cell-life progresses; and it will aid in its turn in the general advance.

We have followed the history of the problem of fertilization from the metaphysical stage through the morphological stage into the physiological stage, and within sight of the physico-chemical stage. Possibly the results seem slight as a record of 265 years of continuous study of a single biological problem. But we read the history of science very superficially indeed if we fail to realize the constant interdependence of all scientific thought. There has probably been no time in the history of our particular subject when a greater amount of work on its problems would have caused a much more rapid advance. Scientific discovery is a truly epigenetic process in which the germs of thought develop in the total environment of knowledge. Investigation of particular problems can not be accelerated beyond well-defined limits; progress in each depends on the movement of the whole of science.

FRANK R. LILLIE
UNIVERSITY OF CHICAGO

THE WORK AND OPPORTUNITIES OF A DEPARTMENT OF RESEARCH MEDICINE IN THE UNIVERSITY[1]

IF we analyze the discussions of present-day problems of medical education we find that an important if not the ultimate object of any particular plan is greater opportunity for research. This we find in the argument of those who support the plan of the full-time teacher, the plan that the university should own its hospital or control one by close affiliation, and also it is evident in all plans for greater endowment. Increased facilities for research and an augmentation of the number of men engaged in research, or combining research with teaching, would ensure, it is contended, not only important progress in the science of medicine, but also a higher development of both medical teaching and medical practise. To what extent this increased interest in research is due to the popularization of medicine through the practical application of discoveries in the fields of bacteriology and protozoology and to what extent to a dissatisfaction with time-honored methods in medical education, it is difficult to say. Both undoubtedly have had some influence but they alone can not explain the rapidly increasing number of experiments in medical education which have for their avowed object the stimulation of medical research in school and hospital. As the most important of such experiments I need only remind you of the so-called "full time" scheme at Johns Hopkins Medical School fostered by the General Education Board, the affiliation between Columbia University and the Presbyterian Hospital of New York City, the development in Chicago of the Otho S. A. Sprague Institute which, without buildings of its own, utilizes for purposes of research in medicine the already existing laboratories and hospitals of that city, and more recently in San Francisco in connection with the University of California, the establishment of a well-endowed department for general research in medicine. On a smaller scale we find the establishment, definitely within the university, of separate departments for the investigation of tropical diseases, of cancer, of tuberculosis, of chronic diseases, or of departments devoted less specifically to experimental medicine, comparative pathology, comparative physiology and the like. As all such foundations must be considered for a time at

[1] Address of the vice-president and chairman of Section of Physiology and Experimental Medicine of the American Association for the Advancement of Science, Columbus, January 1, 1916.

least, as experiments in medical education and research, and as the increase of endowment for the better type of medical effort will naturally depend to some extent upon the efforts, successful or otherwise, of the foundations already in existence, it seems advisable that those responsible for the expenditure of research funds should from time to time report upon their efforts —both useful and futile—in order to guide those giving or receiving funds for investigation in medicine. It is for this reason that I present to you, to-day, the experience of a small university research department for the management of which I have been responsible during the past five years. It is not always comfortable to talk about one's own work and efforts and I realize that I may be criticized for bringing myself and my department into the limelight in this way and particularly on this occasion, but I am satisfied from the number of inquiries I receive about the plan and scope of our work that there is a general desire on the part not only of medical faculties and university trustees, but also of individuals who wish to aid and foster research in medicine, to know more about the experience of foundations already established. For this reason, despite possible criticism, I present the general facts concerning some of the phases of the work of the John Herr Musser Department of Research Medicine of the University of Pennsylvania during the past five years.[2]

This department was endowed in 1909 under a deed of gift which provided for the establishment of a chair of research medicine in a department of similar name.[3]

[2] September 1, 1910, to August 31, 1915.

[3] In 1912 after the death of John Herr Musser, professor of clinical medicine in the university, and at the request of the original donor, the name of the department was changed to The John Herr Musser Department of Research Medicine.

Some of the important conditions contained in this deed of gift which have necessarily determined the work of the department are as follows:

1. That the department concern itself especially with the study of chronic diseases[4] by laboratory methods and with the aid when necessary of the wards of the university hospital.

