

Research Notes.

**The Longest Convex Curve Described
about a Convex Polygon.**

MAYER (*Crelle's Journal*, Bd. 174, Heft 3, pp. 125-128) has solved this interesting problem by means of a very simple analysis. First of all, for a triangle, a quadrilateral, and for all polygons for which the sum of any two consecutive angles is $< \pi$, there are convex curves circumscribing them of as great a length as we like. Therefore, the problem will be of interest for all polygons which do not belong to the above category;

i.e., if $p_1 p_2 \dots p_n p_1$ is the polygon $p_i + 1 p_i$

and $p_{i-2} p_{i-1}$ should meet when they are produced in the way that is indicated; let the triangle that is obtained by adding $p_{i-1} p_i$ as a side be denoted by D_i . If K is the polygon, then it is obvious that the perimeter of every circumscribed convex curve is $<$ that of the polygon (not convex of course) $K + \sum D_i$. Hence, the existence of the curve follows. (By means of a procedure analogous to the proofs of the classic results in the theory of normal family of functions.) By means of a nice elementary geometrical analysis he has proved that the convex curve is found among the polygons $M = K + \sum \epsilon_i D_i$ ($\epsilon_i = 0$ or 1). It is obvious that the following conditions should be satisfied (1) $\epsilon_i = 1$, then $\epsilon_{i-1} = \epsilon_{i+1} = 0$. (2) If $\epsilon_{i-1} = \epsilon_{i+1} = 0$ then $\epsilon_i = 1$; so that the number of different polygons among which we have to search for the longest is appreciably less than 2^n . If $g(n)$ is their number then it is easy to show that $g(n) = g(n-2) + g(n-3)$ (formally put $g(-1) = -1, g(0) = 3, g(1) = 0$).

K. V. I.

**Class-Number Relations of Binary Quadratic
Forms in Quadratic Fields.**

LUBELSKI (*Crelle's Jour.*, Bd. 174, Heft 3, pp. 160-184) has found out the number of classes of quadratic forms whose coefficients belong to an imaginary quadratic field $K(\sqrt{-q})$, (we assume that $q \geq 3$, throughout. He has also found out the corresponding relations for the Gaussian field) the number of ideal classes of which are odd. If H is the number of classes of quadratic forms with integral coefficients out of $K(\sqrt{-q})$ and discriminant $D = 4D'$ [D' quadrat-frei in $K(\sqrt{-q})$], and h and h' are the number of

classes of quadratic forms with discriminant D and $-qD$, respectively then $H \approx hh'$ or $2hh'$ according as $x^2 - Dy^2 = -1$ is solvable in natural numbers are not. In the first part of his work he has solved the problem for quadratic forms whose coefficients are integral ideals of $K(\sqrt{-q})$. The results in this case are mostly analogous to the classical results connecting ideal classes of $K(\sqrt{-q})$ and the rational quadratic forms with discriminant $-q$; we have to consider a relative quadratic field and ideal classes relative to $K(\sqrt{-q})$. Signifying as a real ideal class, a class in which the quadratic forms with integral numbers out of $K(-\sqrt{q})$ as coefficients, it is interesting to note that Lubelski has given examples of relative fields in which all the classes of quadratic forms with integral ideal coefficients are equivalent to the real classes alone.

In the second part, he proves the final result by means of a series of lemmas. A summary of the proof is the following. (Note that $q \geq 3$ and that the number of ideal class is assumed to be odd.) He has first of all considered quadratic forms of two types—the first type consisting of all quadratic forms of the form $ax^2 + bxy + cy^2$ and the second of the form $ax^2 + b\sqrt{-q}xy + cy^2$. (Discriminant D , a , b and c natural integrals.) He has shown that equivalence of the quadratic forms of the first type in the rational as well as in $K(\sqrt{-q})$ is the same. [This theorem is true even if the class-number of $K(\sqrt{-q})$ is even]; and if a form of the first type is transformable into a form of the second type in $K(\sqrt{-q})$, then the form should be equivalent to an *ambig* form and conversely. Next, he has shown that every quadratic form with rational coefficient and discriminant $-Dq$ can be transformed by means of a suitable transformation to one of the second type; and that the product of two forms of the first or second types are equivalent to forms belonging to the same type. By means of a lemma he has connected the equivalence of two forms of the second type with one of the first type with the reduction of the corresponding forms with discriminant $-Dq$ to the form $ax^2 + aqpxy + cy^2$ [$p = 0$ or 1]. Afterwards he has determined the number of non-equivalent forms which are products of a form of the first type and another of the second type in terms of h , h' and v , the odd

