# Research Items

## Roman Fort at Brough

THE existence of a Roman fort at Brough, Yorks, where Ermine Street crosses the Humber, as distinct from a riverside settlement, has been determined only recently. In 1933 an investigation was made of the character of the Roman occupation, previously well attested by frequent finds of coins, sherds, etc., by trial trenches dug in the Bozzes Field by Mr. T. Sheppard, Dr. J. L. Kirk and Mr. Philip Corder. In an interim report by the last-named (Hull Museum Publications, No. 182) a number of facts were established, notwithstanding that at the time of writing the excavation was not complete. A military station involving at least two, and probably three, ditches was established at Brough before the campaigns of Cerialis and Agricola. On the south side, the two outer ditches had been levelled and succeeded by an occupation area represented by floors, hearths and a rubbish pit. In the rubbish pit were Roman sherds, imitating Belgic forms, dated from material from Colchester at somewhere between A.D. 56 and 76. From these the inference is drawn that the occupation antedates the campaign of Cerialis, who founded Malton and York in the seventies. The earliest rampart on the east side was of compact sand and has not yet been positively dated. It is probably contemporary with the ditches on the east and south sides of the fort. Eventually the rampart was cut back and a solid stone revetment added. This was probably in the second century. Sherds from the filling of the ditches are none of them later than the Antonines. Probably the ditches were filled in the second century, when the military occupation was moved to the northern frontier. Third and fourth century occupation is attested by coins and pottery, and a large rectangular building in Trench 1 must fall within these centuries. It is not aligned with the ditches and may have been built after they had ceased to exist. Pottery of the fourth century was found unstratified in considerable quantity.

## Bay Islands' Culture, Honduras

'LAS ISLAS DE LA BAHIA', a little-known group of islands off the northern coast of Spanish Honduras, have been investigated by expeditions of the American Museum of Natural History (1931) and the Smithsonian Institution (1933), and archæological collections were made in 1930 and 1931 by Mr. Mitchell-Hedges on behalf of the Museum of the American Indian, Heye Foundation. In a study of the archæology of the islands by Dr. W. D. Strong (*Smithsonian Misc. Collect.*, **92**, 14) the observations of the two expeditions are combined and the material collected by Mr. Mitchell-Hedges is used for purposes of comparison. The majority of the known archæological sites are on hill-tops, next come caves and rock-shelters; springs and water-holes and large level sites are less frequent. The majority of the sites are shrines, or places of offering of some sort; habitation sites are rare, only four being known, of which one is doubtful, though showing the only known example of, possibly, the foundation walls of a house. Low earth mounds contain scattered burials. The pottery is classified as Monochrome, Elaborate Monochrome, Polychrome i and Polychrome ii, a chronological sequence in which Elaborate Monochrome and Polychrome i seem to be contemporary. The Bay Islands' culture lies on the northern fringe of an important, but little-known, cultural region. It appears to have certain affinities with Maya culture, but this is late and indirect, whereas the affiliation with the western Nicaraguan and northern Costa Rican culture is both intimate and direct. Southern traits permeate the whole culture, and seem to be early and basic. Historical evidence, ethnology, archæology, and linguistics, all combine to suggest that peoples of South American affiliations must have been responsible for most of the remains on Bay Islands and probably for those of northern Honduras as well.

## Factorial Analysis of Human Abilities

IN the *Human Factor* (9, No. 5) Prof. Godfrey H. Thomson states briefly, and in as non-mathematical a way as possible, his criticism of Prof. Spearman's 'Two-Factor Theory'. He regards $g$ as a mathematical variable without any real existence as a separate entity; and argues that the $g$ arrived at by one set of tests is not necessarily the same as that arrived at by another set of tests. He refers to the American work on factorial analysis, which has been concerned with applying the method to any team of tests, and not only hierarchical teams of tests, and points out that an infinite number of mathematically satisfactory results are possible. Prof. Thomson gives illustrations to show the innumerable interpretations that could be made from any one set of correlation coefficients. Determining which of them should be selected is the business of the psychologist, not the statistician. His own belief is that the mind cannot be divided up into unitary factors, but is "a rich comparatively undifferentiated complex of innumerable influences".

