WORLD POPULATION AND RESOURCES

DURING May 5–6 the Executive of the International Geographical Union met in London, and the opportunity was taken to ask three of the vice-presidents to take part in a symposium on world population, under the chairmanship of the Union's president, Prof. L. Dudley Stamp, at the Society for Visiting Scientists.

The discussion was opened by Prof. George B. Cressey (Syracuse University, New York), the immediate past-president of the Union, who outlined briefly the world position which he had elaborated in his presidential address at the Washington conference of 1952 [1]. He used the now generally accepted figures of 2,500 million for the present world population, with a net increase of not less than 25 million per annum. The reality of the situation was vividly brought home by the comment that, by the end of the two hours of discussion, there would be another six thousand mouths to be fed and also another six thousand pairs of hands potentially available for work. Prof. Cressey said that he has been impressed by the extensive abandonment of soil-eroded land over such diverse regions as the United States and China where he has worked and at the same time by the poverty of tropical soils, and he takes the view that the expansion of lands under cultivation will do little more than balance the loss due to erosion. He looks, therefore, for expansion of food output from improved yields of lands already under cultivation. Turning to the position in the United States, where farming efficiency is commonly equated with output per man-hour and not with output per unit area, there is little doubt that agricultural output could be doubled merely by the full application of known techniques. In fact, the doubling of the production between 1900 and 1950 has been achieved by technological advances without any increase in man-power: the spectacular changes in yield which have resulted from the introduction of hybrid maize are indications of possibilities with other crops. The main problem for the future would seem to be an embarrassing surplus, and little likelihood that the prairie monoculturalist will be asked to give up his winter holiday in California in order to secure the greater output from the adoption of mixed farming.

Prof. George Kuriyan (Madras) gave a brief but vivid word picture of the position in the Indian sub-continent, contrasting in almost every conceivable way with the United States. He pointed out that the Union of India had a population of 357 million in 1951 (approximately a seventh of the world's total), compared with 235·5 million over the same area in 1901. During the past three decades (that is, after the great influenza epidemic of 1918–19) the absolute increase in numbers over the whole Indo–Pakistan sub-continent has been approximately 50 million per decade. The British Indian Government, Prof. Kuriyan said, handed on a stable administration after a long period of peace and absence of famine. Improvements in medicine, both preventive and curative, have combined to produce a diminishing death-rate of about 2 per cent per annum against a birth-rate of more than 3.

To compensate this growth, there has been no corresponding increase in the resources, which, as in the past, have remained essentially agricultural. From the beginning of this century, there has been a race between population and resources; but since 1921 population has outstripped resources so significantly that in 1951 the total *per capita* production, taking note of all agricultural output, food and cash crops combined, was approximately 450 lb., while the corresponding figure for 1901 was 600 lb. Furthermore, the pressure upon land has increased so considerably that many parts of the country suffer from over-population, tracts with good agricultural resources having as much as 3,000–4,000 persons per square mile. This, in its wake, has led to the emergence of a class of landless labourers whose total numbers are estimated at 45 millions, a group of people who constitute a vulnerable section in the hands of political propagandists.

The real remedies appear to be, first, to increase the average yield of crops, which to-day is appallingly low; second, to enhance the area under cultivation by improvements in irrigation; third, to find employment for the population in avenues other than agriculture; and fourth, to have a conscious and deliberate check on population growth. The last is certainly the most important; but it is doubtful if it is easily practicable in a country like India, where the standards of education are so low and where religious feelings of the bulk of the population have always looked upon a son as a blessing from Heaven and the more sons the greater the security.

Prof. Hilgard O'Reilly Sternberg (Catholic University of Rio) presented a very different picture from Brazil. The extremely rapid increase in population, now more than 56 million, has been due to only a minor extent to immigration over the past century. Development and close settlement, for so long almost confined to a belt within 100–150 miles of the coast, is now taking place with staggering rapidity in many inland centres. New towns on the pioneer fringe within a few years are finding themselves by-passed as new pioneers move on. It is something like the westward expansion of the United States a century ago but with important differences. Social factors often play a greater part than either physical or economic: there is prestige attached to the ownership of large herds of cattle, and none to the raising of crops of wheat. Consequently, as Prof. Sternberg showed by a series of detailed maps based on the 1950 census, expansion of wheat cultivation coincides mainly with areas of German settlement and not necessarily with the most favoured tracts of land.

The chairman suggested that the three speakers illustrated in a remarkable way that there are at least four levels in the population–food problem. One is the somewhat academic global view; the second the national where, for example, the situations in the United States and India are in marked contrast; in the third place, Brazil illustrates the difference between regions, as well as the fourth stage, which is almost a pin-point relationship between an individual farm or settlement and its productive capacity. While the papers showed the

over-riding importance of the physical factors such as climate and soil, economic factors such as farm prices playing an obvious part, the imponderable social factors illustrated by religion and prestige are extraordinarily powerful and persistent.