2. That the professor of research medicine devote his entire time to the conduct of the department, his duties as a teacher being limited to not less than fifteen lectures or demonstrations on the work of the department to be given to students of medicine of the University of Pennsylvania.

3. That the facilities of the department be open to members of other departments of the university and to such students and practitioners as might be considered capable of conducting research work.

4. That the income of the endowment be applicable to the purposes of the department of research medicine and in and about no other department of the University of Pennsylvania or otherwise.

In brief the conditions of the endowment established a department for the study of chronic diseases, reduced the teaching duties of the staff to a minimum and provided that opportunities for research should be given to those desiring such work and that the income could not be used to eke out the expenses of existing departments. The qualifying statements, however, in regard to each of these conditions allowed considerable latitude of interpretation, both as to scope of work and relations to other departments. The work of the department, as determined by the various conditions stated, may be considered under the following heads:

[4] Some diseases were specifically mentioned, as, for example, gout, rheumatism and nephritis.

1. Investigation of the problems of certain chronic diseases.

2. Cooperative efforts with other departments, particularly the department of medicine.

3. Special elective courses of instruction for medical students, and

4. Opportunities for research offered to physicians and others.

These four lines of effort have been the chief object of the department and upon the success of these must rest opinion concerning the value of such a department to the medical school or the community.

1. INVESTIGATION

From the point of view of the investigator the field of the chronic diseases is the most difficult of approach in the entire territory of medicine and it is for this reason that our exact knowledge of these diseases progresses so slowly. The very slight knowledge we have concerning their etiology, the insidious nature of their onset, their slow progress, the frequent involvement of several organs in a general degenerative process, and the difficulty of reproducing pure types of chronic lesions experimentally, render impossible the brilliant achievements which have characterized the attack on the acute infectious diseases by the methods of bacteriology and immunology. Progress must depend on the slower methods of physiology and chemistry as used in experimental and clinical studies. The immediate problem in a given disease is to understand the gradual and progressive changes in physiology which a particular type of organic lesion produces rather than to discover its exact etiology. Naturally etiology and of course therapeusis, looking to amelioration of a chronic diseased condition, are the ultimate objects of researches in this field, but at present the best form of attack seems to be that designed to explain pathological physiology and especially the physiology or chemistry of the characteristic crises and complications, as, for example, the edema, uremia and hypertension of nephritis, the acidosis and coma of diabetes, the exacerbations of gout and so forth. The investigation of individuals, the subjects of chronic disease, by means of metabolism studies, functional tests and instruments of precision, as those applied to the cardio-vascular system, must constitute an important phase of work in this field. This must, necessarily, be supplemented by experiments on animals which have for their object the reproduction of lesions chronic in nature which may then be studied by the methods of physiology and chemistry, or, if this is not always possible, by the reproduction of isolated phenomena, or analogous symptoms or complications. Chronic disease and its phenomena can not always be imitated perfectly by experiment, but the imperfect experiment may nevertheless throw some light on the phenomena of a particular disease. Finally, a department devoted to this field of disease must be prepared to test out new functional and other tests and to apply immediately the discoveries of physics, physiology and chemistry to both the experimental and clinical study of chronic disease.

Whether or not this plan of approaching the study of the chronic diseases is the best that could be conceived, it remains the plan adopted by the department under consideration. The principal lines of investigation which have been followed during the past five years have been those concerning (1) diseases of the kidney and (2) the spleen in relation to anemia and hemolytic jaundice. The first of these studies was undertaken largely on account of the great importance of nephritis as the common dis-

ease of advancing life and so frequently responsible for the final exitus and partly because it was one of the diseases for the study of which the department was founded.[5] The studies of the spleen were inaugurated on account of the almost total lack of knowledge concerning the function of this organ, the apparent relation it has to certain hemolytic anemias, and the improvement in the latter which follows the removal of the spleen. An analysis of the publications of the department during the five years of its existence shows that nineteen are more or less directly concerned with the study of diseases of the kidney and twenty-four equally so with problems concerning the spleen. Of these about one eighth are comprehensive metabolic or other studies of patients—while the larger number were based on experimental observations on animals. Other investigations concerned themselves with anaphylactic shock, the depressor substance of various tissues and fluids, the coagulation of the blood, the cerebrospinal fluid, the utilization of parenterally introduced serum, diseases of the heart, and the toxemias of pregnancy. As to the ultimate value of this work, we naturally offer no opinion. This brief summary is presented merely to indicate the general character of the research work of the department.

