

tain that we have not yet a common tongue, however probable it may be that mankind are tending in that direction. Misapprehension of each others' meaning is not unlikely to occur; and, at any rate, both the expression and the recognition of ideas will be impeded. To lessen, as far as possible, this drawback, great pains have been taken to prepare, in the three official languages of the Congress, a suitable abstract of every paper; and to place these abstracts in the hands of every member who may wish to acquaint himself beforehand with the authors' propositions. Besides the volume of abstracts, comprising those of all the sections, a few separate copies of those proper to our own, will be in our meeting-room, for the use of those who may not happen to have the volume at hand. These copies remain in the room.

The Executive of the Section have reason to thank the authors for the promptitude with which in most cases the abstracts have been furnished to our indefatigable and able secretaries, who have been at the pains of collating them. If any faults of translation or of printing should be discovered, they will doubtless be attributable to the pressure under which the laborious task has had to be accomplished.

And now, my dear friends and colleagues, let me say that if some difficulties of the kind just mentioned await many or most of you, how much must you find them enhanced by the circumstance, unfortunate for himself also, that your president is to a great extent ignorant of the languages, French or German, in which many of the most valuable communications will be addressed to you, and the speeches delivered. All my life long I have regretted the slightness of my acquaintance with those foreign tongues, which in the past, as in the present, have been and are the channels by which priceless discoveries have been announced to the world, as well, perhaps, as the media of keen, even burning controversies, when men encounter each other in their search after truth. Thus, and from other causes appreciable enough to most of us as life advances, we are apt to fall relatively into the background, and to have to rest content in finding our pleasure rather in learning at second-hand, and after some interval of time, what others have been happily accomplishing, than in hoping to establish for ourselves, or to maintain a forward place. But never till the present moment have I had so much cause to lament my many deficiencies, since now they must of necessity affect others even more than myself. I rely, however, with full confidence on your kindness and indulgence, otherwise I could never at all have ventured to undertake the honourable office of being your president at this great Congress.

AN ADDRESS ON THE RELATIONS OF MINUTE ORGANISMS TO CERTAIN SPECIFIC DISEASES.

Delivered in the Section of Pathology.

BY E. KLEBS, M.D.,
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ARE there specific organised causes of disease? This question, which during the last twenty years has agitated the medical world, and the decision of which, by anatomical and experimental methods, appears now to be near at hand, I will here attempt to answer. A short exposition of the facts of the case will show that, in consequence of the acceptance of this hypothesis, our science will have to undergo a profound transformation.

One circumstance which speaks in favour of the assumption of such a theory of disease—an assumption deeply based in the human intelligence—is that forms of disease, very different from one another, but which at the same time remain uniform in each particular case, and especially those which have always been characterised as communicable, have been from the earliest times ascribed to causes entirely foreign to the normal life of the organism. I would remind you of the arrows of Apollo, which, as the Homeric Greeks thought, brought death into their ranks; and of the wrath of Jehovah, which, according to the Old Testament, produced destructive pestilences. In the middle ages the same view took a form which was coarser, but at the same time more tangible; for the new pestilences which appeared in those times were ascribed to fabulous animals, to winged worms, little dragons, and spiders, which were believed to attack mankind. Here we see foreshadowed in the popular language, though perhaps unconsciously, in a manner accordant with our present views, the second element of the problem, viz., the organised nature of the elements producing disease.

Few physicians, indeed, supposed the causes of disease to be of this material kind; but Van Helmont, for instance, was one who did so.

It was reserved for modern times to give a more definite form to this hypothesis, and it is, probably, to Johann Lucas Schönlein, that the highest credit is to be ascribed. He took his stand upon the ground of natural science, and led on by the researches of Bassi and Audouin, upon the nature of muscardine disease, became the discoverer of the *favus-fungus*, known by his name. Although the way was thus opened up for the further establishment of this hypothesis respecting the nature of morbid processes, the development which it first underwent, through the labours of Henle was purely theoretical; for a strict anatomical demonstration was still impossible, in consequence of the imperfection of the methods then in use.

Just as pathological anatomy since Vesalius and Morgagni has supplied the solid basis on which modern medicine rests, it has been the task of microscopical pathological anatomy to lay the foundations of its latest development; by demonstrating in many diseases, the presence of organised foreign bodies in the pathologically altered organs.

The material changes of the organism, whether of tissues or organs, cannot, it is easy to see, be regarded as the adequate cause of any disease introduced into the body from without. Just as little are any general variations in external conditions of life sufficient to explain the various forms of infective disease. On the other hand, the demonstration in diseased parts of organised foreign bodies capable of multiplication fulfils the conditions of the philosophical postulate, which was framed by the untaught logic of the people, and by the profounder conceptions of men of genius.

