Research Items

Stone Pipes in South Africa

SOME interesting deductions as to early tribal distributions are drawn from the evidence of ancient stone pipes found in the Orange River Colony which, with other objects, have recently come into the possession of the National Museum, Bloemfontein (*Argeologiese Navorsing van die Nas. Mus.*, 2, 2–4). A small decorated pipe of sandstone, coming from the vicinity of Bethlehem, is described by Dr. E. C. N. van Hoepen. It is decorated with grooves, the surface between the grooves being marked with curved and straight lines, but no system or figure can be made out. In contrast, the "Susanna" pipe found nearby is characterised by a snake-figure. This, it is suggested, was the totem or *siboko* of the maker's tribe, which would have been called the Banoga. A tribe of that name now lives near Potchefstroom, claiming to be a branch of the Bahurutsi. Another pipe, also described by Dr. van Hoepen, comes from Buispoort. It shows two vertical figures separated by fields of hanging lines. The figures are shown to represent crocodiles. If these represent the totem of the maker, he must have been one of the Baquena, or possibly of the Bahurutsi, in whose territory the pipe was found, and who are a younger branch of the Baquena. Several pipes from Uitvlugt, near Bethlehem, are also described; but decoration being absent, or consisting only of parallel lines or grooves with a number of connected V's, gives no clue to the makers. A small pipe from Drakenstein also shows the V ornament. The design of grooves and V's as a whole may represent a highly conventionalised vine with leaves and fruit, the *siboko* of the Bamorara, a Baquena people, whose ancestors may have lived in the vicinity of Bethlehem. The interest of these pipes lies in the fact that they come from the territorial limits of peoples who once made stone pipes, erected stone kraals and built stone houses.

Air-breathing Fishes of India

IN a recent important contribution to our knowledge of air-breathing fishes (*Trans. Nat. Inst. Sci. India*, 1, No. 1), Dr. S. L. Hora directs attention to the habitats and habits of the numerous air-breathing fishes of India. He groups them into four ecological associations: (1) fishes of fast-running streams; (2) marshy area fishes; (3) estuarine fishes; and (4) marine fishes; and discusses the factors which appear to have influenced or induced the air-breathing habit in these various environments. In a detailed study of the respiratory function itself, the author has repeated many of the 'drowning' experiments of previous workers and devised a number of new ones. From these laboratory experiments, backed by exceptionally extensive field observations, the conclusion is reached that in all these fishes, with the single exception of *Heteropneustes fossilis*, "the aquatic and aerial respiratory surfaces are capable of interchanging their functions". Whether a fish depends mainly upon aquatic or aerial respiration, therefore, it can live both under water and out of it. Evidence is presented in support of the contention that, in the 'drowning' experiments of previous workers, the quick death of certain of the fishes, when debarred from having access to atmospheric air, was due either to the foulness of the water or to the locking up of air in the air chambers. When such entrapped air surrounding the respiratory epithelium becomes deoxygenated, suffocation and death ensue. The respiratory current is rendered ineffective because it cannot bathe the respiratory surfaces. If this entrapped air be pressed out of the respiratory cavities, for example, in *Anabas* and *Ophicephalus*, so that water may freely enter, aquatic respiration is carried on, and the fish continue to live quite happily for long periods even when kept totally submerged.

The Aleurodidæ of Malaya

AMONG a number of papers published in vol. 17, Part 4 (November 1935) of the *Journal of the Federated Malay States Museums*, brief mention may be made of Mr. G. H. Corbett's contribution on the Aleurodidæ or 'white flies' of Malaya. The fact that, out of 124 species recorded in this paper, 94 are described as new, is an indication of how little many groups of insects have been explored in tropical lands. In the present case, the material had been collected mostly in the vicinity of Kuala Lumpur, Selangor, and consequently the area of Malaya, as yet little explored for these creatures, will doubtlessly yield many more forms. In the text-figures the pupa case, and often certain detailed structural features, are portrayed in the case of more than a hundred species. All the new genera (four in number) and species are based upon characters afforded by the pupal cases; it is not stated whether the imagines were reared in any instances or not, and none is described. The largest number of species (57) is comprised in the genus *Dialeurodes*, which is evidently dominant in the area concerned.

