tions. The total value of school buildings, sites, and equipment is stated to be of the vast total of nearly 2,000,000,000 dollars. The school dollar income is spent as follows: 3·3 cents on general control, 58·2 on instruction, 15·5 on new buildings and grounds, and 23 miscellaneous. The average length of the school year is stated to be 160 days, though the cities usually provide a school term of nine months. More than 6,000,000 children attend school, on an average, less than five months in each year. Great diversity exists throughout the States, due to climatic conditions, the scattered nature of much of the population, racial differences, and varying educational legislation, which largely accounts for the striking differences which prevail. The bulletin is well worthy the close attention of educational authorities in this country.

Societies and Academies.

LONDON.

Physical Society, June 25.—Sir W. H. Bragg, president, in the chair.—Dr. J. H. **Vincent**: The origin of the elements. The atomic weights are regarded as the weighted mean values of the atomic weights of the isotopes of the elements; but it is assumed that, as a rule, the atomic weight is near that of some one isotope. Figures and tables are drawn up showing how this accounts for the values of a large number of atomic weights, if one also assumes that the weights and positions in the periodic table of any isotope are conditioned by laws similar to those holding in the recognised radio-active families. The elements are all supposed to be derived from parent elements by processes known to occur in actively radiating families, but their radio-activity is not, in general, detectable by the usual means owing to the velocity of expulsion of the particles being low. The possibility of the reversibility of some radio-active processes is regarded favourably. The various difficulties in connection with the views advocated are discussed, and some suggestions for experiments made. Finally, the theory is used to explain the so-called laws of the atomic weights of elements of low atomic weight, and the shape of the curve obtained when the atomic weights are plotted against Moseley's numbers.—W. H. **Wilson** and Miss T. D. **Epps**: The construction of thermo-couples by electro-deposition. The method, which was devised to overcome the difficulty of making satisfactory soldered joints between the elements of thermopiles having a large number of closely packed junctions, consists in using a continuous wire of one of the elements and coating those parts of it which have to form the other element with an electrolytic deposit of another metal. If the conductivity of the latter is considerably greater than that of the former, and a fairly thick sheath is deposited, a thermo-couple is produced which is not appreciably impaired in efficiency by the short-circuiting effect of the core. Constantan wires coated with either copper or silver sheaths were found to be suitable for most purposes.—J. **Guild**: The use of vacuum arcs for interferometry. The paper discusses the relative merits of short and long mercury arcs for this work, and points out that the defect of the former is due to the broadening of the spectrum lines consequent on the high vapour pressure within the lamp. It is shown that by attaching a condensing bulb to the lamp, so as to prevent excessive rise of vapour pressure, the short lamp can be made practically as good as the long one as regards sharpness of lines, while still being of much greater intrinsic brightness.—S. **Butterworth**: The maintenance of a vibrating system by means of a triode valve. This paper gives a mathematical analysis of the arrangement, previously described by Eccles, whereby the vibrations of a tuning-fork are maintained by means of a triode.

PHILADELPHIA.

