and sometimes there is a reddish-coloured fluid, or actual blood effused in the tube.

* O'Shaughnessy, p. 72.

The mucous membrane, especially of the lower portion of the ilium and of the cœcum, has sometimes been found excessively loaded with blood of a dark, tar-like colour; the vessels being gorged with this fluid, effusions having sometimes occurred into the substance of the tissues, as in ecchymosis.

If serous and other depositions have ensued, the membrane is often pallid and coated, especially in the large and small intestines, with a whitish, cream-coloured substance or altered mucus; when this was removed, the membrane was often very pallid, but usually some redness was still perceptible.

In most instances, some portions of the membrane are found injected, occasionally in stellated spots; sometimes in patches or ridges, especially where any undigested food or fæces remained in contact with the membrane.

The mucous follicles are found patulous, and the glands of Peyer and Brunner are often enlarged.

If the patients died during reäction, more redness, in lines and spots, and occasionally recent alterations, especially of the glands of Brunner and Peyer, were detected.

The spleen and pancreas were seldom altered.

The kidneys were natural in appearance; a little of the creamy mucus could often be expressed from their tubuli uriniferi, pelves, &c.; the bladder was generally firmly contracted; urine, when present, was of a natural colour and appearance.

Such are the leading facts connected with the post mortem examinations in cholera maligna; few of them can be regarded as constant, or as necessary consequences of this complaint. Those which are the most frequent are the rigidity of the muscles, the lividity and congestion of the skin and of the mucous membranes generally, particularly of the stomach and bowels, and slight congestion of the vessels of the pia mater, connected with the gruel-like contents of the alimentary canal, and a slight enlargement of the mucous follicles and glands. There is very universally no evidence of biliary or urinary secretion. All other changes observed were but occasional, and may therefore be deemed casual. In a female, for example, who died in about eight hours from the attack, ulcers secreting pus were found in large numbers in the small and large intestines, and about two ounces of pus in the cavity of the uterus, the walls of which were much thinned. This patient had been for years an invalid, and a pensioner on the public charities. In another body, dead in six hours from apparently perfect health, red circumscribed spots, sometimes ulcerated and even gangrenous, and always covered with purulent matters, were

detected. The exciting cause of the disease in this case was eating large quantities of green apples. The consequences therefore of prior disease of the stomach, bowels, and other organs, and the effects of occasional accidental causes must be carefully distinguished from those which necessarily result in cholera maligna.

Having thus rapidly surveyed the characteristics of cholera maligna during life and after death, we must endeavour to ascertain its *pathology*, that is, the actual condition of the general system, and of particular organs and tissues, considered as regards, first, their organic life, and second, their animal life.

First, we are to inquire into the condition of the organic life of the cholera patient. If the second or collapsed stage be regarded as the true type of the complaint, the evidence of sedation, or diminution of action in the general system, is undeniable. The cold and livid surface, the tearless eye, the pallid and cold tongue, the coldness of the breath, the weak, fluttering, almost imperceptible pulse, leave no mind in doubt respecting the prostration of vital excitement in all, or nearly all the organic tissues.

It is however contended that this sedation of the general system, and of most of the organs, is a secondary and not a primary condition—resulting not directly from the original epidemic cause, but indirectly from the occurrence of severe local irritation or inflammation—that vital excitement is so concentrated in a particular tissue, the gastro-intestinal mucous membrane, that torpor or prostration of the other tissues ensues. That this sedation is however the direct and immediate consequence of the epidemic influence, is, I think, fully proved by an examination of the symptoms preceding and accompanying the primary stage of the disease. There is no evidence at any time of vascular excitement, no frequency or irritation of the pulse, no dryness or heat of the skin, tongue, or any other accessible tissue. On the contrary, in many instances, long before there is any decided manifestation of the disease, at least to the inexperienced or unobserving, and of course prior to any evacuations, the skin will be found pallid, and of a darker tinge than natural, with a loss of elasticity, the features contracted, the tongue pallid, the appetite impaired, the urine diminished in quantity, and the stools of a light colour, indicating the deficiency of the biliary secretion. These are among the incipient symptoms, and, if careful observation be continued, it will be seen that these symptoms become more decided as the complaint advances; all of them characteristic of sedation—there being no evidence whatever of at least general excitation of the circulation at any period of the disease, whether of a mild or severe

type. This sedation of the general system of organic life is confirmed not only by the bronze-like or livid condition of the external tissues, but by the appearance of the blood in cholera, being, as already intimated, directly the reverse of that manifested in inflammatory diseases. A more striking contrast can hardly be presented than is exhibited between the black, tar-like blood of cholera, with its soft, imperfect coagulum and deficient serum, and the sizy-cupped blood of inflammation, with its scarlet-coloured and dense coagulum, and its abundant and pure serum. This change in the blood was not confined to the blue or collapsed stage as has been asserted, but although then most decided, yet could be noticed among the earliest of the premonitory symptoms more or less distinctly. Blood, whenever drawn from the arm of a patient under the epidemic influence, was darker than on ordinary occasions, and the coagulum which resulted was less firm. This remark has been made not only by myself and other physicians, but by some of the bleeders in this city during the late epidemic, showing that the cause of the change, whatever might be its nature, had an early influence.

The above views are, it is believed, confirmed by examination of particular tissues or organs; for in simple, uncomplicated cases of cholera, there are no indications of local irritation, but those of sedation were generally observed.

The condition of the cutaneous tissue in the incipient, as well as in the confirmed cases, has already been noticed; in all, the cold, inelastic, pallid or livid condition of the surface was early and continuously observed; a state directly opposed to the tense, florid, elastic, and heated condition of this tissue in irritative diseases. The same observation was strictly true of the lips, tongue—indeed of the whole mouth and fauces; the thermometer even indicated a loss of vital temperature, sometimes to 10 or 12 degrees.

The internal surfaces, there are strong reasons to believe, were in a similar condition. There was a deficiency of secretion from the lachrymal gland, without any symptom of irritation. There was no evidence of inflammation in the membranes or substance of the brain or spinal marrow, and none has been contended for. The lungs were so far implicated in the affection, that there was frequently a difficult and oppressed respiration, often with a sense of stricture and uneasiness; and post mortem, the mucous membrane was very universally found preternaturally red, or even livid. That these phenomena did not however depend on irritation or inflammation, seems to be generally conceded—inasmuch as there was no cough, or pain, or other symptom of active disease, and no expectoration; the expired

air was colder than natural, affording a very positive index of the vital heat of the whole mucous membrane; and post mortem, no lymph, or pus, or ulceration, or other products of inflammation were observable, but the structure of the lungs was remarkably perfect.

In the abdomen, we infer there was sedation of the liver from the early deficiency of bile during the premonitory symptoms, and from its entire suppression in all cases after the disease was fully formed, while no symptom of hepatitis was manifested during life, and none of its consequences after death. So also, as respects the kidneys, there was a diminution or suppression of their secretion in all cases, and after death they were found in a normal condition. Respecting the secretion of the pancreas, whether increased or diminished, we of course have no evidence, but this organ and the spleen underwent no perceptible change in cholera. Few pathologists will deny the correctness of the inference, that the organs and tissues above alluded to, are in a state of sedation, varying in degree in the different stages of cholera maligna; but great discrepancy of opinion still exists as to the pathological condition of the stomach and bowels during the progress of the disease. The question is no doubt a difficult one, arising as well from our ignorance of the true nature of their physiological actions, as from the apparently contradictory facts accumulated on this subject.

