

Research Items.

ARCHAIC SCULPTURE, GORGONA ISLAND, SOUTH AMERICA.—Mr. James Hornell, who is the official ethnologist of the *St. George Expedition*, organised by the Scientific Expeditionary Research Association, gives in *Man* for June a detailed account of the archaic sculptures which were discovered on Gorgona Island, off the coast of Colombia. These sculptures were on two groups of boulders, the majority of the older examples being below present tidal level. On many of the stones it can only be discerned that designs have existed, but on four they are comparatively well preserved. These form an ordered group around a huge, roughly quadrangular boulder bearing upon its upper surface the representations of a pair of rude ungainly human figures, male and female, each with a number of rays around the head in the shape of a halo. The figures stand side by side. The male measures 1 ft. 10 in. in height. The outlines are formed by broad, shallow, rounded grooves. On another stone is a rudely sculptured stepped pyramid of four superimposed platforms, progressively decreasing in size. Six circular depressions or cups occupy the face of the third storey and the upper half of the second. This pyramid may be a representation of an early form of the Mayan and Aztec temple of the sun, the six cups representing astral deities. Of the other two boulders, each has a representation of a monkey of crude and childish design. Other sculptures, belonging to another and later group, and pottery and stone implements were also found.

AUSTRALIAN AND MELANESIAN AFFINITIES IN SOUTH AMERICA.—Dr. Paul Rivet, in a communication to the Académie des Sciences et Belles Lettres, which appears in the *Comptes rendus* covering the session 1924, discusses the evidence for concluding that certain of the peoples of Central and South America exhibit affinities to the Australians and Melanesians. Up to the present, all efforts to establish a connexion between the languages of America and of the Old World have failed except in the case of the Eskimo, whose language probably belongs to the Ural-Altaic group. Now, however, it appears that the Hoka group, comprising a great number of tribes, extending with some interruptions along the Pacific coast from the south of Oregon to Tehuantepec, shows marked similarities in vocabulary to the Melaneso-Polynesian languages. A second, known as the Tson group, which includes the Patagonians and the Ona, in like manner exhibits affinities with the Australian languages. It is remarkable that those resemblances are found among the rare words which are common to the highly differentiated Australian dialects. In each case the similarities are the more noteworthy because the Australian and Melanesian vocabularies, from which the material for comparison has been taken, contain a comparatively small number of words. In 1909, ten Kate and de Quatrefages both pointed out that a Californian people and the Lagoa Santa race presented affinities in osteological characters with the hypsisteno-cephalic race of Melanesia, and this has recently been confirmed by R. Verneau; while Graebner, Nordenskiöld and P. Schmidt have pointed to the remarkable similarities in South American and Melanesian material culture. In the case of the Australian, Verneau has pointed to the existence of a platy-brachycephalic type in Patagonia which is Australoid, and recently Lebzelter has described an Ona cranium in which this character is even more marked.

USES OF INTELLIGENCE TESTS.—The Bureau of Education, Washington, has issued a leaflet (City

School Leaflet, No. 20), dealing with the uses of intelligence tests in 215 cities. A questionnaire was sent to all superintendents of schools in cities of 10,000 or more population with the request that they should indicate the various purposes for which they are using tests in the elementary, junior, and high schools. The replies show that group intelligence tests are chiefly used in the schools for the purpose of classifying the pupils into homogeneous groups and for supplementing the teachers' estimates of pupils' ability, and to a much less degree for vocational guidance. Individual intelligence tests are chiefly used for dealing with subnormal children and for classification purposes; standardised educational tests are used for supplementing the teachers' estimates of the pupils' ability and for comparison with other school systems. Among the other purposes are: diagnosis of causes of failure, promotion, vocational guidance, establishment of classes both for subnormal and supernormal children. The three tables supply some interesting and valuable information. It is surprising to find that they are utilised for vocational guidance purposes to a relatively small extent.

