Insects from Rabbit Island

BY E. H. BRYAN, JR.

(Presented at the meeting of September 6, 1934)

Manana or, as it is better known, Rabbit Island, is a little islet lying a mile to the north of Makapuu Point, the eastern extremity of Oahu. It is 1,300 yards offshore at the nearest point. The island, which is composed of two eroded tuff craters*, is nearly circular in outline, a trifle over 2,000 feet in greatest diameter, and 361 feet high. The southern face and north point rise precipitously from the water. A crater depression occupies the more gentle northwest slope. The east slope forms the steep west wall of the second crater, the eastern half of which has been eroded away. The west slope is steep, but not precipitous, with a sandy beach around its foot. The rest of the beach is a nearly continuous wave-cut terrace, just a few yards wide except on the east, where the floor of the eastern crater has been leveled off by the waves to form a platform 400 feet wide and nearly 1,000 feet long, covered with splash pools.

The writer was one of a party of six who visited the island August 25 to 26, 1934. One of the party, Marie C. Neal, who had visited the island on three previous occasions, has compiled a list of twenty-one species of plants which she has observed growing on the island. All but two species were doing well at the time of our visit. The little wild tomato, *Lycopersicum esculentum* Miller, was the most abundant plant on the island, there being scattered patches on all the slopes. Tobacco, *Nicotiana tabacum* Linn., was also abundantly scattered on the northern slope of the highest peak. On the floor of the northwest crater and parts of the west slope were numerous bushes of the fish poison plant or ahuhu, *Tephrosia purpurea* (L.) Pers. The most continuous patch of vegetation was a grassy area on the lower west and southwest slopes, made up of bur-grass, *Cenchrus echinatus* variety *hillebrandianus* Hitchcock; pili grass, *Heteropogon contortus* Beauvois; two or three

* See C. K. Wentworth, Pyroclastic Geology of Oahu, p. 80: B. P. Bishop Museum Bulletin 30, 1926.

other grasses; and scattered bushes of *Waltheria americana* Linn., wild tomato, and ahuhu. The floor of the crater ranked next in density of vegetation, being fairly well covered with wild tomato vines, ahuhu, low Portulaca, and a small patch of tall sedge, *Cyperus pennatus* Lam.

LAND ANIMAL LIFE

The rabbits, which gave the island its popular name, are still present, living in holes, principally in the northwest crater. Three were seen. They are moderately large rabbits, seemingly in good condition, with quite short ears, and a little pompon tail, the hair of which is white at the base and the rest dark gray. The head and back are agouti-brown and gray, and the belly white.

Five species of birds were seen. The dominant bird on the island, present in thousands, in all stages from hatching egg to adult, was the noio or noddy tern, *Anous stolidus* (Linn.) It is curious that this is the only tern on Manana Island, while ten miles away, on Moku Manu, the sooty tern, *Sterna fuliginosa* Gmel. is the dominant bird, living in equally large numbers, with the noddy absent. A few wedge-tailed shearwaters or naukane, *Puffinus pacificus cuneatus* (Salvin), were seen in flight, with their young sharing the holes with the rabbits. A few iwa or man-o'-war birds, *Fregata minor palmerstoni* Gmelin, were seen in flight above the highest peak of the island, none on the ground. One flock of a dozen or so akekeke or turnstones, *Arenaria interpres* (Linn.), was seen flying in and out of the two craters; and two or three stray mynah birds, *Acridotheres tristis* (Linn.) were seen.

INSECTS

Twenty-five species of insects have been identified from the specimens brought back from Rabbit Island. Most of these were obtained by sweeping the various kinds of vegetation which were found. A few species were found in the camp equipment in the morning, after a night spent on the sandy beach. Several spiders, a small fly, and a species of flea found on the rabbits have not yet been identified. The following list probably represents but a part of the insect fauna, as no special effort was made on this trip to collect all the species.

HYMENOPTERA

MEGACHILIDAE

Megachile fullawayi Cockerell (det. by O. H. Swezey), 4 specimens, caught flying along the face of a low cliff near the beach on the west side, below the grassy area. One specimen has the underside of the abdomen covered with yellow pollen.

FORMICIDAE

Solenopsis geminata (Fabricius), race *rufa* Jerdon, the "fire ant," found abundantly in sweeping wild tomato and ahuhu.