Antigenic Components of Botulinus Toxins

THE micro-organism, *Clostridium botulinum* (*Bacillus botulinus*), the toxins of which when present in foodstuffs give rise to the form of food-poisoning known as botulism, has been subdivided into several types or varieties; these differ in some of their cultural characters, and particularly in their immunological relationships. The *A* and *B* types, which especially affect man, are monospecific, that is, their toxins are distinct in that the toxin of one is not neutralised by the antitoxin of the other. Types *C* and *D* mostly affect birds and farm animals, and their toxins are similarly not identical, though not so specific as those of *A* and *B*. According to J. H. Mason and E. M. Robinson (*Onderstepoort J.*, 5, No. 1, July 1935, p. 65), the *C* type toxins contain three components, C_1, C_2 and *D*, the latter in only very small amount. The *D* type toxin contains chiefly the *D* component, with a small quantity of the *C* fraction.

Gas Bubbles in Living Plant Cells

MISS LILIAN FRASER, writing from the School of Botany, University of Sydney, records the occurrence of gas bubbles within air-dry living cells of a number of fungi, liverworts, etc. She suggests that gas is

present in solution under pressure in the turgid cell, and on release of pressure by loss of water some of the gas comes out of solution and appears as a bubble. Her attention was attracted to the phenomenon during her studies of the Australian sooty mould fungi, which form a superficial mat on the leaves and stems of plants attacked by scale insects or aphis. Such fungi must be exposed to wide extremes of temperature and humidity, and the occurrence of gas within these cells may be of importance in avoiding plasmolysis under dry conditions. Earlier observations upon gas in drying cells have been made by several of Renner's pupils, notably by Holle (*Flora*, 108, 75; 1915).

Follicular and other Hormones and Plant Growth

IT has been claimed that the work of Schoeller and Goebel has proved that small quantities of follicular hormones markedly accelerate flowering. In view of the possible horticultural interest of such a phenomenon, investigations were undertaken by Dr. M. A. H. Tincker (*Ann. App. Biol.*, 22, No. 4, 619–629). The experiments were designed to supply the substances ketohydroxyoestrin, theelol and auxin to various flowering species. The solutions of these substances were administered to the roots, by injection and by application to cut surfaces. In no case was any acceleration of growth or flowering obtained, and in the case of hyacinths treated with theelol some retardation of foliar growth was noticed. At the same time, Dr. Tincker is careful to point out that there is no proof that the substances presented to the plant were taken up by the tissues, and suggests that a method which would ensure that the substances reached the flowering region is highly desirable. In the case of root cuttings grown in gelatin, rapid and considerable bacterial growth was observed and proved to be due to a hitherto unknown organism. This has been described in an appendix by Dr. S. E. Jacobs, who has called it *Bacterium auxinophilum*.

Subsidence of East Tokyo

IN three interesting papers, Prof. N. Miyabe considers the remarkable subsidences that have occurred since 1923 in the eastern portion of Tokyo (*Bull. Earthq. Res. Inst.*, 10, 844–857; 1932. 13, 587–591, 763–770; 1935). Series of precise levellings were carried out in November 1929 and March 1932, and with two exceptions of little consequence, all of the 42 bench-marks were depressed, three of them by more than one foot. The zone of greatest depression occupies the district between the Rivers Sumida and Yedo, or that in which the alluvial covering is thickest. Prof. Miyabe divides the whole area into six regions, corresponding with crust-blocks. One of them includes the area of greatest depression, and the tilting of the four surrounding blocks is in each case directed approximately towards its centre. Further light is thrown on these movements by the records at two mareograph stations in the southern half of the area. The mean monthly height of the sea-level is subject to a well-marked annual period, and there is also a secular change by which the mean level at one station rose about 5 in. in each of the years 1932 and 1933, though in 1934 the upward movement had almost ceased. Prof. Miyabe in his third paper considers the origin of this general depression and concludes that it is the result of several causes, such as the reduction in pressure of underground gases, the contraction of the surface soil due to the observed lowering of the underground water-level, etc., acting in combination with crustal deformations, such as block-movements, that are known to prevail over wide areas in Japan.

