painted on some of the pebbles indicate entirely conventionalised phonetic characters. Most of them are isolated markings, as in Fig. 10, which resembles the Greek Π and the Cypriot *go*. In a very few instances two or more symbols are associated together, as in Fig. 11. This is, as a matter of fact, the nearest approach to an inscription. M. Piette makes full use of the recent discoveries of Mr. Arthur J. Evans in early Mediterranean scripts, and we must leave it to experts to discuss the problems opened up by M. Piette's astonishing discoveries. Assuming these markings to be syllabic signs, can it be possible that these pebbles were employed in building up words and sentences, much as children use boxes of letters? The author states that "thirteen out of twenty-three Phœnician characters were equally Asylian graphic signs."

FIG. 10.

FIG. 11.

No longer can markings or designs, made by savage or primitive peoples, be ignored or be superciliously smiled upon as of no moment. We now recognise that such peoples do not while away their idle hours in making meaningless cabalistic signs, or in aimlessly decorating objects. When one looks through the twenty-five beautifully coloured plates of the atlas that accompanies this memoir, the belief is irresistible that these hundreds of pebbles have not wantonly been painted, but that thereon is recorded a hitherto unsuspected phase of prehistoric culture. At times one may feel a little good-natured amusement at the ingenuity displayed by M. Piette; but, at the same time, we respect his enthusiasm, and trust that he may be fortunate enough to bring further evidence to light. A. C. H.

EMIL DU BOIS-REYMOND.

AS was stated in our last issue, Emil du Bois-Reymond, Professor of Physiology in the University of Berlin, and Perpetual Secretary of the Berlin Academy, died on December 26, after a severe illness.

He was born in Berlin on November 7, 1818, where his father, who had begun life as a watchmaker in Neuchatel, had attained an important position. His mother was of Huguenot descent, her family having been driven out of their native country in the seventeenth century. He received his early education at the Collége Français at Berlin, and subsequently at the College of Neuchatel. He entered the university at Berlin when he was eighteen years of age, and was matriculated in the Philosophical Faculty.

At the outset of his university career his pursuits would appear to have been eclectic, for it is stated that he attended Neander's lectures, and was much interested in theology; but about 1837 he took to the serious studies of his life. After a year or two devoted to mathematics, physics and chemistry, he became a pupil of the illustrious J. Müller, and eventually his assistant. In 1841, he was asked by his chief to repeat the observations of Matteucci in his essay "Sur les phénomènes électriques des animaux," which had been published the year before in Paris. This led to the historical studies which he embodied in his dissertation for the degree of D.M. ("Quae apud veteres de piscibus electricis exstant argumenta"), and to the discovery of the main facts of what we now call electro-physiology. His first research on this subject was published in the fifty-eighth volume of *Poggendorff's Annalen*, under the title, "Ueber den sogenannten Froschstrom und über die elektromotorischen Fische." During the next ten years he devoted himself entirely to the line of inquiry he had determined to follow. The fruits of his labour were embodied, not in separate papers, but in his great work on "Animal Electricity," which was not completed till about ten years ago, although the first volume appeared in 1848. When, in 1855, he visited London, he had already acquired a European reputation. Some readers may, perhaps, remember the interest excited by a Friday evening lecture, with demonstrative experiments, which he gave at that time at the Royal Institution. In 1858 he succeeded Müller as Professor of Physiology at Berlin, and in 1867 became Secretary of the Berlin Academy. After the Franco-German war the palatial building in the Neue Wilhelmstrasse was erected according to plans which, with much forethought, he had designed, so as to provide for all the branches of physiological teaching and research. These were carried out with a completeness which has made the Berlin laboratory a model for similar institutions in all parts of the world.

About 1878 du Bois-Reymond published his "Collected Papers," in which all the scientific work done by him up to that time is included, excepting what had been recorded in the "Thierische Elektricitat," and in 1881 a volume appeared, shortly after the accident which deprived his assistant, Dr. Sachs, of his life, containing the results of Sachs' experimental investigations of the *Gymnotus electricus* in its native country.