prime factors of D' . Next he has defined (analogous to the rational case) the characters of a class of quadratic forms; and he has determined the necessary and sufficient conditions in order that a quadratic form with coefficients out of $K(\sqrt{-q})$ is capable of representing natural numbers; first of all, it should be a product of two forms of the first and second types respectively. The second condition depends on characters (Norm-residue symbols of Hilbert). By means of these intermediate theorems the exact number of classes of quadratic forms, mentioned in the beginning is determined.

K. V. I.

An Apparent Failure of the Photon Theory of Scattering.

It is well known that A. H. Compton has explained the scattering of X-Rays by free electrons, assuming that the collision between an X-Ray photon and an electron would be governed by the principles of conservation of energy and momentum. One of the consequences of this photon theory of scattering is that the recoil electron and the scattered photon should appear at the same instant. R. S. Shankland (*Phys. Rev.*, 49, 8) has examined whether this coincidence is true in the region of incident γ -ray quanta. He employed specially constructed Geiger-Müller tubes in two directions for the recoil electrons and the scattered photons respectively, such that the angle between the directions is given by the photon theory of scattering. He also chose the directions of the counters at different angles. Providing necessary arrangements to record coincident discharges in the electron and the photon counters and employing γ -rays from radium-C, he found that the observed coincidences are quite small compared with the expected coincidences and also that the observed coincidences are rather due to the scattered γ -ray quanta entering the electron counters and discharging secondary electrons from the counters. Thus Shankland opines that there are no genuine coincident discharges at all. In reviewing Shankland's results, Dirac (*Nature*, 136, 298) seems to think that they demand a revision of the theory of the interaction between matter and radiation without perhaps the principles of the conservation of energy and momentum.

N. S. N.

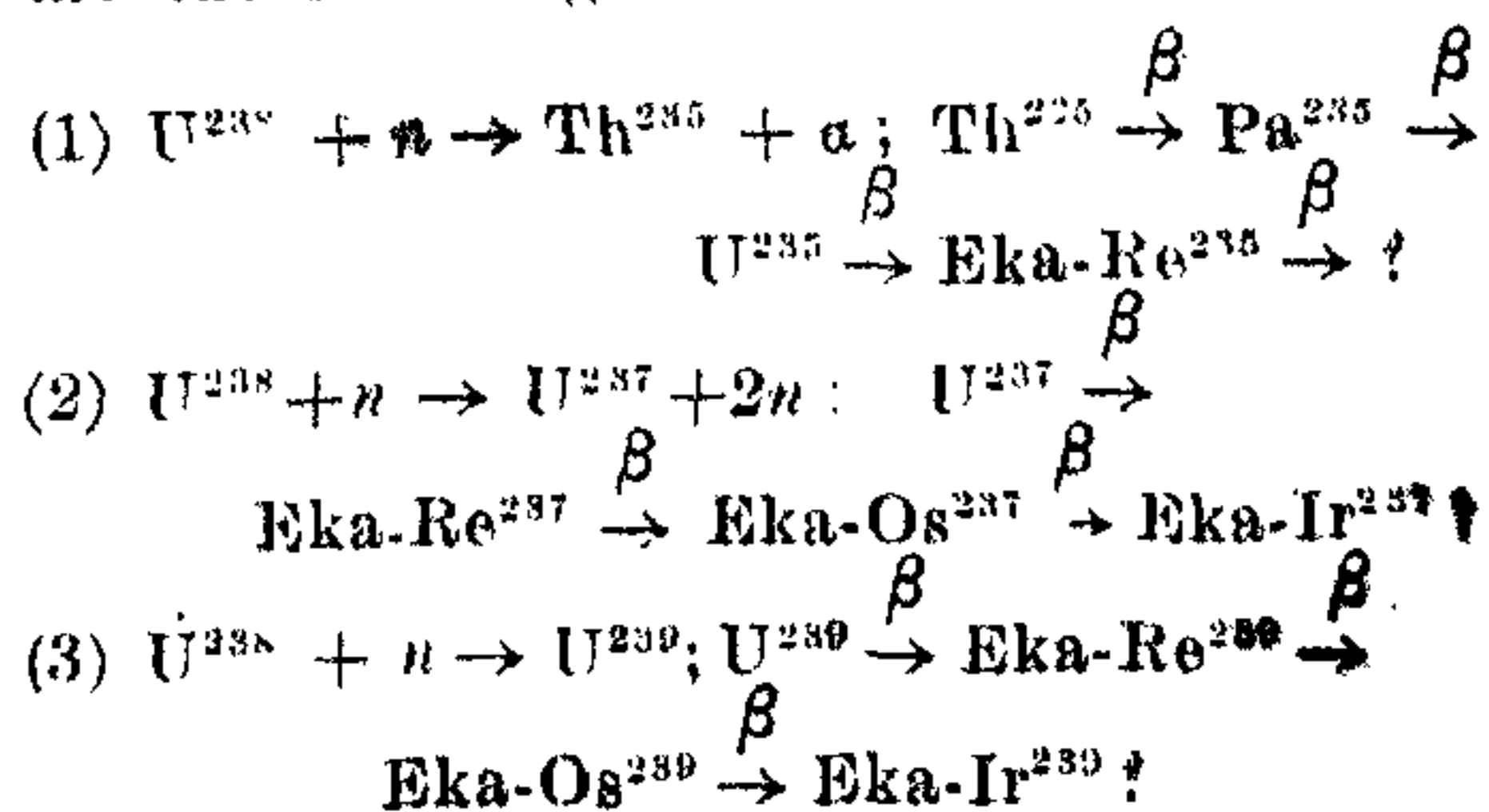
Raman Effect in Chemical Dynamics.

