

Research Items.

Indian Chronology.—In the *Indian Antiquary* for February Mr. F. J. Richards outlines a scheme of periods in Indian history which was originally put forward and discussed at a meeting of the Indian Section of the Royal Anthropological Institute. The object of the scheme is to correlate the periods of the historian with the ebb and flow of culture both inside and outside India. The historic period is divided into three 'major' divisions: (1) The Early, 600 B.C. to A.D. 300; (2) the Medieval, A.D. 300 to A.D. 1500; and (3) Modern, A.D. 1500 to A.D. 1900. Each of these is again subdivided into three. For the early period the suggested division is (I.) 600 B.C. to 300 B.C.; (II.) 300 B.C. to 1 B.C., and (III.) 1 B.C. to A.D. 300. Of these, I., 600 B.C. to 300 B.C., roughly answers to the Hellenic period of Europe, the Achæmenid period of Persia and the close of the Chou dynasty of China. In northern India it covers the rise of Jainism and Buddhism and the consolidation in the lower Gangetic plain of the kingdom of Magadha. Foreign influence is represented by the Persian conquest of the north-west in 512 B.C. and the invasion of Alexander. From 300 B.C. to A.D. 300, roughly the period of Hellenistic Greece and imperial Rome, covers in India the Mauryan empire at its zenith under Asoka and its partition between Sungas, Andhras and Greeks from Bactria, and at a later stage Sakas and Pahlavas from Iran, and secondly the rise and decline of the Kushan empire. Southern India is obscure, but Roman traders were busy in Malabar. As regards foreign contacts, the Mauryas were in touch with Greece, and the Kushans with Rome, but the main thrust came from China. In the period A.D. 300 to A.D. 650 when in Europe imperial headquarters were transferred to Constantinople, in northern India the 'Gupta period' falls into two phases with the Huna invasion (480 to 528). The period 650 to 1200 covers the struggle between the Byzantine Empire and Islam, and the second great expansion of China under the T'ang dynasty and the struggle with the Tartars. In India it answers to the Rajput period, a period of conflicting States around Kanauj. The period from 1200 to 1500, the closing epoch of the Roman empire and of Mongol domination in Asia, witnesses two phases in the Delhi sultanate, but in southern India interest centres in the Chalukyas of the western Deccan.

Mammals formerly eaten in the Dominican Republic.—The examination by Gerrit S. Miller of the remains of mammals from the food refuse of Indians, Spaniards, and an extinct owl left in the coast region of the Dominican Republic, has afforded interesting evidence of the presence of species now extinct, as well as of the peculiar tastes of the feeders. Nineteen species are represented, and although none is new to science, new light has been thrown upon the characters and distribution of some. The presence of a ground sloth is demonstrated in this recently extinct fauna; and there have been identified four of the native mammals, the hutia, the quemi, the mobuy, and the cori, which Oviedo y Valdés, the first European chronicler of West Indian history, stated about 1546, were habitually eaten by natives and Spaniards during the early years of the sixteenth century (*Smithsonian Misc. Coll.*, vol. 82, No. 5; 1929).

Polydactyly in Fowls.—The extra toe in fowls was first shown by Bateson to behave as an irregular dominant in inheritance, following the rule regularly in some families but being transmitted sometimes through normals without an extra toe. The extra

toe is also known to vary in size and in its freedom from the next. Bond has shown that in cases of asymmetry it occurs more frequently on the left than the right foot. Punnett and Pease (*Jour. of Genetics*, vol. 21, No. 3) have summarised the evidence on this subject and added some fresh data which are in accord with earlier results. They conclude that there is probably a definite factor for polydactyly, and that normals may transmit polydactyly owing to the presence of one or more factors which inhibit its expression. In some families, the F_1 are all polydactylous, the F_2 giving 3:1, and the back-cross a 1:1 ratio. This was especially true of the light dorking crosses. Moreover, out of 142 polydactylous chicks, only 7 showed any degree of asymmetry. The silky crosses gave more exceptions. It is suggested that certain 4-toed birds may really represent double asymmetry, factors being present which suppress both the right and left extra toe. Normal birds from a polydactylous parent sometimes in crosses with polydactyls give a high number of birds without an extra toe. Such normals are spoken of as 'resistant', and the evidence indicates that this condition is mainly due to the presence of one inhibitor. In certain cases, however, another factor must also be concerned in inhibiting the appearance of the extra toe. There is no evidence of linkage between polydactyly or asymmetry and sex.

