Biology of a new Halictine Bee
and Specific Descriptions of its Parasites.

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(With 14 Text-Figures.)

Introduction.

The objective of the research was to establish the occurence of parthenogenetic females in the life-cycle of the gregarious bee, *Halictus emeraldensis*, sp. nov.

Dzierzon (1876) was the first to state that the drone of the bee-hive had only one parent, the perfect female or queen. Phillips (1903) and others have since ably reviewed the claim. It is very simple to demonstrate that an unmated queen-bee is capable of producing males: that other virgin bees produce females also has not been so generally accepted.

Fabre (pp. 451—4) asserted that certain wild-bees of France produced such females. Snodgrass (1925) gives a diagram to explain the parthenogenetic generation of males, but it cannot account for the production of parthenogenetic females. The author determined to study an Australian species, of the same genus, in an endeavour to test the claims of Armbruster, Legewie, Stöckhert and Fabre.

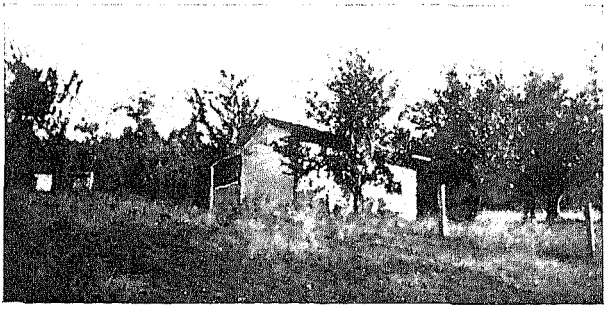

Fig 1. The temporary laboratory on the hillside.

A small house, eminently suitable for a temporary laboratory, and not far from the halictine colony, was generously placed at the author's disposal by Mr. John Ziegler, and the research was assisted by a grant from the Trustees of the Commonwealth Science and Industry Endowment Fund.

The type specimens of the species and the various inquilines, together with the mounted preparations of the morphology, are in the collection of the Division of Economic Entomology, C. S. I. R., Canberra, Australia.

Paratypes are in the collection of the Deutsches Entomologisches Institut, Berlin-Dahlem. The „nest" series in both are distinguished by green (Spring); yellow (Summer) and blue (Autumn) labels.

Locality.

The colony of *H. emeraldensis* was studied at Emerald, in the Dandenong Ranges, 37 miles east of Melbourne; the altitude, 1,045 ft., marks the local station as the highest on the Melbourne-Gembrook narrow-gauge railway. Despite the small outcrops of granite which occur on certain hills, such as „Johns", the contours are rounded, and backed up by the misty-blue of the surrounding ranges, they make a landscape of singular beauty. The annual precipitation is heavy, but well distributed; the district lying within the 42 inch rain-belt. The nights are cold, and in winter fogs, alternating with frosts, keep the ground very wet; at rare periods, light falls of snow are experienced. The summer „shade" temperatures rarely exceed 33° C.

The red volcanic soil of the hills is very deep, and the heavy rains pass through it quickly. In a few places it is displaced abruptly by the tough, grey soil of the gullys, the clay-like nature of wich makes cultivation difficult, but it is regarded as „good summer land". No „nests" of *H. emeraldensis* were observed in the grey soil; the sole colony was in the red ground which, of course, is drained better.

Indigenous Flora.

The original forest was dense, with a still more dense undergrowth. On the hills mountain ash *(Eucalyptus regnans)* reached a height of 300 ft. with blackbutt *(E. pilularis)* and messmate-stringybark *(E. obliqua)* to keep it company.

Blackwoods *(Acacia melanoxylon)* and silver wattles *(A. dealbata)* thrived on the sidlings, along with smaller species such as the golden wattle *(A. pycnantha)* and „prickly moses" *(A. verticillata)*. The undergrowth included the rough bush-pea *(Pultenaea scabra* var. *biloba)*, handsome flat-pea *(Platylobium formosum)*, yellow rice-flower *(Pimelea flava)*, heath *(Epacris)*, with much tea-tree *(Leptospermum scoparium)* and patches of burgan *(Kunzea peduncularis)*; wild- and trailing-hop *(Goodenia ovata* and *G. lanata)*; bitter-pea *(Daviesia latifolia)*; Correa; snow daisy-bush *(Olearia lirata)*; yellow star-bush *(Asterolasia Muelleri)* and wiry Bauera *(B. rubioides)*. In the valleys is the typical flora of the ferngullys, with plenty of christmas-bush *(Prostanthera lasianthos)* along the banks of the streams. Fire was the chief agent employed in the clearing of the hills.

Changing Ecology.