IN the March number of *Physica*, p. 154, W. F. Buzhold and L. S. Ornstein present an interesting report of the applications of Raman spectra methods to a study of chemical reactions, such as the oxidation of transformer oils and the photo-chemical chlorination of chloroform to carbon tetrachloride. A calibration curve for the latter was drawn up by plotting the intensities of the carbon tetrachloride Raman lines against the amount of carbon tetrachloride present in a mixture of chloroform and carbon tetrachloride. The graph was a straight line. The experimental results are discussed in great detail in relation to the dynamics of the reaction. It is suggested that highly unstable chain products could be detected by Raman spectra, as unlike the ultra-violet and infra-red absorption spectra, the former is an integrating effect.

M. A. G. RAU.

New Radioactive Transformations produced by Bombardment of Uranium by Neutrons.

THE discovery of trans-uranic elements by Fermi and his co-workers and its confirmation by Meitner have already been noticed in *Curr. Sci.*, 1935, 3, 376. Meitner and Hahn have recently studied the various products obtained by bombarding uranium with neutrons and by comparing the activities produced by fast neutrons and slow neutrons (slowed down by passage through paraffin) they have reached interesting conclusions regarding the processes that occur (*Naturwiss.*, 1936, 24, 158). The radioactive properties of elements 93 (Eka-Re), 94 (Eka-Os) and 95 (Eka-Ir) have been thus determined. The processes envisaged as leading to the production of these elements are the following:



The following table summarising their results is taken from their paper.

Atom	Half-value period	Produced by
Th ²³⁵	4 min.	Slow neutrons
Pa ²³⁵	Very short?	Slow "
U ²³⁵	24 ± 2 min.	Slow "
U ²³⁷	40 sec.	Fast "
U ²³⁹	10 sec.	Better by slow "
Eka-Re ²³⁷	16 ± 1 min.	Fast "
Eka-Re ²³⁹	2.2 ± 0.2 min.	Better by slow "
(Eka-Os ²³⁷)?	12 hrs.	Fast " ?
Eka-Os ²³⁹	59 ± 2 min.	Better by slow "
(Eka-Ir ²³⁹)?	3 days	?

T. S. S.

On the Structure of Cosmic Radiation.

