southern blood, and if we allow for this it may be asked whether there is sufficient justification for separating the "Celtic pony" as a distinct race, and whether both do not consequently come under the designation of *E. caballus typicus*. If he be right in identifying the original unaltered tarpan with the Mongolian wild pony (*przewalskii*), the author has done good service, as he certainly has in pointing out that the mouse-colour of the tarpan in the Moscow Museum is a sign of hybridism. Whether *przewalskii* might not also be included under the name of *E. c. typicus* is another question that may be left open.

Turning to the author's fourth type—the Barb, Arab, and thoroughbred—we find this standing out in marked contrast to all the above, so that in any case we have two main groups of domesticated horses. The Barb type, as it may be called for brevity, is a larger horse than the dun northern type, with a more delicate, although long, head, prominent nostrils, curiously sinuous profile, full and profuse mane and tail, a colour which appears to be typically bay, relieved frequently by a white star on the forehead and one or more white "stockings." The occurrence of a depression in front of the eye-socket (whether a remnant of the ancestral face-gland, or, as some suppose, a point for muscular attachment is immaterial) in the skull is admitted as a characteristic of this type. From their large size these horses were from the first used for riding, while their gentle disposition led to their being dominated by a nose-band instead of a bit. All the dark-coloured horses of Europe, notably the Shire horse, are believed to have a more or less strong infusion of Barb or Arab blood, which is, however, most predominant in the thoroughbred.

In thus dividing domesticated horses into two main types, the northern dun and the larger southern bay, Prof. Ridgeway will, we think, command the consent of most naturalists. Whether, however, he is right in regarding the full mane and tail of the Barb type as an original feature and not one largely due to domestication may be an open question. Doubt may be also legitimately entertained as to whether he is justified in making North Africa the birthplace of the bay type. In the first place, there arises a suspicion that he has been biased by a former theory (now happily abandoned) that the Barb type is the descendant of the Somali zebra (*Equus grevyi*). Putting, however, this aside, it may be pointed out that the author does not appear to give sufficient weight to the fact that true wild horses are utterly unknown in Ethiopian Africa, and that northern Africa is but a small outlying part of the Holarctic region, the fauna of which is to a great extent identical with that of southern Europe and western Asia. On these grounds, although we may admit that the true Barb was the earliest representative of the bay type to be domesticated, it seems extremely improbable that the ancestral, and now extinct, form of this race was confined to North Africa, while it is much more likely that it ranged over a large extent of south-western Asia in prehistoric times.

To follow the author in his extremely interesting survey of the spread and modification of the domesticated horse during historic times is unfortunately quite impossible within the limits of our available space, and we can only say that it will repay careful reading. The early existence of the Barb type is indicated by a figure of a Libyan woman riding one of these horses, taken from a vase dating between 664 B.C. and 570 B.C.

In conclusion, the present reviewer, who has been so largely quoted (and by no means in an altogether friendly spirit) throughout the work, may perhaps be permitted a few lines in which to explain his own views on certain points. In the first place, he is affirmed to have definitely assigned India as the birthplace of the bay or Barb type; but reference to the original article (*Knowledge and Scientific News*, August, 1904, p. 174) will show that he merely suggested the derivation of the "thoroughbred and eastern breeds generally . . . from an extinct Indian species, *E. sivalensis*." It is true that the expression "eastern breeds generally" is somewhat too extensive, but it was meant to apply primarily to Turks and Arabs; while as to *E. sivalensis*, the writer would be the last to suggest that its range was limited to India, and that it might not have had a wide distribution in Asia. In assigning the origin of the Barb type to this or an allied fossil species rather than to the European *E. stenonis*, which likewise presents a pre-orbital depression in the skull, the reviewer was influenced by the fact that the latter is definitely known to have been succeeded in the prehistoric and Pleistocene deposits of north-west Europe by horses which lack that feature. Moreover, if, as Prof. Ridgeway urges, the northern dun and the southern and eastern bay types are essentially distinct, what is more likely than that they should have been respectively derived from Pliocene types of which one is northern and the other eastern and possibly southern? As regards the main thesis—the existence of the two aforesaid main distinct types of domesticated horses—the reviewer is in perfect accord with the author of the work before him. R. L.

