

Research Items

Glazed Stones

IN continued study of glazed stones, Mr. H. L. Beck deals with glazed quartz and carnelian, agate and felspar (*Ancient Egypt and the East*, Pt. 1, 1935). In the glazing of quartz (including quartzite and chert), great care has to be taken to prevent flawing of the quartz base. The glazing of quartz was practised in Egypt from Predynastic times to the eighteenth dynasty. In Mesopotamia, beads are found at different dates in two varieties, *high polish* and *frosted*, so called on account of the present surface. Some at Ur are dated from before 3500 B.C., though some of A.D. 900 are identical. Beads are also found in Persia and Syria. Three of the high polish variety were found at Mohenjo-daro, one, a lenticular cylinder, being of a shape not recorded in either Mesopotamia or Egypt. A number of specimens of glazed quartz have been found in northern India, which are dated at the first century A.D. No specimens are reported from Europe; and the process is not practised to-day. The great majority of specimens of glazed quartz from Egypt are beads. In India there is a number of small but elaborately worked pendants representing animals. In Egypt a soda glaze coloured was applied to the bead and then fused. The Mesopotamian coloured beads were hammered to cover them with conchoidal fractures before glazing. In the high polish beads the surface is altered by an alkali. It is possible that all types were coloured. The most important other stones chemically treated were carnelian, agates and chalcedonies. They were not actually glazed, but received a special treatment in which soda was added, usually as a decoration. Many carnelian beads have a white patination; but it is difficult to say whether it has been purposely applied or is due to action of the soil.

Kmer Art and the Cultures of Precolumbian America

M. HENRI MARCHAL offers (*J. Soc. Américanistes*, N.S., 26, 2) a tentative explanation of certain remarkable features in Kmer art, which appear out of harmony with its Indian origin and its relation through the art of India with that of ancient Egypt, Greece and the Mediterranean. These incongruous elements are to be attributed to the Polynesian influences which have been discerned in the art of Java and Bali, and also in America. As an example may be taken the monstrous heads, known in Cambodia as *Rahu*, which with the *naga* form one of the dominant motifs in Kmer art. The characteristic lineaments appear nowhere in occidental art (except in the head of Medusa and its derivatives) but are to be found in the Mayan art of America, especially in the heads placed over the openings into buildings, for example, at Palenque, exactly as they are used in Cambodia and Java. They are to be found also on Toltec pottery, where the god Tlaloc is represented without lower jaw. This motif is scattered widely over Polynesia, appearing in Maori art, especially in the carved wooden lintels and gables of New Zealand, and the tattoo-markings and petroglyphs of the Marquesas. The head with flanking forearms or claws of America does not appear in Polynesia, but is present in China. Super-

imposed heads forming balusters before the entrance to Kmer temples may be compared with sculptured figures of Piedras Negras in Central America. A striking resemblance which has impressed everyone who has visited both localities is to be found in the general profile of the *teocallis* or pyramidal mounds of America and the *prasat* of Cambodia. Step pyramids surmounted by sanctuaries in Mayan architecture find their analogies in Kmer temples such as Phimānakas, Bakon and above all the Pran of Kohker. Among other resemblances in construction are the introduction of a wooden beam in masonry work, the projecting stone which is carved, the use of the serpent for decorative purposes, and the employment of the corbelled arch.

Fishes from the Philippine Islands

THE *Philippine Journal of Science*, 55, No. 3, 1934, contains three papers on fishes: (1) "The Philippine Phallostethidae, a Description of a New Species, and a Report on the Biology of *Gulaphallus mirabilis*, Herre" by D. V. Villadolid and P. R. Manacop; (2) "Philippine Sillaginidae" by M. C. and H. R. Montalban; and (3) a long systematic paper on Philippine Isospondylous fishes by A. H. Roxas. The Philippine Phallostethidae comprise a very interesting group of fishes, unique in having a peculiar sexual organ in the male, named the priapium by Tate Regan, who first discovered it in 1913. The pelvic fins are vestigial in the female and absent in the male, the latter having below the head and throat this priapium containing the coiled vas deferens and the end of the intestine, together with a complicated skeletal system consisting of two long curved bones, proved in the present paper to be used as a clasping organ. The eggs are probably fertilised as they pass through the oviduct, and when laid are provided with adhesive thread-like processes with which they attach themselves to weeds. These filaments seem to suggest that the genus is more closely related to Percosoces than to the Cyprinodontes where they are usually placed. Spawning appears to continue throughout the year. Interesting notes on food and feeding habits are added, *Gulaphallus* having a mixed diet both in young and adult consisting of vegetable matter which is less as the animal grows, insects, especially chironomid larvæ and pupæ, which rank first in importance, small crustacea and even the larvæ of its own species, eaten by both young and old but only in January when the breeding season is at its height. The development of *Gulaphallus mirabilis* is described from the newly hatched egg to the time when the priapium is fully formed—in about 19–20 weeks after hatching.