THE nature of the radiation which gives rise to the showers observed by Blackett and Occhialini has been a somewhat disputed question. The primary cosmic radiation is now accepted to be corpuscular and is denoted by the letter A in Geiger's notation. The shower-producing radiation seems not directly to produce ionisation and may be some kind of γ -radiation. Whether it is a B-radiation, i.e., one produced directly by the primary A-radiation, has not been so far settled. Now R. Hilgert and W. Bothe (*Zs. f. Physik*, 1936, **99**, 353) describe experiments which show that the shower-producing radiation is a B-radiation produced in the matter near the earth. Besides this they show that this B-radiation itself comes in the form of bundles so that it is now clear why it should produce showers. The experimental method was to count the number of double coincidences recorded by two counters kept side by side when a lead sheet was placed above one or the other of them and when lead sheets were placed over neither or both. The radiation was allowed to fall on the lead sheets once directly and once after passage through a carbon filter. It was found that when the radiation had first passed through the carbon, the increase in the number of coincidences observed with lead sheets on

both counters was much larger than the sum of the increases observed when one or the other counter had a lead sheet over it. When the radiation fell directly, however, the increase in the number of coincidences due to a lead sheet on either counter was much larger than before but the increase when lead sheets were placed over both counters was simply the sum of the increases due to each sheet separately. These results are explained by assuming that the shower-producing radiation must have started in bundles from a distance corresponding to its range. When the carbon filter was employed the bundles should have come from somewhere near the filter and thus fallen in almost parallel paths on the two lead sheets simultaneously producing showers therein. When the radiation came directly, however, it should have started at a much larger distance corresponding to the range in air, so that the bundles would have diverged sufficiently not to fall simultaneously on the two lead sheets. This explanation was further confirmed by observing quadruple coincidences with four counters, one pair of which was above the other.

T. S. S.

Atomic Weight of Gallium.

LUNDELL AND HOFFMAN (*J. Research of the National Bureau of Standards*, October 1935), starting with a quantity of metallic gallium, previously prepared by one of the authors and the purity of which was estimated to be at least 99.999 per cent., have determined its atomic weight.

Known quantities of this very pure metal were dissolved and converted into the hydroxide, sulphate, and the nitrate, these salts being subsequently ignited to the oxide and weighed. This procedure enabled the calculation of the atomic weight of gallium with direct reference to that of oxygen.

The suitability of metallic gallium as well as that of its oxide for work of this type was established after a careful exploration of the sources of error which were likely to occur, and these included, (a) occluded gas in the metallic gallium employed, (b) oxide film on the metal, (c) presence of minute traces of chlorides in the metal, (d) constancy in weight of gallic oxide after ignition and its hygroscopicity, (e) occluded gas in the

ignited gallic oxide, and (f) constancy in weight of platinum crucibles when heated for long periods at 1200–1300° C.

The averages of the three sets of values obtained from the experiments with the hydroxide, nitrate and the sulphate were respectively 69.73₇, 69.73₅, and 69.73₇. The rounded value 69.74 is therefore put forward for the atomic weight of gallium.

K. R. K.

Vitamin B₆.

IMPORTANT studies on that part of the Vitamin B₂ complex which is responsible for the cure of the specific dermatitis developed by young rats fed on Vitamin B-free diet supplemented by purified Vitamin B₁ and lactoflavin, have been reported from the Cambridge University, by Birch and György (*Biochem. J.*, 1936, **30**, 304). In fish muscle and wheat germ this Vitamin appears to be attached to a protein as a prosthetic group and for quantitative extraction, it is necessary to autolyse the tissue digest with papain. The Vitamin is not precipitated by salts of lead, mercury or silver, or by picric acid, but is precipitated by phosphotungstic acid; it is soluble in ethyl alcohol but is not extracted from a concentrated watery solution by acetone, amylalcohol or ether. Fuller's earth adsorbs the Vitamin from acid solutions, and during electro-dialysis it migrates towards the cathode. Vitamin B₆ appears therefore to be of a basic nature, and, from the fact that it can be inactivated by benzoylation but not by the action of nitrous acid, it is suggested that it does not contain a primary amino-group, but that it possibly possesses a hydroxyl group.

