

cational interest and private liberality are doing for us in the United States a work which remains, to a considerable extent, at least, still in the hands of paternal governments in the old world, and that there is constantly growing up among us a class of men eager to enrich our science and capable of fully profiting by the advantages in their hands. So that clinical medicine and experimental research may go hand in hand, each making the other more careful and more accurate.

The experimenters are constantly furnishing to us data, sometimes of a more exact and scientific character than we clinicians are ourselves able to attain, data which may be of the utmost value in giving us new clues to the complicated tangle which we have to unravel in our study of human disease.

Our material and our methods, no matter how careful we may be, do not permit us the same kind of results or the same kind of precision which may be attained in the laboratory. On the one side the physician who wishes to work for the elevation of his calling, is required, as a scientific observer, to be accurate, to weigh and to count instead of to estimate and suppose, to correctly determine the amount and the location of the lesion, the height of the fever, the amount of the excreta, the species of the bacillus, the dose of the poison; then, also, as a sagacious practitioner, he must gauge the factors which cannot be expressed in a numerical form, the weakness of tissues, the nervous instability, the diathesis hereditary or acquired and, finally, as guide, philosopher and friend, he has to allow for human frailties, the prejudices of family, race, religion, for vice and for ignorance, for interest, for caprice. Verily, the problems of the sick-room are not those of the laboratory.

It seems to me that the function of the physician, as an agent in the advance of biological science or a contributor to the physical welfare of society in the race, ought to approach as closely as the situation will allow to that of the laboratory specialist, and this is all I can offer as my suggestion as to improvements in the methods of work.

That clinical work should be freed, as far as possible, from the personal errors (amiable weaknesses, perhaps, but pernicious to the truth) into which almost every one of us is more or less easily led by ambition, the desire to excel, to originate, to feel that one has done a good or a great work.

That one should report what actually happens, not what he supposes the cause of success or failure to have been, not speculation but observation, and that he should be just as candid with failure as with success.

In other words, that the attitude of the physician toward medical *science*, not toward the patient or toward the medical *art*, should be as impersonal as he can make it.

Discussion.

Dr. David N. Kinsman, of Columbus, Ohio, in opening the discussion said: This subject of immunity is today one of pressing interest to the profession. I believe that any man who has anything to bring to the profession on this subject ought to do so, and, as I have been engaged in some experimental studies with a bearing in this direction, I desire to narrate the results.

The subject of protection is one thing, absolute immunity is quite another. We can by certain processes render a man partially immune; or we can by other processes render him more immune; but I doubt if we can render him entirely immune. As yet we have only the results of experiments from which to draw conclusions. No matter upon what

animal we make the experiments, they have a bearing upon the whole subject.

The speaker then narrated how for some time he had been interested in making experiments in the production of immunity from hog-cholera by means of successive inoculations in the hog.

Dr. Didama, of New York, asked the last speaker whether any results could be obtained from the inoculation of fluid filtered from the cultures, or whether the inoculations have to be made with the bacilli.

Dr. Kinsman replied that they had not made an investigation of the effects of ptomaines and the other products of the bacilli, but that the inoculations had been made with the bacilli.

Dr. Dennison, of Colorado, arose to speak in regard to a statement which, he said, had emanated from Cincinnati. A physician in that city had stated that Professor Koch acknowledged to him that his tuberculin was a failure. After reading the statement the speaker wrote to Professor Koch to inquire as to its truth or falsity. Koch's reply states in the first place, that he has no knowledge or acquaintance with the physician who made the statement, and second, that the statement was utterly false. Tuberculin is not a failure; the failure is on the part of the medical profession. They have not come up to appreciate it. When they do, its success will be assured.

The speaker then referred to the culture experiments which have recently been made with the thymus gland as a culture-medium, by which the strength of the germs had been reduced so much as five or six thousand times. In this manner the poison of diphtheria has been experimented with. It is probable that the material which we use for the attenuation of virus will prove to be an important factor in the result which we attain.

Dr. Greenlee, of Kentucky, stated that he had had some experience with hog cholera, and that from his observations of its spread from a given locality to another, he had concluded that actual contact of the healthy animals with those having the disease was not necessary. He had often seen it spring up among hogs at a considerable distance from any known source of infection.

Dr. S. P. Kramer, of Ohio, remarked that he was happy to state that the individual who made the statement reported by a former speaker in regard to Koch's alleged acknowledgement that tuberculin was a failure was not a resident of Cincinnati but a visitor.