If we now consider the present state of this question, the three following points of view present themselves as those from which the subject may be regarded.

I. We have to inquire whether the lower organisms, which are found in the diseased body, may arise there spontaneously; or whether even they may be regarded as regular constituents of the body.

II. The morphological relations of these organisms have to be investigated, and their specific nature in the different morbid processes has to be determined.

III. We have to inquire into their biological relations, their development inside and outside the body, and the conditions under which they are able to penetrate into the body, and there to set up disease.

I. The question of the spontaneous generation of organisms is one of such universal significance, that it cannot be investigated solely in relation to pathological states.

It is necessary, in the first place, to decide the previous question: whether, supposing that the possibility of spontaneous generation were proved, this process could have any importance in setting up morbid processes. This previous question, must, however, with our present knowledge of these processes, be decidedly answered with "No"; for the communication of infective diseases by transference of material particles from without, can no longer be regarded as open to question; though in the middle ages, for instance, such a doubt did exist with regard to syphilis. Just as little can organisms of this kind, which indisputably do occur as regular and permanent inhabitants of some organs of the normal body, be regarded as the cause of such morbid processes as are conveyed from man to man, or are introduced into our bodies by means of air, water, or food.

In regard to this point one possibility only must be conceded; namely, that such normal inhabitants of the human body may by alteration of the medium in which they occur, acquire virulent properties, and so become causes of disease. It is however, equally clear that it would not be possible for any and every form of disease indifferently to be produced in this way; even supposing, for instance, that the specific elements producing disease were present in a latent inactive form in any part of the body, such as the intestine. Cholera may rise in consequence of chill or fright, but only at the time of a cholera epidemic.

Although this view must appear clearly established to every thoughtful physician, it is still a hypothetical induction, deduced from general facts. Hence arises the necessity for a further presentation of the relation between the morbid cause and the morbid state, and a presentation, if possible, which appeals to the senses. Hence, too, the necessity of a morphological and biological investigation of the subject.

II. If we start from the principle that specific diseases can only be produced by specific organisms, the question arises whether such specific differences of a morphological kind can be demonstrated in those organisms which are constantly found in diseased organs. Since it is quite possible that the specific character of the action of these bodies depends upon minute chemical differences, it could not be taken for granted beforehand that morphological differences would be discovered in these specific disease-producing elements. Fortunately, however, the uni-

versal law of nature is found to obtain here also, that difference of form corresponds as a general rule to difference of function, and only different degrees of functional activity occur within the same series of forms.

A short survey of the facts which have been up till now discovered in this direction, will show in many cases so complete an identity of form in the parasitic organisms occurring in the diseased part, in like pathological processes, that the causal interdependence of the two seems to be thus made certain.

The three groups of Hyphomycetæ, Algæ, and Schizomycetæ, have been demonstrated to occur in the animal and human organism in infective diseases.* Their significance increases with the increase of their capacity for development in the animal body. This depends partly upon their natural or ordinary conditions of life, but partly also, and that in a very high degree, upon their power of adaptation, which, as Darwin has shown, is a property of all living things, and causes the production of new species with new active functions.

1. The hyphomycetæ, on account of their needing an abundant supply of oxygen, give rise to but few morbid processes, and these run their course on the surface of the body; and are hence relatively of less importance. It will be sufficient here to refer to the forms: Achorian, trichophyton, oidium, aspergillus, and the diseases produced by them, favus, ringworm, and thrush, to show this peculiarity. Nevertheless, we see that these organisms also (as was proved by the older observations of Hannover and Zenker) may, under certain circumstances, penetrate into the interior of the organs. Grawitz, moreover, has recently shown that their faculty of penetrating into the interior of the organism, and there undergoing further development, depends on their becoming accustomed to nitrogenous food. It is probable that the processes, as yet insufficiently studied, of Madura-foot and Actinomycosis, owe their origin to similar conditions.

2. Only one of the algæ—viz., leptothrix—has as yet acquired any importance as a producer of disease. It gives rise to the formation of concretions, and that not only in the mouth, but also, as I have shown, in the salivary ducts and the urinary bladder, in both which organs it forms a constant constituent of carbonate of lime calculi. Since these calculi produce no disturbance except by their mechanical action, the penetration of the germs of these organisms into the tissues seems to be in itself harmless, except when they attack the teeth. Here, as is well known from the researches of Leber and Rottenstein, their presence causes caries. Another alga, the sarcina of Goodsir, may indeed pass through the organism, without, however, producing in its passage either direct or indirect disturbances. It seems more worthy of note that many schizomycetæ, and especially the group of bacilli, are evidently nearly allied to the algæ in their morphological and vegetative relations—so as to be assigned to this class by several authors, and especially by Cienkowski.