Another group of fourteen publications presented the results of the study of various new functional tests and methods of diagnosis. These include such subjects as the phthalein test for kidney function, Abderhalden's test for pregnancy, Folin's methods for non-protein nitrogen in the blood, the tetrachlorphthalein test for liver function, a critical study of Crehore's micrograph for recording heart sounds, and the technique of the Eck fistula operation with regard to its possible application to human surgery.

This testing of new methods, while not to be dignified as original investigation, we have considered nevertheless to be an important part of our work. It is well known that the busy hospital laboratory can not take up at once every new diagnostic aid that is announced. If the new method involves a simple technique and is easy of application it may gain wide use at once; but if further observation and experiment is necessary and especially if it demands animal experimentation, or new laboratory equipment, the average hospital waits until further trial in the laboratories of the medical sciences demonstrates its value and thus finally forces its practical application. We have felt that we are justified in giving a part of our time and resources to work of this character in order to reduce the waiting period which usually follows an announcement of a new procedure, applicable to the study of chronic disease. Incidentally the educational value to the department staff is a matter of no small importance, for its members at once become familiar with the technique of the new procedure, and such as engage also in hospital work or clinical teaching can at once put the method into practical use or instruct medical students and others concerning its value.

2. Cooperation with other departments

It is not the usual cooperation between departments that I wish to describe at this time. Every department desires from time to time the assistance, in connection with the solution of its problems, of the skill or equipment of other departments and this has naturally been our experience in connection with the widely varying methods of studying chronic diseases. We have found it necessary to call on the department of

[5] The deed of gift referred specifically to diseases of the kidney.

surgical research for the aid of its special skill in peculiarly difficult operative procedures, on the department of pathology for cooperation in problems demanding the methods of immunology and frequently on the department of physiological chemistry for cooperative assistance in technical procedure. On the other hand, we have given assistance in the solution of their problems to the departments of medicine, neurology, surgery and obstetrics. In the case of each of the departments named the cooperation has been successful inasmuch as the combined efforts at investigation have resulted in the publication of material of benefit to the departments interested. It has been our experience, moreover, that the presence of departments for research[6] stimulates among the workers in various other branches much discussion of borderline problems, with the result that the presence of one or more groups of men, giving their time entirely to research, encourages doubtful or difficult ventures in investigation that the teacher with his many duties and limited time for research would not attempt without the assistance of a department interested in research only. This is particularly true of the average busy clinical teacher whose hazy views on some theory or problem occasionally suggest a workable basis for orientative experimentation. With such views, in that they do not always concretely set the problem, the workers in the fundamental sciences of medicine are usually somewhat impatient. When, however, a department for the general investigation of disease exists, it can afford, in the hope of securing better cooperation with the clinical side of medicine, to sift and analyze such suggestions, and if a possibility of profitable investigation, or of definitely settling a moot point, is seen, it is justified in utilizing a certain amount of its time and funds in thus assisting the clinical department. And if in so doing it can persuade members of these departments to actively cooperate in the solution of the problems under consideration, and thus stimulate the spirit of exact investigation it is doing as much, if not more, for research and the development of clinical medicine than it would by restricting its efforts to the hard and fast lines of fundamental problems.

This cooperative work with other departments, valuable as it is, is, however, as a rule more or less incidental and without definite responsibility on the part of either party concerned. It does not represent sustained cooperative effort, but rather the coming together of two departments when mutual need arises. We have, however, with one department, that of the theory and practice of medicine, developed a community of interest and definitely cooperative effort which we regard as a most important experiment in medical education. Three years ago an agreement was entered into with the professor of medicine (Dr. Alfred Stengel), and largely at his suggestion, by which it was provided that the two associates most intimately concerned with him in the teaching of students and the care of patients in the university hospital, should give half their time to investigation in the department of research medicine. In other words, two men intimately connected with the fundamental instruction in clinical medicine were to devote their mornings to the teaching of students and the care of patients and their afternoons to fundamental research in a laboratory independent of the hospital. In the absence of the "full time" plan in the clinical departments of the school this seemed an experiment with "full time"

