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THOUGHTS

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PRESENT THEORIES

OF THE

ALGIDE STAGE OF CHOLERA.

BY

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Mais cette première période offre-t-elle quelque symptôme constant, véritablement pathognomonique, qu'on puisse considérer comme l'élément essentiel du choléra, symptôme d'où découlerait les autres, et qui, par cette raison, pourrait servir à donner une idée nette et précise du mal? Ici, comme presque toutes les fois que nous cherchons à scruter les faits de trop près, les difficultés ne font qu'augmenter, et la nature intime de ses faits nous échappe. Dans le cas particulier dont il s'agit en ce moment, il est impossible de dire que tel ou tel symptôme soit constant, nécessaire, et pathognomonique; chacun de ceux qu'on pourrait croire essentiels a manqué dans certaines circonstances, de sorte qu'on ne peut dire autre chose que ceci, savoir; que cette première période parait consister en une perturbation profonde de l'organisme, d'où résulte une secrétion gastro-intestinale suraigué et un collapsus presque général. En dire davantage, nous semble impossible. Des cas de choléra, les uns sans vomissements, les autres sans diarrhée, ceux-ci sans alteration du pouls, ceux-là sans diminution de la chaleur, nous arrêteraient bien vite si nous voulions aller au-delà. DALMAS.

THOUGHTS ON THE PRESENT THEORIES OF THE ALGIDE STAGE OF CHOLERA.

While the recent outbreak of cholera has afforded many of us renewed opportunities for observation, it has also enforced a reconsideration of the prevailing doctrines of the malady. I have endeavoured, and I hope without bias, to study carefully its earlier stages; but always with a distrust of the conclusions drawn where they conflict with those arrived at by far abler heads than mine. In truth, so much has been done in the pathology of cholera, that it seems almost perilous to venture on the well-searched ground.

The still unsettled state of opinion, however, on some cardinal points, would seem to prove that even at present no theory completely satisfies the general requirements or carries with it sufficient weight whereon to build a rational therapeutic. It may so happen that the imposing conclusions of the latest research are scarcely yet sufficiently popularised among the profession to afford the necessarily severe though impartial test. We must, therefore, widen both our experience and our pathology; nor must we rest until we have thoroughly learnt from the teaching of the one the truth, or falsity of the doctrines of the other; for on the applied theory often depends not only the life of the patient immediately, but remotely, should he pass into the reaction stage.

Two theories find favour in our schools; and whatever other points of divergence may exist, they both agree in regarding cholera as the result of a specific poison. According to the one theory, the poison is breathed into the lungs, and entering the blood, disorders function there even to the extent of im-

perilling or destroying life, but seeking elimination through the gastro-intestinal tract. According to the other, the hurtful agent is received into this tract, acting primarily and destructively as an emeto-cathartic, and spreading its influence at large over both nervous and circulating systems.

For a right appreciation of these theories in their several points of detail, it will be expedient to take a brief survey of the morbid anatomy of cholera, at least of such particulars as more immediately concern the issue in question. The first great fact ascertained is the entire disproportion between the organic changes and the symptoms. It seems to have been generally admitted that morbid anatomy discovers nothing in the primary stages that can explain the phenomena observed during life. So that for the nature of cholera to be rightly conceived, it must be regarded as an alteration of function, not of structure.

These changes are as follows:—The eyes are collapsed and sunk in their sockets, the cornea almost desiccated, and the sclerotic and conjunctiva nearly black, the general surface is excessively shrivelled, and its still livid tint shows the stasis of the cutaneous capillaries, while the underlying muscles are of dark red colour. The sinuses of the brain contain dark grumous blood, while the brain tissue is often dry. The cerebro-spinal fluid is reduced to a minimum (Schmidt), the spinal venous system congested. The venous system and right chambers of the heart are full, sometimes to distension. The muscular tissue of the chambers has lost its contractility. The left chambers and systemic vessels are comparatively, sometimes almost totally, empty;* at others, in the upper part of the latter, much black blood is found, and the ventricle often contracted, sometimes quite flaccid; the coronary veins full, and the arteries contain black and coagulated blood. Slight ecchymoses are occasionally found upon the heart. The pericardium is usually dry and gluey. The blood, reduced to

* Dieffenbach, in a moribund case of asphyxic cholera, introduced a catheter through the axillary artery down to the heart; no blood flowed, neither did the catheter contain any. Majendie also, under the same circumstances, opened an artery and found it bloodless. *Leçons sur Cholera.*

a minimum in point of quantity—250 to 312 *grammes*—about 6 to 9 ounces, is greatly changed, sometimes black and fluid, at another thick, black, clotty, shining, tarry, or syrupy and of gooseberry-jam colour and consistence; its colourless corpuscles at times increased;* its chemical characters also greatly changed. The lungs are frequently healthy, collapsing from the ready exit to the contained air caused by the dry and otherwise empty bronchi (though now and then emphysematous), pale, dry, and nearly bloodless at their antero-superior portion; but, posteriorly, there exists more or less hypostatic congestion. The pleuræ are dry and sticky, with occasionally slight ecchymoses beneath their costal and pulmonic faces; the other serous sacs are in the same condition; the urinary bladder is always nearly empty, and contracted; the liver is often unchanged beyond slight congestion; the gall-bladder filled with brown or greenish bile; the kidneys occasionally congested with the lining of the tubes detached; the gastro-intestinal tract is here and there congested, its submucous tissue soft and pulpy with its epithelial lining more or less extensively detached and washed away; the various glands are swollen and otherwise changed; the intestines mostly contain a large, and frequently an enormous, amount of the rice-water fluid† occasionally mixed with blood. When this is drained away, a kind of pasty layer often covers the surface of the bowels. So that *cholera sicca* must always be taken simply to imply cases in which no great amount of outward discharge occurs, but in which either from impaction of solid matter below, general paralysis of the bowels, or reflex spasm of the sphincter muscle, the transudation is retained. To this point I would direct special attention from its obvious bearing upon subsequent positions taken with reference to the pathology of collapse. Although the conditions of the circulating and respiratory systems just described are such as agree in the main with the latest researches, and we may be practically safe in