Dr. Kramer stated further, that in the production of immunity, two methods have been principally pursued. The one is that of the employment of attenuated cultures, as developed by Chauveau and Pasteur. The second is the method by which an albumin derived from the body of the germ is utilized. This, when brought in contact with certain principles contained within the animal organism, produces a body that neutralizes the toxic principle and reduces the pathogenic germ to the level of an ordinary saprophytic germ. In the first form, the antitoxin is formed by the growth of the germ within the body; in the second by the growth of the germ in the test tube. The first method, which may be called serum-therapy, has been credited with the cure of six cases of tetanus.

The next in order was a paper on

THE ETIOLOGY OF SPECIFIC DISEASE.

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Mr. Chairman and Gentlemen:—If, in the present paper, I take issue with any of the audience in regard to recent or novel theories relating to the proximate causes of our most important diseases, be assured that it has been done with all sincerity, and with the kindest feelings for those with whom I may differ. The writer does not wish to be considered as actuated by a spirit of obstinacy, or unreasonable skepticism. Indeed, it is so much easier to accept the dictum of others, or to shift the responsibility of our views onto those who set themselves up as authority, than to formulate the lessons of our own observation and experience, so much more convenient to accept the thought of others, than to think for ourselves that natural indolence protests against the sacrifice. In medicine, as in all other pursuits of

life, we are more inclined to simply acquiesce than to contradict, and usually there is so little encouragement to do otherwise that we rarely wish to intrude our own opinion, but infinitely prefer that others may take the lead and we will follow, however fallacious and misleading such guidance may prove. Hence, it may be said to-day, as in the past, the greatest bane to medical progress is slavery to so-called authorities, and that one of the greatest hindrances to the acquisition of real knowledge is a blind reverence for great names.

Asking your pardon for these introductory and somewhat irrelevant remarks we will now call your attention to the subject of our paper, namely, The Etiology of Specific Disease. By specific diseases is meant certain maladies possessing distinct characteristics, and which are not only engendered by special causes, but are supposed to be incapable of development without the application of a so-called specific cause for each disease respectively. Such, at least, is a strict definition of the phrase "specific" as warranted by the phenomena of infectious and inoculable maladies. According to our text-books there are 1,146 diseases which affect mankind, and require the study and attention of the physician, but from this extensive nosological list, less than twenty-five diseases are to be reckoned as belonging to the class under consideration. Yet these are known to cause nearly two-thirds of our total mortality. Medical history informs us that many of the pestilential maladies which scourged the world in past ages belong to this class and far exceeded the mortality of any which now prevail. Indeed, so great was the special increment of their spreading power and malignity that as *Niebuhr* has shown they not only decimated fleets and armies, but influenced the fate of cities and empires.

On the great plains of plague-stricken Asia, centuries before the Christian era, the query: "Shall such ills come by chance?" was then answered—

"Like the sly snake they come
That stings unseen; like the striped murderer
Who waits to spring from the Karunda bush,
Hiding beside the jungle path; or like
The lightning striking these and sparing those,
As chance may send."

—*Light of Asia.*

Shall the intelligent physician of to-day meet this problem with no more rational interpretation than the ancient Buddhists in the earliest dawn of the world's history? Has the acquisition of long experience or the accumulated knowledge of the past thrown no light upon the cause and prevention of the maladies under consideration? In answer to this it may be said that the proximate cause of "specific" disease is now as it has ever been one of the most puzzling questions with which the human mind has had to grapple. It can not yet be said that we have positive knowledge as to the specific poison, if we may so call it, which produces scarlatina, diphtheria, yellow fever or cholera. The chemist can not detect in the atmosphere the cause of those infectious diseases which spread only through this medium, or chiefly in this way, and to assert that he can with certainty detect any peculiar substance in the blood of the most pestilential malady, that is its *positive etiological* factor would be a statement in advance of the facts of exact science. Neither by the microscope, nor by the minutest chemical analysis can we distinguish the pus globule of small-pox or of syphilis