## Musculature of the Blue Crab

MISS DORIS M. COGHRAN has studied the musculature of the blue crab, *Callinectes sapidus*, Rathbun (Smithsonian Miscellaneous Collections, vol. 92, No. 9 (Publication 3282), Jan. 1935). This is an excellent piece of work and one much wanted, for few accurate observations have been made on such an important subject. The chief myological publications in existence relate to crayfish, shrimps and prawns. The complete fusion of the segments of head and body in the crab has resulted in the disappearance of those intersegmental muscles which, in crustaceans like the shrimp and crayfish, give a high degree of flexibility to the movements of the body. On the other hand, the muscles of the appendages are highly complicated, as are also those of the stomach with its gastric mill and of the alimentary system. The abdomen of the blue crab, in the male at least, is apparently progressing towards a condition of partial rigidity, as the third, fourth and fifth segments are immovably fixed in that sex. This fusion is not yet completely established, as the former segmentation is still partly

maintained in its musculature. The female's abdomen has six distinct segments, all of which have the muscles well developed. All these muscles are described in great detail, and there is a discussion of the general structure of the crustacean appendage. The numerous illustrations in the text add much to the value of this undoubtedly valuable work.

### Marine Fauna of the Dutch East Indies

NEW parts of Résultats Scientifiques du Voyage aux Indes Orientales Néerlandaises de LL. AA. RR. le Prince et la Princesse Léopold de Belgique (*Mém. Roy. d'Hist. Nat. de Belgique*, Hors série, Vol. 11) recently published embrace Opisthobranches and Silicodermes (Onciades) by A. Labbé; Prosobranches Parasites by W. Adam (fasc. 14); Sponges by H. V. Bröndstad (fasc. 15) and Cephalopoda by W. Adam (fasc. 16). A. Labbé has discovered that the Oncidiidæ possess a siliceous armature, hitherto unknown, and that the different members of the family have in their bodies more or less widely distributed spicules of silica. For this reason he has proposed the sub-order Silicodermatæ, being synonymous with the Oncidiidæ of Gray. Not only has he made this innovation, but he has also placed them among the Opisthobranchs rather than the true Pulmonates, for he is of the opinion that the Silicoderms play the same rôle with regard to the Opisthobranchs as the Pulmonates do with regard to the Prosobranchs. Seven species were taken by the expedition, five *Oncidium*, three new, two already known, one not determined owing to bad preservation, and one *Oncidiella*. No mention is made of the very careful monograph on South African Onchidella by Hugh Watson (*Ann. South African Mus.*, **20**, 1925) which contains valuable anatomical work and discussions on the geographical distribution. The capulid *Thysa crystallina*, parasitic on the echinoderm *Linckia*, is described by W. Adam, who has discovered the minute male, hitherto unknown, under the shell of the female. The male is mature although less than a millimetre in length and has no disc of fixation. The author, agreeing with Jonker, determines that this disc, which has been subject to much discussion, is part of the head, being innervated exclusively by the cerebral ganglia.

### Pacific Entomological Survey

Two publications (Nos. 6 and 7) of the Pacific Entomological Survey have been issued as Bulletins 113 and 114 of the Bernice P. Bishop Museum, Honolulu, 1935. Bulletin 113 is concerned with reports of various specialists on the insects and other arthropods collected in the Society Islands. Bulletin 114 comprises the second instalment of reports on the insects, arachnids, etc., obtained in the Marquesas Islands. These two bulletins are well illustrated and contain descriptions of numerous species hitherto unknown. The bulletins are of interest to students of geographical distribution and of island life in particular, as well as to specialists in the diverse groups concerned.

