

Agricultural Science in Palestine.

WHEN the Zionist organisation began to develop its programme for the colonisation of Palestine, it realised the need for scientific research into agriculture and horticulture and set up an experimental station at Tel-Aviv under the directorship first of Dr. Warburg, and now of Dr. Elazari Volcani. Laboratories were equipped and arrangements made for field experiments in the various parts of the country being colonised under Zionist auspices. As might be expected, the scientific work has been well done and a number of interesting results have already accrued, opening up many possibilities for the future. The Zionists are not the only Jewish investigators in Palestine: the French organisation, known as P.I.C.A., has its school and experimental farm at Mikveh, where good work is done, and there is, of course, the Palestinian Government Department with its headquarters at Jerusalem.

The agricultural problems are those of a dry region of smallholders—a usual type of holding where irrigation can be widely practised but less common otherwise. The smallholdings are necessitated by the circumstance that Palestine is only a small country, already carrying a considerable population of Arabs who have been there for many years and regard themselves as having a good claim to the land; while the number of Jews who wish to colonise it is considerable. To meet the difficulty, the method was early adopted of working out schemes of husbandry suitable for small farmers of intelligence but not much capital. In the Plain of Sharon, the best prospects are for fruit, flowers for scent, and, near the towns, dairy products and vegetables. In the Emek these are less suitable though dairying is being seriously attempted: the simple obvious products are cereals, but these are not easy to sell profitably.

The Tel-Aviv work is based on a sufficiently comprehensive programme and it covers practically all subjects bearing upon the colonists' problems. Throughout, the purpose is to intensify agriculture in order to provide a higher standard of living for a larger rural population. This involves the more intensive production of existing crops, the introduction of new ones, and the improvement of the native breeds of live-stock. At the same time, the Division of Rural Economics is making a careful survey of the conditions of production of the existing crops and live-stock products with the view of further development. Possibilities of disposal of the increased output are being explored; the home market is not particularly large, but Egypt and the near parts of Europe offer some prospects for an export trade.

Dairy farming, in particular, seems to offer many advantages. It gives a higher output per man and per acre than the traditional agriculture, and thus lends itself to a denser agricultural settlement. The resulting animal manure raises the fertility of the soil for other systems of farming. The investigation has been assisted by the Empire Marketing Board, which arranged that Mr. J. Crichton, of the Rowett Institute, should study the subject on the spot. The technical problems are well on the way to solution. The grading up of the dairy cattle has been started, and also the initial improvement of the soil to a point at which it will begin to carry the new system, and the elaboration of a suitable cropping scheme. The Palestinian demand for dairy produce being insufficient, it is proposed to build up a control organisation strong enough to maintain such a standard of quality as will secure the products in the overseas markets.¹ The possibility of the development of a sugar industry is being examined.² The most hopeful

solution appears to be the combined cultivation of cane and beet, thus spreading the work at the factory over a longer season and broadening the scheme of cropping. Sugar-cane, although little grown, is not a new crop in Palestine. Beet, however, presents certain difficulties in the dry regions, but these can be overcome by irrigation at critical periods.

Among the indigenous plants are eight species of wild flax, and the growing of flax for seed, carried out in Bible days, is being exploited once more. So far no serious diseases or pests have affected this crop, though it is anticipated that dodder is likely to put in an appearance at some future date.

Palestine, however, is always liable to plant diseases and pests, and steps were taken from the outset to cope with them. Dr. Reichert, who is in charge of the Division of Plant Pathology, and is ably assisted by Miss Hellinger, has confined his attention principally to the banana, citrus, and wheat crops. 'Internal decline', a physiological disease of citrus fruits well known in other regions, has now been recorded in Palestine. *Diplodia stem-end rot* is widespread, and in 1929 cost the Palestine orange industry some £25,000. It is, however, practically eliminated by debuttoning the fruit by colouring it. A third trouble, due to *Sclerotinia sclerotiorum*, is common to citrus, banana, and various other crops. The banana is particularly susceptible, and there seems considerable danger of the spread of the fungus thence to the citrus groves. The wheat studies, commenced in 1923 and still in progress, have been chiefly concerned with the relative susceptibility of different varieties to bunt, and it is of considerable interest that the wild emmer (*Triticum dicoccoides*) has been found to be highly susceptible.

