Studies on the Biology of Pentatomid Bugs of the Genus *Rhopalimorpha* Dallas (Heteroptera)

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Summary

OBSERVATIONS on the biology and life history of *Rhopalimorpha obscura* White and *R. lineolaris* Pendergrast (Heteroptera, Pentatomidae) have been carried out in the field and on captive material. The two species have a similar distribution and frequent the same limited number of host plants, mostly members of the Cyperaceae. Individuals of both species are sometimes found living together. Food plants and the process of feeding are described and the formation of small cones of hardened secretion around the points of insertion of the stylets is noted. When starved, a carnivorous habit may be assumed. Experiments indicate that rise in temperature is the chief factor in stimulating copulation. Copulation is not a prerequisite for oviposition, but appears to be necessary for the proper formation of the eggs and for the production of the normal number. The probable part played by the modified lobes of the small ovipositor in the transmission to the eggs of bacterial symbionts is discussed. During oviposition the female rapidly taps a pair of setose areas on the abdominal venter with the hind legs. There is some evidence from histological preparations that these areas have a sensory function. The eggs of the two species differ in size, shape, colour and in the number in each set. A single case of parasitism of the eggs by a Scelionid has been observed.

WITH the exception of the valuable paper of Myers (1926) on the biology of the New Zealand Heteroptera, there appears to have been little published on the habits of the indigenous members of the Pentatomidae. The following account records observations on the relatively common grass- and sedge-haunting bugs of the genus *Rhopalimorpha* Dallas (Pentatomidae; Acanthosomatinae) which is represented in New Zealand by two species, *R. obscura* White and *R. lineolaris* Pendergrast. The presence of the latter was unknown to Myers, and under the name of *R. obscura* he has included, in part, notes on the biology and nymphal stages of what is fairly certainly *R. lineolaris.*

DISTRIBUTION

A list of localities has been compiled from published records, museum collections and personal observations. This shows that the two species are found over the two main islands of New Zealand from North Auckland to Otago. They are recorded also from Cuvier, Motutapu, Waiheke, Kapiti and D'Urville Islands. *R. obscura* alone has been noted from Stewart Island (Howes, 1914), but as the presence of *R. lineolaris* was unsuspected at that time, there is the possibility that this species was collected but not recognized. The only specimen from the Chatham Islands examined by the writer is the type of *R. ignota* Hutton and, as noted in a previous paper (1950), this is clearly *R. obscura* White. In view of their similar distribution on the main islands of New Zealand it would be of interest to discover whether both species are present in the Chathams.

Although the two species have a similar general distribution, one or the other may attain local dominance. For example, at St. Heliers, Auckland, over a period of eighteen months, 159 specimens of *R. lineolaris* were collected and only 5 *R. obscura,* all these latter from a single plant. In contrast to this, at Paiaka,

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Foxton, when bugs driven to the heads of swamp plants by flooding were collected by Dr. R. A. Cumber, only 9 *lineolaris* were obtained for 53 *obscura.* Nevertheless, in some other localities it is quite usual to find both species living together in more or less equal numbers in the same area and even on the same plant.

HOST PLANTS

Both species favour the same host plants, usually grasses and sedges in clear country or bordering streams and swamps. In the Auckland area about six such plants have been noted, although many sedges and grasses have been examined at all times of the year. The most favoured group is the Cyperaceae and, in addition, one introduced grass and a rush are frequented.

Cyperaceae:

Carex longifolia. A large sedge occurring in dense clumps in pastures and offering admirable shelter.

Carex divulsa. A small species, more or less prostrate, and not offering the same shelter as the last-named sedge. However, during the summer months it is a favoured food plant, the seed-heads being crowded with adults and nymphs.

Carex virgata. Noted by Myers (1926). It is fairly probable that many of the numerous species of this genus are important food plants for *Rhopalimorpha.*

Gahnia sp. Both species have been taken from *Gahnia* sp. fringing forest at Titirangi, Auckland.