from the most laudable pus of the surgeon. Nor have the most delicate tests as yet shown any thing especially distinctive in the saliva of a rabid animal by which a specific disease of this class is communicated so certainly and positively by direct contact. The *agens morbi* of these diseases in our present state of knowledge is still an unsettled problem. But since it has been truly said that the "curse causeless shall not come" some explanation of the etiology of our specific diseases, like Banquo's ghost will not down, hence modern physiological, pathological, microscopic and chemical research has led to the presentation of several novel and plausible theories to account for the proximate and specific factors which give rise to the development of the diseases known to be of infectious or contagious character. Before their consideration, however, it may be said that it seems impossible to explain the development of any specific disease either *exopathic* or *endopathic* unless there be a recognition of certain predisposing causes of such maladies. We refer to pre-natal, conditional, and functional influences. There can be no reasonable doubt that some of the so-called specific diseases owe their origin mainly to a hereditary transmission of a proclivity to such disorder. This is notably true of tuberculosis, or it may be supposed that the inheritance lies in the tissues or tissue elements predisposing to certain diseases in certain families. In the spreading of epidemics, contagious and personal, susceptibility may be factors in a partly *conditional* sense. Influences which the old authors called "atmospheric," the various direct and indirect influences which relate to the normal succession, and occasional abnormality of seasons in respect to the isolation of our planet and of the temperature and humidity of air and earth are perhaps generally too vaguely regarded as elements of interest in the present question, but are possibly factors which no one who tries to solve these problems should omit from scientific consideration. Again, failure in the function of the lungs, the liver, the intestinal glandula, the kidneys and the skin to eliminate the *waste products* of the system must be regarded by the physiologist as one of the most potent predisposing factors in the production of every form of zymotic disease. Science is more and more teaching us that the "survival of the fittest" is applicable to specific disease, and that the victory will be on the side of the attacked in direct proportion to the normal condition of all the bodily functions, and that the factors mentioned not only favor the development and intensity of such diseases, but that without such influence their establishment would often be impossible.

The theories of the proximate and specific cause of specific diseases may now be noted in the order of their popularity, but inversely as we believe with respect to their true etiological import. We refer to the *bacterian* theory, the *bioplast* theory, the *chemico-physical* theory, the *nervo-glandular* theory, and the theory of *perverted vital force*. The first hypothesis attributes specific diseases to the agency of microbes or minute living objects. By most authorities these are all classed in the vegetable kingdom, and might be termed microphytes of the fungous order. By some they are dominated parasites. They are supposed to operate by producing changes in the structures affected—the blood, the cutaneous and mucous membranes, the cellular tissue, and glandular organs of a destructive character, deranging their functions,

disturbing the processes of nutrition, of circulation, of calorification and secretion. Fever, loss of appetite, emaciation, prostration of the muscular and nervous forces being the usual results. Their mode of action suggested by the belief that they are living objects, is that by enormous multiplication they may act mechanically through their bulk, obstructing the capillary circulation, and by pressure on solid tissues cause their gradual destruction by robbing the blood of the pabulum used for growth of the mycophytes, thus effecting emaciation by spoliation, and developing fever by conversion of molecular motion into heat, and deranging secretion by mechanical intrusion in the glandular structure; also engendering neurosal affections by similar action on nerve structure.

The discovery of the dependence of alcoholic fermentation upon the presence of the yeast plant (*saccharomices cerevisa*), and the general resemblance between the symptoms of contagious maladies and the processes observed in the fermentation led to the use of the terms *zymosis* to express the action, and of *zymotic*, to express the character of all those diseases to which microbes in general are supposed to give rise. But all such views for the present must be largely speculative. There are many points of difficulty requiring to be more fully illuminated by careful observation before the bacterian theory becomes an established doctrine in etiology. Many of these difficulties have been well formulated by Professor Hartsorn, of Philadelphia, and may be expressed in part, as follows:

1. Throughout all the investigations which have been made, or likely to be conducted, there remains the extreme difficulty, if not impossibility, of total separation between the microbes themselves and the matter of the vehicle in which they exist, such as blood virus, vitiated secretions, artificial culture material, or whatever it may be. All the effects ascribed to the bacteria, except their proliferation and mechanical intrusion, may, with equal propriety, be attributed to the toxic action of a portion, however minute, of the soil in which they have lived, whose modifications must be coincident with those which they undergo.

2. The absence of the characters belonging to definite organisms in the easily studied virus of small-pox and vaccinia is presumptive evidence against the probability of such organisms being essential to the causation of other enthetic diseases.

3. Bacteria are rarely seen in the incipient stages of disease, but after the blood has become impoverished, the secretions depraved or morbid products are undergoing decomposition they are found most abundantly, and are found most numerous in materials of a septic or infectious character after their period of toxic intensity has passed by.

4. Bacteria have been, however, sometimes abundantly discovered in healthy bodies upon the various mucous membranes, in the blood and it is said in countless number in fecal discharges without any specific disease following.

5. Suppuration may be produced without the presence of minute organisms of any kind. Bacteria have been found under Lister's antiseptic dressings without suppuration following. Pathological investigators (Paul Bert and Rosenberger) have destroyed all the microbes in a septic fluid and yet found it to retain its poisonous quality. Various elaborate in-

vestigations have proved that fatal septic poisoning can be produced in animals by the products of decomposition without the presence of living organisms, and experiments have shown that normal blood, when deprived of oxygen, in the absence of microorganisms, may acquire *septic* properties, and also that septicæmia may be induced by the injection of free fibrin ferment and other substances into the blood in the absence of such minute organisms. The same condition has also been produced by the subcutaneous injection of filtered saliva containing no microbes.