I have no hesitation however in expressing the opinion, founded on an attentive examination and consideration of these facts, that there is a sedation of organic life in the alimentary canal; especially that there is a diminution of capillary excitement throughout the whole extent of the mucous membrane, from the mouth to the rectum, in all cases of a simple, uncomplicated character. The facts and arguments in support of this opinion, I shall presently adduce more at length, but it may be now stated, that the usual and acknowledged symptoms of gastritis are not commonly observed, such as sensations of heat and burning; pain aggravated by pressure; fulness and tension of the abdomen: there are no sympathetic irritations; the liver remains torpid; the tongue, instead of being warm, red, and pointed, with elevated papillæ, is cold, livid, and flaccid; there are no burning sensations in the throat, and no excitement in heart, arteries, or capillaries: the evacuations differ in appearance, and chemically* from those which occur in cases of gastro-enteritic inflammation; there are no lymphatic or membranous effusions, no purulent secretions, and even the mucoid depositions have an appearance en-

* Vide statement above respecting the fluids in cholera.

tirely dissimilar from those observed during inflammatory diseases of these tissues.

Respecting the post mortem appearances, I shall endeavour to show, that they differ from those resulting from active irritation, and that the opinion now advanced, is not only perfectly consistent with the existence of intense thirst, with the vomiting and purging of serous fluids, and great congestion of the mucous membrane, but is even confirmed by some of these phenomena.

The dry condition of the peritoneum, so generally observed post mortem, without any indications of inflammation, show that the capillaries of this extensive serous membrane were also in a torpid condition—a state, it may be remarked, which does not exist in cases of gastro-enteritic inflammation, however acute or extensive.

From this review of appearances during life and after death, we infer that there is a sedation of the organic actions in the incipient, as well as confirmed cases of cholera, on internal as well as external surfaces, of the large blood-vessels and the heart, as well as of the capillaries.

It is of practical importance to remark, that this sedation is first manifested in the capillary tissue, afterwards in the larger vessels and the heart—as we notice, the pale, livid, inelastic condition of the skin, the contraction of the features, the livid and cold tongue, the diminution of the urinary and biliary fluids, while the pulse, although free from irritation, is full, often strong and laboured. In a short time the pulse becomes weak, small, fluttering, imperceptible, and the actions of the heart weaker until they cease in death.

This being the condition of the circulatory vessels, alterations must occur in the distribution and in the quality of the blood.

1. The distribution of the fluids is disturbed. The blood, which in health circulates rapidly in the capillary vessels, constituting, no doubt, a large proportion of the circulating mass, and affording materials for secretion and nutrition, is no longer actively determined to these remote vessels. Little blood evidently enters these capillaries; and when introduced, moves very tardily, and, in bad cases, is absolutely stagnant. This is shown, not only by the lividity and coldness of the surface, but by the effect of pressure, which empties the vessels with difficulty, while the part pressed long remains pallid and sunken. The experiment may be satisfactorily made on the mucous membrane of the mouth as readily as on the skin. The blood thus excluded from the capillaries must be thrown upon the larger arteries and veins, especially of the viscera, causing congestion of the organs. That such congestion actually occurs, is manifested by

the fulness and slowness of the pulse in the early stages—by a sense of fulness about the head, chest, and abdomen—by the oppression about the heart, lungs, and præcordia, often with a sense of stricture or weight—by the great and immediate relief afforded by venesection, and by the turgescence remaining after death in the mucous membranes of the stomach and bowels—in the veins of the brain and spinal marrow.

As the sedation extends to the large vessels of the extremities, the blood is here also imperfectly circulated, and the evidences of visceral congestion are more decided, notwithstanding the immense effusion of serous fluids.

2. The blood is altered in quality, as has frequently been mentioned. How this alteration is effected is not known, but it is generally acknowledged that the purity of the circulating fluid in health is preserved mainly by the respiratory process, and by the secretions from the liver and kidneys; and that these processes in the lungs, liver and kidneys are effected, in some way, through the instrumentality of the capillary vessels. The normal excitement of these vessels being diminished, it necessarily results that these vital processes are inadequately executed; the blood therefore is not completely purified; the elements of the urine and the bile are not eliminated by their natural emunctories,* and hematosis is imperfectly executed. The quality of the blood must therefore be altered, and its colour must manifest the venous rather than the arterial hue, as observation has clearly demonstrated. It may be also remarked, that if these observations be correct, the early change noticed in the blood is indicative that the sedation of the capillary vessels of the mucous membrane of the bronchi is among the primary symptoms of cholera, cotemporaneous with the torpor of the skin, liver, &c. and prior to any increased evacuations from any of the tissues.

Connected with these changes in the quality of the blood, should be noticed the change in its consistency. Its viscid condition is supposed to be dependent on the loss of serous fluids, and is considered by many as an important circumstance in inducing and keeping up the stage of collapse even to a fatal termination. That some influence may be thus exerted is probable, but that it has been much exaggerated, is proved by the fact that patients have occasionally recovered from very low stages of collapse; their blood not being too viscid for the sustenance of life, when there is a suitable reäction of the capil-

* Vide table, where it will be seen that *urea* was detected in the serum of cholera blood.

lary system. It may be mentioned also, that such recoveries show that the blood in collapse is still capable of being changed in the lungs when reäction of the capillary system ensues, notwithstanding the loss of serum; a fact confirmed by the experiments of O'Shaughnessy, who affirms, p. 41, that its capability of aëration is shown to be preserved.

From the analysis now presented of the symptoms of cholera, and of the post mortem appearances, it results that there is a primary sedation, (diminution of excitement,) in all the organic actions, followed as a necessary consequence by a passive congestion of an impure blood. It should be added, that this congestion of the internal organs oppresses them, and of course aggravates the symptoms of sedation. The natural disposition to reäction is thus still further resisted, being repressed not only by the influence of the original poison, but by the quantity and quality, perhaps also, by the viscidity of the blood congested in the vital viscera.

That these conclusions to which I have been brought by clinical observations, without any, the least bias from any preconceived opinions, may appear more plausible to others, it becomes requisite to examine some of the facts and arguments adduced to prove that the gastro-intestinal mucous membrane forms an exception to the idea of universal sedation, that this tissue is in a state of high organic irritation, and that all the phenomena of cholera maligna depend on this inflammatory condition of the stomach and bowels; the vital powers and actions being prostrated by the extent and severity of the inflammation, and by the free evacuations. The operation and effects of a severe emetico-cathartic medicine have been adduced as exemplifying and illustrating the state of the mucous membrane and the general system in cholera.

To me, the whole of this opinion is evidently inconsistent with the experience of its own advocates; for they all maintain, that prior to actual collapse, however severe the spasms, or profuse the discharges, cholera can be very easily managed—that by slight remedial measures, such as immersion of the feet in a warm bath, warm fomentations, and some camphor and laudanum, all the phenomena of the disease vanish, and few, if any, need perish during the first stage of the complaint. Certainly these observations cannot be predicated of severe and extensive cases of gastro-enteritic inflammation. It is remarkable that this inconsistency attaches chiefly to the Broussais school, who have so inordinately magnified the effects and dangers of gastro-enteritis.