To many readers who have no special interest in the scientific problems which it was the aim of his life to solve, du Bois-Reymond is known by his contributions to literature, and by the admirable literary style of his essays. Of his numerous writings on historical, biographical, and philosophical subjects, we can mention only the best known, such as (1) the historical introduction contained in the first chapters of his great work; (2) the essay on university organisation (1870); (3) on present and past of physiological teaching, and on the relations of natural history to natural science (1878); and (4) on the limits of natural knowledge (1882).

Du Bois-Reymond's life-work was the investigation of the electrical phenomena of animals and plants, and the relation between them and the vital endowments of the structures in which they manifest themselves. The first part of this task he accomplished all but perfectly. As regards the second, he arrived at theoretical conceptions which, although no longer so predominant as they were, still serve as points of departure in all electro-physiological discussions. To exemplify this, we must go back for a moment to the time fifty years ago, when he undertook the experimental criticism of Matteucci's work. Recognising that the electrical properties which had been described by his predecessors with relation to the whole organism could only be understood by referring them to the parts in which they manifested themselves, he at once limited his inquiry to the electromotive properties of the muscles, choosing for his purpose those of simplest construction—those which consist of parallel fibres. Considering that in such a muscle each fibre must be an epitome of the whole, and that if it were possible to break up a fibre into its constituent fibrils, its properties would also represent those of the whole, and having found experimentally that the surface of a cylinder obtained from a living cylindrical bundle of fibres by cutting it across in two places, exhibited in different parts differences of potential which could be expressed by a very simple law (the so-called law of the muscle current, according to which the centre of each cut surface is negative to every other part), it required but little use of the scientific imagination to suppose that if the cylinder contained elements of indefinite minuteness endowed with properties corresponding to its own, the result would

be as observed. He thus arrived at the theory of electromotive molecules which, with extraordinary insight and thoroughness, he worked out in its relations to all the electromotive phenomena of nerve and muscle when in the unexcited state. But, in doing this, he met with unexpected difficulties. So long as his observations were limited to the properties of the muscle cylinder the theory was applicable; a model could even be constructed of schematic molecules which displayed all the phenomena of the "cylinder" of living muscle; but in the natural muscle certain "parelectronomic" facts, to use du Bois-Reymond's word, presented themselves, which to this day are irreconcileable.

In connection with the molecular theory of the muscle current, he discovered the elementary facts relating to what is called stimulation or excitation, viz. that when a muscle is excited, whether naturally or artificially, the sudden shortening of its fibres is ushered in by still more sudden electrical changes. This phenomenon du Bois-Reymond succeeded in connecting with those of the muscle cylinder by means of the theory above referred to. According to his view, when a muscle is excited, each of its electromotive elements sustains a diminution of its E.M.F., the result of which is that in the muscle cylinder so excited the pre-existing difference between its cut-surface and its natural surface diminishes. Here again the progress of investigation has shown that while some of the electrical phenomena of excitation require such a theory for their explanation, it does not cover the whole ground; for which reason many physiologists decline to assign to it its true value.

A third theory of very wide application relates to the way in which electric currents when used as stimuli act on nerves. It was recognised by du Bois-Reymond that a voltaic current led through a nerve, although it produces those remarkable changes in its electromotive properties which are called electrotonic, fails to excite it to action so long as the current strength remains constant, but that the slightest increase or diminution of current strength excites it with an intensity which is inversely proportional to the time occupied by the change. Under certain conditions he found that his experimental results were in such strict conformity with the principle laid down as to justify their being embodied in a mathematical formula. But even here we now know that this "law of excitation" is not of universal application.