* Reinhardt and Leubuscher.

† This is a fact constantly referred to long ago, not only by Brierre de Boismont and Legallois, but by some of the latest and best observers—Reinhardt and Leubuscher.

accepting them, I neither assert nor believe that they are sufficiently uniform to warrant a general conclusion.

It is well known that epidemics of cholera vary greatly in their general characters,* and it is highly probable that the *post mortem* conditions of the organs may vary also. Indeed, this matter seems placed beyond controversy by the acknowledged skill and trustworthiness of the observers. Cases are recorded in former epidemics in which, on *post mortem* examination made in the algide stage, not only was marked congestion of the lungs discovered, but even nodules of pulmonary apoplexy.† Annesley found both veins and arteries full of black, thick, viscid blood; Christie, black blood in all the vessels, especially in the heart. Labrousse, in ten carefully conducted examinations, found the coronary arteries always full of very black and coagulated blood. Sokolow, again, a most competent authority, as the result of a very large number of autopsies made during the epidemic of Arenburg, found the lungs congested and filled with black blood. Lastly, Jähnichen and Marcus, assisted by several other pathologists, out of forty autopsies made, as the Committee of the Royal Academy of Medicine of Paris report with care, and stated in great detail,‡ found black blood in the heart and arteries, especially the coronary arteries of the heart. Standing between these earlier and later observations and embracing the results of each, are those of Dr. Parkes, who is considered one of the most reliable of English authorities on cholera.

I would further add in reference to the morbid anatomy of

* The following remark is unquestionably from one of the most experienced of modern continental observers, and whose memoir, written conjointly with Reinhardt and Leubuscher, deserves serious attention. "Es ist wahrend der letzten Epidemie öfter geäussert worden, die Cholera sei nicht mehr dieselbe, wie im Jahre 1831, als sie zuerst auf deutschem Boden epidemisch auftrat. Dieselbe Behauptung ist schon 1837 von manchen Aerzten, namentlich von Romberg, der in allen Epidemien sehr viele Cholerakranke gesehen hat, aufgestellt worden." Schütz, *Bericht über die Cholera-Epidemie des Jahres* 1848 *in Berlin.*

† Grisolle, *Path. Interne*, tome i, p. 969. Michel Levy and Tholozan, *Epidemic of* 1849.

‡ *Rapport sur le Cholera Morbus*, 1831.

cholera, that a fatal case of cholera nostras occurred in the practice of Professor Griesinger of Tubingen. The patient died in the algide stage. The examination yielded the same results as those described by the latest anatomists as peculiar to epidemic cholera, so far as regards the state of the thoracic viscera and the distension of the bowels, by a thin, very clear yellowish fluid. He, moreover, states that examinations by other pathologists of the same disease gave similar results.*

There remains one fact I would advert to in the morbid anatomy of cholera. It has been shown that the right heart, large veins and pulmonary arteries are found filled more or less with black, fluid and clotted blood. It will be subsequently seen that Griesinger states that percussion, during life, shows, as a rule, that the cardiac area is small, and states that the fulness named must be a late result. It is just possible that the right auricle, the *ultimum moriens*, may, in its latest struggles, suck in blood from the veins which, distending the right ventricle, may escape, using the artery as a safety valve. So that this appearance may be almost a *post mortem* result.†

In possession, then, of the leading facts hereby furnished, and keeping steadily before us what light they give, we shall be better prepared for an inquiry into the merits of the respective theories and the order of the sequence they attempt to explain. The points at issue, as regards the first theory, may be arranged under the following heads :—First, is cholera the result of a peculiar, though unknown poison, inhaled into the lungs and received into the blood? and, second, has the poison thus introduced the attribute accorded to it by Dr. George Johnson, and by him most powerfully advocated, of inducing, primarily, a spasm of greater or less degree of the minute branches of the pulmonary artery? It is almost unnecessary to remark that, if this first theory be correct, the elimination act

* Cholera nostras. Virchow, *Handbuch, etc.*, B. II., Abth. ii, 1857.

