LOCUST RESEARCH

DISCUSSIONS IN LONDON

IT became apparent early this year that a number of workers engaged on locust research abroad would be on leave in England during the summer, and the Anti-Locust Research Centre, taking advantage of this fact, organized a series of informal discussions on various aspects of current research. It may be taken as an indication of the magnitude of the locust problem, and of the importance now attached to it all over the world, that from such a modest beginning grew the virtually international meetings on locust research held in London during July 18-23 in the rooms of the Royal Meteorological Society. Locust workers attended from Canada, Cyprus, East Africa, France, French Sudan, Israel, Jugoslavia, Northern Rhodesia, South Africa and Syria, and they included representatives from the survey and control organizations concerned with the major locust pests of Africa and the Middle East, namely, the desert locust, the red locust, the African migratory locust, the brown locust and the Moroccan locust. Universities and other institutions in the United Kingdom where research on locusts or related problems is conducted were also well represented.

The keynote of the meetings was informality, and although the period of fifteen minutes allotted to each speaker was too short to allow of more than a brief outline of current problems and research, the good chairmanship shown at all sessions ensured that the maximum amount of factual evidence was put before the meeting in order to provoke discussion. That this was stimulating to all was shown by the fact that almost every person who attended spoke at least once.

The meetings were arranged as a series of sessions each relating to a particular aspect of locust research. The first session, on "Aggregation and Gregarious Behaviour", was marked by the presentation of evidence which allowed gregariousness to be approached on a quantitative basis instead of by the rather vague qualitative methods used hitherto. R. C. Rainey (Desert Locust Survey), Z. Waloff (Anti-Locust Research Centre) and H. J. Sayer (Desert Locust Survey) showed that in spite of random flight orientation, and also of convective turbulence in the air and the dispersal to be expected from wind, swarms of the desert locust traverse hundreds of miles as discrete entities. They have been led by these observations to postulate reactions having the effect of keeping the swarm together, and have observed various behaviour patterns in flying swarms which may have been relevant. P. T. Haskell (Imperial College, London) spoke on the possible sensory mechanisms related to gregarious behaviour, with particular reference to auditory and visual reactions. P. E. Ellis (Anti-Locust Research Centre), W. J. Stower (Desert Locust Survey) and G. B. Popov (Desert Locust Survey) spoke on aggregation in hopper bands and in ovipositing swarms of the desert locust. It was most interesting to hear from L. D. Vesey-Fitzgerald (International Red Locust Control Service) a preliminary theory relating outbreak areas to vegetation pattern in the case of the red locust.

The second session, with Prof. O. W. Richards (Imperial College, London) in the chair, consisted of papers on the "Estimation of Numbers". J. G. Skellam (Nature Conservancy) and D. L. Gunn

(International Red Locust Control Service) spoke about estimations of populations of the red locust, the latter dealing with the figures obtained by the practical method of flushing the insects by means of a motor vehicle. Z. Waloff and R. C. Rainey dealt respectively with numbers in solitary populations and in swarms. J. P. Dempster (Moroccan Locust Research Team) spoke on estimation of populations of various stages of the Moroccan locust, and W. J. Stower and C. Ashall (Desert Locust Survey) on estimations of hopper bands of the desert locust. The latter gave figures showing estimates of the number of hoppers in bands based on experienced visual observation and on various other techniques, and it was interesting to find that the former gave far more accurate results; unfortunately, it is not a teachable technique. G. Popov spoke on egg-pod distribution, a problem which is complicated by the fact that often the extent of the egg-field is difficult to establish. One important point made in the discussion was that the accuracy desired depends on the purpose for which the estimate is required; for control campaigns, figures relating to orders of magnitude of populations are generally sufficient, enabling fairly quick practical methods to be used, but for research, more accurate methods must be found.

The subject of the third session, "Factors in the Fluctuations of Populations", followed naturally that of the preceding one, and M. J. Richards (Anti-Locust Research Centre) and N. Waloff (Imperial College, London) gave papers on the fecundity and fertility of various Orthoptera under laboratory and field conditions; these papers focused attention on the great gaps in our knowledge relating the effect of environment and the physiological state of the insect to its reproductive capacity. J. P. Dempster spoke on variations in a population of the Moroccan locust relative to the changing habitat. No more than a start has been made in studying natural enemies of the desert locust (D. J. Greathead, Anti-Locust Research Centre) and other factors of natural mortality in this species (J. Roffey, Desert Locust Survey).

The session on "The Distribution and Movements of Populations", with P. R. Stephenson (Desert Locust Survey) in the chair, was marked by the interesting papers relating to movements of scattered populations presented by J. T. Davey (International African Migratory Locust Control Organization) for the migratory locust and by Z. Waloff for the desert locust. The former outlined experimental work which suggests a closed-circuit migration by night related to the seasonal rains and floods in the Niger Basin; although there were criticisms of some of the inferences on physiological grounds, nevertheless the theory is most attractive in explaining the appearance of hopper bands in approximately the same parts of the region year after year and the cyclical changes in population densities that occur over parts of the area. The results presented by Z. Waloff demonstrated that movement of scattered adults of the desert locust occurs at night. R. C. Rainey and Z. Waloff spoke on the theory that swarms of the desert locust move down-wind towards zones of convergence of air flow; this conception has the virtue of explaining the observed displacements of flying swarms and the general migration cycle demonstrated by swarm mapping. Again, some aspects of the theory were challenged, and it clearly needs much more work before it can be accepted as a complete basis for the movement of swarms, but no alternative theories

were offered. The papers of P. E. Ellis and W. J. Stower on movements of hopper bands of the desert locust showed that there may be some common features in the behaviour of adults and that of hoppers.

