THE IMPERIAL COLLEGE OF SCIENCE, KENSINGTON:

ITS HISTORY, ORGANIZATION, AND ACHIEVEMENTS.

BY

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THE history of the development of the Imperial College of Science and Technology should prove interesting to the medical profession. The realization of the aims of the College in the region of pure and applied science is, despite difficulties, an example which gives encouragement to the belief that improvement in education and research in medical science and its applications is no mere dream.

THE HISTORY OF THE COLLEGE.

This is not by any means the first time that Kensington has done pioneer work in the cause of education and research. It should be a source of pride to us as members of our profession to reflect that the traditions and progressive tendencies which characterize the educational movements at Kensington were initiated by Huxley, and that the spirit which he infused still lives, though the objects differ. As it was from Kensington in the old days of the Science and Art Department that missionaries of education in the application of the physical and natural sciences went forth to the provinces to assist in the establishment of the technical schools, so to-day it is to Kensington we must refer the enlightened policy which, foreseeing the impending calamities which a neglect of science was likely to bring upon our industries, led to the foundation of this institution. For the need for the training of teachers had passed with the establishment, as a consequence of the Technical Education Acts, of numerous schools of science throughout the country, and the mission of the Royal College of Science had been fulfilled. The Royal School of Mines had shared in the consequent general lapse of the Kensington movement, though the establishment in the region, by the City and Guilds of London, of a College of Engineering kept alive the local tradition.

In the meantime alarm had spread amongst those to whom the importance of the recognition of education and research in relation to the development of science in the arts and industries was fully known. The rapid educational movements in Germany and America had led to a state of industrial efficiency which bade soon to place British industries in a position of inferiority, and indeed had in many instances already done so. Germany had devoted her greatest energies to the developments of technical education. She had, for example, utilized in her factories the chemical researches of the schools, and German factories continually demanded more knowledge and more scientific workers. It was the same in every branch of industrial work. Switzerland was early on the scene in a corresponding development, to which is due the great school at Zurich, set up for the purpose of developing higher education in applied science. In America these European models were generally followed and led to the establishment of the splendid schools and colleges for the study of science and technology which are characteristic of the United States. Everywhere, in fact, except in Great Britain and Ireland, the movement was in full swing, and it was little wonder that alarm at the consequences of indifference spread. Subsequent events have led to a general realization by the country of those things which were formerly familiar only to a few.

It is not possible within the limits allowed me to relate in detail the story of the movement which culminated in the conversion of the three Schools of Science at Kensington into a confederation of Colleges, the whole virtually a Science and Technical University, under the name of the Imperial College of Science and Technology. Suffice it to say that a mere recapitulation of the names of those who shared in the task of its formation would prove that the best brains of the country had been drawn upon to set forth not merely the need but the methods of accomplishing this most necessary task.

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THE ORGANIZATION AND DEPARTMENTS OF THE COLLEGE.

It is rather to the results, which the medical profession who desire it will soon have an opportunity of seeing, during the Clinical and Scientific Meeting of the British Medical Association next April, which will be held in the College, that I prefer, in response to an invitation, to confine myself.

The seven buildings at South Kensington, five of them new, are engaged in giving the highest specialized instruction in various branches of science, especially in their applications to national needs, and are abundantly equipped to enable them to supply the most advanced education and to offer facilities for the highest researches in pure and applied science. To undertake so ambitious a task ample means in money were provided, and great increases in the staff and equipment were made to meet the necessities of so comprehensive a programme. The annual reports of the College are published, and, turning to the financial statements in them, we find that the gross value of the College is now £1,216,299, that increases to furniture, fittings, and scientific apparatus have cost £62,698, and that on additional new buildings the Governors have expended £279,240. The total income of the institution is over £90,000 a year. New chairs have been established and new departments set up. But these things, necessary as they may have been for the successful development of the institution and for the realization of the ideals of the Governing Body, are less attractive to the scientific worker than the quality of the staff. I will not recapitulate the departments, much less their subsections, but a glance at the calendar, which sets forth in great detail the scope of the work, shows us:

In the Royal College of Science, Professor Callendar, F.R.S., Director of the Department of Physics, assisted by Professor Fowler, F.R.S., Professor the Hon. R. J. Strutt, F.R.S., Professor Watson, F.R.S., and Assistant Professor S. W. J. Smith, F.R.S. Professor Baker, F.R.S., is in a corresponding position in the Department of Chemistry, with Professor Thorpe, F.R.S., as head of the Organic side, Professor Bone, F.R.S., head of the Department of Chemical Technology, and Professor Philip responsible for Physical Chemistry.