Mariscus ustulatus. A large sedge which is an important member of many swamp associations. Eggs are laid on the spikelets and all nymphal stages are passed amongst the seeds. *Mariscus* frequently enters the forest along the margins of streams and in swampy depressions and provides shelter and food for *Rhopalimorpha* in these localities.

Gramineae:

Dactylis glomerata. Although other pasture grasses have been examined, Cocksfoot alone has proved to harbour *Rhopalimorpha.*

Juncaceae:

Juncus polyanthemos (*J. effusus*). There is some evidence that the common rush or wiwi is more important for providing shelter for over-wintering than for food. Large numbers of bugs have been taken from the plants during late autumn and winter.

SEASONAL MOVEMENTS

In autumn the adults of both species are found in large numbers crowded together near the leaf bases in cocksfoot grass, rushes, and *Carex longifolia.* In *Mariscus ustulatus* the bugs lie along the midrib near the leaf base, the slightly concave upper surface of the leaf giving admirable protection to the somewhat flattened insect.

During the winter months, May–August, the insects are found nearer ground level. In rushes they inhabit the mass of detritus at the base of the plant, whilst in cocksfoot grass and *Carex longifolia* they may be found actually on the ground amongst the leaf-mould. Apparently, some feeding is carried on, a small number of the specimens examined having food in the anterior part of the gut. There is little sign of reduction of the fat body.

During the months September–November there is a gradual change to the summer habits, time of emergence from the winter hibernation being affected, to some extent, by the situation of the host plants. During October, more and more become active and many may be noted *in copula* in warm situations. Egg development commences at this time, and this is accompanied by reduction in the fat body. In mid-October, 1949, few bugs were found on cocksfoot grass and rushes at St. Heliers, Auckland, but for the first time in the season numbers were noted *in copula* on the inflorescences of neighbouring plants of *Carex divulsa*. There is a possibility that some migrate to this plant, although in some areas immature cocksfoot seeds have been noted as favoured foods for both adults and nymphs. In 1949 egg laying started in mid-October at Auckland, and first stage nymphs were found in the first week of November. During this month fewer males were taken in collections, and laboratory breeding experiments also indicate that, in general, they die soon after the period of copulation.

Throughout the summer months, December–February, both nymphs and adults are active, feeding on the seeds and inhabiting the upper parts of the host plants. Dissections show that only young adults were taken during February, i.e., these were newly moulted adults, the previous generation having died soon after the end of the egg-laying period.

FEEDING HABITS

Both nymphs and adults of *Rhopalimorpha* have been observed feeding from the unripe seeds of the host plant. Also, adults have been noted to feed from the leaves of plants, especially near the bases. It seems probable that the food from the seeds is used during the period of growth and for building up the fat body, but over the winter adults feed occasionally from the leaves.

At no stage have the bugs been observed to suck from the dried seeds, but during rearing experiments in the laboratory fairly successful techniques were devised for supplying food to nymphs reared during the winter. Dried cocksfoot seeds were boiled from 15–30 minutes and then allowed to partially dry out. Both nymphs and adults fed from these, the treatment probably softening the seed coat and partially cooking and softening the endosperm. Another method involved the boiling and grinding up of the seeds to make a watery suspension. Nymphs were able to drink from drops of this and it appeared to supply the necessary food substances.

Myers (1926) believed *Rhopalimorpha* to be purely phytophagous, but the studies reported here have shown that a carnivorous habit may be assumed under special circumstances. A starved male of *R. obscura* was observed sucking the contents from three partially incubated eggs of *R. lineolaris*. Similarly, fifteen eggs which were in a jar with starved individuals of both species were found with the contents sucked from them.