Polyzoa.—The presidential address to the Linnean Society delivered by Sir Sidney Harmer on May 24, 1929, on Polyzoa, has recently been issued (*Proc. Linn. Soc.*, Session 141, 1930). In the first four sections all zoologists will find much of interest since they deal with the group in general, its economic importance, and early chapters of its history finishing with those connected with the names of Linné and Ellis. The latter had remarkably clear ideas on the Polyzoa for the time in which he worked. In recent years, a great deal of important work has been done on these animals by Jullien, Levinsen, Borg, and the author himself, the greater part of which has not yet found its way into the ordinary text-books and so is familiar only to those who have worked in the same field. These investigations have added greatly to our knowledge of the morphology and physiology of the group, and consequently modified its classification extensively. Sir Sidney Harmer has reviewed this work in a critical manner and provided a clearly illustrated account of its most important results. In the concluding pages is a discussion of the most recent classification that has been put forward by Borg. The whole forms an interesting and useful essay for which the author deserves the thanks of his colleagues.

Fresh-Water Crustacea of Norfolk.—Dr. Robert Gurney (*Trans. Norfolk and Norwich Nat. Hist. Soc.*, vol. 12, part 5, December 1929) gives a general survey of the fresh-water Crustacea of Norfolk. He considers the plankton of the Norfolk Broads belongs generically to the Baltic type, but it has marked specific differences attributable partly to marine influence and partly to the factors of depth, size, and climate. The shallow weed-grown Broads are extraordinarily rich in Entomostraca but the richness depends to a large extent on the nature of the vegetation and the salinity of the water. In general, the crustacean fauna is characterised by its great variety and the absence of all northern forms. Of the river crustaceans the most interesting is *Leander longirostris*, the 'white prawn' or 'jack shrimp', recorded for the first time as a British species in 1921, and now known to occur

also in the Tamar in Devonshire. This prawn is almost as much at home in fresh water as in salt water, its range of tolerance being much greater than that of *Palæmonetes varians*, which is very sensitive to water of low salinity. The jack shrimp, however, goes to the sea to hatch its young, and indeed its eggs will not hatch in fresh water, while the larvæ of *Palæmonetes* thrive in brackish water. The author does not accept the view that *Cordylophora lacustris* and *Dreissensia polymorpha* are two species actually in process of migration from the sea to fresh water. *Dreissensia* is very definitely a fresh-water species quite intolerant of salt water and there is no evidence that it has changed its habits in historic times. *Cordylophora* is not an estuarine or even a brackish-water form, and its distribution does not indicate recent penetration from the sea.

Fauna of Sinai.—The results of an expedition to the Sinai Peninsula in 1927, under the auspices of the Hebrew University of Jerusalem, have recently appeared as a small volume edited by Drs. F. S. Bodenheimer and O. Theodor and published by J. C. Hinrichs'sche Buchhandlung, Leipzig, 1929 (price 12 gold marks). The editors contribute general articles on the climate, topography, geology, etc., of the Peninsula, but the greater part of the book is devoted to the insect fauna. Probably the most interesting chapters are those devoted to the manna produced on tamarisk: the history of the subject, the insects responsible for the manna production, and the chemical composition of the latter being discussed. There are also separate articles by specialists dealing with the Orthoptera, Coccidæ, and Formicidæ collected by the expedition. With reference to the Orthoptera, it is noteworthy that the only previous account of these insects from the Peninsula is that of Krauss published in 1909. In the present collections one new genus and four new species are described, and there seems little doubt that a thorough exploration of the Sinai Orthoptera would throw considerable light upon the origin and evolution of the desert fauna generally. The report, it may be added, is well illustrated by text-figures and half-tone plates.

Cereal Breeding.—Dr. E. S. Beaven, chairman of the Council of the Institute of Agricultural Botany, made some interesting comments upon the work of the Institute at the meeting of its Council in December 1929, which received the tenth annual report. Referring particularly to the work of the Crop Improvement Branch, he pointed out that originally emphasis was laid, in the statement of the aims of the Institute, upon the growth and marketing for the trade of new varieties. He points out that, as a matter of fact, in ten years the Institute "has only distributed one new variety and that was only a modified form of an older variety already in cultivation". Dr. Beaven, from his long practical experience of cereal breeding, had anticipated this situation, in view of the fact that it was the Institute's declared policy "to market no new variety unless there is clear proof of its superiority to races already in cultivation in respect of probable monetary value to growers". Dr. Beaven pointed out the practical significance of another task carried out by the Institute: "the testing by systematic and repeated trials at our headquarters and sub-stations in six different locations—all in corn-growing areas—of the relative merits of different races of farm plants". Dr. Beaven also dealt with the practical question of the return for the outlay upon work of this type carried out by the Institute. The records of the Institute's trials show that there are frequently differences of 10-20 per cent in the values of the crops due to the variety or race of seed

sown. Dr. Beaven added: "It is a modest estimate that something over 5 per cent would be added to the monetary return of the arable farmers of the country if they all grew the races of plants best suited to their localities and soil conditions. That would add about £2,000,000 every year to the net returns for arable farm produce."

