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LOCUSTS IN MALACCA

JULY 1914 TO OCTOBER 1915.

On July 3rd, 1914, one of us (I. H. B.) was sent to Malacca to enquire into the locust problem; and on August 15th, 1914, the other (P. C. C.-B.) was appointed Special Assistant for Locust Destruction in Malacca, and went into residence there. We continued to work together until the commencement of November 1915; and we here report on the work done.

The first date coincided with the planting of the rice crop in Malacca, and it happened to coincide also with a reerudescence of hopper-hatching in the Territory. Thus fortuitously it is a convenient one for our report. We believe that the infestation of the Territory with locusts had been increasing up to that time and that the work done against the insects subsequently has decreased it.

We operated by means of bag-traps of the pattern used in the Federated Malay States (vide Pratt, The Malayan Locust, Bulletin No. 24 of the Department of Agriculture, F. M. S., 1915). At first the traps in use were two, so that only about fifty days bagging work per mensem were possible; but the number was increased to six in August 1914, and to eight in November, making possible two hundred days' work per mensem. We obtained information of the whereabouts of hoppers through native subordinate officers such as penghulus and sedangs, as well as personally, and by the employment of locust-scouts who searched the country. So dense is the population of Malacca, and so complete the village system of administration that we believe only a few breeding places could escape detection. Whether the hoppers were destroyed or not, depended on a bag trap and trained subordinate being available to attack them.

Occasionally Malays would catch fliers by night, and were rewarded for doing so; but no campaign against fliers of this nature was organised. Malays both eat the hoppers themselves and used them for feeding fowls.

We were not willing to use poison; for the number of buffaloes and cattle in the Territory is great, the Malays keeping buffaloes for ploughing etc., they and others keeping bullocks for draught, and rubber estates owning bullocks extensively. The buffaloes graze with little supervision; herds of cattle are turned into the lallang wastes daily: and by a circular we ascertained when considering the question that fifty-one out of fifty-six large rubber estates at the time used bullocks for cultivation etc. We hoped by destroying, say, 75 per cent of a swarm of hoppers to bring the destruction of the whole within the compass of their natural enemies, most of which are destroyed along with the locusts when poison is used.

We illustrate this report by maps, whereon every breeding place detected is marked by a dot or a ring. It is necessary to assume that the reader knows enough of the geography of the Territory of Malacca to do without names on the maps. For some reason the breeding places fall very largely within two circles, which for convenience we take as a circle of eight miles radius from Alor Gajah and a similar circle from Jasin. These villages may not be the very centres of circles, 16 miles across, which would contain the most breeding places: but it is convenient to make them so serve as what we say later will show.

There was a plentiful production of hoppers in other parts of the Territory.

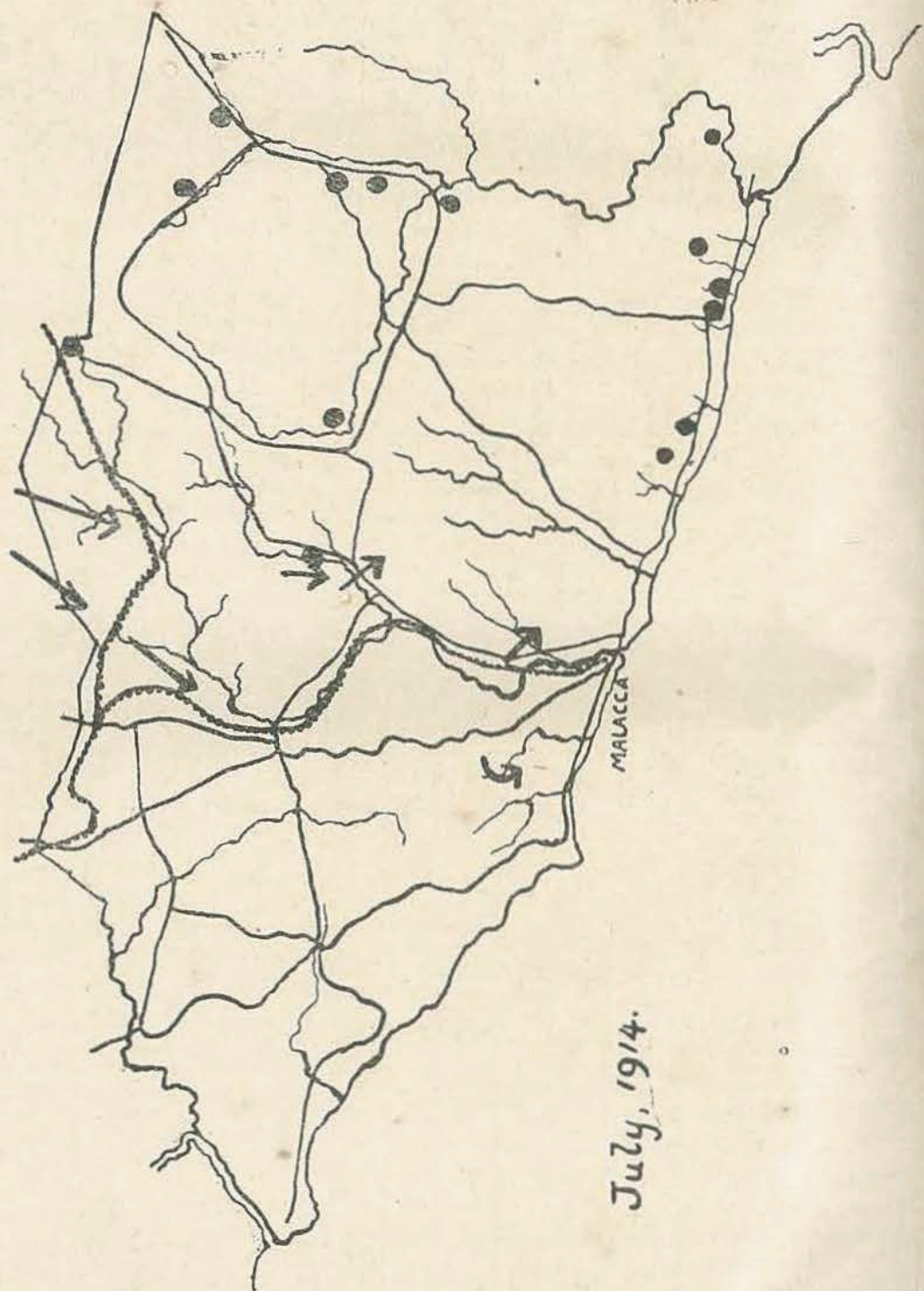
Whether the greater abundance of hoppers within the Alor Gajah and Jasin neighbourhoods can be due to their green rice valleys keeping the fliers from moving away, until their breeding time came, or whether another cause must be sought we are unable to state. We do not think that the breeding places were so much better reported near these centres than elsewhere as to cause a false appearance of local prevalence. On the other hand this local prevalence when realised determined in some measure where the subordinates who had charge of the bag traps should live.

