The price obtained in South Indian bazaars is roughly Re. 1 per lb. for good quality cloves. The wholesale price in England varies from 8 d. to 1 s. per lb.

Cost of planting and maintenance: The charges for the first ten years are estimated to be Rs. 1,500 per acre, but this must necessarily vary in different districts. Thereafter the probable cost of maintenance such as weeding, forking, mulching, etc., would be about Rs. 100 per annum.

N. B. Clove seeds and plants are available at the Agricultural Department Experiment Fruit Station at Burliar in the Nilgiri District, price of the former being Re. 1 per 100 and the latter annas four per plant or Rs. 15 per 100. Seeds can be supplied in September each year.

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* INSECT PESTS OF ORANGES IN THE NORTHERN CIRCARS

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In the N. Circars orange cultivation is carried on, on a fairly extensive scale. The citrus gardens round about Ellore, in and around Palacole and in the vicinity of Rajahmundry in the Godaveri District, and those in the districts of Guntur and Kistna furnish a very imposing sight. The chief varieties grown are the Batavian oranges (*Citrus sinensis*), the Pomelos (*Citrus decumana*), the Sour lime (*Citrus medica* var. *acida*) and the country oranges (*Citrus aurantium*); of these the Batavian forms the most noteworthy. This variety is found to come up well in almost all soils such as sandy or red loams and typical red soils. It requires timely irrigation and the importance is well evidenced by the presence of large wells in these gardens. Good drainage also appears to be essential, since water-logged conditions affect the tap root. The trees are planted 20 to 35 ft. apart. They begin to bear after seven years and normal bearing begins after ten years. Various manures are applied, such as tank and canal silt and horse and cattle manure. This is done during December, and irrigations are given immediately afterwards, the idea being to induce early flowering which commences during December–January. During the beginning of July, the fruits are ready for basketing which is done to induce good colour and early ripening. A month or a month and a half after basketing, the fruits will be ready for the market. The price of the fruits usually varies between Rs. 30 and Rs. 50 per 1000, each fruit selling for an anna or two. Though a paying crop, there is loss in certain years due to insect attack and as such, the fruit-grower in these parts will do well to get some knowledge of these pests and the possible methods of their control.

* Paper read before the Ind. Sci. Congress, Patna 1933.

The object of this paper is to record some of the observations made regarding citrus pests, during the period of two years 1930—31 and 1931—32, when the writer was stationed at the Agricultural Research Station at Anakapalli, Vizagapatam Dt.

The following are some of the pests noted on citrus.

The Fruit-Sucking Moths, so called on account of their habit of sucking the juices of fruits by means of their sharp sucking tube, are widely distributed. Here is an instance where the adult or the imago is able to cause damage to a crop. The minute punctures caused on the rind develope bacterial activity and the fruit consequently turns yellow and drops down. Fruit-fall is a very common occurence in infested orange gardens. The moths attack pomegranate and mango also. More than one species is concerned in the damage, *Ophideres materna* and *Ophideres fullonica* being the chief. The adults are beautifully coloured and may be mistaken for butterflies. These two important species are distinguished by the differences in the wing coloration.

These moths deposit their eggs usually on *Tinospora cordifolia* (*Tippa Tiga* in Telugu) commonly found among hedges and cactus bushes. The hatched-out larvae feed on the leaves of these creepers and when fully grown are about 7 to 7½ cm. long. They are stout and semilooped, forming a characteristic S-shape when disturbed. The larvae show a great deal of colour variations and they are speckled with orange, blue and yellow spots. The anal segment is characterised by bright yellow patches behind and on the sides. In the case of *O. fullonica* the caterpillars are deep greyish-brown with five pairs of prolegs whereas there are only four pairs in *O. materna*. The larvae before changing into a dark brown pupa spin a tough cocoon among the dried leaves. The pupal period varies between 10 and 16 days.

Control: This is a very important pest in this tract causing appreciable loss and deserves some special notice in the matter of control measures. Removal of larval food plants by the gardeners with concerted action among themselves would mean prevention.