6. While Klebs and Koch maintain the definite *specificity* of each minute microphytic organism, on the contrary, Billroth, Burden, Sanderson and others assert their mutual convertibility according to the influences of environment, and Pasteur, Wood and Formad report experiments making it appear that modification by culture is possible, converting an innocent into a malignant parasitic organism, or a death-producing microbe into one capable only of causing a transitory and not dangerous local affection which, nevertheless, secures to the animal thus treated immunity when subsequently exposed to the deadly infection. But in none of these cases is there reported any morphological change, whatever, in the bacilli or micrococci experimented with; their capacity of reproduction through several generations being retained.

7. Other points of objection to the bacterian causation of disease relate to their specificity. While it may be conceded that like produces like is a rule of nature, and that different forms of bacteria may reproduce themselves, it does not necessarily follow that they can reproduce the disease which they may accompany. That disease may be propagated like plants and animals, by means of a peculiar form of these organisms would require the recognition of disease as an entity and not a physiological perturbation, but the analogy is so absurd and the assumption so unwarranted as to need no argument for its refutation. While this theory requires the belief that each specific disease is produced by a certain variety of these organisms and no other, it fails to explain *how* and *why* they are causative of a special disease or of immunity against subsequent attacks. If they act as a specific cause of a specific disease by their enormous multiplication in a mechanical way, through their bulk obstructing capillary circulation, or by pressure on solid tissues causing gradual destruction (as in tuberculosis), this is a property that is not confined to any particular form of such organisms, but is common to all of them. Then why should one particular variety engender one disease and not another, and why should they not continue to produce identical results as often as they gain entrance into the system?

It is held by Professor Jaccoud and others that the bacteria of infection are indistinguishable from harmless ones except by their effects, and that as the liquids inhabited by them are frequently infectious, they are therefore merely a medium through which contagion acts. In some instances becoming so infected themselves as to transmit the property through several successive generations. Again, some observers attribute the symptoms of many acute infectious disorders to rapid development of poisons similar to vegetable alkaloids by bacteria in re-moleculizing the normal fluids. Others hold that such animal alka-

loids are constantly produced in the living body by albuminoid decomposition without such agency, and that the general function of minute cryptogamic organisms, when present, is of a beneficial or conservative nature in re-appropriating the product of organic decay.

Analogy in nature renders this scavenger theory more probable *per se* than that which holds them to be destructive parasites or poison-producers in the bodies which they may inhabit.

We may next briefly consider the vital germ theory, of which Lionel Beale is the chief exponent. Dr. Beale, than whom no greater micrologist has ever lived, uses the term *bioplasm* to designate the physical basis of life and growth. This consists, according to his views, of separate particles of less than $\frac{1}{100000}$ of an inch diameter, originating in the blood, and designed for the nourishment and growth of all the tissues of the body. They are described as soft, without color or structure, and enclosed in a colorless capsule, through which liquid pabulum passes for their growth. New bioplasts are formed by divisions of mature ones, and the new ones continue to grow by imbibition until they divide or contribute to the formation of solid tissues. *Microphytes*, with an average diameter of $\frac{1}{100000}$ of an inch, are considered by him as the lowest form of bioplasm, existing in all the fluid and solid tissues of both plants and animals, as well as in all kinds of mineral substances, and under all meteorological conditions (though dormant under some conditions of temperature and dessication). Being omnipresent, and, as he believes, indistinguishable from each other by any precise physical characteristics, he denies their relation to disease of any kind. Contagious diseases are attributed by him to degraded or perverted bioplasm descended from original healthy bioplasts. These constitute what he terms "disease germs," which have property of self-multiplication like healthy bioplasts, both within the diseased body and in any healthy susceptible body to which they may gain admission. These contagious bioplasts are extremely minute, having a diameter less than $\frac{1}{100000}$ of an inch, and though possessing "specific" characteristics for every disease, one cannot be distinguished from another, either by the microscope or by chemical analysis; neither can the healthy bioplast be distinguished from the diseased by any test except its effects. The disease germs referred to in this connection become noxious only after entering the blood and then passing into the solid tissues and secretions. According to this investigator, their multiplication in the body always elevates the temperature, and this may continue after the death of the victim, and that fever is due to this process, and not to oxidation of tissues; death being the result of change in the composition of the blood and derangement of capillary circulation. Beale's theory of migrating or transplanted bioplasts, in the writer's opinion, contains an element of truth, but has thus far received very little support besides that of its distinguished author.

On the supposition that *disease germs* are only abnormalities or deviations from healthy bioplasts which may be detached from one body and planted, while yet retaining vitality, upon another, and which may there undergo changes more or less morbid and destructive to the individual by whom they have been received, we certainly have a more plausible explanation of the transmission of contagious disease than that which is claimed by bacteriologists.