SIR J. S. BURDON-SANDERSON, BART., F.R.S.

ON Thursday, November 23, in his seventy-seventh year, this distinguished man passed quietly to his rest after a protracted illness of some months. His death removes from the University of Oxford one of its greatest personalities, whilst biological science, especially those branches immediately associated with medicine—physiology and pathology—has suffered an irreparable loss. The remarkable tribute contained in the *British Medical Journal* issued on December 2 shows the extent to which those who are now working at these subjects honoured and reverenced him as their master.

He was born at Jesmond, Northumberland, in December, 1828, being connected on both his father's and his mother's side with men of great distinction; the details of his ancestry are cited in Mr. Francis Galton's hereditary notes as one instance of those family histories which show extraordinary mental capacity or remarkable achievement distributed along the ancestral line. He was never at a public school, but was educated at home in that border county which he always loved, and throughout his life he manifested a special delight in sunlight, stretches of wild moor, mountain streams, rocks, heather, wild flowers, and wild birds. His powers of observation and the interest with which he regarded all natural objects were such that he might have become a great naturalist, but his bent was evidently towards medicine, and his parents, relinquishing their own bias for the legal profession, sent him to Edinburgh for a course of medical training. Goodsir and Hughes Bennett were then the professors of anatomy and physiology, and the latter seems to have exercised great influence on the future physiologist, turning his thoughts to cells and their living processes.

He soon showed some of those characteristics which stamp indelibly the scientific work of his life. Thus,

an entry in the minutes of the students' scientific meetings (Royal Medical Society) of 1850 states that a dissertation was read by John Scott Sanderson, of Newcastle, on vegetable irritability, and his first publication in the *Edinburgh Monthly Journal of Medicine*, 1851, was a criticism of the views held at the time as to the metamorphosis of the coloured blood corpuscles, founded on numerous experiments and observations made by himself. After his graduation in medicine he left Edinburgh and went in 1851 to Paris in order to study chemical methods under Wurtz. Associated with him were several Edinburgh student friends, including Marcet and Pavy; he was soon attracted by the fame of Claude Bernard, whose demonstrations he attended, and by whom he was introduced to Magendie. On his return to England in 1853 Burdon-Sanderson married Miss Herschell (whose brother subsequently became Lord Chancellor), and set up in London as a practising physician, being also attached to St. Mary's Hospital as medical registrar. His wide knowledge and great capacity were immediately recognised, and he was made lecturer in botany and afterwards in medical jurisprudence at the medical school of this hospital.

An opportunity for the display of his powers on a larger scale came in 1856, when he was appointed Medical Officer of Health for Paddington. This office he retained for eleven years, during the last seven of which he held, in addition, the responsible position of Inspector in the Medical Department of the Privy Council, where he became closely associated with one who became his great friend, the late Sir John Simon.

From 1870 his work became more and more identified with experimental investigation along physiological lines, his aim being the more exact study of the reactions of the body tissues in health and in disease. Pathological inquiries were, in his judgment, to be conducted in the spirit, and by the experimental methods, which obtained abroad in connection with physiology, and which he had followed for two years under Claude Bernard. It is the practical application of this physiological view which gives his pathological work such transcendent importance, for in the 'seventies he was the only English pathologist who dealt with the subject in a way which is in accordance with modern methods. A most important outcome of this endeavour to investigate disease by the use of experimental and strictly scientific methods was the bringing over of Dr. Klein to this country.

As assistant professor to Dr. Sharpey in University College, London, from 1870 to 1874, and still more as full Jodrell professor of physiology from 1874 to 1882, he exercised a profound influence upon the advance of medical science. One important aspect of this influence is the revolution which has been effected in the methods of teaching physiology; this was inaugurated by his organisation of class work for practical physiological chemistry and for carrying out simple experiments upon excitable tissues, muscle, nerve, &c. Such practical work, now a conspicuous feature of all academic physiological teaching, was initiated by Burdon-Sanderson, who insisted on its importance, not merely for its obvious educational utility in implanting a knowledge of fact and method, but still more for its value as a means of cultivating powers of observation and inference.

