THE RELATION BETWEEN PRACTITIONER
AND INVESTIGATOR IN MEDICINE*

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In the meetings of the Sections of the American Medical Association, we mean to record our work and accomplishments in the advancement of medical science, and our experiences in applying the facts which science has established at the bedside of the patients. This is the primary aim of our meetings. And yet it is well that there are provided certain occasions when we may interrupt our work for a short while and look backward to recognize the principles in our work and, perhaps, even to inquire into the conditions under which we are working, in order to remove difficulties and to achieve the greatest possible efficiency.

Our Section is one of those that represent, if we may thus express it, the pure medical science in contradistinction to the applied medical science, preponderating in the majority of the other sections. The Section on Pathology and Physiology is the meeting-place of those members of the Association that devote their time almost exclusively to investigation and to teaching. It might, therefore, not be inappropriate to discuss some of the relations as they actually exist between the investigator and the practitioner in medicine. When I speak here of investigator, I have in mind principally the specialist in the so-called fundamental sciences of medicine.

The time at my disposal does not permit me to treat fully of this subject. I have to omit all historical considerations. I cannot dwell on the increasing importance of science in modern medicine and the many contributions to medical science which we owe to the practitioner in medicine who, striving after the highest ideals, finds it possible, after hours of responsible and unselfish efforts in the interest of his patients, to devote a part of his day to the furtherance of medical science. I wish rather to restrict myself to the consideration of certain difficulties and misunderstandings which undoubtedly still exist in the relation between the investigator and the practitioner in medicine, in order to help somewhat in removing those difficulties and in making the common work of the practitioner and the investigator still more pleasant and fruitful. And even here I shall have to be brief, omitting any detailed discussion, trusting that my remarks will rather stimulate a discussion of these problems than present a final statement of the issue.

There can be no doubt that certain difficulties exist; they are noticeable in the medical schools, in the institutions for general or specialized medical research; they can be seen among the profession at large. In the medical school, the point of controversy is not infrequently as follows: The clinicians, objecting to a certain way in which physiology, pathology and pharmacology are taught, demand that these branches of science be considered as a direct preparation for clinical work, and that only those parts of the theoretic sciences which are of special interest to the clinician be considered more in detail. The teacher and investigator, who is inclined to favor the field of general physiology or pathology, is especially liable to call forth criticism on the part of the clinician.

Let us now enter into a critical analysis of this clinical point of view. We may at once concede that a medical

school is a school of applied science, intended for the training of men who are to be, principally, not investigators, but practitioners, who apply scientific experience to the solution of practical problems in the life of the community. Just as in an engineering school mathematics and physics are taught with a view of preparing the student for the building of electrical apparatus, of bridges and other structures, just as in an agricultural department chemistry is taught so as to prepare the student to cope with the problem of soil fertility, so the student of medicine ought to be taught physiology, pathology and pharmacology in such a way that he can both diagnose disease of the various organs and understand the essential characters of disease, and at the same time appreciate the principles of treatment.¹ Apparently the analogy between the principles of instruction for the medical and engineering student is perfect, but in reality there exists an essential difference to which, perhaps, due consideration has not always been given.

The engineer is given a definite problem which he knows he can solve in accordance with the well-known principles of his science. Nothing unusual or impossible is ordinarily demanded of him. He is at once in a position to recognize whether or not his task can be accomplished, and if it should not be feasible he will decline. There is no uncertainty about the character of his work. Either it can or it cannot be done. Furthermore, the number of variable factors the engineer has to consider in his work is relatively small as compared with those in the work of the physician. The engineer is presented with a physical or chemical problem, the physician with a biologic problem. And it is well understood how infinitely larger is the number of variable factors in the latter kind of problems.