The following table gives mukim by mukim (parish by parish) the amount of work done against the locusts, the unit being one day's work with a trap and gang of coolies. The thirty and more mukims which are not named in the table are those where no breeding occurred.

TABLE 1

No. of day's work of a trap.

	August 1914	September	October	November	December	January 1915	February	March	April	May	June	July	August	September	October
Average rainfall ...	3.97	4.12	7.39	8.10	6.15	4.41	1.79	5.39	8.13	4.06	6.43	6.05	6.37	6.12	8.10
Tebong	...	...	...	...	...	...	...	...	...	...	...	8	4	...	23
Ulu Batang Malaka	16	...	...	...	...	...	...	...	...	...	...	...	...	...	17
Circle round Jasin	Nyalas	...	...	...	...	...	...	...	17	43	...	...	...	...	6
	Chabau	...	...	...	...	...	...	...	...	...	13	...	...	...	...
	Chohong	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Chinchin	...	...	15	9	...	...	29	29	...	...	9	...	...	...
	Jus	...	...	19	58	13	...	...	...	...	13	12	19	...	...
	Bukit Singgeh	...	...	...	...	...	...	...	...	...	...	19	...	...	...
	Selandar	...	7	30	28	29	6	...	...	30	21	31	24	...	...
	Kesang	...	...	...	...	...	...	5	11	...	9	10	...	...	...
	Rim	...	...	...	24	9	...	24	...	...	...	11	18	...	...
	Jasin	...	...	23	16	...	...	27	29	16	...	10	33	...	...
Circle round Alor Gajah	Ayer Panas	...	...	...	...	...	...	...	...	...	...	...	12	...	...
	Ayer Molek	...	...	...	...	...	...	...	...	...	...	9	...	...	...
	Melekek	...	...	...	24	...	...	...	...	...	...	...	12	...	...
	Taboh Naning	...	...	...	...	...	...	...	...	...	...	...	...	10	...
	Pulau Sabang	5	...	...	...	7	...	...	12	...	...	...	13	...	...
	Kemuning	...	...	16	12	...	...	21	12	...	...	...	...	...	...
	Tanjong Rimau	2	...	...	...	...	...	...	...	...	...	30	...	...	...
	Padang Sabang	...	...	...	...	3	...	...	...	...	...	...	...	...	...
	Pegoh	...	...	...	...	11	...	...	...	...	...	...	...	...	...
	Ayer Pa abas	...	...	...	...	...	...	...	...	25	...	...	...	...	...
	Kelamak	...	...	...	...	...	...	...	...	...	...	6	...	...	...
	Gadek	2	14	...	12	7	...	...	...	...	17	15	...	...	68
	Malaka Pinda	...	...	...	...	...	...	...	...	...	16	14	...	...	...
	Parit Melana	11	...	...	...	...	...	...	...	...	...	...	...	...	...
	Belimbing	...	...	...	...	4	...	...	...	...	...	...	...	...	...
Coast mostly	Rembia	...	2	...	...	...	...	...	13	...	...	...	...	...	...
	Durian Tunggal	...	1	...	...	...	...	...	...	...	...	...	4	...	...
	Machap	...	...	...	...	...	...	...	...	...	...	...	5	...	...
	Paya Rumput	...	2	...	...	...	...	...	...	...	...	...	18	...	...
	Lendu	...	...	...	...	...	...	...	...	13	...	20	...	...	...
	Bukit Rambai	...	...	...	...	...	...	...	...	...	...	...	...	...	9
	Sungei Bharu	...	...	...	4	23	...	...	9	18	1	...	...	...	...
	Tangah Batu	...	...	...	7	...	...	...	...	...	...	...	...	...	...
	Balai Panjang	...	...	...	...	11	...	...	...	...	...	...	...	...	...
	Telok Mas	...	...	...	...	4	...	...	...	...	...	11	11	...	...
	Pasir Puteh	...	1	...	...	...	...	...	...	...	...	...	...	...	...
	Ayer Pasir	...	...	...	...	...	...	...	...	...	...	...	17	...	...
	Bukit Umbei	...	...	...	...	...	...	...	...	...	...	2	...	...	...
	Merlimau	...	...	...	9	10	...	...	...	...	...	...	...	...	...
	Sabatu	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Sungei Rambai	7	15	...	...	...	...	...	...	...	...	...	...	...	...
Total	43	42	103	192	104	44	—	106	132	145	90	215	192	10	123