Hastening Germination of Acacia Seeds by Soaking in Boiling Water.

EXPERIMENTS reported in the *Agricultural Gazette of New South Wales*, **47**, Part I, show that for effective and rapid germination in the case of certain acacias (*Acacia Baileyan*, *Acacia aneura*, and *Acacia elata*) soaking in boiling water is found very satisfactory. In the case of the first it was found that even six years old seed will not germinate unless the hard outer coat is softened by intense heat. Untreated seed was compared with (1) seed soaked in cold water for thirty minutes, (2) seed soaked in cold water and the water then brought to

the boiling point, (3) water brought to the boiling point and seed immersed and allowed to remain for ten minutes with the heat turned off, and (4) seed placed in boiling water and boiling continued for ten minutes. It was found that the germination in the last three treatments was from 80 to 90 per cent. while the cold water soaking and the control gave less than 10 per cent. It also made very little difference if the seed was only two years old or was six years old.

Cement Concrete for Grain Storage Bins.

QUITE a useful application of cement concrete construction in agriculture is its use for the construction of underground grain bins or granaries. (N. C. Mehta in the *Agriculture and Livestock in India*, **6**, Part I.) The very primitive but, at the same time, very general practice of storing grains like *ragi* and *jola* in underground straw-lined pits common in Mysore has its counterpart in the storage of wheat in Upper India. Here, however, the storage is on a very large scale being adopted by the important and large grain merchants for the holding up of grain intended for sale; it is not the small domestic affair such as prevails in Mysore. Both are however subject to the same drawbacks in regard to damage and deterioration and especially where the soil is unsuitable or the season excessively wet. A loss of some four lakhs of rupees is reported during the very rainy year 1933 in the grain stores of Muzafarnagar, while the danger of the damaged grain getting into the hands of poor people and being used as food was an even more serious matter. The Concrete Association of India has taken up the matter and already some 200 cement storage cisterns are said to have been constructed for the grain merchants of that large trade centre. The cost per 100 cubic feet of storage space is put down at about Rs. 33, with cement at Rs. 52-8-0 per ton, sand and single at Rs. 20 per ton each. While for the grain trade the regular well-equipped grain elevators usual in other countries will be the most suitable type of large-scale storage bins designed to meet modern conditions of transport, these underground concrete cisterns are certainly a great improvement and will suit the needs of the smaller individual trader. For the ordinary cultivator too it is a desirable improvement to adopt and does not appear too costly.

Studies on the Nature of Disease Resistance in Cereals.

APPLICATION of nitrogenous fertilisers has been recognised to increase severity of rust attack in cereals. It is maintained by Gassner and his co-workers in Germany that an increased supply of N, leads to an increase in the availability of protein in the plant, conducive to rust development. Johnson and Johnson (*Canadian J. Res.*, 1935, 13, 355) analysed mature and immature tissues of the wheat plant to ascertain if the latter are richer in organic N than the former, as it is recognised that the immature tissues are more susceptible to stem rust than the full-grown tissues. Analyses of N in six varieties showed that the N-content was greater in the mature tissues than in the immature ones. The greater susceptibility of the younger leaves cannot be attributed to a higher organic N-content, unless it is assumed that the N is present in a more utilisable form than that of the older leaves.

In a previous paper, the authors showed that the young tissues were richer in sugars than the older ones (*Canadian J. Res.*, 1934, 11). It is concluded that the resistance of the mature tissues to rust cannot be explained on a purely nutritional basis.

M. J. N.

The Virus of Sugarcane Mosaic.

INTERESTING studies of the Sugarcane Mosaic Virus both in the laboratory and in the field are reported in the *Indian Journal of Agricultural Science*, 5, Part VI. A study of the physical properties by S. A. Rafay brings out that (1) like the crinkle mosaic of the potato the cane mosaic virus tolerates a 1 in 10 dilution and that by a dilution of 1 in 100 and above the virus entirely loses its potency; (2) it loses its potency in two hours in contrast with the spotted wilt of tomato which does so in six hours and the tomato mosaic virus which remains viable for years; (3) no infection is obtained with a filter paper filtrate or the Chamberlain candle filtrate, while the green residue left on the filter paper is infective; and (4) it is one of the most sensitive of viruses and shows the least resistance to chemical reagents; thus copper sulphate 1 in 1500, hydrochloric acid 1 in 1000, nitric acid 1 in 800, mercuric chloride 1 in 1000, sodium

chloride 1 in 25, hydrogen peroxide 1 in 25, and formalin 1 in 50, all inactivated the virus. It is noted with interest that an oxidising agent (hydrogen peroxide, Merck's) had no effect on the virus in 1 to 50 parts, while Johnson (1926) found even a resistant type like the tobacco mosaic virus to be sensitive to the inactivating effect of oxygen.

