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James S Wilson Mr

Walsall

England

The Germ Theory of Disease

There is a certain number of diseases that may be communicated from one individual to another. That something which serves to carry the disease is called a contagium. If the disease is communicable by direct and obvious contact only, it is said to be contagious — Syphilis and purulent opthalmia are contagious diseases — If conveyed through the medium of the atmosphere we call it infectious; but even such are contagious in the sense that they are inoculable — At least this has been found in the case of many of them. In both classes of contagia the result is the same: the contagium comes in contact with a living tissue, and forth-with sets up within it a

morbid processes peculiar to Man. Clinically it is convenient to distinguish between infectious and contagious diseases, but scientifically it is best to consider them one and the same. The following diseases may be brought about by a contagium passing from one individual to another: Chickenpox, Smallpox, Cowpox, Scarlatina, measles, German Measles, Typhus, Typhoid, Yellow fever; Whooping cough, Mumps, Diphtheria, Influenza, Erysipelas, Hospital gangrene, Pyaemia, Purulent Ophthalmia, Gonorrhea, Syphilis, Venereal Soft Chancre, Cholera, Hydrophobia, Splenic fever, Glanders. In addition to the infectious and contagious diseases, there is a third class resulting from the operation of a contagium passing not from one living creature to another but from dead matter eg. the soil. Such are the

Malarious diseases. Though the contagium in these diseases does not pass from individual to individual, it bears in many respects such important points of analogy to the other contagia, that it should be classed under the same head.

A contagium then, is an invisible something given off from an animal organism, or rising up from the soil, and capable when brought into contact with the tissue of an animal organism of setting a morbid process therein of a character peculiar for each form of contagium. Now the question arises what is the nature of this contagium? Is it a living organism or is it in any way associated with a living organism? The Supporters of the germ theory maintain that the contagium is inseparably con-

-nected with living matter.
There are three great arguments that may be used in support of the germ theory, by the side of which all others are in our opinion minor and insignificant. They are - I The fact that the contagium is capable of multiplying itself indefinitely within the body of the infected individual. II Living organisms have been proved to be the contagia, or at least inseparable from the contagia in one or two instances. III The peculiarity of the contagium.
We shall deal with each of these three arguments separately.
I The faculty of self multiplication is the special property of living things. The Chemist can bring forward no example of dead inanimate matter reproducing its like. Some examples have been

adduced in proof of dead matter possessing such power, but upon closer examination they have been proved to be spurious ones. It is true that a ferment may bring about a continuous chemical action in certain media, but we cannot as yet dissociate fermentation from living cells.

II The contagium of anthrax or splenic fever has been proved to be a living organism botanically specific. This organism — the bacillus anthracis — has been cultivated through successive generations with all necessary scientific precautions, and the generations thus remotely descended have been shown to be capable of producing typical anthrax by inoculation. Dr Klein has in like manner found the

Contagium of "Pneumo-enteritis" as he terms it to be a living thing. Further Spirilla are known to swarm in the blood of those suffering from relapsing fever, but we cannot scientifically utilise this fact as they have not been found to stand in a causal relation to the disease nor can we place any scientific value on the fact that low forms of organic life have been detected in the tissues, and in the morbid products in many cases of (Specific) fevers. We have therefore no absolute proof in the large majority of ~~Cases~~ Zymotic and contagious diseases that the contagia are living organisms or at least inseparably connected with them. And in discussing an hypothesis it is all important that we do not allow our enthusiasm for it to carry us

beyond a strictly logical conclusion, and that we follow a thoroughly scientific method of thought: not first to frame an hypothesis and become so enamoured of it, as to readily absorb all those facts which tend to support it- while we neglect or utterly discard whatever may tend to disprove it. This many of the supporters of the germ theory have failed to do and have taken it for granted that whenever a bacterium is to be found in a diseased tissue, the bacterium is the cause.

All contagious and infectious diseases then, are characterized by an indefinite multiplication of the poison within the organism, and in two of them at least the contagium has been shown to be inseparably connected with certain low forms of life.

III The plastic nature of the contagium.

