with the research spirit in the university and have presumably imbibed something of this spirit. We believe it to be vitally important to the colleges to encourage in every way in their power the spirit of research in their teachers.

It is equally important for the schools of all grades, but their problem is one of much greater difficulty, for they draw their teachers chiefly directly from the excessively pedagogic and therefore deadening atmosphere of the ordinary schools and normal schools rather than from among university graduates. We have, therefore, given our attention chiefly to the colleges, a phase of our educational system apparently now most ready for improvement. Conditions in professional and technical schools need as serious consideration as those in colleges.

In brief, so far as the American college is concerned, our main purpose is to change somewhat fundamentally its intellectual atmosphere, to set up a new standard, so that hack teachers will be barred and young men and young women at the time they are determining their life interests shall be in contact with teachers of scholarly habit and some scholarly attainment. This is a far-reaching program, requiring time and much money for its attainment. The first essential step is to see clearly the goal and to revaluate college customs, ideals and methods in view of this larger conception of college excellence.

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RESEARCH IN MEDICAL SCHOOLS

THE subject of starting medical students in research may well lead to discussion, for opinion now varies all the way from the theory that none should try research up to the idea that every medical student should undertake a problem. In the presentation of the subject as I see it, it will be well to make clear at the outset that one of the elements of liberty in education is freedom for the individual teacher to carry out his own ideas; in other words, outstanding ability for teaching and especially for leading students into research has so large an element of natural gift or creative talent that methods must vary with each teacher.

Medical schools, as they are organized to-day, have three functions: There is first their original purpose of training practitioners of medicine. Second, as professional schools, they must perpetuate themselves by training their own teachers. Third, they must carry their share of the progress of medical science in laboratory and hospital not only through the work of their own teachers but also by training those who are to carry on investigation in research institutes.

As is well known, every science passes through two phases, the descriptive and the experimental. In an address on the late Sir William Osler, Dr. Rufus Cole gave a delightful description of Osler's clinic as an example of teaching medicine in its descriptive phase. During the years from 1893 to 1900, Osler's wards in Baltimore were filled with typhoid fever in the fall, with pneumonia during the winter. In the clinic he had a large blackboard for the permanent records of the term, a line for each case with such essential facts as onset, temperature, complications, etc. The student kept a duplicate list and elaborated his notes at each ward round where he studied the cases and at each clinic where new symptoms were reported and discussed. At the end of the term, the student analyzed the data from his own notes into terms of the percentage of complications, the range of temperature, the duration of the disease, the mortality; in other words, each student wrote a text-book of typhoid fever from the cases he himself had seen, examined and recorded and then compared the findings of his own particular season of typhoid fever with the experience of other years and with the percentages from larger numbers. In this method, carried out with all the charm of Osler, the student became the physician at his very first clinic and started in the method by which he was to become a permanent student of medicine. Thus he had training in the essential methods of a descriptive science, observation, record and the periodic analysis of data.

I have taken this illustration from clinical teaching rather than from the laboratory because in the laboratory it was established even earlier that the student should gain experience from specimens which he himself prepared and studied, that he should analyze his own material and compare his results with the records in his text-book and in the literature. It may now be taken for granted that the method of descriptive science—observation, record, analysis—are so firmly intrenched in the fundamental courses given to all medical students that every single student in medicine must realize that the days when medicine could adequately be described as the art of healing have gone forever, for to the fine skill of dealing with patients has been added the application of the methods of a rapidly advancing science.

To meet the needs of this advancing science, how shall we introduce students into research? There are first those who believe that the demands of the medical course are so great that no student should undertake research until he has won the medical degree. To this idea is added the opinion that no student can have a sufficient mastery of the literature of any

phase of medical science to warrant his starting in research. In advocating my own theory, that the exceptional student, and by this phrase I mean the student with exceptional bent toward research, should be encouraged to undertake a problem during the medical course, these objections seem to be of little weight. In the first place, the medical course, like every other educational course, is actually organized so that the average student gets through, as is amply proved by the fact that in medicine, as in all other professions, only a few show outstanding ability. It goes without saying that the exceptional student can do more than the average and a student selected to do research should be able to carry the regular work with ease. If an occasional student has an interest so exclusively limited to some problem that he can not also carry the course, he can readily work for the degree of doctor of philosophy in the medical sciences and thus limit the amount of general work to the minors required for that degree.