### Physiological Differences between Geographical Races in Forest Mice

INVESTIGATION of the effect of mountain climate upon the human organism has shown that the ascent of high mountains causes an increase in the hæmoglobin content and in the number of erythrocytes in the blood. It is known also that these values are higher in the blood of some mountain animals, as well as of men living normally at high altitudes. The nature of these differences, however, have remained unknown; they may represent either a temporary individual adaptation (as in the case of a man ascending a mountain peak), or they may become fixed during individual or phylogenetic development. Some light on this interesting problem has now been thrown by Kalabuchov (*C. R. Acad. Sci.*, Leningrad, 2, No. 1, 1935) who has made a comparative experimental study of two sub-species of the forest mouse, *Apodemus sylvaticus ciscaucasicus* living at high altitudes, and *A. s. mosquensis* from the plains. Careful counts of the number of erythrocytes proved that the number was constantly higher in the mountain race than in that from the plains. When mice of the mountain race were transferred to the plain, the number of erythrocytes in their blood at first decreased, but two months later the number became normal, and even rose somewhat above the normal. In the controls, consisting of an equal number of plains mice race kept with the experimental animals, no change in the erythrocyte number was observed. This shows that there is a constant physiological difference between two races, independent of the environment.

### A Fertile Species-Hybrid

GENETICISTS usually find that when two species are crossed, the offspring, if any, are sterile. Several garden plants have, however, originated as hybrids between two well-defined species, and now another plant has been found to have a similar origin. It is the pink-flowered chestnut, *Aesculus* × *Carnea*, recently described by Mr. M. B. Crane (*J. Roy. Hort. Soc.*, April 1935). Several well-authenticated instances of successful propagation of the hybrid from seed have been described in the garden literature of last century. Mr. Crane shows that each of the parents has twenty chromosomes, and upholds Skovsted's demonstration that *Aesculus Hippocastanum* has twenty small chromosomes in the germ cells, whilst *A. Pavia* has a similar number of large ones. The hybrid has forty, half of which are large, and the others small. Doubling seems to have been effected by autosyndesis—the non-reduction of both parental germ nuclei—since no parental types appear in the offspring. Several other species-hybrids are mentioned in the paper.

### Effect of Rootstocks on the Nutrition of Apple Trees

MR. L. G. G. WARNE, of the University of Bristol, and Dr. T. Wallace, of Long Ashton Research Station, have investigated "The Composition of the Terminal Shoots and Fruits of Two Varieties of Apple in Relation to Rootstock Effects" (*J. Pomol. and Hort. Sci.*, **13**, No. 1, pp. 1–31, March 1935). Several metabolic disturbances, such as leaf-scorch, have been observed in association with the use of certain types of rootstocks, and the paper under review shows that the various clones of stocks classified by Hatton at East Malling Research Station have certain well-marked effects upon the metabolism of the scion with which they are grafted. Malling stocks types II and V, known to be susceptible to potash deficiency, showed evidence of potash starvation even when that element was present in the soil in abundance. Rootstocks promoting great vigour in the scion produced a high ratio of potash to nitrogen

in the shoots, whilst a positive correlation was established between the ratio of phosphate to nitrogen in the wood, and precocity of bearing of the tree. The dwarfing effect of type IX could not be explained chemically. Many other results are set out in detail in the paper, and the chemical analyses have been correlated with extensive pomological records collected by Dr. T. Swarbrick and his colleagues.

### Atmospheric Visibility

A DISCUSSION of the principles underlying the choice of the marks used in the estimation of atmospheric visibility, by W. E. Knowles Middleton, of the Meteorological Service of Canada (*Monthly Weather Review*, January 1935, p. 17), summarises very briefly the results of recent work in Germany and America on the measurement of the transparency of the atmosphere. This is a subject that has become more important in the last twenty years on account of the development of aviation, and is one which abounds in practical difficulties. It has long been known that the distance expressing the so-called 'visibility' of the atmosphere when determined by observation of the distance of the farthest of a selected group of objects such as trees, buildings, etc., is influenced by a number of factors unconnected with the state of the atmosphere, for example, by the excellence or otherwise of the observer's eyesight, and perhaps still more by the nature of the selected objects and the background against which they are seen. Mr. Knowles Middleton states that it is a common opinion that observations of this element made by the method just described are of no use in synoptic meteorology. He goes on to show that it is only when the objects used are black or nearly black and are seen against the sky that we are in effect measuring $\sigma$, the extinction coefficient of the atmosphere, defined by the equation $dE = -\sigma E dx$, where $E$ is the flux density in a parallel beam of light travelling in the direction of $x$. His remedy is to use only black or nearly black objects against the horizon sky during the daytime, and never objects against terrestrial backgrounds, and to use interpolated values obtained from observations of such objects rather than misleading observations derived from an inspection of objects which appear against terrestrial backgrounds; and to have night observations made with the aid of some standard transmission meter, so that these may be independent of the local distribution of lights not set up specially for observations of visibility.