Germ-Cell Cycle in the Hessian Fly

MARGOT E. METCALFE (*Quart. J. Micr. Sci.*, 77, Pt. IV; 1935) has investigated the germ-cell cycle in the Hessian fly, *Phytophaga destructor*. The somatic cells in both sexes contain four pairs of V-shaped chromosomes. The germ-cells in both sexes contain eight pairs of chromosomes. In the maturation of the egg, eight bivalents are formed, which divide but remain in anaphase until the time of fertilisation.

The polar bodies are then formed, but are never extruded from the egg; they migrate to the surface of the egg, divide irregularly and eventually degenerate. The female pronucleus has eight chromosomes. In spermatogenesis, reduction is effected in a peculiar manner. In the first spermatocyte the chromosomes separate into two groups, of twelve and four respectively, and the four pass into a process of the cell which separates as a small cell. After a short period of rest, the spermatocyte again divides unequally, the resulting spermatid having eight chromosomes and the second bud four chromosomes. Thus each spermatocyte gives rise to one sperm only. The germ-line (that is, the germ-cell nucleus) is differentiated after the third cleavage, that is, in the eight-cell stage. At the fourth cleavage the germ-cell nucleus divides synchronously with the somatic nuclei; there are sixteen nuclei each with sixteen chromosomes. At the fifth cleavage the somatic nuclei eliminate eight chromosomes and are left with eight chromosomes.

Hystricoid Rodents of the Neotropical Region

A VALUABLE, if necessarily dull, account of the taxonomy of these rodents has appeared (*Bull. Amer. Mus. Nat. Hist.*, 68, Art. 5; 1935). The author, G. H. H. Tate, gives fully for each genus its pre-Linnean and post-Linnean taxonomic history, discusses special points of difficulty, indicates the genotypes, and gives a list of all the named forms, specific and sub-specific, with their type localities.

New Garden Alpine Plants

NUMEROUS expeditions to Persia, Tibet, Burma, the Andes and other places have recently been organised for the purpose of collecting new plants for the enhancement of garden beauty. The names of Farrer, Kingdon Ward, Giuseppi, Comber, Ball and others are well known among gardeners for their activities in botanical exploration, and modern gardens owe much of their interest to them. An article by Dr. H. R. Smith on "New Alpines" (*J. Roy. Hort. Soc.*, 60, Part 6, pp. 246-255, June, 1935) enumerates an imposing list of plants for the rock garden which have been introduced during the last five years as a result of such botanical exploration. Lilies and rhododendrons are not treated, but more than sixty species belonging to other genera are described. Campanulas, primulas, gentians and narcissi are well represented, and brief accounts of the circumstances of their introduction are given.

Life-Histories of British Pyrenomycetes

MR. C. G. C. CHESTERS has commenced a series of studies on British Pyrenomycetes. The whole life-histories of most members of this division of the fungi are not known, and many phases probably lie buried among the taxonomic labyrinths of the Fungi Imperfecti. Pure culture methods are used in the investigation, and the first part of the work is devoted to "The Life-Histories of Three Species of Cephalotheca" (*Trans. Brit. Mycol. Soc.*, 19, Part 4, June 1935). The three species which have been recognised are *C. sulfurea*, *C. purpurea* and *C. reniformis*. These are described in minute detail, and characters of the genus are also given. Extensive lists of synonyms appear, and the mass of detail portrayed in the paper is crystallised into a very simple determinative key at the end.