In the discussion which followed, speakers raised such questions as the increased use of fertilizers and the 'cultivation of the sea'. Three other vice-presidents of the Union were present—Prof. Max Sorre (Paris), Prof. Orlando Ribiero (Lisbon) and Prof. Hans Boesch (Zurich). Prof. Boesch thought the papers emphasized the peculiarly difficult position of the older and more populous countries of Europe relying on their exports to purchase essential foodstuffs from overseas. It is clear, he said, that the great primary producers are not only using more and more of their home production, but are also regarding it as a matter of national prestige to develop their own manufactures. L. DUDLEY STAMP

[1] *Economic Geog.*, **29**, 1 (1953).

ACOUSTICS OF ORTHOPTERA

A SYMPOSIUM on orthopteran acoustics was held at Jouy-en-Josas, near Paris, during April 5–8 under the auspices of the French Ministry of Agriculture (Institut National de la Recherche Agronomique) and the able management of R.-G. Busnel, director of the Laboratoire de Physiologie Acoustique. It was intended both to be international and to be a meeting-ground for the scientific interests —physical, systematic, physiological, ethological and ecological—which touch each other in this field. In the event, although it is to be regretted that Italy, the Iron Curtain countries and the Americas were unrepresented, it provided the first opportunity since the Second World War for discussion of the subject between French, German and British scientific workers, a discussion much facilitated by comprehensive pre-circulation of individual contributions in two or three of their languages.

There has been little recent work on the physiology of hearing in insects; and apart from a useful survey of this part of the field by H. Autrum (Würzburg), the conference divided its time almost equally between papers on three aspects of the subject: the technique of recording and reproducing the sounds produced by insects; the analysis, oscillographic and spectral, of such sounds with attempts to relate the results, on one hand, to the structure and movements of the insect and, on the other, to the confusing and cumbrous terminology already in use; and the function of such sounds in communication between insects of the same species. Since the complete proceedings will be published shortly in French, it would be unprofitable, even if it were practicable, to abstract each contribution and each discussion here. It seems better to give what to one observer were the salient features of the conference as a whole.

The saltatorial Orthoptera, though not the only insects in which communication by sound has been established, are the best known and have shared with the cicadas the ability to interest and exasperate the human hearer for millennia. But it is only very recently that technical equipment has become available for recording, analysing and synthesizing their songs and so making possible an experimental investigation of their meaning. The pioneer observations of Regen and Faber had already established that different meanings inhered in different varieties of songs; but they had also shown that in certain circumstances a typical response could be obtained to the crudest of imitations while, in others, the insect was not seduced by what appeared to be a perfect copy. This contrast was sharply pointed by two contributions to the symposium. W. Loher (Paris) showed, in an attractive colour-film, how by an imitation made with his own mouth of the 'ordinary song' of *Chorthippus brunneus* (*ci-devant bicolor*), he could attract females of the species on to his person and even on occasion on to his lips. On the other hand, M. and Mme. Busnel described how they had completely failed to obtain a response from the females of *Oecanthus pellucens* by playing back a high-quality record of the song of the male until, with the introduction of a new type of transducer, the ionophone, they began to get positive results. The ionophone, described and demonstrated to the symposium by its inventor, M. S. Klein (Paris), is clearly a technical advance of the first magnitude. It is a completely aperiodic loud-speaker with a flat response up to more than 100 kc./s., and it has a large undistorted power output from what is virtually a point source. It is nevertheless very remarkable that it should be necessary to employ so perfect an instrument in order to make a passable copy of the song of *Oecanthus*, for analysis has confirmed the aural impression that this song is comparatively 'pure', with a fairly simple oscillogram and a relatively narrow spectrum. It is evident that there is still much to be learnt about how the gryllids and tettigoniids detect a spurious copy; and it by no means follows that because some acridiids respond by a tentative approach to an indifferent imitation of the song of their own species, they are unable to distinguish it from the real thing. It is inevitable that comparisons should be made with the experiments of Tinbergen, Lack, Hartley and others, who have shown that a stereotyped reaction can often be elicited from vertebrates by 'models' which correspond only in one or two essential features with the prototype which normally evokes the reaction. Thus small birds which customarily mob tawny owls will mob any dark mottled object of approximately the right size; but they ignore a living barn-owl which is paler, though in other respects it seems to us a much better 'model' of a tawny owl. The determination of what features of the structure of insect songs are 'essential' in this sense to their communicative function is a task for the future, though the investigation is now technically possible. It was interesting and suggestive to find that a comparison of the oscillograms of the 'ordinary song' of *Ch. brunneus* and of Herr Loher's oral imitation disclosed a similarity in structure which was obvious neither to the untutored human ear nor to the spectral analyser.

The majority of vocal saltatoria produce their songs by one or other of two methods which we are accustomed to regard as standard for the group; but D. K. McE. Kevan (Nottingham) gave a substantial list of species employing unorthodox stridulatory devices which he described and which could only be regarded as the result of independent evolution. Unfortunately, little is known of the degree of development of the auditory (tympanal) organs in the heterodox species, or of the importance of stridulation in their life-history; but their existence (many of them are exotic) is a warning not to generalize too widely from the relatively poor orthopteran fauna of Western Europe. B. P. Uvarov