

regarded as evidence in favour of those rocks being older than the rocks of the Krol belt.

As regards the time of the intrusion of the gneissose granite which is found in the Jutogh series, and similar granites elsewhere (the Central Himalayan gneiss of Stoliczka) Pilgrim and West, while refraining from expressing any definite opinion, except that it was probably pre-Chail in age and possibly Archæan, rejected McMahon's view that the intrusion took place during the Tertiary at the time of the upheaval of the Himalayas. Mr. Auden goes further, and puts forward reasons for supposing the intrusion to have taken place

during the Palæozoic, suggesting that it occurred in connection with certain crust movements which he suggests took place in pre-Krol times, along a line coincident with the line of the old Aravalli mountains if continued northwards into the Himalayas.

Other aspects of the geology, mostly relating to the lithology of the rocks, are described in detail. But enough has been said to show the importance of this paper in throwing further light on the structure of the Himalaya. It is accompanied by a map of great beauty, which does credit alike to the author who made it, and to the Survey of India who printed it.

W.

Research Notes.

Singular Solutions of Ordinary Differential Equations of the Second Order.

THE methods of obtaining the Singular Solutions, which are applicable when a given differential equation or one of its first integrals involves irrational or transcendental expressions, are described by Srinivasiengar in an important paper published in the *Jubilee Memorial Volume* (Vol. 20) of the Indian Mathematical Society.

In Part II of the same paper the author has discussed a number of topics of interest. Several illustrations of differential equations which possess, what the author calls *incomplete primitives*, are given and the readers are cautioned against calling the *residual primitive* as singular solutions. The author disagrees with the existing theory about Singular Solutions of the second order, and explains how *any singular solution of the equation $w(x, y, y')=0$ will satisfy the original equation $F(x, y, y', y'')=0$ in a large number of cases ($w=0$ being the equation giving Singular Solutions of the first order)*. A new method of obtaining the osculants of the system $f(x, y, a, b)=0$ is also given.

Envelopes of Systems of Surfaces.

IN a paper published in the *Tohoku Mathematical Journal* (39, Part I) Srinivasiengar has discussed the methods of obtaining the envelopes of singly infinite and doubly infinite systems of surfaces, when the equations of these systems may contain irrational or transcendental expressions. The

results centre round the following theorem, which is proved in the paper:

If one or more of the first partial derivatives of $f(x, y, z)$ become infinite in virtue of $\phi(x, y, z)=0$, the two surfaces $f=0$, $\phi=0$ touch each other all along their curve of intersection (except in very special cases).

Among the corollaries of this result, the following may be particularly mentioned:

If $E=0$ denotes the envelope of the first species of the system of surfaces $u(x, y, z)=a$, it will also be an envelope of the first species of the system $\phi(u, v)=a$, where ϕ is any holomorphic function of u and v , and where none of the first partial derivatives of v becomes infinite in virtue of $E=0$.

"Showers" of Positive and Negative Electrons.

PERHAPS the most beautiful phenomenon revealed by the application of Wilson's cloud chamber method to the study of cosmic radiation is the occurrence of "showers" of positive and negative electrons apparently emanating from a point in the neighbourhood of the cloud chamber. In the *Proc. Roy. Soc.* for May, C. W. Gilbert describes the results of his experiments on the production of these showers. The investigations were carried out by him in Switzerland at three different heights above sea-level—3500 metres (Jungfranjoch), 2300 metres (Eigergletscher) and 500 metres (Zürich). Using three Geiger-Müller counters, he investigated the simultaneous coincidences in the three counters caused by the presence

of varying thicknesses of lead screen placed above and below the counters. He finds that with increase of height, the number of showers increases at about the same rate as the intensity of general cosmic radiation. From a comparison of the absorption of the shower-producing radiation and of the general cosmic radiation, Gilbert concludes that the two are not identical. There are thus at least three types of rays associated with cosmic radiation: (1) primary radiation in all probability consisting of charged particles with excess of positive and having an energy of the order of 10^{10} electron-volts as shown by the variation of cosmic ray intensity with latitude, (2) shower-producing radiation of unknown kind, perhaps of the ν -ray type, and (3) shower particles consisting of positive and negative electrons with energies of the order of 10^3 electron-volts and originating simultaneously in the field of the nucleus of atoms.

K. R. R.

A High Intensity Mass-Spectrometer.

THE isolation of isotopes in the case of elements available in a gaseous form has been achieved by Hertz and his method has been described in these columns (*Curr. Sci.*, 1932, 1, 173). The separation of the isotopes of solid elements, however, has not been a success so far. W. R. Smythe, L. H. Rubaugh and S. S. West (*Phys. Rev.*, 1934, 45, 724) now describe a form of mass-spectrometer designed by them to achieve the above object. The essential part of the instrument is a new form of pole piece which serves as a magnetic lens. Both boundaries of either pole piece are formed by two circles passing through the origin of coordinates, one of them having its centre on the Y-axis (which is parallel to the original direction of motion of the positive rays) at the focal point C, while the centre of the other is at a distance r to the right of C, where r is the radius of curvature of the trajectories in the field. In order to have an intense parallel beam of positive rays, a concave cylindrical electrode, machined out of an iron block and having only some parts covered with emitting material, was used as the source of the rays and a slit with bevelled edges was used, its width and level as well as its distance from the emitter being adjusted to be suitable to the curvature of the electrode. Two focusing bars were also used to correct any errors in these adjustments.