As far as mastery of the literature is concerned, any person beginning research must depend at the outset on the one who formulates a problem on which he can start as a next feasible step in the progress of medical science. In our own time, when scientific journals have multiplied in number to such an extent that any investigator could occupy his entire time with reading to the exclusion of original research, we will do well to recognize, first, that professional research workers themselves do make use of such cooperative endeavor in the mastery of literature as is represented in such journals as *Physiological Reviews* and that the effort to gain complete mastery of literature is more often concerned with the minor issue of priority rather than the major issue of the advancement of science. That work, sometimes most valuable work, is frequently overlooked is well illustrated in the well-known example of Mendel and has recently been brought out by Dr. Arnold Rich in a delightful account of Dutrochet, until now practically unknown, and yet it was he who first formulated the cell theory fifteen years before the work of Schleiden and Schwann. Rich points out that frequently new concepts are ignored and rejected because the age in which they appear is not sufficiently advanced to comprehend them. To this we may add that the lesson for the investigator is that effective presentation of research involves not only the facts but also their bearing and whither they lead as far as he himself is able to discern. In connection with this concept of a supposed complete mastery of the literature, it seems to me that often the most original minds, the minds most adapted to experimentation, are not the types that enjoy analysis and classification of vast masses of detail in knowledge. In looking back over one's own education one can easily recall two kinds of teachers, one who presented the critical analysis, the classification and organization of data and the other whose interest was concentrated on the growing zone of knowledge. That both types of instruction are valuable to the student is clear; I only wish to bring out the folly of trying to force both methods of work into the one individual. There are investigators who start with a masterly concept of known facts; there are others, equally valuable, often more original, who prefer to analyze the detail of literature when their work is already well under way. Certainly in an age where extreme democracy in education tends toward standardization, we might well consciously give the investigator the freedom of his individuality. My plea for the student is that he may depend on a few of the outstanding contributions on his proposed subject and a few of the newer articles that show him how the subject is growing at the moment, to give him an adequate start and that any supposed complete mastery of literature will be acquired by him, if at all, only by long years of study. Moreover, the beginning of a problem of his own will serve to stimulate as well as to give direction and purpose to his reading.

In contrast to the idea that no student should undertake a problem there are medical schools organized on the basis of research for every student. This means the attempt to organize the work for the medical degree on the same basis as the work for the degree of doctor of philosophy. This method has the advantage in argument that it is now being carried on with success and comes under my original proviso of liberty for the teacher; nevertheless, I wish to express what seem to me to be weaknesses of the system. In medical schools as they are now organized, only a part of the students are to become professional research workers and yet it is perfectly clear that every student, whether preparing for practice, teaching, or research should have the methods of science. That much should be cared for as indicated above in the entire system of medical education. But, when every student is assigned a problem, much of the work, indeed I think one could say the majority of the work, will turn out to be the writing of an essay instead of the presentation of the results of original investigation. This I think will be true for two reasons, first the limitations of the students themselves and second the limitations of the capacity of any faculty for directing research. It is in my opinion entirely feasible to train every single student in a medical school in the methods of descriptive science; but medicine has passed far beyond the stage of a descriptive science, it is now in the experimental phase and the need of the medical school of to-day

is to furnish a certain number of professional research workers in experimental medicine.

This is the problem of our day; the problem of changing medical education from an art to a science was attacked thirty years ago when the laboratories became so dominant, but to-day it is the need of medicine as an experimental science that must occupy educational thought. The story of medicine of the last fifty years has completely committed the medical profession to the concept of the control and mastery of disease, to an idea of life with health as an entirely feasible goal, the time of reaching the goal to be determined by the ability of the profession to handle experimental medicine.

Medical schools must now train physicians to carry out the ever-advancing methods of medical science and to increase the knowledge of the control of disease.

In my opinion the major factor in finding those who will undertake experimental research is the intellectual quality of the teacher. He must present his science with life, he must himself see medicine as a growing subject, with emphasis in his lectures and in discussions with students on new points of attack in places where new work is feasible so that it will be ideas that lead students toward research. It seems to me that the teacher should both suggest research to the student he deems especially fitted for the work and that he should be receptive and understanding toward the student who asks for research. I can not but feel that the leading of students toward research by charm of ideas must be more attractive to any teacher than any application of an "all or none theory" to research.

To select or accept the right students, to choose feasible problems, to direct students so as to retain their interest, to use all their originality, to smooth out their difficulties to some extent, yet not too much, let no one think this an easy task or a task in which any teacher no matter how much of the superman he may be may expect success in every case, but it is the most fascinating task of all teaching. The measure of its success is the measure of the progress of experimental medicine. Any plan of training research workers, whether involving all the students or a selected group, must be judged by the numbers actually trained in the experimental method. Anything less than this misses the point of our present needs.

Training in experimental science needs a degree of supervision that must necessarily limit the numbers for each teacher. The use of animals alone puts the need of supervision beyond argument and the methods of research are of ever-increasing complexity. By this I mean that even if the policy of an institution involves giving every student a problem, it will actually be only the few that get adequate training in an experimental problem. But of more importance than all these technical matters of supervision and of training in method is the attitude of the teacher himself. He may present his own theories which will often be the basis for the start of the student, but he must leave the student's mind free to judge the evidence for himself and free to differ with his instructor; under any other terms there is no liberty in education. No teacher has unlimited problems which he is capable of directing. His own work does not have unlimited new points of attack at any one time, but the new problems develop constantly as the work grows. Thus the taking of research students does not fit readily into a routine; each school is organized to take a stated number of new students into its classes each year, but the number of new research students a teacher can take depends on several variables such as the number of the older group that have finished their problems, the status of the teacher's own work, etc.

