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Cactus-Feeding Insects and Mites

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Director, United States National Museum

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CONTENTS

CACTUS-FEEDING INSECTS AND MITES

INTRODUCTION

INSECTS AND MITES THAT ATTACK CACTUS have been the subject of considerable inquiry during recent years in the United States of America, India, Ceylon, South Africa, and Madagascar, as well as in Australia. On behalf of some of these countries, further investigations have been made in the United States and Mexico.

To place on record for these and other investigations the vast amount of information collected by officers of the Commonwealth Prickly Pear Board and by the Queensland Department of Lands during 1921–1939 and 1958–59, this publication has been prepared.

The Commonwealth Prickly Pear Board was an independent organization representing a cooperative effort by the Governments of the Commonwealth and the States of Queensland and New South Wales, and was financed entirely by them. It was appointed in 1920 expressly to attempt control of prickly pears in Australia by establishing insects and mites that fed on these cacti. These were to be imported from North and South America after host-restriction tests had been conducted to verify their host specificity.

Successful accomplishment of the great experiment became apparent in 1939, and the Board was disbanded. Continuance of any further investigations and the maintenance of a watching brief was left in the hands of the two States. In Queensland the Department of Lands established a Biological Section with laboratory, glasshouse, and insectary facilities in which to carry on the work. New South Wales continued with a State Prickly Pear Commission.

The information in this publication has been extracted by J. Mann and A. P. Dodd from the overseas reports of L. F. Hitchcock, R. C. Mundell, A. P. Dodd, A. R. Taylor, and J. Mann on their investigations in North, Central, and South America; from information in the files of the Alan Fletcher Research Station, Queensland Department of Lands; and from works listed in the bibliography (p. 155).

During the investigations, types of the new species reared by the various investigators, as well as specimens of most of the species studied, were placed in the United States National Museum.

The earliest record of an insect attacking cactus dates back several hundred years. Alexander von Humboldt has said (1812) that there is

263-417—68——2

every indication that cultivation of the cochineal *Dactylopius coccus* Costa was conducted in Mexico and Central America for many centuries before the voyage of Columbus. The Spaniards encouraged the industry after their occupation of Mexico and as early as 1592 passed laws to prevent adulteration of the product. In the 18th century, possibly earlier, other species of *Dactylopius* Costa attacking prickly pear were recognized under the general name "wild cochineals." Some of these forms were taken to other countries with the idea of establishing a cochineal industry—*Dactylopius ceylonicus* Green, for example, was introduced into India in 1795.

Between 1877 and 1895 several other insects were found breeding in cactus plants. Among the earlier published records, mention can be made of the following (see the bibliography for the titles of these and other works):

In 1877 E. A. Popenoe recorded *Moneilema annulata* Say on *Opuntia* Tournefort in Kansas.

In 1886 Eugéne Dugés described and figured the larvae and pupae of *Moneilema variolare* Thomson and *Cactophagus spinolae* (Gyllenhal) breeding in *Opuntia* in Mexico.

In 1889 G. H. Horn published the finding of immature stages of *Coenopaeus palmeri* (LeConte) in stems of *Opuntia bernardina* Engelmann in California.

In 1891 C. V. Riley recorded the breeding of *Melitara prodenialis* Walker from *Opuntia* in Florida in 1877.

In 1892 V. L. Kellogg described and illustrated all stages of *Melitara dentata* (Grote) breeding in *Opuntia missouriensis* De Candolle in Colorado.

In 1895 H. G. Hubbard published an account of the oviposition and larval habits of *Melitara prodenialis* Walker attacking *Opuntia* in Florida.

Further additions to the knowledge of cactus insects were made between 1896 and 1912, mostly in short published notes by various writers.

In 1912 appeared the first comprehensive treatment of the insects of the Cactaceae in the U.S. Department of Agriculture Entomology Bulletin *The Principal Cactus Insects of the United States*, by W. D. Hunter, F. C. Pratt, and J. D. Mitchell. This excellent work describes the life history and habits of various species, summarizes previous information, and provides a very useful bibliography. The bulletin listed 324 species of insects, 92 of which were recorded as injurious species, either attacking directly or associated with cactus plants in the United States. It included also certain species from Mexico and Central America.

Officers of the Commonwealth Prickly Pear Board in 1921 commenced their investigations, during which visits to most of the larger prickly pear regions of North and South America were made as follows:

United States of America: A. P. Dodd, J. C. Hamlin, L. F. Hitchcock, E. Mortensen, J. Mann, R. C. Mundell, A. R. Taylor.
Mexico: L. F. Hitchcock, E. Mortensen, J. Mann, R. C. Mundell, A. R. Taylor.
Central American republics: E. Mortensen.
West Indies: L. F. Hitchcock, J. Mann.
Venezuela and Colombia: L. F. Hitchcock.
Brazil: J. Mann, E. Mortensen, R. C. Mundell.
Paraguay: J. Mann, R. C. Mundell,
Uruguay: A. P. Dodd.
Argentina: W. B. Alexander, G. R. Bassingthwaighte, A. P. Dodd, J. Mann, R. C. Mundell.
Chile, Peru, Ecuador: R. C. Mundell.

Their reports, unpublished, are available in the files of the Biological Section, Department of Lands, Brisbane, Queensland, Australia.

This publication deals with the species considered to be definitely restricted to the family Cactaceae; it does include, however, certain dipterous scavengers which, although not restricted to these host plants, breed in rotting cactus so generally that they should be classed as cactus feeders. The capsid bug *Hesperolabops picta* Hunter, Mitchell, & Pratt is mentioned briefly, although it is known to have other hosts. Other scavengers, flower visitors, and incidental insects have been omitted.

Secondly, the discussion of the life histories, habits, and distribution of the various insects is based on the results of the Board's investigations. Cactus insects which have been recorded by other observers but which were not encountered by these Officers have been omitted, except that the occurrence of a few outstanding forms, such as the pyralid *Beebea guglielmi* Schaus and the cerambycid *Parmenosoma griseum* Schaeffer, has been noted.

In the course of the investigations between 150 and 160 cactus feeding forms were recognised; at least 50 of these proved new to science. Various larval forms encountered during brief visits to certain countries or districts were not reared; some of these certainly could have been new. The investigation was concerned primarily with the insect enemies of the genus *Opuntia*, especially the prickly pear, or *Platyopuntia*, section. In the United States of America passing attention was given to the insect enemies of other types of cacti, while in South America certain observations on insects attacking Cerci were made by the author, particularly in 1958–59. Had the whole of the

Cactaceae been studied as comprehensively as the prickly pears, it is certain that the number of species of cactus insects, particularly among the Lepidoptera, would have been increased materially. The Lepidoptera that have been reared from cacti other than *Opuntia* have proved to be distinct species from those attacking prickly pears and Cylindropuntias.

A considerable amount of information has been secured concerning the distribution, life history, and habits of many species, but in other cases records are incomplete.

The family Cactaceae, being a very distinct plant group with peculiar characteristics of growth and habit, has its own insect fauna. One finds not only species but whole genera and even groups of genera that, so far as is known, are restricted to prickly pears and other types of cactus plants. Almost without exception those insects which are primarily cactus feeders do not attack other plants. Furthermore, insects which are general feeders rarely turn their attention to Cactaceae; this statement is generally true even of omnivorous insects such as grasshoppers.

The prickly-pear pest in Australia flourished unchecked by native insects or by introduced insects of polyphagous habits; there are only a few records of incidental feeders.

And within the Cactaceae there is a considerable degree of host restriction, especially among the Lepidoptera. This host restriction is rarely specific, however, but is confined to plants of the same type. Thus, the moth borers infesting prickly pears may attack most species of *Platyopuntia* in their range of distribution, but they do not attack the Cylindropuntias. Similarly the phycitid borers of such cactus types as *Echinocactus* and *Echinocereus* have not been recorded from either *Platyopuntias* or *Cylindropuntias*. On the other hand, the Argentine phycitid fruit enemy *Ozamia hemilutella* Dyar feeds in *Cereus* as well as in *Opuntia* fruit.

Among the Coleoptera, members of the genus *Moneilema* Say feed mainly on *Opuntia;* various species attack both Platyopuntias and Cylindropuntias in the same district and occasionally they have been recorded from other cactus hosts. Most of the *Gerstaeckeria* Champion weevils seem to be confined to prickly pears, but one species is an enemy of Cylindropuntias. The *Cactophagus* LeConte weevils attack the prickly pears *Nopalea* and *Cereus*, but have not been found in Cylindropuntias.

The coreid bugs of the genus *Chelinidea* Uhler are *Opuntia* feeders, generally attacking both prickly pear and cylindrical forms, but one species seems to be restricted to Cylindropuntias. The other coreid genera *Narnia* Stål and *Leptoglossus* Guérin Ménéville, are inclined to pierce the fruit of various Cactaceae.

The cochineal coccids *Dactylopius* Costa are confined to *Opuntia* and the closely related genus *Nopalea*. One species, *D. newsteadi* Cockerell, would appear to be limited to Cylindropuntia hosts, but the others are prickly pear enemies, since the *Nopalea* food plants are typical prickly pears.

Although many cactus insects in the United States and Mexico attack both Platyopuntias and Cylindropuntias, the latter group has a distinct insect complex. From western Texas to California, three insects, the moth borers *Cahela ponderosella* (Barnes & McDunnough) and *Alberada parabates* (Dyar) and the cerambycid *Coenopaeus palmeri* (LeConte), are associated with various plants of this type, including *O. imbricata* in western Texas and New Mexico, *O. fulgida* in Arizona, and *O. prolifera* and *O. echinocarpa* in California. Attempts to rear the two phycitids on prickly pears were unsuccessful, but occasional examples of *Coenopaeus palmeri* (LeConte) were bred on these plants in cages. *Chelinidea hunteri* Hamlin in southern Arizona appears to be restricted to the cylindrical forms. The two moth borers *Cactoblastis mundelli* Heinrich and *Nanaia substituta* Heinrich attacking the Peruvian Cylindropuntia *O. exaltata* were not found associated with prickly pears.

The slender-jointed Cylindropuntia *O. leptocaulis* of Texas and adjacent districts in Mexico possesses four distinct insect enemies: the moth borers *Alberada holochlora* (Dyar) and *Rumatha glaucatella* (Hulst), the weevil *Gerstaeckeria clathrata* (LeConte), and the flea beetle *Disonycha varicornis* Horn. However, as this plant usually occurs in areas where other Cylindropuntias are absent, the restriction to one host is not definitely established.

In addition to host restriction, there is considerable host preference, or perhaps host adaptability, to be discussed in more detail later. Thus, the bugs *Chelinidea vittiger* Uhler and *Narnia snowi* Van Duzee occur in New Mexico and Arizona, where various Platyopuntias and Cylindropuntias are common plants; *C. vittiger* Uhler is rarely found on the cylindrical forms, while *N. snowi* Van Duzee obviously prefers the fruit of these plants. The seed midge *Asphondylia opuntiae* Felt attacks a great many species of prickly pear; it has been reared on occasion from Cylindropuntia fruit in Texas and Mexico but not in Arizona, where heavy infestations have frequently been encountered in prickly pears.

In Argentina, *Cactoblastis cactorum* (Berg) has been recorded from many prickly pear hosts of varying types of growth, but it has not been recorded as an enemy of the very common prickly pear *O. sulphurea*. On the other hand, *O. sulphurea* is the usual host of the closely related *Cactoblastis doddi* Heinrich, which has not been encountered attacking such normal hosts of *C. cactorum* (Berg) as *Opuntia utkilio* and *O. discolor*. Host preference is very marked among the cochineals *Dactylobius*

Costa. Each species usually possesses several hosts but shows a definite range of limitation in the choice of its food plants. In addition to this restriction, one finds a considerable variation in the degree of success with which *Dactylopuis* attacks its range of hosts; it may increase freely and cause much damage to one species of *Opuntia*, yet multiply slowly and have little appreciable effect on another *Opuntia* seemingly closely related to the favored food plant.

The cactus-feeding insects and mites are classified in the list on pages 9–12, their predators and parasites are shown on pages 12–14, and the cacti they attack on pages 15–28. The classification does not include the scavenging flies of the families Syrphidae and Stratiomyidae nor the Argentine lycaenid butterfly *Thecla melanis* Drury, the larvae of which probably feed on other plants as well as Cactaceae. The capsid *Hesperolabops picta* Hunter, Pratt & Mitchell is included, since it is mainly a cactus feeder, although it is reported to have other hosts. Among the Phycitidae are included various forms known in the larval stage only, and the same is true of one chrysomelid.

The list makes no pretensions of being complete. For example, in the Curculionidae, various species of *Gerstaeckeria* Champion recorded by other authorities as cactus insects have not been added.

When considering the variety of cactus insects, one is immediately conscious of the omission of certain groups. There is only a single record of one representative of the great Lepidopterous family Noctuidae as a cactus feeder. Again, among the Heteroptera the large family Pentatomidae is not represented, although the succulent growth of prickly pear and other cacti should be particularly attractive to these plant-sucking groups.

Obviously there are dominant groups among the cactus insects, which would mean that the cactus fauna have developed mainly along certain lines. The most important group is found among the Phycitidae, with about 40 species divided among a number of closely related genera, all of which are restricted to cactus insects. Insects in these genera occur in all cactus areas of importance, except Central America where further investigations would probably reveal their presence, and they have been found from the northern limits of the cactus region in North America to the southern limits in Argentina and Chile. The Phycitidae are internal feeders within the main stems, cladodes, and fruit.

The groups next in importance are the cerambycid genus *Moneilema* Say and the curculionid genus *Gerstaeckeria* Champion, the former with about 24 species and the latter with at least 10 species. Species of *Moneilema* are found from Colorado in the United States to southern Mexico, while *Gerstaeckeria* weevils occur in the United States, Mexico,

and the West Indies. Other genera or groups with several cactus species are: the curculionid genus *Cactophagus* LeConte, in southern United States to Central America; the coreid genus *Chelindea* Uhler, from the Canadian border south to Venezuela; the closely related coreid genera *Narnia* Stål and *Leptoglossus* Guérin Ménéville, covering a wide area from Colorado in the United States to Argentina; and the homopterous genus *Dactylopius* Costa, occurring throughout the cactus regions.

Roughly 80 percent of the true cactus insects is placed in genera of which all members are restricted to cactus hosts.

PLATE 1 (Opposite)

TOP: Dense prickly pear (*Opuntia inermis*) in belar (*Casuarina*) scrub prior to insect attack, Chinchilla, Queensland, October 1926. CENTER: Same area three years later (October 1929). The prickly pear has been destroyed by *Cactoblastis cactorum*. Cochineal insects (*Dactylopius opuntiae*) can be seen on two regrowth segments in left foreground. BOTTOM: The same area, reclaimed from prickly pear and under pasture—a condition typical of the transformation of 30,000,000 acres of land.


C18


C18

PLATE 2

Quarantine Insectary at the Alan Fletcher Research Station, Department of Lands, Sherwood, Brisbane, Queensland.

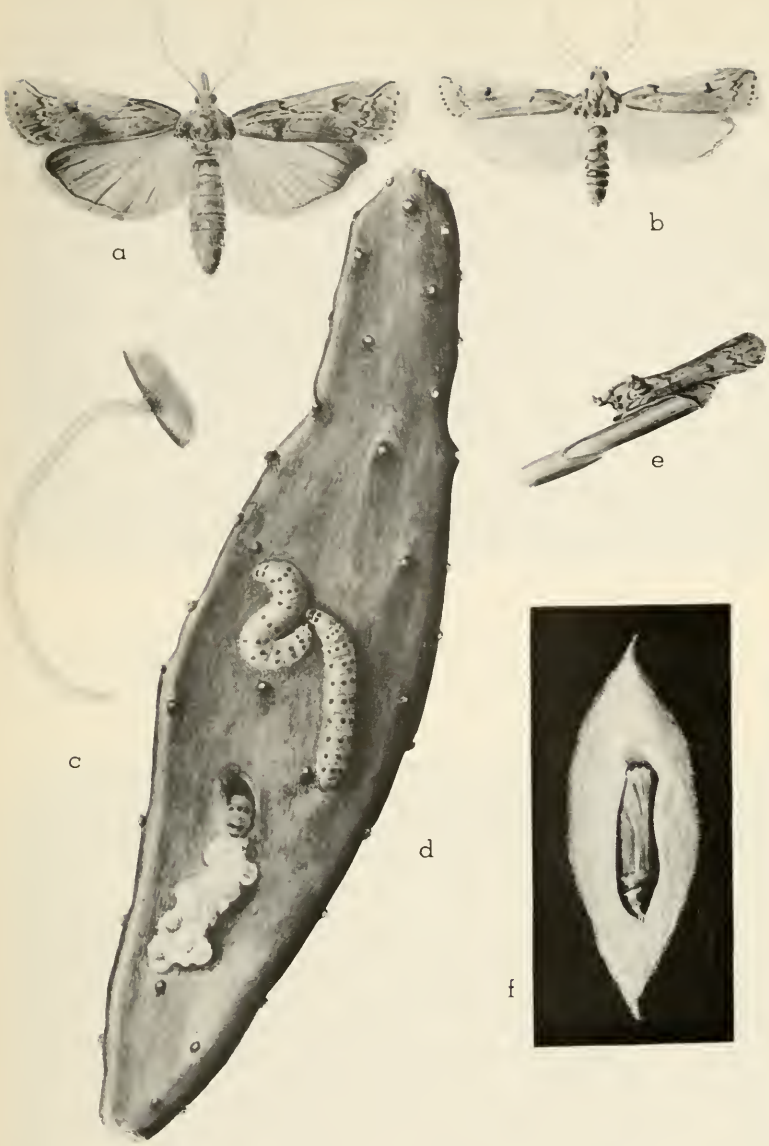

PLATE 3

Cactoblastis cactorum (Berg): a, Female moth; b, male moth; c, egg stick; d, larvae on segment of *Opuntia inermis;* e, female at rest on twig; f, cocoon. showing pupa.

PLATE 4

One day's collection of approximately 25 million eggs of *Cactoblastis cactorum* from the breeding cages at Chinchilla, Queensland, Australia, during the peak of the distribution campaign. BELOW: Segment of *Opuntia inermis* with cuticle removed to show *C. cactorum* larvae feeding within.

PLATE 5

Three egg sticks of *Cactoblastis cactorum* on a young segment of *Opuntia inermis*. BELOW: Regrowth from destroyed *O. inermis*, showing feeding marks of *Chelinidea tabulata*, cochineal (*Dactylopius opuntiae*), and egg sticks of *Cactoblastis cactorum*, October 1929.

PLATE 6

Harrisia martinii (see footnote, p. 16) remains a formidable pest in Queensland, Australia.

PLATE 7 (Opposite)

Cochineal (*Dactylopius opuntiae*) on a segment of *Opuntia inermis*. BELOW: *O. aurantiaca* at Warwick, Queensland, being attacked by cochineal (*Dactylopius* sp. near *confusus* Cockerell).

PLATE 8

Fruit of *Opuntia lindheimeri* at Sherwood, Queensland, attacked by *Asphondylia opuntiae*. Note abnormal production of fruit from fruit, and of cladodes from fruit.

CHECKLISTS

Forms here recognized may be located in the table of contents. A text reference is given for those doubtfully associated with cactus. Scientific names are printed in roman type rather than italic to increase readability.

Insects and Mites Feeding on Cactus

INSECTS

Heteroptera: Coreidae
- Chelinidea Uhler
  - canyona Hamlin
  - hunteri Hamlin
  - tabulata (Burmeister)
  - vittiger Uhler
- Leptoglossus Guérin-Méneville
  - cinctus (Herrich-Schaeffer)
  - concolor (Walker)
  - dentatus Berg
  - subauratus Distant
- Narnia Stål
  - inornata Distant (see p. 133)
  - femorata Stål
  - pallidicornis Stål
  - snowi Van Duzee

Heteroptera: Capsidae
- Hesperolabops Kirk
  - picta Hunter, Pratt & Mitchell (not Uhler)

Homoptera: Coccidae
- Dactylopius Costa
  - argentinus Dominguez (see p. 140)
  - ceylonicus Green (=indicus Green, capensis Green)
  - coccus Costa
  - confusus Cockerell
  - sp. near confusus Cockerell
  - greenii Cockerell (=confusus capensis Green) (see p. 140)

INSECTS—Continued

Homoptera: Coccidae—Continued
- Dactylopius Costa—Continued
  - newsteadi Cockerell (the confusus Cockerell of some authors)
  - opuntiae Lichtenstein (the tomentosus (Lamarck) of some authors)
- Diplacaspis Jacobson
  - echinocacti (Bouché)

Coleoptera: Cerambycidae
- Alcidion Dejean
  - cereicola Fisher
- Archlagocheirus Dillon
  - funestus (Thomson)
- Coenopaeus Horn
  - niger Horn (see p. 88)
  - palmeri (LeConte)
- Moneilema Say
  - albopicta White
  - annulata Say
  - appressa LeConte
  - armata LeConte
  - aterrima Fisher
  - blapsides Newman
  - corrugans Casey
  - crassa LeConte
  - crassipes Fisher
  - ebenina Bates
  - gigas LeConte
  - laevigata Bland
  - mexicana Fisher

INSECTS—Continued

Coleoptera: Cerambycidae—Cont.

Moneilema Say—Continued
- mundelli Fisher
- nigriventris Fisher
- obtusa LeConte
- opuntiae Fisher
- pimalis Casey
- pollens Casey
- punctipennis Fisher
- rugosipennis Fisher
- semipunctata LeConte (see p. 91)
- spoliata Horn
- subrugosa Bland (see p. 91)
- ulkei Horn
- variolare Thomson
- vittata Fisher

Parmenosoma Schaeffer
- griseum Schaeffer

Coleoptera: Curculionidae

Cactophagus LeConte
- fahraei (Gyllenhal)
- spinolae (Gyllenhal)
- spinolae var. rubroniger Fisher
- spinolae var. validus LeConte
- striatoforatus Gyllenhal

Cylindrocopturus Heller
- biradiatus Champion

Gerstaeckeria Champion
- basilis (LeConte)
- cactophaga (Pierce)
- clathrata (LeConte)
- cubaecola (Fisher)
- doddi Fisher
- elegans Fisher
- hubbardi (LeConte)
- insulana (Fisher)
- nobilis LeConte
- porosa LeConte
- unicolor (Fisher)

Huarucus Marshall
- cacti Marshall

Listroderes costirostris obliquus (Klug) (see p. 104)

Onychobaris LeConte
- mystica Casey

INSECTS—Continued

Coleoptera: Chrysomelidae

Disonycha Chevrolat
- varicornis Horn

Coleoptera: Anobiidae

Tricorynus (=Catorama Guérin Ménéville) Waterhouse, spp.

Coleoptera: Buprestidae

Sp. undetermined (see p. 113)

Lepidoptera: Phycitidae

Alberada Heinrich
- bidentella (Dyar) (see p. 42)
- holochlora (Dyar)
- parabates (Dyar)

Amalafrida Heinrich
- leithella (Dyar)

Cactoblastis Ragonot
- bucyrus Dyar
- cactorum (Berg)
- doddi Heinrich
- mundelli Heinrich
- ronnai (Brèthes) (see p. 44)

Cactobrosis (Dyar)
- fernaldialis (Hulst)
- insignatella Dyar (see p. 71)
- longipennella (Hampson) (see p. 71)
- maculifera Dyar (see p. 71)
- strigalis (Barnes & McDunnough)

Cahela Heinrich
- ponderosella (Barnes & McDunnough)

Eremberga Heinrich
- creabates (Dyar) (see p. 61)
- insignis Heinrich (see p. 61)
- leuconips (Dyar)

Erelieva quantulella (Hulst) (see p. 72)

Laetilia Ragonot
- coccidivora (Comstock) (=Zophodia dilatifasciella Ragonot) Also a predator of Dactylopius spp.

INSECTS—Continued

Lepidoptera: Phycitidae—Cont.
- Melitara Walker
  - bollii (Zeller) (see p. 35)
  - dentata (Grote)
  - doddalis Dyar
  - prodenialis Walker
- Nanaia Heinrich
  - substituta Heinrich
- Olyca Walker
  - phryganoides Walker
- Olycella Dyar
  - junctolineella (Hulst)
  - junctolineella pectinatella (Hampson) (see p. 37)
  - nephelepasa (Dyar)
  - subumbrella (Dyar)
- Ozamia Ragonot
  - fuscomaculella (Wright)
  - fuscomaculella clarefacta Dyar (=odiosella Hulst)
  - hemilutella Dyar
  - immorella (Dyar)
  - lucidalis (Walker)
  - punicans Heinrich
  - stigmaferella Dyar
  - thalassophila Dyar
- Rumatha Heinrich
  - bihinda (Dyar) (see p. 54)
  - glaucatella (Hulst)
  - polingella (Dyar)
- Salambona Heinrich
  - analamprella (Dyar) (also a predator of Dactylopius spp.)
- Sigelgaita Heinrich
  - chilensis Heinrich
  - huanucensis Heinrich
  - transilis Heinrich
- Sosipatra anthophila (Dyar) (see p. 72)
- Tucumania Dyar
  - porrecta Dyar
  - tapiacola Dyar
- Yosemitia Ragonot
  - didactica Dyar (see p. 55)
  - fieldiella (Dyar) (see p. 55)
  - graciella (Hulst)
  - longipennella (Hulst)

INSECTS—Continued

Lepidoptera: Pyralidae
- Beebea Schaus
  - guglielmi Schaus

Lepidoptera: Pyraustidae
- Chrysobatys Munroe
  - cambogialis (Guenée)
- Megastes Guenée
  - cyclades (Druce)
- Mimorista Warren
  - flavidissimalis (Grote)
  - pulchellalis (Dyar)
- Noctuelia Guenée
  - elautalis Grote

Lepidoptera: Gelechiidae
- Aerotypia Walsingham
  - pleurotella Walsingham
- Metapleura Busck
  - potosi Busck

Lepidoptera· Blastobasidae
- Blastobasis Zeller, sp.

Lepidoptera: Tineidae
- Dyotopasta Busck
  - yumaella Kearfott
- Tinea Linnaeus, sp.

Lepidoptera: Gracilariidae
- Marmara Clemens
  - opuntiella Busck

Lepidoptera: Lycaenidae
- Thecla Fabricius
  - melanis Drury

Diptera: Cecidomyiidae
- Asphondylia Loew
  - arizonensis Felt (see p. 114)
  - opuntiae Felt
  - betheli Cockerell (see p. 114)
- Cecidomyia Meigen (=Itonida Felt)
  - opuntiae (Felt)
- Mayetiola Kieffer (=Phytophaga Rondani)
  - species A
  - species B
  - species C
- Neolasioptera Felt, sp.

INSECTS—Continued

Diptera: Lonchaeidae

Dasiops Rondani
saltana (Townsend)
Lonchaea Fallén
alexanderi Brèthes

Hymenoptera: Chalcididae

Rileya Ashmead
opuntiae Gahan

INSECTS—Continued

Hymenoptera: Chalcididae—Cont.

Torymus Dalman (=Callimome Spinola)
bifasciipennis (Gahan)

MITES

Acarina: Tetranychidae

Tetranychus Dufour
opuntiae Banks

Acarina: Eriophyidae

Eriophyes Von Siebold, sp.

Scavengers Feeding on Cactus

Diptera: Syrphidae

Copestylum Macquart
marginatum Say
Volucella Geoffrey
avida Osten-Sacken
deceptor (Curran)
esuriens Fabricius
eugenia Williston
fasciata Macquart
fornax Townsend
fraudulenta Williston
pusilla Macquart

Diptera: Syrphide—Cont.

Volucella Geoffrey—Continued
satur Osten-Sacken
scutellata Meigen
spinigera Wiedemann

Diptera: Stratiomyiidae

Hermetia Latreille
aurata Bellardi (= chrysophila (Loew))
illucens Linnaeus
hunteri Coquillett

Predators on Dactylopius Species

Lepidoptera: Phycitidae

Laetilia coccidivora Comstock (=Zophodia dilatifasciella Ragonot)
Laetilia coccidivora quadricolorella (Dyar) (=Valdivia quadricolorella Dyar)
Salambona analamprella (Dyar)

Coleoptera: Coccinellidae

Cybocephalus nigritulus Le Conte
Cryptolaemus montrouzieri Mulsant
Hyperaspis trilurcata Schaeffer

Coleoptera: Coccinellidae—Cont.

Hyperaspis fimbriolata Melsheimer
Scymnus hornii Gorham
Scymnus intrusus Horn

Diptera: Syrphidae

Baccha Fabricius
Salpinogaster conopida (Philippi) (=nigriventris Bigot)

Diptera: Agromyzidae

Leucopis bellula Williston

Neuroptera: Hemerobiidae

Sympherobius amiculus Fitch

Parasites of Cactus Insects

Parasites	*Hosts*
HYMENOPTERA: CHALCIDIDAE	
Brachymeria (Pseudobrachymeria) pedalis (Cresson)	Melitara Walker
"	Melitara prodenialis Walker
"	Melitara dentata (Grote)
"	Melitara doddalis Dyar
"	Olycella junctolineella (Hulst)
"	Alberada parabates (Dyar)
"	Ozamia fuscomaculella clarefacta (Dyar)
Brachymeria (Pseudobrachymeria) cactoblastidis Blanchard	Cactoblastis doddi Heinrich
Sympiesomorpha Ashmead, sp. (this could be a hyperparasite attacking *Eiphosoma* Cresson, spp.)	Mimorista flavidissimalis Grote
Torymus bifasciipennis (Gahan)	Mayetiola Kieffer, sp. C.
HYMENOPTERA: ICHNEUMONIDAE	
Temelucha sinuatus (Cushman)	Melitara prodenialis Walker
"	Melitara doddalis Dyar
Temelucha facilis (Cresson)	Melitara doddalis Dyar
Temelucha Foerster, sp.	Cahela ponderosella Barnes & McDunnough
Trichomma Wesmael, sp.	Melitara dentata (Grote)
Baryceros albosignata (Blanchard)	Nanaia substituta Heinrich
Chelonus electus (Cresson) (=texanus Cresson)	Melitara doddalis Dyar
"	Alberada parabates (Dyar)
	Ozamia fuscomaculella clarefacta Dyar
Cryptus Fabricius, sp.	Cactoblastis cactorum Berg
Podogaster Brullé, sp.	Cactoblastis cactorum Berg
Eiphosoma annulatum Cresson (=bruesi Cushman)	Mimorista flavidissimalis (Grote)
Eiphosoma texanum Cresson	"
HYMENOPTERA: BRACONIDAE	
Apanteles etiellae Viereck	Melitara prodenialis Walker
"	Cahela ponderosella (Barnes & McDunnough)
Apanteles megathymi Riley	Olycella nephelepasa (Dyar)
"	Megastes cyclades (Druce)
Apanteles cactobrosidis Blanchard	Nanaia substituta Heinrich
Apanteles alexanderi Brèthes	Cactoblastis cactorum Berg
"	Cactoblastis doddi Heinrich
"	Tucumania tapiacola Dyar
"	Salambona analamprella (Dyar)

Parasites	*Hosts*
Apanteles mimoristae Muesebeck	Mimorista flavidissimalis (Grote)
Apanteles Foerster, sp.	Olycella junctolineella (Hulst)
"	Ozamia punicans Heinrich
Bracon hebetor Say	Melitara doddalis Dyar
"	Ozamia fuscomaculella clarefacta Dyar
Vipio moneilemae Gahan	Moneilema variolare Thomson
HYMENOPTERA: ENCYRTIDAE	
Ooencyrtus ovidivorus Girault	Moneilema ulkei Horn
HYMENOPTERA: SCELIONIDAE	
Hadronotus atriscapus Gahan	Narnia pallidicornis Stål
Hadronotus Foerster, sp.	Chelinidea tabulata (Burmeister)
"	Chelinidea canyona Hamlin
"	Chelinidea vittiger Uhler
HYMENOPTERA: EULOPHIDAE	
Tetrastichus gerstaeckeriae Gahan	Gerstaeckeria porosa (LeConte)
HYMENOPTERA: PTEROMALIDAE	
Neocatolaccus moneilemae Gahan	Moneilema ulkei Horn
DIPTERA: TACHINIDAE	
Phorocera texana Aldrich & Webber	Melitara prodenialis Walker
"	Melitara dentata (Grote)
"	Melitara doddalis Dyar
"	Melitara Walker sp.
"	Olycella junctolineella (Hulst)
"	Olycella nephelepasa (Dyar)
Phorocera comstocki Williston	Melitara doddalis Dyar
"	Melitara dentata (Grote)
Phorocera Robineau-Desvoidy, sp.	Megastes cyclades (Druce)
Lespesia aletiae Riley	Olycella junctolineella (Hulst)
Lespesia Robineau-Desvoidy, sp.	Melitara prodenialis Walker
"	Megastes cyclades (Druce)
Clausicella floridensis (Townsend)	Alberada parabates (Dyar)
Epicoronimyia mundelli (Blanchard)	Cactoblastis doddi Heinrich
"	Tucumania tapiacola Dyar
Trichopoda pennipes (Fabricius)	Chelinidea tabulata (Burmeister)
"	Chelinidea canyona Hamlin
"	Chelinidea vittiger Uhler
"	Narnia pallidicornis Stal
COLEOPTERA: COLYDIIDAE	
Bothrideres cactophagi Schwarz	Catophagus spinolae (Gyllenhal)

Cactaceae and Their Associated Insects and Mites

Cactus Species	*Insect or Mite*
Acanthocereus (Berger) Britton & Rose	Moncilema mundelli Fisher
pentagonus (Linnaeus) Britton & Rose	Chelinidea tabulata (Burmeister)
Borzicactus Riccobono	Huarucus cacti Marshall
acanthurus (Vaupel) Britton & Rose	(see p. 86)
Cactus caesius (Wendland) Britton & Rose	Chelinidea tabulata (Burmeister)
Carnegiea gigantea (Engelmann) Britton & Rose	?Cactobrosis fernaldialis Hulst
Cereus [Hermann] Miller	Cactophagus spinolae (Gyllenhal) spinolae rubroniger Fisher striatoforatus Gyllenhal Chelinidea tabulata (Burmeister) Narnia pallidicornis Stål Leptoglossus cinctus (Herrich-Schaeffer) Diplacaspis echinocacti Bouché
aethiops Haworth	Dactylopius sp. near confusus Cockerell
alacriportanus Pfeiffer	Ozamia punicans Heinrich stigmaferella Dyar hemilutella Dyar
validus Haworth	Alcidion cereicola Fisher
variabilis Pfeiffer	(see p. 73)
pernambucensis Lemaire	Chrysobatys cambogialis (Guenée)
Cleistocactus Lemaire, sp.	(see p. 46)
Copiapoa cinerea (Philippi)	(see p. 113)
Coryphantha aggregata Engelmann Britton & Rose	Yosemitia graciella (Hulst)
Denmoza rhodacantha (Salm-Dyck) Britton & Rose	Cactoblastis bucyrus Dyar
Echinocactus Link & Otto	Moncilema albopicta White
Echinocereus Engelmann	Cactobrosis strigalis Barnes & McDunnough Chelinidea canyona Hamlin
polyacanthus Engelmann	Yosemitia graciella (Hulst) Eremberga leuconips (Dyar) Moncilema gigas LeConte

Cactus Species	*Insect or Mite*
Echinocereus viridiflorus Engelmann	Yosemitia graciella (Hulst)
rigidissimus (Engelmann) Rose	Cactobrosis strigalis (Barnes & McDunnough)
pectinatus (Scheidweiler) Engelmann	Cactobrosis strigalis (Barnes & McDunnough)
dasyacanthus Engelmann	Cactobrosis strigalis (Barnes & McDunnough)
Echinopsis Zuccarini	Mimorista pulchellalis (Dyar)
shaferi Britton & Rose	Cactoblastis bucyrus Dyar Alcidion cereicola Fisher
tubiflora (Pfeiffer) Zuccarini	Cactoblastis bucyrus Dyar
intricatissima Spegazzini	Dactylopius sp. near confusus Cockerell
Eulychnia acida Philippi	Sigelgaita chilensis Heinrich
Epostoa lanata (H.B.K.) Britton & Rose	Huarucus cacti Marshall
Ferocactus wislizenii (Engelmann) Britton & Rose	Cactobrosis fernaldialis (Hulst) Moneilema gigas LeConte
Hamatocactus setispinus (Engelmann) Britton & Rose	Yosemitia longipennella (Hulst)
Harrisia* martinii (Labouret) Britton & Rose	Tucumania tapiacola Dyar Chelinidea tabulata (Burmeister)
bonplandii (Parmentier) Britton & Rose	Listroderes costirostris obliquus (Klug) Tucumania tapiacola Dyar ?Mimorista Warren, sp.
pomanensis (Weber) Britton & Rose	Mimorista pulchellalis (Dyar)
guelichii (Spegazzini) Britton & Rose	Phycitid larvae
Homalocephala texensis (Hopffer) Britton & Rose	Yosemitia longipennella (Hulst)
Neomamillaria heyderi (Mühlenpfordt) Britton & Rose	Yosemitia longipennella (Hulst)
Nopalea Salm-Dyck	Cactophagus striatoforatus Gyllenhal
lutea Rose	Mimorista Warren, sp.
guatemalensis Rose	Mimorista Warren, sp.
cochenillifera (Linnaeus) Salm-Dyck	Mimorista Warren, sp. Archlagocheirus funestus (Thomson) Dactylopius coccus Costa Diplacaspis echinocacti Bouché

*Some authorities place these *Harrisia* species in *Eriocereus*.

