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THE
CORRELATION
OF
ZYMOTIC DISEASES.

BY
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P R E F A C E.

THE frequent discussions on the origin and course of communicable diseases, and the conflicting opinions we meet with in the writings of contemporaneous authors on the subject, indicate that the prevailing doctrines cannot be looked upon as satisfactory or conclusive. The following pages are an attempt to trace the phenomena met with in this class of diseases to the operation of known physical laws.

I have used the term zymotic merely in its conventional application, without reference to any theory of the causation of disease that the term might be thought to imply.

A. WOLFF.

66, GOWER STREET,
Jan. 20, 1871.

PREFACE

The present edition of the book is the result of a long and laborious work, and it is hoped that it will be found useful to the students of the subject. The book is divided into two parts, the first of which contains the history and the second the principles of the subject. The book is written in a simple and plain style, and it is hoped that it will be found useful to the students of the subject. The book is divided into two parts, the first of which contains the history and the second the principles of the subject. The book is written in a simple and plain style, and it is hoped that it will be found useful to the students of the subject.

I have not had time to revise the book, and it is therefore not perfect. I have, however, endeavored to make it as complete as possible, and I hope that it will be found useful to the students of the subject. The book is divided into two parts, the first of which contains the history and the second the principles of the subject. The book is written in a simple and plain style, and it is hoped that it will be found useful to the students of the subject.

A. W. W.

THE CORRELATION OF ZYMOTIC DISEASES.

EVERY physician who has been during any prolonged period engaged in the treatment of disease must have observed that the various affections he is called upon to treat arrange themselves naturally into two great divisions :—

1. Those diseases that have their cause and origin within the body ; the variously disordered functions, with their long train of consequences ; those various alterations of structure which in their different forms are recognised as organic disease ; and 2. Those affections that have their cause from without.

The latter division comprises all those diseases that nosologists have classed as zymotic, diseases that have at all times excited the terror of the multitude and the curiosity of the scientific. Their nature, their cause, their origin, their cure, have always been and still remain the great debating ground of medical science. Always amongst us in some of their varied forms,

claiming annually their thousands of victims, occasionally, as we read in records and witness in our own time, traversing vast regions in the form of destructive epidemics—the black death, sweating sickness, and plague of former ages, have their analogues in our time under the names of cholera, typhus, scarlatina, small-pox, measles, syphilis, &c.

All these various affections have striking points of resemblance, and it has occurred to me that it would be time not ill spent to endeavour to elicit from the members of the profession the result of their observations on these points, and to endeavour to arrive at some conclusion as to how far these various forms of disease may claim a common origin.

The first point of resemblance that strikes us in all zymotic diseases is their

Periodicity.—At a certain fixed period after the reception of the poison, a succession of symptoms sets in, the sum of which constitute what we term the disease.

The first symptom commonly observed is a rigor, followed by reaction (increase of heat, rapidity of circulation, &c.).

When the poison is received in its most violent and concentrated form, this initial stage is sometimes not observed to follow its usual sequence—the first symptoms being rigor, vomiting and purging, quickly succeeded by collapse and death. This is very commonly

observed in cholera, and not unfrequently in scarlatina and small-pox.

The next phenomenon in the train of symptoms appears to depend upon an effort of the system, more or less successful, to resist the diseased action.

Elimination.—When the noxious agent attacks the body in the tract of the absorbents, the absorbent glands appear to act as a barrier to the further progress of the poisonous action; they become tumid, painful, and sometimes even suppurate. This barrier overcome, the disease pervades the entire system, and the kidneys, skin, and other organs assume an increased activity that has hitherto been looked upon as efforts at elimination of some material poison or diseased secretion; thus giving rise to the symptoms that characterize these various forms of disease.

Contagion.—One of the most marked features of zymotic disease is the property of contagion. By what exact method the disease is spread from individual to individual, whether by actual corporate particles, by living germs or otherwise, still remains *sub judice*.

Immunity.—The comparative immunity from future similar attacks is a feature of zymotic disease that has struck all observers, but hitherto no sufficient explanation of the fact has been offered.