The schizomycetæ furnish, without doubt, by far the most numerous group of infective diseases. We distinguish within this group two widely different series of forms, which we will speak of as bacilli and cocco-bacteria respectively. The former, which was first exhaustively described by Ferdinand Cohn, and the pathological importance of which, especially in relation to the splenic disease of cattle, was first shown by Koch, consist of threads, in the interior of which permanent or resting-spores are developed. These spores becoming free are able, under suitable conditions of life, again to develop into threads. The whole development of these organisms, and especially the formation of spores, is completed on the surface of the fluids, and under the influence of an abundant supply of oxygen.†

The number of affections in which these organisms have been found, and which may be to a certain extent produced artificially by the introduction of these organisms into healthy animal bodies, has been largely increased since the discovery of Koch, that the bacteria of splenic fever (anthrax) belong to this group. Under this head must be placed the *Bacillus malarie* (Klebs and Tommasi-Crudeli), the *bacillus typhi abdominalis* (Klebs, Ebert), the *bacillus typhi exanthematici* (Klebs, observations not yet published), the *bacillus of hog-cholera* (Klein), and, finally, the *bacillus leprosus* (Neisser). It would exceed the time appointed, were I to attempt to describe these forms more minutely. This may, perhaps, be better reserved for discussion and demonstration.

All the diseases named possess one very remarkable property common to them all. They arise from influences which are conveyed to the human body more or less directly from the soil. The conveyance of

the disease from man to man is, however, by no means excluded; and, in one of these diseases, it constitutes, indeed, the most frequent mode of communication. We may perhaps assume, from the course of the disease, that cholera and yellow fever also belong to this group. From the history of their origin, we may designate these diseases as soil diseases.

Alongside of these general infective diseases produced by bacilli, local affections also occur, which indicate the presence of these organisms at the point where the disease begins. As an example of these processes, which probably occur in various organs, I would mention gastritis bacillaris, of which I shall show you preparations. In this, we can trace the entrance of the bacilli into the peptic glands, as well as their further distribution in the walls of the stomach, and in the vascular system.

At the spot where the bacillus enters, inflammatory processes, gangrene, and hæmorrhage, are observed; while its distribution in the circulation appears to be able to lead to serious alterations of other organs. Thus, I have once observed the process in a case of acute atrophy of the liver.

3. The second group of the pathogenetic schizomycetæ I propose to call, with Billroth, cocco-bacteria, because they consist of collections of micrococci, which are capable of transforming themselves into short rods. The former usually form groups united by zooglyca; by prolongation of the cocci, rods are formed, which sprout out, break up by division into chains, and further lead again to the formation of resting masses of cocci. I distinguish, further, in this group, two genera—the microsporina and the monadina; in the former of which the micrococci are collected into spherical lumps; in the latter into layers. The one class is developed in artificial cultivation at the bottom of the cultivation-fluid; the other on the surface. The former requires a medium poor in oxygen, the latter a medium rich in oxygen, for their development.

Among the affections produced by microsporina, I reckon especially the septic processes, and also true diphtheria. On the other hand, to the processes produced by monadina, belong especially a large series of diseases, which, according to their clinical and anatomical features, may be characterised as inflammatory processes, acute exanthemata, and infective tumours, or leucocytoses. Of inflammatory processes, those belong here which do not generally lead to suppuration; such as rheumatic affections, including the heart, kidney, and liver affections, which accompany this process, sequela which, as is well known, lead more especially to formation of connective tissue, and not to suppuration. Here, also, belong croupous pneumonia, the allied disease erysipelas, certain puerperal processes, and finally, parotitis epidemica, or mumps.

Among the acute exanthemata, the following may, up to the present time, be placed in this group:—variola-vaccina, scarlatina, and measles.

