Address.

THE RELATION OF PATHOLOGY TO MEDICINE.[1]

BY W. T. COUNCILMAN, M.D.,
Shattuck Professor of Pathological Anatomy in the Harvard University Medical School.

WE may safely say that in the past fifty years there has been a greater advance in our knowledge of disease and in our methods of treating it than in any other similar period of the world's history. Not only has our knowledge of disease increased, but with it has come from all sides a larger appreciation of the importance of definite knowledge in the practice of the medical art, and the facilities for the study and investigation of disease are constantly increasing. With the increase of knowledge it has been possible to apply more fully scientific methods of investigation and reasoning to medicine. It is becoming more and more a science and daily removed farther from the field of speculative philosophy. Close observation, hypothesis, and the tests of the hypothesis by further observation, comparison and experiment, have taken the place of speculation. The advance has not been pre-eminent in any one department of medicine but along the whole line. Every advance in the knowledge of disease has been followed by a practical application of the knowledge resulting in better methods of treatment. Often those very facts which were seemingly of least practical importance have yielded the greatest practical results. Certainly no one could have foreseen that the discovery by a French chemist that carbolic acid would arrest the progress of fermentation and destroy the lower forms of life would be followed by Lister's method of wound treatment.

Medicine has a greater interest for the layman as well as the physician and inspires in him a greater respect and confidence. Almost a new field has been opened to the humanitarian instincts of the people. Hospitals have been erected everywhere; and in their construction and maintenance nothing has been spared which could add to the comfort, and conduce to the better treatment of the sick within them. Laboratories have been erected in connection with the hospitals, in which the investigation of disease could be more efficiently carried out. In the hospitals, in addition to the physicians and surgeons who are actively engaged in the treatment of the sick, there are men whose work is only in the laboratory and who do not come at all, or only rarely, in connection with the sick. The work of these men lies in two directions. In the first place by the means of the study of tissues or fluids from individual cases, they assist in the diagnosis and thereby in the treatment of the sick. In addition to this their work consists in the study of questions concerning disease, which study is facilitated by the opportunities which the hospital gives.

A broader conception of the work of the hospital has arisen. It is now generally held that in addition to the treatment of the sick within its walls, the hospital has other duties. It is in hospitals that the study of disease can be most efficiently carried out. Large numbers of sick, with different forms of disease and with different stages of the same disease, are grouped together; and the opportunities for observation and investigation are much better than can be afforded by the sick in private practice. Both the medical profession and the public demand that in exchange for the opportunities which the hospital gives for the education and development of the practitioners, those holding positions in it shall by their work contribute to our knowledge of disease.

In the first volume of his *Archives*, published in 1847, in the famous article in which he laid down the lines along which medicine was to advance and along which it has advanced, Virchow says, "the filling of the clinical position in a hospital has now become a matter of supreme importance because the clinician must not only be a scientific practitioner, but also an observer and investigator." The importance of this view of the hospital has been borne out in the histories of all of the great hospitals. The work which such hospitals as Guy's, or the Charité Hospital in Berlin, has done in the actual relief of suffering is as nothing compared with the benefits which the hospital has rendered mankind in the increase of knowledge which has come from the study of disease within its walls. It is only by means of their connection with great hospitals that the work of such men as Bright, Traube, Frerichs and others has been rendered possible.

Our conception of medical education has also changed. It is considered no longer sufficient that the student should be told things. The laboratory and the hospital ward have become more important factors in medical education than the lecture-room. We are becoming more convinced that the student must be taught not only the art but the principles on which the art is founded. He can obtain his knowledge in great part by personal observations and experiment, for in this way only can knowledge come. It is of more importance that the powers of observation and the faculty of scientific reasoning should be cultivated in the student than that he should memorize supposed facts.

That branch of medicine which we term pathology has possibly felt the quickening influence of science more than any other. New fields have been opened to it. It has come in closer connection with biology on the one hand and with the practice of medicine on the other. As comparative pathology it has become an important element in the economy of the country. New methods of investigation in anatomy and physiology have been quickly applied to the study of problems in pathology. The close association and the mutual interdependence of pathology and clinical medicine cannot be questioned. This is so fully recognized that the trustees of hospitals are willing to erect and maintain, at a considerable expense, buildings in which it shall be studied.

I have thought that it might not be without interest to you to learn from a pathologist something of pathology, its position in the natural sciences, its relation to clinical medicine, its problems and its relation to the medical student.

Pathology may be defined in a broad sense, as that branch of biology which has to do with the study of life under abnormal conditions. It is impossible to define life. When matter has certain attributes, when it reacts in certain ways to external influences acting upon it, it is called living matter; and these attributes and reactions common to it in all forms are sufficient to distinguish living matter from all other forms of matter.

[1] Annual Discourse before the Massachusetts Medical Society, June 9, 1898.