"WATER SHUT-OFF" IN OILFIELDS.—Mr. F. G. Rappoport read a paper on this important subject before the Institution of Petroleum Technologists on May 5, wherein he demonstrated the necessity for close co-operation between chemist, engineer, and geologist in dealing with this problem. Little more than arbitrary methods of prevention, usually confined to a particular well, used to be adopted, with the result that though the well might temporarily benefit, it ultimately formed the means whereby water gained access to upper oil-bearing sands over a large area. Experience, however, has taught the lesson; so much so that to-day in many countries not only is there co-operation between the various operators concerned, but Government regulations also exist in order to enforce those measures essential to the control of water flow throughout the oilfields, for example, in California, Burma, Rumania, and the Dutch East Indies. From a chemical point of view the differentiation of waters associated with petroleum is a specialised analytical process which has developed greatly during the past few years; such differentiation is to some extent a means of sub-surface correlation of water sands, and hence often a key to the disposition of related oil sands. Cementation, the universal panacea for all water ills, implies chemical research on the particular cement used. The mechanical means of preventing water encroachment concern the field-engineers, who are not only responsible for the process of cementation or other method employed, but also, acting in consultation with chemist and geologist, are careful to ensure that proper and systematic casing of the well is carried out for water shut-off, as much as for lining the well, as a factor in production.

ESTONIAN OIL-SHALE INDUSTRY.—The Estonian oil-shale or "kukersite," as it is known, was first discovered by Engelhardt some 135 years ago, but its exploitation on a commercial scale only dates from 1919, after the Estonian Government had taken over the original shale mine from the Germans, following their occupation of the country in 1918. There are now two mines, one at Kohtla (open cut mining), the other at Kukruse (underground system); a third mine at Vanamoisa has lately been developed by a syndicate operating with British capital. For 1923 there was an output from the State mines of 206,000

metric tons, while 13,140 metric tons were produced in the same year by private companies. Some diamond drill boring has been carried out for the purpose of testing the extent of available resources of kukersite, and the high reserve of 3800 million tons has been estimated; to this must be added the resources of unexplored areas, which brings the estimated total up to 5000 million tons. Experimental distillation of the shale on a commercial scale, using a continuous producer-retort, has resulted in a throughput of about 8 tons in twenty-four hours, the yield of crude oil amounting to 20 per cent. of the weight of the raw shale. The ultimate composition of this oil is carbon 81.26 per cent., hydrogen 10.15 per cent., oxygen 7.26 per cent., sulphur 1.08 per cent., and nitrogen 0.25 per cent. According to Mr. P. N. Kogerman, from whose paper before the Institution of Petroleum Technologists on April 23 these facts were gathered, this oil is at present used mainly as a fuel oil, little fractionation being attempted, though steam distillation at 100° C. yields a light oil suitable for motor cars, while a heavier fraction of "motor oil" for oil-engines distils over between 280-300° C. The residue is a high quality "shale asphalt." The success of this experimental work has led to the erection of a large oil distillation plant, consisting of a battery of six retorts with a 200-ton shale capacity in twenty-four hours, capable of yielding 40 tons of oil per day.

THE CAUSES OF GLACIAL PERIODS.—Geological evidence leads to the conclusion that there has been a more or less regular series of glacial periods, alternating with warmer interglacial ones, in the history of the earth, but the theories advanced to explain their causes have been inadequate. A well-known Russian meteorologist, P. J. Brounov, has recently put forward in *Privoda*, a periodical of the Russian Academy of Sciences, 1924, No. 7-12, a theory based on astronomical and meteorological data. Formation of glaciers, according to him, depends not so much on coldness of climate as on the quantities of snow falling in a certain country. The main factor causing snowfalls are the ascending currents of air which are characteristic of cyclones. There are two zones of cyclones in the northern hemisphere—the northern, where the cyclones have a N.N.E. direction and bring snowfalls, and the southern, with warm, rain-bringing cyclones. The two zones are separated from each other along the zone of barometric maximum, which runs around the globe between latitudes 33° and 35°. The latitudinal position of this zone plays a most important part in determining the climate of the two cyclone zones. Its position, however, depends to a great extent on the velocity of rotation of the earth, since this influences deviation in the direction of cyclones. There is extensive astronomical evidence that the velocity of rotation of the earth undergoes fluctuations dependent on various causes. These fluctuations must result in corresponding shiftings of the zone of barometric maximum, that is, in considerable changes of climatic conditions in the cyclone zones. Acceleration of the velocity must result in shifting the zone of barometric maximum towards the equator, and that would mean a corresponding extension southwards of the northern zone of cold cyclones with snowfalls; on the other hand, when the rotation of the earth becomes slower, the zone of maximum is shifted northwards and warmer conditions prevail in the middle latitudes. During the last glacial period, according to Prof. Brounov, the zone of barometric maximum ran in Europe, roughly speaking, along the Mediterranean Sea; after that period it shifted northwards, which resulted in a relatively dry and warm period; at present the zone is apparently shifting

southwards, and Europe is threatened with a new glacial period.

