with chiefly at Cambridge; while Aberystwyth, the Welsh plant-breeding station, is concerned principally with the discovery of the production of new and improved herbage plants which must be so important in the West of England from the point of view of pasture and meadows.

(c) *Plant Physiology*.—The chapter on this subject opens with a suggestive discussion on the fundamental principles involved in crop production. These principles are concerned with the causes that determine heavy cropping and light cropping, resistance to disease, and the formation of flower-buds on fruit-trees. The electrical treatment of crops is also receiving attention at Rothamsted, the Harper Adams Agricultural College, and on a station near Dumfries. To quote from the report, "There is no doubt that electrical discharge will increase plant growth, and it is hoped that it will be found possible to continue the patient experimental work that has been going on for some years, for it seems certain sooner or later that electricity must play an important part on the farm in increasing crop production."

(d) *Fruit-growing and Preserving*.—Fruit problems are being dealt with mainly at the horticultural station at Long Ashton and at East Malling in Kent. Much suggestive work has been done on the problem of fruit stocks, a subject that has hitherto been very confused and unsatisfactory. The Paradise stock, for instance, has been proved to be a mixture of several varieties, and it would appear that even the crab stock may be graded into several classes, each of which has a distinct influence on the scion that is grafted or budded on to it. This subject is inseparably connected with the development of the root system, a line of research to which the late

Mr. Pickering gave much attention, showing that it was quite unnecessary to give the amount of attention that is usually bestowed upon planting. This unexpected result appears to have been confirmed at Long Ashton, the original root system playing practically no further part in the growth of the transplanted tree, which seems to develop a new root system independent of the old. Work on ringing, pruning, disbudding, etc., also promises to have an influence on commercial production, while much light is being thrown upon the problem of manuring of fruit. This station has also contributed largely to our knowledge of the factors that determine the production of high-grade cider and perry.

(e) *Plant Diseases*.—In no department of the Ministry's scheme has more activity been shown than in the direction of plant diseases. At the School of Botany in Cambridge special attention has been given to the silver leaf disease, a trouble that is increasing markedly in this country, and is now no longer confined to plums, but has spread to apples and other fruit-trees. How destructive the disease may be is proved by the fact that an apple-orchard of about 6 acres, near Wisbech, showed more than 1000 trees attacked by this disease, the cause being attributed to carelessness in pruning and the neglect to protect the wounds thus caused.

Space does not permit of the publication of details in the departments of animal husbandry, animal breeding, dairying, animal diseases, and agricultural economics, but enough has probably been said to show what an enormous change has come over the country in respect of the provision for agricultural research under the enlightened policy pursued by the Ministry of Agriculture.

The Magnetic Work of the Carnegie Institution.¹

By Dr. C. CHREE, F.R.S.

THE primary object of the volume referred to below is to chronicle the results of observations made on land by members of the Department of Terrestrial Magnetism of the Carnegie Institution, Washington, from 1914 to 1920. During that period 1747 stations were occupied, bringing up to 4028 the number of land stations occupied since the world survey began in 1905. Even the general reader will find much to interest him in the field observers' reports on pp. 98-222. Mr. F. Brown, for instance, who travelled over large areas in China, Mongolia, Manchuria, Upper Burma, the Cameroons, and French Equatorial Africa, and who crossed Central Africa from Angola to Mozambique, relates adventures with brigands, lions, witch doctors, and native kings.

There is also a general account of the land instruments employed, references being made to earlier volumes for constructional details. Plate 2 gives illustrations of the instruments supplied by the Department to Captain Roald Amundsen's *Maud* expedition. On p. 9 there is an explanation of the two standards which have been used, the earlier denoted by C.I.W. (Carnegie Institution, Washington), the later by I.M.S. (International magnetic standards). The use of the latter term for standards which have not received international sanction is somewhat open to criticism.

The observational results occupy some 67 pages, and later in the volume there is a detailed description of the stations. Some of the more picturesque places visited are illustrated in seven plates.

¹ Researches of the Department of Terrestrial Magnetism, vol. iv.: Land Magnetic Observations 1914-1920. By Dr. L. A. Bauer and others; and Special Reports. (Publication 175). Pp. vi+475+9 plates. (Washington: Carnegie Institution, 1921.)

Mr. J. A. Fleming describes the construction at the headquarters of the department, at Washington, of a new non-magnetic building for experimental work. It is of considerable size, 28 ft. × 53 ft. ground area, of double-walled concrete. Provision is made for the supply of water, gas, compressed air, and electric circuits for direct and alternating current. The cost, exclusive of the internal equipment, was 8500 dollars. A magnetic survey made after the completion of the building showed differences of 2' in dip and 25γ in horizontal force between the north and south ends.

Mr. H. W. Fisk discusses errors arising from minute pivot defects in dip needles. He advocates the use of at least four needles at each station, so as to recognise with certainty when an individual needle becomes faulty.

A description by Mr. S. J. Barnett of a new sine galvanometer for determining H (horizontal force) is of special interest at the present moment. The construction of similar instruments has been simultaneously in progress in America, Japan, and England. The instrument described by Mr. Barnett is much smaller than that recently described to the Royal Society by Mr. F. E. Smith. Its coils, of approximately 30 cms. diameter, are wound on Carrara marble. An approximation is made to the Helmholtz arrangement, but the coils are really spirals. It is hoped to measure H with an error less than 1 in 10,000. A preliminary comparison with the I.M.S. standard mentioned above gave a discrepancy of only 0.7γ, or 1 part in 25,000, but the constants of the instrument are as yet to some extent provisional.