In the Circars there is the practice of covering the fruits with baskets, made of palmyra leaves and costing Rs. 1/4/- to Rs. 2/- per 1000. This is done a month or a month and a half before harvest and is done mainly to induce good colour, and the idea of protecting the fruits by means of these baskets may after all be an afterthought. After basketing is done fruit-fall is considerably reduced. Occasionally fruit-fall is noticed both in the case of basketed and unbasketed fruits. One is inclined to ask how far basketing of fruits is effective in preventing the moth-attack. Not only this. These baskets are made of palmyra leaves and the latter are not intact and the moths could easily pierce the fruits through the crevices. If the basketing should prove effective, the fruits should be basketed earlier than is done at present which may affect the development of the fruit. Round about Ellore the fruits are covered with lotus leaves. These are not

as good as those with palmyra leaves, because the former become dried up soon and tear off easily and the fruits are pecked by birds too. It would be of interest to note that it is reported by gardeners that basketing of fruits with lotus leaves prevent fruit-moths' attack on account of the peculiar odour the leaves possess. This is also a point worth investigating.

Spraying the fruits with Crude oil emulsion and handnetting the moths during nights have been found to produce good results.

The Citrus Butterflies: The caterpillars of these butterflies feed on the foliage and the damage to young plants is more serious than to the trees. There are three species generally concerned in the damage; these are *Papilio demoleus*, Linn., the popular lemon butterfly; *Papilio polytes*, Linn., which is noted for its mimicking female forms; and *Papilio polymnestor*, Cram., a very large butterfly with dark and blue shades and markings. These butterflies are commonly seen flying about in all gardens during day time.

The mother butterfly generally lays the smooth rounded eggs singly on the tender parts of the plant. They are pale yellow in the case of *P. demoleus* and yellow in the case of *P. polytes* and in the case of *P. polymnestor* the eggs are bigger. The egg period in the case of *P. demoleus* is 4 days. The fully fed larva is stout and sluggish with small head, stout thorax and gradually tapering abdomen. The larvae show a good deal of variation in colour and markings in the early stages and resemble dropping of birds. The fully fed caterpillars may be distinguished as follows. In the case of *P. demoleus* the larvae are blue, pale blue, or sometimes pale green with yellow tinge with dark dorsal spots. The forked reddish brown process behind the head (Osmeteria) is very long. The larvae of the other two species are velvety green in colour. In general the larvae of *P. polytes* and *P. polymnestor* resemble very much differing only in size. A fully grown caterpillar of the latter is about 7 to 8 cm. in length. Another noteworthy feature in the larvae is that in the early stages they are pale light green with white dorso-lateral patches on the posterior aspect of the abdomen. Head pale green, thorax stout; when disturbed there is no protrusion of the osmeteria as in *P. demoleus*. The larval period in the case of *P. demoleus* is 13 to 14 days and in *P. polytes* 17 to 21 days. Pupation generally takes place on the stem or the twig; the pupa is attached to the twig by two tough silken strands. The pupal coloration varies a good deal among the three species. The pupal period in the case of *P. demoleus* is 8 to 16 days; of *P. polytes* 12 to 35 days and in *P. polymnestor* 16 to 42 days.

From counts made of eggs and larvae of these insects found on citrus seedlings for a period of nine months, it was seen that the species are found right through the year with the degree of incidence only varying, being very high during the summer months. *P. demoleus* is seen in large numbers during the rainy months between July and November and from then onwards they become very limited in numbers and *P. polytes* and *P. polymnestor* begin to be prominent. From the second fortnight of December *P. demoleus* becomes scarce. The relative proportions of *P. polymnestor*, *P. demoleus* and *P. polytes* are in the ratio of 1:22:17 during the period beginning from the third week of January to the first fortnight of April for nearly four months. The pest is serious only on young seedlings.