The phenomena which living matter exhibits, whether it be in the form of a simple unicellular organism or in the complex form of a mammal, under the influence of external conditions, constitute the phenomena of life.

When we study simple unicellular organisms under the microscope, we can in various ways change the conditions which surround them and observe the phenomena which they exhibit under these varying conditions. We find certain conditions which are favorable for them. Under these they absorb food to supply the material which is lost in the production of force; the protoplasm increases in amount, new individuals are produced by the division of the cell, and the species preserved. We can subject them to a greater or less degree of temperature, or expose them to the action of chemical substances, observing them all the while. Under such influences we find that the phenomena which they exhibit change their character. By gradually increasing the temperature, the movements of an ameba at first become more rapid, then slower, and finally ceases. We can also influence in some degree the amount and character of the substances which certain unicellular organisms produce. Or, again, we can so alter the external conditions that the simpler phenomena of life, as shown by alimentation, can be carried on; but there may not be sufficient force conveyed to the organism to enable it to perform the more complexed phenomena involved in reproduction.

Slight variations in the external conditions have no effect on the phenomena which living beings exhibit. The movements of an ameba or the movement of the cilia in a paramesium or a bacterium will continue in the ordinary manner if the temperature be raised or lowered only a few degrees above or below that in which they ordinarily live. The external conditions to which living beings are subjected are constantly varying; not only does the temperature vary but the quality and amount of substance serving for food are constantly changing. This capacity of living under such varying external conditions is spoken of as physiological adaptability or resistance. It is only necessary to think of the conditions under which man lives to see how great is this physiological adaptability of the organism. This is only possible by means of the mutual interdependence of the organs. Under certain conditions more work will be thrown on one organ of the body than on another, or the function of one organ may be so modified that it will act in such a way as to be of advantage to the others. One of the best examples of this interdependence of organs is seen in the action of the skin and kidneys. Physiology teaches us every day more and more of the marvellous ways by which the circulation adapts itself to meet different conditions.

A certain degree of variability in the phenomena is perfectly consistent with a state of well-being of the organism. We call the state produced in living beings by unfavorable external conditions which pass beyond the adaptability of the organism, disease, and the phenomena exhibited under these conditions, symptoms or signs of disease. The phenomena produced in disease are due to alterations of structure. Unfavorable external conditions produce an alteration in the structure of the living material in consequence of which it exhibits different phenomena. These alterations in structure which result from unfavorable influences and to which the phenomena of disease are due are called lesions. In most cases these lesions are sufficiently obvious. They may be present in a single organ or may be widespread. In rare cases we are unable to recognize them with the means at our command, although we must assume them to exist. With the increase of our technical methods of study we daily become better able to ascertain the character of these structural alterations, but even now it is only the more obvious alterations which are accessible to our study. It is perfectly conceivable that there may be alterations in chemical composition which we may not be able to recognize, and which may exercise an important influence on function.

When a number of living beings are subjected to unfavorable conditions, all being equally exposed, they will not be equally affected. If the conditions are sufficiently unfavorable, the majority may be destroyed and only certain individuals survive. The same thing is seen in every tale of shipwreck and privation; certain individuals remain alive while others perish. Although for every species of living beings we can determine in a general way the limits of the unfavorable conditions under which life is possible for the vast majority, certain ones will always be found which will not come up to or will pass beyond the standard. Even in the observation of ameba it is seen that not all will cease their movements at the same time when subjected to the same degree of heat. Some will cease to move before the majority are affected, others long after.

In dealing with living matter we are not dealing with chemical substances of known character in which the same effect is produced by a given cause, but with highly complex substances. Not only does every species, as species, have a law of its own, but even every individual of a species has a definite individuality, and may show in various degrees differences in power of resistance, and in other ways depart from the standard. The variation in physiological resistance may not show itself by any difference which can be demonstrated. It is not possible from the most minute examination of a number of amebæ of the same species to designate in advance those which will prove to be more resistant to heat or chemical substances. The greater resistance may depend upon certain substances which are present in larger quantities in some individuals or upon a greater firmness or regularity in the chemical molecules. This variation in physiological resistance becomes more complex in the higher animals, which are not composed of single units capable of independent life, but aggregations of units arranged in organs and all interdependent.

Pathology being the study of disease, all that belongs to disease comes within its province. It has to do with the unfavorable external conditions, the causes of disease in their action on the living body. Here it has a close relation with hygiene, which is the general study of the causes of disease in relation with other external agencies and the means for preventing their action. It has to investigate those conditions underlying disease in consequence of which the physiological resistance of the organism to external conditions may be lowered. It must embrace the study of the lesions produced by these varying causes and the manner of their production. These lesions may be produced in the embryo and in various ways influence its development. In the study of the lesions there is a

close union with anatomy and embryology. The anatomical lesions produced by disease affect in various ways the functions of the different organs, and the disordered functions and the general phenomena of life of the diseased individual must be studied. In this pathology is closely related to physiology, or the study of the phenomena of life in normal individuals.