A NEW PENTAMEROID BRACHIOPOD FROM ALASKA.—Mr. E. Kirk has published a description of Harpidium, a new pentameroid brachiopod from the Upper Silurian of south-eastern Alaska (Proc. U.S. Nat. Mus., vol. 66, art. 32). So far as at present known the genus is not represented elsewhere. It resembles Conchidium in its general proportions, and Pentamerus in being nonplicate, but Harpidium and Conchidium seem much closer genetically than either is to Pentamerus. No true Pentamerus has as yet been found in faunas of the north Pacific type, but in the interior of Alaska what appears to be a Pentamerus has been met with. The interior region of Alaska, however, has closer affinities with the Rocky Mountain geosyncline and the interior of America than it has with the true Pacific region. The more or less complete separation of Pacific and interior faunas seems to have held up to the time of the high middle Devonian, when there appears to have been fairly free communication between the two faunal regions. The author describes and figures three new species of Harpidium.

UPPER AIR IN EGYPT AND THE SUDAN.—The Ministry of Public Works, Egypt, has issued a Physical Department Paper, No. 17, on "The Upper Currents of the Atmosphere in Egypt and the Sudan," by Mr. L. J. Sutton, Director of the Meteorological Service. Pilot balloon observations were commenced at the Observatory of Helwân, 25 kilometres south of Cairo in 1907, and daily ascents have been made except on Fridays, during the four years 1920-1923. Other observations were made at Wadi Halfa, Khartoum, Mongala, and Roseires on the Blue Nile. The object of the paper is not only to find mean values of the wind velocity and direction at various heights but also, when possible, to associate these values with recognised types of pressure distribution at the surface; thus a study of the daily weather map will provide better assistance in anticipating the upper winds than can be obtained from mean values calculated without respect to the surface pressure. Eleven different types of weather in Egypt are considered, and the accompanying pressure and winds are illustrated by the several maps covering the surrounding neighbourhood for each. The frequency of occurrence for each type is given for the several months and for the year. The discussion will without doubt prove very helpful for aviation, and much valuable information is given of the upper air changes for the several stations and for the different types of weather.

A STUDENT'S THEODOLITE.—The teaching of practical surveying is often hampered by the fact that the number of instruments available for instructional purposes is small in relation to the number of students in the class. The cost of the apparatus is usually the cause of the scarcity. A Student's Theodolite, which has recently been placed on the market by Messrs. C. F. Casella and Co., Ltd., 49 Parliament Street, London, S.W.1, should help to overcome this difficulty. The tribrach, upper horizontal plates and standards are made of seasoned mahogany. The circles are of hard white celluloid, 6 inches in diameter, and engine machined to 1°. The telescope, which gives a magnification of about 4 diameters, has a fixed diaphragm, and both object-glass and eye-piece can be focussed. A graduated bubble and a trough compass are provided, and the instrument is mounted on a twofold tripod. The accuracy obtainable is not of the same order as that of a professional model, but the instrument reproduces all the essential features of a standard

transit theodolite. The outfit should prove of service not only in assisting students to obtain an acquaintance with the broad principles of survey work, but also in preparing them to use instruments with vernier or micrometer scales and other fine adjustments.

THE SPECTROSCOPIC DETECTION OF ISOTOPES.—In line spectra, due to electronic jumps in the atoms, the effect of isotopes is exceedingly minute, since the energy changes are governed by the amount of the nuclear charge, and the mass of the nucleus is of very little importance in determining the frequency of the emitted light. In a paper in the March issue of the *Physical Review*, Dr. R. S. Mulliken gives the results of an investigation of the band spectrum of boron monoxide, having shown in a previous paper that, in the case of a compound, one of the elements of which consists of two isotopes, two similar superposed band systems are to be expected, on somewhat different scales, and with intensities proportional to the relative amounts of the two isotopes in the element. The band spectra are due in part to electronic jumps, but also very largely to vibrations and rotations of the molecule, in which the masses of the nuclei are of importance, and the isotopic effects are considerable. Two such band systems exist in the spectrum of boron monoxide, the weaker and larger scale system being apparently due to the less abundant isotope, B¹⁰, and the other to B¹¹. At certain positions in the spectrum, differences of more than 40 Å.U. were observed between the wave-lengths of corresponding band heads. The measurements agree in a remarkable manner with the theory.

