

## Research Items.

ARCHÆOLOGICAL EXPLORATION IN INDO-CHINA.—Dr. R. Verneau describes in *L'Anthropologie*, T. 35, Nos. 1-2, the results of excavations in the caves of Bac-Son, Tonkin, by Dr. Mansuy and Mlle. Colani of the Geological Service. Some years ago Dr. Mansuy demonstrated by excavations at Pho-Binh-Gia that the neolithic culture characteristic of Indo-China—the only type known until then—was preceded by a more archaic culture. Three skulls associated with this early phase were found to differ entirely from the modern population. Further investigations, covering a large number of caves, have revealed a stone culture, apparently general over the area of excavation, of which the implements are of early palæolithic type—Acheulean. No fossil remains are present, and the animal bones found in the archaeological deposits are all those of existing species. This, coupled with the absence of any of the stages intermediate between the implements of Acheulean type and the polished neolithic implements of the later culture, points to an antiquity of no great degree such as might be inferred from the form alone of the early implements. It is suggested that a primitive culture lingered on until overwhelmed by the incursion of races acquainted with the art of polishing stone. Two skeletons were found; one skull was sufficiently well preserved to admit of measurement; but whereas the skulls from the earlier excavation mentioned above were of a pure Indonesian type, this one is Melanesian; while another skull recently found in the cave of Minh-Cam in Annam presents the characteristics of a Negrito.

EARLY ART IN THE EUPHRATES VALLEY.—The light thrown upon Sumerian Art and its affinities by the discoveries at Tel el Obeid is discussed by Dr. Leon Legrain in the *Museum Journal* (Philadelphia), vol. 15, No. 3. A foundation tablet of Ur-Engur suggests the identification of El Obeid with the city of Kesh and a connexion with Elam, from which tamed bulls and cows probably were first brought to Sumer. The details of the dairy scene in the copper relief from the oldest temple at El Obeid help to explain archaic pastoral scenes from Susa, Tello, and Nippur. A text of Gudea of Lagash dealing with the organisation of the household of the god Ningirsk, refers to a dairy. It also in its ritual details suggests the old mythology of Elam. But while the Elamites was a hunter the Sumerians were farmers. The Elamites represented the gods as composite monsters; the Sumerians adopted the same forms, but in Sumer the god soon assumes the appearance of a king seated on his throne, the ancestor animal surviving as his servant and emblem. A number of known monuments may be compared with the art of Tel el Obeid. These, taken together, seem to bridge over the gap between the pre-Sargonic and pre-Elamite periods. Similar objects have been found by the French at Susa, Tape Mussian, and Bandar Bushir. The pre-Elamite period, represented by the painted wares and engraved seals, seems to be the oldest. The Tel el Obeid art is not so primitive but is to be set apart from, and before the pre-Sargonic period, constituting a new period of art.

THE BIOLOGY OF WHITE MUSTARD.—This subject in the hands of F. Boas and F. Merckenschlager has given results of great scientific interest and of considerable practical bearing. Their results are published in the *Biol. Centralblatt*, 45, pp. 40-53, 1925. That white mustard had some peculiarities had long

been known; thus since 1913 the great difficulty of growing the plant in water culture has been on record, and there are also reports as to its failure to develop in soils previously sterilised by heat. In both these cases, growth could be improved by adding strongly adsorbing substances to the culture medium. Attacking the problem from this angle, these authors now supply very good experimental evidence that these peculiarities are due in the main to the ready penetrability of the plant's tissue by anions. If, for example, roots of mustard seedlings are placed in a 0.5 per cent. solution of ferrous sulphate, within 15-20 minutes the roots are covered with yellow-brown flecks of the hydroxide of iron, other plant roots remaining clear white for hours in such a solution. The root systems of old flowering plants do not show this peculiarity to such a marked extent, but leaf-stalks and hairs show this same ready penetrability to anions. As *Sinapis arvensis*, charlock, has the same peculiarities as *S. alba*, though perhaps to a less degree, this seems to be the phenomenon underlying the practice of destroying charlock by spraying or dusting.