Map 1. Distribution of locusts in Malacca in July 1914. Fliers in the centre flying southward, hoppers in the east.

Within the Malay Peninsula, the migratory locust against which these operations were directed, first attracted attention near Port Dickson, Negri Sembilan, in February, 1912. When it came is not known: but as the several swarms bred synchronously, a common origin is not unlikely, and would be by importation of eggs in soil some 12-24 months previously. The importation may not have been from far away, for, whether we call the locust *Pachytylus migratorioides* or *Pachytylus danicus*, it has been identified with what occurs in Southern India and in the Philippine islands as well as elsewhere. It is certain that the past condition of the country,—well forested—would be inimical to it: but now that wide cultivation has removed the trees, and left large grassy wastes, a condition suiting it has been brought into existence. These artificial wastes, the strongholds of the locusts are most extensive behind Port Dickson, but extend widely through Malacca, and beyond into Negri Sembilan and Johore. They meet the three needs of the locusts:—

- a warm soil for incubation
- a grassy vegetation for food
- a comparative freedom from enemies,

like the wide fire-swept downs of Africa, the steppes of Southern Russia, and the "cogonales" of the Philippine Islands, in which locusts so often multiply in large numbers.

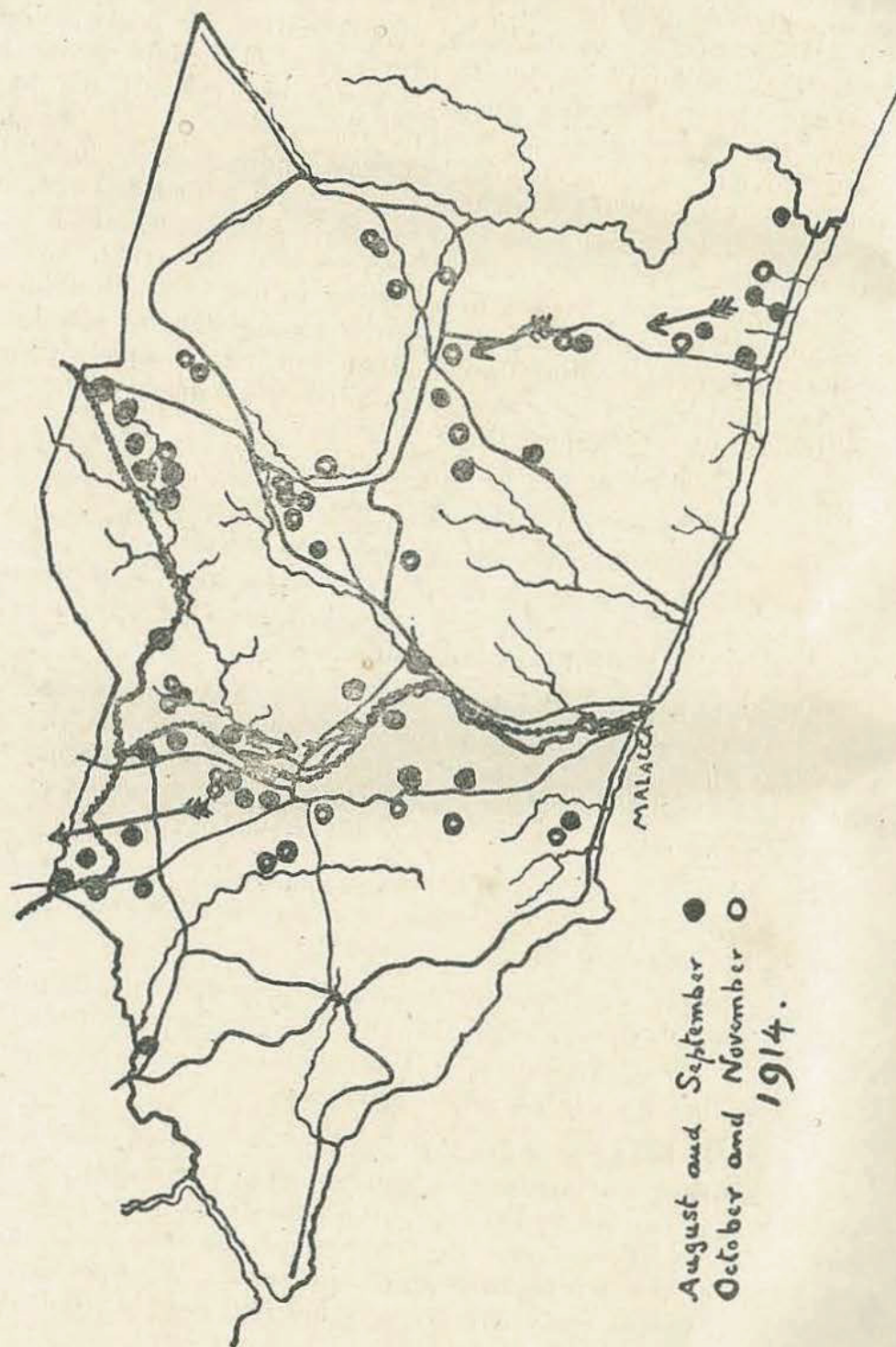
The reader will understand that the forest meets none of these needs; the rice fields, the "grass-weeded" rubber estates, the coconut plantations and the Malay village lands (really orchards in grass) and the lallang wastes meet them in large part, but clean weeded rubber estates do not meet them at all adequately.

