

and the result is a slender, worm-like creature which progresses by gliding movements, and which penetrates into the wall of the mosquito's stomach, and there multiplies to form an immense number of very minute germs, producing a small tumour on the outer side of the wall of the stomach. After a time this tumour bursts, and the little germs pass into the blood of the mosquito. They are carried to and fro in the mosquito's blood circulation, but ultimately pass into its salivary glands, and the mosquito is now infectious. When it next feeds, a swarm of the malarial germs passes down its proboscis into the puncture it makes, and in this way the disease is passed on from one person to another.

The second important discovery mentioned above, that of Smith and Kilborne, concerns a fatal epidemic disease of cattle and other animals, sometimes termed red-water. In this case the two American investigators discovered, not only the cause of the disease, but the method of transmission. The parasites are tiny, pear-shaped bodies which penetrate the blood corpuscles and multiply there, so that two or more parasites may be found in one corpuscle. Similar parasites are now known to occur in sheep, horses, dogs, monkeys, and rats, but are not known with certainty to occur in human beings.

Smith and Kilborne discovered that the parasites of cattle red-water were transmitted by ticks, but not quite in the same way as malaria is transmitted by the mosquito. When a tick feeds on an infected animal, it does not itself become infectious, but gives rise to offspring which are capable of infecting healthy animals, so that the parasite passes through two generations of ticks. Unfortunately, nothing intelligible is known of the development of the parasite within the tick, and an important field of investigation is as yet untrodden.

[For an account of the third discovery referred to above, that of Bruce, see NATURE, November 15 (p. 56).]

Enough has been said, I think, to show that protozoology offers a most interesting and important field of investigation, of which as yet only the fringe has been touched. Almost every day brings news of some new discovery in this field. There are still, however, many questions to be answered relating both to protozoa and to the diseases caused by them, especially in the tropics, where insect life of all kinds is so developed, and there are so many different blood-sucking insects to carry infections of all kinds.

This brings me now to the concluding section of my discourse—what are the problems of protozoology and how should they be attacked? The problems that present themselves to the student of the protozoa are principally of two kinds. In the first place, there are purely zoological problems, such as the recognition, classification, and registration of the innumerable varieties and forms of these tiny creatures; the tracing out of their complicated life-histories and their bewildering changes of form and appearance during development; and the study of their vital processes and reactions to surroundings, as throwing light on many problems of cytology, heredity and evolution, of psychology and physiology. In the second place, the results obtained by the zoologist—that is to say, by anyone working according to zoological methods—must be applied to the elucidation of questions relating to disease in man and beast, in other words, to the requirements of the healing art, as practised by the medical man and the veterinary surgeon. Here, however, all the zoologist can do is to supply a knowledge of facts and principles of which the healer can make use, and the final beneficial result must be obtained by a collaboration of the investigator and the practitioner.

Although it may be urged with justice that the most important outcome of human science is its application to human needs, it would be the greatest possible mistake to attempt to confine any scientific study to just those problems which are thought likely to yield results of direct practical importance. Such a course would be short-sighted in the extreme, and would tend to produce a narrow outlook and a limited range of ideas, in the place of broad fundamental principles on which to base deductions for practical guidance. Thus, to apply this statement to the special case of protozoology, the forms most important for medicine are those which are parasitic upon man, but it would be absurd to study only these forms, first, for prac-

tical reasons, because it is easier to experiment upon animals than upon our fellow-men, and, secondly, because the study of many different parasites and their development supplies analogies which throw light upon obscure points in the life-history of those attacking man. But if we take a still wider view, we find that three-fourths at least of the protozoa are not parasites at all, but live free, independent lives in various situations.

It is obvious, therefore, that to understand properly the highly-specialised parasitic protozoa we must be acquainted with the more primitive free-living forms first and foremost. This conclusion may be illustrated by a few facts from the career of the late Dr. Fritz Schaudinn, whose recent death at the early age of thirty-five was a most deplorable event, cutting off an investigator who, by his genius and industry, had won the very foremost place in the ranks of protozoologists. The bulk of his work was done on forms not of importance from the practical, that is to say, the medical, point of view, and yet it is not too much to say that his work has modified all our ideas upon the protozoa and has built up the modern conceptions of these creatures, so that no one at the present time can write upon them without taking into consideration the facts and principles discovered by Schaudinn, whose work is a living demonstration of the practical, as well as theoretical, importance of non-practical scientific study.

