

air current within the first three kilometres and appear to be shallower than the typhoons of July and August. By December winter conditions become established in southern Asia and no typhoon crosses the Indo-Chinese Peninsula; occasional ones, however, travel westwards farther south in about Lat. 8°N .

It has been pointed out by Visber that, although typhoons attain destructive violence to the west of Long. 150°E ., they are probably generated much further east as indicated by observations in recent years in the Marshall Islands and in the seas south of the Hawaii Islands. This is not improbable as the line of convergence of the south-easterly trades and the north-easterly trades lies well to the north

of the equator in the typhoon months, and extends to the coast of Central America. The typhoons may well be regarded as pressure waves generated in this line of convergence, which travel westwards with the equatorial easterlies, and intensify when they reach more northerly latitudes on approaching the Asiatic continent. If we could draw the tracks of all these low pressure waves in all stages of development, it is probable that we would find that a majority of them have their origin in the East Pacific Ocean and finally recurve into the general westerly circulation of the temperate latitudes in the North Pacific Ocean, China or Upper India.

Research Notes.

Über Gewisse Orthogonale Polynome, die Zu einer Oszillierenden Belegungs-Funktion Gehören.

THE properties of some interesting polynomials arising in connection with Legendre's polynomials are treated in this paper (Szego, *Math. Ann.* B. 110, pp. 501-513). At the same time Szego proves two conjectures of Stieltjes which remained unproved up till the present day. The polynomials that he considers are defined by means of the equation

$$\frac{1}{Q_n(x)} = E_n(x) + a_1 x^{-1} + a_2 x^{-2} + \dots$$

where $Q_n(x)$ as usual represents the Legendre's polynomial of the second kind. Then we have obviously the orthogonality relation

$$\int_{-1}^{+1} P_n(x) E_n(x) x^k dx = 0, \\ (K=0, 1, 2, 3, \dots, n).$$

(Here it is to be observed that the weight-function $P_n(x)$ is highly oscillating.) The two conjectures of Stieltjes which he proves here are: (1) The roots of $E_n(x)$ are all real simple and lie in the interval $(-1, +1)$; (2) The roots of $P_n(x)$ separate those of $E_n(x)$. In this connection Szego remarks that a more general conjecture of Stieltjes is not yet proved and that his methods developed here cannot perhaps be applied to the general case. Some analogous results are also proved for $E_n^{(m)}(x)$ obtained in an analogous manner from the associated Legendre function of the second kind $Q_n^{(m)}(x)$.

K. V. L.

Über die Kleinsche Theorie der Algebraischen Gleichungen.

IN this very interesting article Brauer (*Math. Ann.*, Band, 110, Heft IV, pp. 473-500) has perfected Klein's theory in many important directions. It is well known that Klein has established an intimate connection between the solution of an algebraic equation and the "Formen-Problem" of a group (usually the Galois group of the equation) which is given either as a linear transformation group or as collineation group. The Hermite-Kronecker solution of the quintic equation by means of a modular equation of the fifth order (the icosæder equation) was explained very clearly by Klein by means of this analysis. He and his students have contributed very largely to the theory of the sextic and the septic equation which can perhaps be considered as the most important work in this field since the classical work of Abel and Galois.

The "Formen-Problem" of a group of linear transformations (order n) is the determination of a point in the n -dimension space in which the linear transformations are supposed to act when the values of the fundamental invariants for the point are known. In an exactly similar manner we can formulate the same for a collineation group. The fundamental problem is that of determining the cases when the solution of an equation can be made equivalent to the "Formen-Problem" of a suitably chosen group (it is usually the Galois-group of the equation). In the case of the linear-transformation-group this problem is completely solved. In a very interesting way Brauer solves this problem for the case of collineation groups also. The first part of the article does not presuppose much knowledge

on the part of the reader but the latter part presupposes some knowledge of the theory of hyper-complex numbers and group characters.

It has already been observed by Klein that in the case of the quintic equation the solution can be reduced to that of the "Formen-Problem" of the icosæder group only if we extend the field of the coefficients by another quadratic irrationality. It has been found by Brauer that in general the extension of the field is indispensable; and the theory of hypercomplex numbers gives us much knowledge about the nature of the irrationalities that we have to adjoin. In § 1, 2, 3 he shews how the solution of an equation and the "Formen-Problem" of a collineation group can be related. The principal result that he proves is dependent upon the theory of factor systems of the representation of groups treated by Schur in *Math. Zeit.*, 1919, 5. It is 'If $f(x)=0$ is an equation with coefficients out of a field P with its Galois-group G which is one-one isomorph with a collineation group C , then the complete solution of the equation is equivalent to a "Formen-Problem" of C if among the factor systems of C , a system is found which is associated with the unit system (in the sense of Schur, *loc. cit.*). Here it is shewn that the number of those factor systems that are to be investigated is equal to the index of the group of the inner automorphisms of G with the group of all the automorphisms of G . In § 4 he connects the theory of the solution of the equation with an aggregate of simple normal algebras (or hypercomplex numbers) over P in an independent way. The principal results of § 4 and 5 are these.