If there be this inflammatory irritation of the mucous membrane,

mild cases of cholera, (very many of which occurred,) would, according to received opinions respecting inflammatory diseases, be attended with febrile irritation—the sympathies of the body were not destroyed, as the system readily reäcted in such cases under mild stimuli; but no such sympathetic irritation appeared.

Respecting the analogy between cholera maligna and that prostrated state of the system brought on by a corrosive poison, or an irritating cathartic, the appeal may safely be made to clinical experience to exhibit, even to the unprofessional observer, the most marked discrepancies. In both, it is true, the system is prostrated, but in the latter cases we shall look in vain for the suppression of the biliary secretion, the cold and livid tongue, the livid surface, and all the characteristic physiognomy of prostration from the poison of cholera.

It is said, that cholera maligna must be inflammatory, as the exciting causes are all of them irritants: but this assertion is not universally correct. Perhaps the most frequent exciting cause was change of temperature from warmth to cold. The attacks frequently came on at night from exposure to the weather, sleeping in a draught of air, throwing off the bed-clothes, jumping suddenly out of bed upon a cold floor or mat: spasms, vomiting and purging, were thus frequently excited by the sedative influence of cold acting on a system predisposed to cholera. Hence the almost universal prophylactic direction was to keep the body warm, and to avoid exposure to cold during the epidemic; and perhaps no direction was more beneficial, and no single circumstance more conduced to the preservation of those in comfortable circumstances; while the poor and vicious, who were more exposed and more negligent, suffered severely. In the Philadelphia Alms-house, it was found that the number of cases among the maniacs and idiots was proportionably much greater, and of a more severe type, arising no doubt from their neglect of clothing, especially at night. In all these cases, the sudden diminution of the cutaneous circulation and secretions, and the consequent internal congestion, was the immediate or exciting cause.

But irritants are also exciting causes; of these, food from its quality or quantity is among the most frequent. On the supposition, that sedation exists as the immediate effect of the epidemic influence, the digestive powers of the stomach are enfeebled, and hence, as experience of almost every one can testify, even the ordinary and useful articles of diet were not readily digested. Should, therefore, food prove indigestible from its quantity or quality, the common symptoms of indigestion were excited, characterised by a great sensation of oppression and load at the epigastric, with restlessness and jactitation;

cold, pallid surface; weak pulse, &c. In other words, the powers of the stomach and system were oppressed, even by comparatively slight errors of diet, owing to the peculiar predisposition of the system, and this oppression was often maintained by the same cause, even to a fatal termination. That the symptoms in these cases were not usually dependent on inflammation, is shown by the immediate relief often induced by vomiting—the cause being removed, the effect disappears. That inflammation was sometimes excited by acrid ingesta, no one would deny, but such inflammation is not essential, and however it might aggravate the symptoms, must be regarded merely as a complication to be presently noticed.

Respecting laxatives, my own experience does not confirm the assertion, so frequently made of their injurious effects. I often, indeed continually, prescribed them during the premonitory symptoms, and never knew them to act otherwise than beneficially. That hydragogue, irritating cathartics would be injurious, inducing prostration, there can be no doubt, on principles already advocated, without any support to the doctrine of inflammation.

Another argument adduced in favour of the gastric pathology, is drawn from the liability of the intemperate to cholera, because they are always the subject of chronic gastro-enteritis. Their liability, however, should rather be referred to the exhausted condition of their vital powers generally, and to their proneness to congestive diseases. Hence the depressing influence of the epidemic is sooner experienced, and congestion with its consequences more easily induced.

As to the sensations of heat about the epigastric, the burning and griping pain of the stomach and bowels, the violent tormina or tenesmus, or spasms of the alimentary canal, I have no idea that they ever occur as the ordinary symptoms of cholera; if present, they depend on some accidental complication. I have never in India, or in this city, witnessed tenesmus or spasms of the bowels in a well-marked case of cholera maligna; the spasms are located, not in the bowels, but in the abdominal muscles, and should tenesmus and other dysenteric irritations exist at the access of cholera, they have always in my practice disappeared until the symptoms of cholera were relieved. Ordinarily patients complain only of the cramps of the voluntary muscles; the abdomen is free from tension, and can be pressed upon without any pain or tenderness being excited.

The distressing thirst which characterizes cholera, is dwelt upon as a strong argument in favour of inflammation, but it exists in congestive as well as inflammatory diseases; is as troublesome

during the cold as the hot stage of fever. It is accompanied, not by a dry, red, clammy, and heated state of the tongue, mouth and fauces, but with a soft, moist, cold, and livid condition of these tissues. It increases with the symptoms of collapse, and decreases as signs of excitement appear. Its progress also is *pari passu* with the great susceptibility of the skin to external stimuli, commencing and increasing, or declining together. Hence as all acknowledge, that the surface of the body is not inflamed in cholera, but that its susceptibility to impressions depends on a morbid condition of the nerves of sensation, we have a right to conclude that the thirst in cholera is the result, not of a sanguine irritation, but of a peculiar affection of the nerves. It is a *morbid sensation.*

Again, it is asserted with much confidence, that there must be inflammation, because there is vomiting and purging of sero-mucoid fluids in immense quantities.

That the mere act of vomiting is a proof of sanguine irritation, few perhaps will contend, who reflect that the loss of blood will create nausea and vomiting, even in healthy individuals.

Respecting the profuse evacuations so generally observed in cholera, the question is of importance, and returns at every view of the subject. Do they demonstrate an excited or irritated condition of the exhalants in opposition to the arguments which have been adduced, or may they not be simply effused, poured out from the overloaded tissues, in the same way that blood is effused in passive hæmorrhages? That passive congestions are usually followed by effusion of serous fluids, and that immense evacuations may occur from tissues free from inflammation, and even in a prostrated condition, the following undeniable facts clearly demonstrate.

1st. A profuse serous discharge occurs from the skin of cholera patients, is noticed in the colliquative sweats of hectic fever, and in the cold perspirations which so constantly indicate the approach of death, or which cover the pallid surface of one prostrated under severe pain however inflicted. In none of these cases, will any one suppose that there is an inflammation, or even irritation of the cutaneous tissue, marked as it is by pallor or lividity, by coldness and contraction, and every other sign which can indicate diminution of excitement and death-like prostration.

2d. A similar sero-mucoid fluid is often observed from the conjunctiva of the eyes, in states of great prostration. This is often accompanied by a sudden engorgement of the vessels of the conjunctiva, at a moment when all action is disappearing in every

tissue of the body. It is the stasis of blood, and a consequent effusion of its thinner portions, immediately preceding its universal arrest in death.

3d. Mechanical interruptions to the venous circulation, causing an engorgement of the small veins, will be followed by an evacuation of the thinner portions of the blood, without any evidence of irritation and inflammation. Hence a tourniquet, or ligature, or bandage, moderately tightened on a limb, will cause œdema of the hand or foot. Hence the œdema of the lower extremities in pregnant females, and in patients with varicose or diseased veins, &c.*

4th. The influence of cold suddenly applied, when the circulation is active, renders the part livid and anasarcous, without any indication of inflammatory excitement.