[6] This refers not only to the department under discussion, but as well to the department of surgical research under the direction of Dr. J. E. Sweet.

assistants well worth trying. It should be stated that this arrangement was not due to a lack of opportunity for research laboratory work in the hospital. The university hospital has two spacious and well-equipped laboratories, one in the hospital proper for the usual routine examinations and the other, The William Pepper Laboratory of Clinical Medicine, in a separate building, with an independent endowment and a large staff, engaged in the various research problems arising in connection with clinical observation in the wards. The cooperation with the department of research medicine, which has its laboratory in the medical school building, was for the purpose of enlarging the opportunities of the department of medicine and the department of research medicine by bringing the latter into closer contact with the problems of the wards, and allowing workers in the former department the utilization of the methods of the fundamental sciences in the solution of their problems and the broadening of their training. During the three years this arrangement has been in operation the results have been most gratifying and the arrangement has been of advantage to both departments. The research work of the two men concerned has been in part the study of patients under their care by the detailed methods of metabolic investigation and the use of functional tests, in part experimental work on animals in connection with fundamental problems, and in part the careful testing out of new methods of possible clinical application. Fully a third of the researches of the department completed during the past three years have been published under their names, either as independent authors or in collaboration with other members of the staff. On the side of productive research this is for them a most creditable showing; on the other side, that of their development as clinical teachers, there is abundant evidence that they have found this experience of great value. But for the university there is also something gained. Men desiring to devote themselves to a career as teachers of medicine can by this cooperation gain the proper balance between teaching, research and routine ward work without one phase suffering at the expense of the other. They can keep at all times in touch with each field of activity, and when the time comes that a man is overwhelmed by the lure of the clinic and finds that he must curtail the time given to fundamental research, and feels obliged to limit his investigations to the hospital laboratory, the university has the assurance that his fundamental laboratory training has been satisfactory. On the other hand, it is to be hoped that such a system will occasionally stimulate and hold the rarer type of clinical mind which finds its greatest satisfaction in the solution of the more difficult fundamental problems of medicine rather than in the practical applications of the clinical laboratory. Clinical medicine needs most men who would rather blaze a new path than clear the trail of those who have gone before. It is only through conscientious effort in the fundamental investigation of disease that such can be developed. To assist in developing men of this type is a function of the research laboratory in the university but, falling short of this, it can do what is perhaps only second in importance—cultivate proper ideals in its younger clinical teachers.

3. Elective Courses

The requirement, in the deed of gift, that the department should engage in teaching to the extent of not less than fifteen lectures or demonstrations in each year has been met by offering special elective courses, dealing with the experimental side of medi-

cine, and largely demonstrative in nature. It was the intent of the founder of the department, apparently, that the lectures or demonstrations offered should be given to an entire class. This plan was not carried out, partly because it would duplicate work already given in a systematic way by other departments and partly because it seemed unwise to add another set of didactic lectures to an already overcrowded curriculum. An alternate plan was therefore adopted of a series of elective demonstrations so arranged as to supplement the didactic and clinical teaching in other departments and to illustrate by experimental procedures, in a more or less intensive way, the physiology, chemistry and pathology of various organs or groups of organs. With a desire to determine the best system for such teaching, and also to find out what type of work and instruction appealed most to the student of medicine, the subject matter and method of this instruction has been changed from year to year. As our efforts in this regard are of some interest they will be briefly summarized. During the first year a comprehensive series of demonstrations in experimental pathology was given for the benefit of the class (second year) in pathology. This was offered twice a week during a period of fourteen weeks, half the class attending, if they desired, one demonstration each week. The subjects covered were degeneration and necrosis, inflammation and repair, blood destruction and jaundice, thrombosis embolism and infarction, experimental lesions of the heart, lungs, stomach, intestines, liver, pancreas, and kidney, the problems of infection and immunity, of shock and hemorrhage and the physiology of the ductless glands.[7] As far as possible the gross and microscopic lesions of disease in man were correlated with experimental lesions and the relations to clinical medicine emphasized. Physiological methods of graphic registration were employed whenever possible; changes in the urine and other secretions demonstrated; and the methods of chemical examination shown. Furthermore, in the exercises on the heart and lungs the work was done in cooperation with the instructor in physical diagnosis.