MAIZE IN SOUTH AFRICA.—The increasing importance of the maize crop in South Africa has led to an inquiry into the economics of its production in connexion with the capital required in maize farming, the equipment and labour necessary, the yields and returns obtained, the relation of yield to cost and other points of importance to maize growers. Incidentally, weak points in the system of farming have been exposed, providing valuable information to the farmers. The report on the Cost of Production of Maize Investigation for 1921-22 (by E. Parish, Orange Free State) sets out the means employed in obtaining information and the method of calculation adopted. Costs for native labour, ox labour, and overhead charges were estimated on a comprehensive basis including such incidentals as perquisites, veterinary attendance, and the cost of stalk grazing and husks consumed. The range of costs per bag, including transport, on the thirty-nine farms investigated in a poor season was from 4s. to 17. 14s. 11d., the greatest number of results lying between 7s. and 9s., but in a normal season the costs would be lower. The crop yields showed a similarly wide range, from 0.43 to 8.0 bags per acre (1 bag = 203 lb.), and comparison shows that the relation between yield and cost is very close. Compared with similar figures for several states in U.S.A. the cost of manual labour in South Africa is greater per acre of maize, but land is relatively cheaper and ox labour is less expensive than horse labour. The cost per bag of maize may be brought down by adequate methods of farming, and suggestions are made for obtaining increased yields.

EARTH MOVEMENTS IN CALIFORNIA.—A most comprehensive scheme of research is now being carried out in California with the object of investigating from every possible point of view the alarming disturbances to which the earth's crust is subject in that region. A valuable summary of progress is outlined by Dr. A. L. Day in *Science*, vol. 61, March 27. The U.S. Coast Survey and the Hydrographic Office have triangulated the land and contoured the adjoining ocean floor, and have thus provided a trustworthy system of co-ordinates upon which future displacements can be accurately plotted. The Geological Survey and the universities in California are studying

the geology in adequate detail. The California Institute of Technology, the Mount Wilson Laboratory, and the Geophysical Laboratory of Washington have devised apparatus and established stations for the more systematic recording and study of local earthquakes. It is not surprising that great faults are found along the Californian coast, for the Sierra Nevada rise to more than 14,000 feet on the east, while to the west the ocean floor drops sharply to a depth of 12,000 feet. High temperature gradients and hot springs, and unusually great anomalies of gravity, show further that the region is one of exceptional instability. The danger zones of structural weakness are being carefully mapped, and in future the known directions and magnitudes of the creeping and tilting movements that occur along them as the stresses accumulate will lead to definite predictions of the place or places where earthquakes are likely to occur. Unfortunately, there is no certainty that prediction of the time of rupture is yet a problem that can be usefully attacked.

**ABYSMAL SUBMARINE VOLCANOES.**—The soundings made by the *Challenger* expedition have been investigated by M. J. Thoulet, *C.R. Acad. d. Sci., Paris*, March 16. In the oceanic depths he has found that, in some cases, the curves of submarine density, instead of continuing regularly to the bottom, begin to show a sudden increase in density, the amount of material in solution becoming suddenly greater than before. This appears to be due to the existence of basins, without outlet horizontally, containing submarine volcanoes, which give out materials which dissolve in the water. This increase of density at the bottom of the ocean is not general. In regions in the North Atlantic known to be volcanic, the proportion of bottom densities greater than 1.0280 is 84 per cent.; in the South Pacific it is 37 per cent.; in the South Atlantic, 24 per cent.; Indian Ocean, 13 per cent.; and North Pacific, 2 per cent. M. Thoulet has specially studied certain regions, partly from the point of view of submarine topography and microlithology, and partly with regard to the density of the water. He expresses the view that it may be possible in this way to locate the position of abysmal volcanoes, and perhaps to evaluate the degree of their activity.

**SUBSTITUTES FOR PETROLEUM.**—In his presidential address to the Mining and Geological Institute of India (published in the *Transactions*, vol. 19, 1924), Dr. E. H. Pascoe dealt with the development of the oil industry, and paid considerable attention to the question of vegetable and other products as substitutes for petroleum. Practical experiments have been made with palm oil in the Belgian Congo, where, under tropical conditions, it has been found possible to run a two-cycle semi-Diesel motor on this fuel, resulting in the development of 10 h.p. at 500 revolutions per minute. The calorific value of palm oil is, however, 20-25 per cent. less than that of crude petroleum, so that even if it could be used satisfactorily under temperate conditions, the greater consumption unit for unit would have to be balanced by low cost to make it an economic proposition. Castor oil has already been successfully used as a fuel for internal-combustion engines, though, as with pea-nut, soyabean, and coconut oils, its value for human consumption is great, and any application as fuel would involve the oil industry in serious competition with the food-stuffs and drugs industries. Tetralin is a tetra-hydro-naphthalene manufactured from coal-tar in Germany; this substance was used satisfactorily during the War in that country, when supplies of petrol were short, but it suffers from the same disadvantages as benzol, namely, rapid carbonisation

and difficulty in starting the engine on it from the cold. The prospect of an extended use of tetralin is doubtful. Alcohol is probably the most promising of all the liquid substitutes for oil, chiefly because of the variety of raw materials from which it can be manufactured, *e.g.* molasses (sugar waste), maize, potatoes, sawdust, sulphite liquors (from paper manufacture), artichokes, sorghum, various wild fruits and berries, peat, corn-stalks, garbage and other waste products. Dr. Pascoe concluded his address by urging attention to efficient carbonisation of coal, not only as helping to solve future fuel problems, but also owing to a growing demand for metallurgical coke. The problem of the conversion of cellulose into fermentable material by simple and economic chemical or bacteriological processes is likewise one worthy of thorough investigation, and in commending this and other researches having a similar end in view to Indians for the benefit of posterity as much as their own country, he voiced a plea deserving of world-wide notice and support.