The physician and the zoologist work from points of view which, though apparently opposed, are in reality mutually helpful. The physician, of course, takes the side of the patient, and his only object is to extirpate the parasite. The zoologist, on the other hand, identifies himself as an investigator with the interests of the parasite, and tries to become acquainted with all its migrations and changes, studying it for its own sake. In short, the zoologist must deal with protozoa as if he loved them, but the medical man as if he hated them. There can be no such thing as protozoology studied exclusively in relation to medicine. Protozoology must be studied as a science in which all knowledge is helpful, directly or indirectly. When the protozoologist has worked out his life-histories and obtained his results, then the medical man steps in and carries off the honey to the medical hive. In this way, by the cooperation of the purely scientific investigator with the practitioner, we may hope that protozoology may have before it a bright future, in which both theoretical science and the practice of the healing art may be advanced and benefited to an equal degree.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The Vice-Chancellor announces that the treasurer of the Cambridge University Association has recently paid to the benefaction fund of the University the sum of 904*l.*, resulting from the appeal for the building fund for the new museum of archæology and ethnology. This payment, together with 60*l.* already received by the benefaction fund, is intended to form a nucleus of 1000*l.* for the building fund of the museum. The Vice-Chancellor publishes also a list of subscriptions, paid or promised, amounting altogether to 12,325*l.*, toward the building fund of the department of agriculture.

After considering a resolution of the Classical Association in favour of abolishing the Greek grammar paper in the previous examination, the board of examinations proposes that in part i. of the previous examination (a) the separate paper at present set on Greek and Latin grammar be discontinued; (b) the time allowed for the two papers on the Greek and Latin classics be increased from 2½ hours to 3 hours, in order that more questions in grammar may be set than at present, the questions in grammar to be such as arise from or are suggested by the passages given for translation; (c) the papers set on the alternatives to the Greek and Latin classics be similarly lengthened, with the same object; and (d) these changes shall first take effect at the examination to be held in October, 1907.

Sir James Dewar, who will be unable to lecture next term, has nominated Mr. H. O. Jones, of Clare College, as deputy for the Jacksonian professor of experimental philosophy during the Lent term of 1907. Mr. Jones has

been re-appointed demonstrator to the Jacksonian professor until September 30, 1911.

The Cavendish professor of experimental physics and the Lucasian professor of mathematics have elected Mr. F. Horton, fellow of St. John's College, to be Clerk Maxwell student in succession to Mr. O. W. Richardson, of Trinity College, who has resigned the scholarship.

THE treasurer of Guy's Hospital has received two anonymous donations of 200*l.* and 10*l.* respectively toward the fund for the endowment of medical education and research at Guy's Hospital.

As part of the scheme of university courses in advanced zoology, Dr. W. G. Ridewood will deliver two lectures on "The Structure and Affinities of Cephalodiscus" in the zoological lecture-room of University College, Gower Street, W.C., at 5 p.m. on December 5 and 12. Admission to the lectures is free by ticket obtainable on application to the Academic Registrar, University of London.

It has been suggested to provide a regularly equipped central station for lighting the buildings of the University of Sydney. The work in this station might, it is thought, form part of the college engineering course. In addition to work connected with the generation of power, the scheme would provide opportunity for testing for faults in mains, and for training in the commercial side of station work.

THE Senate of the University of London has received from the Clerk of the Privy Council an intimation that the King in Council has approved the new statutes made for the management of University College and for the constitution and management of the North London or University College Hospital and the School of Advanced Medical Studies connected therewith. All the arrangements made in connection with the incorporation of University College in the University will come into operation on January 1, 1907.

THE University of California has been presented with the herbarium and botanical library of Mr. and Mrs. T. S. Brandegee, of San Diego. The herbarium, *Science* states, is one of the most important in the west of the United States, since it contains something more than 100,000 sheets of carefully selected plants, mostly representative of the Mexican flora, which for many years has been Mr. Brandegee's chosen field, and of the flora of California and neighbouring States, which has received careful treatment at the hands of Mrs. Brandegee. We learn from the same source that the Academy of Natural Sciences of Philadelphia has acquired two important zoological collections. One of these is the Gulick collection of Hawaiian land shells, which served as the basis of Rev. John T. Gulick's well-known work, "Evolution: Racial and Habitudinal," and the other is the Tristram collection of birds, numbering some 7000 skins and representing upwards of 3000 species. This is the second collection made by the late Canon Tristram, the first one having been secured some years ago by the Liverpool Museum.