The group of infective tumours is represented by tuberculosis, syphilis, and glanders. Throughout the whole group of cocco-bacteria the demonstration of organisms in the diseased parts encounters difficulties, which vary considerably in the different kinds. The demonstration of the comparatively large coccus—or bacteria-masses in sepsis, diphtheria, and rheumatic endocarditis, is comparatively easy and certain; the same demonstration may be extremely difficult in the case of scattered cocci which never form larger groups. This is especially the case in the monadistic processes, and more particularly those of inflammatory nature, and in the acute exanthemata. Still the observation of a quite fresh specimen is easier on account of the active mobility of these cocci. They often penetrate into the cells, and cause considerable swelling of them, as I have shown in the case of the monadina of pneumonia, which penetrate the ciliated epithelia of the bronchi. The infective tumours just mentioned present, however, the greatest difficulties in this respect, since in them the organisms, although they are the carriers of the virus, cannot at once be recognised as such within the proper tumour formation. We find here also, it is true, on examining the object in a fresh and living state, a large number of actively moving minute corpuscles, which cease their movements at a temperature of 60° to 70° Cent. (140° to 158° Fahr.), either permanently or temporarily, according to the time for which this temperature has been maintained. But the presence of fat-globules and granular albuminous masses makes it difficult to discriminate them with certainty. The methods of straining have not, up till now, furnished any trustworthy criteria in these cases. On the other hand, it has been found possible, by cultivation in suitable fluids, to see developing from the substance of such tumours organisms which belong to the group now under consideration; and which, when transferred to healthy animals, produce characteristic diseases. This is the case with the organism which I have called helicomonas, and which may be obtained from syphilitic new formations.

* The animal parasites need not here be considered, since their effects in producing disease are either of less importance, or else such as admit of no question.

† I do not here mention the occurrence of the spirilla obermeyerii in relapsing fever, interesting though this fact is, and theoretically of great importance, because the classification of this organism at present involves difficulties.

III. The investigation of the biological relations of these organisms may be approached from two different sides. In those forms which come under observation chiefly in the animal body itself, the diseased organs furnish the most suitable object of investigation; while in those processes which I have spoken of as soil diseases, the examination of soil, water, and air, has also furnished favourable results. The latter method was first successfully applied by Tommasi-Crudelli and myself to malaria, and lately by Pasteur also to splenic fever. If we succeed in breeding from one of these objects organisms which remain constant in form and development, and which when conveyed to animals give rise to the corresponding diseases, it is even by this alone rendered highly probable that the organisms contained in the cultivation-fluids are the actual causes of those diseases. But this demonstration may be exhibited in a stricter form, if we separate the fluid and solid constituents of these cultivation-fluids, and verify the activity of the solid residue, as well as the inactivity of the fluid constituents by experiments on animals. This "separation experiment" was first carried out by Chauveau with respect to vaccine, by allowing the fluids to deposit a sediment. This method is, however, not adequate, since all cultivation-fluids do not furnish sediments. For this reason I first made the attempt in 1871 to use filtration through porous masses of clay, by means of the water air-pump; and the result justified my expectations. Pasteur has of late years substituted for them gypsum filters, which have proved still better adapted to the purpose. The experiment was carried out with favourable results by myself and Fugel on the microsporina of sepsis and diphtheria, as well as on the bacilli of splenic fever; and has been lately repeated by Pasteur for the latter object. The application, in my laboratory, of this method to the monadina of pneumonia and syphilis gave like results.

Finally, we must mention the important results which have been obtained quite recently with respect to the cause of the protective power of certain inoculations with cultivated organisms; and which we owe more particularly to the French investigators, Pasteur, Chauveau, and Toussaint.

They have shown that by certain physical operations the virulence of certain specific organisms may be destroyed, though their protective power is preserved. Heat and the action of oxygen (Pasteur) appeared to be able to produce this effect. Still it remains open to question in what way the organisms thus enfeebled make the body capable of resisting infection with more active organisms of the same species. The French investigators just mentioned appear inclined to ascribe this action either to the introduction or the removal of a definite chemical substance; that is to say, to a chemical alteration of the inoculated animal. Still we should perhaps be hardly justified in assuming a permanent alteration of this kind in the body without a simultaneous development of the protective organism. This question also, highly important as it is, may perhaps receive further elucidation through anatomical investigation; the method which in this department, as in pathology as a whole, has shown itself to be the one, furnishes us with the most fundamental and trustworthy information.

The conclusion which appears to me to follow inevitably from this short survey of the results of modern investigation, is this:—that specific communicable diseases are produced by specific organisms.