The heating elements consisted of 35-mil molybdenum wires wound on 8 mm. Stupakoff tubing passed through two large holes in the source block which was surrounded by a water-jacketed copper box at the same potential. The source could attain 1450°K when the iron evaporated noticeably but without permanent injury, and was found suitable for several Kunsman catalyst alkali metal emitters. The accelerating potential was taken from a 6000 volt, 10 Kw. D.C. generator which was found to be very steady.

The receiving arrangement was a vacuum-tight cylindrical box with two slits; the position and width (1 mm.) were adjusted so as to coincide with the focus regions of the two isotopes of potassium which was the metal studied. The collectors were placed behind the slits. With an ion current of 0.1 milliamp., about a milligram of K_{39} was obtained in 7 hours. Samples of K_{41} for radioactive work are reported to be under preparation.

Negative Protons and Nuclear Structure.

ARGUING from the discovery of the positive counterpart of the electron, *viz.* the positron, and from the fact noted by Williams (*Phys. Rev.*, 1934, 45, 729) that some of the negative particles present in cosmic radiation correspond to a protonic mass, Gamow (*Phys. Rev.*, 1934, 45, 728) infers that there may be a number of negative protons amongst the constituents of nuclei, the neutron being then considered as made up of a positive proton and a negative electron or a negative proton and a positive electron. Consideration of the stability of nuclei on lines similar to those adopted by Heisenberg leads to the conclusion that the exchange forces between positive and negative protons form a repulsive system. Some modifications in the previous theory necessitated by the introduction of negative protons are expected to bring the calculation of limits of stability of nuclei into better agreement with experiment. Another consequence of the new idea is the possibility of existence of isomeric nuclei, *i.e.*, nuclei of the same charge and mass but of different constitution. The radioactive element UZ (found by Hahn) is regarded as an isomer of UX_2 , this view providing an explanation for the fact that UX_1 disintegrates into UX_2 or UZ with a β -transformation although UX_2 has

no tendency to change into UZ, but both disintegrate to form UII.

Tooth Structure and Vitamin-C Deficiency.

WILFRED FISH AND LESLIE HARRIS in a recent contribution (*Phil. Trans. Roy. Soc. Lond.*, 1934, B. 502, 489) have presented the results of their investigations on the teeth and jaws of guinea-pigs suffering from acute full scurvy, chronic sub-scurvy, developing scurvy, curing scurvy, and complications due to other dietary deficiencies. The authors have given a new interpretation of the dental abnormalities seen in vitamin C deficiency, the "Pulptone" theory being rejected and the difference between the appearance of the tooth in scurvy and sub-scurvy accounted for. A theory is advanced as to the mode of action of vitamin C, which is regarded as a primary necessity for maintaining the functional activity of certain types of cells, including odontoblasts, osheoblasts, ameloblasts, etc.; other effects of vitamin C deficiency are physiological sequelæ of this primary action. Attention is also directed to the practical importance of the disorders in the enamel and cementum, overlooked by past workers.

The Segmentation and Chondrification of the Skull of the Duck.

IN an exceedingly interesting paper (*Phil. Trans. Lond.*, 1934, B. 502) Barrington and de Beer have described the segmentation and chondrification of the skull of the duck. The object of this paper has been to clarify some obscure points in the development of the skull. The authors have attempted successfully to explain why the planum sphenolaterale separates the first and second branches of the V-nerve and why the 9th and 10th nerves are separated by a cartilage and also the abnormal passage of the olfactory nerves and carotid arteries and the homology of the turbinates. Barrington describing the segmentation, points out that the skull consists of $9\frac{1}{2}$ segments of which $6\frac{1}{2}$ are metotic. The part on the chondrification of the skull is contributed by de Beer. The author very clearly describes the occipito-atlantic joint in the vertebrates generally and notes that the formation of the condyle in squamata (which resembles the mammals) is different from that of Crocodile, Chelonia and birds. A reference to the occurrence of the 'proatlas' arch is also

made. At the end, the phylogeny of the amniota is briefly described from the viewpoint of chondrification. It is said that a stock in the Amphibia with an inter-segmental occipito-atlantic joint gave rise to Sauropsidan and Theropsidan branches. In the latter branch the inter-segmental type of joint persisted while in Chelonia, Crocodalia and Squamata alone the joint became intrasegmental.

Endocranial Cast of Sinanthropus.