Observers, whilst marking these points of similarity in these forms of disease, have hitherto been satisfied

to account for such accordance, or rather to excuse themselves from accounting for it, by classing them as "blood diseases," and holding that each form of zymotic disease has its own special and peculiar poison. Recently a division of opinion has arisen respecting the exact form of the poisonous matter: one party considers that the poisons are in the form of living germs; their opponents deride this hypothesis, and think the poisons are in the form of particles of vitiated secretion. But both agree in teaching that each form of zymotic disease has its own special poison,* be it germ or particle; thus leading to the unavoidable inference that the atmosphere is pervaded by a Pandora's box of various disease-producing atoms. These hypotheses have not been supported by any actual proof; nor germ nor particle has been offered for examination that might not be accounted for without connexion with disease;† these destructive entities have hitherto escaped the test-tube and the object-glass. How they first came into

* "There is a fair unanimity of opinion on the following points:—That the diseases are dependent on the presence of organic poison. That there is a specific poison for every specific disease."—*Dr. B. Richardson*.

† The fungi observed by Dr. Budd, who supposed them to be the germs of cholera, like the microzymes of Dr. B. Sanderson, have been shown to exist independent of any disease, and observers have failed to trace any connexion between these microscopic bodies and disease.

Professor Hallier, of Jena, considers that the organic forms met with in contagious fluids are analogous, that they exist in all substances undergoing putrefaction or fermentation.

existence has not been explained. Where is their habitat during their period of quiescence? What starts them on their career of destruction, and having once started, why does their action ever cease? What has become of the germs or particles of black death and sweating sickness? Where was cholera hiding previous to its outbreak in the Delta of the Ganges?

With all these and many other similar questions still unanswered, De Bostock may well say, "The question is, how were these diseases first produced? It is impossible to imagine that the first created individual was born with all these diseases upon him, yet we know of no distinct cause now in operation which could in the first instance have generated them."*

But if the various hypotheses that have been submitted for our consideration fail to account for the origin and to explain the phenomena of zymotic disease, is there any other rational explanation that can be offered? Must we content ourselves with a list of mere words, and follow the Registrar-General† in talking of "varioline, vaccinine, equinine, lyssine, syphiline, necusine, erysipaline, metrine, rubeoline," &c. &c., as "zymotic principles"? Surely the points of resemblance in zymotic diseases that have been pointed out—the mode of attack, the periodicity, the

* "Cyclopædia of Practical Medicine," vol. i.

† "Appendix to the Fourth Annual Report of the Registrar-General."

so-called eliminative effort, the contagion, the comparative immunity from renewed attack, cannot be looked upon as mere fortuitous coincidences.

The history and phenomena of zymotic diseases lead us to seek for some starting-point from which all these diseases may trace their common origin; and if we can succeed in tracing them back to such a point, it will further remain for us to seek for and explain the cause of the infinite varieties of aspect they subsequently assume.

Observation and experience amply prove that the laws that govern natural phenomena are capable of expression by simple formulæ, and are of universal application; any apparent deviation from these laws must be attributed, not to any eccentricity in the working of these natural laws, but to our imperfect power of interpretation.

I think that upon investigation it will be found that the laws which govern diseased action will prove no exception to this rule, but will be found to be in strict accordance with the great natural laws that govern growth and regulate decay.

The great physicists, Laplace and Bertholet, have established as a principle in physics, "that a molecule, set in motion by any power, can impart its own motion to another molecule, with which it may be in contact."

It is impossible to overrate the vast importance of

this principle, when dealing with physical phenomena. Liebig thinks it is to this principle that all chemical action may be referred; its influence in accounting for fermentation and putrefaction is well known. But without going into the oft-debated subjects of fermentation and chemical action, is it not possible that in the application of this principle to the phenomena of disease we may find the key that we are seeking to the enigma?

As an example of the most simple form of zymotic action, where there can be no question of special germ or vitiated secretion, we may take a case of dissection wound.

“Professor Dease gave a demonstration on a recent subject, and he awoke early the ensuing morning with severe rigors, sickness, and acute pain in the left shoulder. On the next day a fulness was observed above the clavicle, along the left side of the neck, which could not bear the slightest pressure. On the day succeeding, a colourless swelling was noticed about the axilla, and on examining the hand, there was found the mark of a slight scratch with a superincumbent vesicle. He appeared to improve a little for a day or two, though full, florid, and crimson erythema occupied the side in the region of the pectoral muscle, extending downwards. On the morning of the sixth day he showed symptoms of delirium, and a vesicle appeared on the forearm, which remained

stationary to the last. By the next day the erythematous swelling had extended over the entire side of the body, from a little below the axilla to the hip; and the swollen part became studded pretty thickly with indurated papillæ; the delirium was more confirmed. On the eighth day the inflammation completely involved the axilla, and on its posterior edge an abscess seemed to have formed, though there was no fluctuation. At this period the opposite or right arm exhibited an intumescence on its anterior part, occupying about a hand's breadth of the flexor muscles, which was punctured on the same evening, and discharged about a teaspoonful of serous fluid, but without relief; and within an hour or two afterwards, being the eighth day from the accession of the disease, he expired."*

