

Research Items

Mohenjo-daro. The Sir George Birdwood memorial lecture of the Royal Society of Arts delivered on December 8 by Dr. E. H. J. Mackay (see *NATURE*, 132, 960, Dec. 23, 1933) is published in full in the Society's *Journal* of January 5. The objective of the six years' excavation under Dr. Mackay from 1927 to 1933 was to establish the cultural history of the city in the period represented by the lower strata. Attempts were made to reach virgin soil, but these had to be abandoned at a depth of 43 ft. below the surface of the mound owing to the seepage of water from the Indus. The earliest remains of the city must be regarded as irretrievably lost, failing the employment of expensive pumping operations. The city from the earliest times was laid out in rectangular blocks of remarkable accuracy, the streets running at right angles. Excavations have been carried down to six levels of occupation, the finest and most carefully laid masonry being found in the early levels. Houses were well built up to the end of the Intermediate Period, when signs of economy appear and walls were made thinner. Houses were of two or more stories, the upper being reached by brick staircases. The drainage system is the most elaborate of any city of the same date even outside India. In the last two phases, when the wealthier population had left the city owing to floods, houses were roughly built and those of the *DK* mound were occupied by artisans. The city at this time was apparently exposed to raids from hill tribes, as skeletal remains have been found of inhabitants who had suffered a sudden and violent death. The skulls fall into two classes, Mediterranean and proto-Australoid, one showing a Mongolian strain. Cultural affinities with Mesopotamia, the results of trade, point to a date 2750-2500 B.C. for later strata and about three hundred years earlier for the lower levels. The highest art of the people is shown in the cutting of seals, the subjects affording valuable evidence of their religious beliefs. They appear to have been of western Asiatic origin, but there is at present nothing to indicate the date or route of their entry into India.

Jungle-Fowls from the Pacific Islands. The origin of the jungle-fowls of Polynesia, whether from wild individuals imported from Asia or from varieties already domesticated, is uncertain; but, on the whole, the probability lies with the former suggestion. If that be so, then the great variety of the Pacific races, now living in a feral state, must be due to changes which have taken place since the introduction of the wild species, probably long before Wallis and Cook discovered the natives of the Tuamotus and Tahiti using the birds for food, in 1767 and 1769. Stanley C. Ball, in a monograph of the Pacific Islands forms, points out that, compared with the wild *Gallus gallus*, they are on the average considerably larger, and their variation in size greater (*Bull. Bernice P. Bishop Museum*, 108; 1933). Variation appears to have been greater in the Society and Marquesas archipelagos than in Fiji and the New Hebrides. In the western groups, white spotting is the single remarkable variation, whereas the Marquesas has a red strain with feathered tarsi and yellow-backed males, and in the Society Islands, white-backed males, melanic cocks and hens, white-laced hackles, mingle with the wild type. But all the birds, everywhere, are single-combed.

Scottish Tunicates. Dr. Harold Thompson continues his studies of tunicates in his paper "The Tunicates of the Scottish Area, their Classification, Distribution and Ecology. Part 3: Sedentary Tunicata (continued) Order Diktyobranchia" (Fishery Board for Scotland. Sci. Invest. 1932. No. 2; 1933). Mainly based on records from Scotland, the work represents a thorough overhauling of the groups dealt with, which in the present part include the Rhodosomatidæ, Ascidiidæ, Perophoridae and Cionidæ. In a paper by Lindsay and Thompson (*J. Mar. Biol. Ass.*, 17, 1; 1930) the author has already inquired into the determination of specific characters in the family Ascidiidæ, in which it was suggested that the three recognised genera *Phallusia*, *Ascidia* and *Ascidiella* of Roule might be combined. In the present paper the same combination is kept, and with the genus *Ascidia* are merged both *Ascidiella* and *Phallusia*. There is a very large list of new Scottish records given for *Ascidia scabra* as distinct from *A. aspersa*. Within the order Diktyobranchia there are two species typical of arctic conditions, two of arctic and north boreal conditions, eight typical of boreal conditions and two of south boreal conditions. The boreal species tend to be confined to the Mediterranean and east Atlantic boreal regions, and, with the exception of *Ascidia scabra*, *Ciona intestinalis* and to some extent *Ascidia virginias* and *Ascidia conchilega*, tend to fail in North Sea water proper.

Tidal Bores. In the *Geophysical Supplement* (vol. 3, No. 5) to the *Monthly Notices of the Royal Astronomical Society*, Dr. Vaughan Cornish describes observations made by him on tidal bores on the Severn and Trent. The paper is non-mathematical, but the observations are quantitative, and made with the view of providing data on which can be based an adequate mathematical investigation of the type of bore most characteristic of English and French rivers. In this type the steep slope of the head of the tide breaks up into a group of short waves. In his observations on the Trent, during the years 1922-28, Dr. Cornish observed the same bore at different points up the river, travelling from point to point by motor-car, outstripping the bore. He observed not only the changes in form of the bores when rounding bends, and across points where the river depth changed rapidly, but also in passing the mouth of a canal opening on to the Trent. He urges the need of a co-operative study of the Trent bore, by a group of students equipped with tide-gauges, current meters and cinematographic cameras.

Low Temperatures by Adiabatic Demagnetisation. De Haas, Wiersma and Kramers describe (*Physica*, 1, Dec. 1, 1933) the experiments which have led to the lowest temperatures yet attained. A quantity of a paramagnetic salt is cooled by liquid helium and kept for some time in the field of a large electromagnet. The field is then suddenly reduced, and the demagnetisation of the salt under approximately adiabatic conditions causes its temperature to fall. The specimen is arranged to lie in an inhomogeneous magnetic field and the mechanical force on the specimen is measured by a balance, so that its susceptibility may be determined. The magnetic susceptibility is used to provide a scale of temperature

which is extrapolated below the temperatures measured with liquid helium. The salts used were cerium fluoride and the ethylsulphates of cerium and dysprosium. In an experiment recorded in a footnote potassium chrome alum was used, and gave the lowest temperature—below 0.05° K. (see also NATURE, 132, 372, Sept. 9, 1933).