In the following three years this course was not offered in its entirety. Thus one year a group of ten students (fourth-year class) studied with great thoroughness the normal and pathological physiology of the cardio-vascular system, and in the following year the same course was given as a demonstration course and in less detail to the entire third-year class, divided into sections for this purpose. In still another year the problems of hepatic and renal and pancreatic disease were taken up by small groups of men from the fourth-year class.

At the end of four years of such concentrated experimental work we were impressed by the fact that although the student had gained a better insight into the problems of pathological physiology and therefore of disease processes, the time given to the various experimental procedures left little or no time, in our short two-hour periods, for the discussion of theories and the relation of new facts to old conceptions. And even with the constant presence at all these exercises of the two clinical associates, to whom I have previously referred, whose interest led them to emphasize matters of clinical importance, we felt that a thorough correlation of experimental procedure and clinical observation was not always attained. In the fifth year, therefore, we tried the experiment of a seminar for the discussion of the various problems peculiar to certain groups of disease. In this sem-

[7] Pearce, R. M., "The Teaching of Experimental Pathology and Pathological Physiology to Large Classes," *J. H. H. Bull.*, 1911, XXII., 1.

inar were united the chairs of medicine (Dr. Alfred Stengel), pharmacology (Dr. A. N. Richards), physiological chemistry (Dr. A. E. Taylor) and research medicine with their respective staffs and the seminar was thrown open to students of the fourth-year class as an elective. The medical clinic room of the hospital was used for these exercises in order that lantern demonstrations and the exhibition of patients might be possible. All other demonstrations were barred in order to have plenty of time for discussion. The first trimester started auspiciously with the discussion of diabetes and a sufficient number of students in attendance to guarantee, apparently, the success of the venture. But no student elected the course for the second and third trimesters devoted respectively to renal disease and diseases of the ductless glands. In brief, from the point of view of interesting the medical student, the seminar was a dismal failure. For the teaching and research staffs represented, the exchange of views was very profitable and despite the absence of students the seminar was continued through the year. It is perhaps needless to say that the students lost interest because of the many detailed discussions of opposing and oftentimes irreconcilable views which led the disputants away from the fundamental basis of accepted facts. Perhaps also the fact that the students could take no part in the exercises, except to ask questions, had something to do with their lack of interest.

We have, therefore, abandoned the seminar as an aid to discussion—perhaps it smacks too much of the didactic lecture, anyway—and have this year returned to the plan of offering to small groups of men three short, elective experimental courses dealing respectively with the cardio-vascular system, the liver and bile passages and the chronic degenerative diseases.

I have gone into these experiments in elective teaching in some detail because not only do I feel it is a very important part of our work, but also because I am convinced that in every school the men of the fourth year should have some means of reviewing in a practical way the knowledge they have obtained of one or more of the systems of the body. No better method exists, I believe, than the experimental course with its demonstrations of pathological physiology and chemistry, the necessary review of physiology, pathology and pharmacology and the obvious applications to clinical medicine. In short, such courses help to bring physiology into relation with morphology and to fill the gap which exists between pathological anatomy, on the one hand, and the clinic on the other. It is perhaps peculiarly the function of a university research laboratory[8] to develop such courses, and I consider our efforts in this direction to be a very important part of our work during the past five years.

4. Research by Students and Practitioners

The fourth of the important objects of the department has been to furnish opportunity for investigation, as stated in the original deed of gift, "to properly trained students and practitioners" of medicine. In this, in so far as the student is concerned, we have not been successful. This is, however, not the fault of the department, which has always been ready to encourage research by the medical student; nor, on the other hand, is it the fault of the students, many of whom have attempted to find time for a moderate amount of research work.

[8] In connection with our practical working out of these courses no claim for originality is implied. The general plan here outlined is largely that used several years ago in the department of pathology of the Johns Hopkins School by Professor W. G. MacCallum.

