

This is based on the observation that in certain large groups of organisms variety increases towards the equator, though in cooler latitudes a given species may be very abundant. The diversity gradient is not entirely dependent on temperature so that anomalies can occur, and it is important that the diversity need not be a maximum at the equator itself. Diversity gradients for Permian brachiopods provided F. G. Stehli and C. E. Helsley (both of Western Reserve University) with distribution lines parallel to the present latitudes and therefore disagreeing with the palaeomagnetic data summarized by A. E. M. Nairn (King's College, Newcastle upon Tyne). There is no obvious solution to this disagreement and investigation of the various possibilities is needed. It may be that certain of the forms had wide limits of tolerance or were not restricted by temperature. H. A. Lowenstam (California Institute of Technology) spoke of the importance of the geological time-range over which data were collected, for he showed by isotope measurements that very rapid changes in sea-water temperature had occurred in Western Australia between Sakmarian and Artinskian times.

Faunal distributions also need to be considered. J. Shirley (King's College, Newcastle upon Tyne) pointed out that faunal evidence would be more accurate at times when there were greater temperature differences between equator and poles, due to the narrowing of the climatic zones. He described a pattern of distribution of Lower Devonian marine faunas and showed its similarity to that of some Triassic faunas. At some points this conflicts with palaeomagnetic evidence and at others with the present continental distribution.

The problem of growth patterns leads to a discussion of corals, and of the ideas of T. Y. Ma. Despite the fact that growth rhythms can be present in some and absent in other members of a given coral colony, the position of an equator derived from the distribution of coral localities with and without 'seasonal' growth is surprisingly similar to the appropriate palaeomagnetic equator. A. G. Fischer (University of Princeton) considered that the data for one type of Silurian coral certainly did not fit the present continental positions, but were not sufficiently good to distinguish between the polar wandering, and polar wandering plus drift models.

Thirdly, palaeo-deserts were discussed. Arid zones north and south of the equatorial humid belt are typical of our present climate. These nearly coincide with the zones of the Trade Winds, north-easterly up to about 20° N. and south-easterly to about 20° S. The presence of the easterly winds in low latitudes in contrast to the westerlies in mid-latitudes is a consequence of the temperature gradient between the equator and the pole and of conservation of angular momentum in the atmosphere as a whole. In modern deserts two types of dunes are found, transverse, or barchan dunes and longitudinal dunes. In the former, sand is blown up the windward

side and over the crest to form lee-side slopes up to 33°, which is the angle of repose. Successive layers of sand on the lee slopes can be revealed if dunes are wetted and then dissected, as E. D. McKee (U.S. Geological Survey, Denver) described. Similar cross-stratification is found in many sandstone rocks, which were formed by the cementation of ancient dunes, but cross-bedding, usually on a smaller scale, is also found in beds settled under water. From the direction of dip of the lee slopes of the former, the aeolian sandstones, the ancient direction of the wind can be determined, and diagnostic tests to distinguish these from the latter were discussed at the Newcastle meeting. Rounding and pitting of the quartz grains by impact during transport in a desert is one, but this does not exclude the possibility of the final deposition of the sand occurring under water.

S. K. Runcorn (King's College, Newcastle upon Tyne) described the statistical distribution of directions of dip obtained from various aeolian sandstones: they are interesting examples of the circular normal distribution. He also described investigations made with N. D. Opdyke (University of Rhodesia and Nyasaland) of the Permian-Pennsylvanian Tensleep and Casper Sandstones of Wyoming and Weber Sandstone of Utah, much of which formations show large-scale cross-bedding. The mean directions of transport, and those obtained from the Permian Coconino Sandstones of North Arizona, are consistently from the north-east. This consistency over a wide area must reflect planetary circulation. Similarly, F. W. Shotton (University of Birmingham) described his results on the New Red Sandstone of the Midlands and Scotland, which show easterly winds. Neither of these results fits to-day's general circulation, but if Europe and N. America are restored to their positions in this period, on the basis of palaeomagnetic data, the directions become those of trade winds.

