

Research Items

Iron Age Site, Kilpauk, Madras. A preliminary report on the excavation of what promises to be an important site in the prehistory of southern India has been published by Messrs. M. D. Raghavan and T. G. Aravamuthan (*Current Sci.*, 3, No. 3). The prehistoric cemetery of Kilpauk, Madras, situated in the garden of a bungalow belonging to Mr. E. R. Prudhomme, has been known for about twelve years, and a number of specimens of pottery and a small sarcophagus had been found in the course of laying out the garden. No attempt had been made to explore the site systematically until August last, when operations were begun on behalf of the Madras Government Museum. Up to the date of writing, the authors had extracted a quantity of black-tipped ware, in which the rim and inside are black and the rest red, all-black ware, a figurine of black pottery of high finish, apparently representing a bird, and half of a fine pottery head. Two iron objects were found, of which one was a small hoe blade of a very primitive type with a slightly curved cutting edge and a narrow butt, and the other a stick of iron, about six inches long. The most important find, however, was a sarcophagus about six feet in length, standing on six pairs of short legs, closely resembling specimens found at Pallavaram and Perumbair. It was filled with sand and bits of pottery. A fragment of a human tibia was found nearby. The sarcophagus had been badly damaged by a mango tree root and could not be removed whole. The site has certain distinctive features which mark it off from other prehistoric sites, such as the occurrence of both urn burials and sarcophagus burials, and the abundance of fine pottery. The all-black vessels distinguish Kilpauk from both Perumbair and Adichanallur. Beyond an attribution to the iron age of Southern India, it is as yet too early to attempt any precision in chronological classification.

Pawnee Ritual Games. The Pawnee ghost dance hand game has been made the subject of a study in cultural change by Dr. Alexander Lesser, based in part on field-work among the Pawnee Indians under a project supported by the Columbia Council for Research in the Social Sciences (Columbia Univ. Cont. to Anthropology, No. 16). The Pawnee first came under the United States Government with the purchase of the Louisiana territory in 1803. Their native economy of buffalo hunting accompanied by a digging-stick cultivation of corn and squash broke down with the coming of white settlement, and in 1874-76 they were moved from Nebraska to reservation land in Oklahoma. By 1892, when the Ghost Dance appeared among them, their culture had completely broken down, owing to a great extent to the efforts of the Government to substitute individual agricultural holdings for their village system. Their ceremonies had become functionless and extinct, while their arts, which had centred on the buffalo, had disappeared. They had nothing to look forward to and nothing to live by. The Ghost Dance gave them a new aspiration. In the form of the ritual among the Pawnee the hand game, a gambling game, which under the traditional culture had been associated with hunting and warfare, played an important part. Though there were no longer material stakes, there was still a feeling about winning and losing.

In place of the opposing sides being based upon tribal divisions, they were constituted by such distinctions as 'visionaries' against 'innocents', men and women and the like. The incorporation of the hand game in the ghost dance ceremonial seems to have reached the Pawnee from the Arapaho. Only four other tribes appear to have developed the game in this manner. Not only did these games satisfy the desire for creative effort, but the ceremonies were the occasion of social gatherings on a large scale, which lasted over four days, meeting a real need when the tribe had been scattered over allotments.

Bionomics of the Tsetse Fly on the Gold Coast. The species of tsetse fly, *Glossina longipalpis*, Wied., is of great importance as a vector of human and animal trypanosomiasis in West Africa. Of the common tsetse flies, *G. longipalpis* appears to have been the least investigated. The bionomics of this insect in the country around the Gold Coast port of Takoradi forms the subject of a recent paper by Mr. K. R. S. Morris (*Bull. Ent. Res.*, 25, part 3, Sept. 1934). It appears that the main food hosts of this species were bushbuck and duiker. When these small game animals were driven out of a specific fly-belt by farming and wood-cutting, the insect quickly and completely disappeared. Its distribution is dependent more upon humidity than upon temperature. The main vegetational types frequented by the insect are transition forest, inland savannah forest and coastal savannah, where the range of humidities is between 50 and 80 per cent (relative humidity) and the temperature between 75° and 85° F. It does not occur in the rain forest, where the relative humidity is above 80 per cent, or in the northern savannah, where it is as low as 30 per cent in the dry season. By statistical methods, coefficients of correlation were determined for the fly's density-activity and various climatic factors of the fly-belt. The main policy for control should lie in improving and directing the native's methods of bush cultivation. Farms should be as close to villages as possible, contiguous and kept under permanent cultivation. Clearings should be made at least 100 yards wide around bush villages and at least 200 yards wide around important towns. Small clearings and isolated farms are regarded as a danger.