We will now call attention to the *chemico-physical* theory of Liebig, which embraces the doctrine that the *materia morborum* may consist merely of inorganic elements or compounds which, by entering the body and acting as chemical poisons, engender specific disease, and which affirms that the action of a *virus* is not essential to the development of a zymosis, or fermentation in the human economy. This hypothesis has been more clearly expressed in the phraseology of the late Dr. Snow, of London, as the theory of *continuous molecular change*. Chemists have defined this change to be decomposition by contact, or the action of presence. An illustration of this law is the power which small quantities of certain substances possess of causing unlimited quantities to pass into the same state. The phenomena of crystallization, the molecular motion that takes place in the operation of skin grafting, the diffusion of heat from molecule to molecule, or the extension of a flame from a burning body to combustible material within its reach, may be cited as physical instances, and analogies of the operation of this law. Hence, if a decomposing organic molecule is introduced into the human body, by this law of catalysis or induction it imparts its motion to other molecules with which it may come in contact.

The processes in fermentation, putrefaction, septicaemia and the multiplication of small-pox or syphilitic contagion from the smallest inoculation in the human body, are accounted for in a similar manner. Against the necessity of the action of minute living organisms to produce these morbid processes, the advocates of this theory urge that the above named changes, and many others like them, are produced in the absence of such organism by chemical agents formed in the body, such as *leucomaines* and *ptomaines*, those physiological and putrefactive alkaloids recently investigated by Vaughan and others, and that inorganic substances may develop such changes, similar to the action of sulphuric acid when it changes starch into sugar. In support of this doctrine it may be asserted, that the bacterian theory that every particle of contagious matter is (at one time at least) a living organism, and that only such living organisms reproduce their kind and the diseases which they accompany, is one which loses weight as an argument in view of the natural history of small-pox and analogous diseases.

The *Nervo-Glandular Theory* of the origin of specific disease has been plausibly urged by Dr. W. B. Richardson, of England, and is apparently an outgrowth of his studies of the above doctrine of Liebig concerning fermentation and its relation to nitrogenous material. He was convinced by experiments that zymotic disease could be communicated from one animal to another by inoculation of various secretions. He also succeeded in producing from such fluids alkaloidal substances of crystalline structure. Inoculation of these in solution was followed by the same specific disease as had yielded the alkaloids. (*Leucomaines?* or *ptomaines?*) Hence he concluded that any animal secretion might be made to yield a contagious principle to which he gave the name "septine," and the maladies thus engendered were designated by him as "septinous." The true *contagia*, in his belief, are therefore all of glandular origin, and the venom of serpents was suggested as a type of their source and action, the effect depending not on a multiplication of germs, but a catalytic

influence, the agent changing other substances without undergoing change itself, and that the poison, therefore, is reproduced only in the infected and diseased body through its own secreting organs. He believes, also, that ordinary secretions may change character, and become poisonous without previous infection. For example, the exudation of ordinary peritonitis may give rise to puerperal fever, and typhus fever may be produced in overcrowded apartments by absorption of animal exhalation, and in this way contagia of various kinds may constantly arise *de novo*. In furtherance of his theory, Dr. Richardson emphasizes the fact that the number of separate communicable maladies has a close relation to the number and character of the secretions. As examples, hydrophobia is derived from the saliva of rabid animals; glanders from nasal mucus; enteric fever is traced to the intestinal mucous glands; diphtheria to the mucous glands of the throat, and scarlet fever to the secretion of the lymphatic glands, but admits that in some instances the blood corpuscles become the seat of the catalytic change. As Richardson maintains that communicable disease may arise without intervention of contagious matter, he supposes that the virus may arise through previous impressions upon glandular organs, and refers the origin of such cases to fear or anger, or other emotional disturbance, when no mode of communication can be discovered. In favor of this hypothesis much might be said.