The feeding process has been observed several times, and on each occasion the actions followed the same pattern. Insertion of the mandibular and maxillary stylets is prefaced by careful selection of a suitable place for the operation. During this stage, the insect moves about slowly, stopping from time to time to apply to the plant the tip of the rostrum (labium), the distal end of which bears a mass of sensory hairs. When a suitable place has been found the body is tilted, the anterior end being raised and the posterior depressed. The rostrum is then lowered until it is held vertically against the surface of the seed or leaf. Insertion of the stylets then commences, this being accompanied by a slight up and down movement of the head: As the stylets enter the plant tissue the head approaches closer to the surface of the plant, and the sheath-like rostrum becomes separated from the stylets basally and bends backwards at the first joint, although apically it still remains around the stylets and acts as a guide for them. When these are inserted sufficiently, the rostrum returns to the position of rest along the venter of the body and the stylets function without further support. The feeding process is usually accompanied by further insertion or partial withdrawal of the stylets from time to time. In some cases insertion is so deep that the flap-like labrum makes contact with the plant and is pushed out of place.

During the process a quantity of viscous, colourless fluid collects around the point of insertion of the stylets and builds up a small hollow cone which quickly solidifies. Studies of the histology of the head indicate that this may be a secretion of the maxillary glands. Its probable function can be regarded as two-fold. First, it may bind the stylets together along their length and, secondly, the cone around the region of insertion of the stylets may take the place of the tip of the sheath-like rostrum which, at this stage, is folded beneath the body. In this connection it may be noted that, to the writer's knowledge, there has been no mention of such "feeding cones" in the literature and, in addition, *Rhopalimorpha* is one of the few bugs reported to fold back the rostrum during feeding. In most cases this remains in position, its tip acting as a guide for the stylets during the whole process.

When feeding ceases the anterior end of the body is raised and the stylets are withdrawn, the rostrum is swung forwards, and the stylets returned to the labial groove. The insect then spends some time stroking the stylets within the groove with special strigose organs on the fore-tibiae. Each of these consists of a group of about a dozen very stout, downwardly curved spines placed about halfway along the ventral side of the segment. These organs are applied to the labial canal in a downward movement and probably have the function of both cleaning the stylets and arranging them in place within the rostrum.

Both nymphs and adults drink from drops of water, weak solutions of sugar or honey, and from suspensions made from crushed and boiled cocksfoot seeds. This appears to be detected by the antennae, which are depressed to almost touch its surface. The rostrum is then lowered and the insect assumes the posture noted at the commencement of feeding. In this way the bug may remain motionless for several minutes during which time the amount of liquid may be considerably reduced. On some occasions, when drinking from a thin film of water, the insect may place the fore-tarsi in the liquid and draw them backwards and inwards towards the tip of the rostrum. It would appear that this action is to increase the depth of the liquid at the point of insertion of the rostrum.

COPULATION

Field observations show that, with few exceptions, copulation takes place in spring and early summer, there being only one mating period in the life cycle. Copulation has never been observed in the late summer, autumn and winter, although of the spermathecae of 53 females of *R. lineolaris* examined prior to September, 1949, two contained sperm. These females had been collected on March 20, 1949, and on August 6, 1949, respectively, indicating that in a few cases mating occurs outside the spring and early summer months.

Copulation was first observed in the field on September 11, 1949, one pair of *R. lineolaris* on cocksfoot grass in a warm situation being noted. However, copulation was not general until October and the greatest activity was observed during November.

During the winter months numbers of bugs were kept on cocksfoot plants in rectangular glass jars. These were placed in a partially insulated box fitted with a thermometer and warmed by an electric lamp. Daily readings showed that the temperature varied from 66–72 degrees F., although it should be noted that a somewhat greater variation must have been experienced during the night when readings were not taken. However, in the absence of a constant temperature room, this rather makeshift apparatus provided fairly constant temperatures considerably above those of the outside air. By this means copulation was induced in groups of bugs taken from winter hibernation, thus confirming the field observations that rise of temperature is an important factor in stimulating copulation.