In 1882 he acceded to an urgent request that he should come to Oxford as the first Waynflete professor of physiology. He decided on this course because he believed that it was for the highest interests of medical education, the medical profession, and the public, that the University of Oxford should regain the great position which she once held in regard to medicine. As professor of physiology for twelve years, and then as Regius professor of medicine for nine years, he laboured consistently for this end, and, as his life drew to its close, he had the supreme satisfaction of realising that the end had been practically attained. Departments of human anatomy, physiology, and pathology, efficiently equipped and under competent professors, form the material witness of this achievement, but the students who have passed through the scientific medical course at Oxford furnish still more cogent evidence of the great resuscitation which he has brought about; for Oxford this is his enduring monument.

Sir John Burdon-Sanderson was so distinguished as a scientific man, and conducted important investigations in so many branches of medical science, that it is possible in the space of this memoir to make only a brief reference to the most conspicuous of his researches. As regards the whole of his physiological and pathological work, extending over a period of nearly fifty years, certain features stand out prominently. His adoption throughout of experiment as the only fruitful method; his belief that "no real advance could be made until it became possible to investigate the phenomena by methods approaching more or less closely to those of the physicist in exactitude"; his constant anxiety that attention should be focused upon the processes which are observed in living tissues, whether normally present in health or modified in disease; and finally his conviction that all such processes, observed either in isolated tissues or in particular organs of the body, are to be regarded as exhibited because they are inexorably linked with the interests of the whole organism of which the particular structures form a part—natural selection in its widest sense.

In practical medicine his desire for exactitude led him to invent the stethograph for obtaining mensurable records of the respiratory movements of man, and to modify Marey's sphygmograph in order to obtain such records of the arterial blood pressure.

In pathology he employed similar exact methods for the investigation of the inflammatory process and of infective diseases, particularly tuberculosis, pyæmia, and septicæmia. His reports to the Privy Council, and his other publications on these subjects, reveal conceptions as to the character of the processes involved in disease, and of the nature of the response of the normal tissues to infective introduction, which are still far ahead of the general knowledge of the present day, and are viewed from the standpoint, in all essentials, of the modern pathologist. A remarkable instance of this is furnished by his early work on immunity, a subject which, in its recent development, has acquired an importance for the health of the community which it would be difficult to overestimate. Thus, three years before Pasteur published his celebrated work on the subject, Burdon-Sanderson showed that anthrax virus could be attenuated by its transmission through the bodies of rodents, and suggested that it might be possible, by using the attenuated virus, to confer protection against the disease.

In physiology he carried out from 1871 to 1878 experimental inquiries upon the mechanism of circulation and of respiration, made an extensive investigation as to asphyxia, and was the first to show that the nerve fibres in the corona radiata of the cerebral hemispheres would, when locally excited, give rise to definite body movements. But his main work dealt

with the fundamental characters of those elementary processes which are displayed by the excitable tissues of both animals and plants when their activities are aroused by definite stimulation; he thus returned to the topic which had attracted him during his student life at Edinburgh. The published researches of his later years on this subject have become models for all subsequent work, commanding admiration on account of the completeness of their design, and carrying conviction through the security of their foundation, which rests on the solid ground of mensurable records. The electromotive phenomena displayed by active tissues appeared to him to furnish the most trustworthy of such records, provided that appropriate instrumental methods were employed in their investigation; these he made every effort to utilise, and for this end he introduced into physiological method the recording capillary electrometer. His publications on the electromotive phenomena of the beating heart, on similar phenomena in the excitable leaves of the Dionæa plant, in voluntary muscle, in the electrical organs of fishes, &c., are examples of his activity in this field.

In the last year of his life he was still engaged upon this engrossing subject, and was planning and supervising investigations for the further elucidation of the electromotive phenomena present in muscle when thrown reflexly into activity. This piece of work, and others on various subjects of like nature, remain in an unfinished state, but, though fragmentary, they are so suggestive that it may be hoped they will be included in a future collection of his numerous scientific papers.