Earth-Tiltings before Earthquakes.—Two interesting papers have recently appeared on the tilting of the ground before earthquakes in Japan. Messrs. W. Inouye and T. Sugiyama have examined the records for nearly two years, 1927-29, of a pair of tiltometers erected at the seismological station half-way up Mt. Tukuba (*Proc. Imp. Acad.*, Tokyo, vol. 5, pp. 457-459; 1929). The vector-diagrams show that the earth-tiltings exhibit an annual variation probably connected with changes of air-temperature. From time to time, this regular variation is disturbed by irregular fluctuations of short period during which the earthquakes of the district usually occurred. The centres of two of these earthquakes were close to Mt. Tukuba. Before each shock, earth-tiltings were more or less pronounced for a month or more and they ended simultaneously with its occurrence. Prof. A. Imamura and Mr. T. Kodaira have made similar observations on the tiltings before the Kii earthquake of July 4, 1929 (*Proc. Imp. Acad.*, Tokyo, vol. 5, pp. 460-462; 1929). The earth-tiltings at Tanabe, 12½ miles from the epicentre, showed that the regular annual variation was interrupted by a 'tilt-storm' on June 20. This lasted until July 3, when the tiltings returned to normal conditions, the earthquake occurring on the following day. The authors of both papers conclude that the abnormal tiltings observed were actual precursors of the earthquakes.

A Grating Periodograph.—An interesting application of the methods of pure science to an important industrial problem is described in the January number (vol. 21) of the *Journal of the Textile Institute*, which contains a paper by G. A. R. Foster on "The Grating Periodograph for the Analysis of Series of Observations for Hidden Periodicities". Though the procedure described is applicable to the analysis of any series of observations in which periodicities are suspected, it has been developed at the Shirley Institute, the headquarters of the British Cotton Industry Research Association, expressly for the purpose of detecting periodic variations in the dimensions and properties of cotton yarns as produced under various manufacturing conditions. Briefly, the method consists of throwing an image of the graph to be tested, via a grating, on to a ground glass screen or photographic plate. If the area under the curve has been previously blackened out, there are formed, at certain distances of screen and grating, bands of light and dark fringes of spacing simply related to the hidden periodicities of the curve. Both the practical details and the theory of the method are given. It is undoubtedly a simple and elegant way of carrying out a periodogram analysis, which furthermore allows Schuster's method of secondary analysis to be performed in a very convenient manner.

Illumination Requirements.—A statistical analysis of the requirements in artificial light of the average American family was recently presented before the New York section of the American Institute of Electrical Engineers. The authors commenced by analysing needs in regard to 'work illumination' (reading, writing, sewing, factory work, etc.), 'social illumination' (in the home, places of public assembly, etc.), and 'utility illumination' (passages, store

rooms, streets, etc.). For these the following values of illumination (foot-candles) are suggested :

	Activities requiring—		
	Work Illumination.	Social Illumination.	Utility Illumination.
A. Minimum present good practice	15	5	3
B. Minimum recommended	30	10	5
C. Probable levels of greatest economic advantage	50	15	5
D. Possible desirable levels from eye-considerations only	300	50	30

An attempt is next made to determine the 'light-hour' needs of the average family and hence the possible total demand for electrical energy for light in the United States. The estimate based only on consideration of the eye (D) attains the prodigious total of 778,900 millions of units a year. It appears that the total actual consumption of electricity for lighting in 1929 was about 20,000 million units. It is estimated that at the levels in the above table the saturation is respectively 30, 17, 13, and 3 per cent.

