their birth for the battle of national life. Our fellow-subjects in those distant countries have already displayed their complete fitness to undertake the task of further geographical investigation in that quarter, and to them we may now confidently leave it, assuring them of the continued sympathy and interest with which their labours will be regarded by this Society.

During the period to which I am referring, much also has been done to add to our knowledge of the formerly little understood geography of Central Asia. The Russian geographers on the north, and our own surveyors on the south, have now almost entirely cleared away the darkness that shrouded this part of the earth's surface. The limits and the nature of the central plain lying between the mountains of Siberia and of Tibet have been at length satisfactorily ascertained. The long-discussed problem of the true source of the Brahmaputra has been finally solved. The remarkable plateau of Tibet has been crossed in many directions, and important parts of it have been accurately surveyed, so that here also what remains to be done is rather to complete the delineation of details than to enter upon altogether new investigations.

The large geodetic and topographical operations in connexion with the international demarcation of the northern boundary of Afghanistan will supply all that seems still required to complete the maps of Western Asia between the Indus and the Caspian.

Turning to the American continent, we find a measure of progress which, to say the least of it, quite equals that obtained elsewhere. The exploration of the vast tract lying between the valley of the Mississippi and the Pacific has been carried out by the United States Government with a degree of completeness, both in respect to its topographical representation and its physical characteristics, that has probably never been approached elsewhere, and the whole country has thus been thrown open to the enterprise of the energetic citizens of the United States, who have not been slow to possess themselves of its natural wealth.

In British North America, under less favourable conditions for the prosecution of such systematic surveys as those carried out in the territories of the United States, much has still been done, and the recent opening of the railway connecting Columbia on the Pacific with the eastern Canadian States, and the establishment of another through route to Eastern Asia, will doubtless before long lead to the thorough exploration of the countries through which the railway passes.

The Arctic voyages which had been originally commenced with the hope of finding a practically useful north-west passage to Asia, have long ceased to be animated by such an expectation, and their repetition has been undertaken in the cause of geographical exploration alone.

The results of the numerous expeditions undertaken during the last fifty years, combined with those obtained by land journeys directed from British North America, have very completely defined the southern border of the Polar Sea between Behring Strait and Greenland, and have secured the precise delineation of the somewhat complicated system of channels by which the northern border of the American continent is intersected, and of the islands formed by them, along the Arctic circle. In like manner the boundary of this sea has been determined by voyages directed to the north-east along the northern border of Asia.

The highest latitude reached hitherto is rather less than $83\frac{1}{2}°$ N.—that is, within 500 miles of the Pole. The further extension of the exploration of the north of Greenland and of Franz-Josef Land may still be possible, and it is by journeys in this direction that any closer approach to the North Pole will probably be most readily attainable.

I should not omit mention of the memorable voyage to the Antarctic Circle under the most experienced of the Arctic naval commanders of his time, the results of which were of the greatest scientific value, though the difficulties arising from climate that stand in the way of a near approach to the South Pole prevented the Expedition reaching a higher latitude than 78° 11′ S.

Lastly, I may notice the remarkable additions that have been made during this epoch to our knowledge of the ocean, its depths, its temperature, the winds and climates that prevail over its various portions, its currents, and the life with which it abounds. Much of the knowledge thus acquired has supplied completely new and wholly unexpected data with which to deal in our endeavours to interpret the earth's history, and to understand the phenomena it presents to us.

It has been in connexion with the extension of geographical discovery, both that to which I have thus more specially referred, and other similar explorations to which specific reference has not been possible, that there has been accumulated a great mass of knowledge which has had a most important place among the causes which justify our assigning to this epoch its conspicuous character of deserving to be recorded in the history of the present times as the age of scientific progress. There is no room to doubt that it was only by aid of the accumulation of a knowledge of numerous forms of life from various countries, developed under different conditions, that the remarkable generalizations of Darwin and Wallace as to the origin and distribution of species became possible; and that in this sense those great conceptions of the signification of the wonderful variety in the forms of animal and vegetable life, and of the remarkable manner in which they are found associated in various parts of the earth, which it has truly been said are worthy of being classed with the sublime discoveries of Newton, may be regarded as consequences of geographical exploration and discovery. In a somewhat similar manner the progress of geology follows that of geography, and the same may be said of almost all the natural sciences.

In some branches of science the student is able to submit his conclusions to the test of experiment, to vary the conditions of his investigation at his pleasure, and to draw his inferences from the varying results under the changed conditions. In the great laboratory of Nature no such control of conditions is within our power. But by suitable variation of our geographical position, we are able to observe the effects that the physical forces of Nature have produced under varied conditions, and it thus becomes possible to some extent to obtain a substitute for the power of direct experiment.

Properly to estimate the relation between geographical conditions and any observed effect, it is obviously necessary to possess a sound knowledge of the physical forces that may be called into operation in producing that effect, and consequently such a knowledge is of essential importance to every geographer.