† Presque tous les écrivains qui ont traité ces matières, font les veines pleines de sang après la mort ; et cela est vrai de la veine cave et des autres gros vaisseaux, dans lesquels le froid et d'autres causes, dont je parlerais au chapître sixième, poussent le sang, qui s'amasse à l'entrée des poumons. (Haller, *Sur le mouvement du sang*, p. 96.)

is a necessary consequence, such a process being so thoroughly in harmony with all we have been taught respecting Nature's efforts should any noxious agent contaminate the blood.*

With reference to the proposition under the first head, it might reasonably be supposed if cholera poison could be inhaled into the lung it might be exhaled likewise, and that the disease would be more infectious, especially in its *foci*, than seems at present shown by observation; indeed, observation is rather at variance with the hypothesis.† Injections again of the blood of infected patients when introduced into the veins of animals or of the human subject might be supposed capable of inducing violent results. Schmidt has shown that such injections into the veins of animals are quite innocuous, though his experiments do not accord in their results with those of Meyer and Majendie. Both Pirogoff and Schmidt have also had their hands, recently wounded, steeped in the blood of cholera patients living and dead without any injurious result accruing.‡ And this is surely very extraordinary.

The latter author relates in addition an instance of a drunken man swallowing, accidentally, the recent vomited fluid of a cholera patient without injurious effect. The result is apparently explained by the more recent researches of Pettenkofer, which tend to prove that decomposition of the excreta is requisite for the development of the specific poison. It is still uncertain what is the essential nature of the poison, whether animal, vegetable, or chemical. If the poison be of organic and not of chemical nature, all that can be said of so mysterious an agent is, that decomposition seems essential to the birth of the foul progeny.

With regard to the elimination act, though on the theory,

* Here most are Animists in a true Stahlian sense, and think that Nature almost with intelligence directs the way. Those who are curious to learn the arguments advanced against the *vis medicatrix* are referred to Littré's famous essay in the *Revue des Deux Mondes*, April 15, 1846.

† There are some remarkable facts which seem to favour this view. For a very instructive example, see the account by Dr. Barrow in the *British Medical Journal* for Nov. 3, 1866. The writings of Dr. Budd also must be particularly referred to.

‡ Schmidt, *Character. der Epidem. Cholera*, s. 79, 1850.

admitting the necessity, it must be owned that Nature here adopts a singular device, one mostly at the price of safety, for death too often happens in the act.* It may, however, be rightly urged in counter argument that, in such particular, cholera but approximates in action to some other eliminative poisons of the blood. Still cholera poison must undergo prodigious increase to require such an amount of elimination, dissipating nearly all the fluids of the body, and reducing, as has been seen, the aggregate amount of blood to 250—312 *grammes*, about 9 ounces English measure.†

It is alleged, however, by the advocates of the blood poison view that death, at times, may be directly consequent upon the disturbance of the great functions of respiration, circulation, and consequent calorification without any marked evidence of extra-vascular transudation of the vital elements of the blood. If, during the prevalence of the epidemic a sufficient number of well-marked examples should present themselves, and of such there should be no scarcity where people became cyanosed and passed, almost at once, into the algide stage without either the external evidence of serous vomiting and purging *or the internal evidence of such transudation*, easily detected by percussion, further argument of course would end. But this result is very far, as yet, from being found. I must not be understood as denying the occurrence, but would ask whether such cases do not constitute exceptions to the general rule. Post mortem

* I cite here the testimony of that most experienced physician in cholera, Schütz. "Kranke, die bis dahin nur au Durchfall und Erbrechen gelitten halten, ohne dass im Pulse, so wie in dem Turgor der Haut sich bereits erhebliche Abnormitäten wahrnehmen liessen, leerten in meiner Gegenwart grössere Massen nach oben und unten aus und mit diesen profusen Entleerungen enstand in Kurzer Zeit ein auffallendes Sinken des Pulses und ein allgemeiner Collapsus, der dem Krankheitsbilde ein ganz anderes Gepräge gab und die enterische Form zur asphyktischen umgestaltete. *Op. cit.*, s. 394. Bei Eintritt der Reiswasserstühle sinkt die Temperatur der Haut oft plötzlich. Reinhardt and Leubuscher. In some cases, such has been the enormous amount of serous drain from the bowels, that not only the bed has become soaked, but the discharge has even run in streams upon the floor. The immediate influence such a drain must exercise upon the balance of the circulation may be easily conceived.

† Michel Levy and Tholozan, *Epidemic of* 1849.

investigations tend quite in the opposite direction, nearly all showing the intestines more or less filled with the peculiar fluid.* It is obviously difficult to estimate the further amount of transudation required to produce collapse in subjects weakened either by prior illness or by anteceding choleraic diarrhœa. It doubtless greatly varies, for we have yet to learn the precise relation in which such diarrhœa stands to cholera; it is nearly certain that it is the first stage because the excreta are capable of spreading the infection. We can but roughly judge from observing how frequently in delicate people slight looseness of the bowels will induce extreme prostration, and how often the loss of but three or four ounces of blood in some fat people will cause impending syncope. Nor can we even say it is the actual quantity of poison received into the system. There may be such organic susceptibility that a minimum quantity may induce unusually violent results. That comparatively sudden death may happen when certain poisons act with deadly power upon the organism is familiar truth—witness the plague, the fatal endemic fevers of the East, and some in our own latitude; but here the shock annihilates, at a blow, the vital powers both of the blood and nervous centres, and the victim passes from coma on to death before the changes in these systems can be developed.

As already mentioned, great extension has recently been given to the first theory by Dr. George Johnson, who postulates the existence of spasm of the ultimate branches of the pulmonary artery.