The act of copulation has been observed in both species on many occasions, both in the field and the laboratory. The same behaviour pattern is always followed and no differences have been noted in the two species. No evidence of courtship has been found, the female apparently showing complete indifference to the male, the active partner. During the mating season the males not *in copula* are very active, moving quickly up and down the plant until coming close to another bug. When male and female meet they pass the antennae very rapidly over each other's body for the briefest possible time before the male attempts to mount the back of the female. If the male approaches from the rear it will usually mount on the back of the other bug at once, be it male or female, at the same time passing the antennae over the other's body. At no time, however, has a male been observed to attempt to continue with the act after mounting another male, and, in fact, in every case the active male is shaken off by convulsive side-to-side jerking movements of the other. After mounting on the back of a female, a head to head position is assumed and the male genital segment is protruded somewhat, the male meanwhile jerking from side to side several times. It then moves until its venter lies along the lateral margin of the female's body. These movements take place very rapidly and are usually accompanied by efforts on the part of the female to dislodge the male. While clinging to the side of the female the male has the mobile terminal segments fully extended, the small eighth abdominal segment and the intersegmental membranes being visible. These parts are then turned so that their caudal end is directed anteriorly and at the same time are rotated through 90 degrees on the longitudinal axis. These movements bring the male and female genital regions into correct relationship and copulation is then effected. The male now releases its hold on the female and grips the substrate and, because the female is usually moving forwards during these initial stages in copulation, is immediately dragged around until the normal position for coitus is attained, viz., with the partners facing in opposite directions.

Once union is accomplished, the female apparently ignores the presence of the male and drags him backwards for much of the time. Consequently, the male is sometimes on his back, sometimes at acute angles to the female and often swinging freely as the female crosses from leaf to leaf. During copulation no feeding has been observed, although the females have been noted to drink water from the surfaces of leaves. The bugs may remain *in coitu* for several hours and may repeat the process several times. During the early summer the tips of the hemielytra of the males become permanently turned up from pressing against the female abdomen in copulation. Myers (1926) has also observed this in *Oncacontias vittatus*.

EGG DEVELOPMENT AND OVIPOSITION

In 1949 the first signs of egg development were noted during the dissection of two *R. lineolaris* females taken, with others, from grass on a warm northerly slope at St. Heliers during the last week of September. Sperm was present in the spermatheca, the fat body was slightly reduced, and small oocytes were visible within the egg tubes. Eggs were first noted in the field on October 24, 1949, these being fairly certainly of *R. obscura.* On October 26, 1949, further groups of eggs (*R. lineolaris*) were found, and from this time until near the end of December egg laying was carried out. At the end of this period females brought into the laboratory died after laying what were evidently their last groups of eggs.

Amongst the bugs kept during the winter months in the warmed box, times varying from 8 to 19 days elapsed between copulation and oviposition. It might be asked whether copulation is a prerequisite for egg development. Dissections of females collected in spring and early summer have shown that sperm was invariably present in the spermathecae of females in which the eggs had commenced development. Experiments were carried out in which supposedly virgin females (collected in winter) were kept in the warmed box. It was found that eggs were laid, but these were very few in number, irregularly placed and very distorted in form. Field observations and laboratory experiments indicate that rise of temperature stimulates copulation and egg development and that copulation is necessary for the proper formation of the eggs, and for the continued supply of them.

R. lineolaris females usually lay eight eggs in the first set, whilst in the case of *R. obscura,* fourteen are laid, the number of eggs in the set being equal to the number of egg tubes in the species. Later in the season these numbers are departed from, and in *R. lineolaris* 4–6 eggs are usual at a time and 9–11 in *R. obscura.* Observations on captive groups indicate that at least three sets of eggs are laid by each female.

The eggs of both species are deposited in a single row along the mid-rib on the upper surface of leaves of *Carex* spp. and cocksfoot grass. In *Mariscus,* however, they are always placed in an irregular fashion amongst the developing seeds. The eggs are set almost touching each other and with their long axes at an angle of about 50 degrees to the substrate.

The Egg

The egg of *R. obscura* is truly ovoid in shape, the caudal end being somewhat wider than the cephalic, which is marked by a circlet of about sixteen micropylar pores. When newly laid, the colour is green, although the empty chorion is hyaline. The chorion is finely sculptured, appearing more or less hexagonally reticulate. The dimensions of the egg are very constant, the length averaging 0·86 mm. and the greatest width, 0·67 mm.

