DEVELOPMENTS OF PHYSIOLOGY.

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MOST of the fundamental facts of physiology had been discovered before 1869, but nearly all the progress in the nineteenth century up to that time was made in France and Germany; and those who wished to learn the subject properly had perforce to seek instruction abroad—a condition of affairs which is fortunately in great measure now reversed. During the sixties of last century physiology had ceased to exist as an active science in this country. There were no laboratories, and no systematic investigations of a physiological character were carried on. The men who professed the subject in our medical schools were physicians or surgeons who were switched on to it as it came to their turn, and imparted to their hearers such knowledge as they might have acquired from books, but were themselves ignorant of the methods and aims of the science they were appointed to teach.

There was, however, one notable exception in William Sharpey, who was called from Edinburgh to fill the newly-constituted chair of general anatomy and physiology in University College, London, in 1836, and retained it until 1874. Sharpey, although a great teacher, was not really a physiologist. His training was wholly that of an anatomist, and his teaching was largely anatomical. Of the physiology he taught very little was acquired as the result of personal investigations, and his knowledge of the methods employed in modern physiology was nil. But he had clear ideas regarding the principles of the science, and an extraordinary facility for imparting his ideas and for interesting his hearers in them, so that when the opportunity came for learning the methods they were in an advantageous position to pursue the subject.

It was a pupil of Sharpey—Michael Foster—who founded the famous school of physiology at Cambridge, and it was through Sharpey's influence that Burdon Sanderson was induced to give up the practice of medicine in order to install the practical teaching of physiology in London. These were the pioneers, and their influence gradually spread, so that before very long England succeeded in again taking a foremost place in a science which may be said to have had its birth in our country, for before the immortal discovery of Harvey no true physiology was possible.

The development of the science during the last fifty years has occurred partly along the old lines, which have been thrust forward far in advance of the position they occupied half a century ago, partly on new lines which were at that time not only untraced, but even unthought of. The immense progress on the old lines of investigation is evident whatever be the branch of the science to which we may turn our attention. This progress is actively correlated with the parallel development of the sciences upon which physiology is based—physics and chemistry. More than all, perhaps, has physical chemistry—a branch of science which, if already born fifty years ago, had at any rate not been baptised—enabled the physiologist to see—if still very dimly—into the processes which make up life itself further than could ever have been dreamed of in those distant days.

To give an account of the progress which has been made on the old lines of investigation would occupy a large volume; the shortest description would take many pages. Fifty years ago nothing was known of the constitution of the proteins or of the manner in which they are built up into the tissues. The mode of action of the heart and the factors which regulate circulation and respiration were still obscure. The localisation of functions in the brain had not been discovered. The important changes which cells undergo in the performance of their functions and in multiplication were unknown. The relation of the sympathetic to the rest of the nervous system was in no way understood. But perhaps the most striking fact which has come out as the result of modern investigation is the dominant action of the central nervous system upon all physiological processes. Not that this is entirely new; it was undoubtedly indicated before the period with which we are dealing. But the paths and manner of its action have been so thoroughly studied, and the accumulation of evidence regarding it has become so great, that one may fairly look upon this as the most important development of physiology along the lines it was pursuing some fifty years since. That this advance has been assisted by the remarkable conception of the structure of the nervous system, which we owe in the first instance to an anatomist—Golgi—is willingly conceded, for it must be admitted that our understanding of the mode of action of the nervous system has become vastly simplified thereby.

The new lines on which the science has undergone development within the period with which we are dealing relate to the influence of chemical agencies in regulating the functions of the body. New lines, do I say? Nothing under the sun is ever entirely new. From the earliest times with which history deals, and doubtless even in prehistoric days, it was known that the functions of the body are affected by chemical agencies. For have not drugs, many of them of a potent, not to say poisonous, nature, been administered from time immemorial? Was it not known that the chemical condition of the circulating fluid influences the functions of some organs; that an excess of CO_2 in the blood affects respiration, an excess of sugar the kidneys; whilst any alteration in its constitution or reaction is liable to have a deleterious action

on the body, and may produce fatal effects? For all that, fifty years ago no one suspected that the body itself produces drugs destined to influence its own functions, that certain organs pass chemical substances (chemical messengers, as they have appropriately been termed) into the blood to affect distant parts, and that many functions of the organism are regulated by these chemical agents and self-formed drugs, sometimes in conjunction with the nervous system, sometimes to the exclusion of its action.

