F.R.S. and Capt. Bernier himself. It will be remembered that in 1900 the last-named gentleman described his proposed route of travel after having pointed the courses taken by all the previous important expeditions to the North Pole, including Fridtjof Nansen's important last voyage.

The following officers were elected:

President: Principal J. Loudon, LL.D., of Toronto University, Toronto.

Vice-President: Sir James A. Grant, K.C.M.G., M.D., etc., Ottawa.

Hon. Secretary: Sir John G. Bourinot, K.C.M.G., LL.D.

Hon. Treasurer: Dr. James Fletcher, F.L.S.

The following officers of Section IV. (Geology and Biology) were elected for the ensuing year:

President: Professor Frank D. Adams, M.Sc., Ph.D.

Vice-President: Professor T. Wesley Mills, M.D., etc.

Secretary: Mr. G. U. Hay, Ph.B. (St. John, N.B.).

H. M. AMI.

OTTAWA, May 27, 1901.

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## SCIENCE AND THE LONDON UNIVERSITY.*

### I.

BY the University of London Act, 1898, and the statutes and regulations framed in pursuance thereof, the long-standing controversy as to the form and organization of the London University was finally disposed of. The various colleges and other institutions doing university work within the metropolitan area have been coordinated under a strong and representative senate, which is charged with the duty of providing, for the six millions of inhabitants within a radius of 30 miles from the University building, every kind of instruction of university type. To enable the reorganized London University to cope with this gigantic task, the Chancellor of the Exchequer frankly confesses his inability to do more than provide the office expenses. If London wants a teaching university, London, says the Chancellor, must pay for it. In the special financial circumstances of the moment this appeal to public-spirited Londoners can scarcely be considered unreasonable.

The task of equipping and endowing a University can never be a small one, and the extent and variety of the needs of London might daunt the munificence even of an American millionaire. Fortunately, we do not have to start quite from the beginning. The organization and constitutional framework are completed and stand ready to start. A large part of the materials for a University worthy even of the capital of the Empire only await the hand of the master builder. What is wanted is, first, a comprehensive survey of the field and an appreciation of the amount and variety of the work to be done. Upon this must follow the motive power of money.

The new university is organized in eight faculties, namely, theology, arts, music, law, medicine, science, engineering and 'economics and political science (including commerce and industry).' But, though provision is thus made for all branches of University study, old and new, it is already clear that London University will have a character of its own. The distinctive note of the University is evidently destined to be that of applied science, or the concrete application to every branch of industrial and social life of the discoveries and laws of the various sciences. It is this side of university organization that we must therefore first consider.

In physical science the London University holds an honorable tradition, as having been the first to create a science degree. At present the University includes three 'schools' of science for men, and two more (Bedford and Halloway) for women only. Of these, the Royal College of Science, fully

* From the London *Times*.

staffed and equipped at the Government expense, is confined practically to science teachers, drawn by scholarships from all parts of the country, and to the mining and metallurgical students of what was formerly the Royal School of Mines. The science schools at University and King's Colleges, directed by able professors, are severely handicapped by inadequate accommodation and limited funds, whilst the high fees necessitated by the absence of endowment exclude all but a small number of students. The total number of undergraduate science students in these five schools may be estimated at six or seven hundred. Cheaper science-teaching at more convenient centers, open in the evening as well as in the daytime, is supplied not only at the admirably organized Finsbury Technical College of the City and Guilds Institute, but also by the dozen so-called 'polytechnics.' These latter have been greatly improved during the last few years. By the aid of large grants from the London County Council, their laboratories and scientific equipment have been brought up to a high university standard, whilst the professional staff has been strengthened by the appointment of men of excellent scientific attainments. A large proportion of London candidates for science degrees are now trained in the polytechnic laboratories, which may probably include, in the aggregate, between two and three hundred science students above matriculation standard. The total number of science students of undergraduate status in the whole six million of people apparently does not reach one thousand. Additional centers of science instruction for undergraduates are required in north west London, Hackney and Hammersmith, whilst in the outer suburbs the existing institutions at Croydon, Tottenham and West Ham need developing up to university standard. With additional professors and enlarged laboratories at these twenty-five science centers, all parts of London would be fairly well served, so far as science instruction up to the B.Sc. degree is concerned ; and the number of undergraduate students in the faculty might reasonably be expected to rise to at least 2,000.