American Philosophical Society, April 24.—Dr. G. E. Hale, vice-president, in the chair.—Prof. E. W. **Brown**: The problem of the evolution of the solar system.—W. H. **Wright**: Certain aspects of recent spectroscopic observations of the gaseous nebulæ which appear to establish the relationship between them and the stars. The paper summarises in non-technical terms the evidence afforded by a study of the stellar condensations in the planetary or small gaseous nebulæ which are shown to be spectroscopically identical with stars of the Wolf-Rayet group (Pickering's Class O). A brief account is given of some of the present-day conceptions of stellar evolution for the purpose of indicating the somewhat critical nature with respect to these ideas of the relationship indicated.—Prof. E. P. **Adams**: The Einstein theory. The extension of the principle of relativity and the resulting revision of the concepts of space and time led to Einstein's interpretation of gravitation as a property of space itself when modified by the presence of matter.—Dr. L. A. **Bauer**: The results of geophysical observations during the solar eclipse of May 29, 1919, and their bearing upon the Einstein deflection of light. The present paper gives the results of a special study of the cause of the non-radial effects of the light deflections observed by the British expedition at Sobral, Brazil. It is shown that these non-radial effects may be completely accounted for by incomplete elimination of differential refraction effects in the earth's atmosphere. The same cause may apparently also explain why the observed radial deflections of light exceeded, on the average, by about 14 per cent. the amounts predicted on the basis of the Einstein law of gravitation.—Prof. J. B. **Whitehead**: The high-voltage corona in air. The paper describes the nature of the corona and recent studies of the laws governing its appearance in high-voltage circuits. Its influence as a limiting factor in long-distance transmission occurs through deterioration of insulation and a leakage loss of power between the high-voltage lines. The appearance of corona on a clean round wire is very sharply marked, and may be used for the measurement of high alternating voltages to a degree of accuracy not heretofore possible.—Prof. D. C. **Miller**: The velocity of explosive sounds. Most of the experiments were made in connection with 10-in. and 12-in. rifles, though a few were made with 6-in. and 8-in. guns. The amount of powder charge and the value of the internal pressure developed in the gun are taken into account. The sounds were received by means of specially constructed carbon-granule microphones, those for use near the gun being of unusually rugged construction, while others were of a very sensitive type. The records were made by a specially constructed moving-film camera in connection with a string-galvanometer capable of recording from six stations simultaneously, of the type used by the U.S. Army for sound-ranging. Meteorological observations were made by special observers in the distant stations and on the field near the guns at the time of the experiments, and continuous records were made at the Proving Ground Headquarters and at the United States Weather Bureau Station. These observations covered temperature, barometric height, humidity, wind velocity, and wind direction. Measurements were also made of the velocity of the sound at a series of stations located on a line at right angles to the line of fire and on a line at 45° to one side of the line of fire. Heretofore there has been a general