Pathology must be more than a descriptive science. It must be explanatory. The most exact description of a pathological lesion can give little information of the manner in which the lesion is produced, and still less of the effect which the lesion will have on function. The study of the lesion in itself, although the tissue change may be interesting, is as void of wide interest as the study of human anatomy separated from comparative anatomy and embryology. Pathology must explain the lesion; and this involves the study of the cause, the manner in which this cause acts on the tissue, how it reaches it from the outside, the gradual changes which the tissue undergoes in the production of the lesion, the effect of the lesion on the function of the tissue in which it is situated, the influence of the disordered function of this tissue on the general organism, and the means by which the diseased tissue is repaired or regenerated. The methods used in the study are the same as in any other science, observation and experiment. Experiment is as indispensable in pathology as in any other branch of science.

Such being in brief a general view of pathology, let us consider a little more closely the subjects for investigation. Teratology embracing the cause, the modes of formation and the influence exerted on the entire organism by malformations, may properly be considered a branch of pathology. As such it is closely linked to embryology, and its problems must be attacked from the embryological point of view. The explanation of the mode of development of the malformations can only be fully appreciated by those who have made embryology their chief study. The malformations, constituting as many of them do such obvious departures from the normal type of the individual, have been from the beginning of the study of pathology an object of description. No attempt was made to classify them, or to ascertain their cause. Then came the period in which the malformations were grouped together, classified and arranged in the order of those affecting the entire individual, and those affecting certain organs. A still further mode of classification involves some conception of their manner of production. It was seen that some of them were due to a separation of parts. Many of them were seen to represent the persistence of a condition found only in the embryo. In the first attempt to ascertain their etiology they were considered, as were diseases of that period, to be a manifestation of the wrath of God. Their study advanced from the age of superstition to that of speculation. In the speculative age they were attributed to the intercourse of human beings with animals and to the influence of mental states of the mother on the fetus *in utero*. The first great advance which was made in their study was when it was ascertained that under the influence of unfavorable external conditions malformations could be produced in the eggs of chickens and fishes. With these observations began the study of the experimental production of malformations to which Dareste in France has made the most important contributions. He showed that it was possible to produce certain of the more common malformations in chickens by subjecting eggs to various abnormal conditions, such as shaking them, standing them on end, subjecting them to variations in temperature, etc. All of these external conditions exert an influence on development. With few exceptions, however, it has not been possible to produce at will any given malformation.

The results of this study, together with observations on abortive human embryos, have shown that most malformations take place at a very early period of embryonic life. The observations of Dareste have been carried still further, and the study of malformations from the experimental point of view has become the main work of certain embryologists in Germany and in Italy. Even in this field, which at first sight would seem farthest removed from experimental inquiry, the experimental method has given the only results of importance. Experimental teratology has now investigators in this special field, laboratories devoted to it and an important periodical literature. There is little doubt that certain problems in normal development may be elucidated by the study of the abnormal, in the same way that our knowledge of normal structures and function has been increased by the study of disease.

Teratology has a further important connection with pathology, in that malformations constitute a part of the underlying causes of disease, those conditions of the organism which render it more susceptible to the action of unfavorable conditions. Many of the questions relating to immunity and to inheritance may also be considered under it. In all of these questions there remain problems enough for investigation.

The study of pathological anatomy may be said to have passed through a period very similar to that of teratology. In the beginning pathology was only concerned with the curious. In the first books on the subject we only find descriptions of very obvious departures from the normal type, together with an imperfect account of the symptoms of the individuals, a collection of curious and very often interesting facts without attempt to harmonize them or to explain them. Then came the period of better observation of the lesions and their classification; and this reached its acme under Rokitansky, who may be said to have occupied the same position in pathology that Linneus did in botany. Even to-day nothing can equal the accuracy of Rokitansky's observations. There are few things which he did not see. When some lesion or combination of lesions seems entirely new, it is only necessary to go back to the work of Rokitansky to find that he has observed and accurately described it. Rokitansky made pathology or pathological anatomy a descriptive science. In his attempt to *explain* the pathological alterations he so faithfully described, he had recourse to speculation, elaborated his theory of crasis, and by his force of presentation succeeded in having it generally adopted. According to this, all pathological conditions were due to a certain state of the system known as the crasis. In all pathological new formations a mother fluid was produced, which was termed the blastema; and under the influence of a particular crasis, in the one case, carcinoma, in another case, pus, or in another case, tubercle, could be formed from the blastema.

This school of pathology reached its full development under Rokitansky, and was a legitimate outgrowth of the speculative philosophy of Germany. Systems of philosophy developed in medicine as they

had developed in other branches of learning, and from the beginning of this century up to the time of Virchow German medicine was largely founded on metaphysics. The case was different in England. Here medicine had felt the magic influence of John Hunter. He discarded entirely speculation and went back to observation; and it was due to his influence that English medicine advanced. In John Hunter were combined wonderful powers of observation and skill in experimentation. In Rokitansky were combined powers of observation which have scarcely been equalled and powers of speculation almost as marked.