The egg of *R. lineolaris* is bluntly ovoid, with the greatest width in the middle. The caudal end bears the same number of pores as in *R. obscura.* The eggs are usually cream in colour, although some are distinctly whitish and others very light green. The empty chorion is hyaline and marked in the same way as that of *R. obscura.* The length averages 0 99 mm., and the width 0·75 mm.

The significance of some aspects of oviposition may be better appreciated if the ovipositor, its associated structures, and certain abdominal sense organs are briefly described.

The Ovipositor and Associated Structures

Concealed within the large valvifers and bordering the genital chamber in the eighth abdominal segment of females are certain partially sclerotized lobes which, when observed during oviposition can be identified as the elements of a small ovipositor. Associated with these, and formed as a modification of the second valvulae of the ovipositor, is a pair of folds the epithelium of which secretes a highly characteristic type of cuticle consisting of a mass of narrow open tubes. In a mature female each tube is packed with a dense mass of bacteria held in a granular secretion.

Like many other Heteroptera, *Rhopalimorpha* has bacterial symbionts associated with sac-like crypts or caeca constricted from the mid-gut. Steinhaus (1946) has given a review of the reported cases of such symbiotic relationships. Rosenkranz (1939) considers that in the Pentatomidae the symbionts are transmitted from one generation to the next by being smeared over the surface of the egg and during the resting period after hatching, when the young nymph constantly probes the egg surface with the proboscis, they are taken in and invade the mid-gut. In many Pentatomidae bacteria are associated with the male reproductive system and with a basal expansion of the spermatheca. It seems probable that the colonies of bacteria are so placed in order to ensure infection of the egg surface. This is not the case in *Rhopalimorpha*, but it is evident that this function is carried out by means of the specially modified parts of the second valvulae of the ovipositor.

The Abdominal Setose Areas

The sixth abdominal sternum of *Rhopalimorpha* females bears a pair of conspicuous laterally placed circular setose patches. Essentially similar structures have been found in other members of the Acanthosomatinae examined. Despite this, there has been, to the writer's knowledge, only one reference to these in the literature of the sub-family. Myers (1926), in dealing with *Oncacontias vittatus,* noted that during oviposition the female passed the tibiae to and fro over what he referred to as "dark spots (openings?) on each side of the ventral surface of the abdomen . . ."

In *Rhopalimorpha* each of these structures consists of a circular depressed area bearing a mass of stout bristles. Associated with the bases of the bristles are certain cells, whose highly characteristic appearance and arrangement suggest that they are intra-epidermal sense cells. On this asumption the setose areas would be of a sensory nature and their presence in females only suggests a stimulatory function in copulation or oviposition. Careful observations of the insects before and during copulation failed to show any attempts by the males to touch these areas. However, as will be described below, these structures play some part during oviposition.

Oviposition

Egg laying has been observed with the naked eye, hand lens and on one occasion with the aid of the low-power binocular microscope. On August 13, 1950, a *R. lineolaris* female was found on a piece of cloth beside an egg which had apparently been recently laid. The cloth was transferred to the microscope stage and the remainder of the process observed. (Times are given in minutes from the commencement of observations.)