### Solidification of Nitrogen and Argon

THE *Proceedings of the American Academy of Arts and Sciences* of March contains Prof. P. W. Bridgman's account of his determinations of the melting points of nitrogen and argon under pressures up to 6,000 atmospheres, their change of volume on, and latent heat of, fusion. The gas was contained in a chromium-nickel-steel cylinder closed by a gas-tight piston the movement of which gave the change of volume. The cylinder was surrounded by a liquid propane thermostat, the temperature of which was regulated by a hydrogen thermometer. The temperature of the gas was measured by a copper-constantan thermo-couple and its pressure by a manganin wire resistance gauge. The melting point of nitrogen rises from 63·3° K. at 1 atm. to 149° K. at 6,000 atm., the increase of volume on melting changes from 0·072 to 0·026 c.c. and the latent heat of melting from 218 to 346 kgm.-cm. per gram. For argon the figures are 83·9° K. to 193° K., 0·080 to 0·021 c.c. and 280 to 288 kgm.-cm. per gram. In each case, the change of melting point is nearly a linear function, and the increase of volume a hyperbolic function, of the pressure. The latent heat of fusion is in both cases nearly constant at pressures above 3,000 atmospheres.

### Diffusion of Gases through Metals

C. J. SMITHELLS and C. E. Ransley (*Proc. Roy. Soc.*, A, May) have examined the diffusion of several gases through different metals, and thus obtained a more definite conception of the mechanism involved. The metal tubes were heated electrically and provision was made for analysing the gas which had passed through the tube walls. The dependence of the diffusion on pressure and temperature was investigated. The effect of temperature was satisfactorily represented by Richardson's exponential expression. Except at low pressure, the variation with pressure follows a $\sqrt{P}$ law, the diffusion probably taking place in the atomic state. According to the view of the authors, diffusion is always preceded by adsorption, and the deviation from the square root law may be explained by the use of the Langmuir isotherm. The diffusion is found to be strongly specific; nitrogen, for example, will diffuse freely through iron, chromium, or molybdenum, but not through copper, while no diffusion of argon or helium could be detected with any metal. This agrees with the view that activated adsorption is necessary for the diffusion.

### Chemical Aspects of Biological Oxidation

IN his presidential address at the annual meeting of the Indian Chemical Society on January 4, Prof. N. R. Dhar discussed the chemical aspects of biological oxidations (*J. Indian Chem. Soc.*, 12, 96; 1935). Researches carried out in his laboratory have shown that organic substances, which are not directly oxidised by atmospheric oxygen at the ordinary temperature, can be oxidised by simply passing air through their solutions or suspensions when they are mixed with compounds which readily undergo oxidation in air, such as sodium sulphite, phosphorus, or freshly precipitated ferrous, cerous and manganous hydroxides. It has been found that proteins are more readily oxidised than carbohydrates, and carbohydrates than fats; in fact, the order is the same as was found by Voit in feeding experiments; with cerous hydroxide, as much as 83 per cent of egg white is oxidised, 57 per cent of starch and 30 per cent of butter. In all cases, the substance is oxidised completely to carbon dioxide and water. Prof. Dhar contrasted this process with the rapid oxidation of foodstuffs with hydrogen peroxide or a ferrous or ferric salt, in which intermediate compounds are formed, and compared the former with normal metabolic oxidations and the latter with the changes occurring in abnormal metabolism, such as the appearance of the 'acetone' bodies in diabetes or fasting, from the incomplete combustion of fats. In conclusion, he suggested that certain biologically active compounds, which are reducing agents, owe their activity to their power of inducing oxidations in other substances, and also directed attention to the effect of sunlight in inducing oxidations in the presence of air.