The successor of John Hunter was Virchow, and his work is the foundation-stone on which German medicine has been erected. Virchow may be said to have given us our present conception of pathology. He taught us that our study must embrace, not only the lesion as an anatomical condition, but its causes, its mode of formation and its influence on function. Before Virchow, Morgagni had taught us that disease was to be referred to the organs of the body. Bichat went much further by referring it, not to the organs, but to the tissues composing the organs. Virchow went till further in studying the changes in the cells, and gave us the cellular pathology. It was his great service to have fully appreciated the importance of the work of Schwann and to have carried the principles of the cell theory into pathology. He was the first to recognize that pathology was the study of life under abnormal conditions, and that all we could gain from the study of physiology and embryology had a direct bearing on pathology. More than all, he taught us that the same methods of research which were used in the other natural sciences were to be applied to medicine.

There is probably little more to be done in the way of description of gross pathological lesions. There is much to be done in the study of the finer cellular changes of organs, their causes and mode of production. Many of these changes have only recently, owing to improvements in optical instruments and in methods of investigation, been apparent to us. We are learning to investigate more closely, and that our investigations must have a wider scope. We recognize that lesions which are of great importance are not evident on examination with the naked eye; further, that we must often seek in slight lesions produced in one organ the causes of extensive lesions in another. In certain diseases, as in typhoid fever, the effect of the disease is seen in the production of cellular changes in all the cells of a similar character in the body. Local and general immunity are connected with changes in cells. It is no longer sufficient to investigate single organs in studying the effect of a cause of disease, but all the organs must be investigated. The pathologist is as much interested in cells as the histologist and embryologist, and all methods which facilitate their study in these branches find a quick application in pathology.

(To be continued.)

THE ALERT PRESCRIBER. — A gentleman in the car was telling how good his doctor was. "Clever?" said he, "well, I should say he was. The other day I called him in when I had swallowed five cents. He said if the coin was not counterfeit it would pass, and made me cough up two dollars." — *Medical Record.*

Original Articles.

THE PATHOLOGY, GENESIS AND DEVELOPMENT OF SOME OF THE MORE IMPORTANT SYMPTOMS IN TRAUMATIC HYSTERIA AND NEURASTHENIA.[1]

BY MORTON PRINCE, M.D.,
Physician for Diseases of the Nervous System, Boston City Hospital; Clinical Instructor in Diseases of the Nervous System, Harvard Medical School.

(Concluded from No. 23, p. 540.)

III. — SYMPTOMS WHICH ARE THE PHYSIOLOGICAL EXPRESSION OF EMOTION.

A VERY common set of symptoms, following and frequently continuing some time after an accident, are nausea, vomiting, vaso-motor disturbances, perspiration, palpitation, and the like. The genesis of such symptoms I conceive to be due to the fact that they are the normal physiological expression of emotion or nervous shock. The nervous system is so constructed that a shock like a fright excites these symptoms. This is common knowledge; whether or not they persist for any length of time after the primary shock, often depends upon the state of mind of the person, and whether the same or a similar emotion is persistently re-excited by other circumstances of daily life or by the introspection of the patient. Sometimes their persistence may be due to the persistence of the primary shock; but in my experience it has been a common observation that such complex symptoms having been once excited, afterwards, as long as the subject is in a neurasthenic or hysteric state, any cause which induces a similar even though mild shock, with its accompanying emotions, will induce the same set of symptoms over and over again. These latter sometimes seem to become independent of the original exciting cause. I might cite numerous illustrations of this from my case-book.

Still another phenomenon of emotion is the *final association of the emotions with many of the corporeal symptoms, like pain, fatigue*, etc., exhibited by the patient, so that even after the subsidence of these latter symptoms they are re-excited by anything that re-awakens the emotion. This is a very important group of phenomena in the clinical picture of individual cases. In illustration, I may cite the case of a lady who was a subject of traumatic hysteria from a fall upon her shoulder while getting off a train. During her convalescence, and for a long time after substantial recovery, she experienced all the old burning and lancinating pain of a very intense nature in her arm, together with flushing of the face, mental confusion, nervousness, and other emotional disturbances, whenever the accident was referred to. Another patient, whenever startled by a loud noise, which evidently recalled the crash of the accident, likewise suffered from a whole train of painful and emotional symptoms. Another suffered from nervous spells, feeling of fright and extreme tremor affecting the whole body, by simple thoughts of his condition.

Sometimes the original exciting cause of these symptoms may be forgotten by the patient. The following is a very remarkable example of this, and shows how, to the original emotion become afterwards attached all the other physical stigmata from which the patient suffers.

[1] Read before the Clinical Section of the Suffolk District Medical Society, May 18, 1898.

Address.