It is observable from ancient and medieval literature, that communicable diseases have not remained fixed and unalterable during the course of ages, but that they like all other things, have been the subject of change. New forms have appeared upon the scene, some have died out, and all have undergone a modification in character from generation to generation. We have good reason to believe that many of the Zymotic diseases prevalent now-a-days had no existence in ancient times for it is scarcely likely that the ancient Doctors, who showed such ability in observing and describing other disorders, should have failed in the case of Zymotic diseases. The Black death of the 14th Century and the Sweating Sickness of the two succeeding centuries are both long

extinct; while Syphilis appeared for the first time in the 15th Century, and Cerebro-Spinal fever seems to be a disease of our own day. Diphtheria had long slumbered and was well nigh forgotten, until it reappeared some thirty years since. Further it is noteworthy that each epidemic has its own characteristic. We can only account for these facts on one of three suppositions: either a the contagia have been perpetually suffering change. b Or the nature of the living human soil has been continually changing: c or both together have been changing. In all probability the latter conclusion is the correct one: That the human constitution or, in other words, the ultimate state of nutrition of the individual tissues does change from generation to generation, there is no doubt

There is equally no doubt that the contagia change and thus within a short period of time, for, as just remarked, each epidemic is of special type, and two epidemics of widely different type may rage within a brief limit of time, and it would be absurd to suppose that any alteration of type could be due to so rapid a change in the character of the human soil. This one fact should suggest to us, that of the two — the contagium and the human constitution — the former is the most plastic. Now this fickleness of bearing on the part of the contagium is thoroughly suggestive at all events to us in that the contagium is a living thing: mere dead matters do not exhibit such sudden change in bearing, while we know that microorganism may by a variation in

their environment, be made to exhibit a marked variation of properties. Hence we see that a fresh diseases have developed, b old ones have died out c present ones are continually undergoing change of type, and that this is probably chiefly due to variation in the nature of contagia. In these facts the operation of Darwin's great law of evolution seems dimly visible. Let us consider the subject in its relation to Darwinism.

And first: As regards the question of spontaneous evolution of Zymotic and contagious diseases.

Not only does history tell us that fresh diseases have appeared in past ages but it is an open question whether they are not developing de-novo under our very eyes. Many cases of the so called Zymotic diseases arise apparently

independently of any antecedent case of the same type. That is to say the most careful investigatim of skilled men has failed to discover the origin of many isolated attacks. On the other hand such apparently de-novo cases have often had a sudden and unexpected light cast upon them, and that too, frequently of a most curious nature. Many such cases have been published, we shall cite one to which our attention was recently directed, and which as far as we are aware has not been published. A case of Scarletina broke out in a gentlemen's family living in a house which is situated in its own grounds and far removed from any other habitatim. On the most careful examination no source of the fever could be discovered,

but it was noticed that some earth had been thrown up from an excavation within a short distance of the house. On searching the church register it was found that, many years before, a number of bodies of those dead from Scarletina had been interred in the site of the recent excavation, leading one to suspect that the Scarletina germ had remained buried all those years: and had still retained its disease giving properties. Now if this is so, we can never certainly state that any particular case of specific fever which investigation cannot trace to an obvious source is ~~not~~ not in reality due to some specific germ thus hidden away in the earth. Therefore disbelievers in the de-novo origin of Specific fevers might fairly assign a similar occult—

origin to all apparent de-novo cases. On the other hand a believer in the de novo origin may equally fairly utilize such negative evidence in support of this theory. But supposing zymotic disease thus to arise de-novo, would this fact be an argument for or against the germ theory? Those who disbelieve in the spontaneous evolution of living out of dead matter would obviously say against. Therefore the question of spontaneous generation becomes an important one for the medical man. In respect of this question we must bear well in mind that such spontaneous evolution must have occurred some day and if experimenters deny its occurrence now-a-days, they are merely thrusting back the difficulty into remote antiquity.

We may argue – if spontaneous generation took place then, why should it not do so now? Are not the laws of nature fixed and immutable, and has not the matter of this earth always been the same? But we must remember that this original evolution was one of living protoplasm out of unorganised dead matter. Bastian who supports the doctrine supposes that life may evolve out of dead organic matter, and therefore his evolution whether it be fact or not is not nature's original one. In regard to Pasteur's experiments we are not inclined to accept them as conclusive. What does this great French experimenter do? He takes a glass vessel and places within it certain materials

which he has by certain processes rendered free of living germs. "If every scientific precaution" says he "be taken to prevent the access of to the contents of extraneous matters, no living particles will appear in it, and therefore because I cannot evolve life in a glass vessel spontaneous evolution is an impossibility." But is it not rather presumptuous in a man to suppose that he can imitate in a glass vessel the exact physical conditions essential to the evolution of living out of dead matter – that he can hit off to a nicety that coincidence of those peculiar physical states which we may be sure are essential to such a supreme effort of nature as evolution. We are ourselves inclined to believe in evolution for we take it that the only logical conclusion to be drawn

from Pasteur's data, even supposing they are quite correct, is that he cannot evolve life in a glass vessel. But at the same time we think it worthy that attention should be drawn to the fact that Bastian's evolution cannot be the primeval evolution of nature. In respect however of the spontaneous evolution of contagia — which we regard as a fact — we would remark that such a process does not necessarily imply a spontaneous generation of life. Even supposing contagia to be living organisms: but that it may be, and very probably is, a spontaneous acquisition by noxious bacteria (using this term in a generic sense) of morbid-giving properties. We quote the following

passage in support of this view.