Conduction of Electricity in Metals.—On the classical electron theory of metals, the exact hypotheses made concerning the type or absence of directed motion of the electrons were often not of great importance for the final description of any particular effect. This result, which, although scarcely to be expected, was frequently useful, has now been shown by T. E. Stern, in a paper in the March number of the *Proceedings of the Royal Society*, to be closely connected with the fact that on classical theory the kinetic energy of the electrons is a linear function of their density. On Prof. Sommerfeld's theory, in which the electrons are treated as a degenerate gas, the linear dependence of energy upon density disappears, and with it the equivalence of the different methods of analysis. The properties of a metal which is passing a current cannot be safely deduced from those of an insulated metal, without making careful inquiry as to the nature of the phenomenon in question, a general result which is illustrated by the special cases of the Thomson effect, the evaporation of electrons, and some others. Mr. Stern also raises the question of the applicability of thermodynamical reasoning, such as was applied by Kelvin to the thermoelectric circuit—a problem also recently treated by Bridgman—but shows that Sommerfeld's formula for a thermal electromotive force is in at least approximate accord with Kelvin's results. Mr. Stern's conclusions, although expressed in terms of the present electron theory of metals, are not entirely dependent on this, but retain their main features for any theory in which the kinetic energy is not proportional to the density.

The Kennelly-Heaviside Layer—The Radio Research Board has issued a report of the work carried out from the foundation of the Board until March 1929. It is the first of a series of annual reports. We learn that four committees have been appointed to study the problems connected with the propagation of radio waves, atmospherics, directional radio, and thermionic valves respectively. In each of these committees radio physicists and practical engineers are adequately represented. It is stated that the most important result obtained in the study of wave propagation is the direct experimental proof of the existence of the Kennelly-Heaviside layer. Observa-

tions under Prof. E. V. Appleton's supervision were made at King's College, London, and at Cambridge and Peterborough with the primary object of investigating the effects of ionisation of the atmosphere on signal fading and the propagation of waves in general. Considerable use was also made of a second method in which the variations of signal strength in a loop and vertical aerial are compared. Transmissions on waves of 100 metres length from the National Physical Laboratory were observed simultaneously at the three stations. Downcoming waves were detected at King's College, only eleven miles from the transmitter, almost as easily as they were detected at Cambridge and Peterborough. This indicates reflection on this wavelength at almost vertical incidence. The results obtained from the three stations show very close agreement. The height at which deviation of waves takes place appeared to be normally 50-70 miles, but on many occasions in the middle of the night the height was found to be 130-180 miles. On such occasions the lower region is re-formed after sunrise and lower heights from 50 miles to 70 miles in height are again found. Day observations indicate that a third ionised region exists beneath the reflecting layers, which, however, merely attenuates the waves.

Equilibria in Sulphur Dioxide Solutions.—In spite of the fact that sulphur dioxide is such a well-known compound, there is surprisingly little information in the literature as to the properties of its aqueous solutions. In the January number of the *Canadian Journal of Research* (National Research Council of Canada), which contains several other interesting communications, there is a study by W. B. Campbell and O. Maas of the equilibria in solutions of sulphur dioxide, which has a bearing on the sulphite cellulose industry. They point out that the sulphurous acid behaves as monobasic even at high dilutions, so that SO_2 , H_2SO_3 , H^+ and HSO_3' are the constituents concerned. The proportion of H_2SO_3 decreases rapidly with rise of temperature, whilst the true ionisation constant $K = [\text{H}^+][\text{HSO}_3']/[\text{H}_2\text{SO}_3]$ is 0.03 and does not change much with temperature. Experiments on vapour pressures, densities, and conductivities of solutions of concentrations up to 8 per cent and temperatures to 110° are described which extend the results just stated. These show that sulphurous acid is a strong acid, the apparently weak character being due to lack of hydration of sulphur dioxide in solution.

Ignition of Carbon Monoxide.—It is well known that the ignition of a mixture of carbon monoxide and oxygen is greatly promoted by the presence of small amounts of water vapour or of hydrogen. In the February number of the *Journal of the Chemical Society*, Smithells, Whitaker, and Holmes describe experiments in which the efficiencies of hydrogen and water vapour are compared by passing a spark through two eudiometers in series, one containing the carbon monoxide-oxygen mixture with hydrogen and the other the mixture with water vapour in equimolecular amount. When the drying of the carbon monoxide-oxygen mixture had not been greatly prolonged, it was found that hydrogen was more effective than water vapour, the estimated minimum quantities being 0.03 per cent and 0.12 per cent. With more intense drying of the combustible mixture, the activity of the hydrogen was altogether inhibited. In other words, the superior catalytic effectiveness of hydrogen was in its turn conditioned by the presence of a minimal quantity of water vapour. It may equally well be said, alternatively, that in the presence of hydrogen a minimal quantity of water sufficed to confer ignitability.