The failure is due to the demands of an overcrowded inflexible curriculum and an inadequate elective system. During only one trimester, a period of a little more than ten weeks, in the fourth year, has the undergraduate any freedom in the choice of work and in this period the total of hours that may be given to purely elective work is so small that sustained investigative work is impossible. A few enthusiastic students have occasionally attempted to utilize Saturday afternoons and odd hours during the week, but with, as was to be expected, no very definite results. As a matter of fact, during the five years the department has been in existence only one piece of work by students, deserving of publication, has been completed, and this represented student labors during a summer vacation period. The summer climate of Philadelphia, however, is not conducive to close laboratory work and students desiring medical work in the summer are inclined to seek fields demanding less arduous efforts than those of the research laboratory.

Our experience, then, has demonstrated the futility, in the absence of a liberal elective system, of attempting to interest students in independent investigation. Our present attitude is to recommend to those seeking such that they take the special elective courses which we have already described. These at least give a first-hand knowledge of experimental methods and some idea of the problems of medicine, and this is about all that can be accomplished in the small amount of time our students have for elective work.

The situation in regard to the practitioner of medicine is quite different. During the five-year period under analysis, about fifteen practitioners have entered the department for the purpose of carrying on definite investigative work, and of these, nine, either working alone or in collaboration with members of the regular staff, carried to completion a total of fifteen researches. In part these researches had a close relation to clinical methods and problems, but in a number of instances they were fundamental investigations in experimental pathology. All these workers have expressed the liveliest satisfaction at the opportunity afforded them and in many instances have continued an interest in the research side of medicine. These were, for the most part, younger men, with their hospital interneship back of them, who were starting the practise of medicine and wished to divide their spare time between dispensary and research work, or, as in some instances, to devote it entirely to investigative work. We have felt that a department for research in medicine could use its resources in no better way than to encourage such aspirations and for this reason every effort has been made to guarantee to these men accomplishment without undue loss of time or effort in petty routine work. Naturally such men do not remain for any great length of time[9] because of the demands of practise, hospital, dispensary and other clinical work, but if they carry into the latter the spirit of the investigator and utilize the hospital laboratory in the study of clinical problems, the time and effort given in their behalf by the research laboratory is not entirely lost. If the progress of medicine depends, as we like to think it does, upon the spirit of investigation, young men entering upon the practise of medicine should devote a part of the post-hospital period to methods of exact observation and experiment, and if a university possesses a department of research in medicine, one of its first duties

[9] One man remained with us four years and another two years: the others averaged about six months each.

is to offer to recent graduates who have enough time at their disposal, facilities for such work. For its ultimate success, however, such a policy must have the sympathy of the clinical teachers. If the latter discourage the spirit of research, and do not themselves engage in investigation, and especially if they urge that the younger men enter immediately, and to the full extent of their time, into distinctly clinical work, the research department need not expect many voluntary workers, and might as well plan its activities on the basis of its permanent full-time staff. If, on the other hand, the clinical atmosphere is stimulating and progressive, the research laboratory is perhaps doing its greatest good in providing for the men who wish to combine clinical observation with experimentation in the laboratory.

In this brief discussion of the main phases of the development of the department under discussion I have thus far omitted all reference to the questions which are frequently asked concerning such a department. Is not a department in the university for research only an anomaly? Should not the teacher be an investigator and the investigator a teacher? Would it not be better instead of a department for research only, to divide an endowment for research among existing teaching departments? These and many similar questions have often been put to me during the past five years and I have always answered that teaching and investigation, in my opinion, should go hand in hand, and that if adequate endowment could be procured to place teaching and research in every department of the medical school on a basis which would ensure adequate results, there would be no need for a separate department of research. Unfortunately no school possesses such endowment and probably will not for some time to come. In the meantime, it is evident that there is a tendency on the part of those wishing to advance the knowledge of certain diseases, or groups of disease, to offer to universities funds for the study of such. For the most part these funds do not represent large endowments, but sums which average two or three hundred thousand dollars and are for this reason given to institutions, as universities, which already have the buildings in which such concrete department may be housed, thus obviating the necessity of spending the income or a part of the principal for a new building. Likewise it is usually stipulated that the money is to be used for research and not for teaching. The object of this provision naturally is to prevent the diversion of funds to purposes other than those for which the gift was intended. Such gifts obviously intended for the more or less concentrated study of one disease or a group of disease can do little more than support a chair with one or two assistants or fellows, if much is to be left for diener services and expenses of equipment and maintenance. Its work at the most must be modest in comparison with our larger well-endowed non-university research institutions. But despite these restrictions as to scope, purpose and field no university can refuse a gift which means an added effort for the advancement of medicine. Gifts similar in character, and, it is to be hoped, larger in amount, may come to any medical school prepared to take up such work, and their trustees can not refuse them on the ground that they do not believe in departments for research only and prefer to wait for endowment which may be used to combine research with teaching. They will in the future, as in the past, accept them, in the hope that a research department will find not only a field for independent work, but as well many opportunities to cooperate with and to aid and complement other de-

