SOME SCIENTIFIC CENTRES

VII.—THE PHYSIOLOGICAL RESEARCH LABORATORY OF THE UNIVERSITY OF LONDON.

THE seat of the University of London was transferred to the Imperial Institute in 1900, and in the same year the University received a new constitution, and commenced its career as a teaching university. In May, 1902, a laboratory devoted to research physiology was housed within the same Imperial building, and the secretariat of the University of London was for the first time brought into contact with one of the sources of knowledge, which it had been newly arranged not only to control but also to foster.

The laboratory occupies the upper floor of the eastern wing of the Imperial Institute, and has already been described in the pages of this Journal (NATURE, vol. lxvii., pp. 441, 442). It covers a space of about 3000 square feet.

There are special rooms for experimental psychology, experimental physiology, electrical and chemical work, a lecture theatre fitted up for the delivery of the special courses of lectures in advanced physiology, and a departmental library. The work carried on has been of the double character indicated in the scheme originally adopted by the University Senate. In the first place courses of lectures have been given by a large number of the physiologists who form the professorial staff of the University in this subject. It should not be forgotten that this cooperation has been obtained without an offer of the most trifling award. The professorial staff, by this free gift of its labour, has once more shown its loyalty to interests which are really wider than the interests of any local scheme, but which, nevertheless, are well expressed as the interests of the University of London.

All these lectures, as was originally intended, have been of a peculiarly living type—lectures delivered upon subjects on which each lecturer was actually engaged in research at the time. After submission to referees, they are published for the University by Messrs. Murray; a volume entitled "Signs of Life," by Dr. Waller, and another on the "Biochemistry of Muscle and Nerve," by Prof. Halliburton, have already appeared, and a volume on the Blood, by Dr. Buckmaster, is in the press.

In the second place, room and facilities are afforded to workers in the prosecution of research whether for their doctoral theses or for other purposes. The researches carried on since May, 1902, have resulted in thirty published papers; among them, and specially noteworthy as regards their immediate practical bearing, are the contributions of Captain Leonard Rogers, I.M.S., to our knowledge of the physiological action of the poison of the Hydrophidæ and the physiological action and antidotes of colubrine and viperine snake poisons; of Waller and Plimmer on the physiological action of a ptomaine extracted from commercial beet sugar; and of Waller on the quantitative estimation and graduated administration of chloroform. In physiological psychology, work is continuously carried on by Miss Edgell, who has published a paper on time judgment, and whose work on memory and grasp of the meaning of words is opening out a most important subject.

The output of work from most laboratories bears the stamp of the Director, for in his hands mainly lies the attraction of workers, and their useful employment in the earlier stages of their career. It is his constant patient interest in the problems under investigation in the laboratory which largely determines their direction, and serves to weld them into a solid phalanx of advancing facts. An examination of the list of papers shows the presence of such an influence here, an influence which has already started several workers upon paths of independent inquiry. Acknowledgments of this fact may, for instance, be found in the papers of Drs. Alcock, Collingwood, Legge Symes, Wells, from all of whom valuable contributions have come. Dr. Alcock has carried out several excellent researches upon the electrical response of mammalian medullated and non-medullated nerve. Boldly selecting material offering, as it was thought, almost insuperable difficulties, he has been able to make many observations of value, and in doing so has also extended the general field of inquiry. Dr. Collingwood has designed an apparatus for the exact dosage of chloroform, and elaborated a method for the estimation of percentage of chloroform vapour in expired air. Mr. Legge Symes has published work on the respiratory quotient, estimation of chlorides in blood, and is carrying on work on the physiological action of chloroform and betaine. Mrs. Waller has continued the work upon the distribution and meaning of "blaze currents."