I may at once observe that any theory of the action of cholera poison propounded by Dr. G. Johnson would be sure to meet with due consideration, because it is known that he has bestowed both time and labour upon the history of the disease. Whatever may be the ultimate fate of the theory it must be allowed without dispute to be one of the most original and important suggestions that has yet been made concerning the pathology of cholera. The foundation for the hypothesis may perhaps be discernible in the writings of Dr. Parkes, but without prejudice to the direct enunciation by Dr. Johnson.

* Vide p. 5.

First, then, this theory commends itself by its simplicity and by the direct clue it affords to the early supervention of the algide stage. The specific poison dams up, by inducing spasm, the pulmonary circulation, and if sufficiently intense and uneliminated, by interrupting the vital and chemical processes conditioned on the freedom of the route, may terminate existence. It is, moreover, sanctioned, nay, even apparently supported, by the morbid anatomy of the disease. Happily, *vires acquirit eundo*, as it seems to me, by contrasting it with the phenomena of pernicious ague (the algide fever of the tropics) to which indeed Dr. Billing has likened it.* When death occurs in the algide stage, an event by no means uncommon, and very often without diarrhœa the post mortem results so far as regards the thoracic viscera, exactly resemble those observed in cholera. It is true that such results in algide fever have been generally attributed to acute paralysis of the heart. If such position be untenable, then, other blood poisons may act in the manner assumed by Dr. Johnson in the case of cholera. So that if we are permitted to generalise this action of some morbid poisons in the blood, the theory of Dr. Johnson may be capable of a far wider application.

Another link in the chain of evidence is afforded, at all events is common property, by the results obtained by Dieffenbach and Majendie, and alluded to in a foot-note some pages preceding with respect to the occasional vacuity of the left heart and arteries.

The following objections occur to me with respect to the theory of Dr. Johnson.

* The very original views of Dr. Billing will, I feel convinced, gradually increase in favour; based as they are upon facts too important to be here properly discussed. Not least among the number is the remarkable case of intermittent cholera which so astonished Majendie and his students (*Leçons, etc.*, p. 229), and which was cured by quinine. Even assuming this case to have been only a form of aberrant ague, the alliance between the two diseases must be both intimate and strong. In a case related by Folchi, *Exercit. Pathologica*, p. 14, 1840, of pernicious ague occurring at Rome, it would have been impossible, had the epidemic prevailed, to have distinguished it from one of cholera.

The alleged spasm is rather a matter of inference than of actual demonstration. The phenomena supposed to depend thereon may admit of a different explanation. It is unquestionably shown by morbid anatomy that black blood is occasionally found in the left ventricle, and sometimes in considerable quantity in the upper portion of the aorta. Its presence with such character appears to be totally irreconcileable with any hypothesis of simple spasm. If the spasm were even assumed at times as clonic, to relax its grip, the blood (unless the poison possessed the power to change its colour which is without a shadow of proof) must be oxygenated, for, as a rule, the air traverses freely the remotest cells. It is also opposed by the experiments of Majendie, who, though noting the rare occurrence of almost perfect vacuity of an artery, was nevertheless most firmly convinced that the blood traversed the pulmonary capillaries even in the most exquisitely typed instances of algide condition,* and who illustrated the proposition by exhibiting the black blood, just abstracted, to his hearers, as also by the injection of ether and dissolved camphor into the veins and bowels and detecting the vapour in the expired air.

Moreover, were the theory correct, no sooner had the incubation stage expired and the actual invasion period set in, the agent having for its essence the production of spasm of the pulmonary arteries, such spasm should correspond with the invasion, and algide phenomena precede, at least coincide, with transudation into the intestines, and decrease in proportion to the eliminative discharge. Is this sequence in accordance with ordinary observation?

Again, if it be a characteristic of cholera poison to induce spasm of the pulmonary arterioles and of those of the muscular tissue (?), causing the severe cramps, why do the intestinal capillaries evade the law? We can quite readily understand the action of an agent upon a given organ, or system of organs, *e. g.*, opium upon a certain portion of the brain, strychnine upon the spinal chord, emetin on the stomach, and so forth,

* La continuation de la circulation à travers le tissu pulmonaire est un point capital relatif à l'histoire de la respiration des cholériques. *Leçons, etc.*, p. 104.

but we can hardly understand an agent though for a purpose of elimination, blowing, as it were, hot and cold with the same breath, as for example, strychnine contracting one set of muscles and relaxing another. Agonising cramps are certainly not the exclusive monopoly of epidemic cholera poison, for nothing surely could exceed the violence of those mentioned by Sydenham in the bad sporadic cholera of 1676, the patient jumping out of bed frantic with pain, with a pulse scarcely perceptible.* Death often occurred in twenty-four hours.