I shall not detain you to say anything more on the much-discussed subject of geographical education. I desire to point out, however, that, for such reasons as I have briefly indicated, it is hardly possible to over-estimate the value of exact and scientific geographical research, and that this can only be attained by those who have been properly prepared by previous training. Such a training, it is hoped, may be provided by the instruction which it has been the earnest desire of the Society to see imparted at our chief Universities, and which I trust may not only add to the number of our scientific travellers, but serve generally to throw on many other branches of study that light which an intelligent knowledge of geography alone can supply.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE following is the list of Scholarships, Prizes, Associateships, &c., awarded at the Normal School of Science and Royal School of Mines, South Kensington, for the Session 1886-87:—

First Year's Scholarships—Samuel B. Asher-Aron, William Tate, James A. Schofield, Savannah J. Speak. Second Year's Scholarships—William Blackmore, Henry Sowerbutts.

Edward Forbes Medal and Prize of Books for Biology—Miss Agnes Calvert. Murchison Medal and Prize of Books for Geology—Thomas H. Holland. Tyndall Prize of Books for Physics, Part I.—James W. Rodger. De la Beche Medal for Mining—John W. Sharwood. Bessemer Medal with Prize of Books from Prof. Roberts-Austen for Metallurgy—John Richards. Hodgkinson Prizes for Chemistry—1st Prize, Books, John T. Hewitt; 2nd Prize, Book, William E. Hotson. Frank Hatton Prize for Organic Chemistry—John T. Hewitt.

Associateships (Normal School of Science)—Mechanics (1st Class): Albert Griffiths, Ernest A. Hamilton-Gordon. Physics (1st Class): Arthur T. Simmons. Chemistry (1st Class): John H. Powell, John T. Hewitt; (2nd Class): William R. Bower, Herbert Anderson, Walter D. Severn, Ernest H. Smith, Frank Belcher. Geology (1st Class): Walter G. Ridewood, William F. Hume.

Associateships (Royal School of Mines)—Metallurgy (1st Class): John Richards, André P. Griffiths, James A. Gilmour, Arthur E. Cattermole, Andrew McWilliam; (2nd Class): Sidney Allingham, Hugh Barbour, Arthur M. M. Cooke, George W. Card. Mining (1st Class): John W. Sharwood, Arthur M. M. Cooke. (2nd Class): Cæsar Bello, John Leechman, Andres Franchy, John H. Grant.

SCIENTIFIC SERIALS.

American Journal of Mathematics, vol. ix. No. 4 (Baltimore, June 1887).—The number opens with a further instalment of Prof. Sylvester's lectures on the "Theory of Reciprocants" (pp. 297–352), which grow in interest as we approach their close—promised in a subsequent number. Lectures xxv. to xxxii. are reported as before by Mr. Hammond, and are accompanied by the lecturer's notes.—M. Maurice d'Ocagne (pp. 354–80) in a paper "Sur une Classe de Nombres remarquables," discusses properties of the numbers symbolically represented by K_m^p. Form a table of squares, as in the case of Pascal's arithmetical triangle, putting in the top left corner K, and in the vertical and horizontal lines the successive numbers 1, 2, 3 . . . The K-numbers will then be, first row 1, second row, 1 1, third row 1 3 1, fourth row, 1 7 6 1, fifth row, 1 15 25 10 1, and so on; the law of formation being, "Multiply the number of the pth column of the qth row by the number of the column, and add to the result the number in the $p-1$th column of the qth row to get the number in the pth column of the $q+1$th row": thus, in the above, $15 = 2 \cdot 7 + 1$, $25 = 3 \cdot 6 + 7$, $10 = 4 \cdot 1 + 6$. These numbers, like those of Bernoulli and Euler, frequently occur in analysis. Many curious results are obtained. —We next have "Extraits de Deux Lettres addressées à M. Craig par M. Hermite" (pp. 381–88). These notes are upon a definite integral formula of Fourier, upon a formula due to Gauss, and upon a formula first given by Weierstrass (an expression for the sine by a product of prime factors).—The volume closes with a notelet by Prof. Franklin, entitled "Two Proofs of Cauchy's Theorem."

Rivista Scientifico-Industriale, April 30.—Recent progress in the theory of the microscope, by Dr. Aser Poli. Reference is made more especially to the labours of Abbe, Helmholtz, Crisp, and others, which have been either originally published or reproduced in the Journal of the London Royal Microscopical Society during the last ten years.—On the electric conductivity of gases and vapours, by Prof. Giovanni Luvini. This is a reply to Prof. Edlund, of Stockholm, who has recently urged several arguments against the author's views regarding the non-conductivity of gases and vapours. These arguments are examined in detail, and it is shown generally that, being mainly based on theoretic grounds or gratuitous assertions, they cannot affect the conclusions to which the author has been led by carefully conducted experiments.—Celestine of Montecchio Maggiore, by G. Bettanini. Preparatory to a complete study of this mineral, a brief description is here given of its crystalline forms and general physical properties. Its specific gravity is shown to be 3·965 at a temperature of 14° C.