"I have investigated several out breaks of diphtheria, and in these I have found the earliest deaths referred to membranous croup; and the later ones to diphtheria. The same thing occurred in the reports of the Medical Officers of Health. As long as the exudation was limited to the Larynx and there was no evidence of any previous cases the disease was called croup, but when the disease spread and the subsequent were plainly derived from the earlier ones, it was called diphtheria. With regard to the aetiology of the disease I have made several investigations under specially favourable circumstances in isolated districts; in which the earliest ~~the~~ cases were certainly not contracted from

persons having diphtheria. Over a large area too extensive for personal inspection, there would be a great tendency to sore throat. Then groups of cases would occur in which the disease was decidedly infectious and later on there would be severe cases with patches of membrane on the tonsils, and inflammatory symptoms, or with obscure inflammatory symptoms, difficulty of swallowing with loss of voice but no visible exudation. At last, perhaps in a single village in the infected area there would be an outbreak of diphtheria in its severe and fatal form. Hence the diphtheria appeared to be developed from what was

originally a simple sore throat, and the infectious character was gradually increased. When I meet with cases of membranous croup forming part of an epidemic of diphtheria, they always occur in the beginning of the epidemic, and are also, apparently less infectious than the later cases."

(Dr Shorr Shorne — discussion at Royal Medico-Chirurgical Society May 13th 1879)

Then again in a paper read by the same gentleman at the Epidemico-logical Society. "If the contagia of acute specific diseases do, as has been suggested by more than one observer belong to the vegetable world, I know of no grounds for refusing to believe that organisms capable

of reproducing a minor and incommunicable disease in particular stages of their growth, may in other stages of their growth, or in the course of their subsequent (rare) development become capable of producing a major disease communicable from person to person: the affair being essentially of one sort. This is not at all a question of the development of a living organism out of matter independent of antecedent life, but merely the production by means of a process of evolution of that it gives to an already existing organism that property by which it became specific — a property it may perhaps lose directly it is deprived of the circumstances which favoured its development.

In the same way special characteristics may be artificially developed in higher plant life, and be as easily lost again!!

By repeated evolutions through several human subjects, we may suppose that innocuous or comparatively innocuous bacteria acquired in these particular cases morbid giving properties. Dr Thorne made allusion to the readiness with which higher plants may take on fresh characters and as easily lose them again, but as we should expect this lower forms of life are of a more plastic nature than the higher. The bacterium Lactis may be modified by modifying its environment. This organism produces Lactic acid fermentation when cultivated in milk, but after repeated cultivations

in a saturated solution of meat-extract - it ever acquire the permanent faculty of producing ammoniacal decomposition, for if afterwards it is transferred to milk it no longer brings about lactic fermentation, but continues to cause ammoniacal fermentation. And in regard to the rapidity with which fresh properties are acquired it should be remembered that time from an evolutionist's point of view is not measured by the stroke of the pendulum, but by the number of generations through which the evolving organism passes and bacteria may pass through a thousand generations in a fortnight which is equivalent - in the human race - taking the average length

of each generation as twenty years — We twenty thousand years: ample time, all will allow for the acquisition among men of fresh properties.

Having then touched upon the subject of de-novo origin of disease, let us briefly consider that other property of contagia which as we remarked is of great interest from a Darwinian point of view — the instability of the contagium. Zymotic diseases are continually undergoing change of type. Each epidemic is marked by its own peculiar type. Then too, Scarletina, Measles etc are not such stable diseases as would at first sight appear, for it is in many cases difficult or impossible to assign a particular case of fever to any well recognised and defined Zymotic.

