Research Items

Tuamotuan Stone Structures. Plans and notes of Tuamotuan stone structures made on the Tuamotu Survey of the Bernice P. Bishop Museum in 1929 and 1930 by Mr. Kenneth P. Emory are published in *Bulletin* 118 of the Museum. The only stone remains of any consequence in the archipelago are the maraes. In pre-European times houses were not built on platforms nor were stone walls erected around dwellings or villages. Many of the maraes were roughly built without the use of any squared stone, but many are carefully built and faced with neatly fitted slabs. Megalithic slab uprights trimmed to a conventional shape stand on the platforms in front of them and out on the court. Some of the courts are enclosed by low stone walls. The maraes in the western part of the archipelago have suffered much. Except in the extreme eastern part of the archipelago the maraes of one island differ little from those of another. Throughout they have an unpaved court, quadrangular with a platform at one end ranging from 10 to 80 ft. in length, 2 to 10 ft. in width, and 1 to 5 ft. in height. Along the rear edge of the marae are planted three or more upright slabs, and there is a tiny platform out on the court, placed midway between its sides. The *ahu* uprights range from 2 to 9 ft. in height. The tiny court platform may bear an upright and other smaller uprights may stand on the court. The only stone suitable for building is supplied by outcropping or uncovered limestone ledges. Rectangular slabs of limestone completely dominate the stonework of Tuamotuan maraes. When set on end these slabs serve as uprights. Orientation to the cardinal points was not practised.

Biology of *Calanus Finmarchicus*. The continuation of the important researches of Dr. A. G. Nicholls and Miss S. M. Marshall (*J. Marine Biol. Assoc.*, **19**, No. 1; 1933) adds much to our knowledge of this copepod ("On the Biology of *Calanus finmarchicus*". (1) "Reproduction and Seasonal Distribution in the Clyde Sea-Area during 1932" by A. G. Nicholls. (2) "Seasonal Variations in the Size of *Calanus finmarchicus* in the Clyde Sea-Area" by S. M. Marshall. (3) "Vertical Distribution and Diurnal Migration in the Clyde Sea-Area" by A. G. Nicholls). It is found that *Calanus* passes the autumn and early winter mainly in Stage V. The minimum number occurred in April in Loch Fyne, in general the total numbers being high in September in 1931 and falling steadily to a minimum in March. A sudden increase occurred in May and numbers rose to maximal values, with a sudden decline. Three plainly marked breeding seasons were observed between February and July. The egg developed into an adult in four weeks, the total life of a *Calanus* during summer being about two and a half months, in winter five to six months. The size was greatest when the temperature was low, least when high, but there were also increases and decreases of size apparently connected with the breeding periods, those at the beginning of the breeding season being large and those at the end small. The greatest number of eggs usually occurred when the females were small. The late stages taken in the top 30 m. were almost invariably smaller than those from deeper water. Ova and nauplii were observed to be most abundant in the top 30 m. Copepodite states I, II and III most abundant above 30 m. and only Stage III in the deeper layers; Stage IV migrated to the surface at night; Stage V was always in the deeper water with slight diurnal changes. Females showed definite diurnal migrations both in January and July. Males migrated in small numbers towards the surface at night and away from it in the day. Stage V and females both lived nearer the surface in January than in July, correlated with seasonal changes in intensity of sunlight. Food must play an important part in controlling these migrations, also light intensity; spawning is probably a third factor which will affect adults only.

'Blackhead' in Turkeys. Blackhead disease in turkeys in the United States is due to the invasion of the tissues of the cæca by the flagellate protozoon, *Histomonas meleagridis*, first recognised by Theobald Smith in 1895. In young turkeys, the disease, which is not uncommon also in Britain, is progressive and almost always fatal; if the bird recovers, the protozoon is eliminated from the tissues but may establish itself in the cæcal contents, in which it continues to multiply for a long period. Such a bird becomes a 'carrier' and its discharges, which often contain great numbers of *Histomonas*, are infective for normal birds. Since *Histomonas* survives for only a brief period in the cæcal discharge, cases of blackhead appearing in young birds that have never been associated with older stock could not be accounted for by direct transmission. H. W. Graybill and Theobald Smith (1920) discovered that blackhead may be produced by feeding large numbers of the embryonated eggs of *Heterakis gallinæ*, the common cæcal worm of poultry, and they offered the tentative hypothesis that the cæcal worms lowered the resistance of the bird to the *Histomonas*, supposed to be already present, and hence the protozoon was able to multiply. E. E. Tyzzer (*Proc. Amer. Acad. Arts and Sci.*, **69**, No. 5; 1934) produces experimental evidence to show that *Histomonas* is carried in the embryonated egg of this worm, though it has not yet been possible actually to demonstrate the protozoon in the egg. The hatching of the egg is necessary for the release of the *Histomonas* in the bird's intestine. No other example is known of an intestinal worm serving as the vector of an infectious disease. The author gives details of the morphology of *Histomonas* in the tissues and in culture, records the finding of the protozoon in the epithelium of the intestine of *Heterakis*, and adds observations on the loss of virulence in *Histomonas* in culture and on the immunising properties of an attenuated strain.