Cactus Species	*Insect or Mite*
Nopalea—Continued	
dejecta Salm-Dyck	Dactylopius opuntiae Lichtenstein
Opuntia [Tournefort] Miller	Erelevia quantulella (Hulst) (= Eurythmia hospitella Zeller)
	Ozamia immorella (Dyar)
	Laetilia coccidivora (Comstock)
	Sosipatra anthophila (Dyar)
acanthocarpa Engelmann & Bigelow	Cahela ponderosella (Barnes & McDunnough)
aciculata Griffiths	Moneilema armata LeConte
	Dactylopius opuntiae Lichtenstein
antillana Britton & Rose	Olyca phryganoides Walker
	Mimorista flavidissimalis (Grote)
	Gerstaeckeria insulana (Fisher)
anacantha Spegazzini	Dactylopius ceylonicus Green
ammophila Small	Melitara prodenialis Walker
aoracantha Lemaire	Diplacaspis echinocacti Bouché
arbuscula Engelmann	Cahela ponderosella (Barnes & McDunnough)
	Chelinidea hunteri Hamlin
atrispina Small	Olycella subumbrella (Dyar)
	Noctuelia elautalis Grote
	Asphondylia opuntiae Felt
	Dactylopius opuntiae Lichtenstein
aurantiaca Lindley	Cactoblastis cactorum (Berg) doddi Heinrich
	Tucumania tapiacola Dyar
	Moneilema ulkei Horn
	Dactylopius sp. near confusus Cockerell
	Diplacaspis echinocacti Bouché
austrina Small	Melitara prodenialis Walker
	Gerstaeckeria hubbardi (LeConte)
	Dactylopius confusus Cockerell
basilaris Engelmann & Bigelow	Olycella subumbrella (Dyar)
	Dyotopasta yumaella Kearfott
	Chelinidea vittiger Uhler
	Dactylopius confusus? Cockerell
bernardina Engelmann	Coenopaeus palmeri LeConte
	Moneilema spoliata Horn
	Chelinidea vittiger Uhler
	Narnia snowi Van Duzee
	Dactylopius newsteadi Cockerell

263-417—68——3

Cactus Species	*Insect or Mite*
Opuntia—Continued	
boldinghii Britton & Rose	Amalafrida leithella (Dyar)
bonaerensis Spegazzini	Cactoblastis cactorum (Berg) doddi Heinrich Salambona analamprella (Dyar) Lonchaea alexanderi Brèthes Leptoglossus dentatus Berg Dactylopius ceylonicus Green
brasiliensis (Willdenow) Haworth	(see p. 72)
brunnescens Britton & Rose	Cactoblastis cactorum (Berg)
cacanapa Griffiths	Melitara bollii Zeller Ozamia fuscomaculella clarefacta Dyar Noctuelia elautalis Grote Moneilema ulkei Horn armata LeConte Asphondylia opuntiae Felt Chelinidea canyona Hamlin Dactylopius opuntiae Lichtenstein
cañada Griffiths	Megastes cyclades (Druce) Asphondylia opuntiae Felt
cantabrigiensis Lynch	Olycella nephelepasa Dyar Megastes cyclades (Druce) Aerotypia pleurotella Walsingham Moneilema variolare Thomson Cactophagus spinolae Gyllenhal Asphonylia opuntiae Felt Chelinidea tabulata (Burmeister) Dactylopius opuntiae Lichtenstein Tetranychus opuntiae Banks
canina Spegazzini	Tucumania tapiacola Dyar
canterae Arechavaleta	Cactoblastis cactorum (Berg)
caribaea Britton & Rose	Mimorista flavidissimalis (Grote)
catacantha Link & Otto	(see p. 140)
cordobensis Spegazzini	Cactoblastis cactorum (Berg) Lonchaea alexanderi Brèthes
chlorotica Englemann & Bigelow	(see p. 76)
covillei Britton & Rose	Asphondylia opuntiae Felt Narnia snowi Van Duzee
davisii Engelmann & Bigelow	Disonycha varicornis Horn
decumbens Salm-Dyck	Cactophagus spinolae var. validus LeConte
delaetiana Weber	Cactoblastis cactorum (Berg)

Cactus Species	*Insect or Mite*
Opuntia—Continued	
dillenii (Ker-Gawler) Haworth	Melitara prodenialis Walker
	Olyca phryganoides Walker
	Ozamia lucidalis (Walker)
	Mimorista flavidissimalis (Grote)
	Gerstaeckeria hubbardi (LeConte)
	cubaecola (Fisher)
	insulana (Fisher)
	Cecidomyia opuntiae (Felt)
	Chelinidea vittiger Uhler
	Dactylopius opuntiae Lichtenstein
	confusus Cockerell
discata Griffiths	Megastes cyclades (Druce)
	Asphondylia opuntiae Felt
	Chelinidea vittiger Uhler
discolor Britton & Rose	Cactoblastis cactorum (Berg)
	Tucumania tapiacola Dyar
	Mimorista pulchellalis (Dyar)
	Dactylopius sp. near confusus Cockerell
	ceylonicus Green
durangensis Britton & Rose	Tetranychus opuntiae Banks
echinocarpa Engelmann & Bigelow	Cahela ponderosella (Barnes & McDunnough)
	Moneilema spoliata Horn
	Chelinidea vittiger Uhler
	Dactylopius newsteadi Cockerell
elata Link & Otto	Lonchaea alexanderi Brèthes
elatior Miller	Amalafrida leithella (Dyar)
	Cecidomyia opuntiae (Felt)
	Dactylopius opuntiae Lichtenstein
engelmannii Salm-Dyck	Melitara doddalis Dyar
	Olycella subumbrella (Dyar)
	Noctuelia elautalis Grote
	Moneilema armata LeConte
	gigas LeConte
	laevigata Bland
	Cactophagus spinolae (Gyllenhal)
	Asphondylia opuntiae Felt
	Chelinidea canyona Hamlin
	vittiger Uhler
	Narnia pallidicornis Stål
	snowi Van Duzee
	Dactylopius opuntiae Lichtenstein

Cactus Species	*Insect or Mite*
Opuntia—Continued	
exaltata Berger	Nanaia substituta Heinrich
	Cactoblastis mundelli Heinrich
	Huarucus cacti Marshall
ficus-indica (Linnaeus) Miller	Cactoblastis cactorum (Berg) doddi Heinrich
	Sigelgaita huanucensis Heinrich
	Thecla melanis Drury
	Huarucus cacti Marshall
	Cactophagus spinolae (Gyllenhal) spinolae var. rubroniger Fisher
	fahraei (Gyllenhal)
	Cylindrocopturus biradiatus Champion
	Lonchaea alexanderi Brèthes
	Narnia pallidicornis Stål
	Dactylopius coccus Costa
	opuntiae Lichtenstein
	Diplacaspis echinocacti Bouché
fragilis (Nuttall) Haworth	Melitara dentata (Grote)
fulgida Engelmann	Alberada parabates (Dyar)
	Noctuelia elautalis Grote
	Coenopaeus palmeri (LeConte)
	Moneilema gigas LeConte
	pollens Casey
	Onychobaris mystica Casey
	Disonycha varicornis Horn
	Chelinidea hunteri Hamlin
	Narnia pallidicornis Stål
	Dactylopius newsteadi Cockerell
fuliginosa Griffiths	Megastes cyclades (Druce)
	Cactophagus spinolae var. validus LeConte
	Dactylopius opuntiae Lichtenstein
fuscoatra Engelmann	Olycella junctolineella (Hulst)
	Mayetiola Kieffer, sp.
galapageia Henslow	Beebea guglielmi Schaus
grahamii Engelmann	Dactylopius newsteadi Cockerell
grandiflora Engelmann	Olycella junctolineella (Hulst)
glomerata Haworth	Leptoglossus dentatus Berg
	Diplacaspis enchinocacti Bouché
hyptiacantha Weber	Megastes cyclades (Druce)
	Archlagocheirus funestus (Thomson)

Cactus Species	*Insect or Mite*
Opuntia—Continued	
hyptiacantha—Continued	Moneilema variolare Thomson
	Cactophagus spinolae (Gyllenhal)
	spinolae var. rubroniger Fisher
	fahraci (Gyllenhal)
imbricata (Haworth) DeCandolle	Asphondylia opuntiae Felt
	Dactylopius opuntiae Lichtenstein
	Alberada parabates (Dyar)
	Cahela ponderosella (Barnes & McDunnough)
	Noctuelia elautalis Grote
	Coenopaeus palmeri (LeConte)
	Moneilema variolare Thomson
	rugosipennis Fisher
	armata LeConte
	laevigata Bland
	obtusa LeConte
	Disonycha varicornis Horn
	Asphondylia opuntiae Felt
	Chelinidea tabulata (Burmeister)
	vittiger Uhler
	Narnia pallidicornis Stål
	snowi Van Duzee
	Dactylopius newsteadi Cockerell
	Diplacaspis echinocacti Bouché
	Tetranychus opuntiae Banks
inamoena Schumann	Leptoglossus cinctus (Herrich-Schaeffer)
inermis DeCandolle	Melitara prodenialis Walker
	bollii (Zeller)
	dentata (Grote)
	Olycella junctolineella (Hulst)
	Cactoblastis cactorum (Berg)
	doddi Heinrich
	Tucumania tapiacola Dyar
	Metapleura potosi Busck
	Archlagocheirus funestus (Thomson)
	Moneilema ulkei Horn
	annulata Say
	Gerstaeckeria nobilis LeConte
	Asphondylia opuntiae Felt
	Chelinidea tabulata (Burmeister)
	canyona Hamlin
	vittiger Uhler

Cactus Species	*Insect or Mite*
Opuntia—Continued	
inermis—Continued	Dactylopius opuntiae Lichtenstein
	Diplacaspis echinocacti Bouché
	Tetranychus opuntiae Banks
	Eriophyes Von Siebold, sp.
jamaicensis Britton & Rose	Mimorista flavidissimalis (Grote)
kiskaloro Spegazzini	Tucumania tapiacola Dyar
kleiniae DeCandolle	Moneilema armata LeConte
	Disonycha varicornis Horn
	Dactylopius newsteadi Cockerell
lasiacantha Pfeiffer	Megastes cyclades (Druce)
	Metapleura potosi Busck
	Aerotypia pleurotella Walsingham
	Archlagocheirus funetus (Thomson)
	Moneilema albopicta White
	Cactophagus spinolae (Gyllenhal)
lata Small	Melitara prodenialis Walker
	Chelinidea vittiger Uhler
leptocaulis DeCandolle	Alberada holochlora (Dyar)
	Rumatha glaucatella (Hulst)
	polingella (Dyar)
	Mimorista flavidissimalis (Grote)
	Moneilema laevigata Bland
	Onychobaris mystica Casey
	Gerstaeckeria clathrata (LeConte)
	Disonycha varicornis Horn
	Asphondylia opuntiae Felt
	Rileya opuntiae Gahan
	Chelinidea vittiger Uhler
	Narnia pallidicornis Stål
	Dactylopius newsteadi Cockerell
	Tetranychus opuntiae Banks
leucotricha DeCandolle	Megastes cyclades (Druce)
	Dactylopius opuntiae Lichtenstein
lindheimeri Engelmann	Melitara prodenialis Walker
	bollii (Zeller)
	Olycella junctolineella (Hulst)
	Ozamia fuscomaculella clarefacta Dyar
	Megastes cyclades (Druce)
	Noctuelia elautalis Grote
	Mimorista flavidissimalis (Grote)
	Coenopaeus palmeri (LeConte)
	Parmenosoma griseum Schaeffer

Cactus Species	*Insect or Mite*
Opuntia—Continued	
lindheimeri—Continued	Moneilema ulkei Horn
	armata LeConte
	laevigata Bland
	crassa LeConte
	mundelli Fisher
	Gerstaeckeria doddi Fisher
	porosa (LeConte)
	nobilis LeConte
	Disonycha varicornis Horn
	Asphondylia opuntiae Felt
	Cecidomyia opuntiae (Felt)
	Mayetiola Kieffer, sp.
	Chelinidea tabulata (Burmeister)
	canyona Hamlin
	vittiger Uhler
	Narnia pallidicornis Stål
	snowi Van Duzee
	Hesperolabops picta Hunter, Pratt, & Mitchell
	Dactylopius opuntiae Lichtenstein
	Diplacaspis echinocacti Bouché
	Tetranychus opuntiae Banks
littoralis (Engelmann) Cockerell	Ozamia fuscomaculella (Wright)
	Asphondylia opuntiae Felt
	Dactylopius opuntiae Lichtenstein
macbridei Britton & Rose	(see p. 104)
macdougaliana Rose	Huarucus cacti Marshall
	Dactylopius opuntiae Lichtenstein
mackensenii Rose	Melitara prodenialis Walker
macrocentra Engelmann	Olycella subumbrella (Dyar)
	Noctuelia elautalis Grote
	Narnia snowi Van Duzee
	Dactylopius opuntiae Lichtenstein
macrorhiza Engelmann	Olycella junctolineella (Hulst)
mamillata Schott	Chelinidea hunteri Hamlin
megacantha Salm-Dyck	Cactophagus spinolae (Gyllenhal)
	Narnia femorata Stål
	Dactylopius opuntiae Lichtenstein
microdasys (Lehmann) Pfeiffer	Olycella junctolineella (Hulst)
	Dactylopius opuntiae Lichtenstein
missouriensis DeCandolle	(see p. 2)
monacantha Haworth	Cactoblastis cactorum (Berg)

Cactus Species	*Insect or Mite*
Opuntia—Continued	
monacantha—Continued	Ozamia hemilutella Dyar
	Chrysobatys cambogialis (Guenée)
	Lonchaea alexanderi Brèthes
	Leptoglossus dentatus Berg
	cinctus (Herrich-Schaeffer)
	Dactylopius opuntiae Litchenstein
	ceylonicus Green
nigricans Haworth	Dactylopius opuntiae Lichtenstein
occidentalis Engelmann & Bigelow	Chelinidea vittiger Uhler
	Narnia pallidicornis Stål
palmadora Britton & Rose	(see p. 74, 140, 141)
parryi Engelmann	Cahela ponderosella (Barnes & McDunnough)
phaeacantha Engelmann	Melitara doddalis Dyar
	Olycella subumbrella (Dyar)
	Noctuelia elautalis Grote
	Moneilema armata LeConte
	laevigata Bland
	Asphondylia opuntiae Felt
	Chelinidea canyona Hamlin
	vittiger Uhler
	Narnia pallidicornis Stål
	snowi Van Duzee
	Dactylopius opuntiae Lichtenstein
polyacantha Haworth	Melitara dentata (Grote)
	Olycella subumbrella (Dyar)
	Moneilema annulata Say
	Chelinidea vittiger Uhler
	Dactylopius confusus Cockerell
prolifera Engelmann	Alberada parabates (Dyar)
	Ozamia thalassophila Dyar
quimilo Schumann	Cactoblastis cactorum (Berg)
	doddi Heinrich
	Tucumania tapiacola Dyar
	Ozamia hemilutella Dyar
	Mimorista pulchellalis (Dyar)
	Lonchaea alexanderi Brèthes
	Leptoglossus dentatus Berg
	Dactylopius ceylonicus Green
	Diplacaspis echinocacti Bouché
retrorsa Spegazzini	Cactoblastis cactorum (Berg)
	Olycella nephelepasa (Dyar)

Cactus Species	*Insect or Mite*
Opuntia—Continued	
robusta Wendland	Megastes cyclades (Druce) Aerotypia pleurotella Walsingham Moncilema variolare Thomson Gerstaeckeria unicolor (Fisher) Cactophagus spinolae (Gyllenhal) Cecidomyia opuntiae (Felt) Narnia femorata Stål Dactylopius opuntiae Lichtenstein Tetranychus opuntiae Banks
rufida Engelmann	Olycella junctolineella (Hulst)
russellii Britton & Rose	Cactoblastis doddi Heinrich Tucumania Dyar, sp. Dactylopius sp. near confusus Cockerell
salmiana Parmentier	Cactoblastis cactorum (Berg) Tucumania tapiacola Dyar Chrysobatys cambogialis (Guenée) Dactylopius ceylonicus Green
schumannii Weber	Amalfrida leithella (Dyar)
serpentina Engelmann	Cahela ponderosella (Barnes & McDunnough) Chelinidea vittiger Uhler Narnia snowi Van Duzee
spinosior (Engelmann) Tourney	Cahela ponderosella (Barnes & McDunnough) Coenopaeus palmeri (LeConte) Cactophagus spinolae var. validus LeConte Dactylopius newsteadi Cockerell
spinosissima Miller	Olyca phryganoides Walker Ozamia lucidalis (Walker)
stanlyi Engelmann	Noctuelia elautalis Grote Dactylopius newsteadi Cockerell
stenarthra Schumann	Tucumania Dyar, sp.
streptacantha Lemaire	Olycella junctolineella (Hulst) nephelespasa (Dyar) Cactoblastis cactorum (Berg) doddi Heinrich Megastes cyclades (Druce) Metapleura potosi Busck Aerotypia pleurotella Walsingham Archlagocheirus funestus (Thomson)

Cactus Species	*Insect or Mite*
Opuntia—(Continued)	
streptacantha—(Continued)	Moneilema ulkei Horn
	variolare Thomson
	Cylindrocopturus biradiatus Champion
	Cactophagus spinolae (Gyllenhal)
	Asphondylia opuntiae Felt
	Neolasioptera Felt, sp.
	Chelinidea tabulata (Burmeister)
	Narnia pallidicornis Stål
	Hesperolabops picta Hunter, Pratt, & Mitchell
	Dactylopius coccus Costa
	opuntiae Lichtenstein
	Diplacaspis echinocacti Bouché
stricta Haworth	Melitara prodenialis Walker
	dentata (Grote)
	Olycella junctolineella (Hulst)
	Cactoblastis cactorum (Berg)
	doddi Heinrich
	Moneilema ulkei Horn
	Asphondylia opuntiae Felt
	Chelinidea tabulata (Burmeister)
	canyona Hamlin
	Dactylopius opuntiae Lichtenstein
	Diplacaspis echinocacti Bouché
	Tetranychus opuntiae Banks
sulphurea G. Don in Loudon	Cactoblastis doddi Heinrich
	Tucumania tapiacola Dyar
	Salambona analamprella (Dyar)
	Mimorista pulchellalis (Dyar)
	Thecla melanis Drury
	Lonchaea alexanderi Brèthes
	Leptoglossus dentatus Berg
	Dactylopius sp. near confusus Cockerell
	Diplacaspis echinocacti Bouché
taylori Britton & Rose	(see p. 140)
tenuispina Engelmann	Noctuelia elautalis Grote
tomentosa Salm-Dyck	Olycella nephelepasa (Dyar)
	Cactoblastis cactorum (Berg)
	doddi Heinrich

Cactue Species	*Insect or Mite*
Opuntia—Continued	
tomentosa—Continued	Megastes cyclades (Druce)
	Metapleura potosi Busck
	Aerotypia pleurotella Walsingham
	Archlagocheirus funestus Thomson
	Moneilema ulkei Horn
	Cylindrocopturus biradiatus Champion
	Cactophagus spinolae (Gyllenhal)
	Mayetiola Kieffer, sp.
	Torymus bifasciipennis (Gahan)
	Chelinidea tabulata (Burmeister)
	Dactylopius coccus Costa
	opuntiae Lichtenstein
	Diplacaspis echinocacti Bouché
	Tetranychus opuntiae Banks
tortispina Engelmann	Melitara prodenialis Walker
	dentata (Grote)
	doddalis Dyar
	Olycella junctolineella (Hulst)
	subumbrella (Dyar)
	Moneilema annulata Say
	nigriventris Fisher
	Gerstaeckeria basalis (LeConte)
	Asphondylia opuntiae Felt
	Chelinidea vittiger Uhler
	Dactylopius opuntiae Lichtenstein
	confusus Cockerell
tracyi Britton	Melitara prodenialis Walker
	Dactylopius confusus Cockerell
tuna (Linnaeus) Miller	Mimorista flavidissimalis (Grote)
tunicata (Lehmann) Link & Otto	Nanaia substituta Heinrich
	Cactophagus spinolae var. rubroniger Fisher
utkilio Spegazzini	Cactoblastis cactorum (Berg)
	doddi Heinrich
	Tucumania tapiacola Dyar
	Salambona analamprella (Dyar)
	Leptoglossus dentatus Berg
	Dactylopius sp. near confusus Cockerell
	ceylonicus Green
vaseyi (Coulter) Britton & Rose	Asphondylia opuntiae Felt
	Narnia snowi Van Duzee

Cactus Species	*Insect or Mite*
Opuntia—Continued	
versicolor Engelmann	Coenopaeus palmeri (LeConte) Disonycha varicornis Horn Chelinidea hunteri Hamlin
weberi Spegazzini	Dactylopius sp. near confusus Cockerell
wetmorei Britton & Rose	Dactylopius sp. near confusus Cockerell
whipplei Engelmann & Bigelow	Alberada parabates (Dyar) Cahela ponderosella (Barnes & McDunnough) Dactylopius newsteadi Cockerell
wilcoxii Britton & Rose	Cactophagus spinolae var. validus LeConte
Peniocereus greggii (Engelmann) Britton & Rose	?Cactobrosis fernaldialis Hulst
Pereskia sacharosa Grisebach	Chrysobatys cambogialis (Guenée)
Rhipsalis Gaertner	Diplacaspis echinocacti Bouché
Stetsonia Britton & Rose	Alcidion cereicola Fisher Leptoglossus dentatus Berg
Trichocereus (Berger) Riccobono	Sigelgaita transilis Heinrich Tricorynus Waterhouse, sp. Leptoglossus dentatus Berg
terscheckii (Parmentier) Britton & Rose	Cactoblastis bucyrus Dyar
chiloensis (Colla) Britton & Rose	Sigelgaita chilensis Heinrich
cuzcoensis Britton & Rose	Nanaia substituta Heinrich

CACTUS FEEDERS AND SCAVENGERS

LEPIDOPTERA

The larvae of the various Lepidoptera are internal feeders. The great majority of the species are included in the family Phycitidae; the remainder comprise one species of Pyralidae, five species of Pyraustidae, two species of Gelechiidae, one or possibly two species of Tineidae, and one of Gracilariidae. Also included are one species of Lycaenidae, which may not be restriced to cactus hosts, and undetermined representatives of several other families (see pp. 86–87).

Phycitidae

This is the dominant group of cactus insects, comprising at least 47 species. The cactus-feeding phycitids were revised by Carl Heinrich in 1939 and the American species were later treated by him (1956) in his monograph on the New World Phycitinae. In his valuable 1939 contribution, several new genera were erected for species previously placed in older genera, and in it he recognized 18 genera, 46 species, and 2 varieties. Of his 48 species and varieties, 11 are known from adults only; hence their larval feeding habits have not been established. They are so closely related to species definitely known to be cactus insects, however, that it can be assumed that they are true cactus forms. There are 35 species whose larval food habits have been ascertained; to these must be added several species known from larvae only, or from one or two undescribed adults.

In this publication, the names and synonymy of Heinrich's (1956) paper have been adopted, although two forms of *Melitara*, considered by Heinrich to be synonyms, have been maintained as separate entities. In all, 40 cactus phycitids are here recognized and discussed; an additional 11 species known only from adults are noted but not recognized. Other phycitids found in association with cactus are also mentioned. As has been mentioned earlier, many more species will probably be discovered in this group when greater attention is paid to the insect enemies of cacti other than *Opuntia*, especially in Mexico, Central America, and northern South America. Several solitary forms have been found in various species of Cereanae in Brazil and Argentina.

The larvae are either solitary or gregarious in habit. Among the gregarious forms the most interesting are the species of *Melitara* and *Cactoblastis*, since the females deposit the eggs in the form of chains, or sticks, to which the term "eggstick" is generally applied; the eggsticks may contain as many as 150 eggs, although the usual number is from 35 to 80. The species of *Melitara* occur throughout the United States prickly pear region, except in California; thus distribution extends into northern Mexico but apparently does not reach the great cactus region of the Central Plateau nor the eastern and western coastal strips; the larvae are blue, blue-grey, or blackish-blue in color. The genus *Cactoblastis*, with almost identical larval, pupal, and egg-laying habits, is found in southern Peru, southern Brazil, Paraguay, Uruguay, and Argentina; the larvae are bright orange or orange-red with transverse rows of black spots. In the great intervening region between northern Mexico, southern Peru, and southern Brazil, no gregarious phycitid of the *Melitara-Cactoblastis* egg-laying habit is known. The species of *Olycella*, inhabiting the United States and the greater part of Mexico, deposit eggsticks, but these are shorter and contain many fewer eggs, usually 8 to 12, very rarely up to 30; the larvae are gregarious in their young stages, but soon become solitary. Insofar as is known all other cactus phycitids deposit their eggs singly or two or three together.

LAETILIA Ragonot

Laetilia coccidivora (Comstock)

This insect is a well-known enemy of various Coccidae in the United States and is a common predator of *Dactylopius* species. Apparently, however, the larvae occasionally vary their diet, since adults have been reared from larvae feeding in *Opuntia* flowers at Uvalde, Texas.

MELITARA Walker

This genus appears to be restricted to the United States and northern Mexico. The larvae are gregarious tunnellers in various Platyopuntias. In color they vary from light grey-blue to black-blue, assuming a shade of intense translucent blue immediately prior to pupation; larvae of *M. prodenialis* are usually darker than those of the other forms. The cocoons are of the typical *Cactoblastis* type, to be described on page 49; those of *M. prodenialis* tend to be less stoutly constructed than are those of the other species. They are found among debris at the base of or near the attacked plants, in dried-out prickly pear segments, or, in one form, within the feeding cavities made by the larvae. The adults have a wing expanse of 30 to 50 mm. As with *Cactoblastis*, the

eggs are laid in chains or "sticks," which are attached to the spines or spicules of the *Opuntia* plant.

Heinrich (1956) recognizes two species: *M. prodenialis* and *M. dentata*. However, in this publication four species or forms are kept separate. Efforts to establish these four insects in Australia were unsuccessful.

Melitara prodenialis Walker

During the Board's investigations, this species was found along the whole length of the coastline of Florida except in the Florida Keys; at Biloxi, Mississippi; from New Orleans along the gulf coast to Corpus Christi, Texas; and at a few inland localities in the eastern half of Texas. Its distribution is known to extend from Florida north along the Atlantic coast as far as New York State.

Considerable attention was devoted to *M. prodenialis* both in Florida and on the gulf coast of Texas. The Florida and Texas forms present certain differences in character that may constitute racial distinction. There are three generations a year in Florida, two in Texas. The Texas moths are somewhat lighter in color; the females are more prolific, and the eggsticks contain, on an average, a greater number of eggs. Furthermore, in breeding operations in Australia, the Florida form was reared much more readily on *Opuntia stricta* than on *O. inermis*, whereas the Texas insect made better progress on the latter plant.

The Florida form attacks a wide variety of prickly pears, including the shrub, or bush, pears *Opuntia stricta*, *O. dillenii*, and *O. ammophila*, the low-growing *O. austrina* and *O. lata*, and the narrow-jointed *O. tracyi*. It is prevalent in many areas, as between Miami and Fernandina on the east coast, and around Hudson on the west coast. The larvae frequently cause considerable destruction especially to the very succulent prickly pears *O. austrina* and *O. tracyi*. The winter generation larvae produce moths in March and April; adults of the first summer generation emerge in June, and those of the second summer generation from late August to early October. Each female usually deposits between 30 and 50 eggs; on one occasion an average of 60 eggs per female was obtained from a number of individuals. The eggsticks contain an average number of 30 eggs; however, 40 eggs in a stick is not uncommon; rarely does the number reach 50.

In Texas, the species occurs generally along the coastal strip from the Louisiana boundary to Corpus Christi and is very abundant in the vicinity of Galveston. It has not been observed around Brownsville. To the south of Galveston the distribution does not appear to extend inland for a greater distance than 25 miles. On the other hand, it has been found in the north-central portion of the State near Dallas and at Alvarado in Johnston County. Furthermore, it inhabits the foothills

and valley of the Rio Frio, northeast of Uvalde, although it has not been recorded from the open country between and south of Uvalde and San Antonio, where one of its food plants *Opuntia lindheimeri* is so common. The host plants include the bush prickly pears *O. lindheimeri* and *O. inermis* and low-growing plants such as *O. mackensenii*, *O. tortispina* and relations. The winter generation yields adults from late April to early June, while moths of the summer generation appear from late August to October. In breeding work in Australia, the egg average per female from many examples usually varied between 40 and 75; but in one instance 424 females deposited an average of 103 eggs each. In Texas, an average of 75 eggs per female was obtained from 3,180 females, and on another occasion a number of females laid an average number of 86 eggs. The greatest number of eggs secured from one individual has been 133, and the largest number of eggs counted in a stick has been 91.

PARASITES.—In Texas, three species of parasites, viz., the tachinid *Phorocera texana*, the ichneumon *Temelucha sinuatus*, and the chalcid *Brachymeria* (*Pseudobrachymeria*) *pedalis* attack the pupae of *Melitara* and other cactus phycitids. In Florida, two other enemies of *M. prodenialis* are the tachinid *Lespesia* sp. and the braconid *Apanteles etiellae*.

Melitara dentata (Grote)

Heinrich (1956) has included *M. doddalis* Dyar as a synonym of this species. However, as the two were regarded as distinct forms during the Board's investigations, and as there appeared to be certain differences between the more northern *dentata* and the more southern *doddalis*, they will be treated separately.

The typical *M. dentata* moths of Colorado tend to be larger, with the forewings more uniformly grey and less suffused with darker markings than those of *doddalis*. The full-grown larvae of the former insect are a more intense clear blue and are the most beautiful of the genus; they seem to crawl freely at pupation time and do not spin cocoons in clusters at the base of the plants, as is the habit of *doddalis* and *prodenialis*. The cocoons of *dentata* are stouter and more compactly woven than those of the other three forms.

M. dentata is distributed at elevations of from 2,500 to 7,000 feet from the Panhandle of Texas, northward through western Kansas, Colorado, western Nebraska, and Wyoming to the border of Montana, thence southward through Idaho and Utah to the plateau of northern Arizona, and to Mexico. It has been recorded also from British Columbia, Canada. Throughout its range it is prevalent and often

extremely abundant. The host plants are the low-growing prickly pears *O. tortispina*, *O. polyacantha*, *O. fragilis*, and their relations. Efforts at Uvalde, Texas, to rear the larvae in the bushy *O. lindheimeri* and *O. atrispina* were unsuccessful; however, in Australia this insect completed its life cycle on *O. inermis* and *O. stricta*.

The larvae cause serious injury to the low-growing prickly pears. Individual plants are destroyed completely, and whole fields of *Opuntia tortispina* and *O. polyacantha* are severely damaged. As they develop, the colonies of larvae tunnel through the plant and split up into smaller groups, so that it is not uncommon to find not more than two or three large larvae in each attacked segment. Since the larvae crawl considerable distances at pupation time, the cocoons are not readily located in numbers, even in areas where the insect is prevalent.

There is one generation annually. Pupation occurs in June and July, and moth emergence in July and August. In late June and early July 1926 the life cycle was more advanced on the western than on the eastern side of the Rocky Mountain system; thus, in Kansas, eastern Colorado, and Wyoming the larvae were not full grown, whereas in Idaho and Utah all larvae had pupated. In 1925 moths from northern Arizona emerged during the period July 6 to 18, and those from eastern Colorado from August 21 to 31. The following year, moths from eastern Colorado emerged from July 30 to August 30. Probably the females are capable of laying as many as 200 eggs. The following records were obtained from various lots of material:

Number of females	*Average number of eggs deposited by each*
168	79
36	112
185	116
26	173

The eggsticks contain an average number of 30 to 40 eggs; the highest record has been a stick of 92 eggs. An incubation period of 9 days was obtained at Uvalde, Texas, in July.

PARASITES.—The following natural enemies have been bred from the pupal stage: The tachinids *Phorocera texana* and *P. comstocki*, the chalcid *Brachymeria* (*Pseudobrachymeria*) *pedalis*, the ichneumon *Trichomma* sp., and an undetermined braconid.

Melitara doddalis Dyar

Heinrich (1956) places this as a synonym of *M. dentata* Grote; this form, however, which was described in 1925 from material collected at Mesilla Park, New Mexico, has a wide distribution from the plateau

of western Texas to southern Arizona. The eastern limits of its range appear to extend from Henrietta, on the Oklahoma boundary, due south to Austin, thence in a westerly direction along the edge of the plateau to Rocksprings, and south to the Rio Grande in the foothills country west of Del Rio. It occurs right across western Texas from the Panhandle in the north to El Paso, through the greater part of New Mexico except the northern portion, and in southern Arizona. In southern Arizona, the western limit would seem to be the Quijotoa Mountains between Tucson and Ajo; from New Mexico the insect extends southward through the Mexican State of Chihuahua to its southern boundary.

The food plants comprise the bushy prickly pears *Opuntia engelmannii*, *O. phaeacantha*, and various other related species, and low-growing plants of the *O. tortispina* group. The species is prevalent in various parts of its extensive distribution. In west-central Texas it is often abundant on the Edwards Plateau especially around Marble Falls and in the Albany–Sweetwater region. Farther west, Fort Stockton is a favored area. In New Mexico, it is not uncommon at Mesilla Park and Silver City, while at Douglas, in the southeastern corner of Arizona, colonies of larvae were numerous in an extensive area of approximately 60 square miles of a low-growing *Opuntia* of the *tortispina* type. In the Tucson sector of southern Arizona, the species is rarely found in prickly pears growing in the open mesa country, but occurs rather freely in many places in the foothills and lower valleys of the various mountain ranges.

The larvae cause considerable injury. As they frequently tunnel downward into the basal segments, well-grown bushy plants are often killed completely. In west-central Texas this insect appears to exercise an important controlling effect on Platyopuntias.

There is one generation annually. Pupation takes place in August and September, and moth emergence from late August to the end of October. The females usually deposit in excess of 100 eggs. In 1928 material from various localities yielded an average of from 116 to 128 eggs per female. Other records of averages are:

Number of females	*Average number of eggs deposited by each*
132	110
40	129
261	64
10	137

The last record was obtained from moths that emerged at Uvalde, Texas, from pupae collected in Chihuahua, Mexico. Eggsticks deposited under cage conditions gave an average of 45 eggs per stick; the largest contained 96 eggs.

The incubation period in September and October occupies 12 to 19 days. The young larvae develop slowly during winter; active feeding commences in April. Much difficulty was encountered in attempting to rear this insect in cages at Uvalde, Texas. The young larvae survived the winter months, but invariably succumbed to disease in the spring and summer. Large larve, collected from the field and housed at Uvalde in July and August, often suffered the same fate. Similarly, efforts to establish the species in Australia were abortive, since the larvae died rapidly during humid weather. *M. doddalis* inhabits regions having 10 to 15 inches of rainfall; the annual precipitation at Uvalde and at the Australian rearing stations is approximately 25 inches.

PARASITES.—Pupal parasites include the tachinids *Phorocera texana* and *P. comstocki;* the ichneumons *Temelucha sinuatus*, *T. facilis*, and *Chelonus electus;* and the chalcid *Brachymeria* (*Pseudobrachymeria*) *pedalis*. The braconid *Bracon hebetor* attacks the larvae of this and other cactus phycitids in cages.

Melitara Walker, sp.

This form from southern Texas has been known to the Board's Officers as *Melitara bollii* (Zeller). Heinrich states that the true *bollii* is a synonym of *M. prodenialis* Walker, and in his 1939 monograph included *bollii* under *prodenialis*. In a letter (1939), however, he expressed the opinion quoted below, which he further amplified in his 1956 monograph (p. 241):

> Recently Mr. Leith Hitchcock sent us a large number of specimens representing the rearing experiments in connection with your prickly-pear investigations. Among them was a series from Uvalde, Texas, labelled *Melitara bollii* and evidently what you wanted to separate from *prodenialis* as at least a distinct race. I understand now your position. They are part of what Dyar included under his *doddalis* and which I have identified as *dentata* Grote (equals *doddalis*) from various Texas localities. They are in fact only a south Texas form of Grote's species. I do not think that we are justified (with our present knowledge) in separating the south Texas specimens from *dentata* even as a local race; but in any event the name *bollii* could not be applied to them.

The recognition of this insect as a distinct species or race is based on the fact that it differs from *M. prodenialis*, *M. dentata*, and *M. doddalis* in one interesting larval habit and to a lesser degree in its choice of pupation sites. On hatching from the eggs in October and November, the larvae from one eggstick form a small cell, of one-half inch to one inch diameter, near the margin (usually the upper margin) of the prickly pear segment. This cell is indicated externally by the dead cuticle. The larvae remain in the cell throughout winter and must

consume a minimum quantity of food since they are still very small in April. They become more active during that month and begin to tunnel farther into the segment, but growth is not rapid. They are about half grown in July, when development accelerates, and full growth is reached in late August. The larvae of the other three species do not possess this habit of remaining semiquiescent in a small cell, but develop steadily, if rather slowly, during the winter months. The cocoons of the unnamed form are usually found in the larval feeding cavities, whether in destroyed or green segments.

Unlike the other species, which are widely distributed, this insect has a restricted range. It occurs from a line drawn from Uvalde to San Antonio, Texas, south to the Rio Grande between Eagle Pass and Rio Grande City, and for a distance of about 50 miles south of the Rio Grande on the Mexican side of the border between the two last-named towns. It has not been found in the coastal belt of southern Texas east of long. 98° W., and its range to the west and northwest does not extend into the foothills bordering the plateau of west Texas.

The host plants are the closely allied bush prickly pears *Opuntia lindheimeri* and *O. cacanapa*. The former plant is very prevalent in the Uvalde–San Antonio–Rio Grande sector, where it grows profusely in large fields. Despite the abundance of its food plant, the insect is not particularly common. Colonies of larvae are generally found in scattered plants among hundreds of noninfested plants. Occasionally it has been comparatively numerous in local areas near Laredo and at a few other points.

As in the case of *M. dentata* and *M. doddalis*, there is an annual generation. Pupation takes place in late August and in September, and moth emergence from late September to early November. The females usually deposit an average of 60 to 75 eggs; for example: 125 females laid an average of 70 eggs 167 – 73 and 310 – 69. The average number of eggs in a stick is 40 to 50; the highest count on record has been 110 eggs in one stick. The incubation period may be as short as 10 days in early October, but for eggs deposited in late October and early November the duration may be prolonged to as much as 44 days, the larvae hatching in the first half of December.

In the more robust bush prickly pears such as *Opuntia lindheimeri* and *O. inermis*, the larvae of this insect, of *M. doddalis*, and of the Texas form of *M. prodenialis*, tunnel downward from segment to segment, maintaining a clear communication channel from the lower to the upper parts of the plant. They rarely leave their internal situation unless the food supply becomes exhausted. *Cactoblastis cactorum*, on the other hand, prefers to vacate a segment to seek a new location on the plant rather than to tunnel through from upper to lower seg-

ments, except during the winter months. This southern Texas *Melitara* does not appear to be as destructive to prickly pears as *M. doddalis* and *M. prodenialis.*

PARASITES.—Natural enemies reared from the pupae are the tachinid *Phorocera texana*, the ichneumons *Temelucha sinuatus* and *Chelonus electus*, and the chalcid *Brachymeria* (*Pseudobrachymeria*) *pedalis.*

OLYCELLA Dyar

This genus is restricted in distribution to the United States and Mexico. The larvae are white with broad transverse bands which are generally dark blue or blue-black; the color intensifies in the later stages, and the full-grown larvae are strikingly handsome. In *O. subumbrella* (Dyar), the bands are a light purple and are frequently so pale that the larva appears almost wholly white. The eggs are deposited in short sticks, containing from 3 or 4 to a maximum of 30 eggs. The larvae are gregarious in the early stages but are solitary for the greater part of their development. The host plants are various Platyopuntias; other cacti have not been recorded as food plants.

Heinrich recognises three species and one rather doubtful subspecies: *O. junctolineella* (Hulst) from southern Texas, *O. subumbrella* (Dyar) from western United States, *O. nephelepasa* (Dyar) from the Central Plateau of Mexico, and *O. junctolineella pectinatella* (Hampson) from Vera Cruz. The Board's officers have encountered *Olycella* larvae over the major portion of the western half of the United States and throughout Mexico. However, as adults were not obtained from material found in California, the west coast of Mexico, and southern Mexico, identity was not established in these cases. The three recognized species are characterized as follows:

O. junctolineella. Southern Texas and northeastern Mexico. Larvae banded with dark blue; they close the entrance to the feeding tunnels. Two generations annually.

O. nephelepasa. Central Plateau of Mexico; moths darker and rather larger than those of preceding species, and the eggs are definitely larger. The dark cross bands of the larvae are wider; entrance to larval tunnel is not kept open. Apparently two generations a year.

O. subumbrella. West Texas to Arizona, north to Nebraska; moths dark. Larvae with pale purplish bands; the entrance to the feeding tunnel is kept open for the discharge of frass. One annual generation.

The undetermined forms are as follows:

Larvae with pale-blue bands, occurring in southern Mexico in the States of Puebla, Guerrero, and Oaxaca. These may represent *O. junctolineella pectinatella.*

Larvae with dark blue bands, found at Mazatlán on the west coast of Mexico.

Larvae similar in color and habits to *O. junctolineella*, found on the coastal strip of southern California.

Larvae pale-colored, resembling those of *O. subumbrella*, occurring in the drier sections of southern California. The entrance hole is closed and the frass not discharged. Heinrich includes California in the distribution of *subumbrella*.

Olycella junctolineella (Hulst)

The distribution embraces the coastal and subcoastal portions of Texas, and the northeastern Mexican States of Coahuila, Nuevo León, and Tamaulipas. In Texas it occurs from Brownsville along the gulf coast as far north as Galveston, thence inland as far west as Presidio in the Big Bend country of the Rio Grande; it has not been found north of San Antonio nor on the western plateau. In Mexico its range extends southward at least as far as Tampico; it is common around Victoria in Tamaulipas, but does not seem to occur on the Central Plateau.

The insect is comparatively abundant. The usual food plant is the shrub pear *Opuntia lindheimeri*, which is the dominant and often the only prickly pear growing throughout a great part of its range of distribution. On the Texas coast *O. inermis* is freely attacked, as well as the dwarf pears *O. fuscoatra*, *O. grandiflora*, *O. macrorhiza*, and others of the *O. tortispina* group. In the Mexican State of Coahuila larvae have been found in the low-growing *O. microdasys*, while at Presidio in Texas the related but much larger *O. rufida* is the host plant. In Australia the larvae have bred successfully in *O. inermis* and *O. stricta* and in the younger segments of the tree pear *O. streptacantha*.

The adult possesses grey forewings with indefinite transverse markings; the hindwings are light grey in the female, white in the male. There are two generations annually, but pupation and emergence are extended over a considerable period. In Texas, moths from the winter generation larvae emerge from mid-January to May, the earliest recorded date being January 18, while those of the summer generation appear from late August to early November. Full-grown larvae, young larvae, and unhatched eggs may occur simultaneously in the same field in certain months, e.g., March and October.

The eggsticks contain from 4 or 5 to as many as 30 eggs, the usual number being 10 to 12. They are generally attached to the spines or fine spicules of the fruit and young growth. The incubation period occupies 7 to 14 days according to the time of the year. The females are rather prolific and often produce more than 200 eggs per individual,

the average number being between 100 and 150. On one occasion in Australia 716 females laid an average of 197 eggs per individual. Thus, each female deposits many eggsticks.

The young larvae, which are social in habit, enter the fruit and young segments. Their penetration is soon followed by the decay of the attacked portion; within two weeks young segments usually are destroyed by a black nonliquid rot. The young larvae appear unwilling or unable to escape from the rapidly decaying tissue; generally not more than two or three larvae from the original colony survive this early mortality. Hunter, Pratt, and Mitchell (1912) attribute the scarcity of larvae to cannibalism, but the peculiar reaction of the plant to the attack, a condition which does not operate in the case of the entrance of young *Melitara* and *Cactoblastis* larvae, would seem to be the responsible factor.

After escaping from the original fruit or segment, the larvae adopt a solitary habit. They now attack older segments, entering near the apical end and tunneling straight down through the center. The entrance hole is not kept open and the excrement is packed within the tunnel. As the larva develops, its presence is indicated by a large characteristic swelling which is partially hollow and partly filled with frass and broken-down plant tissue. The swelling fills up with spongy matter and may remain conspicuous for months after being vacated by the larva. Not infrequently larvae die as a consequence of being entrapped by the too rapid development of this tissue. The full-grown larva, which attains a length of 2½ inches, makes its exit toward the base of the attacked segment and spins a stout white cocoon among the debris.

Many fruit and young segments are destroyed as a result of their penetration by the newly hatched larvae. When the larvae become solitary, however, their tunneling does not as a rule incite rot actively and causes little damage to the plant. Sometimes bacterial soft rot and anthracnose fungi invade the tunnels and enlarge the scope of the injury. Thus, although prevalent and often rather abundant, this species is not particularly destructive.

PARASITES.—The following natural enemies have been reared from the pupae: the tachinids *Phorocera texana* and *Lespesia aletiae*, the braconid *Apanteles* sp.; and the chalcid *Brachymeria* (*Pseudobrachymeria*) *pedalis*.

Olycella nephelepasa (Dyar)

This species was described from specimens from Techuacán in the southern highlands of the State of Puebla, Mexico. Heinrich lists Cuernavaca, Mexico City, Aguascalientes, and San Luis Potosí as

additional localities. Officers of the Board have reported the occurrence of *Olycella* larvae practically throughout Mexico from Chihuahua in the north to Oaxaca in the south. The specific identity of the larvae has not been ascertained in most cases. However, material from San Luis Potosi, where the life history received some attention, was identified as *O. nephelepasa*. Probably this is the Central Plateau species, represented by larvae found in the States of Chihuahua, Durango, San Luis Potosí, Aguascalientes, Jalisco, Michoacán, Morelos, southern Puebla, and possibly from Oaxaca. It is thought that larvae from lower elevations in southern Mexico, Vera Cruz, the less elevated portions of Puebla, and Guerrero, may belong to another form, possibly *O. junctolineella pectinatella*.