**THE INITIAL VELOCITIES OF  $\alpha$  RAYS FROM POLONIUM.**—The  $\alpha$  rays emitted by the same radio-active body have been found to have very nearly the same velocity; Geiger, using radium C, finds this to be true to within 0.5 per cent. Mlle. I. Curie, using polonium, found that the ranges of its  $\alpha$  rays differed a little more than was to be expected by the theory; and in a paper in the *C.R. Acad. d. Sci., Paris*, March 16, she describes measurements made by the magnetic deviation method, to find the amount of difference in the velocity of these rays on emission. The rays were passed through two parallel slits before being deviated, and the width of the line formed on the photographic plate depended in part upon the relation between the velocity of the different rays emitted. Other factors affecting this width were investigated, various possible distributions of velocity were considered, and it is shown that it is necessary to measure the ratio between the intensity at the middle of the line and that at its edges. The final result is that there is no indication of any difference in the initial velocities; if it is assumed that the velocities are distributed uniformly between two limits, the extreme difference cannot be more than 0.3 per cent. If, on the other hand, the velocities are assumed to be distributed about the velocity  $V$  according to the probability law, 75 per cent. of the rays have velocities which differ by less than 0.3 per cent.

**THE THERMAL EXPANSION OF HALIDES OF THE ALKALI METALS AT VERY LOW TEMPERATURES.**—A series of measurements, carried out in collaboration with Frl. H. Krüger and Messrs. H. Wiens and J. Hähnel, is described by Frl. A. Henglein in the *Zeitschrift für physikalische Chemie* of February 25. The densities of sodium and potassium chlorides, bromides, and iodides were determined by the pycnometer method at 0° C. and -79° C., and it was found that salts prepared by fusion have a higher density than those crystallised from aqueous solution. The density was also determined with a gas volumometer at room temperature, 0° C., -70° C., and -184° C., the accuracy attained being about  $\pm 0.5$  per cent., using about one gram of salt. The densities are tabulated, those of sodium chloride together with the values of  $\nu$ , the distance between the centres of unlike ions of this substance and the mole volumes being given in the following table:

Temp.	Density.	$\nu \times 10^8$ cm.	Mole Volume.
0	2.168	2.813	26.97
-79°	2.186	2.805	26.74
-184°	2.208	2.796	26.48
-273°	...	2.793	26.41

Grüneisen's law (atomic heat/coefficient of expansion is a constant for all temperatures) holds, so that it is possible to calculate the molecular volume at absolute zero, and so find  $\nu$  at that temperature. The percentage alteration of the molecular volume from 0° to absolute zero is for sodium chloride, 2.1; potassium chloride, 2.1; potassium bromide, 2.3 per cent., or nearly the same number. When the cation remains the same, the coefficient of expansion increases with increased atomic weight of the anion; when the anion is the same, the coefficient diminishes with increased atomic weight of cation.

ALTERNATING CURRENTS AND OVER-VOLTAGE PHENOMENA.—S. Glasstone, in the April issue of the *Journal of the American Chemical Society*, records some observations on the effect of small alternating currents on cathodic and anodic over-voltage for a series of metals in normal acid and alkali. The results indicate that only in a limited number of cases does alternating current of small amplitude reduce the polarisation at such electrodes. A possible explanation of this reduction is discussed.

ATOMIC SPACING IN ORGANIC COMPOUNDS.—The results of X-ray investigations on saturated aliphatic ketones and hydrocarbons are recorded in the March number of the *Journal of the Chemical Society*. The work, which was carried out by W. B. Saville and G. Shearer in the case of the ketones and by A. Müller and W. B. Saville in the case of the hydrocarbons, shows that a study of the X-ray spacing gives an indication of the number of carbon atoms in ketones, and a consideration of the intensity distribution enables the position of the carbonyl group to be located within fairly narrow limits. All the (normal) hydrocarbons which were examined exhibited two typical sets of spacings, one, relatively large, increasing linearly with the number of carbon atoms in the molecule, and the other very nearly independent of this number. The increase per carbon atom of the long spacing is too large to be accounted for by the longest of the tetrahedral chains; some additional variable must be introduced to explain the behaviour. Octadecane,  $C_{18}H_{38}$ , and eicosane,  $C_{20}H_{42}$ , appear to exist in two crystalline modifications.