Thus it is brought about that in a very large number of cases the physician cannot even state offhand whether the task assigned to him can be accomplished or not. As a result of analysis and investigation of the conditions in many cases he will find that, while certain parts of his problem are typical model factors, other parts are made up largely of unknowns. From the beginning, therefore, the work of the physician is that of a biologic investigator and not merely that of a technician brought face to face with a certain routine work. He has to investigate first the character of his problem, whether it is an old or a new problem, and then he will find in the majority of cases that there is, at least in part, a new problem involved. He cannot refuse to treat a patient because there is a new and, so far, unsolved problem involved. An engineer could refuse his services in such a case. A physician cannot. The patient desires and needs help. The physician, therefore, must marshal before him the known parts of the various branches of medical biology, and then he must decide in which direction a solution of the new problem may be attempted. In many cases he will find no indication for any procedure. He is in the dark as to the best mode of attacking the problem. But, however the situation may be, the principal requirement is that he be perfectly clear about the character of the problem he has to face, what part of it has been solved and what part remains unsolved. This process of thinking must be in the highest sense scientific. Very much is demanded of him in the clear analysis of complicated biologic facts. The physician must face his problem in the spirit of a scien-

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1. The educational value of laboratory teaching is clearly stated in the excellent address by E. P. Lyon, Equipment and Instruction of the Laboratory Years, *THE JOURNAL A. M. A.*, May 27, 1911, p. 1536.

tific investigator of the highest type. But here a great lack, due, perhaps, to insufficient training, becomes apparent.

It is just here that the physician often fails; he is not able to circumscribe sharply the known and the unknown parts of his problem. He usually assumes that more is known than is actually the case. In other words, he frequently does not recognize the great number of variable factors that present themselves. He proceeds in a routine manner, ignoring the unknown variables in his diagnostic and his therapeutic work. How much better it would be if he should recognize his limitations and acknowledge that so far he can act as a technician, curing or giving definite relief, and from here on he has to act merely as a friend, sustaining the patient in his suffering through his sympathy to the best of his ability! And in this latter capacity as a friend, again a knowledge of biology in the broadest sense will be a most valuable asset for the physician. It will supply him with the philosophic point of view which enables him to elevate the spirit of his patient, to make him as much as possible forget his own difficulties by leading him into a consideration of a larger world of which he forms a part.

We see thus how essential it is for the physician to be truly trained in the spirit of investigation and scientific analysis and how emphatically his daily task calls for a philosophic conception of the universe, a conception which can be best supplied to him through a broad study of biology and the natural sciences in general, of which medical science forms only a part. There is another difference between medicine and other applied sciences. Owing to the enormous size of the unexplored field, to the multiplicity of variable factors and to the most diligent search of many investigators, frequent corrections and additions are made to the fundamentals of our science every year; light is suddenly shed on hitherto dark fields, and in consequence our views not rarely have to be modified, or even to be changed radically to a much greater extent than in the engineering or agricultural sciences. The practitioner has to adapt his diagnostic methods, his conception and even his treatment of disease to this development of our theoretic knowledge. He can do so only if the scientific training he received as a student was broad. The more his training was merely technical, directed only to the application to practical medicine of the scientific principles evolved at the time of his student years, the less will he be prepared to follow the further development of medicine, the more stereotyped will be his activity in the practice of medicine and the more liable will he be to apply occasionally methods which in the end might prove injurious rather than beneficial.

It is to some extent a chance effect of historic development in physiology and pathology and pharmacology which determines what is deemed essential in the curriculum of a medical student. Thus, in pathology the teaching is to a great extent anatomic and histologic; in physiology and experimental (or physiologic) pathology the teaching of the mechanical factors in disease is very much favored, as, for instance, the dynamics of the circulation and mechanism of the heart action, while the chemie and toxicologic pathogenic factors which are all important, but the study of which is of more recent development, are, perhaps, not yet quite considered as of equal rank. Courses in experimental pathology, especially, seem to emphasize the mechanical factors in disease; on the other hand, I believe that an experimental

study of general pathology must have a broadening effect on the mind of the student.² Much of that which is apparently of purely theoretic interest to-day will be of great practical interest to-morrow. As an example, I might cite the laws of surface tension and the practical application made of them in diagnosis in recent years. The investigator and teacher who to-day will deviate somewhat from the usual field not rarely lays the foundation for that which will become routine to-morrow, and he may often be more able to impart to his students the spirit of scientific analysis and an appreciation of the theoretic foundation of medicine than another teacher who gives to his students the more conventional course. I fully concede that the student must be well prepared to understand all problems which the clinical study of medicine offers and, also, that he ought especially not to neglect the study of the mechanical factors in disease, but I would on the other hand plead for a much greater consideration of the more general conceptions of biologic science in its relation to medicine, and for great liberality in making it possible for the teacher to express his individual tendencies in scientific medicine.