Cardiocondyla nuda Mayr var. *minutior* Forel, a tiny species, found in sweeping ahuhu, pili grass, and about the roots of other plants.

BRACONIDAE

Glyptapanteles n. sp.? (det. by O. H. Swezey), swept from wild tomato.

BETHYLIDAE

Epyris extraneus Bridwell, (det. by O. H. Swezey), a parasite on the tenebrionid, *Gonocephalus seriatum*, was caught in sweeping wild tomato.

COLEOPTERA

COCCINELLIDAE

Scymnus kinbergi Boheman, swept from wild tomato and sedge.

Scymuns ocellatus Sharp (det. by O. H. Swezey), on wild tomato.

DERMESTIDAE

Dermestes cadaverinus Fabricius, larvae observed breeding in a dead bird, and specimens caught in camp equipment.

ELATERIDAE

Conoderus exsul (Sharp), found in camp.

CHRYSOMELIDAE

Epitrix parvula (Fabricius), the tobacco flea-beetle, swept from wild tomato.

TENEBRIONIDAE

Epitragus diremptus Karsch, swept from wild tomato and sedge.

Gonocephalum seriatum (Boisduval), in camp.

CURCULIONIDAE

Pantomorus godmani (Crotch), on sedge.

DIPTERA

DOLICHOPODIDAE

Paraphrosylus sp., a few specimens caught on moist rocks or about splash pools of salt water along the wave-cut terraces.

SYRPHIDAE

Ischiodon scutellaris (Fabricius), one specimen in the northwest crater.

SARCOPHAGIDAE

Sarcophaga fuscicauda Böttcher, among a bird colony on the wind-swept slope.

MUSCIDAE

Stomoxys calcitrans (Linn.), the stable fly, caught flying near camp, and seen on a dead rabbit.

CANACIDAE

Canace nudata Cresson, in vast numbers about moist rocks and splash pools on the wave-cut terrace.

HIPPOBOSCIDAE

Olfersia spinifera Leach, a single specimen, doubtless a stray from a frigate bird, caught near camp.

LEPIDOPTERA

PYRALIDAE

Hymenia recurvalis (Fab.), (det. O.H. Swezey), the "Hawaiian beet web-worm," swept from pili grass and wild tomato in the grass patch, west slope.

CRAMBIDAE

Talis homodora Meyrick, (det. O. H. Swezey), caught in grass patch.

HEMIPTERA

MIRIDAE

Engytatus geniculatus Reuter (det. O. H. Swezey), on wild tomato.

MYODOCHIDAE

Nysius sp. probably *delectus* White, on ahuhu, sedge, and wild tomato.

ORTHOPTERA

BLATTIDAE

Blatella germanica (Linn.), caught in camp.

GRYLLIDAE

Gryllodes sigillatus (Walker), caught in camp.

Economic Entomology of the West Indies—A Review

BY E. H. BRYAN, JR.

(Presented at the meeting of March 1, 1934)

Dr. George N. Wolcott, entomologist with the Insular Experiment Station, Puerto Rico, has done a valuable service for tropical agriculture, both in the West Indies and elsewhere, by assembling into one volume what is known about the insect pests of the principal crops of the Antilles. The Entomological Society of Puerto Rico is also to be congratulated for assisting with the publication of such an extensive book.

In order to make the subject intelligible to persons not familiar with entomology, the first seven chapters discuss the anatomy, physiology, life history, and classification of insects, and their relations to their environment, and control. The rest of the book takes up in turn the insects associated with various crops. These are sugar cane and other grasses, cotton, sisal, coffee, cacao, coconut palms, citrus fruits, pineapples, bananas, papayas, mangoes, avocados, other fruits, tobacco and vegetables. There are numerous bibliographical references and a good index.

The book is written throughout in a readily readable and popular style, which should appeal both to students and farmers. But good illustrations, and the presence of specific names should also make the book useful to professional entomologists. It should be of interest to persons interested in tropical agriculture here in Hawaii, because several of the crops whose insects are discussed are raised here. Although but few of the insect pests which it includes belong to the same species as those which attack those crops in Hawaii, they belong to the same general groups, so that the control measures which are suggested would still be applicable.