Habits of *Aequidens latifrons*. The Cichlid fishes are always favourites in aquaria and have peculiar breeding habits, either attaching their eggs to some solid support and guarding them, or carrying them in the mouth until hatched. Mr. C. M. Breder, Jr., of the New York Aquarium, in "An Experimental Study of the Reproductive Habits and Life History of the Cichlid Fish *Aequidens latifrons* (Steindachner)" (*Zoologica. Sci. Contrib. New York Zoo. Soc.*, 18, No. 1, 1934) studies a species which deposits its eggs on a substratum. The fishes were the aquarium-bred offspring of specimens collected in 1931 by Mr. A. Eisinger at Barranquilla, Columbia, and were brought to the New York Aquarium when still very small. Their behaviour appeared quite normal and like those studied under field conditions. Eggs may be laid every twenty-five days at a temperature of about 25° C., and hatch in two or three days. They are fanned by the parents' fins during the whole of the

incubation period, and the young are protected until another lot of eggs is ready to be laid. The parental care is strikingly shown in the way that both eggs and young are guarded in the aquarium, for they have many enemies and are eagerly eaten by the non-breeding adults present. If the fishes are disturbed they may remove the eggs altogether, taking them carefully one by one to some sandy hollow and incubating them there. The experiments devised in this research are ingenious, and the sketches and photographs which accompany the paper are very interesting.

Resistance of Mice to Irradiation. Jerome Davis (*Amer. Nat.*, 68, Sept.-Oct. 1934) discusses the results which he has obtained on the effect of ultra-violet light on mice. Six generations of hairless mice were subjected to ultra-violet light, and a control group was maintained which did not receive this treatment. Three animals from two litters of the sixth irradiated generation, and two controls of the same age were irradiated together. Slight peeling began on the controls after one exposure, but in the experimental animals not until after the fourth exposure. At the end of fifteen exposures, the controls were severely burned, whereas the experimental animals were only slightly so. In the experimental group the burns disappeared within six days, leaving the animals quite normal. The controls, on the other hand, developed hard callouses due to hyperplasia of the epithelium. Davis tentatively suggests that the difference in response to irradiation between the irradiated and control mice may be due to the inheritance of acquired resistance to irradiation. The author, acknowledging that the results are inconclusive, suggests that they may incite others to repeat and extend his work. But it is to be hoped that he will stage a Mendelian experiment with his own stock. It should be a simple matter to show that the tolerance is, or is not, indeed inherited.

Evolution in the Agarics. A long paper by Mr. E. J. H. Corner of Singapore, "An Evolutionary Study in Agarics; *Collybia apalosarca* and the Veils", has appeared (*Trans. Brit. Mycol. Soc.*, 19, 39-88, Oct. 1934). The account traces the formation and anatomy of the fruit body of *C. apalosarca*, a toadstool-like fungus found growing on wood in Malaya. Characters of the species are given in detail, whilst a new form, *radicans*, and a new variety, *perstipitata*, are also described. The structure of the mature fruit body has been investigated microscopically, and times of spore shedding are correlated with size of the fructification. *C. apalosarca* forms an evolutionary link between *C. radicata* and *Armillaria mucida*, and several interesting comparisons are drawn. For example, the 'root' of *C. radicata* is represented by the lower half of the stem in *C. apalosarca* and by the stem and persistent ring of *A. mucida*. *C. radicata* is supposed to have developed from a naked ancestor; *C. apalosarca* and *A. mucida* from a similar veiled ancestor, whilst the newly-described form and variety mentioned above are intermediates which uphold the hypothesis.