Here we have an example of what I believe to be zymotic action in its purest and most simple form. Some molecules from the subject, in a state of motion, that may perhaps be described as a peculiar stage of catalysis, came into contact with the molecules of the living body, and imparted to them their motion. The extension of this destructive action, and the resistance of the healthy organism, caused the phenomena of the disease. The resistance was ineffectual, and the result, as we see, fatal.

* "Dublin Hospital Reports," vol. iii.

As another example, we may take the recent outbreak of enteric fever in Islington, so well described by Dr. Ballard, where the peccant matter was conveyed into the alimentary canal through the medium of milk.

Mr. Simon, writing on the extension of diseased action, says*—

“What is the meaning of the ordinary ‘sympathetic’ diffusion of inflammatory excitement in the body? When, for instance, in order to make an issue, we burn (say with moxa) a piece of skin the size of a sixpence, why do the surrounding textures to the size of half-a-crown show that they have been disturbed? and why do the nearest lymph glands become somewhat swollen and sensitive? Why, when inflammation is produced—say in the skin and cellular membrane of a finger, by the impaction of a splinter of wood, does not this inflammation confine itself to the particles of texture in contact with the wood? Why does it go on spreading, hour after hour, in wider and wider circles, dying away as vaguely in the distance as the undulations of ruffled water? And why, three feet off, do the lymph glands in the axilla swell, and grow painful and tender, and not unfrequently suppurate? Here are two striking facts of inflammatory contagion; on the one hand,

* Holmes’ “System of Surgery,” vol. i.

as regards the spread of inflammation according to a continuity of tissue, the fact can scarcely be stated in any other ætiological form than this:—that such particles of texture as are directly affected by causes of inflammation, become capable of exciting inflammation in particles with which they have contact. On the other hand, the fact that lymph glands in connexion with an inflaming part are themselves always more or less thrown into excitement, is assuredly not less suggestive.”

I am quite aware how strange it must appear, how contrary to all that we have been taught respecting these diseases, to venture the hypothesis, that in the process above described lies the entire explanation of all zymotic disease; that there is no multiplicity of poisons; that the various forms of zymotic disease, epidemic and other, can be explained on the simple principle of extension of molecular motion; that as we can thereby understand the processes of growth and of decay, so also will it explain and account for many of the phenomena of disease.

When we study the various forms of zymotic disease, we find that they arrange themselves into groups. Variola, vaccinia, varicella, appear to be various degrees of intensity of the same affection. So also measles and scarlatina, we must bear in mind, have at times been described as the same disease; that it is only within the two last centuries that they

have been recognised as separate diseases, and the older physicians were too careful in their observations not to lead us to the inference that the two affections were more similar in their phenomena formerly than they appear to be at present. Cholera, typhus, and enteric fever, again, have many points in common; and the early observers of cholera found that the survivors from the first stage invariably passed through a stage of fever, that, as Dr. Brown states,* could not be distinguished from ordinary typhus. Syphilis, dissecting-wound fever, puerperal fever, and erysipelas form another natural group.

If then we hold that all these various diseases have a common origin, that one single poison is capable of producing each and all of them, how can we explain the great difference they exhibit? How can we reconcile our minds to the idea that diseases apparently so distinct can have a common origin?

We must, however, bear in mind that the difference between any two of these diseases is scarcely greater than the same disease sometimes exhibits in different individuals. Who could believe that a mild attack of scarlatina, with its scarcely visible eruption and slight derangement of general health, was the same disease as the malignant type? Dr. Willan

* "Cyclopædia of Practical Medicine," vol. i.

writes :—" It is truly singular that the slightest of all eruptive fevers, and the most violent, the most fatal disease known in this country, should rank together, and spring from the same cause?"*

Is it possible that the true explanation of the variety of zymotic diseases may be, not that there is a multiplicity of poisons, each exciting a specific disease, but that there is one cause common to all, and that the variety in the disease depends upon the channel through which the noxious agent finds access to the body? Is it possible that the same agent gaining access to the body through the direct medium of the blood, as in syphilis and dissecting-wound fever, may give rise to the symptoms characterizing those and cognate diseases; that the same agent striking through the alimentary canal may give rise to the symptoms of enteric fever, cholera, and that group; that the respiratory organs acting as another channel may perhaps lead to the phenomena that we express by the terms scarlatina, measles, &c.?