The Mexican plateau form attacks many kinds of tree pears of the *Opuntia tomentosa*, *O. streptacantha*, and *O. robusta* types, as well as shrub pears such as *O. cantabrigiensis*.

The adult is a darker grey moth than *Olycella junctolineella*. The larvae have very similar habits. The individual eggs are of larger dimensions. Apparently the eggsticks contain fewer eggs; among many sticks the largest contained 7 eggs, and the average number was 4. The heavy mortality among the young larvae has been observed in this species as in its ally.

At San Luis Potosí there appeared to be two generations annually, with considerable overlapping. Larvae pupated from March to July and again from October to January; adults were reared in April, May, and June, and again in January. A number of female moths deposited an average of 100 eggs per individual.

Parasites.—The tachinid *Phorocera texana* and the braconid *Apanteles megathymi* were reared from the pupae at San Luis Potosí.

Olycella subumbrella (Dyar)

This species has a very extensive distribution in the United States from western Texas to southwestern Arizona, thence northward through Utah, Colorado and Kansas to Idaho, Wyoming and Nebraska. In Texas its eastern limit is the foothills country between the Devil's and Pecos Rivers and along lat. 30° N. to near Austin, thence north along long. 98° W. to the Oklahoma boundary at Henrietta. Northward it has been located as far as St. Anthony in Idaho. In southwestern Arizona its range extends to the Quijotoa Mountains, the western limit of Platyopuntias. Heinrich lists specimens from California.

Throughout its range *O. subumbrella* is prevalent and is often exceedingly common. The list of food plants includes most of the prickly

pears occurring within its region of distribution. The host plants in west Texas to Arizona are the shrub plants *Opuntia engelmannii*, *O. phaeacantha*, and their many related forms; the long-spined *O. macrocentra* of west Texas and New Mexico is especially favored, while in the foothills country of the Pecos River, *O. atrispina* receives attention. In northern Arizona, Colorado, Kansas, Nebraska, and Wyoming, low-growing prickly pears of the *O. tortispina* and *O. polyacantha* groups are attacked freely; in southern Utah *O. basilaris* has been recorded as a food plant.

The moths are darker and rather smaller than those of *Olycella iunctolineella*. The larvae are banded with a light purple instead of deep blue or black, and often the color is so pale as to appear almost wholly white.

Apparently there is one annual generation. The larvae spin cocoons from September to November; winter is spent in the pupal stage and the moths emerge from March to May. *O. subumbrella* Dyar is the only cactus phycitid known to overwinter in the pupal stage. However in rearing cages at Uvalde, Texas, which has a lower elevation than the region of distribution in western Texas, larvae pupated in late September from eggs deposited in April and May; instead of remaining in the pupal stage during winter, adults emerged in October and laid eggs which hatched at the end of the same month.

Fecundity is comparatively high; thus, 17 females deposited an average of 152 eggs per individual in sticks containing 5 to 7 eggs. The young larvae prefer to attack the fruit, of which an appreciable proportion is destroyed in those areas where the insect is abundant. After vacating the fruit or the originally attacked young cladode, each larva enters a segment near the apex and tunnels downward. The entrance hole is enlarged to a greater diameter than that of the developing larva and is kept open by means of a silken lining. As the excrement is discharged through this opening, the presence of larvae is rendered obvious by the pellets of frass held in the webbing around the entrance hole. This habit distinguished *subumbrella* from all other known forms of *Olycella*. The larvae tunnel downwards from segment to segment much more freely than those of *O. junctolineella;* in the prickly pears with smaller cladodes, the tunnel may extend through several cladodes into the underground butt, or bulb. The cocoon resembles that of the related species and is found among debris or just beneath the surface of the soil.

OLYCA Walker

This genus is now limited to the West Indian insect *Olyca phryganoides* Walker.

Olyca phryganoides Walker

The distribution appears to be restricted to the island of Hispaniola. The insect was found prevalent in prickly pear areas in the Republics of Haiti and Santo Domingo by one of the Board's officers from December 1926 to February 1927. A few subsequent observations were made by G. N. Wolcott and A. Audant in 1927–28.

The moths are usually larger than those of *Olycella junctolineella;* the forewings are heavily suffused with black-grey marks and patches; the hindwings are light grey in the female, almost completely white in the male. The larvae are creamy white or light buff, with jet black spiracular markings.

The food plants include three distinct types of *Opuntia:* the shrub pear *O. dillenii*, the brittle-jointed *O. antillana*, and the peculiar tree pear *O. spinosissima*. Nothing is known of the egg stage or the mode of oviposition. The larvae are solitary, and their work is very similar to that of *Olycella junctolineella*, with characteristic swellings in the segments of *Opuntia dillenii*. In *O. spinosissima* the larvae tunnel for a distance of 2 feet or more in the erect main stem. They cause little damage unless many larvae infest one plant, or anthracnose fungi are associated with the attack.

The cocoons, which are large and light brown, consist of a bulky, rather flimsy outer covering and a closely woven inner cocoon. They occur singly or in masses between or under the pear segments, or among the long spines on the trunk of *O. spinosissima*. The pupal stage in August and early September has been determined at 23 days. There are at least two generations annually. Moths have been reared in January and February and in August through to early September. Since large larvae have been observed in March, possibly a third generation would produce adults between April and June.

ALBERADA Heinrich

This genus was erected by Heinrich for the reception of three species from the United States and Mexico: *A. parabates* (Dyar), *A. bidentella* (Dyar), and *A. holochlora* (Dyar).

A. bidentella was not recognized during the Board's investigations and apparently has never been reared; Heinrich records specimens from three localities in southwestern Texas and from Phoenix, Arizona. He suggests that *A. holochlora*, known only from the type specimens, is a synonym of *bidentella*.

Alberada parabates (Dyar)

This insect has a very extensive distribution. In Mexico it has been

found at San Luis Potosí and at Tula in southern Tamaulipas. It occurs at Oceanside and San Diego on the coast of southern California; in the Tucson district of southern Arizona; around Carlsbad in New Mexico; in the Big Bend country of western Texas; at Puebla and Trinidad in southern Colorado; and at Cedar City in southern Utah. The host plants are Cylindropuntias: *Opuntia imbricata* in Mexico, Texas, New Mexico, and Colorado; *O. whipplei* in Utah; *O. fulgida* in Arizona; and *O. prolifera* in California.

The moths are very similar to the species of *Melitara* in size, color, wing pattern, and general appearance, but the palpi of *A. parabates* are longer and more pronounced. The color varies to some extent. Specimens from Texas are darker than those from California; one example from Tucson, Arizona, has a dark blotch in the center of the forewing.

There would seem to be an annual generation. Larvae that hatched in September were not more than one-third grown by the end of April. They were full-grown in southern Utah in early July, and were pupating later in the same month in southern Colorado. Moths emerged at Uvalde, Texas, from field-collected material as follows: early August to late September, from western Texas; mid-August to early September, from southern California; late August, from Tucson, Arizona.

The eggs are laid on the spines of *Opuntia*, usually singly; but sometimes two or three, or rarely as many as five, are placed somewhat irregularly on one another. The larvae are clear blue or green-blue and are of solitary habit. They tunnel in the more terminal segments; except for a dark spot around the entrance hole, a slight yellowing of the affected segments, or a swollen appearance of the segment in the case of *O. prolifera*, there is little indication of their presence. The attacked segments are not destroyed. Even where the larvae are numerous, the damage to the plant is inconsiderable. When full grown, the larva cuts a round exit hole and spins, among the debris on the ground, a stout cocoon resembling that of *Melitara dentata*.

PARASITES.—Pupae from California were severely attacked by the tachinid *Clausicella floridensis*, the ichneumon *Chelonus electus*, and the chalcid *Brachymeria* (*Pseudobrachymeria*) *pedalis*.

Alberada holochlora (Dyar)

Very little is known regarding this species. Several dark-blue solitary larvae were collected in the terminal segments of the slender Cylindropuntia *O. leptocaulis* at Uvalde, Texas, in early August 1925. They immediately issued from the segments, spun small white cocoons of

the *Melitara* type, and produced adults later in the same month after a pupal stage of approximately 10 to 14 days. The moth has a wing expanse of about 18 mm., and hence is not more than half the size of *A. parabates*.

NANAIA Heinrich

This genus was erected by Heinrich for a new species from Peru. There appears to be a second form occurring in the same country.

Nanaia substituta Heinrich

This insect was first found in December 1928 at Cuzco and Tarma, Peru, where the larvae were attacking the Cylindropuntia *O. exaltata*. It was very common at Cuzco, and caused appreciable damage to the plants by destroying the terminal segments. The larvae were inactive in cells, and adults were not reared.

In 1936 larvae were again abundant at Cuzco in late September and early October in both *O. exaltata*. and another Cylindropuntia *O. tunicata;* they occurred less freely in *Trichocereus cuzcoensis*. They were about three-quarters grown and were inactive in cells. The species was located at Arequipa, Peru, in *O. exaltata* but was not common in that area.

Adults from Cuzco material emerged in December and January. They are rather slender moths with a wing expanse of 1½ inches; the forewings are light brown and the hindwings white with a smoky suffusion. The green-blue larvae are solitary feeders in the terminal segments, where they hollow out a large cell.

Parasites.—From dead larvae collected at Cuzco were reared the ichneumon *Baryceros albosignata* and the braconid *Apanteles cactobrosides*.

Nanaia Heinrich, sp.

Somewhat green-blue larvae were found in October 1936 in the terminal segments of *Trichocereus* sp. at Verrugas in the Rimac Valley, west of Lima, Peru. They spun frail cocoons containing brown air globules within the feeding cells. Two adults which were reared in December appeared to differ from the preceding species.

CACTOBLASTIS Ragonot

This is a South American group with four distinct and a fifth doubtful species; the latter insect, *Cactoblastis ronnai* (Brèthes), will prove to be, it is thought, a synonym of the type species *C. cactorum* (Berg).

The larvae are light orange, orange-red, or red, with conspicuous transverse rows of black spots which tend to coalesce and so give the appearance of cross bands. In all species the larvae are gregarious. The eggs are laid in chains or eggsticks. The food plants are various prickly pears (Platyopuntia), Cylindropuntia, *Trichocereus*, *Echinopsis*, and *Denmoza*. The social habits and manner of working of the larvae and the deposition of the eggs in long chains are duplicated in the North American genus *Melitara*.

Cactoblastis cactorum (Berg)

This insect has won worldwide fame because of its role in the control of the prickly pears *Opuntia inermis* and *O. stricta* in Australia. First introduced into Australia by the Prickly Pear Travelling Commission in April 1913, it failed to become established. It was reintroduced in small numbers in May 1925, and then reared and distributed in great quantity. Within twelve years it solved this great weed problem of Queensland and New South Wales. In approximately 30 million acres that had been completely occupied by dense prickly pear, the pest was destroyed by this insect, and in another 30 million acres of more scattered infestations the pest was brought under control. The reclaimed land, hitherto virtually valueless, has now been brought into agricultural and pastoral production.

C. cactorum occurs in the more northern Provinces of Argentina, in Uruguay and Paraguay, and in the more southern portions of Brazil. In Argentina it has been found in the Provinces of Entre Ríos, Corrientes, Santa Fe, the northern portion of Córdoba, Santiago del Estero, Tucumán, Salta, Jujuy, and the Chaco; it has not been located in the more arid western Provinces of Catamarca, La Rioja, and Mendoza, where it is replaced by the allied species *C. doddi*; the distribution of these two forms overlaps in the Province of Tucumán. In Uruguay, it has been recorded along the Uruguay and Plata Rivers from Piriapolis in the south, northward to Salta. From Corrientes in northeastern Argentina the distribution extends northward through Paraguay, where the insect has been observed at Villa de Concepción and in the vicinity of Asunción, into the Brazilian Province of Matto Grosso, where larvae have been recorded at Corumba on the Paraguay River.

The range may include the southern Brazilian Provinces of Rio Grande do Sul and Santa Catarina. In May 1937, at several places in the former Province and at Florianopolis in Santa Catarina, newly hatched to one-third grown larvae were attacking a Platyopuntia of the *Opuntia monacantha* group. These larvae appeared to differ slightly

from those of *C. cactorum*. Two eggsticks, containing 121 and 110 eggs respectively, were observed; the individual eggs seemed to be of larger diameter than typical *C. cactorum* material. This form would almost certainly be *C. ronnai*, described from moths reared from larvae in spineless cactus in Rio Grande do Sul. In view of the wide distribution of *C. cactorum* and of its occurrence in Uruguay, Argentina (Corrientes), and Paraguay, adjoining to the south and west the two Brazilian Provinces, it seems probable, however, that the southern Brazilian insect will prove to be *cactorum*.

The host plants are various species of Platyopuntia, with *Cleistocactus* sp. the one exception. This rather slender Cereus is occasionally attacked in localities in Santiago del Estero, Argentina, where the insect is abundant in various prickly pears. Cerei and other types of cacti which occur freely in northwestern Argentina are otherwise immune from attack. The host prickly pears in South America include the following:

Tree pears: *O. ficus-indica*, *O. cordobensis*, and young plants only of *O. quimilo*.

Shrub pears: *O. brunnescens*, *O. monacantha*, *O. canterai*, *O. delaetiana*, *O. bonaerensis*, and various similar forms of the *monacantha–bonaerensis* group.

Narrow-jointed pears: *O. salmiana*, *O. utkilio*, *O. discolor*, *O. aurantiaca*, *O. retrorsa*, and others of the *aurantiaca* group.

In fact, the insect breeds in all species of prickly pear within its range of distribution, with two rather notable exceptions. The tree pear *O. quimilo*, a frequent plant in northwestern Argentina, appears to be avoided, except in the case of young plants, which are often destroyed by the larvae. The low-growing *O. sulphurea*, a plant with broad thick segments which is very common in Santiago del Estero and Tucumán Provinces in areas where *C. cactorum* is prevalent, has not been recorded as a food plant. This prickly pear is the usual host plant of *Cactoblastis doddi*.

In Australia *C. cactorum* freely attacks the North American shrub pears *O. inermis* and *O. stricta* and the tree pear *O. streptacantha*. In the Mexican tree pear *O. tomentosa* the larvae develop quite readily under cage conditions, but in the field the moths do not oviposit on this species except on very young plants, a circumstance analogous to that of *O. quimilo* in Argentina.

The insect occurs generally, and often abundantly, throughout its range of distribution. In February 1924 every prickly pear plant around Concordia, Entre Ríos, harbored colonies of larvae. It was again common in this vicinity, as well as around Paso de los Libres, in June 1937 and in 1958. Larvae were numerous in shrub prickly pears

and the narrow-jointed *O. utkilio* and *O. retrorsa* at Resistencia in the Argentine Chaco. In the Province of Santiago del Estero, heavy concentrations of larvae have been observed on many occasions in extensive fields of the low-growing, narrow-jointed species *O. utkilio* and *O. discolor;* areas of the latter species were practically eradicated by this insect, while *O. utkilio* suffered very severely. The related *O. aurantiaca* was heavily attacked in southern Entre Ríos. Larvae were located in quantity in the tree pear *O. cordobensis* in the northern part of the Province of Córdoba.

Both in Argentina and in Australia there are normally two generations annually, a shorter summer generation with adults emerging in January to March, and a longer winter generation with moths appearing in September to November. In the warmer parts of Queensland, there is a partial third generation in the autumn, the adults emerging in March to May. Occasional records have been made in the more southern districts of New South Wales where the life cycle occupies 12 months. It is possible, too, that there is one annual generation in southern Uruguay; pupae secured at Piriápolis in December produced moths in late January, which is very late for the normal after-winter emergence and rather early, in view of the cooler climate of the region, for the usual summer generation.

In Australia, the average length of the life cycle is 100 to 120 days in the summer generation and 235 to 265 days in the winter generation. The shortest life cycle on record was completed in 75 days in midsummer. In the winter generation the eggs are laid in January to March and hatch in February to April. The larvae may develop rather rapidly to reach almost full growth by early winter (June), or grow more steadily to attain full size about the end of July. Pupation starts in August and is general in September. Moth emergence begins in September, reaches a peak in October, and terminates in November. In the summer generation the eggs hatch in November and December, the larvae are full grown in January, and the moths emerge from January to March. The emergence period in any locality occupies about 4 weeks in the summer generation, but most of the moths emerge within 10 to 12 days. In the winter generation emergence continues for about 6 weeks, the majority of the moths appearing within a period of 2 to 3 weeks.

The adult female has a wing expanse of 1½ to 1¾ inches, the male 1⅛ to 1⅜ inches. The forewings are brown-grey, lighter along the anterior margin, with indefinite wavy transverse markings toward the distal margin; the hindwings are white at base, smoky brown on the outer half, with a dark line along the posterior margin. The forewings of the male are rather lighter in shade than those of the female,

and the hindwings are pearly white except for the narrow dark marginal line. The proportion of males and females varies within certain limits; normally there is a preponderance of males, the average number of females being 46 to 48 percent. The average longevity of the adult is 9 days, the maximum record being 18 days.

The number of eggs in a stick varies greatly, but the average example contains from 76 to 90 eggs. The maximum record is a stick containing 150 eggs. Each female may deposit several eggsticks; 3 or 4 tend to be the normal procedure, but frequently from 8 to 12 are laid. Where a moth produces several sticks, the first two or three contain the greatest number of eggs and the last two or three the smallest number of eggs.

The fecundity of the females is most variable. The greatest number of eggs deposited by one individual has been 392. In isolation experiments many females have laid between 200 and 300 eggs, but comparatively few have deposited more than the latter number.

High averages from many moths are cited as follows:

Number of females	*Average number of eggs deposited by each*
45	274
204	232
190	223
527	191

With large numbers of moths in oviposition cages, the usual return has been 90 to 110 eggs per female.

The incubation period depends on temperature, the shortest time recorded being 18 days. The eggs usually hatch in 23 to 28 days during January and February, in 30 to 32 days during February and March, in 40 to 45 days during March and April, in 40 to 50 days during September and October, and in 28 to 32 days during October and November. For out-of-season eggs deposited in autumn and hatched during winter, an extreme incubation period of 132 days has been reported.

On hatching, all larvae from one eggstick enter the plant at one point. At first they feed just beneath the cuticle, but soon penetrate deeper. They tunnel freely within the cladodes, consuming the whole of the interior except the vascular bundles and leaving the undamaged cuticle as a transparent tissue. However, their burrowing usually causes bacterial activity which hastens the destruction of the segments. When one cladode has been eaten out or has decayed, the larvae may penetrate into the next segment. More frequently they vacate the damaged segment, crawl over the surface of the plant, and enter a fresh cladode; this action generally results in the division of the

colony, the two or more groups each entering at a separate point on the plant. In the fourth and fifth instar, at the one-half- to two-thirds-grown stage, the breaking up of the original colony appears to be a natural procedure; at this time the larvae issue from segments that still contain a suitable food supply, and divide into from two to several smaller groups. When full-grown the larvae make their exist from the plant separately, drop to the ground, and find pupation sites.

The shortest larval period of 27 days was secured in February and March with an individual of the partial autumn generation. In the summer generation the minimum duration has been 33 days, but the average period is 50 days. In the winter generation the average duration is 180 days, the larvae hatching in March and pupating in September, but development from late-hatching eggs may be accelerated and the larval period reduced to 120–130 days.

The pupa is enclosed in a fine white silk cocoon which consists of a loose outer covering and a more compact and closely woven inner cocoon. Pupation sites occur among debris at the base of the plants, between dead collapsed segments, inside dried eaten-out cladodes, under stones, logs, and bark, and just beneath the surface of the soil. The average length of the pupal (including the prepupal) period is 21 to 28 days during January and February and 35 to 42 days during September–November. The minimum record is one of 13 days duration in January, and the maximum is 90 days between early August and early November.

PARASITES.—In Argentina the braconid *Apanteles alexanderi* is a common enemy of *Cactoblastis* and *Tucumania*. Two ichneumons, *Cryptus* sp. and *Podogaster* sp., have been reared from pupae of *C. cactorum* from Entre Ríos Province.

Cactoblastis doddi Heinrich

Although it was discovered in 1920, this species was confused with *C. bucyrus* Dyar and hence remained unnamed until 1939. It is a native of the more arid portions of western Argentina, the distribution extending through the Provinces of Mendoza, San Juan, La Rioja, and Catamarca to the northern section of Tucumán, and eastward into the northwestern corner of Córdoba. Extensive investigations have not revealed its presence in Santiago del Estero, although *Opuntia sulphurea*, the usual host plant, occurs widely in that Province. Larvae presumably representing this form have been found at Maimara in the Province of Jujuy, while larval tunnels in *O. sulphurea* at Tapiza in southern Bolivia suggest a further extension of its range. The distribution of *C. doddi* overlaps that of *C. cactorum* in the northern section of the Province of Tucumán.

263–417—68——5

The species is not uncommon, at times becoming abundant. In August 1936 larvae were very numerous in northern Tucumán; in many local areas almost every plant of *O. sulphurea* was attacked, while a field of *O. ficus-indica* supported a heavy population. A survey of the Province of La Rioja established its prevalence both in the open semidesert country and in the mountains at altitudes up to 7,000 feet.

The normal food plant is *Opuntia sulphurea*, which, although a low-growing plant, possesses larger, thick cladodes. In northern Tucumán, the tree pear *O. ficus-indica* is frequently attacked, while the larger tree pear *O. quimilo* is occasionally infested. In the Province of Mendoza larvae have been found in the small round-jointed *O. russellii*, a member of the subgenus *Tephrocactus*, but other members of this group, such as *O. aoracantha* and *O. glomerata*, which occur freely in the western Provinces, have not been recorded as hosts.

The narrow-jointed prickly pears *O. utkilio* and *O. discolor* are not subject to attack, even though, in northern Tucumán, they grow in the neighborhood of infested *O. sulphurea* and *O. ficus-indica*. Under cage conditions in Argentina the female moths deposited eggs as freely on *O. aurantiaca* (a close relation of *O. discolor*), *O. utkilio*, and the shrub pear *O. bonaerensis*, as on *O. sulphurea*. Furthermore, in the short summer generation the species was carried through its life cycle on *O. aurantiaca* and *O. utkilio*, and the percentage of larvae that developed from the egg to the pupal stage on these two plants was not appreciably lower than on *O. sulphurea;* however, on *O. bonaerensis* the larvae fed readily but did not complete development. Similar rearing experiments on two occasions with the long winter generation were not successful: in the first year larvae survived for 180 days on *O. utkilio* and *O. bonaerensis*, attained full size, but did not pupate; in the second year a few larvae on *O. utkilio* and *O. aurantiaca* reached the pupal stage, but no moths were obtained.

In Australia, under cage conditions, this insect was reared with some degree of success on the shrub pears *O. inermis* and *O. stricta* and on the tree pears *O. tomentosa* and *O. streptacantha*. Although attempts to establish it in the field failed, it is known that a few colonies passed through the life cycle on both *O. tomentosa* and *O. inermis*.

C. doddi resembles *C. cactorum*, closely in appearance, life history, and habits. The moths of *doddi* are of a general deeper brown tint than those of *cactorum*, and the hindwings are uniformly dusky in the female. The eggstick habit is well developed, although the average number of eggs, 60–65, tends to be lower; the maximum number of eggs in a stick has been 90. The individual eggs are larger than those of *cactorum*, and freshly deposited eggs are slate-colored instead of whitish. The larvae

are truly gregarious. The cocoon is of rather stouter texture than that of *cactorum* and is usually spun just beneath the surface of the soil, particles of which become mixed with the outer layer of silk. At pupation time the larvae wander freely; thus the cocoons are not readily found, as they do not occur in numbers at the base of, or in the immediate vicinity of, the host plant.

In the adult stage, males are rather more numerous than females, the general average being approximately 48 percent females. Under cage rearing conditions, however, the proportion of females is often much lower, i.e., 34 to 38 percent. The females are almost as prolific as those of *C. cactorum;* the following records furnish typical examples of the average egg production:

Number of females	*Average number of eggs deposited by each*
88	87
111	92
312	107
145	118
76	128
35	133
89	157
12	166

There are two generations annually, the adults emerging from late January to early March and again in October and early November. Emergence is less protracted than for *C. cactorum*, and is generally completed within 20 to 27 days at both seasons of the year; on occasion, emergence of several hundred moths started and terminated within 16 days, both in October–November and January–February. The eggs hatch in 26 to 32 days in October and November and in February and March. The larval period occupies 5 to 6 weeks in midsummer; in the winter generation the duration of the larval life is approximately 170 to 190 days. The pupal period in January and February varies between 26 and 46 days, with an average of 35 days; in August–October the time is longer, 49 to 67 days, the average being about 56 days.

The larvae live in large colonies and tunnel through the host plant. They are very destructive to *O. sulphurea*, the plants of which are often completely destroyed. Like *C. cactorum* larvae, they are comparatively inactive during the height of winter, resuming active feeding for a short period prior to pupation.

Parasites.—The most common enemy is the braconid *Apanteles alexanderi.* The tachinid parasite *Epicoronimyia mundelli* is of some importance. The chalcid *Brachymeria cactoblastidis* and an undetermined ichneumonid are other pupal parasites.

Cactoblastis mundelli Heinrich

This species is known from one locality only, Arequipa, altitude 7,500 feet, in southern Peru, where it was discovered in October 1936 attacking the Cylindropuntia *O. exaltata*. Both full-grown larvae and pupae occurred in early October. Adults emerged from October 12 to November 14. The larvae were gregarious and burrowed downward through the segments toward the base of the plant. In color they closely resembled those of *C. cactorum*. The cocoons, similar to those of *cactorum*, were present among debris at the base of the attacked plants. The forewings of the adults bear a yellowish suffusion which is not found in other members of the genus.

Cactoblastis bucyrus Dyar

The adults are darker in color than other species in the genus, with the hindwings of both male and female wholly brown or fuscous. *C. bucyrus* occurs in western Argentina, where it has been recorded from the Provinces of Mendoza, Catamarca, and Tucumán. The known host plants are *Trichocereus terscheckii*, *Denmoza rhodacantha*, *Echinopsis shaferi*, and *Echinopsis* sp. (probably *E. tubiflora*).

The larvae are gregarious and are definitely larger than those of *C. cactorum* and *C. doddi*. They form large cavities in the thick stems of the host plants, at least one of which, *Echinopsis* sp., may be completely killed by the attack.

There would appear to be two generations annually. Several colonies of full-grown larvae, collected at Andalgala in Catamarca Province in early February, pupated during the same month and produced moths in late March; eggs laid by these moths hatched, after an incubation period of 35 days, at the end of April. At Tapia, in northern Tucumán, full-grown larvae were located in August; they pupated in September and yielded adults in the latter part of October. Two eggsticks found in the field in this area hatched in late November; one stick contained 42 and the other 102 eggs. These eggs were brown and were of appreciably larger diameter than those of *C. cactorum* and *C. doddi*.

CAHELA Heinrich

This genus is restricted to one species from North America.

Cahela ponderosella (Barnes & McDunnough)

During the Board's investigations this species was located over a wide area from western Texas to southern California, northward to southern Colorado and southern Utah, and southward into the

Mexican States of Sonora, Chihuahua, Neuvo León, as far as San Luis Potosí. It was found in almost every district throughout this extensive territory where Cylindropuntias occurred, abounding in many places, notably the Big Bend country of west Texas, in southern New Mexico, and in southern California. Heinrich records specimens from localities in the southeastern corner of Nevada.

The food plants are various Cylindropuntias; other hosts have not been observed. Throughout its range in Mexico, Texas, New Mexico, and Colorado, *Opuntia imbricata*, the dominant Cylindropuntia of this region, is selected. Other plants known to be attacked are *O. whipplei* in Utah, *O. echinocarpa*, *O. serpentina* and *O. parryi* in California, and *O. spinosior*, *O. arbuscula*, and *O. acanthocarpa* in Arizona. Thick-jointed species such as *O. prolifera* and *O. fulgida* seem to be avoided, while the slender-jointed *O. leptocaulis* does not appear to be a host plant.

The larvae are wholly white or grey-white and are solitary in habit. They infest the terminal segments and the fruit. The larva enters the fruit a little to one side of the crown and later tunnels through into the segment. It is thought that the newly hatched larva attacks the flower head. The entrance hole in the fruit is not kept open, shows no webbing, and is marked by a dark spot. The fruit turns yellow on one side, then somewhat black, and finally dries up, it remains attached to the segment but is easily detached, since there is no webbing. When fruit are absent the larva enters a terminal segment near its apex; in this case the entrance hole is kept open and is surrounded by a certain amount of webbing in which pellets of frass are mixed. As the larva develops the segment may wither completely. Damage to the plant is rarely of greater extent than the destruction of occasional apical joints, but, if the larvae are numerous, many segments may be killed. The insect is of greater importance as a fruit enemy. Many instances have been reported in which more than 50 percent of a heavy fruit crop on large plants has been destroyed.

Unlike most cactus phycitids, the larva of *C. ponderosella* does not vacate the plant to pupate, nor does it form a proper cocoon. The pupa lies free within the larval excavation; a pad of loose silk around the head suggests an unfinished cocoon. It is usually located at the apical end of the infested segment near the larval entrance hole. In the frequent cases where the larva has not maintained an opening, the emerging moths must push off the loosely attached dead fruit.

The adult has a wing expanse of 1½ inches and is rather more slender in appearance than the various species of *Olycella*, *Melitara*, and *Cactoblastis*. The forewings are grey with two long and several shorter black longitudinal lines; the hindwings are white. The white eggs are deposited singly on the spines of the host plants.

Apparently there are two generations annually. Material from Presidio in western Texas produced moths from late June to early August, while adults from California emerged in the second half of August to early September. Moths from Carlsbad, New Mexico, were obtained in May, and at Tuscon, Arizona, several were captured at light in June. Heinrich records adults in every month from April to August. Under cage conditions at Uvalde, Texas, from eggs deposited in August and early September, adults emerged in late March and the first half of April. Full-grown larvae have been found in western Texas in February.

It would seem that moths emerge in the spring, April–May, and again in summer, from June to September.

Parasites.—Two pupal parasites have been reared, an ichneumon, *Temelucha* sp., and the braconid *Apanteles etiellae*.

RUMATHA Heinrich

Of the three species, all from the United States, included by Heinrich (1956) in this genus, *Rumatha bihinda* (Dyar) is known in the adult stage only, and *R. polingella* (Dyar) is recorded by Heinrich as having been for the first time reared from *Opuntia leptocaulis*.

Rumatha glaucatella (Hulst)

The distribution of this species appears to be restricted to southern Texas. Heinrich lists specimens from several localities from San Antonio and Laredo south to Brownsville, captured or reared in May, June, July, and August.

During the Board's investigations, the whitish larvae were found living singly in the terminal segments of the "tasagillo" Cylindropuntia *Opuntia leptocaulis* at Brownsville, Uvalde, Laredo, and between Stockdale and Yorktown. The plants may suffer considerable damage from the attack. The larvae pupate within the feeding tunnels. Adults have been reared in June and August. The forewings are grey, marked with white, and the hindwings white. This is one of the smaller species, with a wing expanse of approximately three-quarters of an inch.

Rumatha polingella (Dyar)

This species, originally described by Dyar (1906) in *Zophodia* was placed under *Rumatha* by Heinrich (1956), who reports the type locality as Southern Arizona and the food plant as *Opuntia* (*Cylindropuntia*) *leptocaulis*. A small male, reared from this cactus species from Presidio, Texas, is the first such record for this species, previously known from adults only.

The distribution is given as Arizona—Douglas (June, August) Redington, Palmerlee, Paradise (Cochise County; July, September) Pinal Mts. (April), Baboquivari Mts. (June, July, August, September), Santa Catalina Mts. (August), and "Southern Arizona" (April); and Texas—Presidio (August).

YOSEMITIA Ragonot

Of the four species included by Heinrich in this genus, *Yosemitia fieldiella* (Dyar) from Arizona and California and *Y. didactica* (Dyar) from southern Mexico are known in the adult stage only.

Yosemitia graciella (Hulst)

Heinrich records this species from many places in Arizona and from a few localities in California, Nevada, Colorado, New Mexico, and Texas, the adults having been collected or reared in every month from March to July. He lists as host plants *Echinocereus viridiflorus*, *E. polyacanthus*, and *Coryphantha aggregata*.

During the investigations infestation was found in southern Arizona only, where, at Roosevelt and in the Baboquivari Mountains, larvae occurred singly or in small numbers in the fruit and segments of *Echinocereus polyacanthus*. Adults emerged in late June and early July. The moths, larvae, and cocoons were very similar to those of *Y. longipennella*.

Yosemitia longipennella (Hulst)

During the investigations, this insect was not found elsewhere than in the general vicinity of Uvalde, Texas. Heinrich gives several localities in southern Texas from Van Horn in the west to San Benito near, Brownsville, the moths being captured in April, May, and June.

At Uvalde the dark dull-blue larvae attacked *Homalocephala texensis*, *Hamatocactus setispinus*, and *Neomamillaria heyderi*, all of which are rather small, more-or-less globular plants; the first-named appeared to be the preferred host. Eggs are laid singly on the underside of the flattened spines of *H. texensis*, and the young larvae enter the crown of the plant. As many as 75 larvae were recorded in one globular head of this species. They pupate beneath the plant or in adjacent debris, forming rather flimsy cocoons which resemble those of *Ozamia* in texture and in the presence of pink "air bubbles" in the outer layers of silk. Emergence seems to be prolonged over a considerable period; from several infested plants of *H. texensis* collected in May, moths emerged from the end of June to the middle of September. The adults often remain in coition through the day. The forewings are brown-grey with black

streaks; the hindwings are white lightly suffused with brown; the wing expanse is approximately one inch.

TUCUMANIA Dyar

This South American genus contains two described and a third undescribed species. The host plants are all low-growing, with the exception of *O. salmiana*, an erect narrow-jointed form. Normally the larger shrub types of prickly pear are not attacked. In Argentina, larvae of *T. tapiacola* Dyar have been found occasionally in very young plants of the semitree pear *O. quimilo*. In Australia this insect now breeds successfully in the shrub pear *O. inermis*, while under cage conditions it has been reared in the semidecumbent, slender-jointed Cereus *Harrisia martinii*.* Larvae of this type were found in *H. martinii* and *H. bonplandii** in Paraguay in 1957.

The two described species are *T. tapiacola* Dyar and *T. porrecta* Dyar. A third species is represented by a single female reared in October 1932 at Tapia, Province of Tucumán, Argentina, from *O. canina*, a low-growing, narrow-jointed plant closely related to *O. aurantiaca*. According to Heinrich, this specimen represents an undescribed form; it certainly differs from *T. tapiacola* which is prevalent in the neighborhood of Tapia.

Tucumania larvae have been recorded on two other occasions from localities outside the known range of distribution of the above species. At Asunción, Paraguay, in June 1936, very small to full-grown larvae were rather numerous in *O. stenarthra*, a rather narrow-jointed,decumbent plant; adults were not reared. Possibly these larvae represented *T. tapiacola* or *T. porrecta*.

In March 1942, two dark-reddish larvae were obtained in *O. russellii*, a small-jointed clump, or mound-forming, *Tephrocactus*, at Villa Vicencio, altitude 5,500 feet, Province of Mendoza, Argentina. Many cocoons containing emerged pupae were present within the segments, which had been hollowed out by the larvae. The color of the larvae, the pupation within the plant, and the nature of the attack indicated the relationship to *Tucumania* and the species may have been *T. tapiacola*.

Tucumania tapiacola Dyar

Discovered in the Provinces of Santiago del Estero and Tucumán, Argentina, in early 1925, this species received considerable attention during the years 1932 to 1936. It was introduced to Australia for the

*Some authorities place these species in *Eriocereus*.

control of the tiger pear *O. aurantiaca*, and was for a few years established at various points in southern Queensland and in New South Wales.

In Argentina the distribution extends through the Provinces of Santiago del Estero, the northern portion of Tucumán, and the greater part of Salta. Larval tunnelling, presumed to have been caused by this insect, has been observed in the Province of Catamarca. Two very pale larvae with dark spots, which were found in *O. utkilio* at Cruz del Eje, in the north of Córdoba Province, were probably this insect.

A rather doubtful record which would indicate a much wider range was made at Gualeguaychú, in the southeastern part of the province of Entre Ríos, which is not far distant from Paysandú, Uruguay, the type locality of *T. porrecta*. From several larvae feeding in *O. aurantiaca*, one adult was reared. Heinrich identified this example as *T. tapiacola*, although it appears to differ slightly from typical specimens.

The usual hosts are *O. utkilio* and *O. discolor*, low-growing, narrow-jointed plants of the *O. aurantiaca* group. *O. canina* and *O. kiskaloro* of the same relationship are attacked, while *O. aurantiaca* itself has proved a very suitable food plant. The distinctive *O. salmiana*, with its succulent narrow segments and erect habit of growth, is another host. Occasional larvae have been observed in very small plants of the robust tree pear *O. quimilo*.

Larvae have been found in *O. sulphurea*, a low-growing plant with broad thick cladodes, occurring in the immediate vicinity of attacked *O. utkilio* and *O. discolor*, but they have not been reared to the pupal stage in this prickly pear. In Australia the species breeds freely in the shrub pear *O. inermis*, on which the larvae attack segments in contact with or close to the ground and are rarely, if ever, encountered in other situations. Recently (1966) larvae have been found attacking *Harrisia martinii* at Collinsville in North Queensland.

The moths have a wing expanse of 24 to 34 mm. The forewings are soft grey, with a slightly darker pattern of markings which scarcely affects the uniform appearance. The hindwings are pearly white, dusky toward the outer margin; the extent of the duskiness varies to the extreme degree of embracing the outer half of the wing.

The larvae vary considerably in color. Fourth- or fifth-instar larvae may be deep dull red, purple-red, light wine-colored or pink, yellow-brown, light orange, or light yellow, often cloudy or dusky dorsally, and sometimes pink around the dark spots. The thoracic segments each bear four small brown spots in a transverse row. Each abdominal segment has eight spots: two pairs dorsally one behind the other, and one spot above and one below the spiracle on either side. The penultimate segment has four spots in a transverse line and sometimes an additional spot on either side just in front of the lateral pair; these extra spots may

coalesce with the lateral ones. On the apical segment is an irregular brown patch. A long seta arises from all the spots. In younger larvae the spots are larger and often give the appearance of transverse bands.

The life history may be briefly summarized as follows: Eggs are deposited singly on the tips or sides of the spines or fine spicules. The larvae are solitary in habit and tunnel freely in the segments, often transferring from one joint to another. The rather flimsy cocoons are spun either within the hollowed-out segments, among debris, or just beneath the soil surface. The length of the life cycle is irregular, but both in Argentina and in Australia there are usually two complete generations and a third partial generation annually. The summer generation is comparatively short, the winter generation much longer. The partial generation occurs in the autumn and represents the earlier or more rapidly developing progeny of summer generation moths.

Like most of the cactus phycitids, the moths do not feed, or at least do not require nourishment. Emergence occurs in the early hours of the evening, and mating occurs the same night. In confinement the moths usually survive for from 3 to 9 days, but a longevity of 16 days in February (summer) has been recorded, while females have deposited eggs on the twelfth night after emergence. The proportion of female moths averages 47.5 percent; during rearing work over a period of several generations the lowest and highest figures for this sex were 42 and 51 percent, respectively.

The females are more fecund than those of most cactus phycitids studied. The highest number of eggs obtained from one female was 376; in this instance the actual record was 751 eggs laid by two females. Another female deposited 342 eggs. On another occasion two females laid a total of 545 eggs during one night. Other high returns are 315 eggs per female from 3 females, 293 from 73, 265 from 96, and 185 from 1,193.

In breeding work from generation to generation with large numbers of moths, averages of from 150 to 190 eggs per female have been obtained frequently. These figures indicate generally a greater fecundity than that of *Cactoblastis cactorum*, although individuals of the latter insect have deposited as many as 392 eggs. The first eggs are usually laid on the night following emergence, and oviposition may continue throughout the life of the female. A female that lived for 13 days deposited eggs on 10 of 11 successive nights, as follows: second night, (24 hours after emergence) 20; then in succession, 207, 30, 24, 9, 14, 0, 20, 9, 7, 2: a total of 342 eggs. The greatest number of eggs is nearly always produced on the second and third nights following

emergence. For instance, of the total eggs from 37 females, 57 percent was laid on these two nights, the proportion for each evening being:

Night	*Percent*
2	33
3	24
4	17
5	11
6	7
7–11	8

Both at Tucumán, Argentina, and at Sherwood, Queensland, moths emerged and laid eggs in every month of the year. Moderately low night temperatures, falling below 50° F., do not discourage or inhibit oviposition, as they do for such cactus phycitids as *Cactoblastis cactorum* and *Melitara prodenialis*. The following results were obtained at Sherwood, the given temperatures having been taken in the room where the moths were ovipositing:

	Temperature (°F.)		
Month	*Mean minimum*	*Absolute minimum*	*Eggs per female*
June	51.3	45.0	109
July	50.2	42.0	108
August	50.8	45.0	104

Moths placed in mason jars or other types of glass containers oviposited freely on the loose threads of frayed pieces of cloth suspended in the jars. As the eggs are small and rather delicate, and cannot be handled as readily as can the eggsticks of *Cactoblastis* and *Melitara*, this method of securing oviposition simplified the problem of establishment. The pieces of cloth containing the eggs were placed on the prickly pear in the breeding cages or in the field, and the hatching larvae promptly entered the segments of the plant.

The incubation period during the six summer months, October–March, normally occupies 7 to 12 days; the shortest period in our records has been 5 days both in Australia and Argentina. The maximum known duration has been 49 days in the winter months of June–July and July–August.