We have referred to these instances for the purpose of pointing out that du Bois-Reymond's real greatness consisted, not in his theories, but in the exactitude of his observations, the excellence of the methods which he devised, and the number of new relations which he discovered between physical and vital phenomena. Just as Ludwig taught us how to investigate the mechanics of the circulation, and Helmholtz how to determine the time-relations of physiological processes of very short duration, so du Bois-Reymond not only opened to us a new field of investigation, but furnished his contemporaries and successors with the means of cultivating it. For this service we can best show our gratitude by striving to work as he did, never allowing theory to influence our judgment in the interpretation of experimental data, and never contenting ourselves with inadequate methods of observation. In investigations of such difficulty mistakes are unavoidable, and it cannot be asserted that in his fifty years of active work du Bois-Reymond never fell into any errors of observation; but if we compare these with the new truths which he brought to light and established, their importance seems indeed trivial. There can be no more striking proof of the solidity of his achievements than the fact that, notwithstanding the large number of active workers who, during the last few decades, have been engaged in physiological researches, the instruments and methods which he devised are still in use. In every laboratory you find his "Schlitten inductorium," his non-polarisable electrodes, the du Bois key, and the du Bois compensator.

Like other great teachers, du Bois-Reymond founded a school; although his pupils were far from being as numerous as those of Ludwig, they occupy very important academical positions. The man who probably has done more to maintain the influence of his doctrines than any other is Prof. Bernstein, of Halle, whose "Untersuchung über den Erregungsvorgang," published in 1871, was comparable in importance to that of Hermann's research on muscle physiology, published a few years earlier. It is noteworthy that each of them dedicated his research to du Bois-Reymond—the one afterwards to become his energetic opponent, the other then and now his cordial supporter. If on any one the mantle of du Bois-Reymond falls, it must be on Bernstein.

J. BURDON-SANDERSON.

NOTES.

THE elevation of Sir Joseph Lister to the Peerage is a New Year's honour which has been received with the keenest satisfaction in the scientific world. It may be taken as an acknowledgment by the Crown of the high position of the President of the Royal Society, as well as a recognition of the life-long work in science which led to Sir Joseph Lister's selection for that honoured Presidency.

AN address of congratulation, signed by a number of eminent men of science, and by leaders in other branches of learning, has been presented to Mr. Herbert Spencer, in recognition of the successful completion of his "System of Synthetic Philosophy." With reference to this work it is remarked in the address: "Not all of us agreeing in equal measure with its conclusions, we are all at one in our estimate of the great intellectual powers it exhibits, and of the immense effect it has produced in the history of thought." The signatories requested Mr. Spencer to permit them to employ some eminent artist to take his portrait, with a view to its being deposited in one of the national collections. Though at one time averse to a proposal of this kind, Mr. Spencer has now given his consent in a letter to Sir Joseph Hooker, who forwarded the address, and Mr. Herkomer, R.A., has undertaken to paint the portrait. It is gratifying to know that the country will possess an authentic personal likeness of so distinguished a philosopher. Donations for the portrait fund may be sent to the Bank of England, Burlington Gardens, W.

THE distinguished Berlin astronomer, Prof. Dr. Arthur Auwers, has received from the German Emperor a gold medal for his services to science.

M. CALLANDREAU, professor of astronomy at the Paris École Polytechnique, has been elected a Correspondant of the St. Petersburg Academy of Sciences.

THE Council of the British Institute of Public Health have awarded the Harben medal for 1897 to Prof. M. von Pettenkofer, Emeritus Professor of Hygiene in the University of Munich.

IT is understood that Mr. Herbert Goss and the Rev. Canon Fowler, who have been joint Secretaries of the Entomological Society for the past eleven years, do not intend to offer themselves for re-election at the next annual meeting of the Society on the 20th inst.

WE regret to announce the deaths of Dr. Luigi Calori, professor of anatomy in Bologna University; Dr. G. D. E. Weyer, professor of mathematics and astronomy in the University of Kiel; M. Vivien de St. Martin, renowned for his researches in ancient geography; and Mr. Theodore Wormley, of Philadelphia, well known as a chemist.