Control: In the case of young seedlings, from the time of germination for a year or two they may be examined once in four days only, as the egg period happens to be four days; and the eggs and larvae that may be found on them may easily be hand-picked. This method proved the most efficient; and this was done right through the whole year in the case of the young seedlings. The gardener himself may do this, the time taken to carefully examine 80 rows of seedlings being only about an hour and a half. In addition to this, lead arsenate solution (½ ounce, in one gallon of water, diluted with equal quantity of lime) was sprayed occasionally on the seedlings and the insecticide proved effective to a great extent. The seedlings undergo growth and consequently fresh foliage is put forth and this would mean frequent sprayings. Ordinarily handpicking of eggs and caterpillars is the best, efficient and economical method especially in the case of nurseries, where alone the pest is serious.

Lycaenid Butterfly: (*Chilades laius*, Cram.) The caterpillars of this common coppery blue butterfly eat the tender leaves, and now and then prove serious to young seedlings.

The eggs are very minute, white, corrugated and are flat on both the sides. The single eggs are laid indiscriminately on the terminal foliage, on the leaves, petiole, stalk etc., and sometimes may be found in groups of two, three or even a dozen. The egg period is about three days. The larvae on hatching begin to scrape the young leaves and as they grow in size the leaves are eaten away. The mature larva about 10 mm. in length is green, stout, spherical on the dorsal side and flattened below. It is soft and sluggish in habits and remains a larva for about 6 days. The pupa generally found on the leaf is green in the early stages and later on turns dark green. The pupal period occupies 7 to 8 days. The longevity of the adults has been recorded as 3 days when fed with molasses. The pest may be found on the seedlings right through the year abating now and then.

Control: The measures are the same as in the case of Papilios, viz., handpicking of eggs and caterpillars and frequent sprayings with lead arsenate solution of the strength mentioned above.

The Citrus Leaf-roller: (*Tonica zizyphi*, Stn.) The caterpillar of this small moth is also a serious pest of citrus seedling. It attacks the tender sprouting leaves causing them to fold longitudinally and the creature remains inside the fold, scraping the leaves in the early stages and later on eating the leaves from the tip towards the petiole.

The minute eggs are laid on the leaves. The just-hatched larva is pale yellow with black head. When fully fed it turns green and measures about 10 to 12 mm. in length. It is also long and slender with the head black. The body is slightly tapering at both ends. The caterpillar is highly sensitive and when two meet each other they suddenly rush back. The movement is very quick characterised by sudden jerks. Just before pupation it turns pinkish on the dorsal side. Pupation takes place in a silken cocoon inside the leaf-fold. The pupae are green at the outset but later on turn dark brown. The pupal period runs to 6 days. The longevity of the adults when fed with molasses was found to vary from 7 to 20 days.

The pest is noted on the seedlings almost throughout the year. During the rainy months (August—January) the degree of incidence is very high. Subsequently they are found only in limited numbers Beginning with August the incidence is very high till the first fortnight of January. The degree of attack to seedlings was so high that the plants showed only stalks, all the tender leaves being damaged. During February they were almost absent and in March stray cases were found. The pest is always present whenever there is a good flush. as it always prefers tender foliage.

Control. The measures are the same as in the two previous cases viz., handpicking of caterpillars and spraying with lead arsenate solution.

The Citrus Leaf-miner : (*Phyllocnistis citrella* Stn.) The injury to citrus plants results by the miners traversing beneath the epidermal layer of the leaves—both tender and old. The miner always has a partiality for tender leaves which are damaged badly. As the miner feeds in a zig-zag fashion curls are formed resulting in the stunted growth of the seedlings. Gradually the places traversed by the miner undergo browning and put on a scorched appearance; and as the leaves begin to grow at this stage they become torn in these places. The pest is serious in the case of very young seedlings where growth is retarded a great deal. In the case of trees, this does not appear to matter much.