Many similar facts might be presented, very positively demonstrating that no argument can be drawn in favour of inflammation from the evacuations in cholera. On the contrary, when it is remembered that these evacuations differ in their appearance, and on chemical analysis, from the fluids evacuated in acknowledged gastro-enteritic irritations; that they contain, in some instances at least, the principles deficient in the blood;† that the natural secretions diminish or disappear on their occurrence, and return when they are arrested; that the muco-purulent secretions of dysentery are also incompatible with their existence, disappearing on their occurrence, and often returning when they cease; that no relief is afforded by these discharges, the circulation becoming weaker and slower, and the lividity and prostration increased, the conclusion seems unavoidable that they are passively effused, and not actively secreted. They constitute a serous hæmorrhage. Hence we may also conclude, that the condition of the skin, cæteris paribus, making allowance for difference of organization, is a prototype of the mucous membrane of the alimentary canal; in both there is congestion and lividity from dark blood; while a clammy serous evacuation occurs on the surface, a sero-mucoid effusion is poured from the intestines. It is believed that the results of treatment confirm these inferences as will be shown hereafter.

* "When the mechanical hyperæmia is carried to a certain extent, other phenomena may arise as a consequence. Thus the serous portion of the blood may escape from the over-distended vessels, just as water or any other liquid transudes through the permeable sides of a vessel in which it suffers compression." *** "And although these effusions have nothing active in their nature, yet are they considerably diminished, and sometimes altogether removed by blood-letting."—*Andral, Pathological Anatomy, Chapter on Hyperæmia.*

† Vide analysis of the fluids.

Finally, much dependence is placed on the post mortem appearances, as proving the existence of inflammation. The redness often observed we have endeavoured to show is the result of passive, not active congestion; it was, in uncomplicated cases, greatest when patients died early, and was lessened by the effusions; in this respect differing from active congestion, the remains of which are not observable if patients die speedily. The sub-peritoneal tissue of the intestines was remarkably loaded with blood in almost every case of dissection, even when the mucous membrane was pallid—this is peculiar to passive collections; and the colour was always darker than ordinary. There were none of the usual alterations of tissue observed from irritation; no thickening and no softening; strips from the mucous membrane being as long and as firm as on ordinary occasions, according to the report of Dr. Pennock. The difference existing between the sero-mucoid fluids of cholera, and the lymphatic and purulent formations of inflammation have already been noticed.

The enlargements of the mucous follicles, and of the glands of Peyer and Brunner would seem to indicate inflammation, but such enlargements were not universal,* (hence cholera could exist and be fatal without them;) they were seldom very great; they are frequently observed in other diseases, and allowing them to be inflammatory, were therefore altogether inadequate to account for the peculiar symptoms and fatality of the epidemic.

While thus contending that a universal sedation is the primary and essential pathological character of cholera maligna, it is not denied that complications with inflammatory diseases may frequently occur; indeed they are not uncommon, and have no doubt retarded our progress in the study of cholera, by fixing attention on points of secondary importance, while the great leading and original phenomena have been neglected. But this complication is regarded as impossible; how can irritation and sedation coëxist? Of course, they cannot at the same spot, at the same time; but when any portion of a tissue is inflamed prior to the accession of cholera, this inflammation although diminished by the sedative influence of the epidemic cause, may nevertheless continue while the rest of the tissue is torpid and passively congested; again, after sedation in any tissue has occurred, particular portions may become inflamed from any

* In thirty-six examinations made in Paris by M. Louis and Andral, reported by Drs. Pennock and Gerhard, "the glands of Brunner were developed in a notable manner in rather more than two-thirds of the cases; those of Peyer were more visible than usual in a rather less proportion but rarely projected above their ordinary level." p. 76.

acrid irritant. To exemplify these principles,—an individual otherwise in health, has ulcers on the surface of the body, and afterwards becomes the subject of cholera; the ulcers may continue moderately inflamed, and may even secrete purulent matter while the whole cutaneous tissue is cold, livid and torpid:—in another case, after cholera has ensued in an individual previously in a normal condition, severe irritations from wounds, mustard, cantharides, &c. may be excited on the skin, which in every other portion, continues to manifest symptoms of diminished excitement. On these principles, most of the complications from inflammation and ulceration of the mucous membrane may be explained. Thousands, no doubt, of patients with chronic gastro-enteritic diseases, have been the victims of cholera epidemica, and of course, post mortem, the consequences of inflammation will be found conjoined with those peculiar to sedation and passive congestion. This was universally the case with the intemperate, who so remarkably suffered from the epidemic. So also, if no prior inflammation existed, irritation with all its consequences, was frequently excited by improper food, by acrid medicines, &c. in particular portions of the stomach or bowels. These cases afford examples of passive and active congestion, in the same tissue; in the same manner that this combination was exhibited by a blister on the skin in cholera.

Another and third source of inflammation arises from the changes occurring during the stage of reaction; then, when the secretions are returning, and the pulse and skin even excited, inflammation is developed in various organs, and is productive of its usual consequences.

There may be other sources of irritation of the mucous membrane, but the evidence deducible from the symptoms and from dissection, shows that, in all cases, such inflammatory affections are trifling, compared to the intensity of the disease; that the symptoms indicating the state of the general system and of particular organs, are essentially different from those ever produced by gastro-enteritis, however acute; and finally, that the most intense cases have often terminated fatally without any indication of inflammation before or after death.

Second.—What is the condition of the organs of animal life,—the brain, spinal marrow, and nerves of sensation and motion?

In the introductory remarks, the relative influence exerted by the organs of the two lives on each other was alluded to, and especially the fact that, as the cerebro-spinal system for its development and support is entirely dependent on the organic actions, it must be to a certain extent affected by the diseases of organic life. In cholera

maligna I have already detailed the changes in this system, so far as its circulation is concerned, maintaining that it was the subject of sedation and congestion of its capillary and larger vessels, there being no evidence of inflammation or its consequences before or after death.

Notwithstanding this depression of organic actions, there is abundant evidence of *a morbid irritability of the brain and nerves.*

The irritability of this system is manifested by the wild and anxious expression of countenance at the commencement of the attack, by the activity of the intellectual powers in the first stage of the disease—an activity which, though afterwards much diminished, is comparatively great, even in extreme collapse, and sometimes to the last moments of existence. There is often great intolerance of sound, the least noise disturbing or agitating the patient; indeed, all the senses are remarkably acute. The sensibility of the skin is excessive; even when this tissue is perfectly livid and cold, and the circulation seems to be completely arrested, the common warm and stimulating applications are intolerable. The patient begs that they may be removed, and should inflammation be excited, the complaints are often distressing. Experience has shown that great heat, alcoholic and other vapours, sinapisms, cantharides, &c. are often productive of great mischief, in consequence of the extreme susceptibility of the cutaneous nerves, increasing the restlessness and distress of the patient, augmenting the serous effusions, the lividity and coldness of the skin, and prostrating much more rapidly the organic actions.

The same nervous sensibility is manifested by the intense thirst by which patients are usually tormented, and which we have endeavoured to show, is independent on irritation or inflammation.