Is not this hypothesis quite consonant with what we know of the manner in which these diseases arise? Consider the history of the outbreak of enteric fever at Islington: animal matter in some condition of catalysis found its way into the alimentary canal. Have we ever been able to trace an

* "Cyclopædia of Practical Medicine," vol. iii.

outbreak of scarlatina or measles to impure water? But where the air is poisoned by animal exhalations, we look for an outbreak of this class of disease.

If each disease depends upon a special poison, the distinctive character of each disease, the product of such poison should be separate and distinct.

But such is not the case. Measles and scarlatina have so many points in common that for centuries the distinction was not made out. Cholera shows so many of the symptoms of fever that many observers consider it as a fever fatal commonly in its first stage, and it has been proposed to call it choleraic fever. Dr. Graily Hewitt* refers to the strong connexion between puerperal fever and erysipelas and scarlatina.†

To the hypothesis of molecular perturbation, and that perturbation arising from a single cause—organic matter in a condition of catalysis—it will be objected, that when a healthy subject is submitted to the contagion of any zymotic disease, an exactly similar disease is produced; and it will be asked, and very properly asked, how this is to be accounted for?

The result is exactly what might be looked for in

* "Address to the Obstetrical Society," January, 1871.

† Puerperal fever arising when erysipelas is in the same building, and puerperal fever caused by the medical attendant having recently made post-mortem examinations, are well recognised accidents.

accordance with this purely physical theory of disease. The molecular motion is extended in precisely the same direction as that from which it was derived, and the different individuals, though distinct, must be looked upon as mere extensions of surface or substance. As when a heated substance is brought into contact with another of low temperature, the heat is communicated to the cooler body. If a tuning-fork be brought into contact with a sonorous body, the two vibrate in unison.

We must bear in mind another fact. If of many persons subjected to the contagion of one form of zymotic disease some individuals were to manifest the symptoms of the disease in another form, the circumstance would not excite attention in the present state of medical knowledge; the facts would not be looked upon as standing in the relation of cause and effect. When the attention of the profession is directed to this point, it may be found that such cases are not uncommon.

Even now cases may be cited that have been the result of recent observation.

Mr. Metcalfe Johnson, in a paper published in the *Medical Times and Gazette* of Dec. 10th, 1870, speaking of some forms of zymotic disease, says—"Indeed these diseases are at present epidemic among us in such curious combinations, that it appears probable that the cause of all is one and the same thing;"

and gives some cases in illustration, of which the following are examples:—

A. Z., aged 3. Rash distinct, raised, vesicular; tongue slightly furred; catarrhal symptoms; no sore throat; fever slight. Temperature 98° .

B. Z., aged 2. Rash uniform red. Swelling of submaxillary glands. Temperature $101^{\circ}4$.

Throat became ulcerated. Skin peeled off. Eruption of petechiæ, which afterwards disappeared.

These two children occupied the same bed, and were ill at the same time.

Miss A. W., aged 5. Had measles when a baby. Vomiting. Diarrhœa. Delirium in sleep. Submaxillary glands swollen. Tonsils inflamed, afterwards ulcerated. Rash on legs in patches—more diffuse and scarlet on arms.

Master J. W., aged 3. Sleeps in same bed with the above. Rash distinct—prominent crescentic patches. Evidently measles. No swelling of submaxillary glands.

A. B., aged 9 months. Distinct rubeola.

R. B. Ulcerated throat. Tongue red. Enlarged papillæ.

The whole family had a severe attack of scarlatina.

The most interesting, the most difficult, and perhaps the most important phase in which to study zymotic disease, is when it assumes the epidemic form.

How do the hitherto prevailing theories explain the phenomena of epidemics? How do they account for their origin, their diffusion, their decline?

From what source do the germ theorists derive their germs? What created them? Where, when were they created? Where were they lurking previous to the outbreak of the epidemic? Where is their hiding-place in the interval between successive outbreaks? How are we to account for those sudden deaths at the commencement of epidemics—as, for instance, in cholera, where death has been known to occur within an hour or two from the first attack?

This difficulty also meets those who advocate the doctrine of vitiated secretion. In these cases neither germs nor particles have had time to increase to the point of causing death.