The tiny little moths could easily be recognised by the presence of a black spot at the tip of each wing of the forewings. They lay smooth, transparent, spherical eggs on the tender newly sprouting leaves alongside midribs on both sides, and sometimes on the tender stalks. The newly emerged miner begins to mine or tunnel beneath the epidermal layer which can be seen as a thin brown, membranous film and feeds from within. The fully fed miner is about 3 mm. in length and pale brown in colour and when taken out of the tunnel curves itself and wriggles and falls down and the motion is by rolling. In the case of the larva the head region is stouter. The miner is legless characterized by a tapering head. It pupates near the margin of the leaf always inside a curl beneath a tough web of silk. The pupa is light brown in colour. In the case of the pupa each of the abdominal segments bears a pair of hair-like bristles laterally, arising from warts which are hyaline; at the posterior end carries a pair of short stout triangular processes. On the ventral side each of the abdominal segments bears a number of short spines which become more and more distinct posteriorly; those on the last seven segments are distinct and the spines are brown and slightly recurved. At the anterior end there is a dark process appearing as though the head portion ends in a pointed process. The region of the eyes is dark brown. The adult emerges by making an opening at one end of the web. The miners are noticed in the leaves of *Murraya koenegii*, *Pongamia glabra*, *Jasminum*, *Aegle marmelos* etc.

Control : Owing to the miners remaining beneath the epidermal layer of the leaves, it has been found difficult to control these insects. Four methods were tried viz , insecticidal, cultural, biological and mechanical. Crude oil emulsion was found ineffective as the same

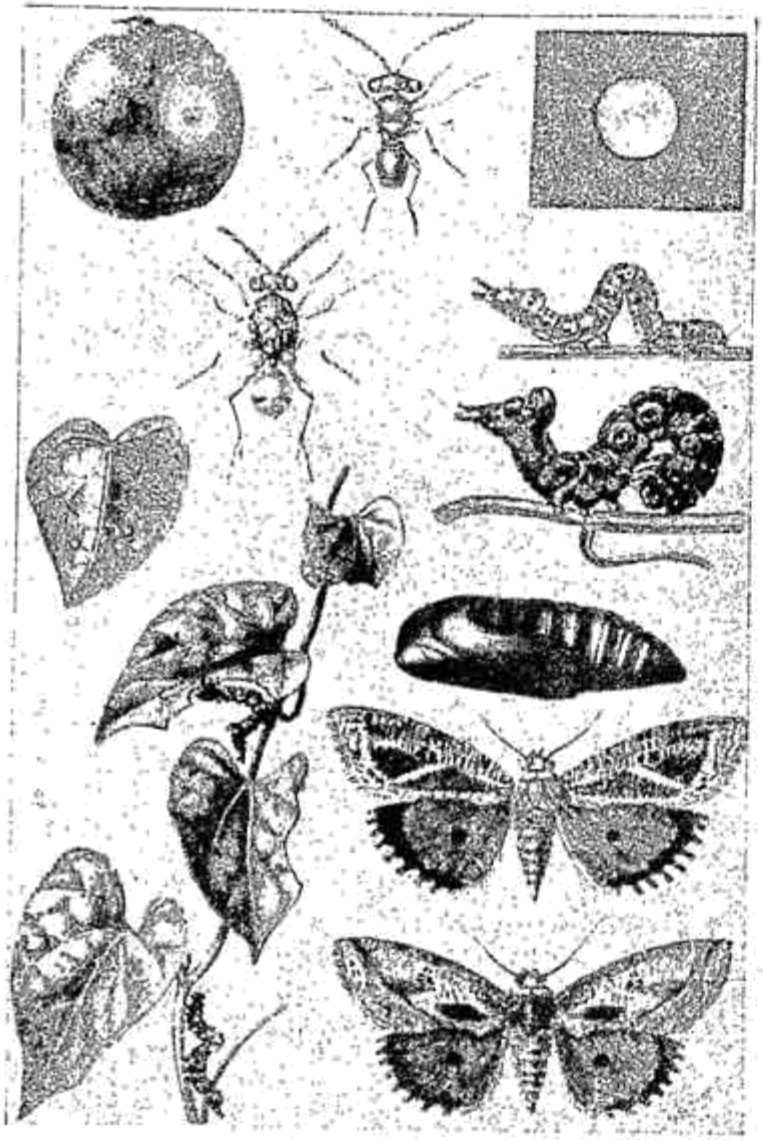

FIG 1. The Fruit-moth ; its stages and parasites.