Distributed as these conditions of vegetation are in Malacca, there appears to be hardly a mukim (parish) in the whole Territory where locust breeding is impossible.

In our work we kept careful records intended to help towards ascertaining whether certain mukims might escape and if so why. And the following is a summary of the distribution of locust breeding during our fifteen months.

In July, 1914, as map 1 shows, the locusts in eastern and western Malacca had not bred synchronously; but eastern Malacca carried hoppers in many places, while to the west fliers alone were found. These fliers were in considerable swarms all moving southwards as the arrows in the map indicate. We were not able to attack all the places where hoppers hatched out, but only those few indicated in table 1.

In August, between the 1st and the 15th, enormous numbers of hoppers hatched out on the Tebong Estate at the very head of the Malacca river, which also we were unable to attack: and others appeared in the central part of the valley of the river from Gadek down to Belimbing, and also east of Merlimau towards the Johore boundary. In both regions the hoppers were attacked, but east of Merlimau only in September.



Hoppers continued to appear at places along the Malacca river valley, through the rest of August and through September also.

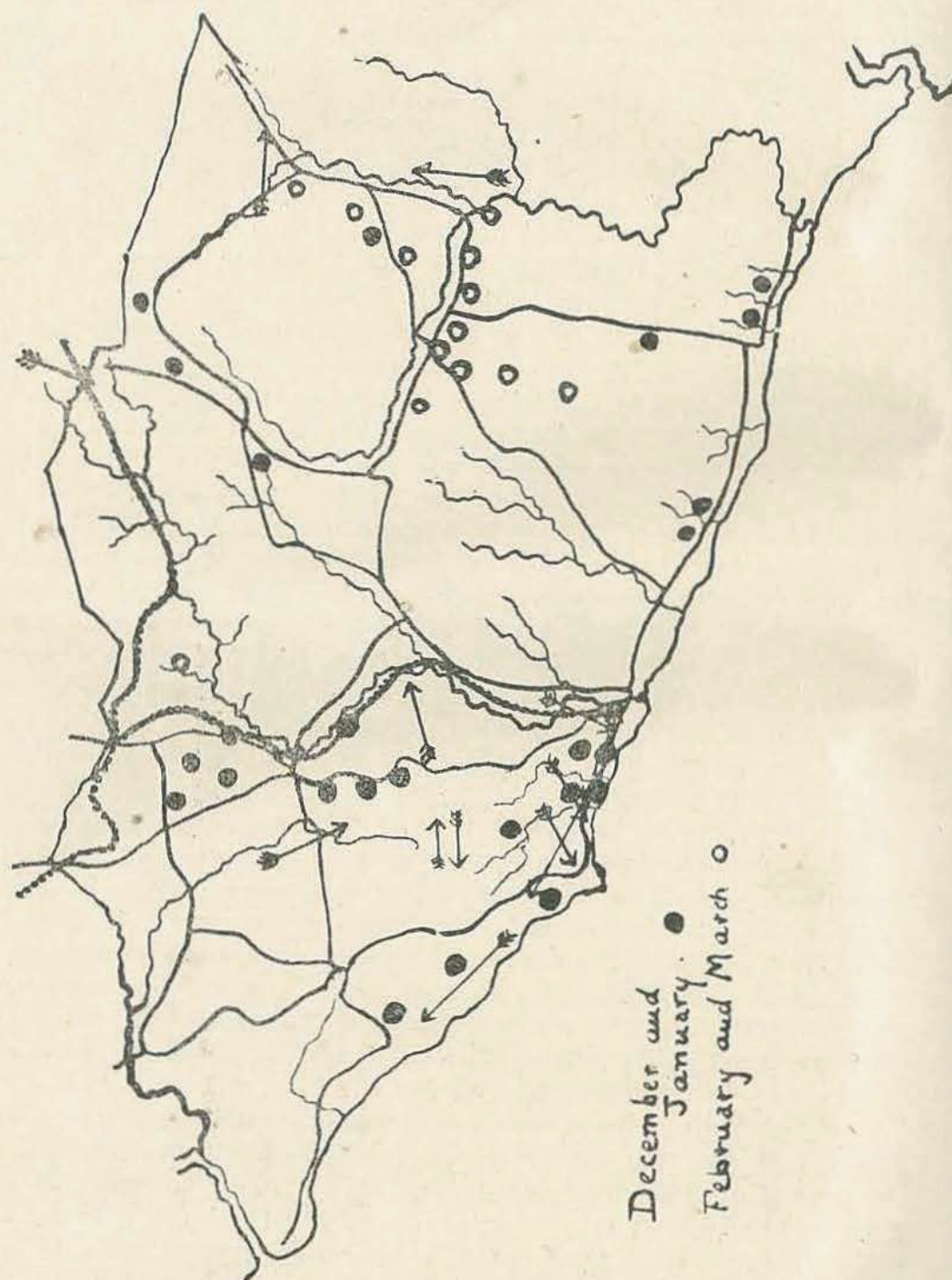
Towards the end of September they appeared in several spots in or near the top of the Jasin valley and near to the road from Malacca to Jasin. They were attacked, and large numbers destroyed. But greater numbers hatched out in October. It seems probable that they were the first descendants of fliers which had been circling about Jasin in the month of September, reinforced by a swarm which had invaded the neighbourhood from the direction of Merlimau. If the reader will kindly examine the second map, it will be seen by the number of rings about Jus, Selandar, Kesang, Jasin and down to Chinchin (all places along the same stream) how great was this infection. Some of the breeding places escaped the catchers' attentions.