The Formosa and Quetta Earthquakes

A PRELIMINARY report on the Formosa earthquake of April 21, by Mr. R. Takahasi, is published in the *Proceedings of the Tokyo Imperial Academy* (11, 224-226; 1935). The number of lives lost was 3,276, and that of the houses completely destroyed 121,398, this great number being due to the poor construction of the houses. Displacements occurred along several faults during the earthquake. Along one, more than six miles in length, the horizontal and vertical displacements were respectively 6 in. and 2 in. Along another, a thrust fault of about the same length, the horizontal movement was slight, but the vertical shift amounted to 10-12 in. The epicentre lay in about lat. 24° 22' N., long. 120° 48' E., or between the two above faults. The detailed report will appear later in a special volume of the *Bulletin of the Earthquake Research Institute*. In a paper in *Science and Culture* (1, 71-72; 1935), Messrs. S. N. Sen and R. Bakshi determine the epicentre of the Quetta earthquake of May 31 as in about lat. 30½° N., long. 66½° E., or along the Khojak Range just to the south of Chaman and about sixty miles north-west of Quetta. Thus, the origin of the recent earthquake coincides closely with that of the severe earthquake of December 20, 1892, caused by a large displacement along the boundary fault which has been traced for a distance of 120 miles.

Thermodynamical Relations

PART No. 740 of vol. 234 of the *Philosophical Transactions of the Royal Society, A*, is devoted to a communication by Prof. A. Norman Shaw of McGill University on "The Derivation of Thermodynamical Relations for a Simple System". The aim of the author is to outline a systematic procedure for effecting transformations of thermodynamical formulæ which involve quantities not directly determined by experiment or determined with low accuracy, in order to replace them by quantities directly observed or determined with higher accuracy. The method adopted is that of converting any thermodynamical equation involving the usual quantities p , v , T , S , E , I , F and G and their derivatives with respect to each other into an equation connecting Jacobians of the partial derivatives of two quantities x and y with respect to two independent variables α , β by assigning to x , y , α , β values identical with any number up to four of the above thermodynamical quantities. Thus the thermodynamical equation $dE = TdS - pdv$ is converted into $J(xE) = TJ(xS) - pJ(xv)$ where J is the symbol for Jacobian and x and the independent variables α and β are undetermined. Once the equations are in Jacobian form the laws of transformation of Jacobians can be utilised to effect the thermodynamical transformations required. To facilitate the work four tables are given in which x , y , α , β are assigned values p , v , T , etc., and the resulting Jacobian expression tabulated in terms of five of the simplest Jacobians. Instructions for the use of the tables and worked examples are given as well as 35 equations useful in manipulations of J functions.

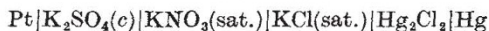
The Electronic Oscillator

CONSIDERABLE research has been carried out recently on the generation of electrical oscillations corresponding to wave-lengths of 10-100 cm., by means of the valve circuit arrangements first demonstrated by Barkhausen and Kurz. The

theoretical study of this subject has resulted in the publication of much complicated analytical work, the physical principles of which have at times been somewhat difficult to visualise. The author of some of this theoretical treatment, Mr. F. B. Llewellyn, has presented a simple statement of these principles in plain language in an article entitled "The Barkhausen Oscillator" published in the August issue of the *Bell Laboratories Record*. The case considered is that of a simple triode valve operating with a positive grid potential; and the oscillating motion of individual electrons between cathode and anode through the spaces of the grid is dealt with. The difference in motion of these electrons due to the static forces alone and with the superimposition of the alternating forces due to the potential difference across the external tuned circuit is explained and illustrated graphically. The maintenance of oscillations is shown to be due to the non-symmetrical motion about the grid of those electrons which are correctly phased relatively to the alternating forces, and the consequent transfer of some of their energy into the external tuned circuit. The tuning of this circuit can modify the frequency of the oscillations by about thirty per cent, but for fixed supply voltages of the valve electrodes, there is a particular tuning adjustment which gives maximum output.