Bulletin de l'Académie Royale de Belgique, May.—A new reptile discovered in the Aix-la-Chapelle district, by the Abbé G. Smets. Considerable interest attaches to this discovery recently made in a sandpit at Moresnet, a comparison with the Dinosaurians brought to light in the chalk formations of the New World showing that it is a carapaced Hadrosaurian, the first representative of this family yet found in the eastern hemisphere. —On the electrical phenomena of the excitatory process in the heart of the dog, by Léon Frédericq. This elaborate paper is introduced by an historical summary, from the discovery of the negative variation of the heart of the frog by Kölliker and H. Müller down to the recent studies of Sanderson and Page, with an account of the stroboscopic method employed by Martins to demonstrate the simple nature of the electric variation of the heart in the dog and rabbit. This is followed by a full description of the apparatus employed and experiments made by the author, who has investigated the subject by means of an electrometer modelled on that described by Lovén. A detailed account is added of the results of these researches, illustrated by a series of photographic diagrams.—The solar eclipse of October 29, 1886, observed on the Congo, by A. Merlon. These observations were taken with great care in 3° 7′ S. latitude above the Congo-Kassai confluence to the north of Kwamouth. By means of the data obtained and here supplied, the longitude of the point of observation may now be accurately determined. The instruments used were Abbadie's theodolite, Leroy's chronometer, and Fortin's barometer.

Rendiconti del Reale Istituto Lombardo, June.—On the sulphate of copper, as a remedy against the mildew of the grape-vine, by Prof. E. Pollacci. A crucial chemical experiment is described, showing that the sulphate of copper cannot pass from the grape to the wine except in the minutest quantities. Some critical remarks are added on various other remedies recently proposed against diseases of the vine.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 16.—"The Electromotive Properties of the Electrical Organ of *Torpedo marmorata*." By Francis Gotch, B.A., B.Sc. London, M.A. Oxon. Communicated by Prof. Burdon Sanderson, F.R.S.

After an introduction, in which the author sets forth the present state of knowledge with reference to the electromotive properties of the electrical organ of Torpedo, he gives an account of his own experimental investigations in three sections.

The first section relates to the nature of the changes produced in the electrical organ by mechanical injury and by heat, and the relation of these changes to those which manifest themselves under similar conditions in muscle and nerve, a subject which has not hitherto been inquired into.

In the second, the duration and the character of the response of the electrical organ to stimulation of its nerve are investigated for the first time by means of the rheotome and galvanometer.

In the experiments which are recorded in the third section, the author has entered on the examination of the after-effects which are produced in the organ by the passage through it of voltaic or induction currents, a subject which has been recently investigated by Du Bois-Reymond.

The author is led by his experiments to believe that the physiological effects produced in the organ by injury, by the passage of currents, and by the stimulation of the electrical nerve, are, notwithstanding that they differ so widely from each other in distribution, duration, and intensity, all phenomena of excitation.

Physical Society, June 25.—Mr. Shelford Bidwell, F.R.S., Vice-President, in the chair.—The following communications were read:—Note on magnetic resistance, by Prof. W. E. Ayrton, F.R.S. and Prof. J. Perry, F.R.S. In the spring of 1886 the authors made experiments on the magnetic induction through horse-shoe electro-magnets when excited by constant currents. The inductions through different armatures and air spaces were also measured. The results show that for small exciting powers the law of parallel resistances is true for magnetism, taking leakage into account. From experiments made with two electro-magnets, the poles of which were placed at different distances apart, the authors conclude that the magnetic resistance of air is proportional to length, or to length plus a constant. A note on magnetic resistance was read before the Society on March 12, 1887, by the same authors, describing experiments on two iron rings, one whole and the other divided by a radial saw-cut. Since then the experiments have been repeated with great care by Colonel Swinton and Mr. Sörenson, of the Central Institution. The resulting curves agree with those previously obtained. On measuring the air space it was found considerably less than estimated, and the magnetic resistance of air relative to iron (assuming no "surface resistance") comes about 1500. Experiments made with different air spaces together with the above seem to show a considerable "surface resistance." Prof. S. P. Thompson thought dynamo-makers had evidence of such "surface resistance" from the care exercised in avoiding joints in the magnetic circuit wherever possible, and Mr. Bosanquet mentioned some experiments he had recently made on the resistance of joints during the various stages of fitting. The changes of resistance are very large, and he concludes that, however good the fit, it is not possible to reduce the surface resistance to a negligible quantity.—On sounding coils, by Prof. W. Stroud and Mr. J. Wertheimer. The paper describes experiments on coils and helices of wire which emit sounds when variable electric currents are passed through them. The pitch depends on the frequency of the current variations. The authors believe the sounds due to the attractions of adjacent parts of the wire which cause shortenings and lengthenings as the current increases or decreases. To prove this, two identical coils were made, and