The evidences of nervous excitement are most decidedly exhibited in the spinal nerves. Even during the premonitory symptoms, and often when no other evidence exists of the epidemic influence, the patients complain of neuralgic pains and of slight spasms of the voluntary muscles. These spasms increase, and often become agonizing in the extreme, during the first stage of cholera, and they sometimes continue during the stage of collapse, even until the close of life, augmenting the jactitation of the patient, the exhausting sweats, and all the symptoms of prostration; in some cases appearing to be the immediate cause of death. Even after death, that is, after the cessation of organic life, animal life is manifested, as already intimated in the contraction of the muscles, producing even motion in the otherwise lifeless members.

During the stage of reäction, the same irritability of the nerves is often witnessed in the watchfulness and sleeplessness of patients;

their susceptibility to noise, and disposition to nervous delirium or mania, which are often so excessive as to exhaust the organic powers, and thus destroy the well-founded expectations of recovery.

In these indications of nervous irritability, there was great variety in different patients, depending on various causes, as original temperament; habits of living; prior diseases; strength, &c. &c. but especially on the condition of the circulation in the brain and nerves. Sometimes there were few spasms, or other evidence of irritability, owing to great congestion of the brain; the patient becoming dull, stupid, and comatose. In a majority of instances, the presence of the spasms seemed to be dependent on a certain degree of congestion, acting as an exciting cause, inasmuch as they were relieved by the loss of blood, or by revulsives increasing the cutaneous circulation. There were many fatal cases, without any suffering from spasms, and in cases, otherwise mild, the rigidity of the muscles and the intensity of the suffering were excessive.

In the preceding observations, we have conscientiously endeavoured to analyze the phenomena of cholera maligna, separating the accidental from the essential and characteristic symptoms of this dire pestilence, and from these last to deduce the actual state of the tissues and organs of the economy; in other words, the *pathology of cholera.*

The conclusion to which we have been brought is, that in cholera maligna there is *a universal sedation of the organic life*, manifested primarily in the capillary tissue, then in the larger vessels and heart, with a consequent passive congestion of an impure blood in the internal tissues, aggravating the sedation, and resisting the natural disposition to reäction; and that there is also a *peculiar and morbid irritability* of the cerebro-spinal nervous system, the apparatus of animal life.

Cholera maligna is therefore virtually a disease, not of irritation, but of sedation; not with active circulation or inflammation in any tissue, but of torpid circulation and passive congestion. Thus constituted, it is modified by temperaments, constitutions, habits, sex, age, prior diseases, strength, &c. of the patients, as other affections, and is often complicated by local irritations from the quantity or quality of the ingesta, or from improper treatment, and by the actual presence of inflammation in one or more tissues, &c. aggravating its symptoms and dangerous character.

This being assumed as the nature of the disease, the therapeutical indications are clearly and easily deduced.

1st. *Organic life is to be stimulated*, that the healthy capillary

functions may be reïnstated. Thus the natural secretions will be restored; the blood be purified by the appropriate organs, the lungs, liver and kidneys, and congestions be relieved.

2d. *The irritability of the animal life is to be moderated*, that the mental agitation, the delicacy of the senses, the morbid sensibility of the skin, the excessive sensation of thirst, the neuralgic pains and the violent spasms may not be injurious.

These apparently opposite indications should be borne in mind in the treatment of every stage and variety of this complaint, and should receive suitable and proportionate attention; so that one set of functions need not be stimulated or depressed to the injury of the other; organic actions be so excited as to aggravate the nervous symptoms, nor these nervous affections be regarded as the sole object of treatment, to the neglect of the organic depression. By judicious, constant, and persevering attention to these indications, we can alone, I think, scientifically and correctly manage cholera maligna, although here, as in most other diseases, patients have recovered, and have perished under every variety of treatment, however judiciously prescribed, or empirically administered.

In detailing therefore the treatment, tested by experience, and resulting from the above pathological views, and to my mind, establishing their correctness, the different stages of the disease must be passed in review.

1st. *Treatment of the precursory symptoms.*—As formerly intimated, there is a moderate depression of excitement in all the organic actions, prior to the occurrence of decided symptoms of cholera, extending to the mucous membranes of the lungs, alimentary canal, liver and kidneys, with some nervous irritability. Hence the indications are, to restore the normal activity of the secretory vessels, and to moderate the nervous excitement. These indications may, at this period, often be fulfilled by the mildest remedies. External measures are often adequate for this purpose, such as frictions, hot pediluvium, manuluvium, warm bathing, and, as acting more constantly and permanently, confining the patient in bed, or using warm clothing, especially flannel, next to the surface; also by the application of simple or even irritating plasters to susceptible portions of the body. These measures should be assisted by the use of warm drinks. All exposure to cool air, or to a current of air, and the use of cold drinks, are very dangerous as increasing the sedation of the surface and internal congestions. Patients therefore should sleep with much warm covering, paying particular attention to their limbs, and avoiding sudden transitions of temperature, especially on rising from bed. In some

cases, it may be necessary to administer mild diaphoretics, as the sweet spirits of nitre, the saline mixture, assisted, it may be, by minute doses of calomel.

But as the irritability of the nervous system usually demands attention, as well as the sedation of the capillaries, the *narcotic stimuli*, in small and repeated doses, become valuable remedies.* Of these, camphor is generally to be preferred, as being a warm diaphoretic, while it quiets nervous irritation. It has been much and deservedly celebrated. Opium, in its various preparations, is often invaluable in fulfilling the same indications, and should frequently be conjoined with the camphor, or be employed as its substitute.

Great attention to *diet* is of the utmost importance, predicated on the simple principle of sedation of the organic actions of the digestive apparatus. Hence the diet should be simple and easy of digestion; for, as already intimated, next to cold, the occurrence of indigestion was one of the most frequent exciting causes of cholera maligna.

This principle should regulate the diet of all the inhabitants where the epidemic influence is prevailing. If no disease be actually present, the diet may be, and indeed ought to be *nutritious*, and sometimes even rendered moderately stimulating by condiments to facilitate the normal excitement and secretions of the digestive fluids. Hence, meat and the farinacea, in moderate quantities, occasionally with spices, form the safest general diet for well persons during the epidemic. Some whose digestive powers are usually vigorous, might employ fresh vegetables well boiled with advantage, and even ripe fruit is often useful, from the well known influence of vegetable matters on the excretions. Great care should, however, be exercised, as even the most vigorous are depressed by the epidemic influence, and indigestion, with all its dire effects, might be the consequence.

Should any premonitory symptoms exist, solid food, of course meat, should be abandoned, and the farinaceous matters with spices be alone administered. If, however, the stomach be oppressed by indigestible food, or any acrid ingesta, a mild emetic is of great value by removing the source of depression and facilitating general reaction. On the same principle, laxatives, especially magnesia or rhubarb, or castor oil, are often highly important, particularly when the

* This class of medicines having at the same time a sedative influence on the nervous system, and a stimulating effect on the organic actions, (whence their name,) is admirably adapted to the peculiar state of the system we are considering, and would seem indeed to confirm the idea, that this combination of organic depression and animal excitement, is not uncommon.

patient has been long costive. I never knew them act as exciting causes of cholera, as has been alleged, but have uniformly found them useful even when diarrhœas or slight dysenteries, ("cholerine,") have been present, but by removing sources of depression, and restoring or keeping up natural secretions, they do good. They should be accompanied or followed by the use of warm drinks, by small but repeated doses of camphor, or other narcotic stimulus, usually combined with mild diaphoretics and aromatics.* The precursory diarrhœa will usually disappear under the above treatment, but may occasionally demand mucilaginous or anodyne enemata, or the more decided plan presently to be indicated.