The Entomological Society of Puerto Rico was scarcely a year old when it undertook the publication of this book. But entomological organization in the West Indies goes back to an earlier date. The first Entomological Conference in Puerto Rico was held May 25, 1912, largely through the enthusiasm of D. L. Van Dine, who was the pioneer entomologist with the Hawaii Agricultural Experiment Station and a charter member of the Hawaiian Entomological Society.

There is a distinct need for a similar work on the insect pests of crops other than sugar cane and pineapples here in Hawaii. The pests of these two major crops have been very well discussed, but very thorough investigation, as well as careful compilation, is necessary to bring up to date the knowledge of pests of other crops in these islands. The sponsoring, or at least the encouraging, of such investigations and the publication of results would be a very worth-while project for the Hawaiian Entomological Society.

A New Genus and Species of Orchid Weevils (Coleoptera, Curculionidae, Barinae)

BY L. L. BUCHANAN

Bureau of Entomology and Plant Quarantine, U.S. Department of Agriculture

(Presented by Mr. Swezey at the meeting of October 4, 1934)

The genus described herein as Orchidophilus will include *peregrinator* new species, *aterrimus* Waterhouse, *orchivora* Blackburn, and *gilvonotatus* Barber, the last three being listed at present in Acythopeus Pascoe. Acythopeus was described as having median or postmedian antennal insertion, basally gibbous rostrum, unarmed femora, and elytra scarcely wider than prothorax, characters that are at variance with the four species mentioned above. Orchidophilus is noteworthy because, as far as known, it is confined to orchidaceous plants, and also because the exact habitat of none of the species is known, all recorded specimens having been collected in greenhouses of North America, Hawaii, or England, or intercepted by plant quarantine inspectors at North American or Hawaiian ports. In several instances the records show that infested orchids were received from the Philippine Islands or the Straits Settlements, indicating that the genus is indigenous in the upper Malayan region. It is probable that many more species than are treated in this preliminary study will be discovered eventually; and two apparently undescribed forms, represented by inadequate material, have been seen in the collections examined. The writer is indebted to Mr. O. H. Swezey of the Hawaiian Sugar Planters' Association for the opportunity to study a good series of Hawaiian specimens, including most of the specimens of the new species. The bibliographic references given in Barber's paper on orchid weevils (Proc. Ent. Soc. Wash., vol. 19, 1917, pp. 19-20) are not repeated here.

Orchidophilus, new genus (Acythopeus of authors, in part, not Pascoe)

Related to Acythopeus Pascoe and Apotomorhinus Schoenherr, but differing from descriptions of both in having the antennal socket located about ⅓ from apex of rostrum (submedian in the other two), in having the pygidium short, abruptly deflexed, and visible from beneath (often simulating a short 6th sternite), and (except in *gilvonotatus*) in having the peduncle of submentum of male elevated in a short, erect, subconical or tubercle-like process.

Derm black, rarely piceous or castaneous, shagreened, at least the elytra opaque or subopaque; true scales wanting above (except in *gilvonotatus*); mandibles feebly decussate; funicle sparsely setose, 1st segment nearly or quite as long as 2nd plus 3rd, outer segments progressively broader, club rather small and narrow, 1st segment of same texture as funicle (though much more densely hairy) and comprising ⅔ to ¾ the total mass; scape failing to reach the eye by distinctly less than length of 1st funicular segment; scrobe rapidly descending, its upper edge forming the lower side margin of rostrum in about basal half; rostrum longer than prothorax, subevenly arcuate, slightly to moderately thicker at base, rising from head at a shallow, obtuse angle; eyes large, lateral; prothorax bisinuate at base; elytra wider than prothorax, conjointly rounded at apex, humeri obliquely rounded, the anteriorly rounded and slightly produced basal margin of each elytron fitting into a shallow excavation of basal margin of prothorax, striae punctate, the intervals aciculate-punctulate, 10th straiae stronger near base and apex, sometimes effaced at middle, 9th usually much wider and deeper near apex; fore coxae separated by ½ to nearly full width of a coxa, front margin of prosternum usually emarginate; femora feebly dilated, more or less distinctly multidenticulate (except *gilvonotatus*), but not sulcate, beneath; tibiae short, nearly straight to distinctly sinuate, uncinate at apex, the inner apical angle not toothed; tarsi short and broad, 2nd and 3rd segments, and 1st in part, spongy-pubescent beneath, claws small, subapproximate at base, but free. Male with base of abdomen broadly and shallowly impressed, and often with uncus of mid- and hind-tibia minutely toothed.