HEXHAM.—Dr. Jackson reports an alarmingly high death-rate of 28.7 in an estimated population of 5,500 souls; and, in the population given by the 1871 census (5,331), a death-rate of 27.8 per 1,000. The mortality from diseases of the respiratory organs was excessive, no fewer than 35 deaths being returned as due to this cause—a rate equal to 20.35 per cent. of the total deaths. The zymotic death-rate was 20.93 per cent. of the total deaths, and 6.54 per 1,000 of population. In addition to an excessive zymotic death-rate, the infantile mortality was unduly high, the mortality amongst children under five years of age being equal to 36.04 per cent. of the total deaths. Referring to this subject, Dr. Jackson states that "a large proportion of these deaths occurred in the lower parts of the town, in badly ventilated properties"; and again, in alluding to excessive mortality, "Hexham is still, what it has been for the last thirty years, one of the most unhealthy towns in England—even the death-rate remains steadily fixed at 60 per cent. above its proper value". An outbreak of scarlet fever, which was fatal in 22 cases, was for some time kept in check by isolation in the fever wards of the workhouse; but, on an independent outbreak occurring there, the wards became no longer available for patients from the town. The water-supply is insufficient in quantity, and "the most considerable portion of it is composed of casual flood waters, contaminated by farm-sewage". The public sewers are not effectively cleansed or properly ventilated, whilst the sewer outlets are practically stagnant cesspools. The slaughter-houses are described as of the "worst possible type".

AN ADDRESS

ON

THE SCIENTIFIC STATUS OF MEDICINE.

Delivered before the Section of Diseases of the Teeth.

BY RICHARD OWEN, M.D., C.B., F.R.S.

THE aim of every student of medicine—and such the true student never ceases to be—is to raise the healing art to the status of a science.

The most significant testimony that the application of human intellect to comprehend phenomena has attained its noble aim, is the "power of prediction".

When the astronomer foretold the date to hour and minute of the advent of an eclipse, or of a comet, or even of a cluster of seemingly migrant aërolites, his peaceful victory was manifest. So, when the palæontologist, on inspection of a new-found fragment, proclaimed the nature and affinities of the extinct animal which, long ages past, had left such fossil evidence of its existence, his methods of interrogating and interpreting Nature were acknowledged to be of the rank of a science.

Certificates to life-assurance offices,* and the bulletins issued by the medical attendants on personages in whose health and life the public have interest, are amongst the forms of prophecy in the precise fulfilment of which the claims of medicine to a like rank may be tested.

The definition of disease is the expression of a sum of knowledge and experience by which the constant and essential characters are distinguished from accessory and occasional symptoms; and the remedies applied are, in like manner, those which the best experience has proved to be most potent. The technical terms of maladies so discerned are, as a rule, "collective names for groups of morbid symptoms".

Permit me to trespass on your patience and crave your indulgence toward one who has long ceased to practise the profession, deemed divine by sages of ancient Greece, if I venture to submit a few examples illustrative of the dependence of medicine upon a once-deemed unpromising inlet of light; but of which, in researches connected with the branch of medicine of the present Section, I have availed myself with unexpected advantage.

The healer may be called in to one whom he finds suffering from "loss of appetite, discomfort and weight in the gastric region, distension of stomach, with eructations and nausea": to this group of symptoms he applies the name of "dyspepsia"; if it be aggravated by aching or burning pain referred to the pit of the stomach, he may term it "gastrodynia". According to symptoms, he may prescribe, for one class carminatives, for another alkaline carbonates in effervescence, or may be led by special indications to administer such drugs as nitrate of silver, hydrocyanic acid, bismuth, and opium, the latter especially, if pain be attended with spasmodic action.

If the physician be called to a case in which the alvine evacuations are excessive in quantity and unnatural in quality, and sums up such symptoms as diarrhoea, he may administer castor-oil or saline purgatives, followed by various astringents, vegetable or mineral. But should a patient, whom the healer may see for the first time, be suffering also from febrile or pyrexial symptoms, thirst and headache, tenesmus and tormina, with rigid abdominal walls, frequent uncontrollable calls to defecate, with little discharge save of watery mucus, of peculiar factor, perhaps stained with blood, he pronounces the case to be one of dysentery, and may prescribe leeches, fomentations, and, according to one authority, may administer purgatives, but, according to another, opiates. In one of our latest compendiums of practice, it is written of this disease—"Calomel is said to have fallen into disuse, and perhaps deservedly" (Bristowe's *Theory and Practice of Medicine*, 1878, p. 683). An eminent physician, Dr. Trousseau, has confidence in ipecacuanha.

Again, the aid of the medical man may be invoked to abate or banish a group of symptoms which he terms peritonitis; and, under this treatment, there may supervene, without the least evidence of causation, another series of sufferings—pain during respiration, dyspnoea—calling for leeches to the chest, counterirritants, as mustard-

* Mr. A. H. Smee, in his *Hunterian Oration*, of February 9th, 1881, at the Hunterian Society of London, affirms, from his experience as medical adviser to an insurance office receiving 1,000 certificates annually: "I have noticed from year to year, for the last fifteen years, the number of cases in which, if the diagnosis of the medical attendant was right, his prognosis was manifestly wrong." P. 6.