In the Royal School of Mines, Professors Frecheville and Carpenter, F.R.S., are the heads of the Mining and Metallurgy branches. Professor Watts, F.R.S., is responsible for the Geological Department and Oil Technology.

The Engineering College is controlled by Professor Dalby, F.R.S., Professor Mather, F.R.S., and Professor Dixon, respectively responsible for Mechanical, Electrical, and Civil Engineering.

The branch which deals with *Mathematics Pure and Applied*, is staffed by such Professors as A. R. Forsyth, F.R.S., and A. N. Whitehead, F.R.S.

The Biological Department, which must have a special interest for readers of the BRITISH MEDICAL JOURNAL, has as its head and director Professor Farmer, F.R.S., with Professor Blackman, F.R.S., responsible for Plant Physiology and Pathology (the late Professor Plimmer held the Chair of Comparative Pathology in this department), and Professor MacBride, F.R.S., for Zoology, the subdepartments of Cytology and Entomology coming under the control of Assistant Professor C. Dobell, F.R.S., and Professor H. Maxwell Lefroy respectively.

Students of these and other branches of science will recognize in these names leaders of scientific thought of whom any country might be proud, and it is not to be supposed that in the competition and rivalry of nations the part which it is now recognized science may play in the development of industries and in practical applications to the arts, the Imperial College is not destined for great achievements.

It must not, however, be assumed that whatever progress has been made by the College since its foundation it has nearly realized its ideals. To some extent the desire which has been evinced to stand aloof from educational politics in London has, by withdrawing it from public notice, also limited its development. On the other hand, its peculiar position in the educational world has procured for it support amongst those who know which it might otherwise have lacked. Even the Royal Commission of the University of London, bent on attaining the harmony and order in educational procedure which cannot be too highly praised, found it necessary, even at the sacrifice of

some symmetry, to realize the ideals of its founders, and only erred in evincing timidity in recognizing the need for an Imperial School of Science and research as distinct from a local institution. Something not dissimilar has previously occurred in Medicine.

VIRTUALLY A SCIENCE UNIVERSITY.

I have described this confederation of colleges as virtually a science and technical university, and the phrase may stand. It has been taken to assume the formation of a uni faculty university, and is regarded as at once a heresy and a paradox. It is neither. The proposal is for a three-faculty university—science, mining, and engineering. I am not myself wedded to the phrase, but if an imperial ideal has been the thought fundamental which has all through led to the establishment of the College, the dependence of such an imperial institution upon other universities for its academic distinctions is surely destructive of the imperial ideal. Nor is the idea distinctive of the Imperial College. It exists elsewhere in other branches of work, and may find realization later by the coalescence of similar movements into an Imperial University. However that may be, this trend of thought has definitely influenced the character of the teaching and the research at Kensington, as was intended, and it would be folly to depart from a policy so thoroughly considered, and upon which so much money and effort has been lavished.

The institution has been established for the vocational training of men intended for the professions of chemistry, the various branches of engineering, economic biology, etc., and this vocational training requires for its essential sub-structure a wide general scientific training of such a kind that the special courses in the special professions are all founded on common courses in science. The system of training is that still known as the Huxley system. The tutorial and laboratory method characterizes it at every part. The students in the departments of physics, chemistry, geology, etc., learn the use of instruments by handling them until technique and scientific method become part of their very being. Set lectures are reduced to a minimum. The student may be said to discover for himself under the inspiration of his tutors. The applications of science serve as the models to illustrate the principles. The ample equipment renders possible the adoption of a system which avoids dependence for its teaching on textbooks and demonstrations.

A LESSON AND A MODEL FOR MEDICINE.