Development of the larvae is irregular, and there may be very considerable variation in the time factor among material hatching on the same day. The shortest larval period has been 27 days in Australia and 28–30 days in Argentina. On the other hand, larvae hatching from February to May may not pupate until September and October, a period of 7 to 8 months.

The newly hatched larvae are most active, wandering rapidly over the prickly pear plants in search of young growth. For successful breeding work, the provision of young segments of *O. aurantiaca* was essential. They seemed unable to penetrate the cuticle of older growth. Under field conditions mortality among the young larvae must be high, for during dry periods new growth may be absent or very limited. Even where special attention has been paid to the question of providing the most suitable food supply in rearing cages, the proportion of pupae obtained from the eggs has rarely exceeded 15 percent. The average cocoon return from accommodated eggs during 18 generations in Argentina and Australia has been 12 percent, while the highest figure in any one generation has been 30 percent in Argentina and 29 percent in Australia. These results compare unfavorably with those secured from *C. cactorum*, and indicate the normally high mortality during the larval stage.

The larvae are solitary and tunnel freely, often vacating one segment to enter another. Although newly hatched larvae need to enter young growth, older larvae are usually found in segments close to the ground and may penetrate into the underground bulbs of *O. aurantiaca*. It has been observed both in Argentina and in Australia that a communication channel of webbing mixed with soil is often constructed from the prickly pear segment into the soil for a maximum depth of several inches, and that on hot days or when disturbed the larva retreats underground; this habit has not been recorded among other cactus phycitids. The frass is not discharged from the plant. One larva is capable of destroying several segments of *O. aurantiaca* and *O. discolor*, reducing the slender joints to thin shells. In large segments of *O. inermis* the damage is minor.

The rather flimsy silken cocoons occur in the dry segments hollowed out by the larvae, among debris, or just beneath the soil surface. The duration of the pupal stage is generally from 12 to 17 days during the summer months, November–March; the shortest recorded period has been 10 days. The time increases to 30 days in autumn and to 90 days in winter; thus from a number of larvae that pupated in April, the first moth emerged after 50 days and the last after 85 days.

Owing chiefly to the irregular development of the larvae, the life cycle varies considerably, even when the eggs have been deposited on the same day. For example, in one lot of summer generation material in Argentina, 90 moths emerged over a period of 54 days, from late January until after the middle of March. The life cycle between March and October is very inconstant; thus at Sherwood, Queensland, eggs laid in February and March produced moths from late March to the end of November, a variation of more than 8 months. The

average duration of the life cycle may be calculated as follows: midsummer, November–February, 60 to 90 days; autumn, January–May, 60 to 120 days; winter, February–October, 150 to 250 days. The shortest period on record is 47 days at Sherwood in February and March, divided as follows: egg stage, 5 days; larval period, 27 days; pupal period, 15 days.

Both in Argentina and in Australia two complete and one partial generations occur annually, the peaks of moth emergence taking place in November, January–February, and April–May. However, the generations overlap to a marked degree. In Argentina all stages of the insect have been observed in every month of the year, and during rearing operations at Sherwood the same conditions prevailed.

Eggs of the summer generation may be laid at any time from September to early December; moths from these eggs may emerge as early as December or as late as March. In 3 years' breeding work at Scone, New South Wales, the majority of the summer generation moths appeared in January. From 25 to 75 percent of the larvae hatching from eggs deposited by these moths develop rapidly and produce the moths of the autumn partial generation from late March to May, while the slower developing larvae reach the adult stage in September and October. The progeny of the autumn generation become adults about 4 weeks later in October and November. In Argentina autumn moths emerge most freely in June, and sporadic emergence occurs throughout July and August.

PARASITES.—The two important parasites in the Argentine are the tachinid *Epicoronimyia mundelli* and the braconid *Apanteles alexanderi;* the former insect attacks the large larvae and emerges from the pupae.

Tucumania porrecta Dyar

Very little is known concerning this insect, which was described from two female moths bred in early February 1925 from two larvae collected the previous month at Paysandú, Uruguay. The larvae, deep-red or purple-red with small dark spots, were feeding in segments of an undetermined, and possible unnamed, low-growing *Opuntia* whose characters suggested an affinity with *O. sulphurea*, one of the dominant species of western Argentina. The larvae formed their cocoons within the excavated segments.

EREMBERGA Heinrich

This is a North American group of three species, of which two, *Eremberga creabates* (Dyar) from California and *E. insignis* Heinrich from San Luis Potosí, Mexico, are known from single captured specimens. According to Heinrich (1956) their food plant is unknown.

Eremberga leuconips (Dyar)

This insect has not been found elsewhere than in southern Arizona, where it was recorded by officers of the Board as attacking *Echinocereus polyacanthus* at Roosevelt, Douglas, and the Baboquivari and Quijotoa Mountains. The larvae are white, with dark spots forming incomplete cross bands, and they live singly or in small colonies within the host plant. They were full grown in June and July, spun loose cocoons beneath the plant, and produced moths in July. Heinrich records moths in August and September. The adult has a wing expanse of 25 to 37 mm.; the forewings are grey, with dark longitudinal lines along several veins; the hindwings are somewhat brown in the female, pearly white in the male.

SALAMBONA Heinrich

This genus was erected by Heinrich for the Argentine form described by Dyar as *Zophodia analamprella.*

Salambona analamprella (Dyar)

The habits render this species one of the most interesting of the cactus phycitids, since the larvae are either phytophagous or carnivorous. In the early summer the larvae attack the flower buds, flowers, young fruit, and very young growth of *Opuntia*, while in the late summer and autumn they are actively predacious on the cochineal mealy bugs *Dactylopius* spp. feeding on prickly pear.

The distribution extends from the Province of Río Negro in the southern section of Argentina, and embraces the main prickly pear area of the Republic, including the western Provinces of Mendoza and San Juan, north through Santiago del Estero and Salta, and eastward to the Province of Entre Ríos and Uruguay. Larvae attacking cochineal at Asuncíon, Paraguay, may have represented this species.

The more general habit is the predacious one. The insect is one of the most important enemies of *Dactylopius* in Argentina. It is very prevalent from February to August and often exercises a very considerable degree of control over its host. The larvae live singly in tunnels in the segments beneath the cochineal cultures. If the available quantity of cochineal is destroyed before the larva is full-grown, it may extend the tunnel for some distance and complete its development as a plant feeder.

By the end of the winter the activities of various predators have severely depleted the population of cochineal, which is usually very sparsely distributed from September to January. Hence, in November, December, and January *S. analamprella* is generally found attacking

the buds, flowers, young fruit, and young growth of prickly pears. At Carmen de Patagones, in Río Negro, and in the Sierra de la Ventana, in the south of Buenos Aires Province, the larvae were very destructive to the fruit of *O. sulphurea* and *O. bonaerensis* in January, while flowers and young fruit of *O. sulphurea* were heavily attacked at Mendoza in December. As a fruit enemy this insect behaves much like *O. fuscomaculella clarefacta* in Texas. The flower head is entered first and is attached to the fruit by silken strands. Entrance to the fruit is made through the center of the crown, and either the ovary or the fleshy portion is eaten. Larvae often occur in the dead flowers.

O. sulphurea, *O. bonaerensis*, and *O. utkilio* have been recorded as direct host plants. Where cochineal has been the host, the larvae have been observed on many prickly pears including, in addition to the three plants already named, *O. discolor*, *O. quimilo*, and various species related to *O. monacantha* and *O. bonaerensis*.

As larvae have been observed almost throughout the year, it is probable that there are at least three generations annually. The larvae are grey-green or black-green in color. The loose white cocoons occur among debris around the plants. Adults have been reared in January, February, and March. The wing expanse is approximately one inch; the forewings are dark grey-brown with a rather broad, somewhat white stripe along the anterior margin; the hindwings are pearly white, with the outer edges lightly dusky.

PARASITES.—The insect suffers heavy mortality from the attack of the braconid *Apanteles alexanderi*.

SIGELGAITA Heinrich

Heinrich erected this genus in 1939 for the reception of three new species from Peru and Chile. The larvae are fruit feeders.

Sigelgaita chilensis Heinrich

This insect was discovered in late 1936 and early 1937 at La Serena and Ovalle, in the more northern section of Chile. The blue or blue-green larvae occur commonly in December and January in the fruit of *Eulychnia acida* and *Trichocereus chiloensis* and destroy a large proportion of the fruit in some areas. They enter the fruit at the base and tunnel into the seed cavity. Frequently the infested fruit rots, and the larva transfers to an adjacent fruit; thus several fruit may be destroyed by one individual. When full-grown the larva lowers itself to the ground by a thread and among the debris spins a frail cocoon containing white air globules.

Adults emerged at intervals from late December to mid-March. The wing expanse is 30 to 45 mm.; the forewings are grey with darker markings, and the hindwings lightly suffused fuscous.

Sigelgaita huanucensis Heinrich

In December 1928 blue or blue-green larvae of solitary habit were infesting the fruit and occasionally the young growth of *Opuntia ficus-indica* at Huanuco and Tarma, Peru. Both very small and fully developed larvae occurred. As a rule, each larva completed development in one fruit, but sometimes two adjacent fruit were attacked by an individual. On many plants, 90 percent of the fruit was destroyed; in other cases the infestation was as low as one larva per plant. The flimsy cocoons were spun within the hollowed-out fruit. The pupal stage occupied 28 to 36 days, adults emerging in December and January. The moth has a wing expanse of 45 mm. and is very similar to the preceding species except that the forewings are more of a brown shade and the hindwings are almost wholly white.

Sigelgaita transilis Heinrich

Green larvae were collected in October 1936 feeding within and destroying the fruit of *Trichocereus* sp. at Santa Eulalia, Peru. They were fully grown and spun frail cocoons containing red air globules. Adults which emerged in late November were definitely smaller than those of *S. chilensis* and *S. huanucensis*, with a wing expanse of about one inch.

AMALAFRIDA Heinrich

Heinrich erected this genus for the reception of the species described by Dyar as *Cactoblastis leithella*.

Amalafrida leithella (Dyar)

The information concerning this insect was obtained in December 1927 and January 1928, when it was found around La Guiara, Caracas, and Barquisimeto, Venezuela, at Puerto Colombia on the northern coast of Colombia, and on the island of Curaçao. Larvae occurred rather freely in various species of Platyopuntia, including *Opuntia elatior*, *O. schumannii*, and *O. boldinghii*. More recently according to F. Bennett (1963, in litt.) the species has been found at Vera Cruz, Mexico.

The larvae, greyish in color with a tendency toward broad transverse bands. were full-grown in December and January. They were of

solitary habit, and their presence on the prickly pear was indicated by large swellings in the segments similar to those produced by larvae of *Olycella junctolineela*. Pupation took place in the named months, and adults emerged in January after a pupal period of about 14 days. The pupation habit is interesting, and, as far as is known, is unique among the cactus phycitids. The larva cuts through the cuticle of the plant to form a trapdoor about one-quarter inch in diameter, the free edges of which are cemented to the surface. The cocoon, which is spun within the larval cavity, possesses a long neck extending to the trapdoor, which is pushed open by the emerging moth.

The adult has a wing expanse of 30 to 33 mm.; the forewings are greyish brown with darker markings; the hindwings are almost wholly white in the male and are mainly fuscous in the female.

PARASITES.—A tachinid was reared from cocoons from Barquisimeto, Curaçao, and Puerto Colombia.

OZAMIA Ragonot

In this genus are included eight forms distributed from the United States to Argentina. Most of the species attacked the fruit of prickly pears and other cacti, but two Argentine specimens are stem borers in *Cereus*. Very possibly undetermined larvae feeding in cactus fruit in other sections of South America would belong here; notes on these insects are given under the miscellaneous Phycitidae (p. 72).

Ozamia lucidalis (Walker)

The type species is known from the West Indian islands of Hispaniola, and Jamaica. It was located in Haiti and Jamaica in January 1927. Near Kingston, Jamaica, the larvae attacked and destroyed 90 percent of the fruit of the Platyopuntia *Opuntia spinosissima*; the dark grey larvae were full grown in January; they pupated and produced moths after a pupal period of 17 days during the same month. A few larvae were collected in the fruit of *O. dillenii* at Port-au-Prince, Haiti; these, too, were full-grown and pupated immediately; moths were reared after a pupal period of 10 days. The adult, which has a wing expanse of 26 to 30 mm., is very similar to *Ozamia fuscomaculella clarefacta* Dyar; the forewings are brown-grey with darker markings, and the hindwings are white.

Ozamia fuscomaculella (Wright)

This variety differs from *Ozamia f. clarefacta* Dyar in the lighter grey color of the forewings and the absence of the green tint on the thorax

and basal half of the forewings. Its known distribution is the coastal belt of southern California from Los Angeles to San Diego. In July 1924 and in June and July 1925, the larvae were attacking the flowers and fruit of the Platyopuntia *Opurtia littoralis*. In both seasons the insect was prevalent in the Los Angeles district and destroyed an appreciable quantity of the prickly pear fruit. The habits were similar to those of the Texas form. Pupation occurred in July, and moths emerged in July and August.

Ozamia fuscomaculella clarefacta Dyar

The distribution of this insect extends from Texas through Mexico as far south as the State of Vera Cruz. In Texas it is known to occur along the Rio Grande from Brownsville as far west as the Devil's River and northward through Uvalde and the foothills country as far as Marble Falls, but is has not been located along the coastal strip between Corpus Christi and Galveston. It is generally prevalent in the large fields of *Opuntia lindheimeri* between Uvalde and the Rio Grande at Laredo and Eagle Pass. In Mexico it extends through the eastern States of Coahuila, Nuevo León, Tamaulipas, and Vera Cruz. The distribution in Mexico may be more extensive, since undetermined *Ozamia* larvae have been observed in the Pacific coast State of Sinaloa.

Investigations have not shown the existence of any *Ozamia* in west Texas and New Mexico. In June 1926, however, larvae were fairly plentiful in prickly pear fruit around Tucson, Arizona, but unfortunately the adults were not reared. During the years 1924–1930 when a great deal of attention was paid to the cactus insects of this section of southern Arizona, *Ozamia* larvae were not recorded on any other occasion.

The usual host plant is the Playopuntia *Opuntia lindeheimeri*, which is the dominant, and often the sole, prickly pear of southeastern Texas and northeastern Mexico. The closely related *O. cacanapa* a plant of rather limited distribution, is freely infested. As it is unlikely that the insect would evince a high degree of preference for specific hosts, probably the fruit of any prickly pear growing within its range of distribution would be favored.

Ozamia fuscomaculella clarefacta is purely a flower and fruit enemy. Flower buds and young fruit rot or dry up from the attack, and several may be destroyed by one larva. Where fully developed green fruit are infested, they ripen prematurely and fall to the ground, but as they do not decay rapidly, one fruit may suffice for the growth of each larva. In the many extensive fields of *Opuntia lindheimeri*, which bears heavy fruit crops, *Ozamia* does not, as a rule, destroy a high percentage of the fruit, but in isolated patches or among scattered

plants of the prickly pear the greater proportion of the fruit may be destroyed by the larvae.

A special investigation of the life history and habits was conducted in 1925 at Uvalde, Texas, both in the field and under cage rearing conditions. Since young larvae were prevalent in early May, adults of the overwintering generation had evidently emerged in April, during or immediately following the main flowering period of *Opuntia lindheimeri*. These larvae entered and fed within the dying flower head, being often found in the style, and then attacked the developing fruit. They rarely penetrated from the flower through the crown. The usual practice was to move from the flower and to enter an adjacent fruit near the base, preferably where two fruit were in contact. A semicircular web of silk, mixed with frass, spun around the entrance hole served both for protection and for attaching the fruit to an adjacent one or to the segment. The larvae tunnelled in the fleshy portions of the fruit, which rotted or dried up. It was rare to find more than one larva in a fruit. The life cycle was completed in 5 to 6 weeks, the adults emerging from May 21 to the middle of June.

A portion of the second generation attacked the relatively small second crop of flowers and young fruit produced by some plants of *O. lindheimeri*, and the flower heads and young fruit of the late blooming *O. cacanapa*. The behavior of the larvae corresponded with that of the first generation; the life cycle occupied 4 to 5 weeks, and the moths emerged at the end of June and in July. The major part of this generation, however, infested the well-developed green fruit. The newly hatched larvae entered the fruit near the crown and penetrated directly to the seed cavity, where they fed on the fleshy covering of the seeds for 4 to 5 weeks or even longer. Development was gradual, and the feeding set up no decay; hence, the presence of the small larva could not be detected by outside indications. When the fruit turned red or purple preparatory to ripening, the larva tunnelled through the fleshy portions; a discharge hole was formed, often near the base of the fruit, and was covered with a small amount of webbing serving to attach the fruit. After leaving the seed cavity, larval growth was accelerated. It seemed that successful development was contingent on the ripening of the fruit. The existence of a small larva in the seed cavity tended to cause early ripening; the few colored fruit among a green crop almost invariably contained *Ozamia* larvae. The fruit became easily detached and often fell to the ground or were suspended by the larval webbing. The life cycle occupied 8 to 9 weeks, almost twice as long as that of the smaller portion of the generation infesting the late flowers. Moth emergence occurred from July 22 to August 10.

The third generation larvae behaved in a manner similar to that of the bulk of second generation. Because of the greater maturity of the fruit, development was more rapid. The life cycle was completed in 4 to 5 weeks, moths appearing from the end of August to the middle of September.

The fourth generation attacked the ripe fruit and completed development in approximately 6 weeks. Emergence took place in October, but occasional individuals emerged at intervals throughout November.

Observations on the life cycle and behavior of the fifth generation were not completed. However, it was learned that the larvae developed rather slowly in the ripe fruit, which gave no indication of their presence other than a slightly shrunken area covered with a tough white scab. In the cages small larvae occurred in late October; in the field small larvae were found in late December, but large larvae were seen a month earlier. It is thought that some larvae pupate, or at least spin cocoons, before the end of December, remaining as pupae or unpupated larvae for about four months, and that other larvae continue to develop slowly through the winter months; in either event the moths emerge in spring, which would be April in the Uvalde district.

The presence of larvae of the first generation is readily discerned because of the webbing around the entrance hole and the rapid decay of the fruit. But in the attack on well-developed fruit by later generations, the occurrence of larvae may be overlooked, since there is little outward sign of the infestation, and the ripe fruit tend to fall to the ground. Hence, general field observations reporting the prevalence of larvae from April to June and their scarcity from July to November have not given a true indication of the position, inasmuch as more intensive search would have been required in order to estimate the *Ozamia* population after the middle of summer.

The adult has a wing expanse of approximately one inch. The forewings are grey with darker markings, and the hindwings are pearly white with a narrow dark costal line. In fresh examples the thorax and basal half of the forewings have a definite green tint. In confinement the moths lived for 2 to 4 days. They feed readily on dilute honey water, a habit which contrasts with that of other cactus phycitids of the genera *Melitara*, *Cactoblastis*, and *Olycella*, the moths of which do not require nourishment.

The pale pink eggs are deposited singly on the fine spicules on or near the base of the fruit. The incubation period occupied about 5 days in May and 3½ days in June. No information was obtained on the fecundity of the females.

The young larvae of the first generation are somewhat white; later they are pink or wine-colored and become dull black in the last instars.

Larvae of the other generations developing in the large green or ripe fruit remain a light pink color and do not turn dark when full grown. The loose cocoons are spun among rubbish and soil, or occasionally in dead flower heads; the pupae are visible through their frail texture. A few small pink globules resembling air bubbles are intermingled with the silk of the cocoon; similar globules are found in the cocoons of species of *Yosemitia* and *Sigelgaita*. A pupal stage of 10 days has been recorded in May.

PARASITES.—Hymenoptera reared from the pupae include the chalcid *Brachymeria* (*Pseudobrachymeria*) *pedalis*, the ichneumon *Chelonus electus*, and two other undetermined ichneumonids. In cages the larvae are attacked by the braconid *Bracon hebetor*.

Ozamia thalassophila Dyar

The sole record of this species is that of the type female which emerged in August 1924 at Uvalde, Texas, in a cage containing material of the Cylindropuntia *Opuntia prolifera* collected at Oceanside, California, in July. It is presumed that the larva had been feeding in the fruit of the plant. The adult had a wing expanse of 28 mm.; the forewings were dark grey with darker markings, and the hindwings were white.

Ozamia immorella (Dyar)

This Mexican species, originally described by Dyar (1913) in *Euzophera*, was placed under *Ozamia* by Heinrich (1956), who reported that a series including one male had been reared in 1946 from larvae feeding in the fruits of prickly pear at Zacatecas, Mexico. The distribution is given as Caxaxa, Tehuacán (July), and Zacatecas (December), Mexico, and the food plant as *Opuntia* (*platyopuntia*) sp.

The wing expanse is 25 to 31 mm., and the color and markings of the forewing are similar to those of *Ozamia thalassophila*, except for a faint purplish red suffusion over the ground color that is especially noticeable on freshly reared examples, and less white dusting on the costal area.

This insect was not reared by the Board's officers.

Ozamia stigmaferella Dyar

This South American insect is known from the type female only. A single larva was found in January 1921 at Catamarca, Argentina, in a small hollow which it had excavated in the stem of *Cereus validus*. It left the plant to spin a loose cocoon, from which the adult emerged in early March. The wing expanse is 26 mm.; the forewings are dark grey with darker markings, and the hindwings are white.

Ozamia hemilutella Dyar

The larvae of this Argentine insect are fruit feeders with habits very similar to those of *O. fuscomaculella clarefacta* in Texas. Although rather widely distributed, the species does not seem to be prevalent, since there are not many records of its occurrence. The species was described from material reared from larva attacking fruit of *Cereus validus* at La Rioja, Argentina, in January and February 1921. In February 1925 fruit of the same plant were infested at Tacanitas, Province of Santiago del Estero, but the several species of *Opuntia* in the vicinity appeared to be immune from attack. During the more intensive investigations in the Argentine in 1931 to 1933, larvae were collected in fruit of *Opuntia quimilo* in the Province of Santiago del Estero and in one of the *O. monacantha* group in the neighbouring portion of the Chaco.

The olive-green larvae have been recorded in February, April, June, August, and November; moths have been reared in February and December, and eggs have been seen in the field in February. Thus, there may be at least three generations annually. In the case of *Cereus validus*, the pink eggs were laid singly on the outer scales of the flower buds; the larvae entered the fruit near the base and tunnelled into the seed cavity; later they attacked the fleshy portions, and the fruit dried up. On *Opuntia quimilo* the larvae occurred in the flowers and the crown of the fruit, many of which were destroyed.

The moth has a wing expanse of 27 to 30 mm.; the forewings are grey with a clear yellow inner area, and the hindwings are white.

Ozamia punicans Heinrich

This Argentine form, described in 1939, is considerably larger than other members of the genus, and the larvae are stem borers. It is known from one locality only: Tapia, Province of Tucumán. However, as will be mentioned later, its distribution may be much more extensive.

Olive-green larvae were found at Tapia in September–October 1933 and again in August 1936, living solitarily in rather large cells in the stems of *Cereus validus*. They spun cocoons within the larval cavities and produced moths in the second half of October in both years.

The adult has a wing expanse of 36 to 44 mm.; the forewings are light grey with several yellow blotches; the hindwings are white with slight fuscous shading.

In April and May 1937 very similar larvae were located in the stems of *C. validus* or a close ally, at Paso de los Libres, Province of Entre Ríos, Argentina, and of the related *C. alacriportanus* at Rio Grande do Sul, Pôrto Alegre, and Pelotus, State of Rio Grande do Sul, southern

Brazil. The larvae, which varied in color from light blue to green-blue, appeared to be about half-grown and had excavated rather large cells which were typical of the work of the Tapia larvae. The more succulent segments were favored, and young plants occasionally were killed by their activity. Adults were not reared.

PARASITES.—A dead larva from Pôrto Alegre produced braconid parasites *Apanteles* sp.

CACTOBROSIS Dyar

Of the five species from the United States and Mexico included in this genus by Heinrich (1956), the three Mexican forms, *Cactobrosis longipennella* (Hampson), *C. maculifera* Dyar, and *C. insignatella* Dyar, are known only from collected adults. He gives *Ferocactus* as the probable food plant of *C. longipennella.*

Cactobrosis fernaldialis (*Hulst*)

During the Board's investigations this insect was located in the general vicinity of Tucson, Arizona, the host plant being the barrel cactus *Ferocactus wislizenii.* Heinrich lists many localities in the more southern section of Arizona, as well as San Diego, California, the moths having emerged or been captured in every month from April to November. He states that one specimen is labeled as having been reared from *Peniocereus greggii* which differs very greatly in its habit of growth from *Ferocactus.* In 1899 H. G. Hubbard recorded the rearing of moths from larvae feeding in decaying pulp of the giant cactus *Carnegiea gigantea.* The Board's officers were unable to find larvae in this host; however, solitary larvae of a dull-blue color were discovered in the giant cactus, but no adult was reared. As the larvae of *Cactobrosis fernaldialis* are gregarious, the solitary larvae in *Carnegiea* presumably represent a different insect.

As many as 100 larvae have been counted in one plant of *F. wislizeni.* Their presence is indicated by the yellowish appearance of a portion of the plant. They tunnel freely, discharging excrement through a few small holes. Often the outer husk of the plant remains alive, the interior becoming a semiliquid mass of rotting pulp in which dipterous and other scavenger larvae breed in great numbers. In the final stage of destruction the plant is reduced to a dry hollow shell. Rather flimsy cocoons of light texture are spun beneath the plant or in adjacent debris. Cocoons collected in June produced adults late in the same month.

The adult has a wing expanse of 34 to 55 mm.; the forewings are grey with darker markings and suffusions; the hindwings are white partially shaded with pale fuscous.

Cactobrosis strigalis (Barnes and McDunnough)

The larvae of this insect feed in various *Echinocereus*. Heinrich lists its occurrence at several localities in Utah, southern California, southern Arizona, and western Texas, and gives a record of one specimen reared from *E. pectinatus* at Mexico City; moths have been captured or reared in April through September.

In the course of the Board's work *C. strigalis* was found attacking the beautiful rainbow cactus *E. rigidissimus* in the foothills of the Santa Rita and Huachuca Mountains, Arizona. It was recorded also in *E. dasyacanthus* in the Davis Mountain sector of western Texas and in an undetermined *Echinocereus* at San Gorgonia Pass, California.

The deep-blue larvae appeared to be gregarious; in most cases several inhabited each plant, which was often hollowed out and destroyed. Half to full-grown larvae were secured in June and July and pupated in July and August, spinning loose cocoons beneath the plant. From these pupae, Arizona moths emerged in July and Californian adults in early September. On another occasion, one-third grown larvae found in Arizona in February produced adults in May. These records would suggest that there may be more than one generation annually. This hypothesis is strengthened by the fact that Heinrich lists adults from western Texas in April, July, and August.

The moth has a wing expanse of 30 to 44 mm.; the forewings are grey, with blackish lines outlining some of the veins; the hindwings are white, but with some fuscous shading in the female. There is a strong resemblance to adults of *Eremberga leuconips*.

MISCELLANEOUS PHYCITIDAE

In May 1925 larvae collected in *Opuntia* flowers at Uvalde and at Devil's River, Texas, produced small greyish moths which were identified by H. G. Dyar as *Eurythmia hospitella* Zeller and *E. anthophila* Dyar.These are the only records, and it is not known if the species are true cactus insects. Heinrich (1956) assigns the former to *Erelevia quantullela* (Hulst) and the latter to *Sosipatra anthophila* (Dyar).

In addition to the many phycitid cactus insects already listed, larvae of other members of this group have been discovered, mainly in South America. Since adults were not reared, the identity of these insects, discussed below, remains unknown.

Brazil. In December 1928 the buds and young fruit of *Opuntia brasiliensis* and *O. monacantha* at Macahé and Cabo Frio, State of Rio de Janeiro, were attacked by larvae which in general appearance and feeding habits appeared to be typical of the genus *Ozamia*.

In the same month similar larvae were located at Bahia in fruit of a *Cereus*. The same or an allied insect occurred rather sparingly in the buds and fruit of *O. inamoena* at Queimadas and Joazeiro in the dry inland section of the State of Bahia and at Bôa Vista in the adioining portion of the State of Pernambuco.

In southern Brazil and at Cabo Frio solitary larvae in flower buds and fruit of *Cereus* spp., were causing damage in November-December 1958.

Ecuador. In January 1929 small dull-purplish larvae, up to one-half inch long, were observed in the fruit of *Opuntia ficus-indica* in the interior valleys of Ecuador, at an altitude of 7,000 to 8,000 feet. The attacked fruit often dried up; if they remained green the developing seeds were destroyed. The larvae pupated in flimsy cocoons in the crown of the fruit. This insect may belong to the genus *Ozamia*.

United States of America. In the vicinity of Tucson, Arizona, a few examples of a dull-blue larva, about one inch in length, were found singly in stems of the giant cactus *Carnegiea gigantea*.

Chile. In December 1936 and January 1937 solitary blue larvae were located in the more succulent top segments of *Trichocereus chiloensis* in the general vicinity of Santiago. The larvae, which appeared to be about half grown, formed tunnels up to 18 inches in length. It was evident that the larvae vacated the plant to pupate in the soil or among debris. A single moth taken resting on a plant of *T. chiloensis* may have represented the adult; this example was considered by Heinrich to be congeneric with the Peruvian and Chilean forms included in the genus *Sigelgaita*.

Brazil. In December 1928 and November–December 1958 at Macahé and Cabo Frio, State of Rio de Janeiro, and at Sousas, solitary larvae were not uncommon in the branches and main stems of *Cereus* spp., including *Cereus variabilis*. They varied in size from very small to apparently full-grown examples 1½ inches in length; the small larvae were wine-colored, and the older ones were green-blue. Each larva had tunneled out a considerable cavity and had sheltered within a black case near the point of entrance. Exit holes had been cut in the stems after the manner of *Olycella* larva, and pupation apparently occurred in the soil or rubbish. As many as 12 larvae were observed in one plant. Many large *Cereus* plants had been killed, presumably as a result of the activities of the insect over a period of several generations.

Brazil. White or cream-colored larvae with black spots were prevalent in Cereus plants at Bahia, Brazil, in December 1928. They varied in size from very small to about one inch in length; the largest examples did not appear to be full grown. They were of solitary habit,

and their work resembled that of the preceding species in that considerable cavities were made in the stems and exit holes had been cut out by the full-grown individuals. Although many of the exit holes had been made very recently, no cocoons were found.

Brazil. Around Queimadas, in the dry inland portion of the State of Bahia, solitary larvae occurred in the erect *Opuntia palmadora* in January 1929. They varied in size from very small to about three-quarters of an inch in length. The very young larvae were white; subsequently they became yellowish and then dark brown, but the largest examples were cream-colored with definite black markings. The small terminal segments of *O. palmadora* were attacked first and were often destroyed. The larvae tunneled freely through into the larger segments and old work was observed in the main stems. Further west at Joazeiro, and between that point and the Rio Branco in the State of Pernambuco, very small larvae that appeared to represent the same insect were found in the low-growing *O. inamoena.*

Paraguay. At least three larvae representing three species of Phycitidae were found in November–December 1958 attacking stems and fruit of *Harrisia martinii*, *H. bonplandii*, *H. guelichii*, *H. pomanensis*, and *Cereus* sp.

Argentina. At Salsacate, Tapia, Vipos, and Cumbre, larvae of four species of Phycitidae were found attacking stems and fruit of *Cereus validus* and *Trichocereus* in December 1958.

Lepidoptera: Pyralidae

The family Pyralidae is represented by one very interesting form.

BEEBEA Schaus

Beebea guglielmi Schaus

This species was not encountered during the Board's investigations, but is included here because of its outstanding interest. In the first place, it is the only true pyralid known to attack Cactaceae, and hence it has no near relations among the cactus-feeding Lepidoptera. Secondly, it is the largest of the cactus-moth borers.

It was described as new, and a genus was erected for its reception, in 1923 from specimens collected the same year in the Galápagos Islands, which are situated in the Pacific Ocean several hundred miles off the coast of Ecuador. However, the insect had been discovered many years earlier in 1905–06 by Dr. F. X. Williams, who (1930) published notes on its habits.

The sole species of prickly pear native to the Galápagos Islands is the extremely variable *Opuntia galapageia* which may be a low-growing creeping plant or which may grow erect to a height of 30 feet. The larva, solitary in habit, forms within the *Opuntia* segments a rather commodious tunnel weakly lined with silk and opening to the exterior by a delicate silken tube. The full-grown larvae are dirty white, pink dorsally, with brown plates. The stout cocoon is attached to the exterior of the plant and is covered with prickly pear spines, lichens, and other available material. The large grey-brown moths with a wing expanse of 2 to 3 inches emerge in September and October. Williams states that *Beebea* Schaus is evidently widely distributed in the Galápagos group.

Lepidoptera: Pyraustidae

MEGASTES Guenée

The following pyraustid species was formerly placed in the genus *Laniifera* Hampson.

Megastes cyclades (Druce)

On account of the truly social habit of the larvae, which live in colonies within the segments and stems of prickly pear after the manner of the various species of *Melitara* and *Cactoblastis*, this distinctive insect deserves more than passing notice.

Megastes is widely distributed in Mexico, from Durango and the mountainous section between Victoria and Tula in the southwest of the State of Tamaulipas in the north as far south as Oaxaca. It appears to be most abundant around Aguascalientes, occurs in scattered quantity in the neighbourhood of San Luis Potosí and Mexico City, and has been collected at many other localities such as Guadalajara and Techuacán. The distribution was thought to be restricted to elevations of between 5,000 and 8,000 feet on the Central Plateau, but in April 1931 one colony of larvae was observed near Tampico on the gulf coast.

In addition to the Mexican distribution, this insect is known to occur in one small area in the Tucson region of southern Arizona. In May 1924 Dr. Vorbies of the University of Arizona found larvae in the Florida Canyon of the Santa Rita Mountains about 25 miles southeast of Tucson. Officers of the Board had no difficulty in locating material in Florida Canyon in 1925 and 1926, but in June 1928 considerable searching resulted in one batch of cocoons. Although general scouting for cactus insects was carried out over a period of several years in southern Arizona, particularly in the Tucson district, no

records of its existence were made in localities other than Florida Canyon. Despite the fact that the insect was not found in the Mexican State of Chihuahua, its range possibly extends northward from Durango along the mountains of the main divide in the extreme western section of Chihuahua into southern Arizona. Another theory is that its occurrence in Florida Canyon is fortuitous and may have arisen through the importation of prickly pear from Mexico for garden culture at Tucson.

The host plants are Platyopuntias. In Mexico tree and semitree pears (much more numerous than shrub pears) are the usual food plants, the records including *Opuntia tomentosa*, *O. streptacantha*, *O. hyptiacantha*, *O. lasiacantha*, *O. leucotricha*, *O. robusta*, and *O. fuliginosa*; the shrub pear *O. cantabrigiensis*, is occasionally attacked. The larvae found at Tampico were inhabiting an undetermined, erect, brittle-jointed prickly pear related to *O. jamaicensis*. In Arizona semitree pears are nonexistent, and the host plants in Florida Canyon were the shrubby *O. cañada*, *O. discata*, and *O. chlorotica*. Under cage conditions at Uvalde, Texas, the larvae developed readily in the shrub pear *O. lindheimeri*.

The moth has a wing expanse of 1½ to 1¾ inches; the forewings are dusky yellow with dark transverse markings; the hindwings are whitish with a dark outer line and a fine wavy line in the center. The newly hatched larvae are brown with pronounced dark markings, although the color gradually becomes lighter and the markings fainter, and full-grown larvae are creamy-white with a light brown spot on each side of each segment.

Megastes was studied at Uvalde, Texas, in 1926–28, at San Luis Potosí, Mexico, in 1930–31, and at Cuernavaca, Mexico, in 1933-35, but, owing to the disinclination of the moths to oviposit in captivity and to the susceptibility of caged larvae to disease epidemic, data on various phases of the life history were rather meager.

Both cage records and field observations indicate that there are two generations annually. The winter is spent in the larval stage. Pupation takes place in May and June, and the adults emerge in June and July. At Uvalde in 1926 larvae from eggs laid in June and July developed rapidly and started to pupate at the end of July; the first adult emerged on August 10, after a life cycle of 52 days. In Mexico very small larvae have been observed rather generally in September and October, indicating that a complete generation must have intervened after June-July emergence.

The moths have not survived for longer than 3 days in confinement. Little is known about the sex proportions; in one batch of 372 moths, 166 (about 44.6 percent) were females. Similarly there is not much in-

formation on fecundity, since under cage conditions the females have usually failed to oviposit. In one instant 1158 eggs were obtained from 15 females, giving an average of 77.2 eggs per individual.

The eggs, flat and either circular or oval in outline, are deposited on the surface of the segment or along the spines. Eggs deposited on the flat surface of the plant are circular and are placed in groups of 40 to 90 with the edges overlapping. On the spines they are usually end to end in a row, pressed tightly against each other, and assuming an oval shape. The incubation period has been as short as 4 to 5 days at Uvalde in June 1926, while at San Luis Potosí in June 1930 the period was 11 to 13 days.

Immediately after hatching, the larvae spin a heavy protective web, usually near an areole. They may live beneath this web for several days, during which time they gnaw holes in the cuticle. All larvae from one batch of eggs enter the plant through one hole, and younger colonies may contain 50 or more individuals. As development proceeds, the colony either divides or else suffers considerable mortality, since older larvae are found in groups of a few to about 30, the average number being about 10 larvae in a colony. They work downward, tunneling through several segments and the main stem to near the base of the plant. In semitree prickly pears with a definite trunk they inhabit a cavity in the form of a long cylindrical tube weakly lined with silk in the center of the main stem. The cavity is kept free from excreta; hence the work in the main stems is not accompanied by rotting. One discharge hole serves the colony for the ejection of frass pellets, and this hole may be situated up to several feet above the point where the larvae are feeding. The larvae are disinclined to transfer from one plant to another, or even to move to another part of the same plant. In cages, if the infested plant decayed, they usually died without making any attempt to enter an adjacent plant.

The flimsy cocoons are spun, generally in small clusters, within the larval tunnels. The pupal stage has been determined to occupy about 30 days in June. In the case where the summer generation completed the life cycle in 52 days, the pupal period was approximately 14 days in late July and early August. *Megastes* larvae are capable of causing considerable destruction to shrub pears, such as *O. discata* and *O. cantabrigiensis*, and to the more succulent semitree pears, such as *O. robusta*. In typical semitree pears like *O. streptacantha*, the tunneling of the larvae effects no greater damage than the weakening of woody main branches and stems, which may be broken off by wind.

PARASITES.—The large larvae are often heavily parasitised by the braconid *Apanteles megathymi* and the tachinids *Phorocera* sp. and *Lespesia* sp., all of which emerge from the cocoons.

NOCTUELIA Guenée

This pyraustid genus of several species contains one cactus-feeding representative.

Noctuelia elautalis Grote

This insect is primarily a flower and fruit enemy. It appears to be restricted to the United States, being distributed over the greater part of the plateau of Arizona, New Mexico, and West Texas. In Texas its range extends eastward from the foothills around Del Rio to Uvalde and along the Rio Grande to Laredo; however, it has not been found north or east of Uvalde. Records of more or less heavy or general infestations of larvae, made between 1924 and 1928, are as follows:

1925: Very numerous in the foothills of Valverde County west of Del Rio, Texas, and around Tucson, Arizona. Present generally in Arizona but not observed in western Texas and New Mexico.

1926: Prevalent around Carlsbad, New Mexico. Fairly numerous in some areas in the Tucson district.

1927: Rather common at Eagle Pass, Texas.

1928: Very few larvae in Valverde County, Texas. Common at Mesilla Park, New Mexico. Generally prevalent in the southern half of Arizona as far north as Ashfork.

The host plants include various prickly pears of the shrub type, such as *Opuntia lindheimeri*, *O. cacanapa*, *O. engelmannii*, *O. phaeacantha*, *O. atrispina*, *O. tenuispina*, and *O. macrocentra*. Cylindropuntia food plants are *O. fulgida* commonly in Arizona, *O. imbricata* occasionally in west Texas and New Mexico, and one record of the small low-growing *O. stanlyi* in Arizona. All species of Platyopuntia occurring within the insect's range of distribution appear to be subject to attack. Thus there is no marked preference for a particular host. However, in Valverde County, Texas, in 1925, when the larvae were very abundant in areas containing a mixed flora of the low-growing *O. atrispina* and both low-growing and taller forms of *O. lindheimeri* and *O. engelmannii*, the former seemed to be the most frequent host, while the taller plants of the other two prickly pears were almost immune from attack. Concerning Cylindropuntias, in the Tucson district where several species are abundant, *O. fulgida* was certainly the preferred, if not the sole, food plant among this group.

The adult has a wing expanse of about one inch; the wings are dull yellowish with somewhat darker markings. The larvae are white, with several narrow crimson transverse bands.

In the case of prickly pears the attack is confined to the flowers and fruit. Of the Cylindropuntia *O. fulgida* both the fruit and the very young soft fleshy growth are eaten; sometimes the new growth is preferred. Usually the larvae infest the flower buds, entering at the apex of the petals. They feed within the buds and in the open flowers, devouring the stamens, style, and fleshy portions of the petals; later they tunnel down into the ovary and eat out the seed cavity. Development is often completed within the flower head. When fruit are attacked, entrance is generally through the crown, which is covered with reddish webbing containing frass pellets; more rarely the fruit is penetrated from near the base. The larvae are active, crawling freely over the plant to transfer from fruit to fruit. Frequently two or three larvae inhabit one flower head, and as many as eight have been counted in an unopened bud. As regards injury to the plant, the feeding in the buds and flowers prevents seed development, since the fruit are rendered sterile; and when the fruit is entered, the seed cavity is generally eaten out.