When first observed the female was standing with the hind tarsi close together under the posterior end of the abdomen. After a few seconds, slight movements of the valvifers were noted, and these were accompanied by characteristic "stamping" of the hind legs. After two minutes the movements of the valvifers became stronger, while the activity of the hind legs continued. The two valvifers were noted to open apart in the mid-line, giving the impression that the egg was held within the genital chamber. The postero-lateral edges of the valvifers were then strongly drawn in and then relaxed, the valvifers moving alternately, and it was obvious that the egg was being rolled around in the genital chamber. After four minutes the valvifers were spread apart and the plates and membranes constituting the ovipositor were partly extruded briefly before being retracted, after which the process was repeated several times at the rate of about one complete movement of protraction and retraction per second. During this, a clear viscous fluid, probably the secretion of the accessory glands, oozed out from along the borders of the valvifers. At about five minutes the movements became stronger, and each time extension occurred the egg became visible, the greater part of it being enclosed within the ovipositor, the bacteria-containing second valvulae of which were observed to be closely applied to it as it was moved in and out between them. At about five minutes the egg, with a mass of viscous fluid, was finally extruded. Immediately, manipulation of the egg by the hind legs commenced. This process is of some interest, and no completely satisfactory explanation can be offered for it. The inner margins of the hind tarsi and the inner distal parts of the tibiae were tapped rapidly and lightly two or three times on one side of the egg and then rapidly brushed about three times across the circular setose areas on the sixth sternum. This process, which was repeated about fifteen times by each hind leg alternately, was continued until the egg appeared to be firmly attached to the substrate by the hardening of the viscous secretion. After seven minutes the valvifers started the preparatory movements again and the female shifted position slightly and the process continued as before, the next egg being laid in the same time as the one described.

It can be seen then, that in this case six minutes elapsed from the beginning of the movements of the valvifers until the actual laying of the egg, while a further minute was spent in the curious manipulation of the hind legs. The part played by the sternal setose areas cannot be adequately explained. Their sensory character has been noted, so that there is a possibility that the touching of them by the legs immediately after oviposition stimulates the genitalia in some way to further activity. However, such an explanation is purely tentative and it is felt that no finality will be arrived at until further investigations have been carried out.

INCUBATION AND HATCHING

The following description of incubation and hatching in *R. lineolaris* applies equally to *R. obscura*. Colours described for the former species are present in the latter, although somewhat masked by a general green coloration in the early stages.

After three days the eggs become slightly darker in colour, and after four to five days two very faint red eyespots, which darken considerably during the next two days, become visible at the cephalic end. On the sixth day the very indefinite outlines of the rostrum and antennae are apparent antero-ventrally, whilst antipodally light orange patches mark the position of the developing scent-gland apertures on the abdominal dorsum. From this time until hatching commences on about the eighth day the outlines of the embryo within the chorion

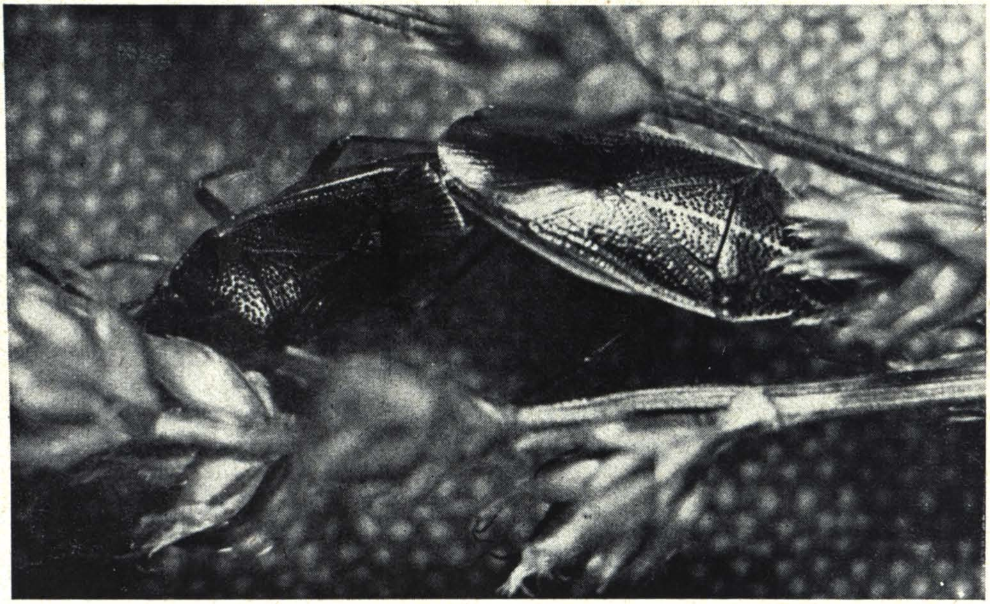

FIG. 1
Rhopalimorpha obscura in copula. (× 7)