It is now known that some of the most remarkable pathological effects may be artificially induced, either by drugs, the precisely localized and measured action of heat and cold, or by other agencies acting upon the nerve centres in the brain and spinal cord. And since it is admitted that the brain is not only the instrument of the mind, but that it presides over and controls the functions of all the other organs, its own disorders therefrom can hardly fail to affect them. Strong mental emotion may not only suspend or pervert particular functions, but is even capable of destroying life by arresting the action of the heart. Sudden mental worry may excite dangerous interference with digestion or start an abnormal cardiac rhythm. Mental shock can check or increase the action of the kidneys, and in fact affect all the secreting or excreting organs of the body. The influence of continued mental anxiety and the pernicious effects of habitual grief upon the nutritive functions, are plainly marked. Under its corroding blight the skin loses its freshness and grows dry and yellowish; owing to derangement of the liver the bowels become confined, and their habitual constipation is apt to be followed by absorption of fermentative and putrefactive gases and other noxious materials, giving rise to fecal toxæmia with all its consequences, and thus not only by reflex influence of local irritation, but direct influence through the blood, the vicious circle is completed by the further induction of disease of the brain and nervous system. Anger often brings on a convulsive attack, and insanity frequently follows close upon exaggerated mental effort, and especially upon violent mental emotion, whether of terror, grief or joy. The principle of moral contagion cannot be denied. The mind is affected by imitative influences. Thus chorea is excited in some individuals by watching choreic movements in others, and a single hysterical patient may arouse in others symptoms almost identical with her own, while the direct influence of

the mental state upon existing disease, and in governing the susceptibility to others or favoring their development, is of the most potent character. For evidence of this influence in the genesis of specific disease the reader is referred to that most interesting book of Dr. Tuke's, entitled "Influence of Mind Upon the Body." Apropos to this subject are also the recent remarks of Sir Joseph Fayer, at the Sanitary Congress at Brighton, England, with regard to the expected invasion of the country by cholera. After denouncing quarantine and cordons as antiquated, worn out and obsolete devices, he urged that the true way to protect ourselves from this disease is to see that our homes are clean, that the water we drink is pure and the food we eat wholesome, and above all else to *keep our minds free from panic*. A panic state implies a disorganized vitality, and of its influence in aiding the class of diseases to which cholera belongs there can be no doubt.

GENERAL CONCLUSIONS.

Theory of Perverted Vital Force.—We must be somewhat brief in presenting the following conclusions as to the etiology of specific disease, as our views have been already emphasized as occasion occurred during our argument. It now remains for us to deduce several general facts which may serve to harmonize all of the theories presented, conceding to each its due importance, and out of all endeavor to construct one of our own which may serve to show how and why communicable diseases are made *specific*. The advocates of the bacterian, the bioplastic, the chemical, and of every other theory of zymotic disease, unanimously concede the fact that the presence of nitrogenous matter in a decomposing or readily decomposable state affords the best possible *pabulum*, either for the development of microphytes, the infection of bioplastic elements, the elaboration of animal alkaloids or the action of ferments. Hence a *common condition* which all these agencies require for their action in the production of specific disease is the presence of an excess of such pabulum in the blood of the individual attacked. Again, a careful study of the foregoing investigation as to the cause of the diseases under consideration certainly teaches that we must be on our guard against ascribing a specific etiological influence to the various forms of vegetable microorganism. For in certain cases these may have been in the first place non-existent, as when such a disease has been "autogenetic," and in no sense a derivative of antecedent disease of the same kind. This caution is especially applicable in regard to such an affection as erysipelas, which, although contagious, is also, on very good grounds, judged to be generable, especially during certain states of lowered health, induced by renal disease and some other visceral affections. Though not so positively known, it is by many deemed probable that a similar caution may be necessary in regard to more general contagious affections, such as diphtheria, typhoid and typhus fevers and cholera, which, though certainly infectious, may also be autogenetic. Among these diseases we might still mention several others which, although their ordinary or normal mode of spreading is by contagion, yet beyond reasonable doubt do sometimes arise spontaneously. We refer to such maladies as scarlatina and yellow fever, gonorrhœa, rabies and glanders; the two last, in fact, being only of spontaneous origin in the lower animals, from which they are communicated to man.

It would appear from the conclusions of Bastain and others, that in those complex, prolonged and continuous morbid processes constituting the phenomena typical of some particular infectious malady, that at some stage of this complicated chain of processes, and somewhere (that is in some organ or tissue, or in the blood) certain organisms may arise *de novo* and are not to be regarded as direct descendants of preëxistent organisms any more than we would regard the pus corpuscles met with in a case of purulent ophthalmia or gonorrhœa as direct lineal descendants of those which may have taken part in occasioning one or the other of such diseases. But admitting that the doctrine of *heterogenesis* is established and that of *archebiosis* or spontaneous generation is disproved by the experiment of Tyndall, it is by no means clear that the assumed mode of operation of microphytes in the causation of disease is the true one, or that their influence in the transmission of disease is not simply that of carriers of contagion the same as the non-vitalized chemical compounds of Liebig, the leucomaines and ptomaines of Vaughan, or the cast-off and altered glandular secretions and tissue elements of Richardson or Beale. It is not yet possible to say with regard to metabolic contagion what is the *essential constitution* of contagious matter, or what is the intimate nature of the transforming power which the particle of such matter exercises on the particles which it infects. Nor are we able, by actual demonstration, to say that contagion is a *material substance*. We know that the ancient philosophers in investigating the nature of heat regarded it at first as a kind of subtle matter which insinuated itself into the substances of bodies and resided there with greater or less manifestation of its presence, but heat is now regarded and proved by scientific observers to be, not a material substance, but simply a *condition of matter*—a phase of force, or molecular motion—and from the nature of its action *contagion* like the *force calorica* is, in the writer's opinion, a mere condition of matter and not a *material substance*.