impression that explosive sounds travel much farther than do ordinary sounds, the velocity being, perhaps, several times the normal velocity. These experiments show conclusively that the velocity at a distance of 100 ft. from a 10-in. gun is about 1240 ft. per second, or 22 per cent. above normal; at 200 ft. from the gun the velocity is only about 5 per cent. above normal. For all distances above 500 ft. from the gun the velocity of the explosive sound from the largest-sized gun is practically normal.—Dr. H. C. **Hayes**: The U.S. Navy MV-type of hydrophone as an aid and safeguard to navigation.—Dr. A. E. **Kennelly**: The transient process of establishing a steady alternating electric current on a long line from laboratory measurements on an artificial line. It is known that the current and voltage do not build up steadily and continuously, but advance by little jumps which occur at regular short intervals of time, accompanying successive reflections of electromagnetic waves from one end of the line to the other. There is presented in this paper a number of observations which have been secured photographically of the rise of voltage and current on a long artificial electric power transmission line in the laboratory, and have compared the observed rates of growth with those which are indicated by theory with a fairly satisfactory agreement.—N. W. **Akimoff**: The strephoscope.—Prof. R. S. **Dugan**: New features in the eclipsing variable U Cephei. (Prof. W. B. Scott, president, in the chair.)—Prof. E. N. **Harvey**: Animal luminescence and stimulation. The production of light by animals is due to the burning or oxidation of a substance called luciferin in the presence of an enzyme or catalyst called luciferase. Light production by animals differs from light produced by combustion in that the oxidation product of luciferin, oxyluciferin, can be easily reduced to luciferin, which will again oxidise with light production. The reaction is reversible, and appears to be of this nature: luciferin + O $\rightleftharpoons$ oxyluciferin + H_2O. The difference between luciferin and oxyluciferin lies probably in this: that the luciferin possesses two atoms of hydrogen, which is removed to form H_2O when the luciferin is oxidised. The H_2 must be added to re-form luciferin. Not only is it most efficient so far as the radiation (being all light) it produces is concerned, it is also most economical so far as its chemical processes are concerned. The above reactions can be demonstrated in a test-tube with a mixture of oxyluciferin, luciferase, and ammonium sulphide. The ammonium sulphide is probably represented in living cells by reducing enzymes or reductases. If such a test-tube is allowed to stand, oxyluciferin is reduced to luciferin, which will luminesce only at the surface of the fluid in the test-tube in contact with air. When the tube is agitated so as to dissolve more oxygen of the air, the liquid glows throughout. Even a gentle knock or "stimulus" to the tube is sufficient to cause enough oxygen to dissolve to give a momentary flash of light which is strikingly similar to the flash of light given by luminous animals themselves on stimulation. This suggests that when we agitate a luminous animal, or when the luminous gland-cells of a firefly are stimulated through nerves, with the resultant flash of light, in each case the stimulus acts by increasing the permeability of the surface-layer of the cells to oxygen. This then upsets an equilibrium involving the luciferin, luciferase, oxyluciferin, oxygen, and reductase within the cell, with the production of light and the formation of more oxyluciferin. So long as the luminous cell is resting and unstimulated, the tendency is for reduction processes to occur and luciferin to be formed. It must be pointed out that not all sorts of stimulation can be explained in this way, as the stimulation of muscles or nerve-fibres may take place in the complete absence of oxygen.—Prof. G. H. **Parker**: The phosphorescence of Renilla. During the day Renilla cannot be excited to phosphoresce, but at night on stimulation it can be made to glow with a beautiful golden-green light. The light is produced in wave-like ripples that spread out from the spot stimulated and run over the upper surface of the animal. They travel at a relatively slow rate that agrees with that at which the nervous impulses of the animal travel. Hence it is concluded that the phosphorescence of Renilla is under the control of the nerve-net of the animal, which apparently pervades the whole colony.—Prof. W. M. **Wheeler** and I. W. **Bailey**: Feeding habits of Pseudomyrmine ants. Examination of the mouth of the larva reveals a singular hitherto undescribed organ, evidently used for reducing the food-pellet to such a finely divided state that it can, when acted upon by the digestive juices of the stomach, yield a certain amount of nutriment which the worker-ant could not extract from it while it was in the infrabuccal pocket. This larval organ may be called the trophorhinium. In all Pseudomyrmine larvæ, and in many larvæ of the other sub-families, except the Dorylinæ and Cerapachyinæ, the trophorhinium is beautifully developed, although in many ants (Ponerinæ) it must be used for comminuting parts of insects given directly to the larvæ by the workers. In its development the trophorhinium bears a strange resemblance to the stridulatory organs of the petiole and post-petiole of many adult ants.—Dr. A. E. **Ortmann**: Correlation of shape and station in fresh-water mussels. It has been found that for certain species more swollen specimens are found down-stream in the larger rivers and more compressed specimens more up-stream, and that in the intermediate stretches of a river these extremes are connected by gradual transitions.—Prof. H. F. **Osborn**: Evolution principles deduced from a study of the even-toed Ungulates known as Titanotheres.—Prof. W. B. **Scott**: The Astropotheria.—B. F. **Howell**, jun.: The Middle Cambrian beds at Manuels, Newfoundland, and their relations. These beds are of special scientific interest because they contain large numbers of unusually well-preserved fossils, which prove that the creatures that swarmed in the waters then covering much of what is now New England, south-eastern Canada, and south-eastern Newfoundland were of practically the same sort as those living in the seas which at the same period washed over many parts of Scandinavia and the British Isles. North America has probably been joined to Europe in this way several times in the geological past, so that the animals living in the coastal waters could spread from one hemisphere to the other.—Prof. W. H. **Hobbs**: (1) The Michigan meteor of November 26, 1919. (2) The glacial anticyclone and the blizzard in relation to the domed surface of continental glaciers.

ROME.

Reale Accademia dei Lincei, March 7.—A. Róiti, vice-president, in the chair.—Q. **Majorana**: Gravitation, viii.—O. **Chisini**: Analytic representation of the fold of a surface by a series of fractional powers of two variables.—U. **Cisotti**: Integration of the equation of wave-motion in a deep canal, ii. The equation of the free surface is determined.—O. **Onicescu**: Newtonian fields in the neighbourhood of a given vectorial field. An application of Levi-Civita's notion of harmonics in the neighbourhood of an assigned function. The author deduces the lamellar and solenoidal magnetisation which gives rise to a given magnetic field, and applies the result to deal with the existence and unique nature of the magnetisation in soft iron.