At the same time, *i.e.* in October, hatching of hoppers was occurring all about the Malacca stream valley between Alor Gajah and the Negri Sembilan border at Tampin, and also on the east side of the middle part of the valley to Durian Tunggal. This hatching was followed by hatching in new spots further west at the end of the month of November: and the hoppers on the west in large measure escaped destruction. Map 2 shows clearly that there is a band of rings, *i.e.* later hatchings on the west side of the dots (earlier hatchings) of the middle part of the Malacca stream valley. And although records of migratory swarms cannot be put together so as to show a common origin for all these western hatchings, it is probable that they had one: and it is known with certainty that one swarm passed through the northern part of this area in the second week of October, flying from Pegoh to Kendong on the Negri-Sembilan border, and there losing its direction against the forests of Gunong Tampin.

The number of locusts maturing from this heavy infection of the middle part of the Malacca stream valley led to fliers reaching Malacca town in considerable numbers in December. It may be stated for general information that they had not come from a far distant area, but were bred almost "locally," as no doubt most swarms of fliers are when not in vast numbers; for vast numbers make a much more unsettled whole than small numbers in a country where there is food for all.

The directions in which the swarms moved about Malacca was very varied, but still with a southerly tendency ending for part of the insects at least in death in the sea. They were seen in the waves of the tide on Jan. 25th, 1915 and on March 27th, 1915, out a little way to sea. One swarm at this time flew westwards and doubled back eastwards again on the same day (Jan. 27th, 1915). Finally in February there was a steady tendency in the locusts to more westwards along the coast as is indicated in map 3 by the long arrows.

Early in December the coastal mukims west of Malacca produced hoppers in many places, and there was a synchronous hatching out about Alor Gajah and on the coast east of Malacca, as well as elsewhere in the Jasin division. It appears as possibly of interest that hoppers should have been so much more abundantly



Map 3. Hopper infested spots in Malacca, December 1914 to March 1915; migrations of fliers marked by arrows.

produced on the coast in December that at other times, and we are inclined to explain this as the result of the tendency to fly southwards in the swarms of the previous months which ended in providing eggs for so many more hoppers than the enemies of the locusts could destroy—a seasonal effect.

In February hoppers were nowhere. Doubtless there were plenty of dormant eggs, and the fliers abroad were depositing more; but the condition of the soil was against their hatching. The recrudescence came in the neighbourhood of Jasin where hoppers appeared in the many places marked on map 3 in March.

In April and right into May hoppers appeared on the west of Alor Gajah about the upper part of the stream which runs north-westwards to the Linggi river: and at the same time they ceased to appear in the Jasin neighbourhood. The area where, west of Alor Gajah, they mostly appeared was that part of the country which had escaped attention in November.

Towards the end of May they began again to emerge in the Jasin neighbourhood, and continued to do so through June.

In July they emerged again in the Alor Gajah division.

The reader should turn to map 4, and note that the localities marked therein fall chiefly into three groups, (i) those on the extreme west being April-May hatchings, (ii) those in the Jasin neighbourhood being May-June hatchings, and (iii) those of the upper part of the valley of the Malacca river being July hatchings.