Oxidising Agents as Fertilisers. Iyer, Rajagopalna and Subrahmanyam (*Proc. Indian Acad. Sci.*, 1, No. 2, p. 106) describe interesting effects of various oxidising agents on crop yield and certain chemical and biological transformations in the soil. Some remarkable increases in yield are recorded, up to 100

per cent, for example, with tomato plants on soil treated with manganese dioxide. Certain other crops responded better to potassium permanganate. Ammonification, with organic manures, was slightly favoured by oxidising agents, and increased oxidation of organic matter was demonstrated by the increased production of carbon dioxide corresponding to the loss of carbon. The treatment also resulted in a temporary increase in the numbers of bacteria and Actinomyces, whilst in some cases depression of fungi occurred. It appears that the results are due more to the facility with which the added substances part with their oxygen than to the effect of the metallic ion, hydrogen peroxide producing effects similar to those of manganese dioxide. Increased formation of bacterial food and consequent increased activity may be involved as well as direct oxidation of organic matter to simpler substances and carbon dioxide.

Deformations of the Crust around Sakura-jima (Japan). Until 1914, Sakura-jima was a volcanic island at the northern end of Kagoshima Bay. After the great eruption on January 12 of that year, it was joined by a stream of lava to the mainland. Series of precise levellings were carried round the head of the bay in 1891-98, 1914, 1915, 1919 and 1932. Prof. C. Tsuboi (*Earthq. Res. Inst. Bull.*, 7, 103-114; 1929) examined the changes during the first two intervals. The graphs are similar in form; each consists of segments of straight lines, and the ends of segments lie on the same abscissæ, which, according to Tsuboi, correspond with the boundaries of six crust-blocks round the head of the bay. In three of these blocks, the amounts of tilting were 9°, 10° and 12°, and the directions converge towards a point a short distance to the north of the crater. Prof. N. Miyabe has continued the work for the last two intervals (*Bull.*, 12, 471-481; 1934). In both, the vertical displacement was reversed in direction, the recovery being at first somewhat rapid. In one crust-block (west of the volcano), the tilting occurred in the same direction as before. In the other two (to the east), the direction of tilting was almost exactly reversed, though less in amount.

Meteorology of the West Indies. The "Handbuch der Klimatologie" of W. Köppen and R. Geiger when complete will be in five volumes (Berlin: Gebrüder Borntraeger, 1934). A number of different parts of this work have already appeared as each has been completed, of which the most recent (Band 2, Teil 1) is entitled "Climatology of the West Indies". The text of this was written in 1927 by the late Prof. R. de C. Ward, formerly professor of climatology at Harvard University, who compiled his account largely on the basis of summaries by W. W. Reed that had appeared a year earlier in the *Monthly Weather Review*. Prof. C. F. Brooks, director of Blue Hill Observatory, with the help of Miss E. M. Fitton and others, extended the tables and summaries; finally Prof. Ward revised the whole work shortly before his death. European meteorologists hear of these regions chiefly in connexion with tropical hurricanes, but the introductory part of this work shows that there are other aspects of their meteorology of almost equal interest. The West Indies show great uniformity of temperature, such as is to be expected of islands of which the greater number lie just within the tropics, but those nearest to the mainland of Central America feel to some extent the effect of the winter cold waves of North America, resulting from south-

ward incursions of polar air; the more easterly and southerly members of the group escape these effects and have a correspondingly small annual range (2° C. only at Barbados). While temperature changes are unexciting and the simple régime of the north-east trade winds is only rarely disturbed by a hurricane, rainfall shows great variability both in the amount experienced in different years at one place and in the normal amount received at places no great distance apart. At Silver Hill, Jamaica, the total fall in three days, November 5-7, 1909, was 2,159 mm. (85 in.) and in the seven days to November 11, it was 3,428 mm. (135 in.). In the same island, two places only 30 miles apart and differing in elevation by only 189 metres have normal annual totals of 735 and 5,638 mm. respectively. The numerous detailed tables in this work repay study, for example, Table 12, which shows thunderstorm frequency. Some of the islands have only about the same number as the English Midlands, but at Port au Prince (Haiti) the annual frequency is about 107.

The Energies of the Positrons in Induced Radioactivity. Y. Nishira, R. Sagane, M. Takeuchi and R. Tomita (*Sci. Pap. Inst. Phys. Chem. Res., Tokyo*, Sept. 1934) have investigated the energy distribution spectrum of the positrons emitted for radio phosphorus ($_{15}\text{P}^{30}$) obtained by activating aluminium by bombardment with α -particles. The activated metal was brought up to a Wilson cloud chamber arranged in a solenoid. The positrons passed through a thin aluminium window into the chamber. The energy distribution is apparently continuous, with a maximum intensity about 0.8×10^6 e.v., and the upper limit of energy is probably in the neighbourhood of 4×10^6 e.v. The results are compared with those obtained by Curie-Joliot, Meitner, Alichanow and others, and by Ellis and Henderson, and published in recent papers. Most of these authors find a rather lower value for the energy at the upper limit. It is suspected that there are other peaks in the energy distribution, but these may well be due simply to statistical fluctuations.