The duration of the larval life has not been ascertained. The active larval stage is comparatively short, probably occupying two to three weeks, and in any case less than a month. The full-grown larvae descend to the ground and form small circular cocoons of fine strong silk covered with earth. Cocoons have not been located in the field, but in cages were attached to the woodwork below the soil level. Pupation does not take place for some time; for example, larvae that formed cocoon cells at the end of April had not pupated by the end of August; probably they remain in this condition for the greater part of the year.

N. elautalis appears in the spring and early summer concurrently with the flowering of prickly-pear. In Texas the larvae occur in April and May, the latest date for full-grown larvae in the field being May 19. Larvae were in various stages of development in Valverde County on April 19, 1925; a week later many were full-grown, and some had already vacated the fruit; by May 9 a few late individuals remained. In New Mexico the main occurrence of larvae is from the latter part of May to the third week of June.

Observations on the life cycle are incomplete, but the various data indicate that there is one annual generation, with a second or partial second generation occurring in southern Arizona. Thus larvae collected in Texas in April were still unpupated larvae in cocoons at the end of August, while in the field larvae were found in this state in April and May only.

As regards the second generation in southern Arizona, the following records are offered. Around Tucson in 1924 the main attack appeared to have ended some time prior to the third week of July, when a few larvae, presumably of a second generation, were noticed in the fruit

and new growth of *Opuntia fulgida*. During the following season at Tucson larvae were abundant in late May and early June, and collected material produced one adult before the end of June. On June 18, several moths were captured at light, while on July 9, following recent rains, young larvae were attacking the young growth of *O. fulgida* in one area near Tucson. It is considered that these larvae would have represented the progeny of moths on the wing on June 18. One final record of a short life cycle in Arizona can be quoted. From larvae, which were thought to be second generation material, collected at Tucson in July 1924, one moth emerged at Uvalde, Texas, in August.

MIMORISTA Warren

This pyraustid genus, containing at least three species, appears to be a true cactus segregate with a distribution extending from the United States to Argentina. The larvae live either internally or externally on the segments of prickly-pear and of other cacti.

Mimorista flavidissimalis (Grote)

The range of this insect embraces the West Indies and the coastal and subcoastal portions of southern Texas and northeastern Mexico. Its distribution may include Central America, since the form recorded on page 82 as *Mimorista* sp. may well prove to be this insect.

In the Board's investigations it was found very freely in Cuba, Haiti, Dominican Republic, and Puerto Rico, and more sparingly in Jamaica. On the mainland it extends from Tampico, Mexico, northward through the State of Tamaulipas. In Texas it is abundant around Brownsville and ranges inland in a northwesterly direction to Uvalde and northward along the gulf coast to Victoria, but has not been observed in the Galveston district. Although it is common in the West Indies, extensive surveys have not revealed its presence in Florida.

In Texas and Tamaulipas the shrub pear, *Opuntia lindheimeri*, which is the dominant prickly pear of these regions, is the usual host plant; on rare occasions larvae have been observed on the narrow-jointed Cylindropuntia *O. leptocaulis*. In the West Indies prickly pears seemed to be attacked indiscriminately, and recorded food plants included the shrub pear, *O. dillenii*, and the three brittle-jointed relations, *O. tuna*, *O. antillana*, and *O. jamaicensis*, as well as the Cylindropuntia *O. caribaea*.

The adult has a wing expanse of three-quarters of an inch; the wings are bright yellow with three or four transverse rows of dark but rather faint markings. Sometimes, particularly in late autumn, the markings are much larger and darker, and the wings are conspicuously mottled.

The eggs are circular and flattened, and are deposited singly on the surface of the segments. The yellowish-white larvae attack the very young cladodes, living beneath a light web, under the protection of which they tunnel in and out of the growth. The species is not truly gregarious, but as a rule from two to several larvae occur on the same segment. The flat cocoon, of firm paper-like texture, is attached to destroyed segments, fallen leaves, and other debris.

The main observations on the life history were carried out at Brownsville, Texas. It was found that there are between seven and nine generations annually, the actual number depending on climatic conditions and on the availability of young growth, since the larvae are unable to subsist on older segments. Between March and August the life cycle of each generation averaged 28 to 35 days; the shortest recorded life cycle was 21 days. In the autumn months of September to November, development was slower. The majority of the last autumn generation pupated in November and remained in the pupal stage until late February or early March, when the adults emerged in numbers. Sporadic moth emergence and oviposition may take place during winter. Thus, in 1932–33 moths emerged and oviposited from November 22 to December 11, and young larvae were seen throughout December; presence of a few of young larvae in the field in early February indicated that some adults had emerged in late January; these larvae died during a period of cold weather in the middle of February.

Adults have remained alive for 12 to 20 days, feeding readily on sweetened water. During the period March to July, the incubation period occupied 3 to 5 days, the larval period 10 to 16 days and the prepupal and pupal period 7 to 16 days.

Around Brownsville and in coastal areas of Tamaulipas the larvae are often very abundant from April to June, which is the main growing season for *O. lindheimeri*. Under favorable climatic and nutritional conditions the species is capable of rapid increase, but in the autumn months the essential young growth is scarce and the population dwindles to small numbers surviving in localized areas. It has been found possible to bring about an increase in the infestation in the late summer and autumn by cutting back the *Opuntia* plants, and thereby inducing the production of new shoots. Owing to the rapid decay and destruction of the attacked young growth, starvation causes heavy mortality among the larvae. Little information has been obtained on the fecundity, but it is known that individual females can deposit at least 50 eggs. In rearing operations the difficulty of maintaining an adequate supply of very young growth has been a serious factor in limiting the increase; on one occasion 1500 adults were reared from 160 parents.

263-417—68——7

In the West Indies the insect was in all stages of development in Cuba, Haiti, and the Dominican Republic in December and January.

When they are prevalent, the larvae destroy an appreciable amount of the young growth. It was estimated that 75 to 80 percent of the new shoots around Brownsville were attacked in May 1933, while in December 1932, 80 to 90 percent of the limited quantity of young segments were infested.

PARASITES.—The larvae are rather freely attacked by the ichneumon, *Eiphosoma annulatum* and *E. texanum*, which emerge from the pupae. The braconid, *Apanteles mimoristae* is a common enemy of the pupating larvae. A chalcid, *Sympiesomorpha* sp. is either a direct parasite of *Mimorista* or a hyperparasite attacking *Eiphosoma* sp.

Mimorista pulchellalis (Dyar)

Although this form has been obtained in several host plants from various localities in Argentina, it appears to be a rare insect. It was described from a single example reared from a whitish larva found in a small plant of *Echinopsis* at Catamarca in February 1921; the larva had eaten out an excavation in the plant and pupated in the cavity.

During the Argentine investigations of 1931 to 1935, a few larvae were found from time to time at Tapia and Vipos in the Province of Tucumán and at Anatuya, in the Province of Santiago del Estero, in young growth of *Opuntia discolor*, *O. sulphurea*, and *O. quimilo*, and in segments of *Harrisia pomanensis*. Larvae were collected in January, July, October, and November, and adults were reared in September and November. One larva produced several braconid parasites.

The adult differs markedly from the two preceding species. The wings are yellow with a large brown central area and a brown outer margin on the forewing.

In Paraguay in December 1958, a few Mimorista-like larvae were found in *Harrisia bonplandii*.

Mimorista Warren, sp.

In November and December 1927, larvae were very abundant at Zacapa, Guatemala, and Tegucigalpa, Honduras, and were observed at Guatemala City and Amatitlán, Guatemala, and in the Comayagua Valley, Honduras. They were attacking the young growth of *Nopalea lutea*, *N. guatemalensis*, and *N. cochenillifera*. Adults were not reared, but the larvae seemed identical in appearance and habits with those of *M. flavidissimalis* Grote.

CHRYSOBATYS Munroe

Chrysobatys cambogialis (Guenée)

The few records concerning this insect were made in southern Brazil and northeastern Argentina. In May 1921, a greenish-white larva was found beneath a web in a small cavity on a plant of *Cereus pernambucensis* at Leme, State of Rio de Janeiro, Brazil; the moth emerged in June. In April 1935, two larvae were collected in young growth of *Opuntia monacantha* at Campinas, State of São Paulo, Brazil; adults emerged in early May. In late April 1937, larvae were taken in the fruit of *Pereskia sacharosa* at Concordia and Paso de Los Libres, Province of Entre Ríos, Argentina; moths were reared in June. The adult is very similar to *M. flavidissimalis* (Grote).

A doubtful record, which probably refers to this species or to *M. pulchellalis* Dyar, is that of a larvae found in *O. salmiana* at Paraná, Province of Entre Ríos, Argentina, in August 1932. This example produced braconid parasites.

Lepidoptera: Gelechiidae

METAPLEURA Busck

This genus of the Gelechiidae is represented by a single species from Mexico.

Metapleura potosi (Busck)

This insect has a rather extensive distribution in the southern half of Mexico, having been located from Pachuca in the State of Hidalgo as far south as Oaxaca. On several occasions it was moderately prevalent in the general vicinity of Mexico City. The recorded host plants comprise tree-pear types such as *Opuntia streptacantha*, *O. lasiacantha*, and *O. tomentosa*. Under cage conditions in Australia the insect bred readily in the shrub pear *O. inermis*.

The moth has a wing expanse of 1.25 inches; the forewings are mottled light and dark brown; the palpi are upturned and prominent. The full-grown larva is about three-quarters of an inch in length; it is dull red in color, with dark raised tubercles on each segment giving an indefinitely banded appearance.

The larvae live in individual cells in both the younger and the older segments of prickly pear; the cells are circular brown areas with a maximum diameter of two inches. There may be 1 or 2 or as many as 15 to 20 larvae in one segment. Normally, little damage is caused to the plant, but segments often rot completely if attacked by more

than 10 larvae. Naked pupae are formed within the larval cells. The eggs are laid singly or two or three together on the segments; in cages they were usually deposited on the cloth and wire, and rarely on the plant.

Metapleura was reared in cages in North America over a period of two years. Although moths emerged practically throughout the year, there appeared to be three overlapping generations, with the crest of moth emergence occurring in April, July, and September, respectively. In 1927 moths emerged in the following numbers:

Month	*Number*
January through March	A few (definite emergence began at the end of March)
April	256
May	146
June	550
July	2,170
August	550
September	7,400
October	2,390
November	470
December	107

The life cycle occupied an average of about 40 days in May and June, 50 days in July and August, and 63 days in July to September. At Sherwood, Queensland, the life cycle was completed in 90 days during the period December to March. An incubation period of 10 days was recorded in North America in September. The moths oviposited freely; for example, 28 females laid a total of 2300 eggs, an average of 82 per individual.

AEROTYPIA Walsingham

Aerotypia pleurotella Walsingham

The distribution embraces the Central Plateau of Mexico from the northern border of the State of San Luis Potosí as far south as Tehuacán. Larvae have been observed in numbers in the neighborhood of Mexico City, at Morelia, State of Michoacán, and at Aguascalientes. The known food plants are the tree pears, *Opuntia tomentosa*, *O. streptacantha*, *O. lasiacantha*, *O. robusta*, and the shrub pear, *O. cantabrigiensis*. Probably all Platyopuntias within its range of distribution would be subject to attack.

The slender moths have a wing expanse of 1.50 inches. The palpi are upturned and pointed. The forewings are silver-white with a brown outer margin and a longitudinal central brown stripe. The hindwings are light brown.

The dull blue-grey larvae live singly in tunnels or cell cavities, usually in the terminal or subterminal segments. Frequently several inhabit the same cladode. The cells are dry and clean, with exterior holes for the discharge of frass. The larvae pupate nakedly within the cells.

Apparently there are two generations each year. The insect is in the larval stage during the winter. Half grown larvae collected in March were full-grown in May and produced moths in June and July. In the succeeding generations the larvae were half-grown in September, yielding adults in November.

As with *Metapleura potosi*, this species does not cause appreciable damage to prickly pear, other than the occasional destruction of segments by several larvae tunneling in the same cladode.

Lepidoptera: Tineidae

DYOTOPASTA Busck

Dyotopasta yumaella Kearfott

Hunter, Pratt, and Mitchell recorded this insect as having been reared from *Opuntia* fruit in Texas, and E. C. Van Dyke (1936) states that the larvae were destroying many clumps of a small *Opuntia*, probably *O. basilaris*, in Kern County, California.

In our experience, *Dyotopasta* is not a primary enemy of prickly pear. Its attack is of a secondary order; the larvae have been found very commonly associated with *Melitara* larvae in Texas, New Mexico, and Arizona, occurring in the feeding cavities of these primary tunnelers and in the dried-out *Opuntia* segments destroyed or partially destroyed by them. *Dytopasta* feed mainly on the dead tissue, but appear to eat to some extent the living tissue surrounding the cavities. It is thought that in certain cases they have aided in the ultimate destruction of the segments.

The distribution extends southward as far as Mexico City where the larvae have been observed in numbers in disused cavities in *Opuntia* previously occupied by larvae of the moth borer *Megastes cyclades*, and of the beetles *Moneilema* spp. and *Archlagocheirus funestus*.

Similar larvae were noted in the dead tissue of *Cereus* sp. near Rio de Janeiro, Brazil.

TINEA Linnaeus, sp.

Pink grey larvae, found in dried stems of *Cereus* sp. at Santa Eulalia, Peru, in October 1936, produced moths in the following January. This insect is probably a scavenger.

Lepidoptera: Gracilariidae

MARMARA Clemens

Marmara opuntiella Busck

This leaf-miner occurs at lower altitudes in Texas from the gulf coast as far north as Austin and as far west as Uvalde. In Mexico it is prevalent on the central plateau from Chihuahua to Mexico City and in the gulf-coast State of Tamaulipas; a record from Mazatlán in the west-coast State of Sinaloa probably represents this insect.

Similar larvae of identical habits have been found commonly at Santiago in Cuba, in all species of prickly pear in Haiti, in the Central American countries of Guatemala, El Salvador, and Honduras, and at Barquisimeto in Venezuela. Typical leaf-miner injury in Platyopuntias has been observed at Puerto Colombia in Colombia, at Simbambe in Ecuador, and at Arequipa in Peru.

Owing to the minor nature of the injuries, the Board's officers gave little attention to the life history. The small red or pink larvae live beneath the epidermis of the more terminal segments, forming winding galleries in which they are plainly visible through the thin cuticle. The galleries may extend over the whole surface in the event of several larvae inhabiting one cladode. Generally the damage is insignificant, but where the infestation is heavy occasional terminal segments may fall off and decay.

It is not known whether one or two generations are completed each year. Larvae collected in August at Uvalde, Texas, and at San Luis Potosí, Mexico, pupated in the soil in the following March. On another occasion larvae at Uvalde vacated the segments to pupate in the soil in August, and moths emerged in the following May. Well-developed larvae have been observed in Texas and in Mexico during the greater part of the year. All prickly pears appear to be attacked without discrimination. In Central America segments of *Nopalea* spp. as well as prickly pears were infested.

Lepidoptera: Miscellaneous Species

***Blastobasis* Zeller, sp. (Blastobasidae)**

Adults were reared in November 1936, from greyish larvae collected the previous month in fruit of *Borzicactus acanthurus* at Santa Eulalia, Peru.

***Thecla melanis* Drury (Lycaenidae)**

This lycaenid is the only butterfly whose larvae are known to be cactus feeders. However, it possesses various other host plants. In

January and February 1921, larvae were feeding externally on segments of *Opuntia sulphurea* at Catamarca and Andalgala, western Argentina; in confinement they readily attacked *O. ficus-indica*. In December 1924, larvae were devouring the corolla of the flowers and were eating holes in young fruit of *O. sulphurea* at Mendoza, western Argentina.

LEPIDOPTERA SPECIES UNDETERMINED

At La Guiara, Venezuela, three larvae were found in individual cells in a segment of the prickly pear *O. schumanni*. They were light orange-red with a dark transverse band on each segment. The colour and habits of the larvae suggest a relationship with the Mexican gelechiid *Metapleura potosi*.

In Argentina at Resistencia in December 1958, semi-looper larvae belonging to the family Noctuidae were found feeding in *Harrisia martinii*. This is the only record of this lepidopterous family on a cactus species.

COLEOPTERA

The coleopterous insects of the Cactaceae comprise approximately 67 species. Hence this order is not greatly inferior to the Lepidoptera in numerical importance. With few exceptions the cactus beetles are included in the Cerambycidae and Curculionidae, and roughly two-thirds belong to the genera *Moneilema* (Cerambycidae) and *Gerstaeckeria* (Curculionidae).

Not more than two species of Chrysomelidae are known to attack cactus plants. This paucity of leaf-eating beetles in rather surprising. As the succulent cladodes and stems of prickly pears and other cacti should be particularly suited to the requirements of this family, one might have expected that a group of cactus forms would have developed.

COLEOPTERA: Cerambycidae

The great bulk of the cactus longicorns are included in the genus *Moneilema* Say with at least twenty-five species. The remaining five species are divided between four different genera. With one exception all the known cerambycid enemies are North American forms.

ALCIDION Dejean

This genus contains one cactus feeding species, which is indigenous to South America.

Alcidion cereicola Fisher

This species was described as new in 1936 from material collected by officers of the Commonwealth Prickly Pear Board in Argentina. It was again found in December 1958. The adult is a rather small stout longicorn measuring 12 to 13 mm. in length by 4.75 to 5.5 mm. in width; the pronotum is light brown; the elytra are dark with a large irregualr light-brown patch at the middle. Material has been obtained at Santiago del Estero, at Tapia in the Province of Tucumán, and at Güemes in the Province of Salta. The known host plants are *Stetsonia*, *Cereus validus*, *Echinopsis shaferi*, and *Cleistocactus* sp. The larvae tunnel in the stems of these plants and have usually been found in small colonies. Large larvae and pupae were collected in August, September, and October, and the beetles emerged in November. The species, which does not appear to be common, is capable of causing serious injury to the attacked plants.

COENOPAEUS Horn

Of the two species included in this genus, one, *Coenopaeus niger* Horn, was not encountered during the investigations. Concerning this form W. S. Fisher of the U.S. Department of Agriculture wrote in September 1937:

> I believe that this is a distinct species, as I have not seen any specimens intermediate between it and *palmeri*. This insect was described from Sierra el Cinche, 2,000 feet, in the extreme southern part of Lower California, Mexico; all the specimens I have seen are from that region.

Coenopaeus palmeri (LeConte)

This mottled black and light-grey beetle, attaining an inch in length, is an enemy of Cylindropuntias in southwestern United States, where its distribution extends from west Texas to southern California. In west Texas it has been found at Shafter in the Big Bend country; in New Mexico it occurs rather freely around Silver City and has been taken as far north as Hot Springs; in Arizona its range includes the Globe, Tucson, and Douglas sectors; in California it has been located in the eastern foothills of the San Jacinto and Cuyamaca Mountains. The distribution probably embraces the more northerly portions of Mexico. A single specimen, taken near San Luis Potosí in June 1927, appeared to differ slightly from typical examples. Dark individuals with very little mottling, collected at Culiacán, in the west-coast State of Sinaloa, were identified by W. S. Fisher as this species.

The usual host plants are *Opuntia imbricata* in Texas and New Mexico, *O. spinosior* in New Mexico and Arizona, and *O. bernardina* in California. In the vicinity of Tucson, Arizona, *O. spinosior* was the favoured host plant; other Cylindropuntias such as *O. fulgida* and *O. versicolor* were selected more rarely. Platyopuntias do not appear to be attacked in the field. However, the adults fed readily on *Opuntia lindheimeri* in cages, while young larvae, transferred in August into segments of this prickly pear from *O. imbricata*, developed successfully in *lindheimeri* segments and produced adults the following June.

There is one generation annually. The beetles emerge from late May to July and live for 3 to 4 weeks; adults have not been observed in the field later than July. The narrowly elliptical eggs are deposited singly beneath a gummy secretion on the broken surface of segments where the adults have been feeding. The larvae tunnel in the stems and branches, and pupate within the galleries in April and May.

On various occasions heavy infestations of larvae have been reported in fields of *O. imbricata*, *O. spinosior*, and *O. bernardina*. The large plants are considerably damaged through the death of infested stems, but are rarely destroyed completely. Small plants may be killed outright; for example, in an area of stunted *O. imbricata* at Shafter, Texas, a very definite proportion of the plants was destroyed by this insect.

ARCHLAGOCHEIRUS Dillon

The one cactus feeding member of the genus, *A. funestus* (Thomson), formerly placed in *Lagochirus* Erichson, appears to be restricted to prickly pears. Special investigations conducted by the Board in Mexico failed to locate other host plants.

Archlagocheirus funestus (Thomson)

This rather large broad longicorn, attaining a length of a little more than an inch, is dark brown in color with a marbling of darker markings. Its known distribution is the southern half of Mexico, where it has been found around Puebla, at Cuernavaca and other points in the State of Morelos, at Chilpancingo in the State of Guerrero, and at Oaxaca. The host plants are robust prickly pears with thick stems and branches of the tree and semi-tree pear groups, such as *Opuntia tomentosa*, *O. lasiacantha*, *O. streptacantha*, *O. hyptiacantha*, and *Nopalea cochenillifera*. The smaller shrubby forms of prickly pear appear to be avoided, although under cage conditions in Australia the insect has completed its life cycle on *O. inermis*.

Attention was paid to its life history during 1934–35 in the State of Morelos, where it was rather prevalent in local areas, more especially

in the vicinity of Cuautla. A few early adults were seen in April, but general emergence occurred in July, reaching a peak late in the month. After August the number of beetles in the field gradually diminished until none could be located in late November. They feed high up on the plants, chewing irregularly circular areas in the apical segments, usually toward the margins.

Oviposition extended from July to September. The mode of oviposition is distinctive in that the female gnaws a series of narrow channels which form an irregular network two to four inches in diameter; the narrowly elliptic white eggs are placed at intervals either exposed in the channels or just beneath the surface at the bottom or edges of these narrow galleries; up to 20 eggs have been counted in one network. The number of eggs laid by individual females is unknown, but dissection of several examples gave an average of 70 eggs. The incubation period in August occupied 10 days.

Since the eggs are invariably placed on the main trunks and branches, the larvae tunnel more or less gregariously in these woody stems. They usually work downward, and by the time they reach full growth may have burrowed several feet from the point of entrance. In Mexico the earliest larvae were full-grown and had constructed cocoons in November. At the end of February about 50 percent of the larvae were in cocoons, but none had transformed to the pupal stage a month later. The cocoons, composed of the inner fibres of the plant, are bulky structures with a diameter or length attaining four inches; in outline they are irregularly circular and rather flattened on the sides; however, the shape is often determined by the free available space. It was evident that one generation occurred annually.

A. funestus was introduced into Australia in 1935 and is now firmly established. In the field there is, as in Mexico, an annual generation with the main emergence of adults in the midsummer months of December and January. However under cage conditions at Gogango in Central Queensland, where the rearing operations have been conducted, two complete or almost complete generations are obtained each year, with the peaks of beetle emergence occurring in November-December and April-May; some adults emerge nearly every month. The extra generation in the cages is attributed to the supplying of moisture in dry periods, thus hastening pupation; on the other hand, emergence in the field appears to await the midsummer rains. The life cycle has been completed in as short a period as 105 days between December and the end of March. Adults have been known to survive for 112 days in summer and for 175 days during the winter months. During the course of eleven generations at Gogango the average return has been 12 beetles per female parent. On one occasion 342

female beetles produced 12,462 adult progeny, a return of 36 beetles from each female parent.

It has been stated that the larvae feed in the toughest and most woody stems of the tree pears. Their activities set up a considerable amount of decay, the branches and main stems being reduced to shells of chewed fibre. The weightier branches, even the main trunks, frequently break off at a point where the full-grown larvae are working, and large plants of *O. tomentosa* and *O. streptacantha* may be completely destroyed by this insect.

PARMENOSOMA Schaeffer

This genus, which is closely related to *Moneilema* Say, contains one species from the United States that attacks cactus.

Parmenosoma griseum Schaeffer

This small longicorn, which was described in 1908 from a single specimen collected at Edinburg, Hidalgo county, southern Texas, was not encountered during the investigations. However, in 1935 G. W. Barnette, who had formerly been on the Board's staff, reared several adults from larvae found in the stems of the prickly pear *Opuntia lindheimeri* at Cotulla, southern Texas. Apparently this insect is very rare.

MONEILEMA Say

This genus, containing many more or less closely related species, is a true cactus complex and primarily an *Opuntia*-enemy group. The adults are stout, very hard, wingless longicorns, wholly black or shiny black or, less commonly, black with white markings. The distribution of the genus embraces the western half of the United States as far north as Washington and Montana, and the whole of Mexico. No species has been recorded from eastern United States, the West Indies, or Central and South America.

The number of species is uncertain, since both Casey and Psota described many new forms whose specific validity is doubtful. During the investigations 25 different species were encountered of which 9 proved new to science. Among other forms not noted by officers of the Board, *M. semipunctata* and *M. subrugosa*, both from Baja, California, are probably good species.

The general habits of the various species are very similar. The adults feed at night by chewing the margin of the segments, usually the younger more succulent growth, or the fruit. During the day they shelter in debris beneath the plants or in protected situations on the

plants. They wander freely across the ground from one plant to another; examples have been found 250 yards from the nearest prickly pear. The eggs are deposited singly, and are affixed by a gummy secretion on the surface of the segment, in cracks, at the union of segments, or against the stem at, or just below, ground level.

The larvae tunnel in the segments, stems, and branches, generally in the basal parts. Their work is attended by considerable rotting of the plant tissue; in fact they appear to thrive best in decaying segments. Branches of the large prickly pears often break off from the effect of the activity of one larva at the junction of the main stems. Two or three larvae in the base of a weighty tree pear may cause the whole plant to collapse. In the case of Cylindropuntias the affected stems tend to dry out rather quickly, and as a rule there is little wet rotting of the branches and stems. The firm cocoons are constructed of dead fibre within the attacked segments.

No preference for specific host plants has been observed The various species seem to attack all prickly pears and Cylindropuntias within their range of distribution. Although *Opuntia* is the primary host, other cacti may be included in the list of food plants.

The forms that have been studied possess either one or two generations each year, or one complete and a partial generation. With species having an annual life cycle, the adults emerge in midsummer. Where two generations are completed or partially completed, there is usually a larger emergence in the spring and a smaller emergence in the autumn. The beetles may live for three to five months in the field, but are capable of much greater longevity. Under conditions of close confinement, females of *M. ulkei* have survived for a maximum period of 300 days, while one male lived for the extreme period of 529 days. The larvae may remain unpupated in the cocoons for several months.

Most species are rather widely distributed, but a few appear to be confined within limited areas. Certain forms, although found over a wide range, have not been encountered in numbers; for example, *M. crassa* in Texas, and *M. appressa* in New Mexico, Colorado, and Utah. On the other hand, *M. gigas* in Arizona, *M. laevigata* in New Mexico, *M. ulkei* in Texas, and *M. variolare* and *M. rugosipennis* in Mexico are frequently very plentiful. A feature of the distribution, which is probably associated with the wingless character of the adults, is their prevalence in local areas. Thus, among the numerous fields of *Opuntia lindheimeri* in the Uvalde district of Texas, *M. ulkei* could be collected in quantity season after season from the same patches of prickly pear, although it remained a rare insect in other *O. lindheimeri* infestations which appeared to offer conditions equally favorable to its requirements. Similarly such species as *M. gigas*, *M. laevigata*, *M.*

rugosipennis, and *M. variolare* occurred in considerable numbers at scattered intervals in particular sections.

The distribution of the species overlaps; two or more may occur in the same region, but generally one is the dominant form. Distribution of *Moneilema* can be roughly divided into the following geographical areas:

Distribution	*Species*
Southern California	*spoliata*
Utah	*obtusa, appressa*
Colorado, Kansas, North Texas	*annulata, appressa, laevigata, crassa, nigriventris*
South Texas	*ulkei, armata, appressa*
West Texas, eastern New Mexico, Chihuahua, Coahuila	*armata, laevigata, appressa*
Southern Arizona, southwestern New Mexico	*gigas, corrugans*
Sonora, Sinoloa	*pimalis, pollens*
Gulf Coast of Mexico	*ulkei, variolare, mundelli*
Central Mexico	*variolare, rugosipennis, aterrima, crassipes, blapsides, mexicana, opuntiae, vittata*
Southern Mexico	*albopicta, ebinina, punctipennis*

There is much variation in size within any one form; very small examples are probably the result of an insufficient food supply in the larval stage. The largest member of the genus is *M. gigas*, in which large females attain a length of 1.5 inches. The closely related *M. pollens* and *M. pimalis* are almost as large. Another group of related forms, *M. laevigata*, *M. armata*, and *M. rugosipennis*, are a little smaller; in fact, females of *laevigata* may approach the size of females of *gigas*. In the small species, *M. crassa*, *M. mexicana*, *M. nigriventris*, *M. annulata*, and a few others, undersized individuals may not exceed one-half inch in length.

The Texas form *M. ulkei* was more fully studied than any, but several other species have been given a good deal of attention. For certain species, however, no information is available except the localities from which adults were collected on *Opuntia* plants.

Moneilema ulkei Horn

This is a medium-sized beetle, the females rather dull black, the males with white markings on the elytra. In Texas it has been found from Brownsville, Beeville, and San Antonio west to the junction of the Rio Grande and Pecos Rivers; it occurs in the foothills north of Uvalde, but not on the western plateau nor in the coastal country around and south of Galveston. In Mexico its range extends through the eastern

portion of Coahuila, and throughout Nuevo León and Tamaulipas as far south as Tula in Tamaulipas and Cerritos in the State of San Luis Potosí. It is prevalent between Uvalde, Eagle Pass, and Laredo, Texas, and between Monterrey and Victoria, Mexico, but as with other members of the genus, its abundance is sporadic in the various districts.

Along the Rio Grande from Laredo to Eagle Pass and in the foothills north of Uvalde, *M. ulkei* is encountered in the same fields as *M. armata*. In the foothills country, where the clumps of prickly pear are rather scattered, the number of adults of both species rarely exceeded more than two or three per plant. Although the two forms are not closely allied, records have been made in this sector of male *ulkei* copulating with female *armata*, and of female *ulkei* with male *armata*. In the southern portion of Nuevo León and adjacent districts in Tamaulipas, the range of *ulkei* overlaps that of the allied *variolare*, and the two occur in the same local areas.

The dominant prickly pear through the region embraced within the distribution of this insect is the shrubby *Opuntia lindheimeri*. The related *O. cacanapa* also is attacked, but no other definite host plants have been recorded in America. In Australia *M. ulkei* breeds sucessfully in the shrub pears *O. inermis* and *O. stricta*, and in the tree and semitree forms *O. tomentosa* and *O. streptacantha;* in addition it has completed its life cycle in the low-growing narrow jointed *O. aurantiaca*.

There are two generations, or rather one complete and one partial generation, annually. Emergence of adults occurs in spring from the middle of April to the end of May. From eggs laid by these beetles, larvae may develop rapidly and yield adults in 3 to 4 months, but the greater proportion occupies the full 12 months to complete the life cycle. Hence, the autumn emergence of beetles in August and September is numerically smaller than the spring emergence. Beetles can be seen in the field in almost every month of the year. Some of the spring adults survive for 3 to 4 months and are alive when the autumn beetles emerge. Most of the latter die before the winter, but a small percentage survives; adults in the field in January-March would represent overwintering stock. At Uvalde, Texas, beetles confined in cages in September-October were inactive in December and January, resuming feeding in February and were mating in March.

The eggs appear to be laid at irregular intervals in numbers of from 1 to 5, the latter figure being the highest number of eggs deposited by one female in 24 hours. Oviposition extends for several weeks or even longer; in Australia a female continued to lay eggs at intervals over a period of 7 months. The greatest number of eggs deposited by one individual has been 74. The duration of the egg stage seems to be influenced by moisture as well as by temperature.

At Uvalde in September the minimum and maximum periods were 5 and 20 days respectively; the variation in development was as great as 12 days among eggs laid on the same day and kept at the same storage temperature. Eggs subjected to a chill room temperature of 45° F. for 50 days have hatched successfully, but the mortality increased rapidly after 35 days at this temperature. In these experiments some eggs hatched in December after an incubation period of 79 days, 34 days after removal from the chill room. Desiccation of the eggs causes serious mortality, and it is probably one of the main factors affecting the prevalence of all species of *Moneilema*. In rearing these insects in cages exposed to the sun and wind, better results have been obtained when periodical watering during dry weather was practised in order to prevent drying out of the eggs.

The duration of the pupal stage has not been ascertained. However the time spent in the cocoon, i.e., the prepupal and pupal stages, varies very greatly, from 3 to 4 weeks in summer to 6 to 7 months in October to April.

Of the two chalcid parasites known, the encyrtid *Ooencyrtus ovidivorus* (Girault [1]) has on various occasions been active in destroying eggs in the Uvalde cages in March to May and in July to October. The pteromalid *Neocatolaccus moneilemae* (Gahan [2]) is a pupal parasite, or rather, emerges from the cocoons. As many as 35 individuals have been reared from one cocoon. Adults have been bred in June, August, and September. This insect severely attacked cocoons in cages at Uvalde in September 1929.

Moneilema variolare Thomson

This insect is closely related to *M. ulkei;* some forms of *M. variolare* are scarcely distinguishable from its ally. The adults are quite variable. Both sexes may be wholly dull black, or the elytra and sometimes the prothorax may be irregularly marked with white. In one extreme form, the elytra and prothorax of the female are patterned with a network of wavy white lines. The density of the punctures on the prothorax and elytra shows marked variation.

This dominant member of the genus occurs on the Central Plateau of Mexico, where it is more abundant than any other *Moneilema*

[1] Girault, A. A., "An essay on when a fly is lovable, the ceremony of baptizing some and unlovely hate." Brisbane, privately printed, June 30, 1925, 4 pp. Description of *Echthrodryinus ovidivorus*, new species, appears on page 3.

[2] Gahan, A. B. "A new encyrtid parasitic in the eggs of *Moneilema* (Hymenoptera:Chalcidoidea." Proc. Ent. Soc. Washington, vol 27, no. 8, p. 167, November 1925. Description of *Neocatolaccus moneilemae*, new species, appears on page 167.

studied in the United States and Mexico. Its prevalence appears to be much more general and less sporadic than *M. ulkei* and other relatively common species. For example, in May and July 1930, adults were abundant over a wide area for miles around San Luis Potosí.

The most northerly records of its occurrence are Durango and Linares in the southern portion of Nuevo León, where its distribution overlaps that of *M. ulkei*. The southern limits of its range appear to be around Puebla and in the State of Morelos south of Mexico City. It is particularly common around San Luis Potosí and Aguascalientes and is rather prevalent in the vicinity of Mexico City.

With the exception of the calandriid weevil *Cactophagus spinolae*, *M. variolare* is the most generally destructive prickly pear insect in Mexico. All forms of Platyopuntia are attacked, apparently with little discrimination; the dominant semitree pear forms with thick woody stems, such as *O. streptacantha* and *O. hyptiacantha*, are favored, as well as the smaller shrub pear *O. cantabrigiensis*. At San Luis Potosí the Cylindropuntia *O. imbricata* was freely infested but to a lesser degree than Platyopuntias. *Cereus* plants were attacked quite appreciably at Puebla. Observations tend to indicate that among the larger prickly pears a certain amount of preference is evinced for *O. robusta*, as compared with such other common plants as *O. streptacantha* and *O. hyptiacantha*.

The larvae feed in the branches and main stems, frequently in the base of the trunk. The heavy branches of the larger prickly pears often break off as a result of the injury. Large plants may crack near ground level and collapse. Complete destruction of fallen branches and plants usually follows, since the adults show a partiality for depositing eggs on collapsed pear.

As in the case of *M. ulkei*, one main and a smaller partial generation are completed annually. In cage rearing work, adults emerged in April and May and in September to November. General field emergence takes place in April-May, but at Puebla beetles appeared as early as February. Adults are numerous in June and July, and are fairly common in October. In the cages, eggs have been laid from April to June and in September and October; an incubation period of 6 days has been recorded in late May. The life cycle may occupy 10 to 12 months, but during summer development from egg to adult has often been accomplished in 4 or 5 months between May and October. Larvae are present in the field almost throughout the year. Some larvae enter the cocoons in the autumn and produce beetles in the spring months of April and May. A limited proportion of the autumn adults survive the winter. The greatest length of life in confinement has been

149 days. The highest number of eggs from an individual female has been 27, but probably the maximum fecundity is greater than this figure would indicate. In small cages the males and females fought violently, soon becoming disabled through the loss of legs and antennae; usually the male was the victor.

PARASITES.—A braconid, *Vipio moneilemae* Gahan, destroyed many pupae in the field at Aguascalientes in May–June 1927; from 10 to 15 parasite pupae were found in each host cocoon, and the adult braconids emerged in September. This insect has been reared from cocoons of *M. obtusa* collected at Cedar City, Utah, in July 1926.

Moneilema rugosipennis Fisher

This species was described in 1928 from specimens collected during the investigations at San Luis Potosí, Mexico, in May and June 1927. It is a rather large, very shiny black beetle, related to *M. armata*; in both forms the newly-emerged adults are covered with a light powdery bloom which is soon lost by abrasion. The beetles appear to be the most aggressive of this genus; they have been known to escape from cages by chewing through copper-gauze screen.

The species has been obtained from the general vicinity of San Luis Potosí, and from Torreón on the border of the State of Coahuila and Durango, but it must occur in the State of Zacatecas. It was very abundant in some seasons at San Luis Potosí, and was fairly common at Torreón. In the latter area the host plant was the Platyopuntia *O. rufida*; the larvae attacked the short main stem, causing the plant to topple and die; considerable destruction among fields of this plant was reported in October 1926. At San Luis Potosí various prickly pears were infested quite freely, but a distinct preference was observed for the Cylindropuntia *O. imbricata*; in 1928 some fields of *imbricata* had been almost completely wiped out by the attack.

There is an annual generation. Adults have appeared in April, but the main emergence is in May and June. In 1928 beetles commenced to emerge in late May and were abundant within a few days. The eggs are laid in May and June. During the winter the larvae become full grown and form cocoons in February to April. Adults can survive for six months. In the field they have been seen in fair numbers in October and some were still actively feeding in November; from material collected in May, some survivors remained in the cages in December.

Moneilema armata LeConte

This species is of moderate size, rather shiny black but not as shiny as its ally *M. rugosipennis*, and with a powdery bloom on freshly-emerged

examples. It occurs in southern Texas and northern Mexico. In Texas its range follows the course of the Rio Grande from near Brownsville as far west as Marfa and Toyahvale in the Davis Mountain country. The northern boundary of its distribution appears to be approximately 100 miles from the Rio Grande from Beeville, through Pearsall, the foothills north of Uvalde, westward to Fort Stockton and Toyahvale. it is found very freely in the fields of prickly pear along the river from Del Rio to Laredo. Around Uvalde it does not seem to be established in the open country 20 to 30 miles to the south, although it is prevalent in the foothills 20 miles to the north. In Mexico, *M. armata* occurs throughout the State of Chihuahua, in Coahuila as far south as Monclova, in Nuevo León as far south as Monterrey, and in the northern part of Tamaulipas adjacent to the Rio Grande.

The host plants in Texas are the dominant shrub pear *O. lindheimeri* and its ally *O. cacanapa*. In the Fort Stockton and Davis Mountain areas it attacks prickly pears of the *O. phaeacantha* and *O. engelmannii* types, and it has been recorded on *O. aciculata* and the Cylindropuntia, *O. kleiniae*. In Chihuahua prickly pears and Cylindropuntias, mainly *O. imbricata* were infested generally.

Adults have been observed in the field in numbers in every month from March to October and less freely in November. The main emergence periods are March–May and September–October. There appear to be one complete and a partial generation each year. The beetles live for several months; thus 90 percent of adults collected in July were alive in October and were then ovipositing freely. Again, among beetles captured in October a few still survived in February.

Eggs have been recorded in April, May, July, August, and October. They may be found on the aerial portions of the plant, placed in scars and wounds or among the spine hairs of areoles near the margins of the segments, and covered with a viscous secretion which hardens rapidly. Many eggs are deposited in small earth cells against the base of the plants just beneath the soil surface. Larvae occur in the butts or in segments well above the ground. The adults are active at night and seek shelter during the day; however, in cloudy weather they have been collected on the plants quite freely until 10 a.m. They travel across the ground from one plant to another; in the early daylight hours they are frequently seen wandering about in the open, apparently in search of prickly pear.

Moneilema laevigata Bland

This species appears to be a northern offshoot from *M. armata*, but is more shiny and has less punctures on the elytra than the latter.

Although variable in size, average examples are larger than *M. armata*, and large females are very little smaller than big individuals of *M. gigas*.

The commonest member of the genus in New Mexico, its range extends from such localities as Toyahvale, Balmorrhea, and El Paso in west Texas, and northward through New Mexico as far as Colorado Springs, Colorado; specimens have been taken at Safford in southeastern Arizona. It is often very abundant in many valleys on the eastern slopes of the Guadalupe and Sierra Blanca ranges in New Mexico and around Trinidad and Walsenberg in the *O. imbricata* region of southern Colorado.

The principal food plant is the Cylindropuntia *O. imbricata*, but prickly pears of the *O. engelmannii*, and *O. phaeacantha* types are attacked to an appreciable degree. In the Uvalde cages the species was reared without difficulty in *O. lindheimeri*. The "tasajillo" *O. leptocaulis*, a slender Cylindropuntia, has been recorded as a host plant.

There is an annual life cycle. The adults emerge in May and June, and are prevalent in June and July. Under cage conditions at Uvalde, beetles emerged in September-October from eggs laid in July, giving a life cycle of 10 to 12 weeks, but it is doubtful whether an autumn emergence occurs in the field. Oviposition takes place from May to July, the eggs usually being fastened in crevices in the segments. The beetles shelter beneath the fruit and growth of *O. imbricata* during the day and do not necessarily descend from the plants to seek cover after their nocturnal activity.