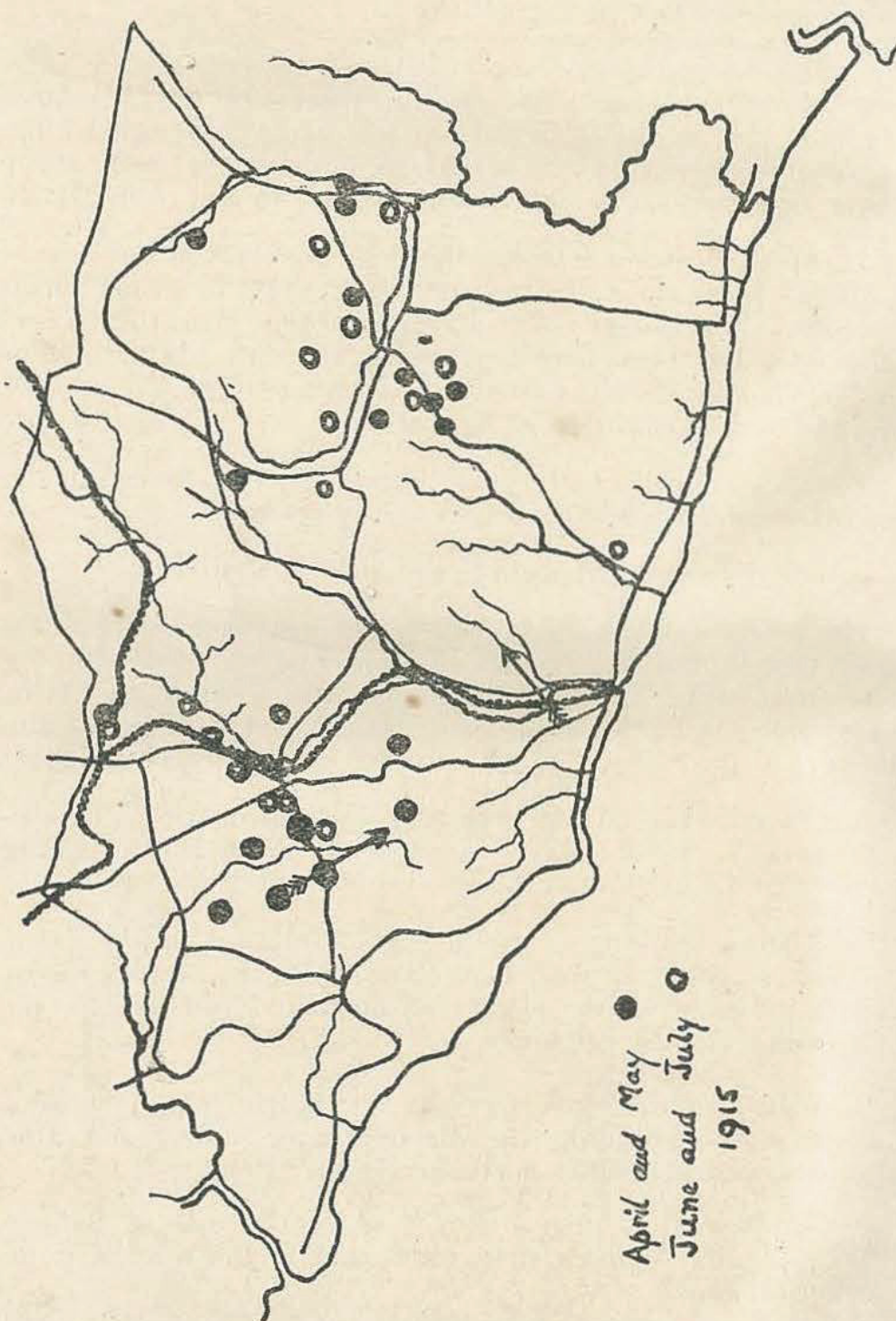
Big swarms movements were only detected on two occasions one towards the south-east, the date being about May 9th; the other towards the north east, the date being about May 2nd.

In August hatching out of hoppers continued in the Jasin valley, and at the same time they appeared at the various places elsewhere indicated by the black dots on map 5, all but one on the map being August hatchings.

In September the whole territory was nearly free of hoppers but fliers were descending the Malacca river valley, and also moving eastward along the northern border.

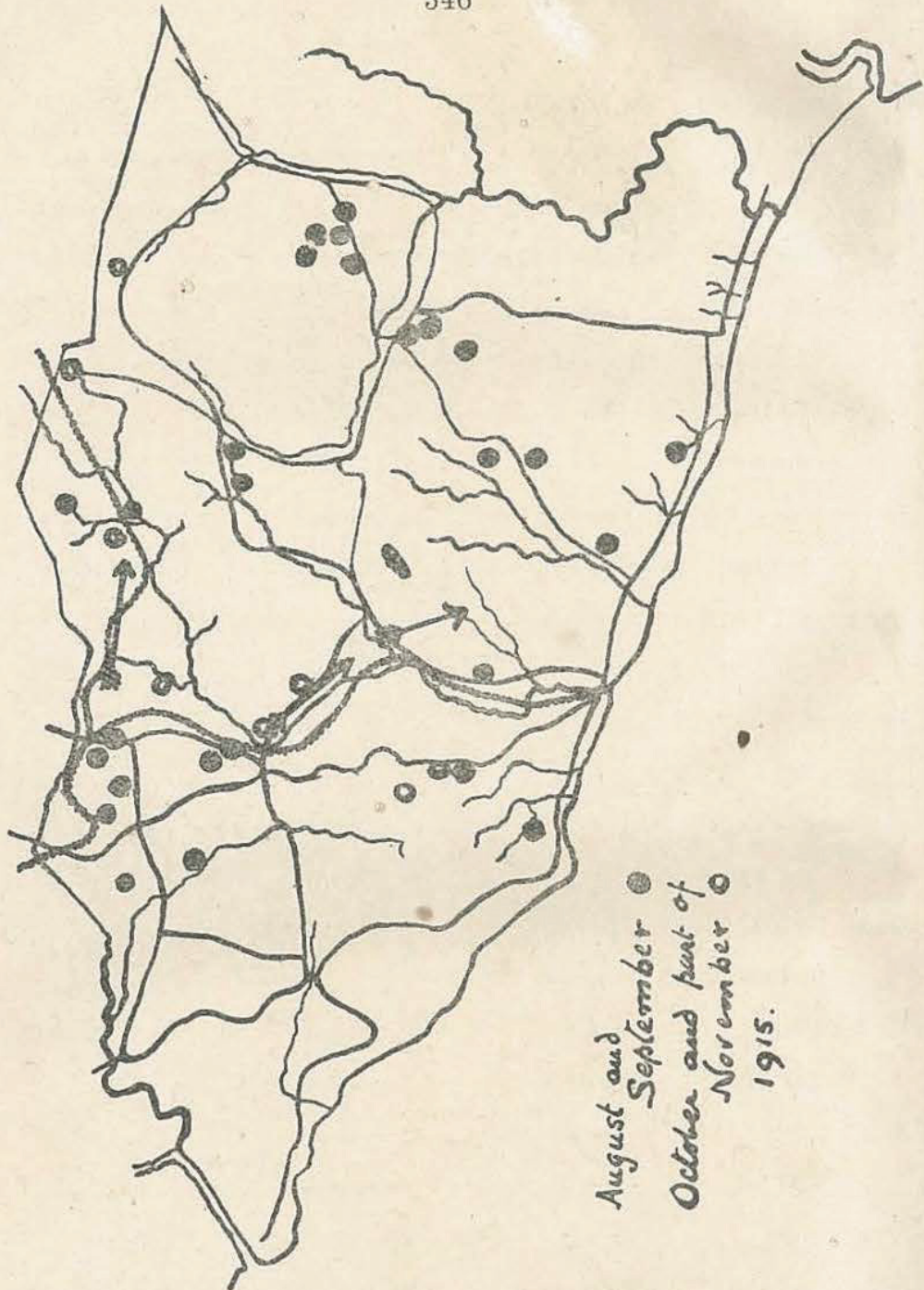
In November hatchings occurred at Nyalas and at Batang Malaka, along the Malacca river valley and to the west of it in the Lendu mukim.