There exist a finite number of normal simple algebras over P , which can be determined and which possess the following property—viz., the complete solution of $f(x)=0$ is equivalent to a solution of a "Formen-Problem" if there exists a complete Matrix algebra among the previously mentioned finite number of them. If there does not exist any such algebra among them, then the field P is to be extended. If m is the smallest of the indices of the algebras over P , then the degree of the extended field P' over P is at least equal to m . If n is the dimension of the space in which the collineations are supposed to act, then the degree of P' over P cannot exceed $(n+1)$. The results are illustrated by taking the quintic, sextic and septic equations.

K. V. I.

Raman Effect of Cyclohexane.

K. HABERL [*Ann. der Phys.*, 1934, 21(5), 301] has found a remarkable fluorescence in the Raman spectrum of cyclohexane excited by Hg-radiation with a great temperature dependence. The regions of fluorescence are about 2,900 Å. U. and 4,000 Å. U. He has also found that the fluorescence disappears if the Hg-radiation is filtered through a glass plate. No explanation of the above phenomenon is yet given.

Experiments with Positrons.

IN *Zeitschrift für Physik*, 1934, 92, pp. 485-512, E. Rupp gives a detailed account of the experiments conducted by him with the object of discovering the properties of the positron. His results agree in the main with those of other workers, particularly J. Thibaud, but the special interest of the work lies in the way in which the positrons were produced. In their first experiments on induced Radioactivity Curie and Joliot found that when aluminium was bombarded by α -particles it was changed to radio-phosphorus which emitted positrons. This has been utilised in the present work to obtain a source of positrons. Even the α -particles were produced in the laboratory by bombarding lithium by highly accelerated protons. The α -particles so produced then hit the aluminium and gave rise to positrons. A large number of experiments were conducted to determine the properties of these positrons. The value of e/m for the positron was found to be 0.95 ± 0.05 times that for the electron. The positrons when scattered by aluminium and gold foils showed no diffraction rings while electrons of the same energy do show such patterns. The absorption coefficients of Al, Cu and Au, for positrons were 30 per cent. smaller than for electrons. The loss of velocity was greater for positrons than for electrons when they traversed similar foils of Al. The positrons did not dislodge secondary positrons but liberated secondary electrons as efficiently as primary electrons do. The positrons excited a strong X-radiation whose wave-length was independent of the velocity of the positrons, while electrons produce X-rays whose wave-length does depend on the velocity of the electrons. In the mean each positron produced two quanta of X-radiation. The positrons were not

found to produce artificial transmutation of elements.

T. S. S.

The Production of Neutrons from Beryllium by means of hard X-rays and artificial Radioactivity.

IN a recent communication published simultaneously in *Nature* (1934, 134, 880) and *Die Naturwissenschaften* (1934, 22, 839), A. Brasch, F. Lange and A. Waly of Berlin and T. E. Banks, T. A. Chalmers, L. Szilard and F. L. Hopwood of London describe experiments in which neutrons were liberated from beryllium by means of hard X-rays. The X-rays were produced by high-voltage electron tubes worked by a high-voltage impulse generator installed in the High Tension Laboratory of the A.E.G. in Berlin and capable of delivering several million volts. The X-rays produced from a tungsten anticathode in a tube working at 1.5 million volts fell on the beryllium. Bromoform was irradiated by the neutrons thus produced and when the radioactive Bromine isotope was isolated in London it was found to have an activity with a half-value period of six hours. The activity was increased when the voltage of the tube was increased to a value below two million volts. The activity showed a rapid increase with an increase in the voltage. This can be explained if there is a limiting wave-length for the X-rays which can liberate a neutron from beryllium, for the fraction of the total output of the X-ray tube, which is harder than this limiting radiation will increase rapidly with increasing voltage applied to the tube.

T. S. S.

The Genesis of Elements.

G. N. LEWIS (*Phys. Rev.*, 1934, 46, p. 897) has put forth an interesting hypothesis regarding the genesis of elements. All celestial bodies except those having the highest temperatures are supposed to consist mainly of the elements that are found in metallic meteors (mostly Ni and Fe) which are assumed to be thermodynamically most stable states with respect to transmutations amongst elements. But they become affected superficially by the action of radiation of the type of the cosmic rays or the much harder rays as are responsible for the so-called "bursts". This results

in the formation of the lighter elements as are found in the earth's crust and the stony meteors. Less often the nuclei may combine to form the heavier elements. The disintegration of the nucleus under the action of radiation mostly takes place so that (a) an even splitting into two nuclei takes place, each having half the mass and half the charge of the original nucleus, or (b) a nucleus of the type " $4n$ " is formed. Sometimes such processes yield a few unknown isotopes. These are assumed to be unstable and are supposed to undergo β -ray transformations producing the more stable elements.