Fast Mercury Ions and the Excitation of X-Rays. D. H. Sloan and W. M. Coates have recently described the further development of the Laurence-Sloan apparatus for accelerating heavy ions in stages to energies of the order 3 million volts (*Phys. Rev.*, Oct. 1). The ions travel through a series of copper tubes which are connected alternately to opposite poles of a high-frequency circuit, and the length of the accelerators is so arranged that an ion once accelerated into the first cylinder passes from one to another always at the right time to receive an acceleration. Detail improvements in the accelerators and their connexions enable higher voltages to be employed than formerly. The maximum voltage applied is 79,000 volts at about 10 megacycles, and about 10 kw. is supplied to the oscillator. About 10^{-8} amp. of mercury ions were obtained at 2.8×10^6 volts. A second paper by W. M. Coates describes the production of X-rays by mercury ions having energies up to 2.4 million electron volts. The X-rays were definitely produced by the ions since they were unaffected by the use of electric and magnetic fields sufficient to eliminate cathode rays from the beam striking the target, while they were stopped by a foil which stopped the positive ions but would be transparent to X-rays produced in other parts of the tube. No radiation was observed from targets of lithium, boron, oxygen,

sodium, nickel or copper. X-rays were detected and the absorption coefficients measured in aluminium and air, for the target elements aluminium, sulphur (probably *K*-radiation), bromine (probably *L*-radiation), molybdenum, silver, tin and lead (radiation not identified with certainty). The radiation was in all cases too weak to measure below 300 kv., and increased rapidly with increasing energy of the ions. It is suggested that these rays are produced by the bombarding ion and the target atom approaching sufficiently close to form a quasi-molecule with the two *M* shells (say) overlapping. When the 'molecule' breaks up, one of the atoms loses one of its inner electrons and the subsequent rearrangement gives rise to characteristic radiation. The observed threshold value for the energy of the exciting ion gives a distance of approach of the two nuclei which agrees roughly with this hypothesis.

Tidal Friction and Planetary Motion. Much time and labour were devoted by the late Sir G. H. Darwin to a step-by-step investigation of the cumulative effects of tidal friction upon the motion of the earth and moon. Lord Kelvin suggested that a more general and less laborious treatment could be obtained by considering the energy and angular momentum. In recent times the problem has been taken up again, by the aid of general theorems in Hamiltonian dynamics. T. Levi-Civita, who has himself worked on the subject, gives (*Amer. Math. Mon.*, 41, 1934) an account of the methods used by G. Krall, which are remarkable in that they enable one to describe the behaviour of a planetary system after an indefinitely great time without calculating the intermediate stages. The conclusions are that everything tends towards a state of uniformity, in which all the bodies will describe circular orbits about their common centre of mass with equal angular velocities. Moreover, each axis of rotation will be perpendicular to the orbital plane, and the period about this axis will be the same for all. In other words, on each planet the length of the year will be the same, and also the length of the day, and there will be no distinction between summer and winter. The above results are for systems which have kinetic energy of rotation comparable with that of translation. A case which has not yet been worked out is that in which the resultant angular momentum is zero. The ultimate fate of such a planetary system would be a catastrophe in which all the bodies collided.

Sunspot Numbers. Tables of monthly and annual sunspot numbers from 1749 to 1933, as determined at Zurich, are given in the September issue of *Terrestrial Magnetism and Atmospheric Electricity*, and are accompanied by a similar table, for the years 1917-33, of the sunspot numbers derived from the central zone of the sun, and a table of monthly intensity of ultra-violet solar radiation at Mount Wilson for the period 1924-33. Diagrams for 1923-33 of the central-zone *daily* sunspot numbers, and of the international daily magnetic character figures, arranged in 27-day sequences, are given by J. Bartels, and illustrate again the fact that strong and long-lived active regions occur on the sun, which affect the earth's magnetic state, even throughout periods in which the sun is practically spotless. The same issue contains two articles, by H. W. Wells and L. V. Berkner, on measurements of the *E* and *F* ionised layers of the atmosphere above Huancayo, in Peru, at latitude 12° S.