THE RELATION OF PATHOLOGY TO MEDICINE.[1]

BY W. T. COUNCILMAN, M.D.,
Shattuck Professor of Pathological Anatomy in the Harvard University Medical School.

(Concluded from No. 24, p. 560.)

A NEW interest has been given to pathology, and new fields have been opened to it, by the discovery of the connection between lower forms of life and changes in tissue. The study of bacteria in their relation to disease must form an integral part of pathology. We have been able by the study of bacteria in connection with lesions to appreciate many important primary lesions which had previously escaped our attention. More than this, we have been able to extend the field of observation by experiment. In the study of the pathological changes in man we are more or less dependent on chance for our material. The lesions we are investigating may be so advanced when obtained from the autopsy that it is impossible to study their mode of formation. We are enabled by the inoculation of animals to obtain a lesion at any stage desirable for our study. Our knowledge of the histogenesis of the tubercle and of different forms of inflammation would have been impossible without such experimental methods. By inoculating animals of different species or animals of different ages, or varying the amount and virulence of the organism inoculated, we are able to produce experimentally and to refer them to definite causes, those variations of lesions of the same character which were formerly inexplicable. We have been able to recognize that certain lesions are due to the direct action of the organisms on the tissues, and that others are caused by soluble chemical substances, either produced by the bacteria themselves or by the tissues under their influence. There is unquestionably much work to be done in the study of bacteria, in their connection with botany and with hygiene. The study of their species, their morphology, their products, their variations, the part they play in nature, and their general relations to disease does not come under the pathologist. The study of bacteria in their definite relation to pathological anatomical lesions is a part of pathology.

Under general pathology come the questions concerning those alterations of function which are the result of anatomical changes. General pathology has also been called pathological physiology, and bears much the same relation to pathological anatomy as does the study of normal function physiology to anatomy. The attempt has been made in the Austrian University to divide pathology into the two departments of general pathology and pathological anatomy, with separate laboratories and teachers for each. This was probably the result of the narrow conception of pathology by Rokitansky and the Vienna School. It was felt that something must be added to the narrow descriptive science of Rokitansky, and, instead of forcing a proper conception of the scope of the science, they made the mistake of dividing it. General pathology has also been considered as experimental pathology in contra-distinction to pathological anatomy, as though the experiment did not form one of the bases of pathological anatomy if we consider this more than a descriptive science. Considered in this sense, general pathology is the connecting link between pathological anatomy and the clinic, and its problems can be approached from either side. The pathological anatomist who pays no attention to general pathology loses the power of thoroughly understanding the character of disease. He could be compared to the clinician who would be contented with the observation of the symptoms of a disease. A pathology which does not come in contact with pathological anatomy on the one hand, or with the clinic on the other, cannot progress, because it does not become acquainted with the character of the problems which disease presents. We owe many of the most important advances which have been made in pathology to those who have entered into it from a clinical point of view. The work of John Hunter in pathology is the most distinguished example of this connection between pathology and clinical medicine. It is seen also in the long list of distinguished English physicians — as Bright, Bennet, Addison, Gulliver, Williams and Fagge — who followed Hunter. The work of these men is important, not only in the actual contributions to our knowledge of disease which they made, but by following scientific methods they kept English medicine in the first half of the century free from the speculative philosophy of Germany. There can also be little doubt that the combined study of clinical symptoms with pathological anatomy makes the clinician broader and stronger. It is difficult to find a great clinician, either in medicine or surgery who has not made important contributions to pathology. We have only to point to English medicine in the first half of this century and to German medicine in the last half, to see the truth of such a statement. It is especially here that the experimental method produces the best results. The pathological anatomist must resort to experiment to ascertain the effect of a certain lesion or function. The clinician can in many cases understand only by varying the conditions of an experiment in what way a lesion acts in producing symptoms. The experimental method as applied to the elucidation of symptoms has yielded fully as important results to the clinician as to the pathologist.

In a consideration of the means for the study of pathology the laboratory comes first. The laboratory is designed to give better opportunities for those who work in the subject. The methods used in pathological investigation are so numerous, so complicated and often so expensive, the apparatus used often requires so much space, that it is rarely possible for a private individual to provide himself with such facilities. The pathological laboratory is a recent creation and with the increase of opportunity which it afforded the advance of the science went hand in hand. When Virchow returned to Berlin, his departure having been occasioned in 1848 by an excess of political activity which the authorities regarded as pernicious, he made one of the conditions for his return, the creation of a pathological laboratory in connection with the Charité Hospital. This example was followed all over Germany, and now no university and hospital is without its pathological institute.

In the United States there are numerous pathological laboratories, both in connection with teaching institutions and with hospitals. There has even been

[1] Annual Discourse before the Massachusetts Medical Society, June 9, 1898.

in this country the example of a pathological laboratory without any connection with either a medical school or a hospital in which pathology was studied as a branch of university work in biology, and as such, made important contributions to the subject. It is most interesting to compare the progress of medicine in England and Germany during this century. The conditions have been exactly reversed in the two halves of the century. The great advance which Germany has made in the latter half may fairly be attributed to the influence of the laboratories, the work of which in England was restricted both by the lack of means and by pernicious and meddlesome legislation.