As one would expect, land so rich in humus is somewhat acid, but

where lime has been applied, prolific crops of peas and beans, strawberries, raspberries, gooseberries and other fruits reward the cultivator. The red ground grows clovers of various kinds, and several English grasses, while a feature of the district is the large number of exotic trees such as conifers, silver birch, strawberry-tree and laurel. The many arboreal introductions are due to the proximity of a large commercial nursery, and it is interesting to see that the Spanish heath *(Erica lusitanica)*, spreading from the nursery, has become naturalized, for clumps may be found growing among the „prickly moses" and wild-hop of the uncleared land. The Monterey pine *(Pinus radiata)*, too, is springing up in the grass paddocks from seed lodged therein by the wind. Two species of bramble *(Rubus)* have become a serious pest to the land holders, but yield large quantities of pale-amber honey and olive-coloured pollen during November and December. In spring, cape-weed *(Cryptostemma calendulaceum)* thrives in the cultivated fields and along the road sides. Later, in summer and autumn, this species is succeeded by another introduced composite, flatweed *(Hypochaeris radicata)*.

A comparison of the indigenous with the exotic flora demonstrates that the advent of man has changed completely the character of the nectariferous and polleniferous plants of the locality; those from overseas having almost supplanted the indigenous species, the genera of which are utterly different. Soon the honey from the hills will closely approximate that harvested in Great Britain.

Fortunately, *H. emeraldensis* and several other wild-bees are adapting themselves to the changing ecology and, no doubt, these will survive in the new conditions, but there are many other species — such as *Trichocolletes daviesiae* Raym., endemic to flowers of the bitter-bea[1]) — which have never been observed to „work" on the introduced plants. Should these bees be unable to re-adjust themselves, they will become extinct in the district surveyed in this paper; indeed, these hairy-eyed, beautiful bees are even now extremely rare. The changed flora will, however, favour the honey-bee *(Apis)* which was introduced to Australia in 1822.

Genus *Halictus* Latreille.

Halictine bees are of world-wide distribution, if the arctic regions, where only *Bremus* is found, be excluded. The Australasian representatives are all small in size, ranging from 2 mm. to 12 mm. in length, and although many have pilose bands on the abdominal terga, yet they are not very hairy. The prismatic species are included in the subgenus *Chloralictus* Rob.

[1]) I am indebted to Mr. P. R. St. John, of the Botanic Gardens, Melbourne, for assistance in the identification of the botanical species.

The glossa is short and acute; paraglossae conspicuous; labrum of female with a peculiar appendage which the author has found of service in determination. The crescentic area of the metathorax is usually more or less rugose or striate, and the hind calcar, with few exceptions, strongly

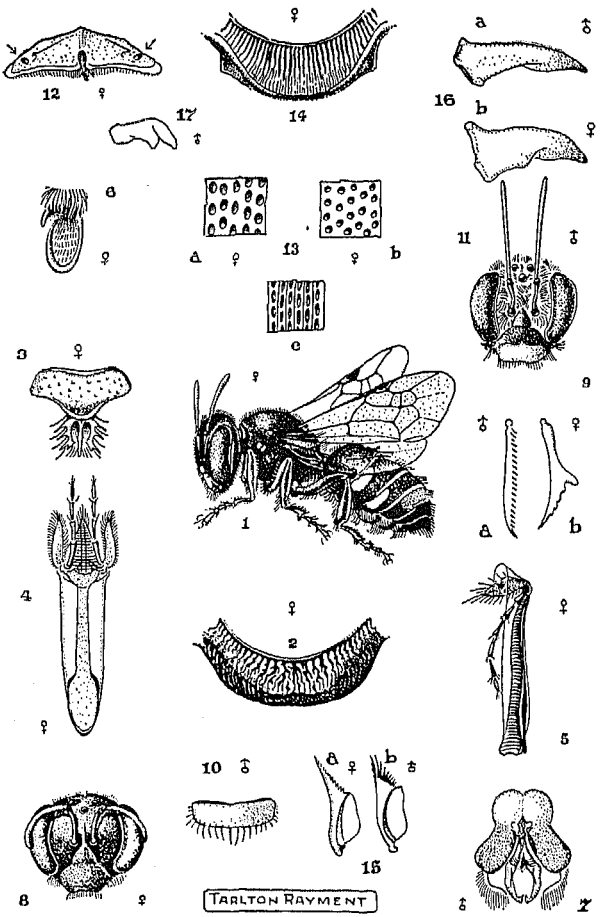

Fig. II.