Next, with respect to the influence of warm saline injections into the veins. The instantaniety of their action shows that the pulmonary circulation must be free. But, as to the explanation of this indisputable fact? Is it in accordance with Dr. Johnson's views that their temperature relaxes spasm, or may it be that the restored liquidity of the blood again affords the condition of its motion? It is, I cannot but imagine, making a large demand on our belief to require the admission that warm venous injections should so quickly cause a spasm to unloose its hold that had obstinately resisted the opium, stramonium, valerian, ether, inhalation of hot vapour (Piorry) of ether, so often and so vainly tried! Saline injections by the time they reached the heart could scarcely possess a temperature very much higher than that actually existing in the right chambers, why then should they be more efficacious in a mere point of temperature than the warm blood therein, were not this blood vitally and physically changed and stagnant by the privation of that intercellular fluid which we are taught by physiology imparts the requisite glibness to its movement, and without which arrested movement would be the inevitable result. This want of motion may be increased by the tendency of the augmented number of white corpuscles, mentioned by Virchow, Reinhardt, and Leubuscher, to adhere to the vascular walls. In fine, saline injections afford for a time pabulum and restore the equilibrium of fluid pressure; they fail, however, in maintaining the vital machinery permanently in action, partly because they again

* In the epidemic of Berlin, 1848, a precisely similar instance is recorded by Schütz. Virchow, *Archiv.*

transude, but principally because they fail in what the blood demands, the restoration of its proteine elements.*

Lastly, we must look at the theory of spasm as tested by the existence of dyspnœa. If the minute branches of the pulmonary artery were closed by spasm, dyspnœa should scarcely ever be absent; indeed, it should be a very prominent symptom in the algide stage; that it is not so in many cases I can most confidently assert. The observations made by Mr. Hill and myself at the Royal Free Hospital, and by me at the East end of London, I can truthfully say have been too carefully made to overlook this important point.† I admit the difficulty holds on any theory, still the fact remains and must be explained by some condition of innervation.‡ The percussion of the cardiac region also yields no evidence of distended right chambers.§ The left ventricle evidently beats to the last; and although the sounds are dull and toneless, resembling those produced by Dr. Halford on closing the pulmonary veins for a short time, still some

* In connection with the question of venous injection, it may be excusable to state that I have paid much attention to this subject, and was, unless I mistake, the first in this country to propose transfusion of blood in some of the blood poisons (*Essay on the Poison of the Cobra di Capello*, Highley, 1852). A week or two since a letter on this subject in connection with cholera was sent to the editor of the *British Medical Journal*, Nov. 10, who did me the favour to insert it. Since then, I have again looked over the results obtained by Dieffenbach from transfusion in cholera, and fancy I discover the cause of his failure. It now occurs to me that the way to ensure the success of the plan is, first to employ the saline injection, and when the circulation is restored, by giving to the blood discs their normal liquidity, then to transfuse blood under the condition insisted on by Panum. The action even of saline injection surely points out the path to follow, no other remedy in the algide stage of cholera for one moment approaches them in their magically resuscitative power.

† The observations of Reinhardt and Leubuscher, *Epidemic of* 1848, fully confirm this statement. "Bei vielen Kranken blieb indess die Respiration bis zum Tode hin ruhig." Virchow, *Archiv*, s. 440, II Band, 1849.

‡ Ainsi donc si la respiration des cholériques est altérée, ce n'est pas par obstacle physique au cours de sang à travers le poumon. Majendie, p. 115.

§ Die starke Füllung des rechten Hertzens scheint während des Lebens noch nicht vorhandin zu sein; die Percussion ergibt (constant?) einen Kleinen Umfang des Hertzens. Greisinger. Virchow, *Handbuch*, B. II, s. 326.

blood must pass as we have already seen. Occasionally the cardiac sounds are attended with bruit from the obstruction offered by the thick and clotting blood.*

The phenomena of intermittent cholera and of the occasionally observed lung cholera are as inexplicable on this as any other hypothesis.

We have now to ascertain what arguments can be adduced in favour of the second theory, viz., that which affirms the cause of cholera to be a poison acting primarily upon and through the gastro-intestinal canal by rapid drain and spoliation of the blood and co-extensive shock upon the spinal chord, cardiac and great abdominal ganglia.

Notwithstanding the opposition this view is now encountering from its talented antagonist, it ranks among its supporters, men of worth and with such clinical knowledge of the various epidemics here and abroad as to enforce authoritatively the fullest examination. No summary dismissal can be tolerated. Perhaps no simpler plan can be adopted prior to the development of the theory, than first to take a passing glance at some points in the general pathology of this extensive tract, next to study some coguate affections and trace the analogies they present.

The affections of the gastro-intestinal tubing and of its investing membrane are alike remarkable, when extensive or severe, for their depressing influence upon the functions of innervation, circulation, and calorification. Consider perforation of the stomach, ordinary, perforative and puerperal peritonitis; the action of certain poisons, such as arsenic, etc., and see how suddenly collapse (algide) phenomena ensue. Indeed with respect to the last mentioned agent the greatest difficulty might, in a diagnostic sense, occur during the prevalence of

* I can neither explain nor understand the statement of some observers that the sounds of the heart are clear and loud almost to the last. If it were so, there could be neither spasm nor obstruction. The left ventricle, as has been shown, is nearly empty, the pulse extinct, and the right ventricle replete with blood of the character just described. If the observation be correct, subject to these conditions, it is clear that the sounds must acknowledge other causes than the shock of normal blood against the valves.