Moneilema gigas LeConte

This fine shining black beetle with pronounced prothoracic spines inhabits southern Arizona from the neighbourhood of Tucson southward and west as far as the Quijotoa Mountains; the Board's most northerly record is the Williams River north of Wickenburg. In midsummer the adults are common in many of the extensive *Opuntia* areas near Tucson and on the lower slopes and valleys of mountain ranges such as the Quinlan and Comobabi systems.

It evinces a preference for Cylindropuntias, particularly for *Opuntia fulgida*, on which the beetles have been collected in large numbers; as many as 10 to 12 have been observed frequently on small plants. The Platyopuntias of the Tucson district, mainly *O. engelmannii*, and several related plants, are attacked and on occasion harbor adults in quantity. Larvae have been found breeding in *Ferocactus wislizenii*, and *Echinocereus polyacanthus*.

There is one generation annually. Emergence commences in May and reaches its height in July. Field observations during several years have indicated that adults are most abundant in July and August. Beetles collected in July were mostly alive in Uvalde cages at the end of October and were still actively feeding in December; many lived through the winter, and the last survivor died in late April, a longevity record of 9½ months. The eggs are deposited from June to August. Adults in cages laid freely during July and the first half of August, deposited few eggs in the second half of August, and laid none subsequently, although they were feeding regularly until December. An incubation period of 21 days was recorded at Uvalde in July. From eggs that hatched in July and August, the larvae developed rather slowly and were not more than one-third to one-half grown in January.

Moneilema pollens Casey

This form is very closely related to *M. gigas*. Adults were collected at Hermosillo, State of Sonora, Mexico, in August 1922, and were abundant on the Cylindropuntia *O. fulgida* at Empalme, Sonora, in August 1926. This species appears to be intermingled with *M. gigas* in the Quijotoa Mountains of southwestern Arizona.

Moneilema pimalis Casey

This is another close relative of *M. gigas*. Adults were taken at Culiacán, State of Sinaloa, west coast of Mexico, in August 1926.

Moneilema spoliata Horn

This Californian black species of medium size does not seem to be prevalent. Adults have been collected in small numbers in June on prickly pears and on the Cylindropuntia *O. bernardina* in the Cuyamaca Mountains and in July on the Cylindropuntia *O. echinocarpa* in San Gorgonia Pass. A doubtful record would suggest its occurrence in western Arizona; beetles captured near the Williams River were either this species or one of the Utah forms *M. obtusa* or *M. appressa*.

Moneilema obtusa LeConte

This is another moderate-size black species. Adults have been collected in July at Cedar City and Zion National Park, Utah, and at Lees Ferry in northern Arizona. In the Zion National Park a very extensive area of *Opuntia imbricata* showed considerable damage as a result of the activities of the larvae.

Moneilema appressa LeConte

A small- to moderate-size black species, this varies considerably in size; some individuals do not exceed one-half inch in length. Although widely distributed, it has not been found commonly in any area. Adults have been collected in May, July, and September in New Mexico at Albuquerque, Santa Fe, Santa Rosa, Carlsbad, and in the Penasco Valley. Others have been taken at Ashfork, Arizona, and Zion National Park, Utah, in July and at Santa Isabel and Moctezuma, State of Chihuahua, Mexico, in September.

Moneilema corrugans Casey

This rather large species is related to *M. appressa;* the elytra are faintly ribbed longitudinally and are very dark brown rather than black. The mode of locomotion differs from that observed in all other members of the genus in that the head is lowered and the body is raised high on the legs instead of being carried horizontally; this peculiar walking habit resembles that of the North American tenebrionid beetles of the genus *Eleodes.*

The distribution seems to be restricted to southeastern Arizona and southwestern New Mexico. It has been collected in Arizona at Oracle and in the foothills of the Santa Catalina Mountains north of Tucson, in the Pinalino and Huachuca Mountains, and at Douglas; New Mexican localities are Silver City and Deming. Adults were rather abundant at Silver City, Deming, Douglas, and the Huachuca Mountains.

Apparently there is one generation annually, the adults emerging in July. Beetles have not been captured in the field except in July and August; material collected in these months and placed in cages died before the end of October. Larvae found at Douglas in February produced adults in July. Eggs were laid in cages in July and August, being deposited singly in earth cells against the base of the prickly pear plants; the eggs were relatively large and compared in size with those of *M. gigas.* Larvae from these were one-half grown in the following February. Platyopuntias appear to be favored, but as with other *Moneilema* no preference for specific host plants has been observed.

Moneilema annulata Say

This small black species is the most northerly representative of the genus, having been recorded from Wyoming, Washington, and Montana, as well as from Alberta, Canada. During the Board's investigations, adults were taken in June and July at Dalhart in northwestern Texas, at Trinidad, Walsenberg, and Littleton in Colorado, and at Wallace

and Atwood in western Kansas. The host plants comprise the Cylindropuntia *O. imbricata* and small prickly pears of the *O. tortispina* and *O. polyacantha* groups.

Moneilema nigriventris Fisher

Another small black species was described from adults collected by officers of the Board on *O. tortispina* at Dumas in the Texas Panhandle in June 1926. Examples taken west of Carlsbad, New Mexico, in June 1927, have been determined as the same species.

Moneilema crassa LeConte

This is a medium-sized black species with a wide distribution in Texas. The reference by Hamlin (1926, p. 104) to this species is a misidentification and should refer to *M. ulkei.*

Material has been recorded from Texas at Pearsall, Uvalde, Del Rio, west to the mouth of the Pecos River, San Antonio, thence in a northerly direction to San Angelo, Sterling City, Big Springs, Lubbock, and Dalhart, and to Tyrone in western Oklahoma. The life history and habits have been studied at Uvalde, where the insect occurs rather generally in company with *M. ulkei* in fields of *Opuntia lindheimeri.* However, whereas *M. ulkei* is often prevalent, *M. crassa* has rarely been encountered in numbers.

Adults have been collected in April, May, June, and July, and on one occasion in September. There is an annual generation, although under cage conditions occasional adults have emerged in November from eggs laid in June. Emergence occurs in April and May, commencing earlier than that of *M. ulkei.* The beetles survive until July. Oviposition extends from April to early July; the eggs are placed singly in earth cells against the butts of the plants or beneath prostrate segments. Many larvae reach full size and enter cocoons in September and October, but do not pupate until after winter; other larvae continue to feed and develop during the winter months.

Moneilema aterrima Fisher

This rather small species, black with the elytra variegated with white, was described from a few examples collected at El Corazón near San Luis Potosí, Mexico, in May, June, and July 1930 and in May 1931.

Moneilema blapsides Newman

A moderately large black species, this appears to be uncommon. A few specimens were taken at Durango, Mexico, in October, and in San Luis Potosí.

Moneilema crassipes Fisher

Another fairly large, wholly black form known from one locality only, *M. crassipes* was described from material collected in August and September 1930, in a valley lying between Miquihuana in the southern corner of the State of Nuevo León and Palmillas in the adjacent territory of the State of Tamaulipas, Mexico. The beetles were not uncommon and were again taken in the same area in June 1931.

Moneilema opuntiae Fisher

A rather small, black, almost-smooth insect, *M. optuniae* was described from a few specimens collected at San Luis Potosí, Mexico, in May and June 1927. There are no other records of its occurrence.

Moneilema vittata Fisher

A medium-sized black species, *M. vittata* has a broad white stripe on the apical half of the elytra. The only specimens were a few collected at Aguascalientes, Mexico, in May 1927.

Moneilema mexicana Fisher

This rather small, wholly black insect seems to be another of the rarer forms. A few individuals have been taken in May and June at San Luis Potosí, and in May at Pachuca, State of Hidalgo, Mexico.

Moneilema ebenina Bates

A moderate-sized black species, *M. ebenina* is found in southern Mexico and is not uncommon in the vicinity of Tehuacán. Adults have been collected in March and April at Tehuacán, State of Puebla, in October at Oaxaca, and in the same month at Chilpancingo, State of Guerrero.

Moneilema punctipennis Fisher

This form was described from specimens taken at Tehuacán, State of Puebla, Mexico, in April 1926. The adult is medium-sized, wholly black, with rather coarsely punctured elytra contrasting with the smooth prothorax.

Moneilema mundelli Fisher

A moderately large species, *M. mundelli* has distinct irregular white markings on the prothorax and elytra, was described from material collected in eastern Mexico in April 1931. The adults were prevalent

at Gonzales, Villa Juarez, and Tampico, in the southeastern portion of the State of Tamaulipas, and at Panuco in the adjacent part of the State of Vera Cruz. The host plants were *Opuntia lindheimeri*, another prickly pear, and an *Acanthocereus*.

Moneilema albopicta White

This is another Mexican form with white markings on the prothorax and elytra. Adults have been observed from March to May at Tehuacán, State of Puebla, and at Cuernavaca, State of Morelos. They occurred in small numbers during August to November at Cuautlá, State of Morelos, feeding on a low-growing *Echinocactus* and on young growth from fallen stems of *Opuntia lasiacantha*. It is possible that two generations are completed during the year; in the only rearing record, beetles emerged in the latter part of September from eggs laid in May.

Coleoptera: Curculionidae

Most of the weevil enemies of cactus are contained in two genera which are truly cactus-feeding segregates, viz., the cryptorhynchid genus *Gerstaeckeria*, with many species, and the calandriid genus *Cactophagus*, with four species. In addition, three species belonging to as many genera appear to be restricted to cactus hosts. With the exception of one Peruvian and one Paraguayan species, all the cactus weevils inhabit North America. *Listroderes costirostris obliquus* (Klug) was recorded in December 1958 on *Harrisia bonplandii* in Paraguay.

HUARUCUS Marshall

This genus was erected for the reception of a cactus weevil from Peru.

Huarucus cacti Marshall

A stout, dull-colored, moderately large weevil, 10 to 15 mm. in length, *H. cacti* was described from material obtained at Huanuco (altitude 7,000 feet), Peru, in December 1928, when both adults and larvae were observed. The larvae tunneled in the segments of the prickly pears *Opuntia ficus-indica*, and *O. macbridei*, the Cylindropuntia *O. exaltata*, and certain other cacti.

In October 1936 adults and larvae were again found at the same locality. The larvae were abundant and were causing considerable damage to *Opuntia ficus-indica* and to the Cereus *Espostoa lanata*. In the same month larvae were observed in stems of a Cereus, either *Trichocereus* sp. or *Borzicactus* sp., at Santa Eulalia in the Rimac Valley,

Peru. One cocoon at Huanuco contained many dead pteromalid chalcid parasites.

ONYCHOBARIS LeConte

One small cactus weevil from the United States is included in this genus.

Onychobaris mystica Casey

The larvae of this small dark weevil feed within the segments of the Cylindropuntias *O. leptocaulis* in Texas and *O. fulgida* in Arizona. Very little attention was paid to this insect, which causes injuries of a minor nature and which does not appear to be common.

CYLINDROCOPTURUS Heller

Cylindrocopturus biradiatus Champion

A small species from Mexico which may be termed the areole weevil. The larvae feed singly in cavities beneath the areoles of large prickly pears, such as *Opuntia streptacantha*, *O. tomentosa*, and *O. ficus-indica*. The affected areas become raised above the surface of the segments and discharge a gummy secretion which hardens and renders the work conspicuous. The damage is of a minor order. Larvae were observed in numbers in June at Morelia, State of Michoacán, in October at Cuernavaca, State of Morelos, and in March near Mexico City. From material collected near Mexico City, adults emerged in late March, April, and June.

Excellent figures, illustrating the various stages of the insect and the nature of its attack were published by Dr. A. Dampf (1929).

GERSTAECKERIA Champion

Approximately 25 species of these rather small cryptorhynchid weevils have been described. It would appear that all forms are cactus insects, the majority being restricted to prickly pears. The distribution embraces the United States, Mexico, and the West Indies. The larvae live singly in cells in the cactus segments, and under normal circumstances cause very little damage to the plants. They form circular firm cocoons within the cells.

Many named species, even Texas forms, were not encountered during the Board's investigations. However, little attention was paid to the group as a whole, although studies were conducted with several species. In the vicinity of Uvalde, Texas, are found four species, *G. clathrata*, *G. doddi*, *G. porosa*, and *G. nobilis*. Normally the adults are active at night and shelter during the day.

Gerstaeckeria clathrata (LeConte)

This small species attacks the "tasajillo" *Opuntia leptocaulis*, in Texas, and has been recorded from other Cylindropuntias as far west as southern Arizona. It is not uncommon around Uvalde, where adults have been observed from March to November.

Gerstaeckeria doddi Fisher

The original description in 1925 was based on material from Uvalde, Texas, in which vicinity the insect is prevalent. It occurs quite commonly through the Mexican States of Nuevo León, Tamaulipas, and San Luis Potosí. The host plants are Platyopuntias. Adults have been collected in every month from March to November. Around Uvalde the beetles were present in considerable numbers in certain areas of *Opuntia lindheimeri* during June, July, and August.

The larvae live in cells near the base of the plants and in segments in contact with the ground, even in detached portions. There would appear to be at least three generations annually. Development is rapid during the summer. Thus, adults collected in June had produced many full grown larvae by the end of July, while in August larvae were full-grown and were pupating 18 days after the parent beetles had been placed in the cages.

Gerstaeckeria porosa (LeConte)

The distribution of this species is very extensive, from the lower Rio Grande Valley through western and northwestern Texas, Colorado, western Kansas, Nebraska, Wyoming, Idaho, Utah, Arizona, and New Mexico. Specimens taken by the Board's entomologists in all these States were given this identification. Frequently it occurs in abundance in the Uvalde-Del Rio sector of Texas. In May 1928 it was very common throughout the Edwards Plateau country of central-western Texas.

Adults have been taken in every month from March to September. Immediately around Uvalde, *G. porosa* is found in company with *G. doddi;* the latter species, however, seems to prefer the more sheltered fields of *Opuntia lindheimeri*, while *G. porosa* is more prevalent in the drier, more exposed areas. West of Uvalde, *G. doddi* ceases to occur and *G. porosa* is prevalent.

Emergence occurs in spring from March to May. At Uvalde the first beetles appear about the middle of March, and they are numerous in April. Probably there are at least two generations annually. The food plants comprise many species of prickly pear. The presence of the insect is rendered conspicuous by the circular larval cells, measuring up

to 2 inches in diameter, in the disk of the upper segments. The tissue of the affected area is destroyed, producing a "shot-hole" effect. Where the species is common, several separate cells may occur in one cladode; each cell contains one larva, which pupates in a small hard cocoon within the cavity.

In addition to the usual mode of development within the segments, breeding may take place in the *Opuntia* flowers, a habit that has not been observed among other species of *Gerstaeckeria*. In late April 1925 in the foothills country west of Del Rio, Texas, many adults were feeding on the buds and unopened flowers of various kinds of prickly pear. Larvae were very abundant within the flower heads, devouring the stamens, style, and fleshy base of the petals; they pupated within the dead corolla; very occasionally the larvae penetrated into the fruit. No instance was recorded of the presence of larvae in flower heads that had opened. The injured buds were unable to open, and the fruits were rendered sterile. In some areas fully 75 percent of the flower heads contained larvae or pupae. Collected material produced adults in May and June. A similar infestation was noticed in the same locality in mid-April 1928, when the adults were extremely numerous.

A chalcid parasite, *Tetrastichus gerstaeckeriae*, has been reared from the cocoons.

Gerstaeckeria hubbardi (LeConte)

This is a Florida species that is widely distributed in that state, having been taken at Jacksonville, Gainesville, Palatka, New Smyrna, Miami, and other localities. Adults have been observed practically throughout the year. The larvae live in individual cells near the base of *Opuntia dillenii*, *O. lata*, *O. austrina*, and other Platyopuntias.

Gerstaeckeria nobilis (LeConte)

An inhabitant of the more coastward areas of Texas, it is prevalent from Galveston to Brownsville. The most northerly record was made at Dallas, and the most westerly locality is Uvalde, where it is comparatively rare in comparison with the abundance of *G. doddi* and *G. porosa*. Adults have been taken in all months from February to November and have been reported as abundant in February, March, April, May, and October. Probably there are two or three generations annually.

The larvae live singly in cells on the margin of the upper segments of *Opuntia lindheimeri*, *O. inermis*, and other prickly pears. Their presence

can be determined by the hard black sap exudation from the affected areas. Where the insect is abundant, several cells may occur in one cladode, which may rot through the action of plant diseases that extend the injuries caused by the weevil larvae. Under these circumstances *G. nobilis* is capable of bringing about considerable damage to prickly pear plants.

Gerstaeckeria basalis (LeConte)

Adults reared from *Opuntia tortispina* at Littleton, Colorado, were given this determination.

Gerstaeckeria cactophaga (Pierce)

This weevil appears to be confined to the lower Rio Grande Valley of Texas, where adults have been collected on prickly pear at Kingsville and in small numbers at Brownsville.

Gerstaeckeria elegans Fisher

The original description was made from a single specimen taken on prickly pear at San Luis Potosí, Mexico, in June 1927.

Gerstaeckeria unicolor (Fisher)

Described in 1928 from an adult collected at San Luis Potosí, Mexico, this weevil appears to be common in the general neighborhood of the type locality, where it is found in company with *G. doddi*. In April and May 1930 larvae were extremely abundant and, assisted by Syrphid larvae and plant diseases in the rotting tissue, were causing considerable damage to the more succulent forms of prickly pear such as *Opuntia robusta*. Undetermined *Gerstaeckeria* adults from Saltillo, Zacatecas, and Mexico City, Mexico, may represent this species.

Gerstaeckeria cubaecola (Fisher)

This weevil was described in 1928 from several adults collected on *Opuntia dillenii* at Santiago, Cuba, in December 1926.

Gerstaeckeria insulana (Fisher)

This weevil was described in 1928 from material taken on *Opuntia dillenii* at Port-au-Prince, Haiti, in January 1927. In the same month an emerged pupa and typical feeding punctures of adult *Gerstaeckeria.* were observed on *O. antillana* at Azua, Dominican Republic, Hispaniola.

CACTOPHAGUS LeConte

This purely cactus segregate of large calandriid weevils is distributed from Central America to the southern border of the United States. The host plants are various prickly pears of the genus *Opuntia*, the closely allied *Nopalea*, and certain species of *Cereus*. The only Cylindropuntia definitely recorded as a food plant is *O. tunicata* in southern Mexico, although adults were taken on one occasion on *O. spinosior* in Arizona.

Four species and one variety are recognised in this publication. *C. validus* LeConte, often considered a color variety of *C. spinolae* (Gyllenhal) is treated as a separate species since it possesses a distinct geographic distribution. On the other hand *C. rubroniger* Fisher is regarded merely as a color variety of *C. spinolae*.

These weevils are the most destructive enemies of prickly pear in Mexico. The larvae tunnel freely within the *Opuntia* segments and set up wet-rot conditions which are enhanced by the activities of dipterous scavengers and of plant diseases. Larvae pupate within the plant, constructing rather bulky fibre cocoons. The adults measure three-quarters of an inch to one inch in length.

Cactophagus spinolae (Gyllenhal)

A black beetle with two orange markings on each elytron, *C. spinolae* is the most important enemy of prickly pears in Mexico. It is distributed throughout the Central Plateau where its occurrence is very general. The most northerly records were made at Parral in the south of the State of Chihuahua, and Victoria and Palmillas in the southwestern section of the State of Tamaulipas. The southern limits of its range appeared to be in the States of Puebla and Morelos. It was extremely abundant in the neighborhood of Puebla and Tlaxcala, and prevalent in areas around Mexico City. It was found in numbers at Durango, Aguascalientes, and Morelia (State of Michoacán), and everywhere in the State of Morelos, while it was obtained at San Luis Potosí, Zacatecas, Guadalajara, Jalapa (State of Vera Cruz), and many other places.

The dominant Platyopuntias of the Mexican Plateau are tree and semitree prickly pears, of which there are many species, such as *Opuntia streptacantha*, *O. hyptiacantha*, *O. lasiacantha*, *O. robusta*, and *O. tomentosa*, all of which, as well as cultivated "tunas" of the *O. ficus-indica* and *O. megacantha* types, are attacked without apparent discrimination. The less common shrub prickly pears such as *O. cantabrigiensis* and *O. engelmannii* (at Parral in Chihuahua) are favored. In addition, different species of *Cereus* are infested freely.

Where the larvae are abundant, they cause a great amount of damage. Their activity sets up rot condition. Segments, branches, and whole plants fall to the ground where the destruction is completed by succeeding generations of larvae assisted by plant diseases and scavenging insects, mainly syrphid and stratiomyid larvae. At a village near Puebla in March 1927 the prickly pear hedges surrounding cultivation plots were partially destroyed by very great numbers of larvae, while the fields of cultivated prickly pears, comprising young plants mostly, were heavily infested. The inhabitants stated that although hand picking of the adult beetles was practised, it was necessary to replant the plots of prickly pear every few years owing to the depredations of *Cactophagus*. In June of the same year these people, on being requested to collect adults, brought in 1500 beetles the first morning and 5000 beetles next day.

Observations on the life history were conducted under cage conditions at Piedras Negras, State of Coahuila, in 1926–27 and at Cuernavaca, State of Morelos, in 1933–35. During the latter period field studies were carried out around Puebla, Mexico City, and Cuernavaca.

There is an annual generation. The winter period, when little rain falls for 6 months, is spent in the larval stage. Pupation may commence in December, but full-grown larvae predominate in January and February, most pupation taking place in March and April. A few adults can be seen in February and March. However, the main emergence awaits the break in the dry period, and beetles appear in numbers from late April until the end of June. It has been found that moistening the cocoons hastens emergence. The adults live for several months, and their numbers continue at a high level from May until September. They were very plentiful around Puebla and Tlaxcala in May 1934. The beetle population decreases after September, and very few can be found by the end of November. Under cage conditions at Cuernavaca they did not survive later than December, but at Piedras Negras the maximum longevity was 12 months. They are able to live for several weeks without nourishment.

Oviposition commences at the end of May, is general in June, July, and early August, and ceases by the end of August. The eggs may be placed in wounds and feeding punctures but the favoured location is the areole. The female pushes aside the small spines, makes a small hole in the centre of the areole, deposits the eggs, and covers it with a light brown secretion which sets hard; the position of the eggs is not readily detected. The incubation period occupies 12 to 16 days. Larvae develop rapidly; many are well grown at the end of August, and most are almost full-grown by September 30.

A coleopterous parasite, *Bothrideres cactophagi*, has been reared from the cocoons, the adults emerging in April.

Cactophagus spinolae var. *validus* LeConte

A uniformly dull-black beetle, *C. spinolae* var. *validus* is found in southern Arizona and southern California and along the Pacific coast of Mexico as far south as the State of Sinaloa. In California adults have been taken sparingly in June and July at Oceanside, San Diego, and the Coachella Valley. In Arizona beetles have been collected in June, July, and August at Oracle, Globe, and the foothills and lower valleys of the Santa Rita, Quinlan, Huachuca, and Tumacacori Mountains. Although fairly widely distributed in the southern portion of Arizona, the insect does not appear to be prevalent in any locality; it favors the foothills and lower valleys of the various ranges and has not been observed among the extensive cactus belts of the open mesa country.

In contrast to the lightness of its population in California and Arizona, this species would seem to occur in considerable numbers in the Mexican State of Sinaloa. In August 1926 larvae were very abundant at Mazatlán and Culiacán, where they were causing considerable destruction to prickly pears, including the low-growing *Opuntia decumbens* and the much larger *O. wilcoxii* and *O. fuliginosa;* frequently seven or eight larvae infested one segment; many plants of *O. decumbens* were completely destroyed by the attack. The insect was again prevalent at Mazatlán in December 1933.

The record host plants are Platyopuntias of various types. However, adults have been captured in Arizona on the Cylindropuntia *O. spinosior*.

Observations on the life history, made under cage conditions at Uvalde, Texas, indicated an annual generation. Beetles collected in the field in July fed and mated freely until December, hibernated during January to March, and died in April. They laid eggs in July and August; the larvae developed irregularly, many being almost fully grown within six months; in April, cocoons contained pupae and unpupated larvae; the adults emerged in May and June, after a life cycle of approximately ten months.

The adults hide during the day among debris at the base of the plants; they become active toward dusk and feed by puncturing the fruit and the younger segments: the eggs are laid singly just beneath the cuticle near the base of both the more apical and basal segments. The larvae tunnel freely from one segment to another, usually working downward toward the base of the plant.

Cactophagus spinolae var. *rubroniger* Fisher

This dark red-brown beetle appears to replace the typical form at Tehuacán in southern Puebla, Mexico. A few adults have been taken in March and April, in late April large larvae and cocoons were numerous, and in November larvae in various stages of development were common. The larvae cause considerable damage, even complete destruction, to large types of prickly pear such as *Opuntia hyptiacantha* and cultivated *O. ficus-indica*, and to the Cylindropuntias *O. tunicata* and *Cereus*.

Cactophagus fahraei (Gyllenhal)

A distinct species with dark-red prothorax and black elytra, each with two orange markings; the elytra are densely punctate. It is prevalent at Oaxaca in southern Mexico where the larvae are destructive to *Cereus* and to large types of prickly pear, including *Opuntia hyptiacantha* and cultivated plots of *O. ficus-indica*. A few adults have been collected in April and November; large larvae were very numerous in the latter month.

Cactophagus striatoforatus (Gyllenhal)

This Central American species is wholly black with punctate elytra. It was encountered in November and December 1927 attacking prickly pear and *Cereus* at La Unión in El Salvador, and *Cereus* and *Nopalea* at Zacapa in Guatemala. Adults were rare, but larvae were not uncommon. The habits appeared similar to those of the Mexican forms.

Coleoptera: Chrysomelidae

DISONYCHA Chevrolat

Disonycha varicornis Horn

This flea beetle, measures approximately 7 mm. in length; the head and prothorax are yellow, the elytra blue. The distribution extends from southern Texas to southern Arizona. The host plants are Cylindropuntias; in Texas the "tasajillo" *Opuntia leptocaulis* is the usual food plant, but in west Texas to Arizona *O. kleiniae*, *O. imbricata*, *O. davisii*, *O. fulgida*, and *O. versicolor* have been recorded. On one occasion, in March 1927, larvae were numerous and were causing considerable damage to the very young growth of *O. lindheimeri* in

the field station grounds at Uvalde, Texas; this is the only report of prickly pears being attacked.

Adults and larvae have been observed at various times from March until October. The larvae feed externally and without any protective covering on the younger segments. As a rule the insect is not common. At sporadic intervals heavy infestations have been noticed on a few or individual plants; under these circumstances the younger growth is severely damaged.

CHRYSOMELIDAE SPECIES UNDETERMINED

In February 1924 at Humahuaca (altitude 9,000 feet) in the northern province of Jujuy, Argentina, bluish-black chrysomelid larvae, about one-half inch in length, were feeding externally or internally on the younger segments of a small-jointed, mound-forming Tephrocactus, either *Opuntia russellii* or a close relation. The larvae were solitary in habit and moved from one segment to another. Attempts to rear the adults were unsuccessful.

COLEOPTERA: Anobiidae

TRICORYNUS Waterhouse, spp.

Adults of a small beetle of this genus were bred from prickly pear at San Luis Potosí, Mexico, in July 1928. The larvae tunnelled beneath the epidermis of the segments and pupated within the channels. Their work resembled that of the lepidopterous miner *Marmara opuntiella*.

Another species of this genus has been found in Peru. In October 1936 creamy-white larvae were feeding in the fruit and flower heads of *Trichocereus* sp. at Santa Eulalia in the Rimac Valley. From one to several larvae inhabited the fruit, which were sometimes destroyed by the attack. Adults emerged from late October to January.

COLEOPTERA: Buprestidae

Moderately large cream-colored larvae were located in November and December 1936 feeding within the stems of *Copiapoa cinerea* at Taltal in the drier northern sections of Chile. They formed fibrous cocoons within the feeding cavities. In association with scavenging insects they caused considerable damage. The adult was not bred, but R. C. Mundell reported that skeletal remains inside plants represented "a medium-sized buprestid with blackish elytra and shining green underparts."

263-417—68——9

DIPTERA

Only the Diptera that are primary enemies of cactus plants are considered in this publication. The many species of Syrphidae and Stratiomyidae, whose larvae are scavengers or secondary enemies, following up mechanical wounds, plant-disease lesions, and the injuries caused by the primary cactus insects, are not discussed.

The primary Diptera are restricted to several species of gall midges of the family Cecidomyiidae, and two species of the muscoid family Lonchaeidae. In view of the heavy crops of fleshy fruit produced by prickly pears and other cacti, it is significant that no true cactus fruit flies, family Trypetidae, have been discovered. There are a few records of fruit flies having been reared from *Opuntia* fruit, but in each instance a polyphagous species was involved.

One incomplete observation of undetermined dipterous larvae infesting prickly pear fruit was made at Anatuya, Province of Santiago del Estero, Argentina. In February 1935 cream-colored larvae were abundant in the fruit of *Opuntia sulphurea* and were found occasionally in fruit of *O. utkilio*. One larva occurred in the seed cavity of each affected fruit, which became discolored and fell off before it ripened. Sometimes the larva tunneled into the fleshy parts of the fruit. A very high proportion, estimated at between 80 and 90 percent of the fruit of *O. sulphurea* in the locality, contained larvae. Several pupated during the same month but no adults were reared.

DIPTERA: Cecidomyiidae

Several species of gall midges have been reared from prickly pear segments, but none appears to be of any importance. However, *Asphondylia opuntiae*, which breeds in *Opuntia* fruit, has a definite controlling effect, and is of unusual interest.

ASPHONDYLIA Loew

Three species of this large genus, *A. betheli*, *A. opuntiae*, and *A. arizonensis*, have been recorded from prickly pear. During the investigations in the United States and Mexico, when particular attention was paid to these fruit midges, one species only was encountered, and this was invariably identified as *A. opuntiae*. *A. betheli* was described by Cockerell in 1907 from prickly pear at Boulder, Colorado. *A. opuntiae* was described by Felt in 1908. Through the courtesy of Professor T. D. A. Cockerell, officers of the Board secured fruit of *Opuntia tortispina* infested with *Asphondylia* larvae from Boulder, the type locality

of *A. betheli.* The adult midges reared from this material were determined by Dr. E. P. Felt as *A. opuntiae.* The question arises whether *A. betheli* and *A. opuntiae* represent one species; if this should prove to be the case, the former name has priority.

Asphondylia opuntiae Felt

This cecidomyid has a very wide distribution, from Colorado in the north to southern Mexico, and from Texas to California. The most northerly records of its occurrence have been made at Boulder, Colorado, and at Zion National Park, southern Utah; it was not found in Kansas, Nebraska, and Wyoming. In Mexico it occurs as far south as Tehuacán and Oaxaca in the southern highlands. It is not uncommon on the Pacific coast between Los Angeles and San Diego, while in Texas its range extends to the Gulf coast.

The experience of the Board's officers would indicate that the species is most abundant and most generally distributed over the Edwards Plateau in the central-western portion of Texas and in the region lying between Austin, Brownwood, San Angelo, and Rocksprings, where it was observed in quantity in 1925, 1928, 1929, and 1931. The following extracts from reports will serve to illustrate its prevalence in that region:

May, 1938: fully 80 percent of *Opuntia* fruit attacked along the Pedernales River; quite common at Eden, San Angelo, and Water Valley.

October, 1938: particularly abundant in the San Saba valley near Hext; in some areas almost 100 percent infestation of fruit.

July, 1929: for miles around Ballinger, Coleman, Brownwood, and Lampasas, the rather scattered growth of *Opuntia lindheimeri* Engel bore a heavy crop of fruit; all plants showed not less than 90 percent and many plants 100 percent of the fruit attacked by *Asphondylia* Loew.

August, 1931: fully 90 percent of the fruit attacked in the San Angelo-Sonora sector.

Around Uvalde the insect is not uncommon in local areas, usually in more or less wooded country, rarely in the exposed fields of *O. lindheimeri;* it becomes prevalent in the foothills section west of Del Rio. The distribution extends northward to Fort Worth and Dallas. East and southeast from Uvalde the midge has been located fairly generally as far as the Navidad River and Beeville. However, it appears to be extremely rare along the Gulf coast. Considerable exploratory work has not revealed its occurrence in the Galveston and Brownsville districts; in fact the only positive records from extreme coastal areas in Texas were made at Rockport, at Sinton, and near Lolita. The species is not common in the drier parts of southwestern Texas, although it has

been found at Sanderson, Marathon, and the Davis Mountains. There are very few observations from New Mexico; however, it was prevalent at Ute Park in northeastern corner, and has been taken at Carlsbad in the southeast and at Silver City in the southwest of that State. In Colorado, infested fruit has been located at various points between Trinidad and Boulder. The only record from Utah was made at the Zion National Park near the southern border.

In Arizona the insect is not abundant except in local areas. In the northern sector it has been met with at Ashfork and Mormon Lake. Most of the records are from southern Arizona, for example, Oracle, Santa Rita Mountains, Santa Catalina Mountains, Baboquivari Mountains, and Chiricahua Mountains, where the infestation is often heavy in the foothills and lower mountain valleys, but is, at the most, occasional among the extensive fields of prickly pear on the open mesas. In southern California, *Asphondylia* occurs near Los Angeles, on the coast at Oceanside and San Diego, and in the Cuyamaca Mountains; as in Arizona, the valleys appeared to be favored, and very large fields of *Opuntia vaseyi* and *O. covillei* in exposed situations showed no evidence of its presence.

In Mexico the midge has been reported from such widely separated localities as Saltillo, in southwestern Coahuila, Aguascalientes, Zacatecas, around San Luis Potosí, and in Tehuacán and Oaxaca in the southern highlands. Considering the general abundance of prickly pears, records from the Central Plateau of Mexico are surprisingly few and do not include one locality in the states surrounding Mexcio City. Again, no sign of its existence has been seen in the large areas of *Opuntia lindheimeri* in the gulf-coast State of Tamaulipas.

As regards host preference, many species of prickly pears (Platyopuntias) are known to be attacked, and very occasionally the fruit of certain Cylindropuntias. In the parts of Texas where the insect is most prevalent, the common and often the sole *Opuntia* is *lindheimeri*, which is the most general host plant. The related *O. cacanapa* is freely infested in the Uvalde district. In the Del Rio sector *O. atrispina* and *O. phaeacantha* types are attacked. In southern Arizona, shrub pears of the *O. engelmannii–phaeacantha* group, including *O. discata* and *O. canada*, are selected without apparent preference for any particular species. The shrub pears *O. littoralis*, *O. vaseyi*, and *O. covillei* are the host plants in California. Low-growing forms such as *O. tortispina* and its relations receive attention in the Dallas–Fort Worth–Austin sector of Texas, in Colorado, and in northern Arizona. In Mexico, the shrub pear *O. cantabrigiensis* appears to be preferred to larger plants at San Luis Potosí and Zacatecas, but fruits of tree pears are not immune from attack, the records including *O. streptacantha* at

San Luis Potosí and *O. hyptiacantha* at Tehuacán and Oaxaca. In Australian experiments the fruit of the shrub pears *O. inermis* and *O. stricta* proved suitable to the insect.

Although *Opuntia imbricata* and other forms are widespread from western Texas to Arizona and in northern Mexico, reports of midge infestation of Cylindropuntias have been obtained from one locality only. In March 1927 infested fruit of *O. imbricata* were quite common near Aguascalientes, Mexico, but no attack was observed among the various kinds of Platyopuntias in the vicinity. In March 1928 *O. imbricata* fruit were infested over an extensive area in the same locality; again, no sign of injury to fruit of the several species of prickly pear could be traced. From *imbricata* material brought to Uvalde, Texas, the adult midges that emerged oviposited readily in fruit of the prickly pear, *O. lindheimeri.*

Although the slender-jointed *O. leptocaulis* has been recorded as a host plant on a few occasions, it is evident that its fruit are rarely selected. In March 1928 two plants with infested fruit were found in the Uvalde district. In October 1929 attacked fruit were observed on a few plants at Aguascalientes and San Luis Potosí, Mexico.

The life history of *A. opuntiae* is peculiarly adapted to its host. There is one generation annually. The midges emerge in the early spring when the prickly pear plants are producing new growth and flower buds. The females select for oviposition buds from 2 to 7 days old and usually less than one-half inch in length; these buds bear small leaflets and have reached a stage where there is an air space in the ovary and the flower style has not yet appeared. The attacked buds develop into normal flowers. About four weeks after the eggs have been laid, the result of the infection is indicated by a slight but definite yellowing of the young fruit. The seeds do not develop but remain soft and partially formed. The fruit remains green-yellow throughout the summer and does not ripen. Very small yellow or orange larvae are found among, but not in, the seeds. Their growth is very gradual and is hardly perceptible to the eye until December. In the mid-winter months of December and January, the larvae become more active, but they are still quite small in early February. They then grow rapidly, pupate in late February and March, and emerge as adults in March and April. These observations apply to conditions in Texas and Mexico; in northern Arizona and in Colorado, emergence occurs in May and June. For the whole period of their existence the larvae feed among the seeds and do not attack the fleshy parts of the fruit; they pupate in the seed cavity. When ready to emerge, the pupae work their way through the flesh and project through the sides of the fruit. Shortly after emergence of the adults the fruit shrivels

and falls off. The life cycle occupies 12 months, of which at least 11 months are spent in the larval stage; the pupal period is 5 to 10 days.

A prime consideration involved in the experiments toward the possibility of establishing this insect in Australia was that the adult midges must emerge in September and October, concurrently with the flowering of prickly pear, instead of in March and April as in North America. This objective was attained by shipping the infested fruit from Texas as soon as they showed the characteristic signs of attack. Material dispatched in April, about four weeks after the eggs were laid, reached Australia in May, and yielded adult midges from mid-September to the end of October. Thus, the life cycle was shortened from the normal 12 months to approximately 6 to 7 months. It should be pointed out that the larvae left Texas in the spring and arrived in Australia at the beginning of the Southern Hemisphere winter; hence, the larvae were not subjected to summer heat, either in North America or in Australia. The acceleration of the life cycle by subjecting the young larvae to comparatively cool climatic conditions, instead of the normal hot summer, is a matter of considerable interest.

On the other hand, cold temperature experiments with older larvae in North America arrested or retarded development. Material placed in storage at 39° F. early in February, before the larvae had entered the rapidly-growing stage, showed no appreciable growth after an interval of 3 months. Again, infested fruit placed in early February in a cool vault, where temperatures were variable but considerably below atmospheric readings, were retained at the cooler conditions for 103 days; the adults emerged in June, 23 days after removal of the fruit from the vault and 2½ months later than emergence in the field.

The life history has been studied at Uvalde, Texas, both in the field and under cage conditions. Emergence of adults in various years in the Uvalde district occurred as follows:

1922. In the second half of March.

1923. The only record was made on April 15.

1925. Commenced on March 12, and was general until March 30; a few adults appeared in early April.

1926. Commenced on March 9, reached the peak on March 22, and was almost complete by March 31.

1927. March 15 to 31.

1928. At Uvalde commenced on March 20, and 25 miles south of Uvalde began on March 15. At Del Rio, 80 miles west of Uvalde, commenced on March 1. Continued until middle of April.

1929. Commenced on March 8; about 50 percent had emerged by March 31; continued until middle of April.

It is evident that the temperature and atmospheric conditions that stimulate the after-winter growth and flowering of prickly pear influence both the rapid development of larvae at the end of the winter and the emergence of the adult midges. For example, at Del Rio in 1928 midge emergence was 3 weeks earlier than at Uvalde, and the flowering of prickly pears in the vicinty of Del Rio showed approximately the same period of advancement. In 1926 interesting records were made of the effect of temperature on the emergence of adults from field-collected fruit. Emergence commenced on March 9; until March 18 the daily number of midges varied between 0 and 36; during this period shade temperatures varied between 54° and 79° F. maximum, and 37° and 57° F. minimum. Thereafter the following data were secured:

Date in March	*Temperature (°F.)*		*Number of midges*
	Maximum	*Minimum*	
18	76	57	28
19	69	60	80
20	79	64	147
21	86	68	176
22	84	62	376
23	81	55	300
24	83	54	223
25	65	53	81
26–31	55–70	35–50	153

Thus, of 1658 midges that emerged in the period March 9–31, 1222, or almost 75 percent, appeared during the 5-day period, March 20–24, inclusive, of relatively high temperatures.

In addition to observations at Uvalde, emergence has been noted at other localities as follows:

Marathon, western Texas: mid-March 1925.

Navidad River, eastern Texas: March 25, 1928.

Boulder, Colorado: May 2–3, 1925.

Mormon Lake (7000 ft.), northern Arizona: June 9, 1925.

San Luis Potosí, Mexico: March 2, 1928, about 50 percent had emerged.

Aguascalientes, Mexico: Emergence had commenced on March 11, 1928.

Tehuacán, southern Mexico: First week of March 1927.

The appearance of adults from one fruit usually extends over several days, and even over 12 days in extreme cases. The time of emergence varies considerably. At Uvalde, in March 1925, 75 percent of the

midges issued from the fruit between 7 and 9 a.m., and none emerged after 3 p.m. On the other hand, in March 1927 at Uvalde, emergence occurred after sundown. In experimental work carried out in Australia, the adults appeared between 4 and 6 p.m.