I now turn to the relation between the practitioner and the investigator in research institutions, and here I must be still briefer. Here again the practitioner, the clinician, not infrequently is dissatisfied with the attitude of the investigator. In the first place, the practitioner feels that he does not receive sufficiently direct assistance in his work from the laboratory worker. He expects the latter to be at his disposal whenever he wishes help in the diagnosis of the disease, and in other ways in the study of the case during life and especially after death. Secondly, he is inclined to make the criticism that the work of the investigator is too theoretic, has not sufficient bearing on those aspects of disease in which he is especially interested and does not bring immediate practical results.

Inasmuch as the medical department of a university represents a combination of a teaching and a research institution, the difficulties encountered in the research institutions may be found to exist in the medical schools. In the first-named special research institutions, it is especially the pathologist against whom the criticism is directed. There is no doubt that the clinician needs assistance and that he himself is usually not in a position to carry out certain pathologic and biochemic examinations which would aid him much in the diagnosis and the treatment of the disease. It appears, however, very doubtful to us whether it is desirable that the professor of pathology and biochemistry or the director of the laboratory, essentially intended for the furtherance of scientific knowledge and research in medicine, should undertake such work. He would be obliged to scatter his efforts and could not accomplish his essential tasks. During a relatively long period in the history of pathology the careful study of material obtained at autopsies was the principal field for research in pathology. These investigations laid the foundation for our knowledge of pathologic anatomy and histology. At that time the cooperation between clinician and pathologist at the post-mortem table was equally in the interest of clinical medicine and pathology.

Although considerable work undoubtedly remains to be done in this direction, still the principal structure of

2. It may, perhaps, be of interest to mention that in a course in experimental pathology which I prepared and gave in 1904 and in the following years I embodied much work in general pathology. I would also like to refer in this connection to the address of Dr. Yandell Henderson, the chairman of this section at the Los Angeles meeting of the A. M. A., *THE JOURNAL*, Sept. 9, 1911, p. 1857.

this part of pathology has been erected, and new fields of research that have already given important results and promise still greater results have since been opened, and now claim the best efforts of the investigator. Under these conditions it seems, in general, preferable that this part of pathologic and biochemic work, which is in the main subsidiary to the practical needs of the clinician, should be entrusted to special workers. There is no doubt that here, also, results of interest to science may be obtained, so to say, as a by-product, but this work is not primarily undertaken from this point of view and such results cannot be counted on as certain. Whether these workers in what, in a wider sense, we might call clinical pathology ought to be attached to the department of pathology or of clinical medicine depends on the special character of the different institutions. As a general rule, the clinical pathologist ought to be connected with that department which can use, to the greatest advantage in science, the data obtained through his efforts.

While we thus find that the demand for scientific assistance on the part of the practitioner is justified and that a way can be found to satisfy his needs without impairing the work of the investigator, I believe that the solution for the second difficulty, expressed in the criticism that the work of the investigator is too theoretic, must be looked for in another direction. We all desire results that diminish the suffering of mankind, but they are not best obtained by decrying the efforts of the worker who follows apparently purely theoretic lines of research. I believe that the urgent demand for practical results in scientific research ought to be counteracted through a brief course on the development of human knowledge, which each medical student should receive at some time early in his studies. Perhaps a few lectures given on that subject in connection with the course on biology or physics, in the first or second year of college, or perhaps a few introductory lectures given with the course in chemistry or physiology in the medical school, and a few additional lectures on the modern history of medical science given in the third or fourth year might produce the desired effect. Such lectures might create an appreciation of the fact that although progress in science is continuous and connected, yet the making of a valuable discovery depends to a great extent on a certain lability of thought in the mind of the investigator.

In definite instances the element of happy accident has, of course, to be taken for granted. Individual peculiarities on the part of the investigator in the selection of problems and in the way of attacking the problem must not only be tolerated on the part of the practitioner, but must even be encouraged. History has shown that the development of science is continuous and connected, but it has also shown that this development does not, usually, take place in such a direct and straight line that we are in a position to foretell its course. Much depends on the personality of the investigator. It is only the highest type of investigator who may appreciate in which direction the solution of a problem may be expected, and he, also, frequently depends on the aid of favorable constellations in the development of his work. Dictation from the outside will lead to the use of stereotyped methods which have given some results in the past, but may not be adapted to new problems. Frequent criticism on the part of the outsider is liable to dampen the enthusiasm which is a valuable asset in the work of the investigator.