The Pennine Wool Industry

MUCH has been written on the factors that localised the wool industry in the Pennine area of the West Riding, but Mr. W. B. Crump in a recent paper ("The Wool Textile Industry in its Physical Setting", *J. Textile Inst.*, 26, 1935) considers the subject more fully than usual from a geographical point of view. From York, the original textile centre of the north of England, the industry spread southwards, and by the sixteenth century had taken a firm hold in the West Riding. The grit-stone country was particularly favourable in production of wool and of soft water, while the adjacent Lower Coal Measures with their larger population provided a nearby market. The poverty of the small holdings on the uplands encouraged the manufacture of cloth. Early in the nineteenth century, the application of steam power was facilitated by the proximity of the Lower Coal Measures to the grit-stone area. Only Manchester and Wakefield were textile towns at a distance from the grit-stone country and both had easy access. Another important localising influence was the occurrence of iron ore, since iron wire was needed in carding. This is expressed in the expansion of the industry into the Middle Coal Measures with their black band iron ore in the district of the Calder valley. These and other influences are fully discussed and illustrated in distributional maps.

Progressive Lightning

B. F. J. SCHONLAND, D. J. Malan and H. Collens have continued their observations of lightning flashes, using a Boys' camera with two lenses mounted on a rapidly revolving disk. Their results (*Proc. Roy. Soc.*, *A*, Nov. 15, 1935) now cover a fair sample of South African lightning discharges. The lightning flashes are in general quite complex and each stroke consists of a 'leader' spreading from cloud to ground and a return stroke from ground to cloud. The first process of all is a 'stepped' discharge which is propagated downwards with high velocity, but with pauses of the order 10–100 microseconds. The 'steps' often start out in a new direction, giving the channel of the discharge a zig-zag form, and downward branching is frequent. As soon as this leader reaches the ground, a bright discharge starts at its lower end and spreads upward with velocity of the order 5×10^9 cm./sec. This discharge spreads into the previously formed branch channels, and usually gets less bright as it moves upward. Later strokes do not usually show the stepped effect; their leaders are 'darts' moving downwards at velocities of 10^8–10^9 cm./sec. A theoretical discussion is promised in another paper.

Electron Optical Bench

IN the Research and Experimental Section of the recent Physical Society's Exhibition held at the Imperial College of Science, the Research Laboratories of the G.E.C. showed an apparatus for investigating the performance of experimental electrode systems for cathode ray tubes. A special 30 cm. (12 in.) diameter cathode ray bulb is

provided with a vacuum-tight round glass joint at the end of the neck. The detachable portion of the joint carries a 12-pin cap for making connexion to the twelve sliding contacts on the 'electron optical bench' contained inside the tube. The apparatus was developed to facilitate the design of high vacuum cathode ray tubes for television. The effect of different arrangements of the electrodes on the size of the spot, on brightness and distortion, on sensitivity to control, etc., can be readily determined. The tube operates satisfactorily at 4,000 volts, and the time required to open it, make an adjustment and pump out again, is usually less than 30 minutes. The cathode retains its emission after several exposures to the atmosphere. It should prove very useful to those experimenting on television.

Interatomic Distance and Resonance

In 1932 L. Pauling pointed out that resonance between two or more structures leads to interatomic distances nearly as small as the smallest of those for the individual structures. In benzene the carbon–carbon bond resonates approximately equally between C–C and C=C, and the observed carbon–carbon distance, 1·39 A., is much nearer the C=C distance, 1·38 A., than the C–C distance, 1·54 A. Where the two structures contribute unequally, the bond may have any intermediate character. L. Pauling, L. O. Brockway and J. Y. Beach have now (*J. Amer. Chem. Soc.*, 57, 2705) considered the nature of the function expressing the dependence of interatomic distance on single bond–double bond resonance, and have used the function to obtain information regarding the electronic structures of resonating molecules for which interatomic distance values are available. The effect of resonance on bond angles is also discussed. They plot the distances 1·54, 1·38, 1·39 (benzene) and 1·42 (graphite) against the "bond character", benzene being half-way between diamond and the double bond, and graphite two-thirds single bond character. The curve shows that a small amount of double bond character causes a large decrease of interatomic distance, but even fifty per cent of single bond character produces little change in the double bond value. The distance criterion for resonance thus provides quantitative information only through about half the bond character region. The authors then use the curve to calculate the amount of double bond character for a number of carbon compounds for which the interatomic distances are known. Polynuclear aromatic hydrocarbons are included in the discussion.