Any method which might involve an assignment of research students to a given teacher would in my judgment be most unfortunate. One of the most essential requirements for success is an intellecutal compatibility between student and teacher resting on the basis of free choice on both sides.

It is rare that a teacher can direct research that is far from the range of his own work either past or present, but this does not mean that every or even any students should be brought directly into the teacher's own problem, but it does mean that the teacher must be familiar with the ideas and the type of methods. A glance at any of the scientific journals of the day will show that medical research is tending markedly toward joint endeavor. This is inevitable because the complexity of experimental methods puts certain problems, and now an ever-increasing number of them entirely out of the scope of ability of a single worker. This is true in the use of a given technique and in problems that involve the techniques of two or more branches of the medical sciences, as, for example, the combinations of biological and chemical research. Such joint endeavor is of the utmost advantage to science and to trained investigators themselves. To bring a student just beginning research into joint research is, in my opinion, sometimes justified and feasible, but it must always be done with the utmost care and foresight lest the student become merely a technician and fail to get an adequate training.

The selection of a problem for a student needs nice judgment. It should be a task, in the first place, which is feasible. The trained investigator can often

afford to try out a problem that is purely speculative, but a student needs a more safe investment. Secondly, though the instructor is convinced that the problem can be solved, it must offer some chance for the student's own initiative, must give him some play of ideas; it should involve the preparation of specimens, of the performance of experiments which he can carry out himself so that he can be gaining the concept of the essentials of experimental science, which are the formulation of ideas, the development of plans to put them to the test, and then observation, records and analysis. Thirdly, an ideal problem for a student must open up a field for him for further work so that he will get the best thing out of research, a training in a concept of knowledge as a growing thing. With these points in mind, it will be evident that joint research between teacher and student has certain disadvantages for the student that can only be overcome provided the instructor is frank in discussion of its dangers and alive to the idea of giving the student a well-rounded training. The advantages to the student of solving a problem during his medical course are threefold. First, he receives valuable training and gains a new standard of work. Many times I have seen the quality of all the work of a student raised as the result of his training. Second, it enables the student to analyze his own abilities and tendencies from his actual experience. Third, it opens to him the door of opportunity in case he finds that he is actually interested in research and teaching.

From what I have said, it will be obvious that I should make each teacher entirely free in the matter of the training of students in research. This freedom would of course include taking no students, some or all. To make a place in a university for the work of a Willard Gibbs, whether he takes some students or none, whether his work is understood in his day or not, is the great reward of freedom in education. But from the standpoint of the development of medical science, I should judge a school that gave no opportunity for students to start in research as not carrying the full load of the modern university. With the question as to the most fruitful way of meeting the problem of introducing students into medical science, whether by starting every student with a problem and selecting the best or by trying to select those best suited to research and giving them more intensive training, I should let the results be the judge. But, in my opinion, it will not be the method that will be the decisive factor but the individual teacher; given a Ludwig, a Mall or a Welch on the faculty, the question of research will take care of itself. Find the teacher with the gift for stimulating students toward research and give him freedom; he will determine his own method.

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DISCUSSION OF DR. SABIN'S PAPER

I HAVE had a rather unusual opportunity to see how such a plan as outlined by Dr. Sabin would work. For a number of years I taught classes in which were her research students, and there is no question but that the enthusiasm produced by their work with her was of great value to them and stimulating to the other students. Certainly there is a very great chance for the student to gain an experience and to develop a scientific critique which will be of value to him throughout the remainder of his life.

There is an obvious corollary to this discussion which might be mentioned and that is that there should be experienced and active investigators in all medical schools. I think it is not too optimistic to hope that each teacher of medical students will be an active investigator in the field in which he is teaching. I believe that a teacher not engaged in active investigation can not give the student what the student deserves.

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RESEARCH IN LAW

IF one examines existing university law schools he will find that even the best of them have down to date been chiefly professional training schools for those who expect to practice at the bar. A few have arranged to give the members of their faculties a teaching load light enough to permit them to engage in research and writing. None have purported to do much in the way of training legal investigators, except in so far as they have claimed that the pursuit of the regular professional curriculum does so. It must be confessed that the notion that the curriculum does accomplish this purpose is widespread among law teachers, although, as will be pointed out later, nothing could be more unfounded. In addition, the work which students of high standing are expected to do in editing such periodicals as the Columbia and Harvard *Law Reviews* and the *Yale Law Journal* is supposed to give the privileged few who are chosen to the editorial board an adequate training in legal research.

To complete our survey of present conditions we need to add that in recent years a few of the schools —they can be counted almost on the fingers of one hand—have offered a year of graduate work in addition to the regular three-year law school course, and