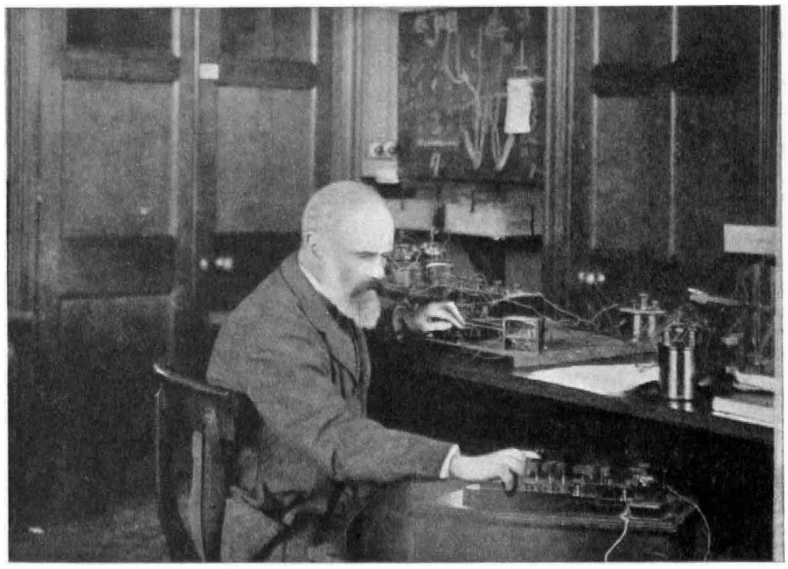

FIG. 1.—Dr. Augustus D. Waller, F.R.S., Director of the Laboratory.

That the many-sided industries of this laboratory are by no means completely stated in the last paragraph is at once seen from the fact that its walls have also looked out upon the work of several investigators who have obviously been attracted by its conveniences and equipment alone. It is sufficient to mention the names of Drs. Brodie, Buckmaster, Goodall, Locke, Macdonald, Mummery, Seemann. Dr. Pavy is engaged in work on the metabolism of the carbohydrates, and will give a course of three lectures in the summer on the results of his investigations. Dr. George Oliver is now working in the laboratory on the effects of various organic pro-

ducts on the blood-pressure of animals and man, and on the improvement of blood-pressure apparatus for physiological and clinical observation on man. He will shortly also be engaged with Dr. Samuel Rideal in investigating the influence of various gases on the blood-pressure in man. Some of this work has already found expression in this term's course of lectures by Sir Lauder Brunton. Mr. G. P. Mudge is engaged in work which will bear on the theory of transmission of acquired characters. The laboratory is, in fact, not only a consistent school making its influence rapidly felt in work of a particular character, but also a laboratory offering highly appreciated advantages to independent workers.

The laboratory owes no small share of the fact of its existence and present energetic life to the director, Dr. Augustus Waller. His prescience and alertness, and the confidence felt by the authorities and by his colleagues and friends in a scheme which had obviously enchained the full measure of his personal interest, must in this connection remain accountable for many things. The value of his services is best assessed after a consideration of the indefatigable years which he has spent in fruitful furtherance of the science of physiology. His first paper, a contribution to the study of cardiac and vascular innervation, was published from Ludwig's laboratory in 1878. His remaining contributions, many and all well known, have been published as a consequence of work carried out within London itself; and with the scientific life of this city Dr. Waller has been identified since 1879. "The graphic record of the propagation rate of the pulse wave," "The recurrent pulse," "Measurements of the length of systole and diastole with different pulse frequencies," are titles of some of these earlier papers, reminding us of our indebtedness to Dr. Waller for valuable contributions to our knowledge of the circulation. In 1881 he secured the thanks of all workers upon the phenomena of the central nervous system by his contributions to the study of tendon-reflex. In 1881 he devised and first made use of the method, now generally adopted, for the photographic record of electrical currents. His work upon electrotonic currents in the nerves of the human body, carried out with the assistance of Dr. De Watteville, 1882, forms one of the foundation-stones of the art of electro-therapeutics. This and his subsequent record of the electrical changes accompanying the beat of the human heart, 1887, serve to render the first decade of Dr. Waller's experimental work ever memorable in the annals of "Animal Electricity," and were made the basis of two ceremonies of mutual honour. Dr. Waller was invited to Berlin by Du Bois-Reymond to demonstrate the electrical changes due to the heart-beat, and the Academy of Science at Bologna—the birthplace of animal electricity—presented him with the award of the Premio Aldini sul Galvanismo. The Academy of Science of Paris also showed its recognition of the interest of these observations by its award of the Prix Montyon.

In 1885, Dr. Waller laid a basis for the study of "fatigue," by recording his discovery of the site of peripheral fatigue. He again facilitated the study of this phenomenon by the invention and use of the "dynamograph," and contributed important papers upon the "Sense of Effort." In these papers Dr. Waller dealt with matters on the border-line between physiology and psychology, and here also is placed other work of his of admitted importance upon colour contrast, hearing, weight discrimination, the functional attributes of the cerebral cortex. In 1891, Dr. Waller published his "Text-book of Human Physiology." This book marked an era in the methods of physiology classes throughout the country, and served as a standard for the increased extent of scientific training rendered possible by the changes then taking place in physiological staffs and laboratories. In writing this book Dr. Waller rendered an important service not only to physiology but also to medical education.