In the daily round of my own duties as *servus professorum* it would be strange indeed if my thoughts did not frequently turn to my own profession and its splendid possibilities in the educational sphere, especially in London. It often strikes me that the parallel between medicine, chemistry, biology, mining, etc., is complete. The foundations are the same, and only the applications are different. At a particular period in his career at the Imperial College a student of any of the departments of knowledge could be diverted to medicine without delay or disadvantage, for, as I have said, the foundations are the same. The systems and methods of Kensington are applicable to medicine, and since they are costly they could only have been attained by combination of effort amongst the three constituent colleges.

Is there not in the history of the Kensington movements an example which may well be followed by the London medical schools? If the individuality of the separate schools here is retained while a combined effort for mutual assistance and support is sustained in the confederation of colleges, why should not the same system operate in medicine? It is true that combination of effort is difficult to secure in medicine, but, after all, in my experience, it is no less difficult in other professions. It must not be supposed that the path of the reformer at Kensington has been strewn with roses any more than it is anywhere else. All that can be said is that a sense of a common misfortune has proved stronger than vested interests. The tendency in medicine is centrifugal.

Combination, discipline, establishment of principles have carried Kensington as far as it has yet gone. Similar efforts in London medicine should lead to similar results, and one day perhaps we may see in London and elsewhere an Imperial School of Medicine, an Imperial School of

Law, an Imperial School of Art, as we have to-day an Imperial School of Science and Technology. It may be the mission of the Universities Bureau to bring together the now scattered elements of such a confederation for the formation of a great Imperial University.

THE DEFENCE OF THE RESPIRATORY MEMBRANE AGAINST INFLUENZA, ETC.

BY

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In the account of a research on the action of ozone¹ carried out some years ago with M. Flack, after pointing out the poisonous action of too high concentrations on the lung, and the oedema and pneumonic condition produced thereby, and that very low concentrations could safely be used to add a quality to the air and take away offensive smell, we added the opinion "that ozone might possibly have some value in the treatment of disease of the respiratory tract if used in a concentration which produced a slight irritation and thus brought more blood and tissue lymph to the part."

Observations have demonstrated that the concentration which can safely be used in ventilation does not destroy bacteria in the air, and inhibits their growth on media slightly if at all. The respiratory membrane is much more easily attacked than the micro-organisms protected by their waxy or other resistant cuticle.

A poison gas like ozone, phosgene, or chlorine, when inhaled is concentrated by solution in the secretion covering the membrane, and the membrane defends itself by secreting fluid and so diluting and washing away the poison; hence the oedema of the lung, which increasing finally puts an end to the gaseous exchange and drowns the subject. The membrane responds in the same way to bacterial toxins.

How much a poison gas may have to be concentrated is shown by some experiments we carried out in 1915 on ciliated epithelium. While 1 in 100,000 of chlorine by volume is too irritating to breathe, it took over 1 in 40,000 by volume of chlorine to stop the movement of the cilia when chlorine water was added to the preparation.

In the case of smells, while it is true of certain substances that 1 in 100 million parts of air may be smelt, yet concentration of unknown extent must in this case also take place in the fluid bathing the olfactory sense organ. The act of sniffing, by directing the air on to one part of the membrane, must bring about this concentration.

In researches on the influence of atmospheric conditions on the nose² I have put forward the important influence which cool air—cool and therefore of low vapour tension—has on bringing more arterial blood to the respiratory membrane, and increasing evaporation from and therefore flow of tissue lymph through it. Warm moist atmospheres are against this natural washing and immunizing defence. In this, I claim, lies one explanation of the good effect of open air treatment, and the ill effect of crowded tenements. Exercise in the open air, by increasing the breathing perhaps five times, greatly increases the blood flow through and evaporation from the respiratory membrane, and in this lies one of the good effects of exercise. At Alpine health resorts the air is not only cool, but owing to its tenuity a greater volume must be breathed.

By some observations made in the recent spell of frosty weather, breathing first in and out of the nose, next in by the nose and out through the mouth, then in by the mouth and out through the nose, lastly in and out through the mouth, and taking the temperature with a thermo-junction inserted far back in the nose, I find the cooling, and therefore the evaporative, power of the air is by no means spent in the nose, but acts on the deeper parts and probably right down to the smaller tubes of the lungs. Especially is this the case when the breathing is made deep and the lungs fully expanded. A man may in an hour easily evaporate an ounce and a half of water from his membrane when taking exercise in cold weather.

There is another thing to consider, namely, the actual cooling of the membrane, which may check the growth of