A session on "Locust Phases" began with a review by J. S. Kennedy (Cambridge) of the recent approaches to the problem with emphasis on the endocrinological and behavioural aspects of phase variation. Papers by F. O. Albrecht (Laboratoire de Biologie Animale, Paris), P. E. Ellis and P. Hunter-Jones (Anti-Locust Research Centre) illustrated the great amount of laboratory work that is being done on many aspects of the biology, morphology, physiology and behaviour of the phases. Perhaps the greatest need suggested by these papers and the subsequent discussion of them is for basic physiological knowledge to link together the results of widely separated experimental approaches to the problem. R. E. Blackith (Imperial College, London) and D. E. Davies (Anti-Locust Research Centre) spoke on the application of statistical methods, in particular the generalized-distance method, to the analysis of phase variation in locust populations.

The research that is being done on control methods was described and discussed under the heading "Control Development", with Dr. D. L. Gunn (International Red Locust Control Service) in the chair. It ranges from field investigation of the use of aircraft against swarms, hopper bands and egg-fields to laboratory work on problems such as the cumulative effect of sub-lethal doses of insecticides, the comparative toxicity of different materials and formulations, and the comparative susceptibility of species and stages of locusts. The principal speakers included R. D. MacCuaig (Anti-Locust Research Centre) and J. H. Lloyd (International Red Locust Control Service), the former dealing with laboratory research and the latter with the various methods, including spraying adult locusts from light aircraft, used for controlling the red locust in its outbreak areas near Lake Tanganyika.

Papers by Z. Waloff, R. Skaf (Syria), R. C. Rainey, G. B. Popov and W. J. Stower, on "The Desert Locust Problem", emphasized a fact suggested at many of the previous talks, that the desert locust remains the most difficult of the plague locusts from the point of view of both research and control. The lack of clearly definable outbreak areas, the very long-range migrations of which the insect is capable, the possibility of continued nomadic existence of swarms in small numbers during interplague periods, and the large number and diversity of countries affected by it, all conspire to complicate the problem, but also to make it most challenging to research workers. B. Zolotarevsky (International African Migratory Locust Control Organization) spoke on some unusual seasonal movements of swarms of the desert locust in West Africa.

The final session, on "Trends and Needs in Locust Research", was introduced by T. H. C. Taylor (Anti-Locust Research Centre) in a talk designed to illustrate the gaps in present-day knowledge revealed by the preceding sessions. In the discussion which followed, two main trends were apparent. These were, on one hand, a call for more physiological research relating to sensory physiology, internal physiological states and the relation of such states to behaviour and to phases; and on the other hand, the treatment of the problem quantitatively from the point of view of population dynamics and ecology.

This gathering was the first for which locust research workers assembled solely to exchange views and discuss current work, previous locust conferences having been largely concerned with matters of international co-operation and control arrangements. Its success was undoubtedly due to the informal atmosphere, which encouraged the airing of unconventional and tentative proposals, and thus helped to enliven the discussions. Perhaps the emergence of several tentative and controversial theories may reduce the empiricism which has perforce formed such a large part of locust research hitherto. The Anti-Locust Research Centre, under its director, Dr. B. P. Uvarov, who took the chair at most of the sessions, is to be congratulated on initiating this stimulating review of current research on locusts.

P. T. HASKELL

COLONIAL STUDENTS IN GREAT BRITAIN

THE inquiry conducted by Political and Economic Planning (PEP) into Colonial students in Great Britain* had as its practical aim to discover whether any changes in approach or organization on the part of the authorities concerned might lead to a more effective use of the resources devoted to the education and training of men and women from the Colonial territories, and to make constructive suggestions where necessary. The general implications have been discussed elsewhere in *Nature*, but the inquiry, supplemented by questionnaire, interview and field work, and the detailed information about scholarship holders kept by the Colonial Office, brought to light concrete facts and figures which are not otherwise easily available. These facts, on which the main recommendations are based, are presented in one chapter of the report and in the appendixes, and in their collection PEP was guided by four main considerations: the interest which the student or his sponsors has in the use to be made of his education; the possible wish for him to acquire more than a qualification or purely professional skill; the requirements of the society from which the student comes; and the effect which the education of Colonial students in Britain may have upon relations between Britain and the Colonial territories.

The grand total of Colonial students in the United Kingdom and the Republic of Ireland on January 1, 1955, was 10,200, but this includes 2,040 student nurses who are otherwise excluded from these statistics. In 1939 there were about four hundred Colonial students at British universities with an unknown number at other institutions. Ten years later the combined total was 3,300, of whom 1,745 were university students. For the academic year 1954-55, there were 8,160 students, of whom 2,915 were university students; but although in 1953 nearly a tenth of university students in Britain were overseas students, only one-fifth of these, or about 2 per cent of the total, were from the Colonial territories. While, however, the number of university students in Britain is slightly decreasing, the number of students coming from the Colonial territories is increasing, and, since 1950, the number of post-graduate Colonial students has become significant. During the academic year 1954-55 nearly one-third

* Colonial Students in Britain: a Report by PEP. Pp. ix+257. (London: Political and Economic Planning, 1955.) 21s.