Dr. Oppenheim, of the Division of Horticultural Breeding, is working principally upon the sugar content and the acidity of the orange fruit during its development, and upon breeding methods for improving the citrus crop. He emphasises the importance of bud selection and suggests the establishment of a national organisation for the selection of stock and of bud-wood from trees already existing in the groves.

Of the insects giving trouble to the grower, locusts are the best known, and the Government has set up a good locust service to observe and deal with the insects as soon as they appear. Other insects, however, are also harmful. Dr. F. S. Bodenheimer, in his bulletin on the Coccidæ or scale insects of Palestine, enumerates some 65 species, of which eight are new to science. Even this list by no means exhausts the Coccid fauna and he has since issued supplementary notes. He has studied also the Wood Leopard moth (*Zeuzera pyrina*), an insect which causes great damage, particularly to olive and apple trees, by its larva tunnelling in the wood. The use of paradichlorobenzene or calcium cyanide is recommended as a remedy easy to handle and to apply. Among other entomological papers, the report by H. Haupt on *Homoptera Palestine* I.³ and that of F. S. Bodenheimer on tobacco pests may be mentioned. Some of the latter originally affected wild Solanacæ and other plants, but are now passing over to the newly planted tobacco and cause considerable injury.

Spraying naturally comes in for a good deal of study: one interesting paper deserves mention.⁴ Assuming varied standards of mortality by spraying, and a 95 per cent natural mortality in each generation of the larvæ from the eggs surviving spraying, it is shown that insects with 10 or 20 eggs per female cannot maintain their existence under such control measures, but that the Red Scale (*Chrysomphalus*

aurantic), which has 100 eggs per female, can only be controlled by a spray giving at least 90 per cent mortality, and that one, or at most two, sprayings per year are then sufficient. The control measures should be applied at the time of population minimum; the numbers cannot be materially reduced if dealt with at the time of population maximum. Similar considerations are applied to field mice control.

The publications of the Tel-Aviv Institute are not confined to agriculture and horticulture. A systematic survey of the flora of Palestine is now being carried out by A. Eig. Two bulletins on the systematic side and one from the ecological aspect give an excellent bird's-eye view of the flora of Palestine. The flora is in process of active transformation owing to the effect of modern methods of land cultivation. Marsh species are tending to disappear owing to increased drainage, while certain dry land species are vanishing with the spread of irrigation.

The attempt to fix the shifting sand dunes will probably affect the dune flora. These imminent changes render it desirable for the botanical surveys to be pushed forward as rapidly as possible, but the work is handicapped by the fact that most plants are short-lived, appearing in the spring only, so that only relatively small areas can be investigated each year. The flora is much affected by physical factors, especially by the distribution of rainfall, as the period of greatest heat synchronises with that of absence of rain. Steps are already being taken to preserve the native flora, to guard the reserves, and to plant woods of forest trees.

One of the publications makes an especially wide appeal: Dr. Volcani's pamphlet, "The Fellah's Farm", which, apart from its special agricultural matter, is of general interest because of its many references to survivals of ancient Jewish and fellah folklore. Here, for example, is a summary of the rites still performed

by the local peasantry when the rain has failed to appear:

"Each district has its local rites. There may be a procession of girls in the twilight after the evening meal, beating empty petrol tins containing pebbles, in order to make even more noise. They knock at the doors of the houses, and are sprinkled with water. An old woman marches before them, a handmill on her head, on top of which a rooster shut in a basket crows lustily to call forth divine compassion. A pitcher of water occasionally replaces the handmill. A white cock and a black hen are carried along and beaten at intervals so that they may cry all the louder. Grain and flour sifters are carried on the head to symbolise the famine threatening man and beast. Sometimes an old woman, riding a donkey backwards and carrying an infant, grinds an empty handmill. These figures are meant to personify innocence. The old woman can no longer do wrong, while the infant has not yet tasted sin. The rooster represents the domestic animals."