2d. The *treatment of the first stage of cholera.*—Should the premonitory symptoms be neglected, or injudiciously managed, the sedation of the capillaries is more marked, and there is fulness or oppression of the larger vessels with the severe consequences already detailed. The remedies already recommended should now be actively exhibited, and will sometimes be adequate for the emergency by recalling the circulation to the extreme vessels and restoring the secretions, but generally direct evacuation must be employed to relieve the congestion which resists the natural disposition to reäction, and the effect of remedial measures. *Copious bleeding* from the large veins had the most beneficial tendency, not simply by unloading the vessels, but by thus indirectly facilitating reäction—manifested by more fulness and activity of the pulse, and renewed activity of the capillary circulation. The advantages were generally striking and immediate; the feelings of oppression about the head, lungs, heart, and abdomen, were at once relieved—the surface would become warmer, even the livid colour would be lessened—the vomiting and purging would diminish or disappear, while a warm perspiration be universally diffused over the surface, indicative of a similar return of the internal secretions. Even when all these good effects were not immediately displayed, the symptoms would be ameliorated, and the susceptibility of the tissues to remedial agents be aroused.

In this and similar states of the general circulation, the object and the effect of venesection is, not as in inflammatory diseases, to reduce the pulse and diminish capillary action, but by relieving congestion and oppression, thus indirectly to facilitate the development and activity of the arteries and capillary vessels. That this indication

* The following formula, recommended by Dr. Parrish, I found very grateful:—℞. Sp. Lavend. co. ʒi.; Laudan. ʒi.; Sacch. alb. ʒij.; Aq. camphor. ʒiij. M. S. ʒij. or ʒiv.

is fulfilled, is evinced not only by the increasing fulness and frequency of the pulse, and the warm perspiration, but also by the changes occurring in the blood, even during the operation; for it was observed that the blood first discharged was of a very dark colour, and in many instances flowed with difficulty, and tardily, even from a large orifice in a large vein, sometimes *guttatim*, but in a short time the momentum increased, and the colour improved, so that a full stream of almost arterialized blood would sometimes be poured forth with considerable impetus. As, in these cases, the pulse would rise from its depressed condition, becoming full and active, as the oppression was ameliorated, and as the secretions and the heat of the skin returned, large quantities of blood could often be beneficially abstracted; ℥xx. to xxx. could frequently be taken from even delicate individuals, while from the strong and plethoric I have taken ℥lx. to lxx. with great and immediate advantage, and without any reason subsequently to repent of this active depletion. The patient was usually found at a subsequent visit with a warmer skin, a fuller pulse, and more natural secretions. In cholera maligna, we bleed not to diminish excitement, but to relieve oppression.

After venesection, the patient might sometimes be trusted to the mild measures already indicated, to mild *diaphoretic anodynes*, with warm and moist applications to the surface. But if the disease be severe, more active measures are demanded to excite and keep up the secretions, as large doses of camphor and ammonia, in the form of powders, or of mixture, Dover's powder, assisted by warm drinks, such as wine whey, or warm aromatic infusions, &c. Stimulating frictions to the extremities, with spirit of ammonia, spirit of turpentine, Cayenne pepper, &c. the application of sinapisms and other rubefacients, and sometimes of blisters, were very advantageous in quickening and keeping up the cutaneous circulation—as also of dry heat, by means of bottles of hot water, hot bricks, sand, oats, &c. where the sensations of the patient would tolerate these measures.

To fulfil, however, the all-important indication of reëxciting the capillary actions, no medicine was comparable to calomel. Other remedies were useful in accomplishing this object, but however rapid in their action, their effects were often trifling and transitory, compared to the decided and permanent influence exerted by the mercurial preparations. Calomel was usually preferred, and was given in doses of gr. ij. or iij. alone, or in combination with diaphoretics, every hour, or every two or three hours, until some twenty or thirty grains were administered, or until the symptoms were relieved.

Operating slowly, but very certainly, upon the extreme vessels, augmenting their circulatory and secretory actions, it admirably fulfilled the indication presented in cholera, and was therefore the main dependence of the practitioner. Thus, by obviating the sedation of the exterior vessels by direct and indirect means, by suitable stimuli and by venesection, congestion and consequently effusion are obviated. The skin now secretes a natural perspiration, and the biliary and mucous secretions are substituted for the effusions from the congested vessels. Frequently will it be found that all the peculiar discharges in cholera are arrested by bleeding and calomel, separately or combined.

As soon as any evidence of capillary reäction is manifested, the calomel should be followed up by the free exhibition of laxative medicines, such as the ol. ricini, senna, salts, Seidlitz powders, &c. all of which assist in exciting the natural secretions, and relieving congestion, and are also useful in emptying the alimentary canal of any irritating contents, especially the biliary and other secretions, as they are formed. Should the calomel and cathartics operate favourably, bilious and mucous dejections will be observed as substitutes for the serous effusions, which, with no beneficial tendency, were exhausting the powers of the patient.

On these principles, and by the above-mentioned remedies, the organic life in this first stage of cholera maligna, may be managed so that in very few instances will the patient pass into the second or collapsed stage, unless severe complications exist. No benefit, I conceive, is derivable from the use of anti-emetics, or astringents, with the view of checking the vomiting and purging of serous fluids. These effusions will continue so long as the congestion remains; hence the best, if not the only certain means of relief, is to remove congestion by bleeding, and by those measures calculated to restore the natural secretions from the capillaries. So also no confidence was placed in any medicines said to arterialize the blood, such as the saline medicines recommended by Dr. Stevens, formerly of Santa Cruz, and now of London. Believing that the morbid condition of the blood was owing to the diminution or suppression of the natural excretions from the lungs, liver, kidneys, skin, &c. I necessarily inferred that the best method of purifying the blood, was to restore the excretions, and believe that this view was confirmed by experience. For this purpose the saline medicines were useful, but as already hinted, were far inferior to calomel, or even the use of hot drinks, the warm bath, &c. &c.

In this stage, particular attention must be paid to the irritations

existing in the organs of animal life, especially to the spasms, pain, intense thirst, &c.

The spasms are usually most severe at this period, and as formerly mentioned, seem to be intimately associated with *congestion* as an aggravating or exciting cause, being however essentially dependent on the peculiar morbid irritability of the nerves. Hence, the relief of congestion by *venesection*, warm bathing, diaphoretics, &c. as already advised, always mitigated, and sometimes immediately relieved the spasms. The tenderness of the surface, the neuralgic pains, and slight spasmodic actions which remain after congestion is removed, are easily combated by anodyne frictions, by external warmth, and by the internal use of camphor, opium, æther, &c. directly diminishing nervous excitement.

At this early period, the morbid sensation of thirst is becoming very distressing, and the anxiety of patients for *cold drinks* is exceedingly urgent. The free gratification of this desire is productive of much mischief by increasing the load and oppression at the præcordia, and aggravating the vomiting; and thus the exhaustion of the patient is enhanced by the quantity of fluid, and by the sedative influence of cold on the gastric mucous surface. Cold drinks if administered at all, should be given therefore in very small quantities, and at regular intervals, but in *ice* we have a most excellent substitute. Ice in small portions, allowed to dissolve in the mouth, is exceedingly grateful to the patient. It quiets this morbid sensation, and extending its influence to the nervous system generally, moderates its peculiar irritability, and the consequent restlessness, jactitation and anxiety which do so much mischief. Cold when thus administered has no perceptible injurious effects on the organic actions, indeed indirectly is useful to them, by quieting the nervous excitement which contributed to their further exhaustion.