—L. **Tonelli**: Researches on primitive functions, iii. —V. **Sabatini**: Leucitic lavas of the volcano of Roccamonfina. This deals mainly with the composition of the spurs, and particularly with the presence of leucite.—B. **Peyrouel**: A parasite of the lupin, *Blepharospora terrestris*. In December, 1919, plants of lupin were received infected with this parasite from Pantano and Pratolongo, near the Lake of Regillo. It appears to kill the plants, completely destroying the tubercles of the roots. The question is raised as to whether the parasite is of American origin, but the author considers it probably an indigenous type that has recently become destructive.—T. **Levi-Civita**: Harmonics in the neighbourhood of an assigned function. The problem is reduced to the determination of the Newtonian function having the given function as its density.—R. **Perotti**: Nitrogen of the cyanic group in manures. A contribution to the determination of the mechanism of action of cyanic nitrogen in vegetable nutrition and the conditions for its utilisation.—M. **Ascoli** and A. **Fagiuoli**: Sub-epidermic pharmacodynamic experiences, ii. The action of pituitrin is discussed. The limit of reactivity in normal subjects fluctuates about a dilution of 500. —L. **Cattolica**: Obituary notice of G. Dalla Vedova, professor of geography in the University of Rome.—Sig. **Baglioni**: The life and work of the late Luigi Luciani, professor of pathology at Parma from 1875 to 1880, and afterwards professor of physiology at Siena, Florence, and Rome in succession.

March 21.—F. D'Ovidio, president, in the chair.—Q. **Majorana**: Gravitation, ix. Gravitation may be partly absorbed by matter, and this absorption may give rise to heat. Bodies will then have two kinds of mass, apparent and real, and the real density of the sun will then be three times its apparent or astronomical density. An experimental test is being arranged at Turin for studying the action of 100 quintals of lead on a small central mass.—O. **Chisini**: Contact of curves of diramation for an algebraic function of two variables.—M. **De Angelis**: Crystalline forms of nitrodichloroacetanilide. This substance is dimorphic, modifications α and β both being monoclinic and prismatic, the former with $a:b:c=1{\cdot}1507:1:1{\cdot}1348$ and $\beta=66°\ 23'$, the latter with the values $1{\cdot}5792:1:1{\cdot}0952$ and $62°\ 23{\cdot}5'$. The second form is decidedly unstable, and when left in the mother-solution, or even dried, it transforms in time into an aggregate of crystals of the stable phase.—R. **Perotti**: Measure of the ammoniating power of soils. The best conditions for employing the method of solutions are 10 c.c. solution of peptone of 1·5 per cent. in test-tubes, adding 5 c.c. of a mixture formed of 50 grams of earth in 500 grams of water; cultivation for four days in a thermostat at 20°–25° C., and determination of ammonia by distillation on oxide of magnesia.—M. **Ascoli** and A. **Fagiuoli**: Sub-epidermic pharmacodynamic experiences, iii. Certain alkaloids, such as atropine, pilocarpine, muscarine, physostigmine, morphine, eserine, nicotine, cocaine, and scopolamine, which offer a cutaneous reaction of œdematogenous type, are referred to.

Books Received.

The Theory of Electric Cables and Networks. By Dr. A. Russell. Second edition. Pp. x+348. (London: Constable and Co., Ltd.) 24*s*. net.

Wild Creatures of Garden and Hedgerow. By Frances Pitt. Pp. ix+285. (London: Constable and Co., Ltd.) 12*s*. net.

Every Boy's Book of Geology. By Dr. A. E. Trueman and W. P. Westell. Pp. 315. (London: R.T.S.) 6*s*. net.

The Fall of the Birth-Rate. By G. Udny Yule. Pp. 43. (Cambridge: At the University Press.) 4*s*. net.

Kritik der Abstammungslehre. By Prof. J. Reinke. Pp. v+133. (Leipzig: J. A. Barth.) 13 marks.

History of the Theory of Numbers. By Prof. L. E. Dickson. Vol. ii., Diophantine Analysis. Pp. xxv+803. (Washington: Carnegie Institution.)

An Introduction to the Study of Hypnotism: Experimental and Therapeutic. By Dr. H. E. Wingfield. Second edition. Pp. viii+195. (London: Baillière, Tindall, and Cox.) 7*s*. 6*d*. net.

Industrial Colonies and Village Settlements for the Consumptive. By Sir German Woodhead and P. C. Varrier-Jones. Pp. xi+151. (Cambridge: At the University Press.) 10*s*. 6*d*. net.

A Handbook of Physics and Chemistry. By H. E. Corbin and A. M. Stewart. Fifth edition. Pp. viii+496. (London: J. and A. Churchill.) 15*s*. net.

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