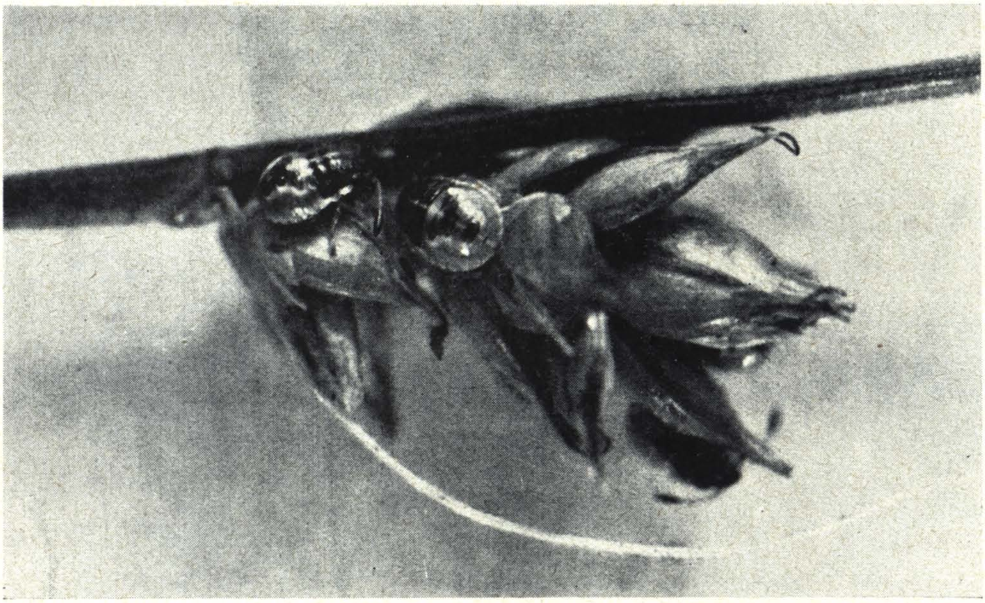

FIG. 2
R. lineolaris: Second instar nymphs on seeds of *Carex divulsa*. (× 10)

become increasingly plain, the eyes, rostrum, antennae, legs, abdominal segments and scent-gland apertures being apparent.

At emergence of the nymph, longitudinal splitting of the chorion occurs. This starts at the cephalic end of the egg and exposes the strongly pulsating vertex, after which the split is extended downwards and the antennae and rostrum appear. These become free before the rest of the head emerges. The fore-legs, followed by the remaining legs, then emerge and after a few minutes these and the antennae start to move actively. Meanwhile, splitting of the chorion has continued to the caudal end and the nymph is left sitting vertically within the split chorion, the legs and antennae waving about in an attempt to free the body. This stage usually continues for about ten minutes before the nymph is able to struggle free. The entire process takes from 25–30 minutes, but may be considerably extended if the rather elastic chorion prevents the complete emergence of the nymph.

NYMPHAL DEVELOPMENT AND HABITS

The following tables are based on records from both winter and summer rearing experiments. Table 2 presents the results obtained in the rearing of nymphs of *R. lineolaris* during the winter of 1949 in the warmed box. Table 1 shows the results of summer rearing experiments of the same species when the nymphs were kept on freshly gathered seed-heads of *Carex divulsa.* It is felt that the progressively greater times required for the development of later instars shown in Table 2 compared with those in Table 1 reflect the lack of a complete food which was available to summer-reared nymphs. Unfortunately, none of the nymphs reared in the warm box was brought through to the adult stage, the fifth instar nymphs dying, apparently through desiccation. Table 3 shows the times required for incubation and nymphal development in *R. obscura*

TABLE I—DURATION OF THE PRE-IMAGINAL STAGES OF *R. lineolaris.* (SUMMER, 1949-50)