3d. Should the above measures fail in arresting the course of cholera maligna, (which is very rarely the case,) the second or collapsed stage is witnessed, and very frequently, it is in this state, that patients are originally presented to the practitioner, either from neglect of early symptoms, or from the virulence of the disease.

As formerly shown, the state of the system and organs is similar to that in the first stage, but all the essential peculiarities of the disease are aggravated, particularly the torpor of organic life, and the morbid irritability of the nervous system. Hence the indications are precisely the same, but their fulfilment becomes exceedingly difficult, sometimes impossible.

The congestion and consequent oppression are greater, but the circulation is now so depressed, that blood can no longer be detracted

in any quantity from the vessels of the extremities, or if a small quantity be procured, reäction does not follow, and sedation is increased. Venesection should therefore be abandoned in decided collapse. Some advantage is occasionally gained by the use of cups or leeches over the vital viscera, but they also detract but little blood, and seldom fulfil the requisite indications.

Hence, our reliance must be placed on the *direct* mode of facilitating reäction by the judicious use of suitable stimulants, internally and externally. The attempt to fulfil this indication was attended with much difficulty from the peculiar morbid condition of the nervous system. External heat for example, so useful and grateful in ordinary cases of prostration, was here *intolerable*, notwithstanding the coldness and lividity of the surface, and the stagnant condition of the cutaneous circulation. Even the common covering with blankets was unpleasant, and all applications of hot bricks, sand, oats, of alcoholic, or other vapours, created great distress to the sensations of the patient, and hence aggravated his restlessness, increased the coldness and lividity of the surface, and the effusions from the skin, and hastened the fatal progress of the disease. Frequently also sinapisms could not be tolerated, or indeed any powerful rubefacient.

Similar difficulties, although not to the same extent existed as to the internal exhibition of stimuli, particularly as regarded alcoholic preparations: these could seldom be administered. Even the drunkard no longer hankered for his accustomed potation, and in all cases, spirits seemed to be unpleasant, if not injurious. Hence the rule adopted at the Penn street Hospital was *to stimulate the organic actions as freely as possible, without disturbing the sensations of the patient, or in any way aggravating the nervous irritation.* Fortunately this rule could be acted on, and yet powerful stimuli be administered externally and internally.

Externally.—Simple frictions long-continued with the hand, flesh-brush, or coarse cloths, were very important in relieving the torpor of the vessels. They became still more valuable when made with liniments or ointments, rendered stimulating by means of the aq. ammoniæ, the oil of turpentine, the tincture of capsicum, &c. Occasionally sinapisms, especially if lowered by means of flour, would be tolerated, at least for a short time, and then could be removed to another portion of the skin, (*"Emplastrum volans,"*) and very generally blisters, were borne without complaint. They were then very beneficial in relieving congestion and exciting capillary actions. A large plaster of cantharides was usually applied over the epigastric and sternum whenever the symptoms became serious, and frequently additional plasters to the extremities. If vesication were excited, stimulating ointments were used for the dressings.

Internally.—The stimulants best tolerated and apparently most efficacious, were the vegetable spices, especially cloves, ginger, and capsicum. The various preparations of æther, and of ammonia, also the oil of turpentine, were often advantageous; but of this class of remedies, nothing seemed to equal the capsicum, as well in its power of exciting capillary action, as in the little offence it gave the sensations of the patient. It could be freely administered. I adopted the following formula, which some eighty years since was recommended by Dr. Steuart, of London, for cynanche maligna:—Take three table-spoonfuls of common Cayenne pepper, and two tea-spoonfuls of fine salt; beat them into a paste; pour half a pint of boiling water on the paste, and strain when cold; add an equal quantity of strong vinegar. One table-spoonful was not unfrequently administered every half hour, for several hours in succession, and often with great apparent advantage. Camphor, opium, æther, and other narcotic stimuli were occasionally important, but should be given in small doses, and not too frequently repeated, as otherwise they would induce stupor, and perhaps aggravate the congestion, especially if reäction did not ensue.

But notwithstanding the importance and efficacy of these remedies, the main dependence, in most instances, should be placed on *mercury*, for reasons already advanced. If by the above-mentioned stimuli, the susceptibility of the tissues could be aroused, and life be thus protracted until a mercurial influence should be established, an evident and often a permanent effect will be induced. The capillary actions and secretions return, first internally, as indicated by the vomiting and purging of bilious matters, and by the discharge of urine; and then externally, as indicated by the pulse becoming gradually developed at the wrist, by diminution of the coldness and lividity of the surface, and increase of the cutaneous circulation. There is also a diminution or actual cessation of the effusions from the skin, stomach, and bowels. These favourable symptoms increase until the third, or recuperative stage of cholera be fully established, when of course a new and completely opposite condition of most of the tissues will ensue.

The manner in which mercury should be exhibited has been the subject of dispute, but in such critical circumstances, we should not incur the least risk of failing in an object involving the life of our patients, from timidity in the exhibition of approved medicines. Hence I used mercury freely, internally and externally. Calomel was given in doses of gr. v. with gr. ij. of powdered capsicum every half hour or hour, until some sixty or eighty grains had been administered, or sometimes in doses of twenty grains every three or four hours, while blistered and ulcerated surfaces were dressed with the strong mercurial ointment, and frictions with this ointment combined

with turpentine or capsicum, were made to the whole cutaneous surface.

Should any favourable indications appear, cathartics rendered more or less stimulating should be administered, to keep up the secretions now returning, and to carry off the excretions from the liver and mucous membrane which, remaining in the stomach or bowels, might oppress the powers of the system, or give rise to inflammation and its unpleasant consequences. Seidlitz powders, sulph. magnes. &c. were often given, as also the castor oil, oil of Croton, Warner's cordial, rhubarb, &c. I generally preferred a strong infusion of senna with ginger, as best fulfilling the required indications.

But while pursuing the above plan, attention should be paid to the removal of any additional cause of depression, particularly to that resulting from indigested food in the stomach and bowels. The best treatment is often unavailing when the stomach is thus oppressed by its contents, while all the symptoms of the disease are highly aggravated. Hence even in extreme cases of collapse, emetics are often of the greatest importance, and should be freely administered; hot brine, and also the mustard were frequently given; ipecac. and sulph. zinc. were much and advantageously employed. They had an effect, not only in relieving the oppression, but also in exciting the organic actions of the mucous membrane of the stomach and of other viscera.

For similar reasons cathartics were often to be given, even before secretions were restored, that the sources of depression from indigested food, fæces, &c. being removed, the system might more readily reäct.