As regards the question of the form of force which may explain the transforming power of the contagion of specific disease, science is still ignorant. Yet expert chemists express clearly enough the conviction that there exists a certain great unit of force in nature which lies beyond their power of analysis, measurement, or even of definite nomenclature. But in that most interesting, yet most difficult and hitherto almost uninvestigated branch of chemical dynamics, we are supposed to have our nearest clew to the scientific problems connected with the specific etiology of disease. Any theory which tends to explain the *rationale* of the processes under consideration must recognize the existence but perverted operation of the so-called vital forces. The theory which we present assumes the identity of the physical and vital forces. The physical forces embrace magnetism, chemical affinity, heat, electricity and motion. The vital forces are assimilation, combustion, animal heat, nerve force, and muscular contractility. All scientists now concede the correlation of the physical forces, that they are all convertible the one into the other, and the force, like matter, in any form can neither be created nor destroyed, and as presented to us in the universe, they are both indestructible and inseparable, perpetually existing, and unchanging in quality, yet ever changing in form. The intimate na-

ture of force, however, is the greatest mystery of all unrevealed phenomena, visible only in its effects as manifested to our senses, it becomes at once an unknown and unknowable power, transcending all human knowledge and conception. We can only judge of its presence, therefore, by the peculiarity of its action, and the effects which it produces. If we accept the teaching of modern science, all matter is the vehicle of change, motion the result of change, and *force* the cause of change. Life, as we understand it, depends upon the presence of a material substance operated upon by force, resulting in movement, and the harmonious interactions of these conditions when applied to the animal body not only constitute life, but health, while its derangement as surely eventuates in disease and death. According to the demonstrations and conclusions of modern investigators of physical science, the *vis viva*, or life force, is simply the combined influences of the physical forces which are constantly changing in form during the various vital processes, the supply and action of the same being maintained by the food we eat, the fluids we drink, and the air we breathe. Let us suppose, for illustration, that the nutrient fluid charged with oxygen is placed in an *electro-positive* condition, at the same time the tissues are in an *electro-negative*, or magnetic condition, by which assimilation or chemical affinity is induced; this involves oxidation, combustion and molecular motion. Molecular motion is converted into (animal) heat, and heat is converted into (animal) electricity, or nerve force, and nerve force induces muscular contraction or mechanical motion, which in turn serves to assist and perpetuate the operation of the other manifestations of force, in that it maintains the respiratory function, contracts the heart and arteries, propels the blood to all parts of the system, and thus supply tissue waste and equalize temperature, as well as control the various secretory and excretory functions of the body.

Such are the different manifestations of the so-called "vital forces," the harmonious and normal operation of which constitute life and health, but when perverted will not only occasion disease and disorganization, but death either local or general, as conditions may determine. For example, if the blood from any cause becomes contaminated or deficient in oxygen, the forces governing nutrition, such as assimilation and combustion, will be perverted in their operation, waste materials, or *materia-morbi* will be developed, which may eventuate in morbid effects, either as irritation of nerve centers governing heat production, or local irritation exciting inflammation of various tissues or organs, as well as malnutrition and disorganization of various degrees and variety according to the extent of toxæmia, and the functional activity of those organs provided for elimination. For the *materia-morbi* thus accumulated may remain in a latent condition until equilibration is commenced by increased oxygenation, and this may augment the amount of animal heat within the body, causing fever, which may in its turn induce pathological lesions, varying in character with its intensity, ten degrees of which mark the difference between life and death. Although force can only manifest itself by molecular motion, yet it may exist in two general forms known as potential energy and actual energy. Force stored up in certain conditions of matter, as in the tension of the particles of an explosive compound, such as nitro-glycerine, or in com-

bustible materials as wood, coal and the food of animals, is known as potential energy, that is, power capable of being liberated for the production of effects. But when the nitro-glycerine explodes, the fuel is burned, or the food is oxidized in the animal body, the force they contain is given out in the form of effects produced, and the potential energy becomes actual energy, or in animal bodies, living force. Such is the nature of unxygenized material in the blood constituting an *agens morbi*, in that it represents potential energy, becoming actual energy, and capable of producing morbid effects when subjected to zymotic action.