No difficulty was experienced in securing mating and oviposition in different types of cages. At Uvalde, both acts were general between 9 a.m. and noon in March 1925; but in March 1927 mating and oviposition were not observed until after sundown, continuing until after dark. In Australian cages, oviposition took place between sundown and dark, and very occasionally between 5 and 7 a.m. The female crawls over the young bud and selects a position on the side of the bud at about one-half its length. The ovipositor, which is 3 mm. long, is thrust between the small leaflets into the air space in the ovary. About 25 to 30 minute granular eggs are deposited, lightly cemented together in a mass about 0.5 mm. in diameter and resembling a bundle of miniature grapes. Three egg masses have been observed in one fruit. One female may oviposit in several fruit, and two or more may lay in the same bud. The incubation period occupied 5 to 10 days at Uvalde in March. The adults live for 3 to 5 days.

Judged on larval counts or by the issuing adults, the number of eggs deposited in each bud varies very greatly. In *Opuntia lindheimeri* the average number of larvae was 40 to 50 per fruit; counts of 70 were not uncommon; and as many as 100 and as few as 2 larvae have been found in individual fruit. At Tehuacán, Mexico, the larvae in fruit of *O. hyptiacantha* averaged 20, but sometimes not more than 4 or 5 were present. The small fruit of *O. leptocaulis* generally produced three midges. In Australia as many as 80 larvae occurred in one fruit of *O. stricta*.

As a rule the affected fruit are definitely yellow and are readily detected. Frequently they are very much swollen, or, if not enlarged, their contour is abnormal in comparison with healthy fruit of the same variety of prickly pear. At Tehuacán, Mexico, infested fruit of *O. hyptiacantha* were not appreciably yellow but were much enlarged. In Australia, fruit of *O. stricta* were greatly swollen, even to the extent of being three times the size of normal examples; so great an enlargement has not been observed with any of the various prickly pears recorded as host plants in America.

In Texas attacked fruit of *O. lindheimeri* and the closely related *O. cacanapa* very often assume the character of segments and produce new growth of either segments or fruit. The infested fruit alter in shape to become short and stout or long and narrow. The development of new growth in these fruit commences several weeks after the midges have oviposited in the buds and continues until August or September. More usually segments arise, but fruit production from attacked fruit

is not rare. From one to several segments or from one to six fruit may develop; as many as 10 fruit have been observed growing from one infested example. These new fruit, which are quite normal, mature before the end of summer. Although it may have acquired the growth-producing function, the affected fruit invariably falls off after emergence of the adult midges. On one occasion, near Hext, Texas, two fruit growing from an infested fruit were themselves attacked by *Asphondylia.* This phenomenon was observed in 1928, a season in which emergence was prolonged over a period of several weeks; it could not have happened in a normal year.

Despite the fact that the incidence of segments and fruit from infested fruit is common in *O. lindheimeri* and *O. cacanapa,* it has been recorded with only one other *Opuntia;* in California affected fruit of *O. vaseyi* have produced both segments and fruit. This growth-forming peculiarity of the fruit has never been observed among the *O. engelmannii-phaeacantha* group of host plants in western Texas to Arizona; in the *O. tortispina* forms in Texas, Colorado, and other places; in *O. littoralis* and *O. covillei* in California; in *O. inermis* and *O. stricta* in Australia; or in *O. cantabrigiensis, O. hyptiacantha,* and *O. imbricata* in Mexico.

Concerning the importance in control, since all seeds in an infested fruit are rendered sterile, the potential value of this insect in reducing the natural spread of prickly pear is very great. However, in most districts where *Asphondylia* is well distributed, areas showing a heavy percentage of fruit infection are scattered or are localized. Thus, one may encounter plants and even stands of prickly pear with 90 percent fruit infection, and yet in the same district the vast majority of the plants shows no trace of attack. The midge is of real importance on the central-western plateau of Texas in the region lying between Rocksprings, San Angelo, Brownwood, and Austin, where the degree of fruit infestation is very high and very general. It is considered that the sporadic occurrence of prickly pear in the Ballinger–Brownwood–Lampasas country may be due to the large-scale destruction of the seeds by this insect. On the other hand, it has been reported that infested fruit of *O. lindheimeri* can produce as many as 12 normal fruit. If this condition were general, the midges would assist the spread of prickly pear through the increase in the quantity of seeds yielded by each plant; but, actually, the number of additional fruit produced in this manner does not nearly counterbalance the proportion of seeds rendered incapable of germination.

In some instances, the attack by *Asphondylia* supplies favorable conditions for the entrance of plant disease organisms. Around Del Rio, Texas, in April 1928 the anthracnose fungus *Gloeosporium lunatum* was active in 90 percent of the fruit from which the midges had just

emerged, had penetrated into the segments to which the fruit was attached, and not infrequently had advanced through these segments into the penultimate cladodes.

CECIDOMYIA Meigen

Cecidomyia opuntiae (Felt)

This midge was described in 1910 from material reared from prickly pear segments growing in the New York Botanical Gardens. It was still breeding in the greenhouses of the Gardens in 1924, but no more recent information is available. Although the original infestation was probably introduced with *Opuntia* plants from some part of America, the insect has not been recorded from the field. The larvae live in cells beneath the areoles.

In September 1921 infested segments of several species of prickly pear, including *O. dillenii*, *O. lindheimeri*, *O. robusta*, and *O. elatior*, were received at Uvalde, Texas, from the New York Botanical Gardens. Adults emerged in October, but efforts to secure oviposition in prickly pear segments in cages were unsuccessful.

MAYETIOLA Keiffer

Mayetiola Keiffer, species A

This insect would appear to be very rare or to have a local distribution. The two records of its occurrence were made in the neighbourhood of Floresville, Wilson county, Texas. In August 1924 the orange-colored larvae were numerous in cells in segments of *Opuntia lindheimeri* in one small area; the affected segments bore a yellow appearance. Several of the infested cladodes had been produced by fruit attacked by *Asphondylia*. No adults were reared.

In February 1928 apical segments on a plant of *O. fuscoatra* near Floresville were infested with midge larvae living in cells beneath the areoles, which were swollen and yellow. The small adults emerged in March and were identified by C. T. Greene of the U.S. Bureau of Entomology as an undescribed species of the genus (*Phytophaga* Rondani=)*Mayetiola*.

Mayetiola Keiffer, species B

This is another form that has been identified as an undescribed species. The two records of its occurrence were made at Cuernavaca, State of Morelos, Mexico. In April 1926 a yellowed segment of the tree pear *Opuntia tomentosa* contained between 100 and 200 small orange larvae; adults were not reared. In March 1928 two segments of *O.*

tomentosa infested with the midge larvae were located in the same neighborhood; one segment when opened contained several hundred larvae; from the other cladode adult midges emerged in May.

Mayetiola Keiffer, species C

This third undescribed species is known from one record only. Adults emerged in April 1928 from segments of *Opuntia tomentosa* collected at Cuajimalpa near Mexico City. In addition, the infested material produced adults of the chalcid *Torymus bifasciipennis* (Gahan).

NEOLASIOPTERA Felt, sp.

This undescribed species was discovered attacking segments of *Opuntia streptacantha* and a related prickly pear at Aguascalientes, Mexico, in 1927 and 1928. The bright-red larvae were in colonies of from 25 to 50 individuals, forming cells about one-half inch in diameter. As many as 15 cells were present in one segment. The larvae spun light silken cocoons side by side in clusters. At emergence, the pupae cut through the cuticle and projected from the surface of the segment. Large larvae and pupae occurred in early March. The first adult appeared on March 17, and emergence continued into April. In confinement the midges mated readily and attempted to oviposit in *O. lindheimeri.*

Diptera: Lonchaeidae

Two species of Lonchaeidae form cells in prickly pear segments.

LONCHAEA Fallèn

Lonchaea alexanderi Brèthes

This Argentine species appears to be widely distributed. It was described from adults reared in April 1921 from larvae found during the previous month infesting a segment of the low-growing broad-jointed *Opuntia sulphurea.* Later it was located at various points in the Provinces of Salta, Tucumán, and Santiago del Estero, at Concordia in the Province of Entre Ríos, and in the Botanical Gardens at Montevideo in Uruguay. In August of 1932 and 1933 the insect was rather common at localities in northern Tucumán; in August 1933 it was also abundant at Güemes and El Quebrachal, Province of Salta. The favoured host plant seemed to be the tree pear *O. quimilo,* but larvae have been observed in *O. monacantha, O. bonaerensis, O. elata, O. ficus-indica,* and *O. cordobensis,* as well as in *O. sulphurea.*

The larvae live in individual cells which are filled with dead plant tissue. Their presence is conspicuous on account of the yellow or brown circular patches, less than an inch in diameter, on the surface of the segment. Several or many cells, each containing one larva, may occur in one segment. At Tucumán the larvae pupated within the cells in August, and the adults emerged in September. The insect was in the pupal stage at Montevideo in December, the adults appearing in the same month.

DASIOPS Rondani

Dasiops saltana (Townsend)

A Mexican form was discovered in October 1926 infesting the younger segments of various kinds of prickly pears at Aguascalientes and at Morelia and Uruapán in the State of Michoacán. The larvae occurred singly or in small colonies containing as many as eight individuals, in cells usually on the margins of the segments; the affected portions were noticeably swollen, and the cells contained semidry tissue. From one to several cells were present in each segment. The larvae pupated within the cells, and the adults emerged in November. Damage was minor where plant disease organisms gained entrance through the cells and spread through the segments. In March 1928 this insect was found in the pupal stage at Cuernavaca, State of Morelos; the adults emerged in the same month.

HYMENOPTERA

Chalcididae

Two chalcidid species have been reared from prickly pear under circumstances that might indicate a phytophagous habit. However, it is possible that both insects are parasites on cecidomyid larvae.

TORYMUS Dalman

Torymus bifasciipennis (Gahan)

A green and black callimomid with a long ovipositor, described as new in 1936, was reared in numbers from segments of *Opuntia tomentosa* collected at various points within 30 miles of Mexico City. The orange larvae occurred singly or in colonies in cells beneath the areoles; the adults emerged through the areoles. Large larvae and pupae were present in March 1928, and the adults emerged in March and April. A few specimens of the cecidomyid *Mayetiola* Keiffer sp. C. were reared from the same segments. The *Torymus* larvae were found in various stages of development in cells in which no *Mayetiola* larvae were living.

A. B. Gahan, of the U.S. Department of Agriculture, states (in litt.) that while a few species of *Torymus* are phytophagous, most species are bred from cecidomyid and cynipid galls.

RILEYA Ashmead

Rileya opuntiae Gahan

This black eurytomid was described in 1936 from material reared from the small fruit of the Cylindropuntia *Opuntia leptocaulis* at Uvalde, Texas, in March and April 1928. The cecidomyid *Asphondylia opuntiae* was bred from the same collection of fruit, but not necessarily from the same individual fruit.

Gahan has advised that there is very little exact information regarding the life history and habits of species of *Rileya*, although most have been definitely associated with Cecidomyiidae. However, many eurytomids are phytophagous. It might be pointed out that during the Board's investigations *Asphondylia* was reared in very large numbers from fruit of various Platyopuntias, and in no other case was *Rileya* bred in association with the midge.

HETEROPTERA

Coreidae

With the exception of the capsid *Hesperolabops picta* which is reported to feed on other plants besides cacti, all the true cactus bugs belong to the family Coreidae and are included in three genera, *Chelinidea*, *Narnia*, and *Leptoglossus*, each with several species. *Chelinidea* and *Narnia* appear to be segregates restricted to the Cactaceae, but *Leptoglossus* contains many species that do not feed on cactus.

In America and in Australia other Heteroptera, usually more or less general feeders, are occasionally found in the adult stage on prickly pears, but it is doubtful whether any of these insects complete their life cycles on *Opuntia*.

CHELINIDEA Uhler

This genus contains four species, although it may be doubted whether *C. canyona* is specifically distinct from *C. tabulata*. The three forms, *C. tabulata*, *canyona*, and *vittiger* are primarily enemies of Platyopuntia, while *C. hunteri* attacks Cylindropuntias.

The life history and habits of the species are quite similar. Both adults and larvae (or nymphs) feed by puncturing the joints, and

sometimes the fruit, of the plants. Typical pale-yellow circular areas arise around each feeding puncture, and the prickly pear joints present a spotted appearance. Where the attack is concentrated, the joints become wholly yellow and sickly. Younger segments may wither and fall off from the injuries, and whole plants may show the unhealthy yellow condition. The growth of the plant is definitely impeded because of the destruction the bugs cause among the young growth and flower buds as they sprout from the joints. In fact, in preventing growth and fruiting, *Chelinidea* exercises a greater degree of control than in destroying joints and plants. It has frequently been observed that *Gloeosporium lunatum* and other fungi are prone to attack joints that have been injured by the bugs, and that the fungus lesions develop around the feeding punctures.

The adults, although capable of strong flight, are sluggish insects and rarely take wing. When disturbed they either move rather quickly to the protected side of the joints or drop to the ground. Flight usually occurs under certain climatic influences of high temperature and humidity. In Australia *C. tabulata* has been known on several occasions to swarm in large numbers and fly in one direction for at least several miles. This phenomenon has been recorded once for *C. vittiger*.

The eggs are deposited in a row on the underside of the prickly pear spines, but although this is the usual practice, it is not invariable. *Opuntia inermis* in Australia produces mainly fine spicules or spine hairs from the areoles and very few long spines. Hence, *C. tabulata* either lays eggs in clusters on the flat surface of the joints or on any adjacent object i.e., on grass stems and twigs, on or under the bark of tree trunks, and on the foliage of trees and shrubs; quite often its eggs have been found attached to eggsticks of *Cactoblastis cactorum*.

Nothing is known of the life history of *C. hunteri*, but both in the United States and in Australia *C. tabulata*, *C. canyona*, and *C. vittiger* pass through two generations annually. In his review of the genus *Chelinidea*, J.C. Hamlin (1924, p. 198) suggests that in Texas, *C. vittiger* has four or five generations, *C. tabulata* three to five generations, and *C. canyona* three generations each year. This confusion with regard to seasonal history has arisen because of the frequent occurrence of adults, all stages of larvae, and eggs in any given locality at almost any period during the summer. The explanation of the admixture of various stages lies in several factors; the adults are long lived; the egg-laying period in each generation is extended over 2 to 3 months; and the rate of development of the larvae varies considerably, particularly in the autumn months. The bugs overwinter in the adult stage, but large larvae may be found during the greater portion of winter. During the colder months, the adults shelter among debris, often in congregations,

at the base of the plants; hibernation is not complete, since the insects will become active and feed to some extent on warm sunny days. It is possible, however, that at higher elevations and in colder latitudes of the United States *C. vittiger* hibernates completely for 2 or 3 months.

The overwintering adults oviposit in spring from March to May in Texas and Mexico and from April to June in the more temperate regions. In the Brownsville district of Texas *C. tabulata* adults may deposit eggs in February if the weather becomes warmer; in Mexico eggs are frequently laid during February. The first generation reaches maturity in May to July, and oviposition extends from July to November. The second generation larvae develop to adults at any time between August and November, while a small proportion, representing the tail-end of the generation, may spend the earlier months of winter as large nymphs. The adults of the second generation do not oviposit until spring.

The adults are capable of sustained longevity. The following records of adult life were made under cage conditions in Australia:

C. tabulata. Adults of the first summer generation lived for a maximum period of 350 and 424 days in the case of a male and a female, respectively. The female laid eggs during January to April and again during August to December; the interval between the first and last batch of eggs was 390 days. A female of the second summer generation lived for 330 days and deposited eggs over a period of 170 days from August to January.

C. canyona. A female of the first summer generation survived for 343 days, depositing eggs during January to March and again in October and November, a period of 10 months between the first and last eggs.

C. vittiger. A female of the second summer generation survived for 542 days ovipositing freely in October and November and laying a few eggs in February and March.

PARASITES.—The tachinid *Trichopoda pennipes* has been reared in Texas from *C. tabulata*, *C. canyona*, and *C. vittiger*, and in Florida from *C. vittiger*. This insect attacks many Heteroptera, and although a common enemy of *Chelinidea*, appears to exercise little control.

An egg-parasite *Hadronotus* sp., has been reared from eggs of *C. tabulata* and *C. vittiger* at Uvalde, Texas, and from eggs of *C. tabulata* at San Luis Potosí, Mexico. One parasite issues from each egg. The life cycle was completed in 20 to 26 days at Uvalde in September and October. In September 1930, 80 percent of the *Chelinidea* eggs collected at Uvalde were attacked by this insect.

Chelinidea tabulata (Burmeister)

This species has a very wide distribution from Texas through Mexico and Central America to northern South America. In Texas its northern and western limits are in the vicinity of Uvalde and San Antonio, where it frequents the moister and more sheltered situations; it is prevalent around Brownsville but has not been found along the greater length of the Texas coast between Brownsville and Galveston. Its range extends throughout the length of Mexico as far south as Oaxaca; it is a very abundant insect in northern coastal State of Tamaulipas and in many areas throughout the Central Plateau from Chihuahua City and San Luis Potosí to the vicinity of Mexico City. There are no records of its occurrence in the northern portion of Chihuahua. On the west coast of Mexico it has been collected at Tepic, in the State of Nayarit, but it has not been discovered in Sinaloa and Sonora, where *C. vittiger* occurs. In Central America *C. tabulata* has been observed in considerable numbers at Zacapa and around Guatemala City in Guatemala, at La Unión in El Salvador, and at Tegucigalpa and Comoyagua in Honduras. In northern South America it occurs at Barquisimeto in Venezuela.

The adult bug is about one-half inch long and approximately half as wide. Its normal color is light brown-yellow, with the legs and venter of the abdomen more distinctly yellow and the venter of the thorax mottled black; the membranous section of the elytra is black. There is considerable color variation in different localities. In many Mexican examples, the elytra and venter of the abdomen are dark blotched and the basal portions of the legs are dusky. Specimens from Durango and Parral (Chihuahua) are more red-brown in general ground color. Venezuelan adults resemble the darker Mexican forms but are considerably smaller.

The life cycle may be considered to occupy 2½ to 4 months. In Australia the incubation period has been determined at 9 days in midsummer to 39 days in August–September (early spring). The duration of the larval period varies to some degree for material hatching on the same day. Australian observations showed the duration to be 59 to 90 days in October to January, 57 to 90 days in January to March, and 66 to 79 days in September to November. The first three larval instars occupy approximately the same period, but the fourth and fifth instar tend to a longer duration. Here again, examples are cited from Australian data in the tabulation above:

The number of eggs laid by each female varies very greatly. In Australia, the average fecundity was about 80 eggs; the greatest number

Instar	Days			
	October–January	*January–February*	*September–November*	*Average*
1st	8–17	8–11	13–16	12
2nd	7–15	9–15	12–14	12
3rd	11–16	13–18	8–11	12½
4th	13–18	15–22	15–18	16½
5th	20–24	18–24	18–20	21
Average larval period				74

deposited by one female was 233 eggs laid in 30 separate lots at intervals over a period of 170 days; the largest number deposited in one day was 25 eggs.

Unlike those of *C. vittiger*, the larvae of *C. tabulata* are not gregarious; those hatching from one batch of eggs feed separately and soon disperse over the plant. However, where the species has occurred in enormous numbers in an area, hundreds of larvae have congregated on the same joint.

This species attacks Platyopuntias generally. In Texas the host plant is usually *Opuntia lindheimeri*. In Mexico shrub pears of the *O. lindheimeri* and *O. cantabrigiensis* group, and robust plants of the *O. streptacantha* and *O. tomentosa* types, are freely infested. In certain sections of Mexico observations have indicated some degree of preference for shrub pears in comparison with semitree and tree pears. In Australia, the shrub pears *O. inermis* and *O. stricta*, the semitree pear *O. streptacantha*, and the tree pear *O. tomentosa* are all subject to attack; but where the four species are growing in one locality, *O. inermis* is the more favoured host plant.

One note has been made of feeding on Cylindropuntias, the species being *O. imbricata* at San Luis Potosí. In Central America *Nopalea* and *Cereus*, in addition to *Opuntia*, were infested. Feeding marks were observed on *Cactus caesius* in Venezuela. *Acanthocereus pentagonus* and *Harrisia martinii* has been recorded as a food plant in Australia.

***Chelinidea canyona* Hamlin**

In contradistinction to *C. vittiger* and *C. tabulata*, this insect has a very restricted distribution. It occurs in the higher valleys of the Frio and Nueces Rivers, north of Uvalde, Texas, thence westward through the foothills to the Big Bend country north of the Rio Grande, extending into Mexico, San Luis Potosí, Canoas, and Ciudad Mante, according to F. D. Bennett (1963, unpublished report). It is not uncommon north of Uvalde, and has been found in numbers in the Chisos Moun-

tains and the mountainous sections of Brewster and Presidio counties in the Big Bend country, and at the Devil's River, west of Del Rio.

The adult *C. canyona* can be distinguished without difficulty from the typical form of *C. tabulata* occurring at lower elevations. The ground color has a red tinge, the elytra are shaded black, the legs are smoky basally, and underneath the body the light-yellow abdomen contrasts with the dark thorax. Nevertheless, doubt may be expressed with regard to the specific distinction of *C. canyona.* There is some evidence that it is merely a variety or geographic race of the widely distributed *C. tabulata.* For instance:

Dark forms of *C. tabulata:* occur at various points in Mexico. Examples from Durango and Parral (Chihuahua) are not only dark but possess the red tint of *C. canyona;* in fact, they could be referred to either species.

C. vittiger and *C. tabulata* are variable species, according to locality; two quite distinct color varieties of *C. vittiger* occur within 50 miles of each other.

The taxonomic characters used to separate *canyona*, namely, the number of teeth on the femora and the relative length of the juga and tylus, appear to be variable.

In Australian experiments *C. canyona* and *C. tabulata* interbred very readily; the hybrid progeny were fertile and were bred through several successive generations.

If *C. canyona* is merely a variety or race of *C. tabulata*, an explanation is necessary to account for the occurrence of the two forms within 20 miles of each other. The typical *C. tabulata* occurring from Brownsville to Uvalde is obviously a coastal form that has spread northward from the lower elevations of Mexico through the States of Tamaulipas and Nuevo León. In view of the similarity in color between the Durango and Parral specimens of *C. tabulata* and *C. canyona*, it would seem reasonable to consider that a western or mountainous form or race of *C. tabulata* has spread northward along the western edge of the Mexican plateau through Durango and Chihuahua to enter Texas by way of the mountains of the Big Bend.

C. canyona attacks Platyopuntias such as *O. lindheimeri*, *O. cacanapa*, and *O. engelmannii-phaeacantha* types. Bennett (1963, unpublished report) records it on *O. megacantha* and *O. streptacantha*. Hamlin (1924) records *Echinocereus* as a host plant. In Australia *O. inermis* and *O. stricta* proved suitable food plants.

The life history and habits are similar to those of *C. tabulata*, except in certain particulars. Adults have been observed in Texas in all months of the year. Both in Australia and in cages at Uvalde they became active and oviposited earlier in the spring than either *C. tabulata* or

C. vittiger; in the field north of Uvalde they were feeding actively and mating during a period of warm weather in the latter part of January.

The eggs are deposited in smaller batches and are more scattered than are those of *C. tabulata*. Moreover, fecundity appears to be lower. In Australian records, the maximum number of eggs deposited by an individual female was 86, in comparison with 233 eggs laid by one *tabulata* female. One *C. canyona* that survived for 343 days deposited 320 eggs in 11 batches over a period of 10 months, oviposition taking place in late summer, January to March, and in the following early summer, October and November. The incubation period in Australia decreased from 41 days in August and September to 10 days in January.

Hamlin (1924) states that the larval period was completed in 63 days. In Australia it has been ascertained that the development of *C. canyona* is slower than that of *C. tabulata*. During September to January *C. tabulata* larvae reached the adult stage in 59–90 days, in comparison with 76–103 days for *C. canyona;* the duration of the various instars is shown below:

Instar	*C. tabulata*	*C. canyona*
1st	8–17	12–20
2nd	7–15	11–15
3rd	11–16	13–19
4th	13–18	17–23
5th	20–24	23–26

***Chelinidea hunteri* Hamlin**

Very little is known concerning this insect. Its distribution appears to be confined to southern Arizona and Sonora, Mexico, and its host plants seem to be restricted to Cylindropuntias. The original description was based on a few adults collected on a Cylindropuntia of the *O. imbricata* group at Hermosillo, Sonora, in August 1922. Hunter, Pratt, and Mitchell (1912) recorded adults taken on *O. arbuscula*, *versicolor*, and *fulgida* at Tucson, Arizona, in May. In July 1924 adults were found sparsely on *O. fulgida* and *mamillata* in the Tucson district, while in June 1928 the species was observed in the foothill valleys of the Santa Rita Mountains near Tucson.

***Chelinidea vittiger* Uhler**

The range of this insect practically coincides with the distribution of prickly pears in the United States and extends into the northern section of Mexico. In addition to areas investigated by the Commonwealth Prickly Pear Board, it has been recorded from Virginia, North

Carolina, Georgia, Alabama, Tennessee, and Louisiana, and from Baja California in Mexico. The following notes taken from the Board's records indicate its general occurrence:

UNITED STATES: FLORIDA: Northern portion only, especially around Gainsville. TEXAS: All along the Gulf Coast from Brownsville to Galveston; Laredo, Del Rio, Uvalde, San Antonio, Rocksprings, Brownwood, Austin, Palestine, Dallas, Plainview, Amarillo, Sanderson, Davis Mountains. NEW MEXICO: Carlsbad, Organ Mountains, and northeastern districts. OKLAHOMA: Tyrone, Guymon. KANSAS: Liberal, Garden City, Scott City, Wallace. COLORADO: Trinidad, Boulder, Pueblo, Littleton, Fort Morgan, Denver. NEBRASKA: North Platte. WYOMING: Cheyenne, Casper, Douglas. IDAHO: St. Anthony, Blackfoot. UTAH: Salt Lake City, Nephi, Beaver, Toqueville. ARIZONA: Lees Ferry, Ash Fork, Jerome, Tucson, Douglas. CALIFORNIA: Los Angeles, Oceanside, Coachella Valley, San Diego, Bakersfield.

MEXICO: TAMAULIPAS: Throughout the State from the Rio Grande to Tampico and Palmillas. NUEVO LEON: Throughout the State. COAHUILA: Monclova. CHIHUAHUA: Chihuahua City. SINALOA: Culiacán.

The distribution of *C. vittiger* and *C. tabulata* overlaps in northern Mexico and southern Texas. The former is especially common in the Mexican State of Tamaulipas, along the Texas coast, and generally in the eastern half of Texas to the northern border. It occurs abundantly in Wyoming and Idaho; at Blackfoot in Idaho thousands of larvae were observed in June 1926. In some years it is also prevalent in Southern Arizona.

Both adults and larvae exhibit considerable variation in color, and some authorities have divided the species into subspecies and varieties. In the form occurring in the gulf coast section of Texas as far inland as Uvalde, and in the Mexican States of Tamaulipas and Nuevo León, the adults are light-colored, being a dull yellow with yellow legs. In the dark forms the pronotum is yellow, often with black margins, the elytra are mostly dark, and the legs are partially black. The relative amount of black and yellow in the dark forms and the intensity of the coloration are not constant in these dark forms, which occur in Florida, and throughout Northern Texas to Idaho, Utah, northern Arizona, New Mexico, California, and Chihuahua. Both light and dark forms are found near Galveston, Texas. Around Tucson, Arizona, the color approaches that of the coastal Texas form. Examples from Culiacán in the west-coast State of Sinaloa are light in color and are unusually large. The larvae differ in color, particularly in the latter instars; the legs and antennae may be black or mainly red; the abdomen may be green-black, dark green, red, or even dark crimson. This degree of color variation is found in the same locality.

Unlike *C. tabulata*, *C. vittiger* is gregarious and, particularly so in the larval stages. Not only do the larvae from one batch of eggs feed to-

gether, but hundreds will congregate on one small prickly pear joint. The social habit and the concentrated attack on the joints make this species a more destructive insect than *C. tabulata.*

The host plants of *C. vittiger* Uhler include most, if not all, species of Platyopuntia growing within its range of distribution. These embrace the shrub pears (*O. lindheimeri* and *inermis* in Texas; *O. dillenii* in Florida; *O. discata, phaeacantha,* and *engelmannii* forms in western Texas to Arizona; and *O. occidentalis* in California), and the dwarf pears (*O. lata* in Florida; *O. tortispina* and *polyacantha* forms in North Texas to Idaho; and *O. basilaris* in California). More rarely, Cylindropuntias are attacked: the Board's records include *O. leptocaulis* in Texas; *O. imbricata* in West Texas and New Mexico; and *O. bernardina, serpentina,* and *echinocarpa* in California.

The fecundity compares with that of *O. tabulata.* In Australia the greatest number of eggs from one female was 230; this female laid freely during October and November and deposited a few eggs in February and March. Another individual laid 220 eggs in 27 separate lots in January and February.

The incubation period varies with the time of year. The shortest duration of the egg stage recorded in Australia and Texas was 9 days. Hunter, Pratt, and Mitchell (1912) give periods for each larval instar which total 41 days for larval development; Hamlin's (1924) figures make a total of 53 days for the larval period. In Australia larval development occupied 40–59 days in October and November, the life cycle taking 53–73 days. In January–March, the larval period occupied 54–67 days, and the life cycle 66–79 days as follows:

Stage	*Days*
Egg	12
1st instar	8–11
2nd instar	7– 9
3rd instar	11–14
4th instar	13–15
5th instar	15–18

Under similar conditions the development of *C. tabulata* was less rapid, occupying 57–90 days for the larval stages and 67–100 days for the whole life cycle.

NARNIA Stål

The several species are primarily fruit feeders, although they will attack prickly pear joints. We have not been able to recognize *N. inornata* Distant, but believe that records of this species in the United States and Mexico refer to *N. pallidicornis* Stål.

Narnia pallidicornis Stål

The distribution of this species extends from Texas to California and throughout Mexico. The adults are rather variable in the color of the body, elytra, and appendages, and in the degree of the dilation of the hind tibiae. In view of these variations, it is possible that many records of the occurrence of *N. femorata* and *N. inornata* in the United States and Mexico refer to *pallidicornis*.

In Texas the range of *N. pallidicornis* extends from Brownsville along the coast to Corpus Christi, and throughout central and western Texas, west from a line drawn from Waco to Abilene. It also occurs over the southern half of New Mexico and Arizona, being abundant in some years in the Tucson district, and is common in southern California from Los Angeles to San Diego. In Mexico it has been taken in the Pacific States at Hermosillo in Sonora and Culiacán and Mazatlán in Sinaloa. It is prevalent in the gulf-coast State of Tamaulipas from the Rio Grande to Tampico and is found, often abundantly, throughout the central plateau from Chihuahua and Coahuila as far south as Tehuacán.

The host plants include both Platyopuntias and Cylindropuntias (the former much more favored); shrub pears such as *O. lindheimeri*, *engelmannii*, *phaeacantha*, and *occidentalis* in the United States; and semitree pears of the *O. streptacantha* and *O. ficus-indica* groups in Mexico. Among the Cylindropuntias our records include *O. leptocaulis* at Uvalde, Texas, *O. imbricata*, in western Texas and New Mexico, and *O. fulgida* and other species in southern Arizona. At Tehuacán, Mexico, adults and nymphs were attacking the fruit of a large *Cereus*.

Both adults and larvae prefer the fruit, but they have been observed to feed on younger joints. They appear to cause very little damage. Even where their numbers were concentrated, either in cages or in the field, the fruit ripened normally, and few were destroyed. They favor direct sunlight, and the adults are active insects which fly readily. During the winter months they take shelter among debris near or at the base of the plant and hibernate for a period of 2 to 3 months. The eggs are deposited end to end along the spines; more than one row of eggs may be placed on the one spine. The number of eggs deposited by each female is unknown, but fecundity is comparatively high. Thus, from 100 adults placed in cages in June, 4,000 adults and nymphs were obtained in September; assuming that the original number comprised equal proportions of the sexes, the average number of eggs per female would be not less than 80.

There are two generations annually. The overwintering adults oviposit in March and April, and the first generation reaches maturity in May and June. Eggs of the second generation are deposited from

the middle of May to early August, and develop to adults in August to early October. Thus the life cycle occupies about 2 months. Our records do not give the duration of the incubation period or of most of the larval instars. Hunter, Pratt, and Mitchell (1912) record 27 days for the incubation period and 39 days for development of the larvae. The duration of the first instar is brief; observations at Uvalde, Texas, give 4 days in April and 2–3 days in August, and 7 days for the second in the latter month.

PARASITES.—Two parasites are known. The tachinid *Trichopoda pennipes* attacks the adults and larvae. At Uvalde the egg parasite *Hadronotus atriscapus* was reared in August 1923 and 1924.

Narnia snowi Van Duzee

The distribution of this form appears to be restricted to the United States, extending from western Texas, through New Mexico as far north as southern Colorado, and across southern Arizona to southern California.

In western Texas it has been observed commonly in the Davis Mountains, at Alpine, Brewster County, and at Presidio on the Rio Grande. Records from New Mexico include Carlsbad and Albuquerque. In July 1925 the species was abundant at Trinidad in southern Colorado. It is not uncommon in the Tucson district of Arizona as far west as the Quijotoa Mountains. In southern California it was prevalent in June 1925 at San Felipe on the eastern slopes of the Cuyamaca Mountains.

The host plants include both Platyopuntias and Cylindropuntias; and the attack seems to be restricted to the fruit. In June–July 1924 the food plant in west Texas and New Mexico was invariably the Cylindropuntia *O. imbricata*, whereas in the Tucson district the bugs were feeding on the fruit of Platyopuntias only (*O. engelmannii* and *O. phaeacantha* forms) although Cylindropuntias were more abundant. At Alpine, Texas, in August 1924 they were plentiful on *O. imbricata* and sparse on the Platyopuntia *O. macrocentra*. In the Cuyamaca Mountains, California, in June 1925 both prickly pears *O. covillei* and *O. vaseyi* and Cylindropuntias *O. serpentina* and *O. bernardina* were attacked. Under cage conditions at Uvalde, Texas, they attacked both *O. imbricata* and *O. lindheimeri* without appreciable destruction.

Our information on the life history is most incomplete. It is not known whether one or two generations occur annually. Eggs were laid in June and July, and the larvae reached maturity in August–October. The life-cycle occupied about two months. A stock of 90 adults in June had increased to 2,000 adults and large nymphs by September.

In the Uvalde cages, the adults commenced to hibernate in October, were dormant during November and December, resumed active feeding in January, and deposited eggs in February and March.

Narnia femorata Stål

A species larger than *N. pallidicornis*, with greatly dilated hind tibiae and a white cross band across the elytra, specimens were found commonly on prickly pear fruit at Zacapa in Guatemala, La Unión in El Salvador, and Tegucigalpa in Honduras in November–December 1927. In Mexico, it was found in San Luis Potosí and Chapinga on *O. robusta* and *O. megacantha* (Bennett 1963).

LEPTOGLOSSUS Guérin-Méneville

Leptoglossus dentatus Berg

Identified by H. G. Barber (in litt.) as a cactus feeder, this species has a wide range in the Argentine and occurs in Uruguay. Our records give the following distribution in Argentina, Provinces of Buenos Aires (Carmen de Patagones and the Sierra Ventana), Entre Ríos (Concordia), Corrientes (Paso de Los Libres), Santiago del Estero (Anatuya, Villa Angela Bandera), Tucumán (Tapia), Jujuy (Jujuy), Córdoba (Cruz del Eje), Catamarca (Catamarca, Recreo, and Adnalgalá), La Rioja (Chilecite), and Mendoza (Mendoza); and in Uruguay at Salto and Piriapolis.

Both adults and larvae attack the fruit and more rarely the joints of various *Opuntia*, including *O. bonaerensis* and related *monacantha* types, *sulphurea*, *quimilo*, *utkilio*, and *glomerata*, as well as many forms of cerei, such as *Trichocereus* and *Stetsonia*. The eggs are laid along the spines after the manner of *Chelinidea*, and are not placed end to end as in the case of *Narnia pallidicornis*.

Leptoglossus cinctus (Herrich-Schaeffer)

A Brazilian species identified as a cactus feeder by W. L. McAtee (in litt.), it has been collected at Rio de Janeiro and Macaé in the State of Rio de Janeiro, Queimadas and Joazeiro in the State of Bahia, and Bôa Vista, Belém, and Rio Branca in the State of Pernambuco. Adults and larvae attack the fruit and joints of *Cereus* and *Opuntia*, including *O. monacantha* at Rio de Janeiro and the dwarf *O. inamoena* in Bahia and Pernambuco. The larvae are gregarious and the result of their injuries on the joints resembles the work of *Chelinidea vittiger* in Texas.

Leptoglossus concolor (Walker)

Our only records of this insect are of adults captured on prickly pear in April 1926 at Cuernavaca, State of Morelos, and in October 1926 in the State of Michoacán, Mexico, and identified by W. L. McAtee as doubtfully *concolor* Walker.

Leptoglossus subauratus Distant

Adults were collected in Central America from prickly pears at Antigua, Guatemala, and at La Unión, El Salvador.

Leptoglossus Guérin-Ménéville, sp.

This form, determined by W. L. McAtee as *Narnia femorata* Stål, is very different from the Central American *femorata*. It was collected from prickly pears at Barquisimeto, Venezuela, and Puerto Colombia, Colombia, and was rather common on the Island of Curaçao in December 1927 and January 1928.

Heteroptera: Capsidae

HESPEROLABOPS Kirk

Hesperolabops picta Hunter, Pratt & Mitchell (not Uhler)

This small capsid feeds on the joints of Platyopuntias and is reported to attack other plants. It is distributed in southern Texas from Uvalde and San Antonio to Brownsville, throughout the Mexican States of Nuevo León and Tamaulipas, and on the Central Plateau of Mexico from Chihuahua and Coahuila in the north to Mexico City. Adults and larvae are gregarious in habit and often occur in abundance on *Opuntia lindheimeri* in Texas. In the State of Tamaulipas, Mexico, they were very plentiful around Tampico in November 1923 and between Victoria and Tampico in March 1931. In October 1929 they were very common at many localities on the Central Plateau. On the latter occasion large plants of *O. streptacantha* at Cautitlán near Mexico City were yellow and sickly from the attack, although, as a rule this insect causes little injury. Its life history has not received attention.

HOMOPTERA

The scale insect enemies of the Cactaceae are represented by several species of cochineal of the genus *Dactylopius* Costa and by the scale insect *Diplacaspis echinocacti* Bouché. Other scale insects and mealy

bugs (*Pseudococcus* Westwood) have been recorded on cactus plants on various occasions and from various localities, but their restriction to cactus plants has not been ascertained and, at least in some cases, is very doubtful.

Homoptera: Coccidae

DACTYLOPIUS Costa

This genus, as at present defined, contains several species and is restricted to the cactus family. Indeed, the various forms are almost wholly confined to the genus *Opuntia* and the closely allied *Nopalea*. The only exceptions to the last statement of which we are aware are records of cochineal, either *Dactylopius indicus-ceylonicus* or the South American form of *D. confusus*, on *Cereus aethiops* and *Echinopsis intricatissima* in Argentina.

COCHINEAL INSECTS: HISTORY

The name "cochineal" is familiar to everyone as the crimson dye which is obtained from the insects' bodies. All species produce this coloring matter, but only *D. coccus* has been used commercially for this purpose. This insect, variously termed the true cochineal, the cochineal of commerce, or "grana fina," is the largest species and hence produces a greater quantity of the dye substance, which is said to be of a better quality than that obtained from the other forms.

When the Spaniards conquered Mexico in the 16th century, they found the cochineal industry well established by the Aztecs. Indeed, according to A. von Humboldt, its cultivation appeared to have been maintained for hundreds of years. It remained an important pursuit after the conquest; in 1802, more than 3,000,000 pounds of cochineal were exported through Vera Cruz. The Spaniards established the insect in the Canary Islands, where the industry reached its highest development about 1876, when the world crop amounted to about 7,000,000 pounds per annum. The discovery of aniline dyes brought about the decline of the industry, but the production of cochineal is still firmly established in the Canary Islands, although on a greatly reduced scale.

The introduction of prickly pears to such countries as India, Ceylon, South Africa, and Australia in the 18th and the early years of the 19th century was due primarily to the desire to establish the cochineal industry. Lack of knowledge regarding the different species of these insects and the types of *Opuntia* or *Nopalea* suitable to *D. coccus* resulted not only in the acclimatization of *D. ceylonicus* in India and Ceylon and of *D.*

greenii in South Africa, but also in the establishment of the "pest pears" of the various countries. With reference to Australia, it is on record that Governor Phillip, en route to Australia with the first colonists in 1788, called at Brazil and took on board his vessel plants or joints of prickly pear, and cochineal insects as well, for the specific purpose of establishing a supply of the dye for military uniforms. The insect, probably *D. indicus* Green, did not, however, become acclimatized in Australia.

FORMS RECOGNIZED

There has always been confusion regarding the specific identity of the cochineals, due to some of the following factors:

The species are very similar in appearance; observations and records in the field have very often not been substantiated by the submission of material to specialists in the group.

Morphologically the species offer few characters that facilitate determination; in our experience, specialists have made erroneous identifications.

Each species possesses a wide range of *Opuntia* host plants; two species may occur on the same host in the same region. Cochineal from various sources in America became established in other countries, and their origin was lost long before taxonomic entomologists described and named them; thus *D. indicus* Green, described from India, *D. ceylonicus* Green from Ceylon, and *D. capensis* Green from South Africa are all now considered to be *D. ceylonicus*.

Our own records are very imperfect. However, experience in the field, combined with identifications made by various specialists, has gained for us a knowledge of the probable identity of the cochineals occurring in regions which have been given more than passing attention, viz., the United States, Mexico, and Argentina. We recognize the following forms:

Dactylopius coccus Costa: the cochineal of commerce, naturalized in many countries; native habitat probably Southern Mexico or Central America; except for doubtful records from Peru, we have not encountered this in the field. Host plants, *Nopalea cochenillifera* and tree and semitree types of *Opuntia*, such as *O. ficus-indica*, *O. streptacantha* relations, and *O. tomentosa*.