Genotype, *Orchidophilus peregrinator,* new species

Orchidophilus peregrinator n. sp.

Length, 3.3-3.8 mm.; width, 1.5-1.8 mm. Integument black, elytra opaque, each puncture with a minute, silvery seta, interocular puncture generally indistinguishable from the numerous punctures on lower half of front of head; pronotum distinctly convex, rather coarsely and closely punctate; elytra with rows of deep punctures set in the much narrower and shallower striae. Male without tooth on inner edge of middle tibia, but with apical margin of last sternite minutely indented each side of middle, leaving at middle a shiny, subrectangular piece that is about 3 times as wide as long.

Rostrum about 1/7 longer than prothorax, a little longer and stouter in male, gradually and only moderately thicker at base, sides above scrobe rugosely sculptured, with coarse, shallow, often indistinct punctures and 1 or 2 carinae, the lower carina faint or absent, the upper one stronger and reaching from antennal insertion to about basal fifth; rostrum above very feebly widened at apex, moderately shining, densely punctate to near apex, generally with a smooth median line or feeble carina from behind middle to the polished, impunctate apical area; head opaque; pronotum 5/6 as long as wide, without smooth median line, the rather coarse interspaces encroaching on the margins of many of the discal punctures so that the outlines of the latter are not evenly curved in their entire circumference, but are more or less angulated or truncated, especially around their anterior half; prothorax widest a little behind middle, sides nearly straight and slightly convergent from here to base, strongly converging to the slightly constricted apex which is about 2/5 the greatest width, the apical constriction marked down flanks by a vertical row of deep punctures; ocular lobe feeble; basal margin of pronotum bisinuate, the median lobe rounded at middle; scutellum convex; elytra with sides converging from near base, striae 1 to 3 broader and deeper on declivity where the strial punctures are smaller than toward base, intervals flat, with fine, aciculate punctures which form toward apex a fairly regular single row, but become broadly and irregularly zigzag in basal half; subapical callus obsolescent; beneath with the setae larger than above; prosternum emarginate anteriorly, and generally with 2 large transversely placed punctures in line with the impressed row on flanks, rarely with a faint longitudinal impression; punctures beneath large and close-set, but not so dense as in *aterrimus,* the mesosternal side pieces with large, shallow punctures, those along posterior margin of meso-epimeron 5 to 8 in number and sometimes more or less coalescent; metepisternum at middle with a single (rarely partly double) row of punctures; sternite 1 with evenly distributed punctures, sternite 2 more sparsely and unevenly punctate, and with an impunctate space along anterior margin, 3rd and 4th sternites with a single row of punctures along apical margin, 5th sternite subrugosely punctate; pygidium short and, in strongly contracted specimens, only visible from below, more convex transversely in male, shorter and either flattened or slightly hollowed transversely in female; femora feebly dilated, the denticulations stronger in male, feeble in female where they are obsolescent on at least hind legs; mid- and hind-tibial unci of male with a minute, anteapical tooth, projecting at about a 45-degree angle.

Holotype, female, catalogue No. 50424, U. S. National Museum, labeled "Atherton's orchid house, Manoa Valley, Oahu, 3-1-1928, O. H. Swezey." Type and paratypes in U. S. National Museum; paratypes returned to Mr. Swezey.

Described from the following 11 specimens: 7 females collected in Atherton's orchid house, Manoa Valley, Oahu, Hawaiian Islands, 3-1-1928, O. H. Swezey; 1 female on orchid, intercepted at Washington, D. C., January, 1923, H. Y. Gouldman; 1 female on *Phalaenopsis schilleriana* from the Philippines, intercepted at Honolulu, Hawaii, June 1, 1930; 1 male, on stem of *Phaelaenopsis schilleriana,* intercepted at Honolulu, Hawaii, May 12, 1932; 1 male, on bulb of *Grammatophyllum multiflorum* from Philippines, intercepted at Honolulu, Hawaii, April 10, 1933.

The chief diagnostic characters of *peregrinator* are the fine elytral striae which are considerably narrower and shallower than the contained punctures, the indistinct interocular puncture, and the minute indentations on last sternite of male.