The pathological laboratory should be considered from three points of view; but the different views obtained so merge into one another, and the different subjects are so interdependent that they form but special features of a single landscape. The three points are: first, its connection with a hospital in assisting in diagnosis and directly furthering medical art; secondly, a place in which all the opportunities for research shall be afforded; and, thirdly, a place for teaching. It is equally possible to view the hospital from such points of view, as a place for the best treatment of the sick, as a place for medical research and a place for teaching; and the excellence of development in any one of these aspects furthers the other. The best hospital and the best laboratory will be one in which all three sides are developed to the fullest extent.

First, in its connection with the hospital as a place where methods of diagnosis can be carried to a fuller extent than in the hospital. There has been to a certain extent some attempt in hospitals to separate this part of the work which so closely appertains to the clinic, from the other work of the pathological laboratory, and to call the place where it is carried out, the clinical laboratory. No good can come from such a separation, no more than has come from the separation of general pathology and pathological anatomy. It is of the utmost importance that the worker in one department should come in contact with those who are studying in others. That the man who has come from the clinic examined the urine of a man who has certain symptoms and found albumin and certain morphological products should exchange ideas with a man who is studying the pathological changes in such kidneys. Each obtains a more comprehensive view of the disease. The presence of tubercle bacilli in sputum should call up not only the clinical picture which would be presented, but the condition of the lungs. It is possible that in certain points a greater advance might be made by such separation but the broader point of view is lost. In the pathological laboratory should be contained every means which will facilitate such purely clinical investigations. They should in great part be carried out by the young men in the hospitals who themselves come in contact with the sick. Their work should be supervised by a man who is specially skilled in such methods of investigation and who can correct or assist them. Every day sees a greater advance in these clinical pathological investigations, and methods of examination become more complicated. Such investigations are of as much importance for the surgeon as for the physician. In the case of a tumor it is often of the utmost importance to know its exact character before operating. This knowledge will often determine the character and the extent of the operation. Nearly every disease, either medical or surgical, is more or less open to investigation by objective methods. An individual appears in the clinic with an inflamed throat, and we no longer surmise as to whether it may be a case of diphtheria without membrane formation or a membranous inflammation without diphtheria, but a culture is sent to the laboratory and the diagnosis is made on exact knowledge. It would take too much time to multiply examples. Experiments must often be performed in connection with such work. We are often only able to direct the presence of certain organisms by inoculating animals.

Next in the relation of the laboratory to the hospital comes the post-mortem examination. To make a post-mortem examination in a proper manner demands much more now than formerly. Bacteriological cultures must be made of every organ to determine not only the cause of disease but the extension of the organism in the body. There may be primary infection and secondary infection depending upon this. The organisms found may be of great virulence or attenuation, which can only be told by inoculation. There must be a thorough investigation of all the organs; the character of the lesions, their cause, and the effect of lesions in one organ, in determining lesions in another, must all be borne in mind. Thorough microscopic examination must be made of all the organs, for some of the most important lesions of disease can only be determined by microscopic examination. We do not know any disease; exactly the same conditions are not found in any two individuals dying of the same disease. We should regard a disease as an experiment, and the conditions of the experiment are more varied than we could possibly make them. The post-mortem investigations should be made with a knowledge of the symptoms and all that can be learned from the clinical course of the disease and especially by the objective methods of clinical investigation. Many conditions in the pathology of the circulation may become clear to us when objective methods of measuring blood pressure shall come into use. The work of the pathologist and the clinician should go hand in hand. The pathologist has a certain advantage in that the cause, histogenesis and relations between the lesions are for him a legitimate subject for investigation. The clinician cannot dispense with the pathological anatomical investigation unless he content himself with the bare diagnosis. The clinician should not think of the pathologist as a more or less useful individual who can sometimes give him information, nor should the pathologist regard the clinician as the blind instrument who under Providence furnishes him with material for investigation. All the work of the laboratory should be carefully recorded and the records made easily accessible. In such a way the work of each individual may be utilized even when he works no more.