J. J. Bigarella also showed similar studies of the Triassic Botucatu Sandstone of Uruguay and S. Brazil. The mean wind direction is westerly, again agreeing with palaeomagnetic studies, which show the latitude and orientation of South America to have changed little since the Triassic. Bigarella's results on the Botucatu Sandstone for north-eastern Brazil give results which he interprets in terms of the present wind pattern in the South Atlantic, which is not that of a trade wind.

Finally, M. G. Rutten (State University of Utrecht) suggested in discussion that the palaeomagnetic latitude should be adopted as a reference and tested against other evidence of ancient climates. This, coupled with a critical search for decisive criteria, seems likely to characterize developments in this growing research field.

The *Proceedings* of the conference, including the discussions, will shortly be published in two volumes by J. Wiley and Sons, New York.

A. E. M. NAIRN
S. K. RUNCORN

THE CENTRAL AGRICULTURAL RESEARCH STATION (TATE AND LYLE), TRINIDAD

DUE to the commercial implications of their work, industrial research organizations are seldom able to publish much of their findings, or even indicate their field of work. Such publication as is made is often long after the event.

These criticisms cannot be levelled at the annual report for 1961-62 of the Central Agricultural Research Station (Tate and Lyle), Trinidad*, published in full detail within three months of the final assessment, enabling the

findings to be applied in the 1963 season, and the reader with specific interest to examine the recorded observations. Further, the report illustrates how a small team, nine graduates and six assistants, actively led (in this case by the director, Dr. A. J. Vlitos), can complete a considerable programme in a restricted season. This is no doubt facilitated by concentration on a single crop, sugar cane, and spurred by an industry which must apply the results of research as rapidly as possible to remain profitable.

With labour rates continuously on the increase, and the sugar price largely stabilized under the Commonwealth Sugar Agreement, it is not surprising that the main research

* Annual Report of the Central Agricultural Research Station (Tate and Lyle), Trinidad, 1961-1962. Pp. 288 + 82 appendixes. (Central Agricultural Research Station, Carapichaima, Trinidad, 1963).

projects are directed to increased economical production per acre by new varieties or increased use of fertilizers, and reduced costs of weed and frog hopper control, all compared on a cost/performance basis like a series of *Which?* surveys. This work was planned when sugar production appeared surplus to world demand and a different yardstick may be required to deal with the situation where increased production at a higher cost per ton may be more profitable. The facts are there for such deliberation. In addition, a number of basic, long-term research projects are in hand.

The introduction of benzene hexachloride in 1951 to control the frog hopper brought great economic benefit to the industry. This pest is frequently so severe in Trinidad that inability to control it could mean the end of profitable production of sugar, at 1962 sugar prices, hence the consternation when resistance to chlorinated hydrocarbons appeared in 1955. Long-term control must depend on a better knowledge of the insect, about which little has been published since 1921.

The fecundity of the female frog hopper examined in captivity at the Central Agricultural Research Station is much greater than estimated. In the 3-4 weeks of her life she may be expected to lay from 239 to 318 eggs with an incubation period of 14 to more than 210 days. Only a negligible percentage of the eggs were infertile or parasitized. Frog hopper eggs laid in the dry season and kept under moist conditions, even when laid by the same female on the same day, exhibit wide variation in their degree of diapause, with no apparent relationship to adverse conditions. Investigations are in progress with juvenile hormones, chilling, and dry conditions in relation to hatching. With the higher field cost for chemical control of frog hoppers resistant to chlorinated hydrocarbon insecticides, and the constant threat of resistance to other groups of insecticides developing, 21 insecticides were screened against the frog hopper. Ten per cent 'Thimet' granules remains the outstanding product for effective and economic control, with 'Thiodan' and methylparathion the most promising of the newer insecticides tested. All, however, are highly toxic. The data illustrate the complexity of field evaluation of insecticides on this pest, which may produce up to four generations in the season.