If our records be tabulated, hatching within a circle of eight miles of Alor Gajah and hatching within a circle of eight miles of Jasin, and hatchings close to the coast, the following results:—



Map 4. Hopper-infested spots in Malacca from April to July 1915; migrations of fliers marked by arrows.

Month	Alor Gajah	Jasin	Coast
July 1914	.....	hoppers emerge	hoppers emerge in east
August 1st half	<i>hoppers emerge very freely</i>	.....	emerge freely in east
2nd half	continue to emerge	.....	.....
September 1st half	emerge	.....	.....
2nd half	emerge	begin to emerge	.....
October 1st half	emerge	<i>emerge very freely</i>	.....
2nd half	.....	.....	.....
November 1st half	emerge	emerge	emerge freely
2nd half	<i>emerge very freely</i>	emerge	emerge freely
December 1st half	emerge	.....	emerge
2nd half	.....	.....	.....
January 1st half	.....	.....	.....
2nd half	.....	.....	.....
February 1st half	.....	.....	.....
2nd half	.....	.....	.....
March 1st half	.....	emerge freely	.....
2nd half	emerge	.....	.....
April 1st half	emerge	emerge	.....
2nd half	emerge	emerge	.....
May 1st half	emerge	emerge	.....
2nd half	emerge	emerge	.....
June 1st half	emerge	emerge freely	emerge
2nd half	emerge freely	<i>emerge very freely</i>	.....
July 1st half	emerge freely	emerge	.....
2nd half	.....	.....	.....
August 1st half	emerge	.....	emerge
2nd half	.....	.....	.....
September 1st half	emerge	.....	.....
2nd half	.....	.....	.....
October 1st half	emerge	emerge	.....
2nd half	.....	emerge	emerge



Map 5. Hopper infested spots in Malacca from August to November 1915; migrations of fliers marked by arrows.

From this tabulation one fact is patent, namely that between December and March locust hatching is prevented: and the prevention is doubtless by the relative dryness of the soil in consequence of the lessened rainfall. The rainfall is shown in the top line of table 1.

We have taken the rainfall statistics as published in the Government Gazette, and compared them carefully with the record of locust hatching. Unfortunately for our purpose all the Malacca records read at police stations are of very little value: but again on the other hand fortunately accurate records are read at the District Hospitals of Alor Gajah and Jasin: and these we use in the next table.

Month	Alor Gajah.			Jasin		
	No. of rainy days	Amount	Locusts, abundance indicated by breadth of column.	No. of rainy days	Amount	Locusts, abundance indicated by width of column.
July 1st half	5	3.44		9	4.06	✱|✱
2nd half	1	1.92		5	2.66	
August 1st half	3	3.51	✱✱✱	7	1.87	
2nd half	3	3.95	✱✱✱	3	0.67	
September 1st half	5	2.66	✱✱✱	5	1.32	
2nd half	3	2.22	✱	6	1.57	
October 1st half	2	1.23	✱	3	0.88	✱
2nd half	10	11.64	✱	14	12.61	✱✱✱
November 1st half	8	6.27	✱	11	6.47	✱✱
2nd half	2	1.86	✱✱✱	8	2.49	✱✱
December 1st half	7	6.55	✱✱✱	13	2.47	✱✱
2nd half	4	4.21	✱	8	2.49	
January 1st half	1	1.96		5	4.18	
2nd half	4	2.37		8	3.71	
February 1st half	2	1.36		4	2.37	
2nd half	2	1.26		2	0.94	
March 1st half	4	2.05		5	4.30	✱✱✱
2nd half	9	3.01	✱	6	0.87	
April 1st half	8	7.63	✱	11	4.43	✱✱
2nd half	8	7.12	✱✱	13	6.21	✱✱
May 1st half	3	1.33	✱✱	4	2.84	✱✱
2nd half	2	0.63	✱✱	2	2.11	✱✱
June 1st half	6	4.01	✱✱	7	3.58	✱✱
2nd half	5	2.58	✱✱✱	6	3.84	✱✱✱
July 1st half	3	3.95	✱✱✱	7	1.83	✱✱✱
2nd half	5	1.66	✱✱✱	6	3.18	✱✱✱
August 1st half	5	2.03	✱✱	6	2.12	✱
2nd half	6	10.72	✱	11	3.18	✱
September 1st half	4	2.87	✱	6	3.27	
2nd half	5	1.77		10	1.86	
October 1st half	3	1.17	✱	6	2.83	✱
2nd half	11	7.91		6	4.62	✱