It has been repeatedly pointed out in the past how the most far-reaching results, also from a practical point of view, were obtained through often long and tedious work of a very theoretic character, apparently without connection with medical practice. We might even assert that the practical problems given by the practitioner are frequently of such a specialistic character, restricted in their general significance, that with some preparation, the practitioner might best be suited to undertake such investigations himself. The more far-reaching results which benefit wider circles are usually the outcome of biologic, physiologic or chemical investigation originally undertaken without a direct view for practical application. We may assert that in the natural course of its development a branch of science may be treated purely from a theoretic point of view. In the course of this theoretic development, the point will be reached at which the possibility of practical application will become apparent. Not only the general research laboratories of the medical department, but also the research institutions devoted to the pursuits of special problems must shape their policy in accordance with these facts and encourage investigation on the broadest possible basis; otherwise they may undermine their most valuable source of intellectual supply.

But we must go even farther and state that the obtaining of results, practical in the sense in which this term is usually applied, is not the only aim of investigation. It is well understood that physics, chemistry and biology are not cultivated merely from the point of view of the discovery of methods of use in the daily life. They all serve besides a philosophic purpose; they give us an understanding of the universe and of man's rôle in the universe. What holds good of zoology and botany holds good also of physiologic and pathologic study. They are at least as important for our philosophic understanding of life as botany and zoology. And this applies not only to physiology and pathology in general, but even to special branches in these sciences. They all have to serve a double purpose, namely, to contribute to the solution of a practical problem and to our understanding of life in all its physical, intellectual and moral aspects. There does not need to be any dispute as to how far one aspect of investigation ought to be favored at the expense of the other. Both sides of investigation go in reality hand in hand and, as we pointed out, the road of purely theoretic research will ultimately lead, also, to the most far-reaching practical results. Theoretic investigations in physiology and pathology are therefore necessary as instruments with which to obtain practical results which can be directly applied in the treatment of disease. Theoretic investigations are also necessary, as we pointed out, in order to satisfy our philosophic needs. If we oppose here practical and philosophic aims, we must recognize that such a division does not altogether do justice to the real state of things, for investigations in physiology and pathology are of a practical character in proportion as they subserve philosophic needs.

And it is the practitioner in medicine, daily confronted with the experience of the greatest physical and mental suffering in patients asking for his help, who will appreciate the assistance which a philosophic study of the sciences will give him; it will sustain him in his daily difficult task, increase his sympathy with human suffering and add to his power to give consolation and strength to his patients by raising their thoughts to higher spheres. The investigator, in his turn also, depends to some extent on the moral support of the general prac-

itioner who is not directly connected with a medical-teaching or research institution. His task will be made more easy and more fruitful if he finds a sympathetic understanding on the part of the practitioner. Furthermore, the practitioner might come into closer touch with the work of the investigator, adopting the latter's attitude of mind in those cases in which he is confronted with new situations and new problems in his practice, and at the same time he might add to his usefulness and to the dignity of his position by becoming a source of intellectual and moral help to the community by fortifying himself in his difficult task through the philosophic study of science, and by communicating the spirit of science to the circle of those who are under his care. The realization of this conception will effect a very close union between investigator and practitioner. The physician can be and ought to be thus a bearer of the message that science has for mankind.

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EXPERIMENTAL DEVASCULARIZATION OF SEGMENTS OF INTESTINE WITH AND WITHOUT MECHANICAL OBSTRUCTION *

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Any experimental work dealing with intestinal obstruction as one of its chief features requires a preliminary statement of the present status of obstruction. The exact cause of death in obstruction of the bowel has never been definitely determined. The three theories advanced are: (1) the nervous theory, which holds that the nervous system is affected in somewhat the same way as in shock; (2) the bacterial theory, which holds that death is due to the bacteria contained in the obstructed intestine; (3) the toxemia theory, which holds that death in obstruction is due to some perversion of intestinal metabolism. Metabolic toxins may be formed in the epithelium of the intestine, or the mucosa may permit the direct absorption of peptones and products from the intestine that are normally changed by the epithelium before being discharged into the circulation. The nervous theory has few advocates, but the bacterial theory and the theory of toxemia have many champions.