In 1895 began a series of researches based on the Weber-Fechner law, the electrical response of the retina to the stimulus of light, the mechanical response of muscle to electrical stimulation, the electrical response of medullated nerve to electrical stimulation, leading to the general conclusion that where we can plot physical cause along an abscissa, and physiological effect along ordinates, an S-shaped curve is the result.

The foregoing experiments involved an examination of the electrical response of nerve under the influence of anæsthetics, and led to the systematic employment of nerve to gauge the activity of a large number of reagents, a method having been devised for exciting the nerve at regular intervals and recording its negative variation by photography.

Three mainly important conclusions resulted from this method of work—that CO_2 is evolved in nerve during tetanisation, that the inexhaustibility of nerve and retina is due to an extremely rapid disintegration and reintegration in their tissues, that the effect of anæsthetics on nerve may be taken as a measure of their effect on the human subject, and the method may therefore be employed for studying the limits of safety of chloroform dosage. The important fact was educed that safe anæsthesia requires the continuous administration of a mixture of chloroform and air at an average percentage of 1·5—not below 1 per 100 and not above 2 per 100. Many of the facts of physiological interest made known by these researches are to be found in a course of lectures delivered by Dr. Waller at the Royal Institution, and published in 1897 under the title of "Animal Electricity." Short, and freed from technicalities as it is, this book is unique and permanent, and, as a classic, needs no commendation. The "Characteristic of Nerve," "Veratrine and Protoveratrine," are titles of other papers of physical and physiological interest.

From a study of the electrical response of the eyeball (retina) to the admission and exclusion of light Dr. Waller passed to a consideration of its response to electrical stimulation. This very marked and vigorous response he named the retinal blaze, and this led to a general study of the "blaze-currents" of the eyeball and of other living plant and animal tissues; the importance of this phenomenon as an exact and critical measure of the processes occurring in living tissues can scarcely be overestimated. As a sign of life, its observation (*e.g.* for vitality of seeds) may be of practical advantage.

Within recent years Dr. Waller's energies have also been largely directed towards the problems connected with chloroform anæsthesia, and the apparatus designed and inspired by him promises to lead not only to a further knowledge of the subject, but also to check the lamentable waste of human life so often caused by faulty and inaccurate methods of chloroform administration.

The little that has been said may serve to show that in this Institution and its officers the University has already much upon which it may be congratulated. It is surprising to examine the financial basis upon which this scheme has already been carried to such a pitch of usefulness. When the scheme was first mooted, in March, 1901, no funds were available for its support. The only asset was the promise made by the foremost physiologists in London to deliver courses of lectures, without emolument, upon the branches of physiology with

which they were most conversant. The Senate favoured the scheme, and Sir Walter Palmer, by a timely gift of 2000*l.*, rendered available the space which the Senate had assigned for the laboratory. The University supported the scheme with a grant of 500*l.*, and has since provided an annual grant of 400*l.* for five years, conditional upon the acquisition of 600*l.* per annum from other sources. Upon this annual subsidy of 1000*l.*, it is estimated that the present activity of the laboratory can be sustained. So far the support obtained from outside sources, the 3000*l.* required for the five years, 1904–1909, is represented by 2000*l.* subscribed by Mr. G. W. Palmer and Mr. A. Palmer. The sum asked for has therefore not yet been collected; when collected, it should be noted, it will not serve to maintain the laboratory upon a scale commensurate with its activity and promise. Thus the estimated expenditure of 1000*l.* per annum includes no provision for the honoraria of lecturers, or for additional assistants, or for research scholarships. The sum of 50,000*l.*, it is estimated, would suffice for the accomplishment of this greater object.

THE MONTE ROSA AND COL D'OLEN INTERNATIONAL LABORATORIES.

SOME time ago (NATURE, April 17, 1902, vol. lxv. p. 568) I directed the attention of the readers of NATURE to the international laboratory, the Capanna Regina Margherita, which had been established on the Gnifetti peak of Monte Rosa by Prof. Mosso, of Turin, through the generous aid of the Regina Madre of Italy. Already much valuable work has been done in that laboratory, and if this has been chiefly of a physiological kind, though provision is made in the laboratory for physical and meteorological as well as other investigations, the reason is to be sought partly in the fact that Prof. Mosso is a physiologist, partly in the special interest attaching to the physiological problems presented by living beings at high altitudes.