Bond (Medical Officer of Health - Gloucester Shire) said of a Scarletina epidemic. "It shades off so imperceptibly into Measles on one side, into diphtheria on another, and into ordinary catarrh in a third, that it is practically impossible as far as my experience goes, to say where the line of demarkation is to be drawn." Again Dr Wilson in a paper read at a meeting of the British Medical Association referring to an epidemic of Measles remarked "The short duration of the premonitory symptoms, the prominence of throat trouble rather than Coryza, the peculiar character of the eruption and its early appearance, the swollen lymphatic ..... while they

are very characteristic of Nötheln or certainly unusual in an immodified epidemic of Measles, on the other hand the Symptoms supposing them to proceed from Nötheln were unusually severe for the disease." Further over and above the well recognised fevers there remains a large number to which we can give no name whatever. How do we know but that these may be immature forms of the more perfectly developed and well recognised Zymogens? We are too apt to keep in view standard types of certain Zymogens, and to attempt to assign all varities of fever with which we come across to one of them, instead of taking each on its own merits. We regard the diagnosis as not made unless we give the disease a name

And spend all our endeavours
in pigeon-holing it into one of
our artificial compartments of Disease.
See what Hughlings Jackson says
on this head. "Students have been
taught to study cases as the
symptoms show an approach to
certain clinical standards, and
not as they show departures from
healthy states." (Medical Times & Gazette.
August 15th 1868)
Some are even beginning to question
the specificity of the Zymogens, not
only from the facts above related
but also for the following reasons.
I Each so called specific disease
does not always give rise to the
same kind. Dr Newport records the
case of a girl affected with diphtheria
inoculating a child with scarlatina

And other persons were infected with Scarletina from this child. Lancet May 16 '85
Dr Parsons has also observed Diphtheria and Scarletina interchange.

II The same insanitary conditions sometimes give rise to two or three or more specific fevers. Dr Clement Dukes asserts that the same poison may give rise to Typhoid fever and Diphtheria." On the beginning of January 1875 Mr J. of Rugby developed diphtheria which was followed by paralysis. In the same house on January 15th 1879 Mr J's servant sickened with Typhoid fever went through a severe illness but recovered. During the last days of December 1874 there being something amiss with the pipes which carried the water supply from the town to the cistern the water was cut off for one day

to remedy the defect. On that day a pump in a yard at the back of the house was used for their water supply — this was much fouled from adjoining stables. There was however another possible source of poison, for the tap of the water closet was defective and allowed an escape of sewer gas into the house. Both sources of poison were remedied all the family sent out of the house and we hear of no further cases."
(British Medical Journal Jan 25th 1879)

But whether we believe that bacteria stand in a causal relation to all diseases resulting from the operation of contagia, or whether we do not — it is quite certain that we cannot explain all the phenomena of these diseases by

either hypothesis. Take for instance the incubative period, which is invariably in all diseases brought by contagia. A certain period always passes between the introduction of the contagium and the development of the disease resulting therefrom. In the case of purulent opthalmia and Splenic fever this interval is short- and we can imagine it to be occupied by the multiplication of the living contagia, and that then there is not sufficient accumulation of the poison to bring about an obvious morbid result, until the termination of the incubatory period. But how are we to explain the long incubatory period of hydrophobia which is rarely less than a month, sometimes it is said extends over a period of years, and is certainly often of

Several months duration. Maclagan considers that the explanation just given of the short incubatory period in the case of splenic fevers and purulent ophthalmia is likewise sufficient to account for the long incubatory period of the acute specific fevers. He justly alludes to the fact that the temperature is not taken during the period, and that the patient invariably complains of vague feelings of ill health. The rigor and sudden onset of the fever he would appear to attribute to the sudden breaking down of the nervous system under the excessive strain put upon it by the indefinite growth in its tissues of innumerable organisms — This explanation however scarcely seems satisfactory to us. Nor is it agreed

upon amongst pathologists as to how the bacterium affects the morbid results, whether it is by starving the tissues of their food, by setting up a specific form of fermentation in the blood and tissues, or finally by the production of effete and poisonous products.

Maclagan seems to be of opinion that the morbid result is due chiefly to a starvation of the bodily tissues resulting from an excessive consumption of nutriment by the tissues. Indeed he spends nearly three hundred pages in elaborating this idea, while Ziegler is of opinion that the withdrawal of nutriment is seldom the most important change effected by the bacteria. The effect of bacteria on their nutrient fluids, and the production

of poisonous matters have much more to do with the genesis of the symptoms in most of the micro-parasite affections than has the mere withdrawal of nutriment."

In regard to the fermentation theory it has been remarked that if the contagium of fowl cholera be cultivated in chicken broth, it is capable of causing fermentation within it resulting in the formation of an organic alkaloid.

Our knowledge of the subject is therefore still of a nebulous kind, and not fashioned into a fixed and definite form. We seem to see a great truth looming in the distance, and we believe in it — as if by instinct — but the strictly scientific mind must acknowledge that the germ

theory has not passed into the world of fact; although it seems quickly approaching to that destiny.