From this table a second fact seems to appear, namely that hopper emergence was reduced in any half month when the local rainfall was very heavy. Thus in the second half of October, 1914, when Alor Gajah had 11.64 inches of rain falling on ten days, there were no hoppers discovered nearer than the Negri Sembilan border at a distance of more than eight miles; and in the second half of August, 1915, when 10.72 inches fell on 6 days, no hoppers emerged; and again when in the second half of October, 1914, Jasin had 12.61 inches falling on 14 days, no hoppers emerged, or at least none were discovered.

It is quite possible that such an effect could be produced by the evaporation from the wet ground resulting in a temperature just under the surface too low for the eggs to develop.

The maximum and minimum amounts of rain in half months when hatching occurred were:—

Alor Gajah,	maximum 7.63 in amount or 9 in days.
	minimum 0.63 in amount or 2 in days.
Jasin,	maximum 6.21 in amount or 13 in days.
	minimum 0.88 in amount or 2 in days.

The minimum is the absolute minimum of either place during the period of the observations.

Excessive hatching was recorded in half months when the rainfall was:—

Alor Gajah	3.51	1.86	3.95.
Jasin	0.88	4.30	3.58 and 3.84.

We sum up all that we can say then thus:—that we believe the soil moisture in such places as the locusts choose for depositing eggs to be in Malacca territory sufficient through nine months of the year to allow the eggs to develop, but that excessive rain is liable to create by evaporation a temperature which inhibits the development. Such a view explains the cessation of appearance of hoppers at the times recorded.

Mr. F. W. South has written (*Agric. Bull. of the Federated Malay States*, iii, 1915, p. 295) "from April to October there is a tendency to a general movement of the locusts in the Malay Peninsula in a north-westerly direction; while during the remainder of the year the direction is reversed." We suspect that the tendency is different in Malacca and the forces, light winds or whatever they be leading the insects to move southwards, are much stronger than Mr. South's statement would imply; and further we suspect that the tendency such as it is, sends swarms of fliers down to deposit eggs near the coast, in the low land not subject to fires where as enemies are more numerous, the toll taken of the hoppers is greater than in the lallang lands towards the north. This view regards the lallang wastes as danger spots,—foci whence the broad coastal rice lands may get infected recurrently, and therefore regards the latter more as a "permissive area" to invading locusts.

A record has been kept of the nature of the vegetation in which hoppers were observed; and it may be summed up as follows:—

in rice fields and nurseries	17 occasions.
in rubber plantations (grass weeded or weedy) ..	38 "
in tapioca crops	3 "
about houses in villages (kampong land) ..	14 "
on grass pastures	8 "
on roadsides which are chiefly like pastures ..	10 "
on the railway embankments which are chiefly in lallang	2 "
in lallang waste land	38 "
in lallang turning to scrub (belukar)	1 "
in pasture turning to scrub (belukar)	1 "
in scrub (belukar)	8 "

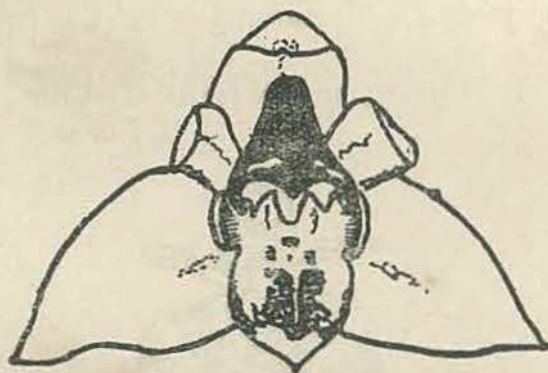
P. C. COWLEY-BROWN.

I. H. BURKILL.

ORCHID NOTES

THECOSTELE SECUNDA, RIDL.

The flower of this orchid was described in the Bulletin on p. 318. To that description it appears well to add the annexed figures, and a note on the mechanism as regards pollination by insects.



Thecostele secunda,—flowers. $\times 2$, from in front.

A visiting insect should settle on the lip and be of such weight as to depress it on the hinge marked in the sectional drawing. When the lip is depressed, a way is opened to the abundant honey through the groove over the centre of the crest. Just under this groove is a yellow spot as described on p. 318. When the weight of the insect is removed the lip returns to the position in which it was, closing the road to the honey again. The part of the lip fitting over the mouth is furnished with hairs such as would prevent small insects from entering the honey-cavity.