Of the 3 other species, *gilvonotatus* Barber (3-3.5 mm.) is distinguished by the dense patches of pale scales near base of elytra, by the lack of submental tooth in male, and by the virtual absence of femoral armature; 4 of the 8 specimens examined were intercepted at Washington, D. C., San Francisco, Calif., and Honolulu, Hawaii, on orchids shipped from the Philippines. *O. aterrimus* (Waterhouse) is characterized by its rather large size (3.5-6 mm.), by the relatively wide, deep, and clean-cut elytral striae, the double or partly triple row of punctures on metepisternum, and by the tooth on inner edge of middle tibia of male; of about 40 specimens examined, several were intercepted on orchids from the Philippines, 3 on orchids from Straits Settlements, and 1 on orchid from Singapore. *O. aterrimus,* as interpreted here, is extremely variable, and may include more than one form. *O. orchivora* (Blackburn) is represented in the Museum collection by the 3 specimens taken in an orchid house at Rutherford, New Jersey, U.S.A., and discussed by Barber (1917, p. 18); it is distinguished by its small size (2.7-3.3 mm.), broad thorax (1/4 broader than long), and to some extent by the narrow impunctate space that separates the interocular puncture from the shallow punctures on head.

Apotomorrhinus orchidearum Kolbe (Gartenflora, vol. 55, 1906, p. 4) probably belongs in *Orchidophilus,* but appears to be different from any of the above species. Kolbe's species is described as being 3.75-4 mm. long, opaque-black, the pronotum with a smooth but not elevated median line, the eyes small and feebly convex, and the femoral tooth strongest on fore legs.

Larva of Tetrigus fleutiauxi* Van Zwaluwenburg

BY J. A. HYSLOP AND A. G. BÖVING
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(Presented by Mr. Van Zwaluwenburg at the meeting of December 6, 1934)

The following description was prepared from material collected under the bark of a fallen tree on the island of Ongea-ndriti, in the Lau Archipelago of the Fiji Islands, at a point below the 300-foot elevation line on July 28, 1924. The larvae were collected by E. H. Bryan, Jr., of the Bernice P. Bishop Museum, and submitted for description by R. H. Van Zwaluwenburg, of Honolulu, Hawaii.

GENERAL DESCRIPTION

Length 19 mm., breadth 4 mm.

Body (figs. 5, 7, and 9) robust, dorso-ventrally depressed, subparallel, with all segments, except the ninth abdominal, of about the same width and wider than long. Feebly sclerotized and creamy white, except head, prothorax, mesothorax, legs, and ninth abdominal segment, which are moderately sclerotized and light brown.

Head (figs. 1 and 2) subquadrangular, laterally convex, slightly broader than long. Dorsal surface with a large, flat, depressed region limited on each side by a deep groove (*ds*, fig. 1) with elevated outer margin extending in an outward curve from the base of the antenna to near the collum (*col*, fig. 1). Frons and dorsal face of epicranium with numerous minute setae in rather large and deep cups; frons also with 4 pairs of long setae (*af*, lf_1, lf_2, and *pf*, fig. 1); epicranium with 3 additional pairs of long dorsal setae (*aed*, *led*, *ped*, fig. 1), a long series of setae of medium length along each of the deep dorsal epicranial grooves (*dss*, fig. 1), and setae of medium length distributed evenly over the surface. Ventral surface of cranium with a single longitudinal groove (*vs*, fig. 9*a*) on each side extending from near ventral end of pleurostoma obliquely inward toward paragenal area (*pge*, fig. 9*a*), the exterior limitation of which it forms. Two long setae (lev_1 and