Field studies in the Punjab by J. C. Luthra and Abdus Sattar covering a period of three to six years show the following, viz., (1) only the primary symptoms, i.e., mottling of leaves occur in the Punjab and that the secondary symptoms, i.e., the dwarfing of the canes, etc., are not observed; (2) the amount of infection on any particular variety varies from place to place and that some varieties are more infected than others, observations having been made on about 45 varieties nearly all of them co-types; (3) the canes show the first symptoms about a month and a half after planting and that the infection goes on increasing till October; (4) in the variety Co. 223 (during three years' observations) no decrease in the yield of cane, juice or gur occurred as the result of mosaic nor was there a deterioration in the quality of the juice; and (5) that roguing can keep the disease within limits in those varieties only which are not very susceptible to mosaic.

Detergent Action of Soluble Silicates.

SILICATE solutions have been used as cleansing agents in a variety of ways, and the advantages of employing soluble silicates is of great importance to those interested in detergent technique. The different aspects of this problem has been studied by Vail in a recent paper (*Ind. Eng. Chem.*, 1936, 28, 294). The effect on the pH values of solutions by variation of the $\text{Na}_2\text{O} : \text{SiO}_2$ ratio, as also by changes in concentration, have been investigated. The advantage of employing sodium silicate for cleaning metallic surfaces at higher temperatures, without appreciable corrosion, has been pointed out. So far as bactericidal effect is concerned, silicate solutions are more effective than soaps. The silicate solutions are better deflocculating agents than soaps and their wetting power is also decidedly better. They are good emulsifying agents when mixed with soaps and are technically employed in the preparation of asphalt

emulsions. It is therefore clear that sodium silicate is no longer thought of as an adulterant to soap, but as a useful adjunct in improving its properties.

M. P. V.

The Skull of the Therocephalia.

A MINUTE study of the cranial characters of the mammal-like reptiles of the group Therocephalia forms the subject of an important paper by R. Broom (*Phil. Trans. Roy. Soc., Lond., B*, March 1936, 226, No. 529, 1-42). The study has been made by means of sections of these fossil forms all of which belong to South African Permian beds. The importance of this group cannot be overestimated as it is highly probable that the "line of mammalian descent passed through some members of the Therocephalia". The skull, which is remarkably like that of a mammal in structure, includes factors like heterodonty and a temporal arch formed of the jugal and the squamosal. But the differences are none the less striking. The place of the single median vomer of the mammal is taken in the Therocephalids by a pair of bones situated well behind and probably homologous with the dumb-bell-shaped bone of Ornithorhynchus. The quadrate is still a very pronounced bone and the lower jaw is still a compound structure.

Geological Aspects of Underground Water-supply.

IN discussing the underground water-supply of England in a series of three Cantor Lectures delivered at the Royal Society of Arts (*Journal of the Royal Society of Arts*, Feb. 1936, 84), Dr. Bernard Smith has shown that this water-supply is largely dependent upon rainfall, evaporation and percolation. The large quantity of water which percolates downwards is utilised partly by plants and mineral substances; but the greater portion is stored up under suitable conditions in rocks. The availability of this water depends upon several factors like porosity, perviousness and joints. Several rocks, such as coarse sandstone, clay and chalk, are highly porous and hence contain a large supply of water. The igneous rocks have an average porosity of only 1 to 2%, but yet such of them as are

highly jointed and fissured like the Indian basalts contain a steady supply of water as shown by Dr. Fox.