By this hypothesis it has been possible to account for the nature and extent of occurrence of the more abundantly occurring elements in the earth's crust and the stony meteors. This supports the favourite theory of the petrologists that the interior of the earth consists of metallic masses resembling nickel steel.

K. S. G. D.

Platinum-Rhodium Alloys for Oxidation of Ammonia.

THE catalytic oxidation of ammonia to oxides of nitrogen is from the standpoint of industry, one of the most important reactions in heterogeneous catalysis. The choice of a suitable catalyst and the conditions of economic operation have been the subject of a number of investigations. Two general types of commercial processes have been in use: (a) Those in which the operation is carried out at atmospheric pressure; (b) Those in which the reaction is conducted at high pressures. The choice of a proper catalyst is thus governed by the operating conditions. During the War, iron oxide catalyst with bismuth oxide as promotor was employed in Germany, but was subsequently given up in view of the low efficiency. Platinum in the form of fine gauze has been extensively used, but the loss of metal under the operating conditions is a factor which cannot be neglected. The optimum condition for the minimum loss of catalyst by disintegration, high conversion efficiency and large capacity under the actual conditions of commercial operation have been worked out by Handforth and Tilley (*Ind. Eng. Chem.*, 1934, 26, 1287). They have shown that Platinum-Rhodium alloys containing 5-10% of Rhodium have been found to give a low loss of metal and

high capacity under the operating conditions required for the maintenance of high conversion efficiency. Thus at the same temperature (900°C.) the conversion efficiency of 10% Rhodium alloy is 99% while that of pure platinum is 95%. The loss in weight under similar conditions for the Platinum-Rhodium alloy is much lower than that for pure platinum. The results are of importance not only in industry, but also in the elucidation of the theory of promotor action.

M. P. V.

Observation on Spherulites.

A COMPREHENSIVE study on spherulites has been made by R. J. Colony and A. D. Howard (*Am. Mineralogist*, Nov. 1934, 19, No. 11) from the rocks collected from various places in America. The point of interest is the distribution of microlites both within and around the spherulites. The microlites within the spherulites are arranged in a confused manner, while around the spherulites, they are bent and show a characteristic alignment. Experimental determination with menthol and pyroxene showed, that as long as the melt remained sufficiently liquid the microlites were borne toward the growing spherulite and the arrangement was haphazard. As the viscosity increased the movement became slower, and theoretical discussion has revealed that the fibres of microlites will curve around the spherulites. He has also observed the interesting phenomena of spherulites growing within spherulites, and after discussing the various alternatives, he suggests that the larger or the host spherulite started growing first, and when it included the smaller one the latter could not grow due to lack of supply of material, while the former became bigger and bigger due to continuous growth. From the experimental evidence and theoretical discussion he has concluded that at the time of emplacement the lava was sufficiently liquid, so that the microlites were disturbed by the diffusion currents set up in response to spherulitic growth. From this study he has shown that since there is a close relationship between viscosity and the rate of cooling, the arrangement of microlites in the spherulites may be used as an indication of the comparative rates of cooling of similar lavas.

Magmatic Wedge.

AFTER contributing a series of important papers on crustal mechanics J. S. DeLury has published a very interesting article (*Am. Journal of Science*, Nov. 1934, 28, No. 167) on 'the magmatic wedge'. In this he has made a detailed study of the geothermal gradients and their relation to the development of magma in sub-crustal regions. In this connection he suggests that magmas are locally formed and locally intruded in contrast to huge vertical magma chambers. From the geophysical data available he has discussed the principle of hydraulic wedge and migration of magma with reference to solid flow. His conclusions have a direct bearing on such major problems of geology as continental drift isostasy and petrogenesis. In the end he suggests that assimilation in its broadest aspect would appear to be the controlling factor in the development of diverse rock types though some aspects of differentiation cannot be ignored. This is indeed a statement, which will revoke the controversy between the two schools, namely, the assimilation and differentiation. But, however, it is gratifying to note that a further contribution on this aspect of the question is under preparation and petrologists in particular will be watching with interest the publication of the same.

Liopelma Studies.

NO. 1. INNER EAR; NO. 2. CRANIAL CHARACTERS.

D. S. WAGNER in these two papers (*Anat. Anz.*, 1934, Bd. 79, 51-64-65-112) amply puts forth evidences in favour of the erection of the group *Liopelmidae* by Noble to accommodate *Ascapus* and *Liopelma*. The *Liopelmidae* lack a middle ear, annulus tympanicus plectrum and eustachian tubes. Only the operculum persists. The quadratomaxillary is also absent. The inner ear, however, does not suffer a parallel degeneration. *Liopelma* is linked with *Ascapus* further in possessing separate passages for V and VII nerves, and a foramen acousticum medium. Thus the study of the otico-suspensorial region of the skull of *Liopelma* certainly affords corroborative evidence of the autonomy of the *Liopelmidae*.