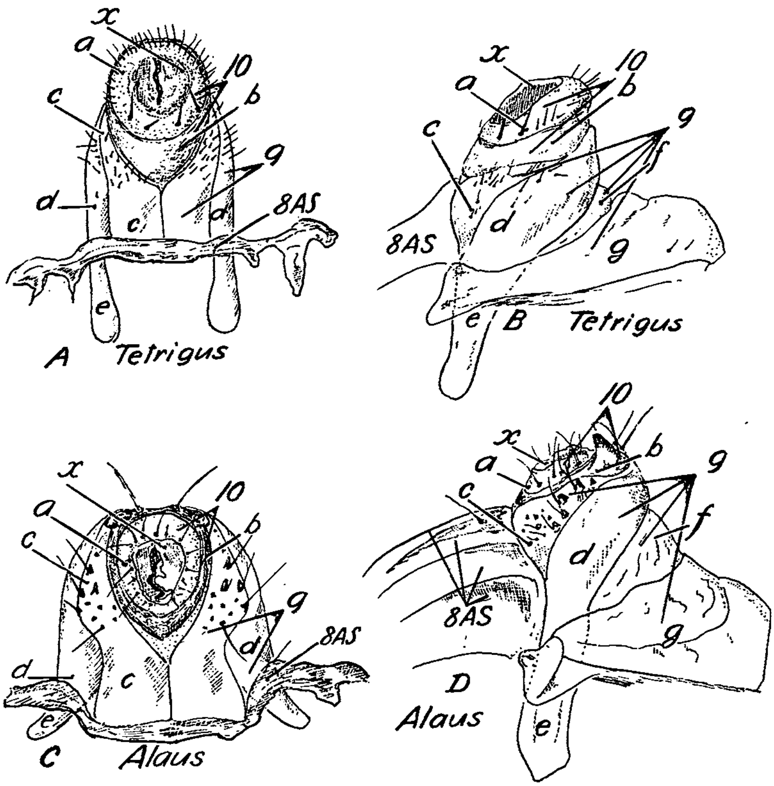
*This species was described in Stylops, vol. 2, pt. 8, pp. 176-177, 2 figs., August 15, 1933.

lev$_2$, fig. 2) on each side, a series of long and moderately long setae along the ventral groove (*vss*, fig. 2), and a few shorter setae placed antero-laterally and medio-laterally (fig. 2).

Terga of prothorax and mesothorax glabrous; terga of metathorax and first two abdominal segments asperate with very short, densely set setae arranged in a median patch covering about anterior half of terga; terga of third to eighth abdominal segments lacking this median patch (fig. 7); tergum of metathorax (*mtt*, fig. 8) with lateral patches of asperities flanking median patch; terga of first 3 abdominal segments (*1abd, 2abd, 3abd,* fig. 8) also with lateral patches but with the asperities decreasing posteriorly in size and numbers; terga of fourth and following abdominal segments to ninth with patches only feebly indicated or absent (fig. 7).

Ninth abdominal segment (figs. 5, 7, and 9) about two thirds as wide as preceding segments and, exclusive of the urogomphi, about as long as wide, subcordate, and terminating in a pair of short, biramous, upwardly directed urogomphi. Urogomphi distinctly separated by a subtriangular interspace with extreme width about equal to width of a single urogomphus. Dorsal surface of tergum rather densely beset with pointed asperities which increase in size posteriorly, each bearing a single seta at its base or several setae radiating from the base (figs. 7 and 7*a*). Pair of paramedian, straight, and parallel grooves extending from anterior margin of tergum to middle. Under surface of tergum without asperities but with many long, fine setae (figs. 5 and 9). Each ninth pleural area (*9p*, figs. 5 and 9; *d* and *e*, text figs. A and B) irregularly lanceolate, with proximal part (*e*) invaginated into connecting membrane between eighth and ninth segments; distal part nearing setae. Ninth sternite (*9st*, figs. 5 and 9; *c*, text figs. A and B) flat, with a sagittal suture; anterior margin straight, posterior margin deeply emarginate for reception of tenth abdominal segment; densely setose at emargination.

Tenth abdominal segment (10, figs. 5 and 9; *a* and *b*, text figs. A and B) tubular, short and stout, divided into a ring-shaped, slightly sclerotized proximal part (*b*) and a smaller, disklike, membranous distal part (*a*). Disklike part with a median longitudinal anal slit. Margin of disk provided anteriorly with 4 strong setae and posteriorly with a semicircular series of fine, densely set setae.



Ninth and Tenth Abdominal Segments of Tetrigus and Alaus
A, Tetrigus, ventral view; *B, Tetrigus,* lateral view;
C, Alaus, ventral view; *D, Alaus,* lateral view.

a, distal part of tenth abdominal segment;
b, proximal part of tenth abdominal segment;
c, ninth abdominal sternum;
d, distal part of ninth abdominal pleurum;
e, invaginated proximal part of ninth abdominal pleurum;
f, membrane between ninth abdominal pleurum and epipleurum;
g, ninth abdominal epipleurum;
x, region with anus;
8AS, part of eighth abdominal segment.