The discovery of these internally formed drugs has led to the development of a new branch of physiology to which the term "endocrinology," or physiology of the internally secreting glands, has been applied. Fifty years ago the pituitary body, the thyroid gland, and the suprarenal capsules were mere names. Little was known of their structure, nothing of their functions. The account which we are now able to give of these organs reads like a fairy-tale. That one of the smallest should by its secretion be able to influence the growth and stature of the body, rendering this man a giant, that man a dwarf; that another should produce a material without which the nervous system is not in a condition to perform its functions; that yet others should elaborate materials which when discharged into the blood exercise a profound influence upon the activity of totally distinct and distant organs of the body, are secrets of Nature which were unrevealed fifty years ago, although now amongst the commonplaces of physiological instruction.

The individuals who have been responsible for these advances—whether on the old or on the new lines—are too numerous even to be mentioned here; those who most deserve such mention would indeed be the last to desire it. But History will carve their names on the monument they have joined in erecting, and Science, no less mindful of her votaries than Religion of hers, will not fail to reward their services with the grateful encomium: Εὖ, δοῦλε ἀγαθὲ καὶ πιστὲ.

THE MODERN SCIENCE OF PSYCHOLOGY.

THE progress made by psychology since 1869 may be justly described as unparalleled. In that year the subject had no laboratories, and it was regarded as a matter of philosophical study. To-day a psychological laboratory exists in nearly every important university, and psychology has become recognised as the youngest recruit to the natural sciences—the natural science of mental processes.

The modern science of psychology, while admitting the great value of the older purely introspective psychology of the philosophers (represented in this country by the writings of Ward and Stout), realises its dangers and its inadequacy, and seeks to remove it from all metaphysical implications and to study mental processes under known variable conditions. From experimental psychology, thus established, have arisen the sub-sciences of (i) physiological psychology, in which the relation of mental to nervous processes is investigated, (ii) animal psychology, which studies the relation of animal to human mentality and behaviour, and (iii) individual and racial psychology, which determines the mental differences between different individuals and races of mankind.

There have also developed various "applied" psychological sub-sciences—*e.g.* (iv) educational psychology, the results of research in which are now taught to teachers in their period of training; (v) social psychology, which includes the psychology of religion and other social institutions and characteristics; (vi) abnormal psychology, which forms a subject of examination for the post-graduate diploma in psychological medicine now established in the Universities of Cambridge, Edinburgh, Manchester, and elsewhere; (vii) industrial psychology, which is concerned in discovering the best conditions for the highest mental efficiency of the workers, in connection with which applications for the services of psychologically trained investigators are now coming from pioneer industrial and commercial firms; (viii) the psychology of æsthetics, in which laboratory investigations of importance for art have been published in this country and elsewhere. Particularly in America, but also in Germany, many special journals have arisen devoted respectively to the psychology of education, abnormal psychology, individual psychology, animal psychology, industrial psychology, the psychology of evidence, etc. In this country we have the British Psychological Society, consisting of about 500 members, and publishing the *British Journal of Psychology*.

Fechner, who worked at Göttingen, and Wundt, of Leipzig, who in the 'seventies established the first psychological laboratory, may be reckoned the fathers of experimental psychology. Fechner was the first to formulate the psychophysical methods, a thorough grounding in which is indispensable for the avoidance of the many pitfalls of psychological experiment. To Wundt or to his pupils (especially Külpe) flocked students from other parts of Europe, and notably from America, who sought to be trained in the principles of the science. But in Italy, Austria, and Russia experimental psychology has attracted few workers. In Switzerland it has followed the