Culture of Barley for Brewing. The second Horace Brown Memorial lecture of the Institute of Brewing, delivered by Dr. E. S. Beaven on "The Culture of Barley for Brewing", has now been published in the Institute's journal (*J. Inst. Brewing*, **40**, 188–203; 1934). The lecture covers a wide field, but the greater part of it consists of an account of the methods so successfully used by Dr. Beaven in breeding and testing new barley varieties. The environmental factors which affect yield and malting quality in barley are described, and the heritable characters of the crop—productivity, tillering, the "coefficient of migration" and the nitrogen content of the grain—

which provide a basis for selection, are discussed. The successful new varieties bred by Dr. Beaven arose from the crossing of not widely dissimilar races of proved economic worth, which were themselves obtained by selection from the produce of single plants of old established races. Little or no success was obtained by hybridisation of plants of widely differing characteristics. When the selections were made and multiplied, the next stage was to test their value in field conditions. Dr. Beaven, in association with "Student", was a pioneer in the development of modern methods of field experimentation. Though the 'chequer-board' and 'half-drill strip' methods which he describes no longer fulfil the requirements of statistical theory, they have proved of great value in variety testing. The paper concludes with references to recent work on differential response of varieties to environment, and on brewing quality in barley.

Frost Injury to Trees. In *Oxford Forestry Memoirs* No. 16, 1934 (Clarendon Press), W. R. Day and T. R. Peace of the Imperial Forestry Institute discuss the "Experimented Production and the Diagnosis of Frost Injury on Forest Trees". One of the objects of the research is to ascertain the possible relation of frost damage to the occurrence of fungus pests such as *Dasyscypha calycina*, *Phomopsis pseudotsugæ* and others. The experiments were confined to the periods September–November and January–June. It is held that the time thus covered was sufficient to make it evident that, in general, susceptibility increases during the spring, is at a maximum during the summer, and decreases again in the autumn to a winter minimum. The experiments showed that Douglas fir and Sitka spruce are most susceptible to autumn damage. To winter frost Douglas and Scots pine are the most susceptible. Early spring frosts affect European and Japanese larch, Douglas fir and *Thuja plicata*, followed by Scots Pine; oak, which at the beginning of the period is one of the hardiest species, is by the end of it one of the more susceptible. Work of this type is of value, but many foresters would probably agree that it is a slant of frost-laden biting wind which does the greatest harm to young tree growth and often even to old. Refrigerator experiments do not produce this condition. The monograph is illustrated by a series of excellent plates.

The Chad Basin. Perhaps the most interesting—and astonishing—fact about Lake Chad, which is discussed in considerable detail in "The Chad Basin: Geology and Water Supply" by Dr. Raeburn, assistant director of the Geological Survey of Nigeria and Mr. Brynmor Jones (Crown Agents for the Colonies, 4, Millbank, S.W.1) is that this vast sheet of water, covering, according to secular variation, anything from 5,000 to 8,000 square miles, is liable "at a relatively early date" to disappear almost completely from the map of Central Africa, of which at present it forms so notable a feature. There is a danger that the important system of drainage into the lake through the Shari–Logone Rivers, which contribute 76 per cent of the lake's water supply, may be captured by the River Benue, in which case it would be diverted entirely from the Chad Basin. The lake is aptly described as unique among inland seas: notwithstanding its enormous extent, it is shallow, with a mean depth not exceeding 13 ft. and sometimes as little as 3–4½ ft.; its salinity is insignificant; it has no apparent outlet; it lies on the edge of one of the world's greatest deserts, and there are only one or two vantage points from which its waters, concealed behind thick reed banks, can be observed. Much other interesting scientific information is contained in the publication relative to the Chad Basin, which is the largest basin of inland drainage in Africa, occupying an area of roughly 650,000 square miles of tropical grasslands and desert in British and French territory, including an account of the geology of the district, climate and rainfall, the latter being monsoonal in character with fluctuations in irregular cycles, topography and scenery, vegetation, soil and water supply, which is mainly obtained from wells, ranging in the British area down to 300 ft. in depth. A number of the wells are sub-artesian and there are at present no flowing wells in the Basin. The question of water supply is naturally of importance in relation to the development of Nigeria.

Atmospheric Ozone. The results of nearly four years of regular measurements of the amount of ozone in the atmosphere on all sunny days at the Commonwealth Solar Observatory, Mount Stromlo, Canberra, are given in a recent memoir of the Observatory (No. 3) by Mr. A. J. Higgs. The observations are made by the normal photographic method in which spectra of the ultra-violet region of sunlight are measured, and the absorption caused by ozone in the atmosphere is calculated. The work generally confirms the results previously found at other places: there is an annual variation with a maximum in September or October and a minimum in April, while the average value of the ozone content for the year is about 0·27 cm. The Australian observations have also confirmed the connexion found between the meteorological conditions and the amount of ozone, and the usual relation of high ozone in low pressure areas and low ozone in high pressure areas obtains, though the connexion with the absolute value of the surface pressure is small. Estimates of the average height of the ozone in the atmosphere have been made by observations on direct sunlight when the sun is low. The average value of 56 km. is in reasonable agreement with the value found by this method in Europe, but it is now known that this method is unreliable and gives results which are much too high. The work is a valuable contribution to our knowledge of atmospheric ozone.

Generalised Function Theory. In the ordinary theory of functions of a complex variable, a great part is played by monogenic functions, which are closely associated with certain partial differential equations, in particular Laplace's equation. Interesting generalisations of these ideas are contained in V. Volterra's "Équations aux dérivées partielles et théorie des fonctions" (*Ann. l'Institut Henri Poincaré*, **4**, fas. 3). Instead of the ordinary functions, which depend upon the co-ordinates of a point in a plane or on a surface, he considers functions of lines, which depend upon the co-ordinates of every point upon a straight or curved line. The field due to an electric circuit is an example of such a function. The term isogenic is then given to a relation between two functions of lines, corresponding to monogenic for ordinary functions. Theorems are found analogous to Green's theorem and Cauchy's theorem, with a partial differential equation corresponding to Laplace's. The work can be extended to any number of dimensions.