When the spasms, which are generally moderate during this sinking state of the system, continue severe, partial relief may be afforded by powerful frictions, the use of the tourniquet, and the exhibition of antispasmodics, particularly the æther; but evacuations to relieve the congestion of the spinal marrow and brain are forbidden. The extreme sensibility of the surface, so intolerant of heat, is usually obviated by free exposure to the air, which relieves the restlessness and agitation arising from this cause, while the copious effusions from this tissue are moderated by the stimulating frictions and ointments already recommended, without offence to the sensations of the patient. The ointments and frictions seem very advantageous in diminishing the effusions and the coldness of the surface, by exciting the capillaries and lessening evaporation. *Ice* appears to be alone capable of allaying the tormenting thirst, with all its attending anxieties, and hence should be constantly supplied to the exclusion of cold drinks, which oppress the stomach and induce vomiting.

Should our efforts prove, as they sometimes may, successful, reäction

ensues in some of the forms indicated, presenting states of the system and the organs with which we are more familiar, but which nevertheless manifest some peculiarities arising out of the previous condition of the solids and fluids.

It was formerly remarked that the symptoms of the stage of reäction might be advantageously arranged under four general heads, demanding some important modifications of treatment.

1st. Healthy reäction.—The only attentions requisite in such cases are for the prevention of mischief, by a diet nutritious but easy of digestion; by suitable tonics to invigorate the digestive apparatus and the general system; by the occasional employment of simple enemata, or the mildest tonic laxatives, to maintain the peristaltic motions of the bowels; by the occasional use of a tepid or warm bath, with frictions and warm clothing, and by moderate exercise in the fresh air, to encourage a healthy action of the surface, and invigorate the general powers of the system.

2d. The second state of reäction noticed, is where, with the return of the natural secretions, there is a morbid excitement of the brain and nerves, greatly endangering the life of the patient. The symptoms being exceedingly analogous to those of mania a potu were to be managed on the same principles, by supporting the organic actions by nutritious food, condiments, tonics, and even stimulants, while the nervous excitement should be moderated by rest, seclusion and narcotics carefully administered. Cups or leeches, assisted by cold to the head, and revulsives to the body and extremities, were valuable in diminishing cerebral irritation and preventing congestion.

3d. The third variety of reäction, in which some important viscus became the subject of active congestion or inflammation, was very dangerous from two circumstances. First—the imperfect reäction of the general system, as the pulse usually remained very weak, and the extremities cold, and even shrivelled; and second, the active determination of blood to viscera already oppressed by a passive congestion. Hence active and passive congestion were conjoined, and the system was exhausted or oppressed, forbidding the employment of active measures. The indications however were clear to unload the affected organs, and to diminish their organic excitement. The antiphlogistic course should be adopted as far as possible: general bleeding could very rarely be tolerated, but cups and leeches could be freely and frequently employed with great advantage. All stimulants should be abandoned, the diet should be very simple, and cathartics be freely exhibited, unless severe gastro-enteritic irritations exist. They are exceedingly useful, as evacuants and alteratives when bleeding is forbidden; particularly as so much congestion

exists, and the secretions are so imperfectly restored; hence they should often be conjoined with mercury, unless the system be already under the influence of this mineral. Revulsives of every kind become very valuable as the sympathies are now reviving, to be applied not only to the still torpid extremities, but to the body, and especially over the affected organs. Much in this way may frequently be accomplished, although for reasons already stated, the engorgement could not always be obviated, especially in the old, infirm, and intemperate.

4th. The fourth series of phenomena characterizing the stage of reäction, were analogous to typhoid fever; no individual organ being the subject of such overwhelming congestion, but where the sedation of internal and external tissues was superseded by febrile irritation, generally with inflammation in some internal organ, and with some disposition to stupor. The treatment need not be specified being very similar to what is suitable in ordinary cases of typhus mitior.

From the pathological and therapeutical principles advocated, it would result, that the epidemic cause of cholera maligna is a sedative poison, causing a depression of the organic life, with some excitation of the cerebro-spinal system, differing therefore from the narcotic poisons, as opium, &c. which primarily excite the heart and arteries, and moderate nervous irritability. These narcotic stimuli might therefore be regarded as antidotes to cholera maligna, when not severe, or complicated with congestion, &c. Hence it may also be inferred, that the accessory causes of cholera epidemica impair vital power or action; some by a direct influence, as cold, profuse hæmorrhages, or other evacuations, anxiety, fear, &c.; others by an indirect operation, overwhelming vital actions, as indigestion from quantity or quality of the food, inordinate stimulation from food or drink, severe local irritation or inflammation. Finally, as a state of perfect health, where strength is greatest, and the functions are regularly executed, of course the blood equitably diffused to small and large vessels, is best calculated to resist injurious causes, the prophylactic measures must be based on the principle of supporting this normal condition in opposition to the depressing influence of the epidemic poison, as well as to the ordinary sources of disease. All inordinate stimulation from food, drinks, caloric, exercise, &c. are to be carefully avoided, while the organic actions are judiciously sustained at their healthy standard, by means already indicated.

My object was to present a selection of cases illustrating and confirming the observations and reasoning of this paper, but these from the want of space must be deferred. The following summary, from the Cholera Hospital, No. 4, on the Delaware river, in Penn street,

south of Pine street, may be of some value as connected with this essay, and with the history of the epidemic in Philadelphia. Dr. J. K. MITCHELL was appointed Physician-in-Chief, but in consequence of severe sickness resigned. The hospital was then committed to my charge, and I was ably assisted by Drs. SMILEY, USELMA CLARKE, MUSGRAVE, and EDWARD PEACE.

Admissions from the 4th of August to the 1st of September, with the results.

Whites - -	27	Males	13	Females 14
Coloured - -	9		3	6
Deaths - -	10		5	5
Recoveries -	26		11	15

Intemperate -	18,	of these 5 died.
Temperate -	15,	" 3 do.
Unknown -	3,	" 2 do.

Total number, 36—Males, 16; Females, 20.

Ages.—Under 10 years, 2; from 10 to 20, 3; 20 to 30, 14; 30 to 40, 6; 40 to 50, 8; 50 to 60, 2; 70 to 80, 1.

The admissions from the 4th to the 7th of August, under the superintendence of Dr. J. K. Mitchell, were 9, (of these 8 were from the Arch street prison;) of whom 2 died, and 7 recovered. From the 8th of August to the 1st of September, 27 were admitted; of whom, 18 were in the first stage, and 9 in a state of collapse.* There were 19 recoveries and 8 deaths. Of those admitted in the first stage, all recovered; one only, J. Hines, passed into the second or collapsed stage three hours after admission, having been ill for forty-eight hours.

Of the 10 cases of collapse, including J. Hines, 4 died in this stage.

1 in 12 hours after attack--4½ after admission.
1 in 36 do. 10 do.
1 in 9½ do. 5½ do.
1 in 24 do. 7½ do.

Six revived from the state of collapse.

Two recovered—1 after active congestion of the brain, on the 17th day after attack—14th after admission: 1 after severe nervous (cerebral) irritation, on the 12th after attack, and 14th after admission.

Four died—1 from congestion of brain, on the 3d day after attack—on the 2d after admission: 1 from nervous irritation, (as in mania a potu,) on 7th day after attack—on 6th after admission: 2 from typhoid fever—one on the 5th after attack, and 2d after admission—1 on the 5th after attack, and 5th after admission.

* None were regarded as collapsed unless the pulse was exceedingly weak or imperceptible, so that venesection could not be employed, and the surface cold, livid, with shrivelled fingers, &c.

THE END.