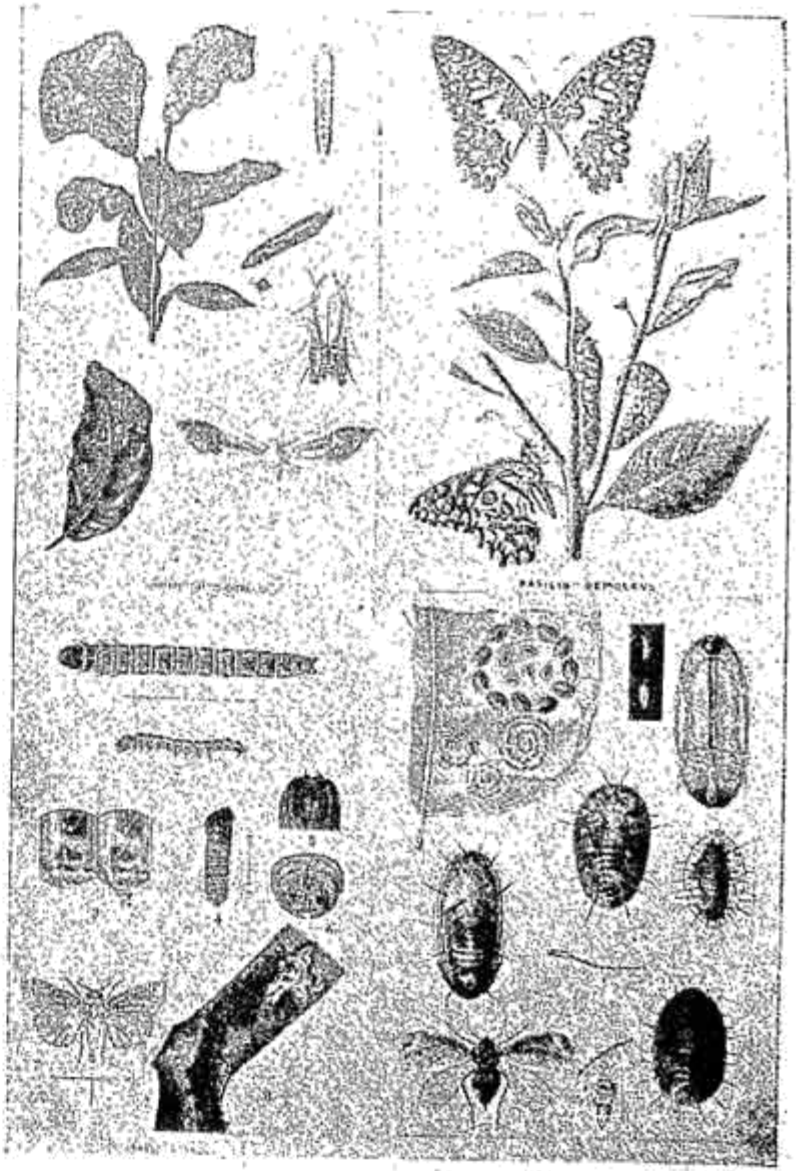

FIG 2. 1. The Citrus Leaf-miner; 2. The Lemon Butterfly;
3. The Citrus Bark-Borer; 4. The Citrus Mealy-wings.

does not appear to soak through the thin epidermal layer; but in the case of tobacco decoction stray miners were found dead in the treated leaves. The eggs and pupae do not appear to be affected. Even in the case of tobacco decoction, it is not a preventive and sprayings have to be repeated frequently at least once in ten days, as fresh leaves are put forth resulting in fresh attacks. Bordeaux Mixture was tried as a deterrant with no effect. Therefore in the case of insecticidal trials the sprayings have to be repeated and if the pest persists right through the sprayings may have to be given frequently. Moreover the spray fluid may not reach the underside of the leaves. Thus the scope is very limited. As regards *cultural methods*, observations made during two seasons go to show that soon after good showers, the seedlings recover beautifully well. Even otherwise copious irrigations coupled with treatments with tobacco decoction at a strength of one pound in 5 to 6 gallons of water were found to give results during periods of heavy miner infestations as the plants begin to put forth more vegetative growth which minimise the infestation a great deal. This extra output of foliage leads to a less concentration of the pest. If the plants are weaker and stunted in growth there will be greater concentration of the pest. Tobacco decoction on the seedlings was found to act as a good stimulant. Coming to the *biological method*, though chalcid parasites are noticed on the miners during certain months, scope for this method is limited. With reference to *mechanical means* whenever there are very bad infestations handpicking of the mined leaves will reduce the infestation.