How also do these hypotheses account for the well-ascertained fact that the cases at the commencement of an epidemic are most severe; that they gradually decrease in severity; and that whereas at the first outbreak of an epidemic no remedy avails, at a later period any remedial agent appears efficacious?

But the greatest difficulty meets us when we attempt to explain the cessation of epidemics. The poison has been gradually increasing in quantity. Each successive patient must multiply in an enormous ratio the mass of poisonous material. Each

individual becomes a focus from which a fresh dissemination of the poison starts ; and yet, whilst a large proportion of those subjected to the contagion remains unattacked, the epidemic yields, and gradually dies out. How are these facts to be accounted for ? Why does not the epidemic progress in a constantly increasing ratio of severity and diffusion ?

Those who admit the hypothesis of molecular perturbation will have less difficulty in meeting these questions.

In all epidemics of which we have any history—whether plague arising in the Delta of the Nile, cholera commencing in the Delta of the Ganges, syphilis breaking out with such severity at the siege of Naples as to assume the epidemic form, and leading to the erroneous idea of that being its first appearance, or an ordinary epidemic of scarlatina—one constant condition appears to obtain.

A number of individuals aggregated under unfavourable hygienic conditions are submitted to the poisonous influence of animal matter in a condition of catalysis. The exact form that the epidemic shall assume may depend upon a variety of causes.

1st. As has been already mentioned, the channel through which the noxious agent comes into contact with the healthy subject.

2nd. The condition, hygienic and other, under

which those subjected to the noxious influence are living.

Dr. Bostock writes—"It was about the period when the western part of the old Continent was in its lowest state of degradation, that we hear of the ravages of those varieties of fever emphatically styled 'Black death' and 'Plague,' which were described in the thirteenth, fourteenth and sixteenth centuries as invading various parts of Europe and Asia, and sweeping away a large proportion of the inhabitants. The account which we have of these epidemics would indicate that they were not an absolutely new disease, but that the symptoms were modified and aggravated by the peculiar condition of the great bulk of the people."*

A certain number then of individuals subjected to the contagion of these molecules in motion have the action extended to their bodies, and diffuse the diseased action in a constantly widening circle. And this very diffusion whilst extending the ravages, tends to limit the duration and gradually diminish the intensity of the disease. As the undulations of ruffled water gradually die away in the distance—as the waves of sound decrease in intensity as they are diffused through a larger space—as a heated substance gradually imparts its motion to contiguous

* "Cyclopædia of Practical Medicine," vol. i.

matter until a condition of stasis is arrived at—so this poisonous action loses in intensity as it gains in extension, until the diseased action is too feeble to overcome the resistance of healthy action, and a state of stasis (restoration of health in the individual, cessation of the epidemic in the community) is the result.*

If extended observation should show that the hypothesis put forward in the preceding pages is founded on a truth, many hitherto obscure points in the history of communicable diseases will become more capable of explanation. It will be seen, too, that the molecular motions of synthesis and catalysis that mould our frames from the first moment of intra-uterine life until and even after death,† account for many of the phenomena of disease. We shall cease to look upon disease as an entity. Medical science will teach that the changes occurring in the human

* The prevailing epidemic action may be intensified by a repetition of the original exciting cause, as well exemplified in Shoreditch during the cholera epidemic of 1849. A foul ditch filled with decaying animal matter ran along the side of the Eastern Counties Railway Station. I witnessed fourteen deaths from cholera in forty-eight hours, all occurring within two hundred yards of this ditch.

† “Fatty transformation occurs abundantly after death; witness the well known conversion of dead flesh into adipocire, and Dr. Quain’s experimental demonstration that muscular substance perfectly healthy at the time of death will within a few weeks, if kept moist without access of air, assume all the characters of fatty degeneration”—*Simon*, “Holmes’ System of Surgery,” art. Inflammation.

frame are explicable by the same laws that govern the movements of all other forms of matter. A glimmer of light will be thrown on the obscure question of hereditary tendency to disease. Diseases will be no longer looked upon as inexplicable accidents—discords in nature's harmony—but will be recognised as necessary consequences from known causes.

A fresh impetus will be given to the extension of legislative action in the direction of sanitary regulations, as it will be evident how all-important to public health is the hygienic condition under which a community is living, and how vain is the attempt to stamp out one form of disease whilst the causes still remain that must inevitably lead to its speedy reappearance in the same or some cognate form.

Finally, curative medicine will be encouraged to seek for some means of arresting preventable catalytic motion, when it is acknowledged that the same principle of cure will apply to a variety of diseases.

THE END.