Force acting upon different forms of material substance will manifest itself in different ways, as chemical affinity, combustion, electricity, etc. Also force in its different forms acting upon the same material substance may give to a multiplicity of effects, as quantity and local conditions may determine. But force of any particular form, whether physical or vital, operating in a certain direction, producing certain results, *tends to continue its action in that direction, and the production of the same results as long as conditions favorable to its action obtain.* Thus the molecular motion imparted to a conducting wire from a galvanic battery may continue for thousands of miles. A spark of fire may destroy a city, and so the smallest quantity of chemical or perverted vital force arising from the blood in a state of zymosis, and conveyed by means of its own elements, may set up the same morbid action in other individuals whenever their blood is of a suitable zymotic condition, and it is operation of this law that gives us the *rationale of contagion*. But we find in the physical forces, so in the vital forces; as in the great laboratory of nature, so in the individual organisms, that action is met by counteraction, and the force, however manifest, sooner or later tends to equilibration. For this reason galvanic batteries become exhausted, fires must be fed with fuel, and zymosis ceases, and disease ends in the affected individual, and in communities when the material suitable for its action has been extinguished. Strictly speaking, therefore, *contagion is a phase of perverted vital force*, and this morbid influence does not imply the agency of microorganism any more than that of any other medium, vital or otherwise, which may serve to convey its action. The essence of contagion is not a material substance, nor does it necessarily require a definite agency through which it must operate, but is simply a form of force as imponderable in its nature as heat, light or electricity. Specific only so far as it naturally tends to operate in the same direction upon the blood of another individual when it contains certain constituents of identical character with those upon which it has been operating in the blood of the infecting individual, which is likely to be the case when individuals and communities are alike subjected to the same general and special predisposing causes of disease.

In conclusion it may be affirmed and reiterated that the agency through which contagion acts is not limited to any particular form of mycophyte, or to the bioplasts of Beale, or to the waste products incident to tissue metamorphosis, for all may serve as carriers of a perverted vital force. While the types and varieties of infectious disease may be determined by the impressions made upon the nervous system, but influenced by the condition of the individual

with reference to his powers of constitution, age, susceptibility, weakened condition of certain organs or tissues from previous disease or tolerance from like causes. And where the initial factor is due to accumulation of "waste products," then also by the character and degree of the defective excretion, and the route or channel by which the vital forces attempt its elimination. And finally, since any of the elements hitherto described as factors of contagion are infected through defective excretion, it necessarily follows that the character of an infectious or contagious disease depends upon the variety or nature of that glandular excretion which is most defective, and as these infected elements are most prone to elimination through those glands whose defective function has produced the blood contamination, we are thus afforded the *rationale* of the glandular involvement of specific disease. And if any such morbid elements were still under the dominance of the natural laws of *elective attraction* which appropriates from the blood certain elements to certain tissues or parts of the body, or that normal *repellant force* peculiar to certain excretory glands, their *deposition* in these localities would be secured, or their ultimate *elimination* (if the patient survived) through those glands and parts of the body identical with those from which they have been derived would be effected. And thus again would be stamped upon the disease its "specific" character.

Owing to the great length of the paper, only a part of it could be read, and it was passed without discussion.

(To be continued.)

SOCIETY PROCEEDINGS.

Gynecological Society of Boston.

Regular Meeting, held June 9, 1892.

THE PRESIDENT, AUGUSTUS P. CLARKE, M.D., IN THE CHAIR.

(Concluded from page 52.)

²⁵ Children's Hospital: The catgut is first scrubbed with yellow soap, and allowed to stand in ether 48 hours, in corrosive (50 per cent.) 48 hours, and finally preserved in the following solution:

Corrosive sublimate, gr. xv;
Glycerine, oz. ijss;
Absolute alcohol, oz. xxxj.

²⁶ Brunner scrubs the raw catgut with strong potash soap, then places it either directly in corrosive sublimate, 1-1000, or after leaving it one half hour in ether. It is finally stored in the following solution:

Corrosive sublimate, 1 part.
Absolute Alcohol, 900 parts.
Glycerine, 100 "

To test the aseptic condition of gut prepared in this way, Brunner manufactured gut from the intestines of an animal dead of anthrax; some he prepared and used without producing trouble, whereas the raw gut when inoculated into animals, caused fatal anthrax in all cases.

²⁷ Roswell Park immerses the catgut in benzine or ether; it is then dried and soaked in 1 per cent. sublimate solution for one or two days, again dried and placed in juniper oil and finally preserved in alcohol containing corrosive sublimate 1-1000.

²⁸ Bilroth's Clinic: Catgut is first washed with potash soap, it is then laid in ethylic ether twice for 12 hours each time, then dried and sterilized in a dry chamber by raising the temperature to 250° F. Then it is immersed in a solution of