The Citrus Shoot and Bark Borer: This caterpillar is noted to damage citrus by boring through the shoots in the gardens round about Palacole and Rajahmundry. Injection of chloroform and creosote mixture was found effective. Further studies have to be made on this insect.

The Citrus Mealy Wings: (*Aleurocanthus spiniferus* Qt.) These minute creatures are fairly common on citrus from July onwards till next March. Observations go to show that between each brood a month may elapse each lasting about a fortnight.

The minute white eggs are laid arranged in concentric circles on the underside of the leaves in the nature of a spiral; they gradually turn dark brown. The just hatched nymphs distribute themselves on to the whole leaf surface so much so the leaf turns black. These feed by sucking the sap from the tender foliage. Owing to the feeding of the nymphs in large numbers and due to the secretion of the honey dew, sooty mould is formed on the leaves.

Control: The trials to kill the nymphs with tobacco decoction, crude oil emulsion, potash fish oil soap and Bordeaux mixture did not prove effective. The best time to spray is when the adults begin to emerge. But if the broods happen to be irregular then very frequent sprayings may have to be given which may not prove

economical, when we take into consideration the extent of damage caused by the pest.

A Coreid Bug: (*Dasynus antennatus*) is noticed in some of the gardens round about Rajahmundry in small numbers. Numerous adult bugs and nymphs are often found on a single fruit; but the damage does not appear to be serious and no punctures or rotting of any kind is seen on the surface. The only injury seems to be to make the fruits turn yellow and riven earlier. These can be controlled by hand-netting.

The Jasmine Bug: (*Antestia cruciata*, Fb.) which generally attacks jasmine in certain parts of the province is often reported from Rajahmundry on citrus. These are found in numbers on branches and leaves, more particularly on "Kuranji" variety. The bug sucks the juice causing white patches on the leaves and flowers which fade and drop during the flowering season. Handnetting the bugs will be found effective.

The Red Tree Ant: (*Oecophylla smaragdina*, Fb.) This notorious insect is common in almost every batavian garden round about Rajahmundry and other places. It is also found on mango and other fruit trees. The nests are found made among the leaves by means of webbing sometimes enclosing the fruits also. The insect has powerful stings and is a nuisance to gardeners. The nests may be destroyed with poles.

Minor pests: The *Cockchafer* beetles (*Aserica* sp.) are found to eat leaves during night time. Spraying with Bordeaux mixture may be tried as a deterrant. Weevils of different species, chiefly *Myllocerus* are noted to eat the leaves and dusting the leaves with calcium arsenate diluted with lime may be done with good result. The scale insects *Aspidiotus aurantii*. Mask. and *Psudococcus corymbatus*, G. are occasionally noted on the shoots and leaves. Species of *Aphids* called the "Citrus Aphid" are common on young shoots causing leafcurls in young plants and these can successfully be tackled by a spraying with tobacco decoction. There are also *mites* on the leaves and fruits which produce small white dots. Occasionally *Psychid* caterpillars may be found eating the leaves and these may be checked by a spraying with lead arsenate solution at the usual strength.

General Remarks: Of the above pests, fruit-moths may be considered as the major pest of citrus. So far as the seedlings in the nurseries are concerned, the leaf-miners and the leaf-eating caterpillars such as the Papilios, the citrus leafroller and the Lycaenid may prove serious. On the Agricultural Station at Anakapalli, all these four pests were found simultaneously on the seedlings throughout the year with varying degrees of incidence. And recourse was taken to frequent sprayings with lead arsenate solution; and hand-picking was resorted to systematically thus keeping the seedlings in good condition.