VISCOSITY AND ALLOTROPY OF GLASS.—The March issue of the *Journal of the Society of Glass Technology* contains a paper on the viscosity and allotropy of glass, by H. le Chatelier. M. le Chatelier gives a theoretical discussion of the work of Washburn and Shelton and of English, and finds that the results of these workers may be expressed by the relation  $\log(\log \eta) = M(t - 1000)/1000 + N$ , where  $\eta$  is the viscosity,  $M$  the rate of variation of  $\eta$  as a function of temperature  $t$ , and  $N$  is the viscosity at 1000°, *i.e.* in the middle of the working zone of glass. The greater  $N$  is, the harder is the glass; the smaller the value of  $M$ , the more extensive is the range of fusibility of the glass. No definite relation has been found between the chemical composition of glass and its range of fusibility, but a connexion definitely exists between composition and viscosity. Glass exhibits an allotropy phenomenon similar to sulphur, with the difference, however, that in the case of glass changing its state, only the law of variation of viscosity as a function of temperature is altered, not the absolute value. There is some uncertainty as to the temperature at which the transformation takes place.

COBALT.—An account of the production and uses of cobalt, by T. H. Gant, appears in *Chemistry and Industry* for February 13 and 20. The chief sources

of supply are Canada and Australia, the main ores being smaltite, cobaltite, and asbolite. The latter is a mixture of metallic oxides and may contain up to 30 per cent. cobalt oxide. In Canada, the ores are worked for the small quantities of precious metals which they contain, the cobalt being recovered as a by-product. The ore is smelted with a flux (*e.g.* lime if the ore is siliceous), a certain amount of iron being allowed to enter the speiss, or crude arsenide, which is formed. Its presence prevents the passage of cobalt into the slag in any appreciable quantity. The slag is re-smelted; the speiss is then calcined, the arsenic driven off being collected and sold. The roasted speiss, which contains about 10 per cent. of arsenic, is treated with hot hydrochloric acid and allowed to settle. The filtered mother liquor is nearly neutralised with lime, when nickel hydroxide and ferric arsenate are precipitated, enough iron having been added to convert all the arsenic to this compound in the acid treatment stage. The remaining arsenic and copper are removed by sulphuretted hydrogen, or, in the latter case, electrolytically. The solution now contains only cobalt and nickel chlorides; the former is precipitated by adding just the correct quantity of lime and the nickel solution, after separation, is precipitated by adding further quantities of lime. This method of separation of these metals has a very interesting history. The metal is obtained from the oxide by mixing the latter with a starchy material and heating to a high temperature in a retort. The principal and oldest use of cobalt oxides is in the ceramic industry; they are used as stains, either body stains, glaze stains, or under-glaze stains. Certain salts (*e.g.* hydroxide, borate, oleate) are finding use as driers; certain organic salts of cobalt are the most efficacious and convenient driers known. Cobalt, in the form of smalt, is also used for colouring enamels blue, and the oxide is used to neutralise any yellow colour in a white enamel caused by iron oxide. Electroplating with cobalt solutions seems to be more satisfactory than with nickel; the plating occurs much more rapidly and a lesser weight of hard cobalt deposit offers the same protective coat as a greater weight of the softer metal.

INDUSTRIAL ILLUMINATION.—Within recent years much attention has been directed to the rapidity with which operations involving vision can be accomplished under various intensities of illumination. The General Electric Co. of America has published in the *Journal of the Franklin Institute* for April a paper on this subject by P. W. Cobb, who is a psychologist, and F. K. Moss, who is a physicist. A large number of experiments were carried out, and definite curves connecting brightness with mechanical precision were obtained. Extreme values of brightness were not used, so the problem is not complicated by the introduction of glare. The results of this investigation prove that for accurate mechanical work the brightness must exceed a definite value. They can consequently be applied directly to many industrial operations. When the output is on a quantity production basis and the various operations follow one another at fixed and predetermined intervals, the gain in accuracy shown by the laboratory experiments in increasing the brightness to the definite value would be realised in practice. It has been objected that the better illumination induces the workers to function their eyes at an unnatural rate and so they would be more fatigued at the end of the day. The evidence, however, does not support this objection. Eye fatigue is not generally experienced in daylight, where the illumination is generally several hundred times that of present artificial lighting.