I trust I have shown how much the second part of the laboratory work, that of research, is dependent upon the first part. But the research may extend much farther afield. Pathology is the study of life under abnormal conditions, and as such, and regarded simply as a branch of biology, is as worthy of study without any relation to the clinic or to man as is physiology. Some of the greatest advances which have been made in pathology have come from those

who have attacked its problems from this point of view. It is possible that some of the pathological conditions in single cells will become much clearer to us from the study of cell changes in the unicellular organisms. The pathological laboratory should be provided with aquaria and with means for the study of vegetable pathology. The latter study has yielded most important results and has helped us to understand many things better. It is needless to say that in such a laboratory comparative pathology should have an important place. The science of comparative pathology has attained such an importance that it has its own laboratories and men who are exclusively devoted to it. The diseases of animals are now much better known from the anatomical and bacteriological point of view than they are from the clinical. Nothing can be gained but much lost by such separation of comparative and human pathology. This side of pathology has made and is making great advances. Investigations in it have been of great influence in the economy of the farm and country. By means of it many things in human pathology have been cleared up or the way for further investigations pointed out. The pathological laboratory then should afford opportunities to work, for those who wish to work in any department, and whose training has especially fitted them for certain lines of work.

In what relation does pathology stand to the medical student. We may start with the assumption that the student is to be taught those things which will enable him to practise his calling, and that medical education is certainly the best which will produce the best practitioner. Probably the greatest fault to be found in medical education at the present time is that with the greater extent of ground which it covers and with the greater specialization of departments there is a lack of organic connection. The student learns anatomy, chemistry, physiology; he passes his examination on these subjects, and they more or less pass out of his life and memory. On his first entry into the clinic he begins the study of conditions which seem utterly at variance with what he has learned before. He finds on auscultation of the heart of an individual that in the place of a short, sharp, second sound, there is a murmur almost comparable to the water rushing along a pebbly brook. In the place of the normal slow increase in the size of the artery at the wrist he feels a sudden sharp increase in size, then as sudden a collapse. He looks at the nails and sees that they first blush then pale. He is told that this condition is due to a regurgitation of blood at the aortic orifice, and he cannot see how his study of the normal circulation helps him in appreciating the condition here. If he is to understand the disease he must go much farther. He must understand how under the influence of a certain cause or causes a pathological process has been started in the valves and has led to a certain alteration in structure, called a lesion. That this lesion is the result of an inflammation in a tissue of a certain anatomical structure, and that in consequence of it the structure of the valves has become so altered that they can no longer perform their physiological function. His knowledge of the normal circulation tells him that the aortic valves should close slightly after systole, and how this is brought about, that the blood pressure in the arteries rises at each systole and slowly falls, the arteries emptying into the capillaries. It is only by comparing the normal structure with the abnormal, the normal function with the abnormal, that he is enabled to understand how the abnormal sound is produced and what it means. He must go farther, he must understand what compensation there is, what other changes have taken place which have made it possible for the circulation to continue in spite of such an abnormal condition. He finds that the heart is hypertrophied and dilated, and that at once brings him to the question of why and how this takes place. He must understand what effect this condition has had on the blood pressure, and to do this he may resort to experiment. What effect has this abnormal condition of the circulation had on the general blood-supply of organs and their nutrition. In certain cases he finds that in individuals with this lesion, the skin of the ankle pits on pressure; that the character of the urine is changed. He may recognize by a closer observation of all the clinical phenomena that in certain cases the active process by which the lesion is produced is still in progress, while in others the lesion is completed. In connection with the cause comes the action of bacteria. If he understands the disease it is necessary that he recall all that he knows of physics, anatomy, physiology and pathological anatomy — all these bear on the case — as soon as he begins to study the lesion and the effect of this in producing the abnormal function. Or he finds at the clinic that a patient presents himself with a swelling at a certain part of the body. He endeavors to distinguish by palpation whether the swelling is due to an exudation in the interstices of the tissue, or to the dilatation of an artery or to a new formation of tissue. He cannot learn this by being told that an exudation gives a certain sensation to the hand, an aneurysm another, a neoplasm another. He must know why this is the case, and the "why" again recalls all his previous knowledge. If the swelling be due to a neoplasm, he must know not its name but its character, why in the one case a simple excision is all that is necessary, and in another that the tissue must be removed from far around the tumor together with all the lymph glands connected with the part in which it originated.

Pathology serves this most important purpose, that it serves to connect the so-called theoretical branches of medicine with the so-called practical. The student gets a broader point of view, and when this is once acquired it serves him as a basis for his reasoning powers. Moreover, the student learns in the study of pathology the methods of investigation of disease. If he is to practise his profession in any other way than as a day-laborer, he will constantly meet cases which present to him new features. He must know how to make a post-mortem examination himself, and must know how to appreciate the relation between the anatomical lesions and symptoms. He must learn to investigate the causes of the conditions which he has found. If he is to become a teacher in any department of medicine, it is necessary that he should acquire the broader point of view, and the methods of reasoning which come from research combining clinical phenomena and anatomical changes. With regard to how the student shall be taught pathology, there are many questions to be considered. Laboratory instruction combined with experiments and demonstrations should form the basis of his instruction. He should be taught first those general pathological processes on which anatomical alterations depend and their causes, how the anatomical structure of an organ