In the case of young seedlings, at certain stages, they look very much stunted in growth and any incidence of insect attack is greatly augmented by certain other causes. For instance, when the seedlings are kept in cut pots and then placed above ground, one finds stunted growth and the insect attack is accelerated. But when the pots are buried flush with the ground level and then watered, one finds the same seedlings coming up very well as could be seen by the amount of foliage put forth. Thereby the insect attack is greatly mitigated. Same is the case when the seedlings are given a drenching with tobacco decoction at a strength of one pound in 5 to 6 gallons of water at an interval of a week. One finds a good flush. It has been the experience of the writer that the seedlings put on good flush on receipt of a shower, thereby showing that a certain amount of frequency of irrigations is necessary in the absence of showers. The broad principle underlying this study is that under particular conditions the degree of incidence in the case of any pest will range about a point. Under this degree of insect attack, the plants fare badly with a certain output of foliage. If by cultural means, one is able to improve the condition of the plants, thereby inducing them to put forth good foliage. the degree of incidence being the same, with the increase of leaf surface the insect attack is greatly mitigated. This is the observation which the writer was able to make while studying these pests. Under normal conditions, seedlings may require a particular degree of watering, manuring, etc., when there is no pest. But during periods of infestation, the plants suffer ; normal conditions are upset and consequently one may have to change the treatments given under normal conditions so as to suit the changed conditions. This would mean an extra irrigation or an extra dose of manuring or something in the nature of a stimulant like tobacco decoction. Cultural methods of this kind would go a long way, if need be, supplemented by mechanical methods, in mitigating severe infestations.

In order to make the paper very brief details pertaining to descriptions, insect habits and the degree of incidence in each case have not been given in full. The thanks of the writer are due to Dr. T V. Ramakrishna Ayyar, Government Entomologist. Coimbatore for advice and suggestions and for identifying the species; and to the then Deputy Director of Agriculture, I Circle, Mr. A. C. Edmonds under whom the writer worked during the period for affording opportunities to study these insects.

List of Pests of Citrus arranged according to the Different Insect orders.

ORDER: LEPIDOPTERA

Family *Noctuidae*:

Ophideres fullonica, Linn.

Ophideres materna, Linn.

Family *Papilionidae:*
Papilio demoleus, Linn.
Papilio polytes, Linn.
Papilio polymnestor, Cram.
Family *Lycaenidae:*
Chilades laius, Cram.
Family *Oecophoridae:*
Tonica zizyphi, St.
Family *Phyllocnistidae:*
Phyllocnistis citrella, Stn.
Family *Psychidae.*
Family *Arbelidae.*

ORDER COLEOPTERA

Family *Melolonthidae:*
Aserica nilgirensis, Shp.
Family *Curculionidae:*
Myllocerus evasus, Mshl.
Myllocerus dentifer, F.
Amblyrrhinus poricollis, Boh.

ORDER HYMENOPTERA

Family *Formicidae.*
Oecophylla smaragdina, Fb.

ORDER RHYNCHOTA

Family *Coreidae:*
Dasynus antennatus,
Family *Pentatomidae:*
Antestia cruciata, Fb.
Family *Coccidae:*
Aspidiotus aurantii, G.
Pseudococcus corymbatus, Mask.
Family *Aphidae:*
Family *Aleurodidae:*
Aleurocanthus spiniferus, Quaint.

ORDER ACARINA

Species of mites.

AGRICULTURE IN RUSSIA

BY A. MUIR, B. Sc.

Russia is a country of almost immeasurable agricultural possibilities. Its enormous area covers one-sixth of the earth's surface, and its climate ranges from Arctic Siberia in the North to the almost tropical Caucusus in the South. Between these extremes lie the vast forest regions and the great steppe zone, with its large expanse of fertile black soils, ideally suited for crop production. A further variety of climate and soils is found in the mountainous southern regions—the Crimea, the Caucusus and Turkestan.

The revolution in Russia in 1917 brought about an abrupt transition in practically every phase of national activity; in agriculture the complete change over from little more than primitive systems to large scale productions by modern methods presented problems of special difficulty. In order to appreciate the magnitude and the complexity of this task, it is necessary to review very briefly the conditions of work and life on the land prior to the date of the revolution.