RECENT EXPERIMENTAL WORK

It is not our purpose to review the literature on this subject, which can be found in a number of recent articles, particularly those by Hartwell and Hoguet,¹ Murphy and Vincent,² and J. W. Draper,³ to say nothing of the German and French work, which in the last few years has been quite extensive. We desire, however, to call attention to some of the deductions made from recent experimental work. It does not seem probable that the chief cause of death in intestinal obstruction is a lesion of the intestinal mucosa as Hartwell and Hoguet believe, though this may be a contributing cause. If a

lesion of the mucosa is chiefly responsible, it would be difficult to explain why the symptoms of ileus do not develop after any ulceration of the bowel, or after any wound in which a raw surface is necessarily left in the mucosa, as in intestinal resection. It has been pointed out by Roger and Garnier and by others that the normal products of intestinal digestion, particularly the peptones, are poisonous if directly injected into the circulation. The intestinal mucosa exerts some chemical change on this material during the process of absorption, which not only renders it non-toxic, but converts it into nutrition for the body cells. Experiments, then, which depend on the fact that material taken from a strangulated loop of intestine and injected into an animal produces illness and death, do not by any means prove that this material is peculiar to the strangulated intestine. The normal products from the normal intestinal tract when injected will also produce marked toxic symptoms and death.

It is generally recognized that a high intestinal obstruction, within 12 inches of the pylorus, is more rapidly fatal than an obstruction low down in the ileum. This is classed by Draper, Roger and Garnier and others as proof of the fact that some vital secretion of the duodenum and no bacterial product is the toxic substance in obstruction, for it is well known that the upper part of the intestinal tract contains fewer bacteria than the lower part of the ileum. The experiments of Murphy and Vincent emphasized this difference in bacteria in the duodenum and the ileum as they found that when material from normal unobstructed bowel of cats was injected within the peritoneal cavity, necropsy revealed a peritonitis which corresponded with the level of the intestine from which the material was taken; that is, the most marked peritonitis was found when the contents of the ileum were used and the mildest when the contents of the duodenum were injected. This does not sustain the theory that the toxic substance is due solely to bacteria, for a low obstruction with a large amount of bacteria should be more rapidly fatal than a high obstruction with a small amount of bacteria.

The fact that the toxic material of obstruction can be reproduced in a section of removed intestine, as was done by Murphy and Vincent, does not exclude the possibility of this material being formed by the cells of the intestinal mucosa. In pathologic conditions of the thyroid gland, as hyperthyroidism, the toxic products may be prepared from the gland after it has been removed and when injected reproduce to a large extent the symptoms of hyperthyroidism. In like manner, a toxic substance might be formed in the intestinal mucosa and extracted after the bowel had been removed from the body, or might be produced by body heat and devascularization, which would be the condition of the intestinal loop placed in an incubator. The careful work of Murphy and Vincent has thrown much light on obstruction, but the rapid death and marked symptoms which they report from intraperitoneal injection of the unsterilized material from an obstructed intestinal loop may be due to septic peritonitis. It is at least conceivable that the peculiar toxic product of acute ileus may be formed from the epithelium of the intestinal mucosa of the obstructed loop under the stimulus of a perverted circulation, of an excessive amount of bacteria, or of both. If toxic products sometimes occur in the thyroid under stimulation of excessive nervous impulses, we cannot dismiss the possibility of some stimulation of the mucosa of the intestine by excessive bacterial toxins or altered circulation causing toxic products here.

* Read in the Section on Pathology and Physiology of the American Medical Association, at the Sixty-Third Annual Session, held at Atlantic City, June, 1912.

1. Hartwell, J. A., and Hoguet, J. P.: *Experimental Study of High Intestinal Obstruction*, *Am. Jour. Med. Sc.*, March, 1912.

2. Murphy, F. T., and Vincent, B.: *Experimental Study of Cause of Death in Acute Intestinal Obstruction*, *Boston Med. and Surg. Jour.*, Nov. 2, 1911.

3. Draper, J. W.: *Experimental Intestinal Obstruction*, *The Journal A. M. A.*, Oct. 21, 1911, p. 1338.