The workers at Tel-Aviv, and the Zionist Organisation supporting them, are to be heartily congratulated on the volume and quality of the work they have already done under conditions which have sometimes been both difficult and trying. With the setting up of the new experimental field at Rehovot, we may expect an even more extensive study of Palestinian problems. A good beginning has been made: we wish the workers all success.

THE STAFF OF ROTHAMSTED EXPERIMENTAL STATION.

¹ Preliminary Report on the Agricultural Aspect of a Sugar Industry in Palestine, *Tel-Aviv Bull.*, 3, 1924.

² The Dairy Industry as a Basis for Colonisation in Palestine, *Pub. Palestine Econ. Soc.*, 1928. The Transition to a Dairy Industry in Palestine, *Tel-Aviv Bull.*, 11, 1930.

³ Homoptera Palestine, 1, *Tel-Aviv Bull.*, 8, 1927.

⁴ Theoretical Considerations on the Evaluation of Control Measures, by Dr. F. S. Bodenheimer. *Hadar*, vol. 3, No. 12, December 1930.

The Satellites of Jupiter.

PROF. DE SITTER, Director of Leyden Observatory, delivered the George Darwin Lecture of the Royal Astronomical Society on May 8, taking as his subject "The Satellites of Jupiter". The lecture began with a sketch of the progress of our knowledge of the system. Galileo attempted to make tables of their motion. Romer deduced from them the finite velocity of light. Wargentin devoted a large part of his life to the study of their motions. Bradley made careful observations. La Grange improved the mathematical theory. Delambre and Damoiseau made tables, which remained in use until recent times. Forty years ago, Sir David Gill carried out a series of observations with the Cape heliometer; he compared the satellites with each other, not with Jupiter itself, finding that this increased the accuracy of observation very notably. The positions of certain stars had been found with great accuracy in connexion with the determination of the solar parallax from observations of the planets Iris, Victoria, and Sappho. These stars were now used to check the scale of the heliometer, and this was considered to be known to one part in 100,000. Prof. de Sitter took a large part in reducing these observations; he found from a combination of all determinations that the mass of the Jovian system is $1/1047.40$ of the sun, with a probable error of 0.03 in the denominator.

Prof. de Sitter then gave an outline of the different classes of perturbations, which he divided into four groups: (1) Those with periods of less than 17 days; (2) periods of 400–500 days; (3) the small libration

of satellites I, II, III about their equilibrium position—he found that the period of this is close to six years; (4) those exceeding Jupiter's period of revolution. The inequalities of short period exceed in magnitude the oscillations arising from the eccentricities of the orbits; he therefore used intermediary orbits based on these inequalities, instead of using ellipses.

The values given by Prof. de Sitter of the masses of I, II, III, IV were 381, 248, 817, and 509, expressed in units of the seventh decimal of Jupiter's mass. Those of II and III are the best known, the different determinations of these being very accordant. He made a comparison between the Jovian system and (1) the four interior planets, (2) the four giant planets. He noted that 33 years in the satellites corresponded to 17 centuries in the terrestrial planets and to 1200 centuries in the outer planets. Consequently, progressive changes take place much more rapidly in the satellite system, which adds interest to the study of them.

Prof. de Sitter also alluded to his studies of the variations in the rate of the earth's rotation as shown by the fluctuations in the motions of the moon, the inner planets, and Jupiter's satellites. Certain discrepancies between the results from Jupiter's satellites and those from the other sources suggest the possibility that the Jovian system might have fluctuations of its own. He showed from a diagram that the fluctuations were small during the nineteenth century, so that it was not until the present century that their reality could be affirmed with some confidence.