cholera. In the first examples but little actual transudation may ensue; but here, loss and shock are, practically, convertible terms. Let us again select one or two examples of remedies acting like poisons by a relatively overdose. Who can have had much experience in the use of elaterium in the dropsical effusions of cardiac diseases and not have witnessed well-marked examples of impending collapse follow from the enormous drain of serum from the blood, the rapid sinking of the pulse and temperature, with cyanotic tint, requiring at once the liberal use of stimulants, opium and warmth, and all this from what was from the idiosyncrasy of the patient, a relatively overdose? and who could resist the conclusion that if the action of the poison did not cease death must ensue? The entire class of remedies of this description administered with the direct intent of causing watery drain must, if true to their mission, necessarily rob the blood of its fluid constituents rendering it thicker and more concentrated for a time. They equally give the mucous lining a sodden, succulent appearance and force away its epithelial lining. In such a case, however, the balance of the circulation is soon restored by the sucking in by the vessels of the serous fluid effused into the serous sacs and connective tissue by the diseases for which they are administered. Dr. Wood, of Philadelphia, no ordinary authority, states that in a case of poisoning by croton oil there existed vomiting, purging, burning pain in the œsophagus, great prostration, *with appearances resembling those of the collapse of cholera.* These few examples show how certain agencies may act, and, so to speak, foreshadow cholera. They are, however, unfit for more than superficial comparison in consequence of the associate irritation they induce from concentration of the agent. These toxics agree in action with that of cholera in the great fact of their specific power of soliciting a transudation process from the intestinal capillaries; they differ not so much in intensity as in continuousness of action, their action ceasing with the dose; that of cholera is continuous from the incessant multiplication of the poison.

We next proceed to the examination of affections having direct kinsmanship with cholera. The *symptomatic* difference being one simply of intensity.

I shall first borrow from Trousseau,* whose graphic power of description will not, I take it, be impugned. There is an affection excessively fatal at times in Paris, and termed by him "Infantile Cholera" (Summer-disease of American Pathologists). Its principal characters are:—Sudden and remarkable change in the physiognomy; the face of leaden hue, though not markedly cyanosed; the eyes deeply sunk in their sockets, and surrounded by a blue halo; the nails are also blue; the pulse at first excessively frequent; the thirst intense; the voice husky (choleraic?); the vomiting and purging excessive; the discharge consisting of a greenish serum; the temperature rapidly falls, and death is frequent in the algide stage with increase of the symptoms. Should the child pass into the reactive stage, the typhic phenomena resemble those of epidemic cholera. Here, then, is an illustration of a typical affection occurring at a given season in ill-nourished children (much resembling cholera, it must be confessed), yet differing from it in the entire absence of any special poison, but from the nervous shock and drain, speedily passing into an algide stage. The sequence here seems tolerably clear.

To take another example, and that, we must allow, an exaggerated one, from severe English cholera. The evacuations may be excessively profuse, from three to twenty in a few hours. Well marked algide phenomena are at times observed; the tongue and breath are cold, and the urine suppressed. Griesinger states that he observed a case of this description, in which the face and hands were as blue as in an advanced stage of Asiatic cholera. We have also seen that the cramps may be equally severe, and the *post mortem* results identical.

Searle† relates the following occurrence. In the year 1829, at a boarding school for boys, in the neighbourhood of London, a sewer full of mud was emptied, and the horribly fœtid decomposing matter placed in the garden. Within two days, twenty out of thirty boys were seized with English cholera; two died, and the *post mortem* appearances were identical with those of Asiatic cholera. The observer, as is well known, was

* *Clinique Médicale*, t. ii, p. 444, première édition.

† *London Medical Gazette*, vol. 4, p. 375, 1829.

most competent, having specially studied the subject. Here was an unequivocal example of fatal English cholera, produced either by direct absorption of a poison into the blood, or by a profound impression upon the nervous system through the olfactory ganglia.

Once more, then, is found a class of cases in which, from the severity and excess of the discharges, algide phenomena are induced, and this, exception made for the last case, as is generally believed, without the necessity of admitting the influence of any special poison, an admission, however, I must say, I believe a very hazardous one. But, admitting the adopted view, if such cases occurred during the prevalence of epidemic cholera, they would, beyond all doubt, be included in the category. Is the difference then one of kind or only of degree?

From the preceding sketch, I think there is a warranty for drawing two conclusions. First, that affections of the gastro-intestinal tract and its associate structures, by the shock they reflect into the nervous ganglia, may seriously embarrass the higher functions of respiration and circulation, and induce the symptoms of profound collapse; second, that, in addition to such shock, excessive draining of the serous elements of the blood may further cause the milder form of algide phenomena—and this, as generally admitted, without the aid of any special poison in the blood—it now remains to show the culmination of this state by the still greater drain produced by epidemic cholera, and rendered manifest by every evidence that a shrunken, shrivelled, dried-up body can adduce.*

Before proceeding with such attempt, it may be useful to recall to mind certain general facts connected with the action of poisons. There appear to be three modes in which a noxious agent, insufficient in intensity immediately to destroy life, may affect the system. Such agent may be immediately introduced into the circulation, or mediately through the lungs or gastro-intestinal canal, or it may directly operate upon the nervous

* Après la mort, il est difficile d'en (sang) recueiller plus de huit ou dix onces sur un cadavre, quelquefois je n'ai pu en obtenir que moins de six onces; ce fait s'explique par les évacuations abondantes qui ont leur source dans la masse du liquide sanguin. Majendie, p. 133.

system. When either of the former modes occurs, there exists a tendency to simple elimination through some given channel, and usually through the medium of increased secretion: in one case by the bowels, in another by the kidney, skin, and so forth. It would be vain inquiry why Nature selects, in each particular case, some given outlet. The fact is ultimate, the reason inscrutable. The same statement applies even to the action of our most ordinary remedies. There remain mysterious affinities of agent and organ we cannot yet unravel.