THOUGH it was more common a few years ago, there is still a disposition in some educational circles to refer to the study of the applied sciences as merely "bread-and-butter studies." In a recent address to the Wolverhampton Technical Schools, published in pamphlet form by Messrs. Longmans, Green and Co., Prof. Ripper has much of value and interest to say as to this contention. He urges, very rightly, that these studies, if properly pursued, must develop scientific methods of thought and give new and higher interests to the student. As Prof. Ripper said, "The same spirit which originally led to the study of technical science will tend also to the desire to travel beyond it. The same qualities which have made the technical expert, will tend also to make the enlightened and cultured citizen." The address concludes with an optimistic estimate of the educational outlook. There is, Prof. Ripper thinks, much more demand than formerly for technically trained assistants. Employers are offering facilities for extended courses of study for their apprentices; for example, several firms in Sheffield arrange for some of their apprentices six months' study at the university and six months' study in the works. Employers, too, are immensely stimulating the work of education by

making their appointments and promotions depend in an increasing degree upon educational fitness.

THE anniversary address of the Royal Scottish Geographical Society was delivered by Sir George Goldie, president of the Royal Geographical Society, on November 22. The subject of the address was "Geographical Ideals." Among a variety of subjects discussed in the address, great prominence was given to the question of the value of geography in war. This value, Sir George Goldie said, might be best brought home to our own countrymen by recalling the enormous expenditure in which the want both of maps and of geographical training of our officers indirectly involved us during the Boer War. He went on to say that he could speak confidently on these points from having served for nearly a year on the Royal Commission on the South African War. He added that the lesson of the war in this respect has not been altogether forgotten. During the last four years a certain amount of money has been expended in Imperial mapping of hitherto unsurveyed regions, and if this process is not altogether arrested by a spirit of false economy, we may possibly at some distant date possess fairly adequate maps of all British possessions. Our ideal must be to reach the level attained by Japanese and German officers. Sir George Goldie finally dwelt upon the importance of educating the people on the subject of geography, and its removal from the subjects of the examinations for the Foreign Office and Diplomatic Service.

THE report of the work of the department of technology of the City and Guilds of London Institute for the session 1905-6 is now available. Statistics are given showing the continuous growth of the work of the department since 1879. The number of subjects in which examinations were held during the session under review was the same as in the preceding year, but the number of separate classes increased from 2601 to 2820, the largest number recorded. There was, too, a marked increase in the number of students in attendance, the number having risen from 41,618 to 44,464. At the examinations at the end of the session 20,610 candidates were presented in subjects of technology, and of these 11,665 passed. Numerous candidates were examined in India and the colonies. We notice that Cape Colony, Jamaica, Malta, Suez, Melbourne, Granville (New South Wales), all presented candidates, but that the largest contingent of colonial candidates was that sent by New Zealand. The system of inspection inaugurated by the institute grows in usefulness. The inspectors appointed by the institute are men and women possessing somewhat different qualifications from those of the inspectors of the Board of Education, and their work is supplementary to that of the Board. Whilst the Board's inspectors report upon the general equipment of technical schools and upon the general character of the teaching, those of the institute are concerned only with the special facilities provided for trade instruction, and report on the methods and the value of the teaching as part of the training of artisans.

SOCIETIES AND ACADEMIES.

LONDON.

Chemical Society, November 15.—Prof. R. Meldola, F.R.S., president, in the chair.—The determination of the rate of chemical change by measurement of gases evolved. Preliminary notice: F. E. E. **Lamplough**. When a chemical reaction takes place in solution resulting in the formation of a gaseous substance, the solvent becomes supersaturated with the gas. The excess of gas so dissolved may be almost entirely expelled by brisk agitation. Under conditions of efficient stirring the rate of evolution of a gas furnishes an accurate and trustworthy method of investigating reactions.—The formation and reactions of imino-compounds, part ii., condensation of benzyl cyanide leading to the formation of 1:3-diaminonaphthalene and its derivatives: E. F. J. **Atkinson** and J. F. **Thorpe**.—Note on the anhydride of phenylsuccinic acid: F. B. **Dehn** and J. F. **Thorpe**. The authors conclude that the anhydride of phenylsuccinic acid exists only in one form, which melts at 53°-54°.—Influence of sodium arsenate on the fermentation of glucose by yeast-juice. Preliminary notice: A. **Harden** and W. J. **Young**. It has been previously shown