But the most serious deficiency in the London faculty of science is not the inadequacy of the instruction for the science degree, but the lack of anything like adequate provision for chemical, physical and biological technology, or the application of science to industrial processes. The munificence of Mr. Ludwig Mond has provided a well-equipped laboratory at the Royal Institution, in which a few highly qualified scientists find the opportunity for pursuing special researches. But of public provision for instruction in scientific technology there is practically none. The same national neglect which lost us the great industry of coal-tar products—positively a British discovery that we failed to utilize and abandoned to Germany—now bids fair to lose us one branch of applied chemistry after another. At the present moment perhaps the most promising outlook in the scientific field is presented by electro-chemistry, including both electrolysis and the multifarious operations of the electric furnace. This new science has already transformed the commercial production of copper and aluminum, and given us such new products as carbide of calcium (for the economical production of acetylene) and carborundum. It bids fair, moreover, to revolutionize the whole alkali industry. Yet beyond certain small experiments, due to personal initiative of two or three professors, London offers no means and no opportunities for instruction and research in the subject. If electro-chemistry is destined to transform the world's industry, it is to Germany, and not to England, that the advantage of the first start seems at present likely to accrue. There is no more pressing need in London's University equipment than a special school of electro-chemistry, fully equipped with its necessary expensive apparatus, and provided with an endowed and not overworked staff of professors, able to inspire and direct the studies and researches of a selected band of graduate students. The same deficiency is found in other branches of technology. Mining and metallurgy are provided for on what must be called a small scale at the Royal College of Science, and mineralogy also in two or three small classes elsewhere. But nothing that can be called adequate exists for the technical education, at convenient centers and hours, at low fees, of the swarm of mining and metallurgical engineers that London ought to be sending out to every part of the Empire. It deserves the attention of those who are interested in the great mining enterprises of South and West Africa, America and Australasia, whether the time has not come for the establishment of a distinct school of metallurgy and mining, with special reference, not to coal and iron and the conditions of Great Britain, but to the products and needs of other climes. In applied chemistry, too, beyond the praiseworthy attempt at the Herold's Institute (Bermondsey) to deal with leather dyeing and tanning, practically nothing in the nature of a school of chemical technology exists in the metropolis. London transcends every other city in the magnitude and variety of the local industries depending on one chemical process or another. Besides its large interest in every branch of the clothing trade, in all the materials for construction, and in such specialties as the use of india rubber, London is the greatest center for all the applications of photography and the various lithographic processes still most incompletely taught and studied. It is, moreover, the largest center of gas manufacture, and hence the most extensive producer of coal-tar. At present the valuable by-products of London's gas works are for the most part only so far dealt with on the spot as to reduce the cost of their freight to other parts. Practically all the skilled and remunerative treatment of coal-tar products is left to Germany, to which country we export what is virtually the raw material of a most valuable trade, from sheer lack of scientific knowledge of how to make the most of it. Apparently we are contented with this state of things, seeing that London has to this day no center of instruction in gas manufacture and the treatment of its by-products; nor any provision for systematic research into their possible developments. Even the immemorial London industry of tanning is falling behind. Hides are positively beginning to be exported from England to New York to be tanned in the United States by new processes and sent back as leather to Leicester and Northampton. It is probable that few, if any, investments would, in the largest sense, pay better than the establishment — possibly in east or south London—of a great school of chemical technology; and, if we turn from physics and chemistry to biology, we must notice that, whilst the Institute of Preventive Medicine studies bacteriology from the pathological standpoint, London has as yet no provision for instruction and research in its industrial side. One of the largest and most profitable of London industries depends on the bacteriological process of fermentation. The whole future of London's food supply—to say nothing of its sewage disposal—is involved in the same question; and refrigeration, to name only one out of many applications, is already the nucleus of a great industry. The most economical means of lowering temperature on a large scale, under commercial conditions, has become literally a matter of life or death in certain industries. This knowledge can hardly be 'picked up' at the works or in the office.

Yet there is no institution teaching it. We need to expand our few and scanty classes in zoology and physiology into an organized school of instruction and research into all the biological processes that are or can be applied to industry. We pass to another range of science in mathematics and astronomy; but it is one in which London has a special interest. It seems almost incredible that in the greatest port of the world, providing its own large quota to our mercantile marine, absolutely no public provision exists for instruction in the art of navigation, or in the application of mathematics and astronomy on which the art depends. There is urgent need for the establishment, in connection with the University, preferably in East London, of a school of nautical astronomy and navigation, including the applications of magnetism and meteorology to the sailor's art.

The Science Faculty seems thus to require:

1. Increase in staff of professors and instructors at existing centers—say, £15,000 a year (£500,000).

2. Extensions at existing centers in buildings and equipment to accommodate additional students—say, £80,000.

3. New centers — building, equipment, and endowment of science departments at, say, three at £40,000 (£120,000).

4. New subjects—provision for buildings, equipment, and endowment of centers for electro-chemistry (£100,000), mining and metallurgy (£100,000), technological chemistry (£100,000), bacteriology and biology in its industrial relations (£100,000), nautical astronomy and navigation (£100,000), etc.—total for science, £1,200,000.

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## SCIENTIFIC BOOKS.

*Lehrbuch der vergleichenden mikroskopischen Anatomie der Wirbelthiere.* By Dr. Albert Oppel. Dritter Theil. Mundhöhle, Bauschspeicheldrüse und Leber. Jena, Fischer. 1900.

With this volume is completed the discussion of the digestive system. Volume I. comprised the stomach and included 543 pages; Volume II., the esophagus and intestine, in 682 pages. The present volume consists of 1180 pages, with XI. plates and 679 figures in the text, therefore exceeding considerably the preceding volumes in size in accordance with the greater complexity of the parts considered.

The work follows closely the plan of the preceding volumes. Each subdivision is discussed in historical sequence, the statements of the author being included between oblique lines, //. In accordance with the plan, the greatest pains have been taken to show the present state of knowledge of the structure of each part in the different forms, and to this end the search in the literature has been made exhaustive, and references to all papers, however trivial, have been sought out. No prejudice has influenced the writer in favor of continental investigators to the exclusion of others; indeed, the recognition of American work seems to be greater than that accorded by many American writers. The quotation of each author is followed by his name and the year of publication. The complete title is given in a bibliography in the end of the volume.

Where there are differences of interpretation (as, *e.g.*, as to the nature of the demilunes in the mucous salivary glands), the different theories are propounded, weighed and (where possible) some choice is indicated.

The text is followed by a table of animal forms, giving a key to the position of the species considered in the text and an arrangement of their families in systematic order. This is followed by the bibliography of 50 pages, and finally, author and subject indices.

In the body of the work the oral cavity with its adnexa, pancreas and liver are taken up successively. In connection with the oral cavity are discussed: the structure of the mucous membrane in the different classes; the pharynx of mammals; the lymphoid tissue of the oral cavity; the tongue; nerves and sense-organs; and finally, the oral (salivary) glands. The teeth, which on many accounts might seem to be properly included, are omitted to be discussed with the skeletal system in a subsequent volume.