The third manner in which such agent may effect the system is through the solids by direct impression on the nervous system. It has been long admitted that the presence of a worm or other irritant in the bowels, may, by reflecting irritation on the spinal chord, determine violent convulsion without any aid from the process of absorption. It is conceivable that cholera poison might come within the category, and that a micro-zoon or -phyton might not entirely be a figment of imagination. In place of almost universal spasm, the choleraic cause might reflect irritation on the spinal centre and invite the transudation stream by influence on the vaso-motor nerves.

There is assuredly nothing in the *prodromata* of cholera—the prostration, giddiness, tinnitus aurium, pallor, syncopal tendency, loss of appetite, abdominal uneasiness—inconsistent with this view, for such symptoms are incident to most disorders of the digestive tract. Indeed, the hypothesis of a microscopic organism is even supported by the extraordinary discovery by Bilharz,* of very numerous microscopic ova of a *distomic hæmatobium*, not only on the surface of the intestinal mucous membrane, but within the submucous tissue, and even within the capillary vessels of the glandular tissue of subjects dead of dysentery at Cairo. This pathologist even originates the question whether this distoma does not stand in the same relation to dysentery that the acarus scabiei does to psora. The observations also of Sir H. Holland,† "Hypothesis of In-

* Henle, *Rationell. Patholog.*, B. II, s. 448.

† *Medical Notes and Reflections.* See, moreover, with especial reference to the existence of some fungoid organism, the researches of Melzer, 1856.

sect Life as a cause of Disease", will amply repay perusal in their relation to cholera. Without for one moment asserting such to be the cause of the disease, it is only conjectured that its action might commence from the intestinal tract.

But, ceasing this digression, a rallying point is found in the known action of certain agents, when introduced into the blood, upon given portions of the nervous system. Strychnia limits its action to the spinal chord, digitalis to the ganglia of the heart, emetin to the stomach, croton-oil to the vaso-motor nerves of the large intestine, while other agents it may be by a local influence, as melons, cucumbers, modify the function of the nerves of the small intestines, causing transudation into the corresponding portion of the canal. These latter results have been pointed out by Schmidt, and correspond, though on a minor scale, with those induced by cholera poison, and they would seem to point to the great danger of administering any purgative medicines, particularly those of the saline class* during the prevalence of cholera for any slight disturbance of the digestive functions; for should a minimum dose of poison be in the system, such agents might excite a fatal transudation stream; the same caution should be observed with respect to sudden change of temperature, a most frequent determining cause of cholera, through an influence over the spinal centre.

If we consider the enormous transudation which occurs in cholera (whether regarded as eliminative or otherwise, but little matters to the argument) we find an influence exerted on the largest and most rapid scale over the standard composition of the blood. With each half circuit a large amount of its watery part and salts escape with corresponding spoliation of its fibrine; so that the returning current by the veins gradually

Thiersch, Pacini, Mühry, and more recently of Dr. Beale, who has detected in the excreta the presence of the bacteria, but without supposing it essential to the disease.

* Twining relates a case in which a dose of salts caused rapid death by cholera. *Broussais* observed during the last three or four weeks of the epidemic of Paris, 1832, that the smallest doses of tartar emetic produced the most dangerous symptoms; excessive vomiting and purging, algide phenomena, and failing of the pulse. *Rigler* noted similar results at Constantinople in 1847.

becomes more concentrated and dense and *pro tanto* less disposed for motion. To restore the balance for a time the lubricating and nutritive fluid of the various sacs and tissues is absorbed into the circulation, again to pass by the transudation stream. While the vessels lose rapidly the fluid in which the blood-discs float, exosmose of the intra-corpuscular fluid, as Schmidt has shown, occurs into the main channels to be transuded in its turn into the intestines, and thus the act of hæmatosis must be eventually seriously impaired, for it is difficult to conceive that a fluid as unfit for motion as for oxygenation could traverse readily the delicate channels of the lungs,—and do not the characters of the residual blood, black, syrupy, clotting and stringy, reduced at times almost to a *magma*, justify the view? The right ventricle must labour hard to force such effete fluid onwards, and that which passes to the left heart, an ever lessening quantity, as shown by the failing pulse, circulates through the coronary arteries (where it is found after death black and coagulated) still adds by its paralysing influence to the embarassment of the right chambers.

The final result of such disturbance of the equilibrium of the circulation would be; fulness of the right heart with strings of coagula often extending into the pulmonary artery; partial vacuity of the left chambers and systemic vessels, diminished fluid pressure, absent *vis à tergo*, arrest of renal, depressed sensorial function. It is obviously a mistake to suppose that great engorgement of the venous system generally exists. This cannot be, for often not more than from six to nine ounces of blood remain free within the body, a fact attested by the very best observers.* This small quantity of slowly moving blood is limited principally to the large veins near the heart,† while another quantity is left stagnant and motionless over a large superficial area of capillaries, a result dependent partly on diminished *vis*

* Dieffenbach, Majendie, Michel Levy, Tholozan.

† When the pulse is nearly or quite gone at the wrist, and the cardiac pulsations are hardly perceptible, at this period the blood, which shortly before was only thick, black, and difficult to obtain from the vein, can now no longer find exit, or at least is only forced out with difficulty. *Report of French Committee*, p. 13.