Stage	Length in Days		
	Minimum	Maximum	Mean
Incubation	7	9	8.0
1st Nymphal	6	8	6.9
2nd Nymphal	8	10	8.8
3rd Nymphal	9	10	9.3
4th Nymphal	9	12	10.7
5th Nymphal	10	18	12.4
Total			56.1

TABLE II—DURATION OF SOME PRE-IMAGINAL STAGES OF *R. lineolaris.* (WARMED BOX, WINTER, 1949)

Stage	Length in Days		
	Minimum	Maximum	Mean
Incubation	6	7	7.0
1st Nymphal	6	7	6.8
2nd Nymphal	7	14	10.4
3rd Nymphal	12	16	13.7
4th Nymphal	14	19	16.0

TABLE III—DURATION OF THE PRE-IMAGINAL STAGES OF *R. obscura*. (SUMMER, 1949-50)

Stage	Length in Days Minimum	Maximum	Mean
Incubation	8	9	8 5
1st Nymphal	6	7	6.8
2nd Nymphal	9	12	10.8
3rd Nymphal	7	10	8.8
4th Nymphal	8	12	10 5
5th Nymphal	9	13	11.1
Total			56 5

From the rearing experiments and field observations it appears that the time of pre-imaginal development approximates eight weeks in both species, while the season for this development extends over sixteen to eighteen weeks during the months October–February.

It is intended to include descriptions of the nymphs of both species in a later paper, but some of their habits are noted below

The newly hatched insect remains sitting on the empty chorion for the first, and sometimes the second day. When newly emerged the nymphs are light in colour, but during the first half-hour darkening of the pigments commences, and by the end of the first hour the thorax has darkened to a smoky hue and the abdomen is lemon-yellow. In *R. obscura* all parts have a distinct greenish tinge. After the second day the nymphs may move off the eggs, but usually remain in a compact group, sitting motionless, often with their heads all directed towards the centre of the group. First instar nymphs have been noted to drink water on occasions, but have never been observed to feed.

The second stage nymphs are readily distinguished by their active habits. They are rarely found in groups, but move about quickly, apparently in search of food, because they frequently lower the rostrum and apply the tip to the substratum Nymphs of this and succeeding instars are frequently observed feeding, the process being similar to that described for the adult.

Moulting

For a period before and after moulting the insects cease feeding and remain inactive. Before moulting commences, the nymph takes up what might be termed the "moulting attitude," with the antennae projecting cephalad in the same plane as the body, and the legs symmetrically arranged gripping the substrate with the tarsal claws. Myers (1926) has stated that the first ecdysis is accomplished by a median longitudinal split which does not include the head cuticle In fact, none of the ecdyses is accompanied by longitudinal splitting of the head capsule, morphological studies having shown that a coronal line is absent in this genus, if not in all Pentatomidae. In all the ecdyses, cleavage of the head cuticle takes place along two diverging ecdysial lines starting at the posterior border of the head a short distance on each side of the mid-dorsal line and running forwards to the inner margins of the eyes. Posteriorly, there is a transverse rupture along the suture between thorax and abdomen, while in the mid-line there is complete cleavage of the nota. The heads of the exuviae are strongly deflexed, with the antennae and rostrum laid along the venter, so that a wide gap is produced between head and thorax by which the insect leaves the cast integument.

PARASITES

A single case of parasitism of the eggs of *Rhopalimorpha* has been noted. On January 5, 1950, fourteen eggs of *R. obscura* on a *Carex* blade collected by Dr. R. A. Cumber at Paiaka, near Foxton, were found to be parasitized. The eggs were black in colour and during transit an hymenopterous parasite emerged from each. These were identified by Dr. O. W. Richards, of Imperial College, London, as a species of *Microphanurus* (Scelionidae). The cephalic end of each egg had been removed on emergence of the parasite, leaving a hole with jagged edges. Woodward (1949) has recorded similar parasitism of the eggs of some Pentatomids in Britain by *Microphanurus* spp.

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