MEAN FREE PATH OF NEUTRAL SILVER ATOMS IN NITROGEN.—Dr. F. Bielz describes, in the *Zeitschrift für Physik*, April 28, a series of measurements made with an apparatus similar to that previously employed by Prof. Born and Fraulein Borman. A stream of silver atoms passed from a chamber, which was heated in an electric oven, through a narrow tube, into a space containing cool nitrogen at a low pressure, forming a narrow "beam." Three small glass plates at different distances from the entrance tube could be shifted in turn into the path of the beam by means of a magnetic arrangement, the times of exposure of the three plates being nearly equal. The thin layers of silver deposited were treated with iodine vapour to convert them into silver iodide, and their thicknesses, which varied with the distance from the entrance tube, were measured, using an Abbe microspectroscope and the Wiener interference method. The mean free path of the silver atoms was then calculated by means of a formula derived by the author, and it was found that the product of pressure and mean free path was constant, within the limits of experimental error, for pressures of 1 to 7×10^{-3} mm. Hg. The radius of the neutral silver atom calculated from this product is 1.0 Å.U.; values ranging from 0.57 Å.U. to 1.78 Å.U. have been found by other observers using other methods. Dr. Bielz states that no source of error occurs in his experiments which would make his value too low.

OPTICAL PHENOMENA AND THE QUANTUM THEORY.—In the April number of the *Physical Review*, Dr. J. C. Slater puts forward a detailed theory of optical phenomena, based on suggestions already made by him in conjunction with Bohr and Kramers (*Phil. Mag.*, vol. 47, p. 785). The atoms are supposed to radiate and absorb during the stationary states, and the transitions from orbit to orbit influence radiation only by terminating the radiation characteristic of the first state and commencing that of the second. The strict law of conservation of energy does not hold, since the atoms do not change their energy

while radiating, though the energy in the field of radiation increases during this interval; the atomic energy changes discontinuously during the transitions. There is, however, conservation of energy and of momentum, considering both the atomic energy and that of the radiation field, when an average is taken over a great number of atomic processes. The new suggestion is made that resonance radiation is to be identified with the radiation of the spherical wavelets which, by their interference with the external field, also produce absorption. Einstein's statement of the probabilities of the transitions of atoms is used, and the probability of interruptions of coherent vibrations is discussed. Detailed descriptions of the fields emitted, which consist of spherical wavelets with the frequencies of the various quantum lines which the atom can emit or absorb in its existing stationary state, are given, and it is shown how dispersion results. The assumptions made satisfy the correspondence principle, and the radiation field is essentially like that of the classical theory, which is known to agree generally with experiment. The theory gives a minimum value for the breadth of emission and absorption lines, which is the same for both classes and depends on the finite life of the wave-trains; Kirchhoff's law also holds for these lines. The applications of the new theory to emission of light by bombardment with electrons at the resonance potential, to resonance radiation and its quenching by foreign gases, and to absorption, scattering and dispersion are dealt with in a satisfactory manner.

TOTAL HEAT OF SUPERHEATED STEAM.—The electric lighting industry is looking forward to great improvements in steam generation in the boiler-house. During recent years the standard working steam pressures have risen from 200 lb. per sq. in. to 450 lb. per sq. in.; but much higher pressures are in use. The Edison Co. of Boston has boilers supplying steam at a pressure of 1200 lb. per sq. in. to a high back pressure turbo-generator. The exhaust steam is reheated to 700° F., and then enters a second turbine which is of ordinary construction. Engineers are contemplating even higher pressures. In the June issue of *World Power*, a valuable report by Prof. H. L. Callendar to the Electrical Research Association on the total heat of superheated steam at high pressures is published. Many conflicting tables have recently been published in Germany of the total heat at saturation. As a rule these have been obtained by extrapolating empirical formulæ representing small uncertain deviations at comparatively low pressures, little regard being paid to the well-known properties of fluids in the critical region. In this report Prof. Callendar describes a direct method of measuring the total heat which has already been applied successfully at moderate pressures and, provided the difficulty of regulating the pressure can be surmounted, there is no reason why it should not give with equal facility accurate results at the highest pressures obtainable. There are many advantages in the steady flow method of calorimetry which he adopts over the more ordinary methods. The difference of temperature to be measured is steady, and admits of direct observation by a single reading with a differential pair of platinum thermometers. No correction has to be applied for the water-equivalent which is so great a source of uncertainty at high temperatures. The flow of the fluid itself supplies sufficient stirring, and each part of the apparatus can be jacketed with its own flow. A discussion is given of the effect of time-lag in evaporation of nuclear drops. The primary object which the author has in view is the verification of the tables of the total heat near saturation, and his results will be of great value to the electrical industry.