Spectrographic Analysis of Biological Material

J. S. Foster, G. O. Langstroth and D. R. McRae (*Proc. Roy. Soc.*, Dec. 2, 1935) describe in detail their technique for determining traces of lead in cerebrospinal fluid. The method is applied to concentrations between 10^{-8} and 2×10^{-5} gm./c.c. and the precision of a determination is said to be better than 15 per cent. The fluid is dried on a plane metal plate, which is made one electrode of a point-plane spark gap excited by D.C. condenser discharges. The spark is made to traverse the whole surface of the plate. The intensity of the lead lines is compared on a microphotometer with that of a magnesium line present in the spectrum, and the comparison is repeated on another sample of the same fluid with the addition of a known amount of lead. The intensity of the lines is proportional to the amount of lead if this is small.

Fluorine and its Compounds

In a review of the chemistry of fluorine, A. Damiens (*Bull. Soc. Chim.*, 3, 1; 1936) points out that modern methods of electrolysis of fused acid fluorides with a graphite anode in an apparatus of copper, graphite, silver, magnesium or monel metal, could be adapted to the industrial production of fluorine if the element found technical uses. The compounds of fluorine with other halogens are: ClF, ClF_3; BrF, BrF_3, BrF_5; IF_5, IF_7. The monoxide, F_2O, is a stable gas, which is obtained by the action of fluorine on water in presence of alkali, and was previously confused with ozone. It is a powerful oxidising agent, liberating iodine from potassium iodide solution, which absorbs it completely. By the action of the electric discharge on a mixture of oxygen and fluorine at low temperature and pressure, to avoid explosion which otherwise occurs, an orange-coloured solid, melting at $-160°$ and volatile at $-100°$ to a brown gas, is obtained. The gas is F_2O_2; it decomposes at $-64°$ into a colourless gas, FO, which at higher temperatures dissociates into a mixture of oxygen and fluorine. On cooling FO it does not again form F_2O_2 (Ruff and Menzel, 1933). Nitrogen fluoride, NF_3, is a colourless gas, insoluble in water, obtained by the electrolysis of acid ammonium fluoride (Ruff, Fischer and Luft, 1928). Small quantities of NH_2F and NHF_2 are also formed in the reaction. Several compounds of fluorine with carbon have been described (CF_4, C_2F_6, C_3F_8, C_4F_{10}), of which the tetrafluoride is best known; it is a colourless, inert gas, with a boiling point of 126°.

Research Surveys of the Minor Planets

More than one thousand asteroids have been discovered and sufficiently observed to admit of fairly reliable determinations of their orbits. The task of keeping track of these small bodies is a stupendous one, for which international co-operation offers the only hope of securing adequate resources. The Berlin Rechen Institut bears most of the burden of correcting orbital elements and computing ephemerides; but in 1925 the International Astronomical Union entrusted to Prof. A. O. Leuschner, of the University of California, the task of carrying out a research survey of the orbits and perturbations of all the minor planets of which trustworthy orbits were available. The "Research Surveys of the Minor Planets 1 to 1091" has now appeared as vol. 20 of the Publications of the Lick Observatory. The history of the discovery and details of the orbits that have been computed are set out for every planet. To quote Prof. Leuschner, "The preservation of planetary discoveries by observation and prediction with the aid of approximate perturbations is not the ultimate end of astronomical science, but a necessary and unavoidable means to an end. The ultimate aim rests on a determination of mean elements and general perturbations which hold for all time or at least for very long periods within the limits of accuracy set by observation". Whether this aim will ultimately be realised or no, Prof. Leuschner's volume is of great importance in presenting in a compact form information which was previously scattered throughout more than a hundred journals, some of which are old as modern periodicals are reckoned. The minor planets which are bright enough to be observed with a meridian telescope are now to be used to play an important part in fundamental astronomy, and it is expected that in their case, at least, Prof. Leuschner's ideal will be realised within a decade.