A NOTABLE contribution to our knowledge of the remarkable fossil man of China is made by J. L. Shellshear and G. Elliot Smith (*Phil. Trans. Roy. Soc.*, B. 503, pp. 469-487). The endocranial cast of Sinanthropus is perhaps the best preserved of all the fossil men known and lends itself to a comparison with the actual brains of modern men. It is undoubtedly clear from the examination of this cast prepared by Late Prof. Davidson Black that we are dealing here with a remarkably primitive brain. The occipital region is identical with that of the apes and a comparison with the brain cast of Pithecanthropus reveals that Sinanthropus is more primitive and in an earlier stage of evolution. A precocious expansion of the posterior end of the second temporal convolution and the orbital margin of the frontal territory are noticeable. There is again a precocious expansion of the lower parietal area and a pushing forward of the pole of the temporal region. An important peculiarity is the remarkable degree of symmetry between the two cerebral hemispheres, which is a very rare feature in the human brain.

Differentiation in Basaltic Magmas.

A VERY important paper on "Trends of Differentiation in Basaltic Magmas" is published by W. Q. Kennedy in a recent number of the *American Journal of Science*, 1933, 25, pp. 239-56) in which certain ideas previously published by the author in his paper on "The Parent Magma of the British Tertiary Province" have been further developed so as to include basaltic rocks in general. As a result of these studies it has been shown that the two main basaltic magma-types—the Olivine-basalt Magma-Type and the Tholeiitic Magma-Type—are both of world-wide distribution and fulfil the conditions of primary magmas.

It is therefore suggested that we must recognise that these two are distinct parent basaltic magmas, each of which has its own independent line of descent. There is no evidence for supposing the existence of a common source for these two basaltic magmas nor is there any reason to infer that either of them is a derivative from the other.

Crush Conglomerates of Dharwar Age.

IN a recent number of the *Rec. Geo. Sur. Ind.* (67, Pt. 4) Dr. M. S. Krishnan has published a short paper on "Some Crush Conglomerates of Dharwar Age from Chota Nagpur and Jabulpore" in which he has given a petrographic account of some crush

conglomerates which he has noticed in the Gangpur State of Bihar and Orissa and in the Jabulpore District of the Central Provinces, and compared these with the 'auto-clastic conglomerates' described elsewhere in India. The author recognises the fact that "the criteria for distinguishing autoclastic from crush conglomerates of sedimentary origin are generally difficult of application in the field where highly folded and metamorphosed sediments are concerned." He is, however, of opinion that practically all the material described by him in the present paper are undoubtedly conglomerates of sedimentary origin, although in some places the sedimentary characters have been obscured by intense shearing and crushing.

Agricultural Education in India.

By Keshava Sharan Agarwala, M.Sc., LL.B.

IN a predominantly agricultural country like India where the vast majority of the population lives on agriculture, the importance of agricultural education cannot be over-emphasised. The need for it has been fully realised by the Government of India and the Provincial Governments and much has been done in this direction in recent years in the form of practical demonstration and propaganda on Agricultural farms and by providing facilities for higher education in agriculture. Besides the Agricultural Research Institute at Pusa and the Imperial Institute of Animal Husbandry and Dairying at Bangalore, which provide post-graduate training and research facilities in agricultural science and for which the Government of India is responsible, the provinces have their own agricultural colleges teaching diploma and degree classes. In addition to these agricultural colleges, some of the Indian Universities have also recently instituted B.Sc. courses in agriculture.

The collegiate education in agriculture is no doubt very useful and necessary, but even at the best, only a very small portion of the population can hope to obtain it. Moreover, the graduate coming out of the agricultural college, as a rule, seeks Government or other employment instead of taking up practical farming where he could give the fullest benefit of his advanced education to the country's agriculture. For the rural masses, considering their number as well as their gross illiteracy, what is required is a type of general agricultural education of a school standard and imparted through the vernacular medium of instruction. There should be established agricultural schools all over the country so that the children of the agricultural classes may freely join them after the necessary vernacular education and learn the up-to-date methods of cultivation and the use of new implements, etc., under trained teachers in a course of 3 to 4 years just to suit

their practical needs. These schools will provide the country with a set of young men who will take up the cultivation of land according to modern agricultural methods.

There are very few agricultural schools at present in India and there is a definite demand in the country for more schools of this type. Unfortunately, the recommendation of the Royal Commission on Agriculture to the effect that there should be no extension of such schools greatly retarded their growth. Time has, however, amply proved the immense utility of such institutions and the Provincial Governments are also recognising their usefulness. In this connection, it is gratifying to note the decision of the Bombay Government to continue the two farming schools in the presidency, the abolition of which was recommended by the Thomas Reorganisation Committee. The Government have, however, decided to effect economies in the working of these schools. It may be mentioned that in the case of educational institutions, economies are effected either by curtailing their activities by staff reduction or by increasing the fees. None of these methods should be adopted in this case since there is necessity for opening more schools and also for popularising them by fixing the fees as low as possible so as to bring them within the reach of the rural masses.

It might be pleaded that in these days of financial stringency, much attention and money cannot be devoted to agricultural education. It must not, however, be forgotten that the interest of the whole country is at stake in agriculture and that agricultural education is a necessity if the country is to have the fullest benefit of its agricultural industry. Its development will undoubtedly lead to greater prosperity and a bright future. The educational activities about agriculture therefore require extension and should on no account be curtailed.