partments interested primarily in teaching.

To emphasize some of these possibilities and opportunities, as exemplified in our department at Pennsylvania during the last five years, in the hope that our experience may be of benefit to other universities, is the principal object of this exposition.

RICHARD M. PEARCE
UNIVERSITY OF PENNSYLVANIA

SCIENTIFIC NOTES AND NEWS

DR. EUGENE WOLDEMAR HILGARD, professor of agriculture in the University of California from 1875 until his retirement in 1904, distinguished for his contributions to agricultural chemistry and geology, died on January 8, in his eighty-fourth year.

THE American Association for the Advancement of Science held a special meeting in Washington on January 3 and 4, in honor of the Pan-American Congress. On the evening of January 3 Dr. R. S. Woodward, president of the Carnegie Institution, presided, and Dr. W. W. Campbell, president of the American Association, delivered an illustrated address on the "Evolution of the Stars." On January 4 two sessions were held at the new National Museum when programs were presented relating mainly to the natural history of South America.

THE Italian government has placed the zoological station at Naples under the control of a royal commission, of which F. Sav. Monticelli, professor of zoology in the University of Naples, is president. The commission announces that it will furnish means to continue the work of the station, and engagements entered into in regard to tables for research.

DR. REID HUNT, of the Harvard Medical School, has been elected president of the American Society for Pharmacology and Experimental Therapeutics.

DR. SAMUEL G. DIXON has been elected president of the Academy of Natural Sciences, Philadelphia, for the twenty-first time and executive curator for the twenty-fifth time.

ROBERT BRADFORD MARSHALL, chief geographer of the United States Geological Survey, has been appointed superintendent of national parks.

DR. JOHN S. BILLINGS, JR., has been appointed deputy health commissioner of New York.

MR. BURIAN, the Austrian premier, is reported to have suggested through a neutral ambassador that Dr. Robert Bárány, the Viennese aurist and winner of the Nobel prize in medicine, now a prisoner in Russia, be exchanged for a Russian prisoner held in Austria.

DR. ALFRED IRVING LUDLOW, professor of surgery and surgical pathology, Seoul Medical College, Korea, will sail for the Orient to resume his duties on January 8, 1916.

PROFESSOR GEORGE NEIL STEWART, director of the H. K. Cushing Laboratory of Experimental Medicine, Western Reserve University, has returned from abroad.

THE magnetic survey vessel, the *Carnegie*, at present under the command of J. P. Ault, of the Department of Terrestrial Magnetism, arrived at Port Lyttelton, New Zealand, on November 3, after a successful continuous trip of ninety days from Dutch Harbor, Alaska. Leaving Port Lyttelton on December 5, the *Carnegie* is now engaged on the accomplishment of the circumnavigation of the region between the parallels 50° and 60° south, where almost no magnetic data have been secured during the past 75 years.

A BIOLOGICAL expedition to the island of Santo Domingo will be undertaken next fall by Professor J. G. Needham, of the department of entomology in the college of agriculture, Cornell University. He will be accompanied by his son, J. T. Needham, '18, and by Ludlow Griscom and K. P. Schmidt, both assistants in his department.

PROFESSOR C. P. BERKEY, of the department of geology of Columbia University, has just completed a series of investigations of the geology of New York City. He has mapped out a scheme to save borings or explorations for any project in the city, such as aqueducts,