Mr. J. A. Fleming also deals with the results of comparisons, direct and indirect, between Carnegie Institution instruments and the standard instruments

in use at a number of observatories. He claims that the results show, first, that the Carnegie Institution standards are in every way satisfactory, and second, that "the absolute precision obtainable with carefully designed magnetometers and (dip) inductors, provided instruments are carefully used and comparisons are made with reliable standards at least every two or three years, is of the order 0.2 in declination and inclination and of the order 0.00015H (i.e. 37 in England) in horizontal intensity." If this be true, the gain in accuracy to be hoped for from coil instruments is not great. If, however, as stated on p. 468, a complete observation of H with the coil instrument occupies only 2 minutes, its use at an observatory would represent a great economy of time, always

provided little time is spent on keeping the apparatus up to the mark.

However this may be, what is really more wanted is a coil instrument for measuring V (vertical force). Base line values of V curves are at present dependent on dip circles or inductors. Even if the accuracy claimed by Mr. Fleming for dip inductors be conceded, it must be remembered that an error of 0.2 in the dip at a place where the value of H is only 0.03 (the approximate value at the base station of the Australasian Antarctic Expedition 1912-13) leads to an error of about 90% in V. Thus a coil instrument which could give V directly, to within $\pm 5\%$ even, would be an immense improvement on a dip inductor for use in high latitudes.

New Social Coleoptera.¹

By Dr. A. D. IMMS.

IF we regard as truly social only those insects in which the parent, or parents, live with their offspring, protecting and feeding them, there have been known hitherto but three groups of beetles which come into this category, namely, the Platypodidae, Scolytidae, and Passalidae. Prof. W. M. Wheeler has recently added to the list two genera of Silvanid beetles belonging to the family Cucujidae, discovered by him in British Guiana. The beetles in question are *Coccidotrophus socialis* and *Eunaisibius wheeleri* both of Schwartz and Barber. The bulk of his observations concern the first-mentioned insect, the other species being apparently rare. The beetles enter the hollow petioles of a Leguminous tree *Tachigalia* and either bore their way in, or gain admittance through perforations previously made by other insects. They enter either as a single pair, or one beetle enters and is very soon joined by an individual of the opposite sex. Upon taking possession of their future habitation the beetles remove any loose pith, or the remains of previous tenants, by pushing this debris into the pointed ends of the cavity by means of their flattened heads. This behaviour brings the insects into contact with the outermost layer of pith adhering to the walls of the cavity, and certain strips of nutritive parenchyma. The latter tissue forms the food of the beetles, and is also shared by young Coccidae of the species *Pseudococcus bromeliae*, which soon begin to enter the petiole-cavity. By means of the feeding action of the beetles, the strips become converted into grooves, the coccids stationing themselves in a row in each groove. The beetles carefully avoid soiling their food material and store their frass in the areas between the grooves. They lay their eggs along the frass ridges, and the larvæ which hatch out feed upon the same nutritive parenchyma as their parents. When mature, they

construct brown cocoons within which pupation occurs. The beetles emerging from the latter remain in the petiole with the original pair; they mate and produce eggs and larvæ in turn, thus leading to the climax stage of the colony, which may eventually consist of several dozens of beetles of both sexes, and many larvæ and pupæ in all stages of development. The Coccidae also increase in number, so that the cavity of the petiole sometimes becomes crowded with inmates. In the meantime, the old and exhausted beetles die off, and their bodies are consigned to the refuse accumulations already mentioned. When this crowded condition is reached, beetles begin to leave the colony either singly or in pairs and, seeking other petioles, thus found new colonies.

Both the larvæ and imagines of the *Coccidotrophus* solicit honey dew from the coccids by "stroking" the latter by means of the antennæ. The relations of the beetle to the coccids, moreover, are physiologically similar to those of symphile beetles to host ants that supply them with regurgitated liquids. *Coccidotrophus*, like the symphiles, has specially modified antennæ and labium, such modifications occurring in both the larvæ and adults. This type of relationship with Coccidae has not been noted hitherto in any Coleoptera and, apart from ants, very few insects are known to have developed the ability to solicit honey dew from among the Homoptera.

It appears that the Silvanids have a more primitive social life than any of the three families of beetles previously alluded to, but there is no definite preparation of larval food by the parents. Their colonies represent a stage in social development intermediate between the families mentioned and the merely gregarious species of Cucujidae. For further details, and many interesting observations on the numerous and heterogeneous "biocenose" of other insects associated with the plant *Tachigalia*, the reader is referred to Prof. Wheeler's original paper.

¹ W. M. Wheeler, "A Study of some Social Beetles in British Guiana and of their Relations to the Ant-Plant *Tachigalia*," *Zoologica*, New York, vol. iii, Nos. 3-11, Dec. 24, 1921.

Spectroscopic Studies of Stellar Velocities.¹

By Dr. WILLIAM J. S. LOCKYER.

IN order to determine the distribution and motion of stars in space it is necessary to know four important facts about each star. The first is its position, known as its Right Ascension and Declination; the second is its proper motion, i.e. the move-

ment at right angles to the line of sight; the third is the radial velocity or movement towards or away from the earth; and lastly, the parallax or distance of the star from the earth.

During the last few years the accumulation of a large amount of such data, extending over many years, has led astronomers to the important problem of investigating the systematic motions of the stars

¹ "The Radial Velocities of 594 Stars," Publications of the Dominion Astrophysical Observatory, Victoria, B.C. (vol. 2, No. 1), by J. S. Plaskett, W. E. Harper, R. K. Young, H. H. Plaskett (Ottawa, 1921).