may modify the character of the lesion. Lectures are necessary to amplify what he has learned in the laboratory. Demonstrations should have the end of showing him what changes are produced in man by such processes. If possible, he should study with the demonstration the microscopic changes which have produced the gross appearance. In his laboratory course the student should thoroughly study one disease. He should inoculate an animal, study the clinical course of the disease, the lesions and their mode of production, and the relation of the lesions to the clinical phenomena. In an ideal course on pathology the student should have the opportunity for pathological work throughout his third and fourth year, when clinical instruction is given the most attention. He should during this time have a place in the laboratory where he can under some supervision carry on more or less independent work. He should have the opportunity to make for himself examinations of sputum, urine, blood, etc. Having followed a case through its clinical course and through the autopsy, he should have the opportunity to study for himself the lesions in connection with the clinical phenomena. It is only in this way and by keeping constantly in his mind the connection between the lesion and the clinical phenomena of disease that the student appreciates that pathology is not the study of macro- or micro-scopic changes in organs, but of life under abnormal conditions.

Original Articles.

REMARKS ON THE PATHOLOGY OF EPITHELIOMA OF THE UTERUS WITH REFERENCE TO OPERATIVE INTERERENCE.

BY CHARLES GREENE CUMSTON, B.M.S., M.D.,
Assistant Professor of Surgical Pathology, Tufts College Medical School; Fellow of the American Association of Obstetricians and Gynecologists, etc.

EPITHELIOMA of the cervix presents several anatomical types which are due to the fact that the cervix is lined by two different types of mucous membrane; one being the pavement epithelium which is in the vaginal portion, while the second is the cylindrical epithelium, found in the cervical canal. Two classifications may be made: the first is based on the histological structure of the neoplasm, and the second is based on its anatomical form. The first of these is the least useful, surgically speaking, because it gives only a slight idea as to the nature of the affection. Pavement-cell epithelioma develops on the cervix and easily invades the vagina and the bladder; its evolution is perhaps a trifle less rapid than that of cylindrical-cell epithelioma, although on that point there is nothing exact.

The cylindrical-cell epithelioma, on the contrary, is more malignant, but its seat in the beginning, which is in the centre of the cervix, will necessitate its destroying the uterine neck almost entirely before it can reach the vagina or the parametrium, and consequently this fact demonstrates why the disease may be present for some little time and still be in a proper condition for a radical operation.

We will only consider the various anatomical types which have been established from clinical observation, and at a period when the neoplasm is still in a state of only slight advancement, because towards the end of its evolution the invasion of the neighboring organs causes it to lose its principal characters.

There are three types, namely, the vegetating type, ulcerating type, and lastly, the interstitial type. We will also rapidly review the different varieties which are very infrequently met with, and which belong both to the cervix and to other neighboring organs, such as the corpus uteri and the vagina; but the clinical symptomatology, which is very characteristic, assigns them a separate place in the history of epithelioma of the uterus. As De Sinety states in his article in the "Dictionaire Encyclopedique," all the anatomical varieties of uterine cancer are similar both as to their progress and their gravity. Nevertheless, two principal factors appear to contribute to increase or to diminish the progress of the neoplasm, and its generalization. On the one hand, we must consider the invading growth, and on the other, the tissues which are invaded, and which will react against this invasion in a different manner, according to their anatomical structures.

The anatomical element of the neoplasm has a more or less considerable proliferating power, according to its age, and whether it is going towards the adult type, or whether it remains in the embryonic condition. Clinical observation shows that in the larger number of cases certain forms have a slower evolution than others; for example, the cavernous form has a far more rapid progress than the vegetating type.

We will first consider the vegetating type. It begins in two ways, either producing papillary productions at once which form on the surface of the cervix, or by a hollow irregular ulcer, with raised infiltrated borders, which is very difficult to distinguish from a benign ulceration of the cervix. No matter what may have been the manner of the commencement of the epithelioma, it ends by the formation of a papillary fungus production, which bleeds on the slightest contact, and whose volume may increase to such an extent that it may fill the vaginal cavity.

The cervix on which the neoplasm is implanted may be only partially invaded, but more commonly both lips are infiltrated and the orifice of the cervix is hidden in the midst of the neoplasm. At length a time comes when the cul-de-sacs are invaded, and when this has taken place the disease will invade the periuterine tissues with rapidity.

This form seems generally to have a less rapid progress than that which will next be described, due perhaps to the fact that it has less tendency, at least in the beginning, to invade the deeper structures, and it would appear that the epithelial proliferation has a tendency to extend *outwards* rather than *inwards*. The general condition of the patient is less rapidly affected, perhaps for the reason that kidney lesions are less rapid to appear, and that the absorption of septic products is less easy than when we have the irregular cavities which we find in the ulcerating type of epithelioma.

The vegetating type is one of the forms of epithelioma in which the surgeon has to operate very frequently, and where we expect to obtain very excellent results. For example, Terrier, in a series of 17 hysterectomies performed for cancer, operated on four cases of the vegetating type. The results that he obtained were as follows: One patient had a recur-