In conclusion, reference must be made to that commanding influence which true greatness exerts over other scientific workers, moulding their thought, stimulating their powers, and enriching their lives. The factors which contribute to the wielding of this influence defy precise definition, since, apart from acknowledged achievement in science, their essence is to be sought for in certain mental, moral, and physical qualities. In Burdon-Sanderson's case conspicuous traits stamped him as a leader of men, for his inspiring personality, his extraordinary charm of manner, and his wonderfully expressive face made a profound impression even on those whom he casually met. But his students, using the term in its largest sense, were conscious that the real impression made upon them was the work of more potent factors; his courtesy to even the humblest worker, the sympathetic interest with which he followed all experimental work, the breadth of his view, the profundity of his knowledge, ever placed ungrudgingly at the disposal of everyone who sought his help, the genuine character of his devotion to scientific truth, and the unwavering firmness with which he advocated the use of experimental methods. All these combined to attract and hold the younger physiologists and pathologists, and since they realised that it was a delight to him to mix with younger men the influence he exerted was profound. He often expressed his intense satisfaction at the vast change of which he had been a witness, a change which has in thirty years advanced British physiology and pathology into the first rank. The name of Burdon-Sanderson will be permanently associated with this extraordinary advance, for it is generally recognised that by work, example, and precept he has contributed in a very special degree towards the creation in this country of that vigorous band of workers who have given English medical science such a wide reputation.

F. G.

ANNIVERSARY MEETING OF THE ROYAL SOCIETY.

THE anniversary meeting of the Royal Society was held on Thursday, November 30, when the report of the council was presented, the president delivered his address, and the new council already announced (p. 33), for the year 1906, was elected. In the evening the anniversary dinner was held at the Hotel Metropole, Lord Rayleigh, the newly-elected president, being in the chair.

The report of the council refers, among other subjects, to the Royal Society Catalogue of Scientific Papers, the International Catalogue of Scientific Literature, the Meteorological Office, tropical diseases, Antarctic work, seismology, the International Geodetic Association, Indian Trigonometrical Survey, Astrographic Chart, and the National Physical Laboratory. A few matters recorded in the report have not been announced or described in these columns, and may therefore be mentioned here.

At the beginning of August, the Treasury expressed willingness to place on the estimates a sum not exceeding 200*l.* as an annual national contribution toward the expenses of the central bureau of the International Seismic Organisation should the adhesion of Great Britain to the international scheme be agreed to. On November 2, the council, having received a report on the subject from the Society's seismological committee, agreed to recommend that H.M. Government should join the organisation, and advised that Prof. Schuster be appointed the representative of this country to the organisation. The Treasury has agreed to the continuation by Great Britain of its adherence to the Geodetic Convention of 1895 for a further period of ten years from January 1, 1907, and to a payment during that period of an annual subscription of 6000 marks. Also, at the instance of the Royal Society, the Treasury has undertaken that one-half the cost of printing the British section of the International Astrographic Catalogue executed under Prof. Turner's direction, within a limit of 1000*l.*, shall be met from public funds.

The report of the council concludes with an expression of appreciation of Sir William Huggins's services to the Society during the five years in which he held the office of president, and the announcement that Lord Rayleigh had accepted nomination as his successor.

In his presidential address, Sir William Huggins dwelt upon the influence which discoveries of science have had upon the general life and thought of the world, especially during the past fifty years, and the place that science should take in general education. Some extracts from the address are subjoined:—

> The influence of science during the last fifty years has been in the direction of bringing out and developing the powers and freedom of the individual, under the stimulation of great ideas. To become all that we can become as individuals is our most glorious birthright, and only as we realise it do we become, at the same time, of great price to the community. From individual minds are born all great discoveries and revolutions of thought. New ideas may be in the air and more or less present in many minds, but it is always an individual who at the last takes the creative step and enriches mankind with the living germ-thought of a new era of opinion.
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> All influences, therefore, and especially all laws and institutions which tend to lose the individual in the crowd, and bring down the exceptional to the level of the average, are contrary to the irresistible order of nature, and can lead only to disaster in the individual and in the State.
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> I should not omit to mention the marvellous secondary effects of scientific discoveries upon the mental progress of