à tergo, viscidity of fluid, low temperature of the surface,* and almost universal arrest of nutrition.

Now it is readily conceived that a poison, as, for example, serpent poison, may vitiate the quality; but what disease but cholera can so completely diminish bulk of blood, and in what way save that of transudation?

But other factors, coextensive in their operation, weigh with cumulative force. As a direct result of loss of blood and fluid pressure, conjoined with the exhaustive influence of the incessant vomiting and purging, profound disturbance of the spinal centre, abdominal and cardiac ganglia further diminish both temperature and cardiac power. When, finally, we superadd the action of a poison either existing in the blood or sucked in from the intestinal canal and carried to the right chambers of the heart, the sum of fatal operations is complete.

That this analysis finds some support from observation I do believe, but that it is very far from perfect no one can feel more than myself. That cases can and will be cited in disproof† I admit; indeed, all must admit that there are still residual difficulties in the study of cholera—gaps which require filling in—awkward cases that will not, seemingly, mould themselves to any extant theory—changes peculiar to the different epidemics probably dependent upon the *constitutio anni* and upon individual peculiarity,—are facts forced upon us by our daily experience. The circle of inquiry, however, appears now so much narrowed that we must hope these difficulties are not invincible, and that ere long we may be rewarded with a pathology sufficiently comprehensive to warrant a more uniform plan of treatment than at present exists; for it is certain that one or other theory must be radically wrong, and consequently, in its application, proportionately destruc-

* Dove's experiments on the influence of temperature over the transit of fluids.

† Perhaps best from Romberg, *Epidemic*, 1855.

tive. In our present painful transition stage of treatment, each practitioner must, from the conflict of views,* trust to his judgment in the individual case.

That cases may do well without our aid we sometimes see, for cholera has its *plus* and *minus* forms. But, face to face with the disease in its more serious shape, eye witnesses of the telling influence of the oft frightful drain, does it impress us as nature's act to cure, or carry with it one character of safety? do patients tell us at each escape of fluid they feel relieved or have their strength increased? for such are the results that should attend eliminative or critical discharge.† If they do, their looks belie them strangely. In such a state, no matter how we regard the disease, fever or flux, irritation or poison—no matter how we treat it—calomel to restore the bile, salines to moderate the congestion, or opium and astringents to repress—again and again we seize the symptomatic indication, and try our best, each in his way, to stop that vomiting and purging, alike the symptoms and the danger of epidemic cholera.‡ Is this mere routine, or the settled con-

* Compare, for example, the theory of Dr. Johnson with the views this week put forth by a physician apparently of much experience in cholera, Dr. Beamish. *Medical Press*, Nov. 13.

† Is the discharge eliminative, and if so, what is eliminated by the drain? Nothing that the most refined chemistry or microscopy can detect, nothing that seems directly infectious, but only becoming so from decomposition. Arguing from analogy, the elimination that removes a poison from the blood generally happens in the febrile or reactive stage, the visible evidence of Nature's power to struggle with her oppressor. "Nature," says Sydenham, "being by this means irritated, raises a fermentation in order to expel the enemy with less difficulty, this being the common instrument she uses to free the blood of its morbid particles, as well in fevers as in some other acute diseases." There are other affections caused by some poison in the system, as ague, erysipelas, and others, in which we do not trust to any elimination, but having tolerably certain remedies at hand, stop the disease yet nascent, not only without injury, but really with the prevention of injury. In the latter disease, we try to arrest even the elimination by covering the cutical patches with iron solution.

‡ Unless some singular error prevails, the arrestive treatment yields by far the best results. According to Boudin, *Traité de Géograp. et Statistic. Médicales*, p. 366, 1857, the mean mortality is thus stated—

viction of reasoned experience? If we are wrong, we have at least for our consolation the example of our betters; take that of the late Dr. Graves, a physician of more than ordinary fame, or look abroad, and search opinion there;* and in the face of such teaching it must, indeed, require overwhelming evidence in favour of an opposite procedure; for the experience of able men, when theories clash, must be the fitting and the only guide.

One closing argument in favour of the arrestive plan may be drawn from the state of the epithelial lining of the gastro-intestinal tract; the longer the drain the greater the destruction, and the more tedious and intractable its repair.

Evacuant treatment	-	-	-	71·7 in 100	
Stimulating	,,	-	-	- 54	,,
Alterative	,,	-	-	- 36	,,
Astringent	,,	-	-	- 20	,,

To understand the exact arrangement of his tables the original work must be referred to.

* Ainsi, en général, plus les evacuations sont copieuses et prolongés et plus le choléra est fatal. Majendie, p. 133.

C'est sur-tout à diminuer les evacuations qui doivent tendre les indications symptomatiques. Rien ne mène plus rapidement à la ruine des forces, rien ne hâte davantage le progrès des plus redoutables symptômes, que la fréquence des vomissements et des selles. Non-seulement alors toute medication, toute réparation, sont impossibles, mais il en resulte encore un épuisement général et une perte absolue de toute resistance vitale, par les déperditions et par la lassitude que causent les besoins sans cesse renaissans de ses dejections continuelles. *Rapport de l'Acad. Roy. de Paris*, 1831, p. 77.

London, November 20th, 1866.