1. Female *Halictus emeraldensis*, sp. nov. 2. Rugose area of metathorax. 3. Labrum of female has a peculiar appendage. 4. Glossa, paraglossae, labial palpi and mentum. 5. Maxilla and palpus. 6. Knee-plate of posterior tibia. 7. Genitalia of male. 8. Anterior of head-capsule of female. 9. Hind calcar (a) of male, (b) of female. 10. Labrum of male. 11. Anterior of head-capsule of male. 12. Fifth tergum of female with rima and two spiracles. 13. Sculpture of female, (a) mesothorax, (b) first tergum, (c) frons. 14. Striate area of metathorax of *H. imitans* Ckll. 15. Strigil of anterior leg, (a) of female *H. emeraldensis*, (b) of male. 16. Mandible, (a) of male, (b) of female. 17. Claw of male tarsus.

dentate; these two characters are of prime importance in systematic description. All females have a prominent rima on the fifth abdominal tergum; a Family character responsible for the vernacular rame, „Furrow-bees". Males are smaller, but their antennae are, with few exceptions, longer, and the clypeus generally with the anterior half pale-yellow. Maxillary combs are absent in this genus.

Some mutations of the new species have simple mandibulae, (Fig. II, 16), but the typical form for the genus is bidentate (Fig. III, 13—14). All the species studied by the author are strongly gregarious; establishing their colonies in the earth. (Rayment pp. 236—319).

The alimentary canal is a series of enlargements and constrictions parallel with those of the hive-bee. The long slender tube of the oesophagus passes from the head, through the thorax, to the abdomen, where it enlarges into a transparent honey-sac which, in turn, is constricted to form the muscular proventriculus.

The remarkable proventricular valve (Fig. XII, 10) controlls the passage of food from the honey-sac into the strongly corrugated ventriculus, and is similar in form and function to that of the honey-bee. Though the four lips of the valve can open widely, yet it appears to have only a „one-way" function, for no trace of the pasty contents of the ventriculus was found in the clear nectar of the sac in the many specimens dissected.

Schönfeld (1886) claimed to have demonstrated, in the honey-bee, the return of food from the vertriculus to the honey-sac, and he may have done so by setting up a kind of unnatural „antiperistaltic" action (Fig. XII, 11). However, the author was unsuccessful in experiments to bring this about in *Halictus*. Snodgrass (p. 158) reports similar failure with the hive-bee. The ventriculus is constricted at the small intestine which expands into the globular rectal-gland and rectum.

The number of ovarioles is small, about six or so, and the Malpighian tubules, too, are few, and without muscular fibrillae, though Trappmann (1923) claimed that the tubules of the honey-bee posesses such fibrillae; Snodgrass (p. 163) says he is unable to find any in that genus. The glandular system of *Halictus* had to be left unstudied.

Mutations.

Critical examination of the taxonomic characters of females of the three generations revealed certain differences which, in ordinary systematic classification, would be regarded as varietal only, but investigation of the biology showed that even a small divergence from the typical morphology demanded further study.

It was found that a few of the mutated females excavated isolated

shafts and chambers at a little distance from the parent colony, whereas the typical form remained within the original area. Later it was demonstrated that the generations of at least one mutation alternated with those of the parent colony.

On 25th January 1936, such a shaft was excavated by the author, and six fully developed females and one male were captured just as they were about to leave the nest. This was in marked contrast to what obtained in the parent colony, where the typical progeny were only at the larval stage when the faeces are about to be discharged.

Unfortunately, since the research recessitated the capture of the entire brood of the shaft for microscopical examination, no further investigation of the biology of this mutation could be made. But the genitalia of the sole male differed very considerably from the typical form by having leaf-like, hairy appendages (Fig. III, 3).

The work of Morgan (1925) and McClung (1923) in America, and Hurst (1932) in England, and many other investigators of the chromosomes in various genera, has enabled us to form a clearer concept of what constitutes a species, and to perceive better how new species may come suddenly into existance as the result of gene complexes originating in the division, or even amalgamation, of the chromosomes, and mutations in the morphology, accompanied by changes in the biology become evident. Whiting (1929) has shown that the chromosomes of wasps are subject to electrical influence.

(Fortsetzung im nächsten Heft.)

Über die angewandte Entomologie in den verschiedenen Ländern [1]).

8. Über die Entwicklung und Organisation der landwirtschaftlichen Entomologie in Deutschland.

Von Regierungsrat Dr. W. Speyer,
Leiter der Zweigstelle Stade der Biologischen Reichsanstalt.

(Schluß.)

Sowohl in der Mutteranstalt wie in den Zweigstellen werden Arbeitsplätze für Doktoranden und Ausländer zur Verfügung gestellt.

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[1]) Nr. 1 und 2 erschienen in: Arb. phys. angew. Ent. Berlin-Dahlem, 2, p. 50—55, 1935; Nr. 3 und 4: ebenda, p. 87—96; Nr. 5: ebenda, p. 213—214; Nr. 6: ebenda, p. 282—288; Nr. 7: ebenda, 3, p. 21—25; Nr. 8 (Anfang): ebenda, p. 156—160.