In August and September, 1903, two physiological expeditions were carried out at the Capanna Regina Margherita, one under the direction of Prof. Zuntz, of Berlin, the other by Prof. Mosso, several observers taking part in each. The records of some of (not of all) the results obtained in these two expeditions are now brought together by Prof. Mosso in a volume[1] of some 300 pages, elegantly bound in such a way as to be easily itself carried to high altitudes, and appropriately dedicated to that Mæcenas of science M. Ernest Solvay, who has so freely given back to science of the good things which science has given to him.

I do not propose, in this notice, to deal in detail with the twenty-one memoirs which make up the volume. One, that by Durig and Zuntz, is given in German; all the others, though written by Italian observers, with that generous abnegation of their own tongue which it is to be hoped will not be considered necessary for them in the coming years, appear in French. I may here perhaps be allowed to express my regret that no memoir by any English observer, either in his own or any other language, is to be found among them. All of them treat, more or less directly, with one or other of the many problems of metabolism which are presented by life at such a high altitude as 4560 metres. At that height the responses which internal chemical, metabolic, processes and the expenditure of energy make to changes in the environment are so different from those which take place at lower levels as to raise great hopes that persistent researches in such Alpine laboratories may carry us far towards solving the intricate problems of the relation of chemical and physical changes of living substance to the energies of life. It may be added that such researches may be expected to explain, and so to afford practical guidance as to, the beneficial sanitary effects of life at high altitudes on many diseases.

Most of the memoirs, as might be expected, record studies on the respiratory exchange and on the condition of the blood at the high altitude as compared with what is found at an ordinary low level; and in some of them the effects of artificially lowering barometric pressure at Turin are compared with the effects of the natural low pressure on Monte Rosa, accompanied as the latter is with other conditions. All these are of great interest to the physiologist, and to him chiefly; but one memoir may perhaps attract the attention of the general reader, and that is the one by Mosso and Galeotti on the physiological effects of alcohol at high altitudes. These observers found that a dose of alcohol, 40 c.c. of absolute alcohol adequately diluted, which at Turin brought about a condition bordering on drunkenness produced, on Monte Rosa, so far as subjective sensations were concerned, hardly any effect at all. I may add that the present volume does not record all the observations made in the expeditions of 1903, a second volume being about to appear shortly. Nor are physiological researches the only ones which have been carried out; important meteorological and physical inquiries have also been conducted.

In spite of every effort to make the accommodation at the Gnifetti laboratory as complete as possible in the circumstances, those circumstances offer many obstacles to continued successful observations. The period during which study is possible is short, and the hardships of living and working at such a high altitude are such as cannot easily be borne by many persons otherwise capable of carrying out fruitful investigations. Hence Prof. Mosso conceived the idea of establishing in connection with the Gnifetti laboratory a supplementary laboratory at a lower but still high level, where work could be carried on in connection with the higher laboratory, but under easier conditions, and for a longer period of the year.

Visitors to the southern slopes of the Monte Rosa group probably know well the little wooden inn at the Col d'Olen at the height of about 3000 metres, reached by a long but easy walk or mule ride from Alagna, and most admirably kept by the well known enterprising hotel proprietors Guglielmina. From it one may, when the air is clear, see afar off the Duomo of Milan, while at one's feet alongside the path to Gressonay lies an Alpine garden which Kew may envy, brilliant in late summer with sheets of gentian and other lovely flowers. Close by the inn, Prof. Mosso has secured a plot of ground on which he is building the new laboratory; this he hopes to have finished next autumn, but it will not be ready for actual use until the summer of 1906.

It is to be a laboratory fully equipped for researches in physiology, meteorology, physics, and botany; but in addition to this it will have sixteen comfortable bedrooms, so that sixteen workers carrying on investigations will have each a bedroom to himself; and if the number of observers should happen at any time to exceed sixteen, accommodation can be obtained at the inn close by. At such altitudes success in investigation is largely dependent on personal comfort, including suitable food; and probably there are not a

[1] Laboratoire Scientifique International du Monte Rosa. Travaux de l'année 1903. Publiés par A. Mosso. (Turin: Loescher, 1904.)