The assessment of new cane varieties on a formula which converts yield and sugar content to pre-processing

cost, shows wide differences between varieties and that one variety may be the most economic producer as a plant crop but not as a ratoon. Some of the 54 and 55 series of Barbados varieties look promising on 1962 performance. The standard fertilizer treatment is 4 cwt. of sulphate of ammonia and 2-cwt. muriate of potash. Not all soil types responded to potash and few to phosphate, and on these 2 cwt. of superphosphate were as effective as 4 cwt. At St. Madeleine an initial phosphate application to plants is adequate for subsequent ratoons. Additional nitrogen frequently increased cane yield but reduced juice quality. The large series of trials confirm estate practice but show that small adjustments could be made profitable on certain specific soil types. A number of proprietary compounds tested with varying ratios showed no improvement over straights and were more expensive.

Over the past two or three years, the estates have adopted the persistent pre-emergence herbicides, diuron or atrazine, with 2:4 dichlorophenoxyacetic acid, as the most effective and economical treatments. About 15 new compounds were field tested, four of which are recommended for more extensive testing. 'Pesco 18-15' was outstanding on a cost/performance basis, 5 months control for 50s. per acre. A new approach to reducing harvesting costs, which on an acre basis may exceed cultivation costs, is the use of a plant auxin such as 'Pesco 18-15' or a 'Suerol' oil formulation, both of which were shown to give a significant reduction in the tons cane/tons sugar ratio when applied four weeks prior to harvest, by helicopter.

Continuing basic investigations include quantitative evaluation of the fluctuation in soil micro-organisms, with the ultimate intention of determining their role in cane growth and the development of the root system; the physiology of frog hopper blight, naturally occurring plant growth substances, and standards for foliar analysis.

Half the cane acreage of Trinidad is cultivated by small-cane farmers who produce one-third of the sugar. This report explains in detail how high yields can be obtained economically. The extension of these methods to the cane farmers offers a potential increase of 15 million dollars in exports, greater than the total exports of all other agricultural produce. This would be a tremendous boost to the Island's economy and particularly the 12,600 small growers; can the authorities accept the challenge?

G. WRIGLEY

THE CARNEGIE TRUST FOR THE UNIVERSITIES OF SCOTLAND

THE sixty-first annual report of the Executive Committee of the Carnegie Trust for the Universities of Scotland for the year 1961-62* records the decision of the Trust to add a special allocation of £250,000 to its normal allocation of £300,000 to the universities by way of capital grants for the new quinquennium. This is accompanied by a request that the universities should concentrate it on projects unlikely to be supported by the University Grants Committee or on projects for improving student amenities or recreation and facilities, towards the cost of which the University Grants Committee would contribute only a relatively small proportion. The allocations of £53,500 each to the University of St. Andrews and the University of Aberdeen and of £85,500 each to the University of Glasgow and the University of Edinburgh have been allocated in accordance with this wish.

Expenditure under the research scheme rose by almost 25 per cent to more than £74,000; £34,131 of this was

on fellowships and scholarships, £10,000 in block grants to universities for travelling expenses, £2,945 to the Trust's own scheme for travel and maintenance abroad, and £16,195 to general grants in aid of research: the corresponding figures for the previous year are £27,871; £7,000; £1,335; and £12,834. A further marked increase in expenditure on scholarships and fellowships is anticipated in 1962-63, partly because of the steep, all-round increases in 'approved fees' chargeable over and above the titular value of the award, and partly because the titular values of Carnegie awards have been increased to £400 and £500 for scholarships, £650 for senior scholars and £1,000 for Fellows. The new regulations for scholarships and fellowships are appended to the report.

Expenditure on assistance to students under Clause B of the Trust Deed decreased by more than half from the comparable figure of £15,575, reflecting the extended assistance to students made available by the State as a result of the Anderson Report. Moreover, although vacation awards increased slightly, it is not expected that the expenditure on assistance with fees will appreciably exceed the present figure of about £7,500. Vacation

* The Carnegie Trust for the Universities of Scotland. Sixty-first Annual Report for the Year 1961-62. Pp. vii+68. (Edinburgh: The Carnegie Trust for the Universities of Scotland, 1963).