Platinum Electrode in Solutions of Foreign Ions

MR. I. ORESTOV, of the Middle Asiatic State University, Tashkent, informs us that he has studied the behaviour of a platinum wire electrode in a series of solutions of potassium sulphate of normalities 0.5005, 0.1001, 0.0500 and 0.0100, with a salt bridge and saturated calomel electrode:



and very variable potentials were found. When, however, a stream of pure nitrogen was passed through the left-hand half element, a reading taken after 90 minutes showed that all four electrodes had on the average the same potential of 0.2336 ± 0.0010 volt. Observations with one electrode ($N \text{K}_2\text{SO}_4$) at 23.1° were then made every minute and 90 readings obtained. These were arranged in a statistical row which was found to correspond very closely with the natural theoretical row, the standard deviation σ being ± 2.35 mv., the index of closeness of fit (Pearson) being $\Delta = \pm 2.33$, the asymmetry number S being $+0.23$, and the excess $Ex = +0.2$. The source of the fluctuations, following a suggestion of Posner, is regarded as the fluctuations of ions in a Helmholtz double layer on the electrode. Further observations are in progress, when the theory of fluctuations (Smoluchovsky-Svedberg) will be applied to the results.

Probability and Frequency

A SATISFACTORY basis for the theory of probability has not yet been found. The weakness of the 'equally-likely' definition is well known, but the 'statistical' or 'relative frequency' definition, favoured by Chrystal and others, is also open to objection. An interesting discussion of some of the fundamental difficulties has been given recently by F. P. Cantelli (*Ann. l'Institut Henri Poincaré*, 5, 3; 1935). If a symmetrical coin, equally likely to turn up head or tail, is tossed a large number of times, it is not certain that the proportion of heads will be exactly $\frac{1}{2}$. What is more, it is not even certain that the propor-

tion will approach $\frac{1}{2}$ as a limit; for if it were, to any number ϵ , however small, there would correspond a number N such that for every set of N or more tosses the proportion of heads would *never* differ from $\frac{1}{2}$ by more than ϵ . But this is not true; long runs of heads or of tails are not impossible, a fact which is awkward for mathematicians as well as for gamblers. The statement of the approach to the limit must be weakened, with *never* replaced by *scarcely ever*. The principal object of Cantelli's work is to express this replacement in precise mathematical terms drawn from the theory of aggregates.

Molecular Weights by the Ultra-Centrifuge

THE most satisfactory method for the determination of the molecular weights of macromolecules is by means of sedimentation equilibrium in the Svedberg ultra-centrifuge. The equations can be developed by thermodynamics, so that for sufficiently dilute solutions the shape of the molecule is not involved. In the case of material containing molecules of different sizes, average molecular weights are obtained. It is then necessary, for purposes of comparison with values found by other methods, such as viscosity determinations, as used by Staudinger, to have properly defined averages, and W. D. Lansing and E. O. Kraemer (*J. Amer. Chem. Soc.*, 57, 1369; 1935) have distinguished three such averages. The first, the number average, M_n , corresponds with osmotic methods involving counting of the molecules; the second, the weight average, M_w , corresponds with Staudinger's method, and a third, the so-called 'Z-average' molecular weight, M_z , is obtained from centrifuge data. The concentration of a solution subjected to a centrifugal or gravitational field is such that the concentration gradient at equilibrium ensures that at every point the chemical potential is equal but opposite in sign to the gravitational potential. Equations can then be set up giving the molecular weight from the experimentally observed concentration gradient. If this value varies with the distance along the cell, the material is assumed to be non-homogeneous. The authors enter into a detailed discussion of the calculation of the average molecular weights and apply the results to experiments on gelatin. The equations enable a correct comparison to be made between results obtained by different methods, thus avoiding a good deal of confusion which has hitherto resulted in this field.

Distance of Nova Herculis

THE majority of novæ are so far away that accurate measurements of their distances are very difficult to obtain. Trigonometrical parallaxes are too small to be trustworthy, and the best method so far depends on the rate of expansion (when available) of the surrounding nebular disc. An entirely independent method is now possible through the relation between distance and interstellar calcium absorption. This has been used in the case of Nova Herculis by E. G. Williams (*Monthly Notices, R.A.S.*, 95, 573), who has measured the intensity of the interstellar [K] line on twenty-four plates taken at Cambridge. The large displacements of lines due to the Nova itself, together with the absence of lines which might blend with the interstellar line, make these measurements comparatively simple. They yield a distance of 370 parsecs for Nova Herculis, corresponding to an absolute magnitude at maximum of -6.5 and a pre-outburst magnitude of about $+6.7$.