Dactylopius opuntiae Lichtenstein (the *tomentosus* (Lamarck) of some authors): Texas to California and throughout Mexico; naturalised in Madagascar, India, Ceylon, and Australia. Host plants, many species of *Opuntia* of shrub and tree-pear types.

Dactylopius confusus Cockerell: Florida, Kansas, and Colorado to Wyoming and Utah. Host plants, many species of shrub and dwarf prickly pears.

Dactylopius sp. near *confusus* Cockerell: Argentine. Host plants, many species of *Opuntia* of varying types. This Argentine form appears to possess taxonomic characters of specific value.

Dactylopius ceylonicus Green (=*D. argentinus* Dominguez, *D. indicus* Green, and *D. capensis* Green): Argentina, Uruguay, and Brazil; host plants, various species of *Opuntia*. Naturalized in South Africa, India, Ceylon, Australia.

Dactylopius newsteadi Cockerell: United States and Mexico. Host plants, various species of Cylindropuntias.

Dactylopius greenii Cockerell (=*D. confusus capensis* Green): Naturalized in South Africa; origin unknown, but almost certainly South America. This species may be identical with the unnamed Argentine species.

In our investigations *D. argentinus* Dominguez has not been recognized; it must represent either *D. ceylonicus* (Green) or the unnamed Argentine form.

Our *D. opuntiae* Lichtenstein material, which was recently (1966) submitted to Dr. D. J. Williams, Commonwealth Institute of Entomology, has been referred by him to *D. confusus* Cockerell. The material was reared in Australia on *Opuntia inermis*, *O. tomentosa*, and *O. streptacantha*. Dr. Williams agrees with our name of *D. ceylonicus* for the species on *O. monacantha* and with *Dactylopius* sp. near *confusus* Cockerell for the form on *O. aurantiaca*. He believes that *D. newsteadi* Cockerell is a synonym of *D. confusus* Cockerell.

UNDETERMINED SPECIES

The identity of cochineal found in the West Indies and in northern Brazil has not been ascertained.

In the West Indies cochineal was found sparsely on *O. dillenii* in Jamaica, but *O. spinosissima* and *O. jamaicensis* growing in the vicinity were not infested. In Haiti a few cultures were seen on the tree pear *O. spinosissima*, but none was discovered on the exceedingly common *O. dillenii*, *O. antillana*, *O. taylori*, and *O. caribaea*. In the Dominican Republic few individuals were noticed on the tree pear *O. catacantha;* but the low-growing *O. antillana* and *O. taylori* and the tree pear *O. caribaea*, which are extremely abundant, were not recorded as host plants.

In the interior of the Brazilian States of Bahía and Pernambuco, cochineal was observed fairly generally on the upright *O. palmadora*

and the low-growing *O. inamoena* in December 1928. The cultures were numerous in many places and caused appreciable damage to the younger growth of *O. palmadora.*

Cochineal insects of one species or another occur from the northern portions of the United States to Argentina; but investigations in several regions where prickly pears flourish did not reveal their existence, viz., Cuba, Venezuela, Curaçao, northern Colombia, Ecuador, Honduras, San Salvador, and Guatemala. However, the surveys conducted in these areas were more or less hurried, and may have overlooked the presence of these insects. The cochineal found in Peru was almost certainly *Dactylopius coccus*, which may have been artificially established in that country.

HOST SPECIFICITY

One of the curious features of cochineals is the range of host plants in the genus *Opuntia.* As far as we are aware, no species of *Dactylopius* is restricted to any one host plant. In fact each form attacks a variety of prickly pears, including types that are not closely related. On the other hand, cochineal insects exhibit varying degrees of preference for or, at least, ability to thrive on, allied *Opuntias.* Their behavior in this respect suggests that, in addition to recognised taxonomic species, there are biological strains, or perhaps biological species. The subject is discussed more fully, under the separate species, but one point might be mentioned here: *D. opuntiae* on *O. lindheimeri* in Texas, and on various shrub pears from Texas to California, is considered to be identical taxonomically with *D. opuntiae* on *O. streptacantha* in Mexico. In Australia the Texas, Arizona, and California strains of *D. opuntiae* could not be induced to attack *O. streptacantha*, but in Australia material on *O. streptacantha* from Mexico readily transferred to the same plant.

ENEMIES

In North and South America, wherever cochineals have been studied, predacious enemies have exercised a very marked degree of control. The relative scarcity of *D. opuntiae* in Texas and Arizona is almost certainly due to the prevalence of various attacking insects. In Argentina, where *D. indicus* and *Dactylopius* sp. near *confusus* occur freely, and in Florida, where *D. confusus* is abundant, the cochineal infestation is reduced periodically to light dimensions.

Natural enemies include the adults and larvae of many species of coccinellid beetles and larvae of several phycitid moths, of syrphid and agromyzid flies, and of brown lacewings (Neuroptera).

The most important predators encountered in our investigations have been, in North America, the phycitid *Laetilia coccidivora* and *L. c. quadricolorella* in Texas and Florida, and the coccinellid *Hyperaspis trifurcata* in Texas and Mexico; and in South America, the phycitid *Salambona analamprella*, the coccinellid *Cybocephalus* sp., and the syrphid *Salpinogaster conopida* in Argentina. Other enemies have included: Coleoptera—the coccinellids *Hyperaspis fimbriolata*, *Cybocephalus nigritulus*, *Scymnus intrusus*, and *S. hornii*, all in Texas; Diptera—the syrphid *Baccha* sp. in Florida and the agromyzid *Leucopis bellula* in Florida and Argentina; Neuroptera—the hemerobiid *Sympherobius amiculus* in Texas and one related species in Mexico.

In Australia, the coccinellid *Cryptolaemus montrouzieri* and chrysopid and hemerobiid lacewings are known to attack the introduced *Dactylopius*.

Salambona analamprella in South America and *Laetilia coccidivora* in North America are either carnivorous or polyphagous, in that the larvae may feed also on the buds and flowers of prickly pears. Indeed, the former insect assumes some importance in this connection. Moreover, after devouring the available cochineal it will often tunnel and complete development within the prickly pear joint.

Most of the natural enemies appear to possess at least three, and possibly as many as five or six, generations annually.

Laetilia coccidivora in Texas passed through one generation from early August to early September. In the following generation a few moths emerged in October and further larvae pupated in late November and early December. Most of the larvae, however, remained inactive from November to February. A few pupated early in March and produced moths late in the same month. In early April larvae were full-grown and pupating in Florida; and larvae of the next generation were prevalent in June and July.

Observations on *Hyperaspis trifurcata* in Texas indicated that three generations occurred between August and April, as follows:

August	Larvae present; a few adults emerging.
September	Larvae present; adults emerged in numbers.
October	Larvae in large numbers; pupation generally late in the month, when a few adults emerged.
November	A few larvae observed; pupae and adults plentiful.
December	Pupae and inactive adults.
January	Larvae, mostly small, abundant.
February	Larvae, mostly small, abundant.
March	Larvae plentiful in all stages; a few adults.

HABITS AND LIFE HISTORY

Cochineal insects are conspicuous by the covering of pure white cottony or silky threads of fine waxy filaments secreted by the insects. The covering of *D. coccus* is light and powdery; but that of all other species is dense and woolly. The North American *D. confusus* tends to have the heaviest coating.

The habits and life histories of the various species appear to be very similar, with the possible exception of *D. coccus*, which has not been studied in this investigation. Observations on the duration of the life-cycle and of the number of generations yearly have been made in North America with *D. opuntiae* in Texas and Mexico and with *D. confusus* in Florida; in South America with *D. ceylonicus* and *Dactylopius* sp. near *confusus* in Argentina; and in Australia with material of the above-mentioned insects obtained originally from each of the named localities. Furthermore, in Australia the life history of *D. opuntiae*, and to a less degree of *D. confusus*, has received considerable attention. The following life history of cochineal is based on my studies of *D. opuntiae* in Australia.

The eggs are laid singly beneath the body of the female and hatch in from 15 minutes to 6 hours into six-legged active pink or red larvae, termed "crawlers." Newly hatched male and female crawlers appear indistinguishable, but differ in their subsequent development.

Most female crawlers select a permanent position within 24 to 48 hours, commence to feed by inserting the proboscis deep in the plant tissue and remain stationary for their life period. Many settle down around the parent colony, while others crawl to other parts of the joint or the plant. Some, however, may feed at various points over a period of several days before choosing a fixed location. The newly hatched crawlers are capable of living for as long as 10 days without food. They are freely carried by air currents; thus, wind is the main factor in dispersion, and its influence explains the spread of cochineal to isolated plants of prickly pear.

The female crawlers begin to secrete a woolly protective covering as soon as they settle down. Once the proboscis has been inserted in the plant tissue, the developing insect cannot be removed without breaking that delicate organ and so causing death. The legs shrink and become functionless; the antennae, too, decrease in size. After removal of the white wool, the mature female appears to comprise nothing more than the large segmented abdomen, from which the rudimentary legs and antennae protrude. Maturity, deemed to be reached when reproduction commences, occurs within varying periods; in the summer months the usual time is between 40 and 90 days; in winter, development from the

egg to the egg-producing female may occupy 180 days, while in some cases the summer life cycle is probably as short as 30 days.

The male crawler moves about freely, and inserts and withdraws the proboscis frequently; the feeding position may be changed several times within 24 hours. Finally it crawls onto a female culture or colony of cultures and spins an oval white silky cocoon, in which the last larval and pupal stages are completed. The male life cycle has been determined at 45 to 59 days in October–November in Australia, including 15 to 19 days in the cocoon; in January a cocoon stage of 12 days has been recorded. The perfect male insect is an active fly, with two delicate white wings, and with two lengthy white anal filaments; the imperfect mouth parts are incapable of absorbing nourishment.

Oviposition by one female may extend over a considerable period. Records of the egg-production period from individual females during summer varied between 35 and 52 days in one experiment with *D. opuntiae;* in another, three *D. opuntiae* females each oviposited for 19 days and three *D. confusus* females for 19 to 23 days. The greatest number of eggs obtained from a female *D. opuntiae* was 420; ten individuals yielded an average of 350 eggs. The highest production from a *D. confusus* female was 361 eggs; three individuals laid an average of 329 eggs. When egg laying is completed the empty body shrivels, and the female dies.

Parthenogenesis is a usual procedure. Crawlers from fertilized and virgin females appear identical. Two fertilized females produced 720 crawlers, of which 123 were males; two virgin females produced 660 crawlers, of which 138 were males.

GENERATIONS

Our experience with the various cochineals in North and South America and in Australia has indicated that there are either four or five generations annually. In warmer climates a fifth generation is more or less frequent; where winters are more severe, four generations tend to occur. However, the generations are not regular, even in the same locality. The females continue to reproduce for from 3 to 6 weeks, and even longer in the cooler months. Temperature variations and other climatic changes influence reproduction, and the succulence of the food supply affects the rate of development.

The life cycle in the summer months occupies from 4 to 10 weeks, the average period being 6 to 8 weeks. There are usually three generations during the 6 summer months (October through March in South America and Australia, April through September in North America). During the winter, both in North and South America, the life cycle

is extended to 4 to 6 months. In Australia crawlers appear at intervals throughout the winter. At Tucumán, Argentina, reproduction has been observed in June, July, and August, but the July crawlers immediately succumbed to a drop in temperature; increase was not general, however, until October. At Uvalde, Texas, crawlers have appeared in late November, but not in December and January; in February and early March reproduction may occur whenever a period of mild weather occurs; thus in 1932 crawlers were produced in the first week of February and again in the last week of February and the first few days of March, but not in large numbers until the last week of March.

THEIR EFFECT ON HOST PLANT

Experiments in Australia have shown that cochineal is negatively phototropic and makes more rapid progress when protected from direct sunlight. The cultures are more numerous on the under surface of prickly pear joints and on plants growing in the shade. Rain is a second important factor, influencing the preference for sheltered situations. Heavy falls of rain wash the crawlers and even the well-grown cultures from the plants, and, futhermore, by destroying the protective woolly covering of the developing and mature females, expose the insects to the depredations of enemies. Thus, dry weather aids the increase of cochineal, and thunderstorms and other heavy rains retard progress. Wind is important in the spread of cochineal, but also has an adverse effect, as the majority of wind-borne crawlers are deposited away from food plants and are lost.

Cochineal feeds on all aerial portions of the plant, but in general prefers young growth, developing fruit, and detached joints on the ground. When the infestation is heavy, the infested joints shrivel up and fall off. Small seedlings are very susceptible to the attack. The effect on the fruit is to cause premature ripening and falling off before the seeds are mature. Although the more succulent growth is preferred, cultures are often found on the woody basal joints. The so-called Texas strain of *D. opuntiae* has been noted in Australia for its infestation of the basal stems of *Opuntia stricta* and the main stem of the tree pear *O. tomentosa;* on *O. stricta*, a heavy ring of colonies often occurred around the junction of basal joints; these habits are peculiar to the Texas strain.

Frequently the damage caused by cochineal is out of proportion to the insect population. The falling off of upper joints when the insect colonies are mainly on the lower stems is not uncommon. Examination has proved that the insect's proboscis penetrates into the phloem of

a vascular bundle, and that the tissue immediately surrounding the apex of the organ dies and becomes filled with a pink substance. It is thought that the action of cochineal is toxic in character and is carried from the point of attack through the plants by the vascular system.

Vigorous plants of prickly pear are often able to resist the attack by forming a layer of cork around the insect's proboscis. This development must either cut through or at least injure the delicate organ to bring about the death of the insect.

Dactylopius coccus Costa

In January 1929 cultures of a large-bodied cochineal were found on *O. ficus-indica* at Tarma and Huanuco, Peru; this record is held to represent the above species. No other observations were made of the existence of cochineal in Peru and Ecuador.

It seems strange that *D. coccus* has not been discovered in our extensive field work in Mexico and other prickly pear areas. The species is established in South Africa on the spiny prickly pear, an *O. streptacantha* type of which the identification is uncertain. The usual host plants of the commercial cochineal are *Nopalea cochenillifera* and *O. ficus-indica*. In Australia (1921–1930) it was reared successfully on *O. tomentosa*.

Dactylopius opuntiae Lichtenstein

This form attacks prickly pears throughout Mexico and in the southern portions of Texas, New Mexico, and Arizona. In the northern parts of Texas, New Mexico, and Arizona, and northward through to Kansas and Wyoming, *D. confusus* appears to be dominant, but it is possible that the range of *D. opuntiae* overlaps that of *D. confusus*. On the gulf coast of Texas, *D. opuntiae* is found from Brownsville north to Victoria, but has not been observed in the vicinity of Galveston.

On the whole, cochineal is not prevalent in the southern United States, although it occurs in all districts from the Texas coast to the Californian coast. The extensive fields of *O. lindheimeri* in Texas are often free from infestation; occasionally, however, the insects become numerous in local areas. The same remarks are true of New Mexico and California, but in southern Arizona this species occurs more generally. In Mexico the distribution extends from the northern border to Oaxaca in the south; the species is found freely and often in great abundance on the Central Plateau at such points as Aguascalientes, San Luis Potosí, and Queretaro.

The host plants include practically all species of Platyopuntia growing within its range and are mainly shrub pears in the United

States and semitree and tree pears in Mexico. The following list indicates the species of prickly pears attacked:

UNITED STATES: TEXAS: *O. lindheimeri*, *cacanapa*, *engelmannii*, *phaeacantha*, *macrocentra*, *atrispina*, and *aciculata*. NEW MEXICO: *O. engelmannii* and *O. phaeacantha*. ARIZONA: *O. engelmannii*, *phaeacantha*, and their various relations; and *O. tortispina* types (dwarf pears). CALIFORNIA: *O. littoralis*.

MEXICO: *O. streptacantha*, *megacantha*, *hyptiacantha*, *leucotricha*, *robusta*, *macdougaliana*, *fuliginosa*, *tomentosa*, *ficus-indica*, and *cantabrigiensis*.

In Australia, *D. opuntiae* has been reared on *O. inermis*, *O. stricta*, *O. dillenii*, *O. nigricans*, *O. elatior*, *O. monacantha*, and *O. microdasys;* and on *Nopalea dejecta*. With the exception of *O. inermis*, these forms are not found within the insect's range in the United States and Mexico. *O. inermis* is indigenous around Galveston, Texas, but cochineal has not been observed on any species of prickly pear in that vicinity.

Records of cochineal on the small low-growing Cylindropuntias of the clavatae series, viz., *O. stanlyi* in Arizona and *O. grahamii* in Texas and Mexico, have been referred to *D. newsteadi*. It is possible that *D. opuntiae*, as well as *D. newsteadi*, may attack certain Cylindropuntias.

Dactylopius confusus Cockerell

According to T. D. A. Cockerell (1929, in litt.) this species is common in the Rocky Mountain districts of Colorado and Texas. In the present paper, the cochineal prevalent on the low-growing Platyopuntias *O. tortispina*, *O. polyacantha*, and their allies, in the more northerly sections of the United States is deemed to be *D. confusus*. The Prickly Pear Board has recorded infestation on *O. tortispina* types in Oklahoma and Colorado and in Kansas and Nebraska, and on *O. polyacantha* in Colorado, Wyoming, and Utah. In July 1926 cochineal was commonly observed on *O. polyacantha* from Denver, Colorado, to Cheyenne, Wyoming. Material found on the low-growing *O. basilaris* at Lees Ferry and the Grand Canyon in northern Arizona probably represents this species.

In Florida, where *D. opuntiae* has not been found, *D. confusus* occurs everywhere. It is especially prevalent on the northeast coast between New Smyrna and the border of Georgia and is common in southwestern coastal areas. Moreover, the host plants include not only low-growing prickly pears but also the shrub pears *O. stricta* and *O. dillenii*, both of which are commonly attacked. Low-growing forms that are very subject to infestation are *O. austrina*, *O. polyacantha*, and the narrow-jointed *O. tracyi*. In Australia the Florida strain was reared with some difficulty on *O. inermis*.

Cochineal appears to be more abundant in Florida than in any other portion of the United States and Mexico. Cultures were very numerous in many localities in August 1927, December 1929, and April to December 1932. During the latter period, heavy infestations caused considerable destruction of new growth.

Dactylopius sp. near *confusus* Cockerell

Two species of cochineal occur in Argentina, *D. ceylonicus* and the undetermined form near the North American *D. confusus*. Their distribution overlaps, and their range of host plants includes some of the same prickly pears. *D. ceylonicus* is the less woolly species. Hence, field determinations have been made with some degree of certainty.

The near-*confusus* species of *Dactylopius* is quite prevalent in central and western Argentina, in the Provinces of Santiago del Estero, the Chaco, Salta, Tucumán, Catamarca, La Rioja, San Juan, Mendoza, and Córdoba. The usual host is the low-growing, thick, and rather large-jointed *O. sulphurea*, which is common throughout these Provinces. The narrow-jointed prickly pears *O. utkilio* and *O. discolor* are infested, but not as freely as by *D. ceylonicus*; and the insect breeds readily on *O. aurantiaca*. The mound prickly pears of the Tephrocactus group, *O. weberi*, *O. russellii*, and *O. wetmorei*, are also attacked. Cochineal on *Cereus aethiops* and *Echinopsis intricatissima* in the province of Mendoza very probably represented this species. The tree pear *O. quimilo* and the many shrub pears of the *O. monacantha* type have not been recorded as food plants.

Observations in the Provinces of Tucumán and Santiago del Estero indicate that cochineal is most abundant in April and May; its numbers decrease during winter; in August to November the infestation is light and scattered, and then gradually increases during summer. Natural enemies play an important role in controlling these insects. Heavy infestations are not uncommon on *O. sulphurea* in January to March in Mendoza and the adjacent provinces; in the case of a severe attack, the *O. sulphurea* joints often become deformed to some extent and produce many small joints from the lateral areoles; this abnormal growth is in turn freely attacked and is frequently destroyed. In March 1921 many clumps of *O. wetmorei* were severely damaged at Tunuyán, Mendoza.

Dactylopius ceylonicus Green

This species is found in southern Brazil, Uruguay, and over a wide area in Argentina, from Entre Ríos to Córdoba, Catamarca, Salta, and the Chaco. It commonly attacks three distinct types of Platyo-

puntia, the tree pear *O. quimilo*, the shrub pears of the *O. monacantha* type, and the narrow-jointed pear of the *O. aurantiaca* relationship.

O. quimilo is infested almost wherever it occurs in Santiago del Estero and in the adjoining provinces in the north and west. The shrub pears are greatly favored host plants and include *O. monacantha* on the coastal strip near Rio de Janeiro, Brazil, and *O. bonaerensis* and several undetermined species of the same type in the Provinces of Entre Ríos, Corrientes, Santa Fe, Santiago del Estero, Tucumán, Salta, and the Chaco in Argentina. In Santiago del Estero, Córdoba, Tucumán, Catamarca, and Salta the common low-growing, narrow-jointed forms *O. utkilio* and *O. discolor* are regularly infested; a related form *O. anacantha* has been found to be attacked in the Chaco; the narrow-jointed but upright-growing *O. salmiana* is infested in Santiago del Estero and neighboring regions. A food plant of a different type is an undetermined *Opuntia* related to *O. sulphurea* in the Province of Entre Ríos. *O. sulphurea*, the common host of the other Argentine cochineal, is seldom attacked by *D. ceylonicus* in midwestern Argentina.

In Entre Ríos this cochineal is prevalent on *O. monacantha* types and on an undetermined species close to *O. sulphurea*, but has not been found on *O. aurantiaca*, even where the three species were growing in the same field. However, no difficulty was experienced in breeding stocks on *O. aurantiaca* from material transferred from the related *O. utkilio* and *O. discolor*.

D. ceylonicus reaches its greatest profusion in March to May, the autumn months. It is subjected to very severe depredations by natural enemies which appear to bring it under control during the late winter and spring. Its increase becomes marked in January and continues until April or May. Observations in the years 1932–34 reported very sparse cultures in August and September and heavy infestations in April and May.

O. quimilo is often severely attacked, and the younger plants are seriously injured. Prickly pears of the *O. monacantha* type, such as *O. bonaerensis* and its allies, are frequently covered with cultures; in March 1925 it was reported that between Rosario and Santa Fé the scattered areas of *O. bonaerensis* were heavily infested, while at Tostado, Province of Santa Fé, large plants of this species viewed from a distance appeared to be covered with snow. In the Province of Santiago del Estero this insect causes considerable damage to *O. utkilio*.

Dactylopius newsteadi Cockerell

L. F. Hitchcock of the Board's staff made this determination of cochineal infesting *O. imbricata* from Carlsbad, New Mexico. In the United States and the northern States of Mexico various Cylindropuntias

are host plants of cochineal. This publication refers all these records to *D. newsteadi*, although it is possible that *D. opuntiae* may attack Cylindropuntias as well as prickly pears. Investigations at Uvalde, Texas, showed that cochineal on *O. leptocaulis* would transfer to *O. imbricata*, although not readily; but it could not be induced to transfer from *O. leptocaulis* to *O. lindheimeri*, the common prickly pear of the Uvalde district where the *O. leptocaulis* infestation was obtained. Cochineal taken on *O. echinocarpa* in California infested *O. imbricata* without difficulty.

Our records of cochineal on Cylindropuntias include:

UNITED STATES: TEXAS: *O. imbricata*, *leptocaulis*, and *grahamii*. NEW MEXICO. *O. imbricata*. ARIZONA: *O. fulgida*, *spinosior*, *stanlyi*, and *whipplei*. CALIFORNIA: *O. echinocarpa* and *bernardina*.

MEXICO (northern): *O. imbricata*, *leptocaulis*, *kleiniae*, and *grahamii*.

In western Texas and New Mexico, plants of *O. imbricata* are often heavily attacked and considerably damaged. *O. leptocaulis* usually escapes infection, but occasionally individual plants support heavy cultures. *O. echinocarpa* in California has been observed to carry dense infestations. In October 1926 at Torreón, southwest Coahuila in Mexico, cochineal was quite common on *O. imbricata*, *O. leptocaulis*, *O. kleiniae*, and *O. grahamii*, but Platyopuntias in the same district were free from attack.

DIPLACASPIS Jacobson

Diplacaspis echinocacti (Bouché)

This scale insect has a very extensive distribution and a wide range of host plants among the Cactaceae. It is not prevalent in the United States, but we have records of its occurrence on *Opuntia lindheimeri* in Texas and on the Cylindropuntias *O. imbricata* in New Mexico and *O. echinocarpa* in California. It is rather generally distributed on the Central Plateau of Mexico, where heavy infestations have been observed on *O. streptacantha* in the general vicinity of Mexico City; various Platyopuntias and Cerei are attacked.

The species is generally distributed through the West Indies on various Platyopuntias and Cylindropuntias; *Nopalea cochenillifera* has been observed as a host plant in Trinidad. This scale has been seen on prickly pears in Colombia and Peru.

In April 1921 it was causing considerable damage to *Cereus*, *Opuntia*, and *Rhipsalis* in the Botanic Gardens at Rio de Janeiro, Brazil.

D. echinocacti is not uncommon on *Opuntia aurantiaca* in the Province of Entre Ríos, Argentina. In the central and western Provinces of Argentina it is prevalent and attacks *Pilocereus*, *Cereus*, and such forms

of *Opuntia* as *quimilo*, *ficus-indica*, *sulphurea*, *glomerata*, and *aoracantha*.

It has been established in Australia for many years (recorded by H. Tryon in 1911) on *O. inermis*, *O. stricta*, and *O. tomentosa*, but evinces a decided preference for the last-named. Occasionally it becomes abundant on a few plants in local areas, but in the main it is held in check by a chalcid parasite and by predacious Lepidopterous larvae.

This scale rarely attains importance in America. In Mexico and Argentina, heavy infections have been observed to cause damage to a limited number of plants. Often one prickly pear plant is severely infested, with a light attack on adjacent plants, and little sign of scale elsewhere in the district.

ACARINA

Tetranychidae

TETRANYCHUS Dufour

Tetranychus opuntiae Banks

This spider mite is found on the shrub pear *O. lindheimeri* in Texas as far north as Waco, west to Uvalde, and south to Laredo and Brownsville and in the Mexican States of Coahuila, Nuevo León, and Tamaulipas, as far as Tampico. Around Uvalde at times plants are so heavily infested that many segments fall off and are killed. Red spider is rather general and is probably the most destructive agent on *Opuntia lindheimeri* in the Brownsville district. In Tamaulipas work of the mites has been observed everywhere on the same host plant.

The species occurs over a wide area on the Mexican plateau and is often prevalent around San Luis Potosí and Aguascalientes, the recorded host plants being the shrub pear *O. cantabrigiensis*, the semitree *O. robusta* and *O. durangensis*, and the Cylindropuntias *O. leptocaulis* and *O. imbricata*. The typical corky areas caused by these mites have been observed on *O. tomentosa* at Cuernavaca, State of Morelos.

In Haiti a few segments of *O. dillenii* were injured by red spider.

In Australia, *T. opuntiae* freely attacks *O. inermis* and *O. stricta* but prefers the former plant.

Both in Australia and in America this species increases rapidly during dry periods. Thunderstorms and other heavy rains reduce or even stop its activity.

The feeding of the mites gives rise to circles of whitish cork, usually around the areoles, and when feeding is severe these areas extend and coalesce. When the affected segments are completely or wholly covered by the corky growth, they fall from the plant and shrivel up.

Acarina: Eriophyidae

ERIOPHYES Von Siebold, sp.

Since 1931 this tiny acarid has infested joints of *Opuntia inermis* throughout the prickly pear territory of Queensland and New South Wales. The effect on the plant is very similar to that of *T. opuntiae*. A. M. Massee of the Imperial Institute of Entomology has expressed his opinion that the species is an undescribed form. Hence, its country of origin and host relations other than that of *O. inermis*, are unknown.

SCAVENGERS

Decaying cactus, whether prickly pear or other types, offers a very suitable breeding ground for insects that live on rotting vegetation. Hence, scavenging insects are well abundant, both in numbers and in species, and include many syrphid, muscoid, stratiomyid, and other Diptera, and histerid and staphylinid Coleoptera. Most of these scavengers are associated with decaying vegetation generally, and can in no way be regarded as true cactus insects. The rotting of the plants from the attack of *Melitara* and other phycitid larvae, or the attack of *Moneilema*, *Cactophagus*, and other coleopterous primary enemies is followed by the advent of the various scavengers.

However, many syrphid Diptera belonging to the genera *Volucella* and *Copestylum* are mainly cactus insects, although they do breed in other rotting vegetation. It is possible, also, that certain species in these genera are restricted to prickly pear and other cacti. They are very prevalent in both North and South America.

The flies are attracted to cactus joints that are infested with lepidopterous and coleopterous borers, have been injured by mechanical means, or are attacked by bacterial and fungus diseases.

The general scavenging insects infest cactus pulp that has reached a considerable degree of decomposition. The syrphid group, however, will attack the green joints, provided that insects, disease, or injuries have set up a certain amount of decay, which attracts the adult flies.

Thus, these insects are of considerable importance as cactus destroyers, inasmuch as they extend the scope of the injury. Wounds that might otherwise dry up and cause little material damage are enlarged by the action of the syrphid larvae to such an extent as to bring about complete rotting of the affected joints and, in extreme cases, of whole plants. The most common species are:

Volucella pusilla, Florida, Texas.
Volucella fasciata, Florida, Texas.
Volucella esuriens, Texas, Florida, Arizona, Mexico.

Volucella spinigera, Argentina, Peru.
Volucella scutellata, Argentina.
Copestylum marginatum, Texas, Arizona, Mexico.

Other species reared from prickly pear are:

Volucella avida, Texas, Arizona.
Volucella satur, Colorado, New Mexico.
Volucella fornax, Arizona.
Volucella fraudulenta, Colorado.
Volucella deceptor, Mexico.
Volucella 2 sp., Mexico.
Volucella eugenia, Jamaica.

Although the adult flies were freely attracted to cages containing other prickly pear insects and deposited eggs on the cages and on any heaps of decaying cactus, reared material could not be induced to oviposit under any conditions of confinement, from small glass and other vessels to large wire enclosures.

The same difficulty was experienced with flies of the stratiomyid genus *Hermetia*: *H. aurata*, *H. hunteri*, *and H. illucens*, which are very common cactus scavengers in North America.

BIBLIOGRAPHY

At the Alan Fletcher Research Station, Department of Lands, Brisbane, Queensland, Australia, are filed reports on investigations in Australia and elsewhere by L. F. Hitchcock (1926–28), J. Mann (1929–39, 1958), E. Mortensen (1921–29), R. C. Mundell (1928–37), F. H. S. Roberts (1928–30), and A. R. Taylor (1931–38).

Banks, N.

1908. A new *Tetranychus*. Proc. Ent. Soc. Washington, vol. 10, p. 36. *Tetranychus opuntiae* Banks.

Blanchard, E. E.

1922. Apuntes sobre *Zophodia analamprella* Dyar y otros lepidōpteros que viven sobre Cactaceae en la Argentina. Physis, Buenos Aires, vol. 6, pp. 119–123. *Salambona analamprella* (Dyar), *Cactoblastis*, *Mimorista*, *Ozamia*.

1923. Apuntes sobre dos dipteros Argentinos. Physis, Buenos Aires, vol. 6, pp. 319–323. *Vappo alexanderi* Brèthes, *Leucopis bellula* Williston.

1935. Apuntes sobre calcididos Argentinos. Rev. Soc. Ent. Argentina, vol. 7, pp. 103–105. *Brachymeria cactoblastidis* Blanchard.

1935. Apuntes sobre dipteros Argentinos. Rev. Argentina de Ent., vol. 1, pp. 5–8. *Epicoronimyia mundelli* (Blanchard).

Blanchard, R.

1883. Les coccides utiles. Bull. Soc. Zool. France, vol. 8, pp. 217–328.

Brèthes, J.

1922. Himenopteros y dipteros de varias procedencias. Anal. Soc. Cient, Argentina, vol. 93, pp. 119–146.

Brookes, H. M.

1957. The Coccoidea (Homoptera) naturalized in South Australia. Trans. Roy. Soc. South Australia, Adelaide, vol. 80, pp. 81–90. Dactylopiidae.

Busck, A.

1907. New American Tineina. Proc. Ent. Soc. Washington, vol. 8, pp. 86–99.

Cockerell, T. D. A.

1929. Biological control of prickly-pear. Science, vol. 69, no. 1786, pp. 328–329. Important notes on cochineal.

1907. A gall gnat of the prickly-pear cactus. Canadian Ent., vol. 39, p. 324. *Asphonaylia betheli* Cockerell.

Coquillett, D. W.

1909. A new stratiomyid from Texas. Canadian Ent., vol. 41, p. 212. *Hermetia hunteri* Coquillett.

Dampf, A.
1929. Una nueva plaga del nopal. Boletin de la Oficina para la Defensa Agricola, Mexico, vol. 3, nos. 1–4, pp. 7–17.

Dodd, A. P.
1940. The biological campaign against prickly-pear. Commonwealth Prickly Pear Board, Brisbane. 177 pp.

Dugès, Eugène
1886. Métamorphoses de quelques coléoptères Mexicains. Ann. Soc. Ent. Belgique, vol. 21, pp. 26–45.

Dyar, H. G.
1902. Descriptions of the larvae of some moths of Colorado. Proc. U.S. Nat. Mus., vol. 25, pp. 369–412. *Olycella junctolineella* (Hulst).
1908. Description of eleven new North American Pyralidae. Proc. Ent. Soc. Washington, vol. 10, pp. 112–118.
1922. Insecutor inscitiae menstruus, vol. 10, nos. 1–3, pp. 15–17. *Mimorista pulchellalis* (Dyar), *Cactoblastis bucyrus* Dyar, *Salambona analamprella* (Dyar), and *Ozamia stigmaferella* Dyar.
1925. Insecutor inscitiae menstruus, vol. 13, no. 1–3, pp. 13–15. *Ozemia thalassophila* Dyar, *Melitara doddalis* Dyar, *Olycella subumbrella* (Dyar), *Alberada holochlora* (Dyar).
1928. Notes on cactus moths allied to *Melitara*, with two new genera and one new species. Proc. Ent. Soc. Washington, vol. 30, no. 8, pp. 133–137. *Olycella* Dyar, *Parolyca* Dyar, and *Cactoblastis* Ragonot.

Felt, E. P.
1908. New species of Cecidomyiidae, II. Rep. Ent., no. 23, *in* New York State Dept. Educ., Mus. Bull. 124, pp. 307–422.

Fernald, M. E.
1903. A catalogue of the Coccidae of the World. Massachusetts State Agric. Coll., Bull. Hatch Exp. Station 88. 360 pp.

Ferris, G. F.
1955. Atlas of the scale insects of North America. Stanford Univ., Calif., Stanford Univ. Press., vol. 7.

Fisher, W. S.
1925. A new cactus weevil from Texas. Journ. Washington Acad. Sci., vol. 15, no. 18, pp. 425–426. *Gerstaeckeria doddi.*
1926. New cactus beetles I. Proc. Ent. Soc. Washington, vol. 28, no. 9, pp. 214–216. *Moneilema nigriventris, M. mexicana.*
1928. New cactus beetles II. Proc. Ent. Soc. Washington, vol. 30, no. 1, pp. 3–7. *Moneilema opuntiae, M. rugosipennis, M. rittata; Gerstaeckeria elegans, G. unicolor, G. insulana, G. cubaecola.*
1931. New cactus beetles III. Proc. Ent. Soc. Washington, vol. 33, no. 8, pp. 197–201. *Moneilema crassipes, M. aterrima, M. mundelli.*
1936. New cactus beetle from Argentine Republic. Proc. Ent. Soc. Washington, vol. 38, no. 1, pp. 7–8. *Alcidion cereicola.*

GAHAN, A. B.

1925. A new encyrtid parasitic in the eggs of *Moneilema*. Proc. Ent. Soc. Washington, vol. 28, no. 8, p. 167. *Ooencyrtus moneilemae*.

1932. Miscellaneous descriptions and notes on parasitic Hymenoptera. Ann. Ent. Soc. America, vol. 25, pp. 737–738. *Antrocephalus stokesi* (Crawford).

1936. Four new species of Chalcidoidea parasitic on cactus insects. Proc. U.S. Nat. Mus., vol. 83, no. 2995, pp. 481–486.

HAMLIN, J. C.

1923. New cactus bugs of the genus *Chelinidea*. Proc. Roy. Soc. Queensland, vol. 35, no. 4, pp. 43–45.

1924. A review of the genus *Chelinidea*. Ann. Ent. Soc. Amer., vol. 17, no. 2, pp. 193–208.

1925. Important *Opuntia* insects of the United States. Biological notes on the moth-borers Pyralidae. Pan-Pacific Ent., vol. 2, no. 1, pp. 1–11. *Melitara* Walker and *Olyca* Walker.

1926. Important *Opuntia* insects of the United States. Pan-Pacific Ent., vol. 2, no. 3, pp. 97–105. *Mimorista* Warren, *Dactylopius* Costa, *Asphondylia* Loew, *Moneilema crassa* LeConte.

HENRICH, CARL

1939. The cactus-feeding Phycitinae: A contribution toward a revision of the American pyralidoid moth of the family Phycitidae. Proc. U.S. Nat. Mus., vol. 86, no. 3053, pp. 331–413.

1956. American moths of the subfamily Phycitinae. U.S. Nat. Mus. Bull. 207, pp. viii+581, 1135 figs.

HORN, G. H.

1889. [On *Coenopaeus palmeri* (LeConte)]. Ins. Life, vol. 2, p. 162.

HUBBARD, H. G.

1895. The oviposition of *Melitara prodenialis* Walker. Proc. Ent. Soc Washington, vol. 3. no. 3, pp. 129–132.

HUMBOLDT, A. VON

1811–12. Political essay on the kingdom of New Spain. Tr. from orig. French by John Black. 4 vols.

HUNTER, W. D.; PRATT. F. C.; and MITCHELL, J. D.

1912. The principal cactus insects of the United States. U.S. Dept. Agric. Entomol. Bull. 113, p. 71.

JOHNSTON, T. H., and TRYON, H.

1914. Report of the Queensland Travelling Commission (Prickly pear). Brisbane, A. J. Cumming, Government Printer.

KELLOGG, V. L.

1892. Notes on *Melitara dentata* Grote. Kansas Univ. Quarterly, vol. 1, no. 1, pp. 39–41.

KNIGHT, H. H.

1928. *Hesperolabops periscopis*, a new periscopic bug from Salvador, with a note on the Texas member of this genus (Hemiptera: Miridae). Proc. Ent. Soc. Washington, vol. 30, no. 4, p. 67. *Stylopidea picta* Uhler, *Hesperolabops picta* Hunter, Mitchell, and Pratt.

MARSHALL, G. A. K.
1929. Four new South American Curculionidae. Ann. Mag. Nat. Hist., London. ser. 10, vol. 4, pp. 264–270. *Huarucus cacti* Marshall.

PIERCE, W. D.
1912. Systematic notes and descriptions of some weevils of economic or biological importance. Proc. U.S. Nat. Mus., vol. 42, no. 1889, pp. 155–170.

POPENOE, E. A.
1877. A list of Kansas Coleoptera. Trans. Kansas Acad. Sci., vol. 5, pp. 21–40.
1878. Additions to list of Kansas Coleoptera. Trans. Kansas Acad. Sci., vol. 6, pp. 77–86.

PSOTA, F J.
1930. The *Moneilema* of North America and Mexico. Coleopterological Contributions (published privately), vol. 1, no. 2, pp. 111–141.

RILEY, C. V.
1888. The food habits of North American Calandridae. Ins. Life, vol. 1, no. 6, p. 198. *Cactophagus spinolae* var. *validus* LeConte.
1891. [On *Melitara prodenialis* Walker.] Canadian Ent., vol. 23, p. 256.

SCHAEFFER, C.
1908. List of the longicorn Coleoptera collected on the Museum expeditions to Brownsville, Texas, the Huachuca Mts., Arizona, with descriptions of new genera and species and notes. Mus. Brooklyn Inst. Arts & Sci., vol. 1, no. 12, p. 344. *Parmenosoma griseum*, new genus and species.

SCHWARZ, E. A.
1896. [Proceedings for June 4, 1896.] Proc. Ent. Soc. Washington, vol. 4, p. 48. *Moneilema crassa* LeConte and *Gerstaeckeria* Champion.

TAYLOR, J. S.
1943. Notes on *Brachymeria* sp., A pupal parasite of *Cactoblastis cactorum* (Berg). Proc. Roy. Ent. Soc. London, vol. 18, parts 7–9, pp. 58–63.

UHLER, P. R.
1876. List of Hemiptera of the region west of the Mississippi including those coll. Hayden expedition of 1873. Bull. Geol. & Geog. Surv. Terr., vol. 1, no. 5, ser. 2, pp. 269–361. [Reference copied.]
1894. Observations upon the heteropterous Hemiptera of Lower California. Proc. California Acad. Sci., vol. 4, ser. 2, pp. 223–295. *Narnia* Stål spp. and *Chelinidea vittiger* Uhler.

VAN DYKE, E. C.
1936. A cactus destroyer *Dyotopasta yumaella* Kearf. Pan-Pacific Ent., vol. 12, no. 3, p. 103.

WILLIAMS, F. X.
1930. *Beebea guglielmi* Schaus, a pyralid moth borer of *Opuntia* cactus in the Galapagos Islands. Pan-Pacific Ent., vol. 7, no. 1, pp. 1–4.

ZELLER, D. C.
1872. Beiträge Zur Kenntniss der nordamerikanischen Nachtfalter, besonders der Microlepidopteren. Verhandl. Zool.-bot. Ges. Wien., vol. 22, p. 550. (*Zophodia*=)*Melitara bollii* (Zeller).

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