With the help of sketches, Dr. Bernard Smith has also referred to the development of Artesian wells and the factors which control the water-supply in them. The chief water-bearing strata of England are the Carboniferous limestone, millstone grit, coal measures, inferior oolites and great oolites. The geological factors which control the underground water-supply are faults, flexures and missing formations. It is thus obvious that the underground water supply is beset with numerous difficulties and usually it requires the co-ordination of the geologists and the water supply engineers to locate suitable spots for successful operation.

Some Alkaline Rocks of the Shansi Area. N. China.

AT a time when the problem of the genesis of the alkaline rocks is being widely discussed, it is interesting to observe that the Nystrom Institute for Scientific Research in China has published (E. T. Nystrom, *Bull. Geological Institute of the University of Upsala*, 22) a very comprehensive account of the alkaline rocks of Shansi. This area is equal in size to England and Scotland combined, and the alkaline rocks were first discovered here by E. T. Nystrom in 1910. This part of North China has been divided into three important tectonic divisions. In the central portion, where the trend lines of the tectonic system meet, are developed a series of dislocations which have resulted in the eruption of the alkaline rocks.

The alkaline rocks themselves are distributed in three distinct regions and they occur mostly as laccoliths or stocks either in the archaens or in the later sedimentary rocks, such as shales and limestones. In the latter case the sediments have been metamorphosed, accompanied by an abundant development of calc-silicates. In some cases huge blocks of limestones have been caught up by the intruding magma and they have been burnt and rendered powdery. According to the author, the intrusions seem to have taken place in the mid-tertiary period.

There is a striking similarity in the sequence of eruptions in the different localities,

and the parent magma seems to be of an akeritic composition as in Oslo (Christiania) and Hobart (Tasmania). This akeritic magma shows evidences of differentiation in three distinct branches—granitic, syenitic and dioritic. It is evident that by the elimination of the granitic differentiate a large quantity of the silica content has been removed; and there has been a considerable impoverishment of plagioclase and feldspar minerals by the dioritic differentiate. The

residual syenitic magma has been the source for the evolution of the more alkaline types, such as nordmarkite, nepheline syenite, leucite syenite, tinguaite, etc. The paper contains a large number of analyses, charts, figures and calculations of great petrographic value. This is the first time that such a detailed presentation of the alkaline rocks of the Shansi area is made and it is bound to be of great interest to all igneous petrologists.

Progress of Science in India.

IN the course of his address welcoming the delegates to the Joint Session of the Scientific Societies held at Bangalore (10th-14th April), Sir C.V. Raman, Kt., F.R.S., N.L., pointed to three ideals which should guide research workers to secure for India a prominent place in the scientific map of the world. A fastidious attention to a high standard of quality in scientific research constitutes the first ideal; weeds shall have no place in the garden of science and, to ensure a steady and wholesome growth and development, the weeds must be scrupulously kept out. The second ideal is to recognise the essential unity of knowledge. Science should not be conceived in terms of water-tight compartments even as a matter of administrative expediency. Administrative separatism leads to intellectual separatism and eliminates that essential factor which makes for intellectual co-operation among scientists pursuing different branches of knowledge, a co-operation which is necessary for the fruitful progress of science. Many of the outstanding discoveries have been made in laboratories which have stood for such an ideal, and where several scientific subjects are studied in close juxtaposition. To cite one instance,

the discovery by von Laue, of the diffraction of X-rays, was made possible in the favourable environment provided by the Munich Laboratory where such stalwarts like Prof. Sommerfeld, the eminent mathematical physicist, and Prof. Granz, the famous mineralogist and crystallographer, were working. Lastly, it is necessary to recognise the leadership which mathematical thought possesses in the progress of science. It is utterly futile to evaluate science on the gold standard. There is an amazing contempt for scientific work which does not bring an immediate monetary return. "With all the emphasis I can command, I sound a note of warning of the dangers of this attitude," said Sir C. V. Raman. "The deeper and fundamental aspects of science appeal to but a few who possess a disciplined attitude of mind. No progress can be achieved in any branch of science if we lose our respect for, or withhold support to, the fundamental sciences of Mathematics and Philosophy; the more we neglect these the less we advance." Research, not founded on fundamental mathematical concepts, is like food devoid of vitamin, that entity which makes all the difference between calories and nutriment.