Oxidation and Condensation of Phenols. The *Proceedings of the Royal Society* of December contains a set of papers by H. G. H. Erdtman on the oxidation and condensation products of phenols. It seems probable that the complicated substances called 'humic acids' possess an aromatic structure and that they are produced by the coupling of quinonoid molecules. The first part of Erdtman's work is the investigation of the reactivity of some simple monocyclic quinones in the light of Lapworth and Robinson's application of the electron theory of valency. According to this theory, the reactivity of unsaturated molecules may be explained in terms of the 'polarisation' of parts of the structure. The reaction studied experimentally was the acetylation of the quinines with a mixture of acetic anhydride and sulphuric acid, and the reactivity of the various quinones showed a fairly good agreement with the predictions of the theory. The theory also suggests a mechanism for the coupling of carbocyclic rings during the oxidation (dehydrogenation) of phenols. A typical example is the formation of a hexahydroxydiphenyl on the oxidation of pyrogallol in baryta solution, and a whole series of such couplings was investigated. During the work, an investigation of the polymerisation of toluquinine led to the discovery of a termolecular condensation product, and a termolecular product was also obtained from benzoquinine, though in this case further polymerisation leads to a poor yield; α -naphthoquinone yields more crystalline termolecular product than toluquinine.

Medieval Glass. Very little information is available on the chemical composition of medieval glass, although this is obviously an important criterion of the genuine nature of particular specimens. A detailed account by M. Chesneau (*Bull. Soc. d'Encouragement pour l'Industrie Nationale*, 132, 609; 1933) of the chemical analyses of French window glasses of the twelfth and thirteenth centuries is therefore of considerable interest. These glasses contain less silica and more alkali (potash and soda) and alkaline earths (lime and magnesia) than modern glass, the mean percentages being 70 per cent silica, 17 of alkali (soda) and 13 of lime, and are therefore more fusible and more easily attacked by moisture and atmospheric carbon dioxide, although the actual specimens were well preserved. The addition of common salt during fusion, as mentioned by Agricola, is considered probable, since the proportion of soda to potash in the glasses is larger than could be accounted for by the use of wood ashes alone, as specified by Theophilus. The probable method of working is fully described, the glass being first blown, and the pear either pierced and spun or worked into a cylinder, afterwards cut and opened out. The glass had been decolourised by addition of pyrolusite and the colours were due to metallic oxides, the red glass, however, being formed by a thin sheet of red superposed on or interposed between colourless glass. The red was coloured with cuprous oxide; the blue with cobalt with traces of cupric oxide and having

a grey tone owing to the presence of nickel; the yellow contained antimony oxysulphide with some ferric oxide; the violet had oxide of manganese (pyrolusite) together with some ferric oxide, giving the flesh tint of all ancient violet glasses; and the green contained cupric oxide. The cobalt mineral in all probability came from Saxony, the other minerals being native in France.

Transient Waves on Transmission Lines. The importance of preserving the best possible continuity of supply on electric transmission lines has led engineers to study the effects produced on them by transient or 'travelling wave' phenomena. A great many experimental and theoretical researches particularly in the United States have now been published on this subject. The waves are caused mainly by lightning, but sometimes a fault connecting the line to the earth by an arc, or even switching operations will cause them. In a paper read to the Institution of Electrical Engineers on January 4 by Dr. J. L. Miller, the influence of these waves on electrical devices is discussed. Dr. Miller states that lightning is practically always the cause of dangerous over voltages. American experimenters have shown that lightning surges can cause a pressure rise of about seven or eight times the normal voltage. In one particular case careful records were kept of the disturbances occurring on five different transmission lines over a period of five years. It was found that one per cent reached fifteen times normal line voltage, five per cent reached eleven times normal line voltage and ten per cent reached eight times this voltage. Altogether, nearly 700 surges were recorded and 73 of them were more than eight times normal. It is concluded that a line at the British grid pressure of 132 kilovolts would, if placed in this district, be liable to three surges per annum of the order of a million kilovolts. It will be seen that transformers and other electric devices would have to operate under dangerous conditions. An oscillogram has been obtained which shows a surge which rose to five million volts in less than two microseconds. The author gives a fairly complete mathematical theory and checks it by showing high-speed cathode ray oscillograms of the phenomena. He has explored a very wide field about which opinion is still divided.

The Support of the Chromosphere. A novel theory of the manner in which the chromosphere is supported has been put forward by Dr. S. Chandrasekhar (*Mon. Not. R.A.S.*, 94, No. 1, November 1933). The difficulty of accounting for the enormous extension of the chromosphere was first met by Prof. E. A. Milne, who suggested that the calcium atoms were supported by selective radiation pressure. It has also been suggested that turbulence is a cause of the behaviour of the chromosphere. Dr. Chandrasekhar has extended Milne's theory in a very interesting way. Guided by the observed granular appearance of the solar disc, he discards the notion of hydrostatic equilibrium, and introduces instead the hypothesis that the chromosphere is in a hydrodynamically steady state. The mean flux of radiation corresponds to full support of the chromosphere, and atoms over bright areas are accelerated outwards, while those over the darker patches tend to fall back. The theory predicts for the outward march of the density gradient a law which keeps numerically close to an exponential law.