DETAILED DESCRIPTION

Head (figs. 1 and 2) medium-sized; wider than long across the middle, considering the length from the insertion of the mandibles to the base of the head, subquadrangular with arcuate sides and a short collum (*col*, fig. 1); flattened above and below. Frontoclypeal region well limited by distinct frontal sutures; anterior part transverse, elongate-oval, laterally extending to bases of antennae; posterior part longitudinal, spatulate, extending back toward but not quite reaching occipital foramen. Gular suture long and well defined.

Nasale (*n*, fig. 1a) with 3 subequal, blunt lobes. Subnasale (*sn*, fig. 1*a*) also trilobed, but lateral subnasal lobes fused with lateral nasal lobes exteriorly; thus forming together a 4-leaf rosette.[1]

Paranasal lobes (= frontal angles auct.) (*pn*, fig. 1) strongly produced beyond nasale, sulcate anteriorly. Anterior dorsal margin of sulcus with a row of long setae; anterior ventral margin densely pilose.

Talus (*tal*, fig. 1), with the condyle for the mandible, produced and strong.

Ocellus not well defined in preserved material at hand.

Antenna 3-jointed, about two thirds length of mandible. Basal joint (1, fig. 1) clavate; second joint (2, fig. 1) cylindrical, half as wide as basal joint and three fourths as long; apical joint (3, fig. 1) lost in specimen at hand. Sensory appendix (*sj*, fig. 1) inconspicuous, conical, and with a strong seta at base. Basal and second joints beset with several long, strong setae.

Mandible (fig. 6) falciform, with width at base about three fourths of length; terminal part incurved but strongly deflected upward. Inner face of terminal part excavated, with sharp edges and a median longitudinal carina. Retinaculum absent. Basal part (*b*) protuberant on side toward buccal cavity, rounded and carrying small granules. Fossa for antenna profound (fig. 7). Penicillus lacking. Two fine setae on outer face.

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[1] In elaterid and cantharoid larvae distinct subnasal features are present below nasale, consisting of the median subnasal denticles (or lobes) and a pair of wing-shaped, large, but often rather indistinctly defined, subnasal flaps on each side of the denticles. The entire subnasal region is here interpreted as representing the epipharyngeal region of coleopterous larvae which, as for instance in *Prionocyphon* or *Ptilodactyla*, possess a distinct labrum and clypeus. See Böving, A.G., and Craighead, F.C., "An illustrated synopsis of the principal larval forms of the order Coleoptera," 1931, plate 78, A, compared with plates 65, A, and 67, A. (Reprinted from Ent. Amer. 11 (n.s.): 1-351, illus.)

Ventral mouth parts as long as sides of head, excluding palpi and other appendices. These mouth parts move as a unit forward and backward usually in a horizontal plane with cardines acting as hinges (*c*, fig. 3).

Cardines (*c*, figs. 2 and 3) small, sagittally adjacent, obliterating submentum. Each cardo subtriangular, posteriorly attenuate and ending with a small, dark condyle which fits into a fossa of a small, triangular sclerome (*scl*, figs. 2 and 3) in the floor of the head immediately anterior to the bottom of the deep sinus of the basin-shaped hypostoma (*hy*, figs. 2, 3, and 9).

Stipites large, approximating at base (fig. 9). Proxistipes and dististipes distinctly separated. Proxistipes dark, hard, with sides subparallel, somewhat curved on outer margin but straight within, carrying numerous long setae distally on outside. Dististipes (*dis*, figs. 2 and 9) proximally dark, distally whitish, subtrianglar, ventrally glabrous, dorsally densely setose toward buccal cavity; setae branched.

Lacinia (*lac*, fig. 2) elongate, rather indistinct, densely setose; setae branched.

Galea (*ga*, fig. 2) 2-jointed. Basal joint ring-shaped, slightly wider than long. Distal joint thimble-shaped, slightly more than twice as long as basal joint but not so wide, terminally beset with one strong spine, which is about as long as the joint itself and with a few shorter and finer setae.

Maxillary palpus 4-jointed. Basal joint (1, fig. 2) ring-shaped; second joint (2, fig. 2) cylindrical, three times as long as basal joint; third joint (3, fig. 2) ring-shaped, similar to basal joint but only about half as wide and somewhat shorter; distal joint (4, fig. 2) cylindrical, about three times as long as third joint but not so wide. All joints except distal joint beset with long, fine setae.

Submentum lacking.

[2]Mentum (fig. 9) dark and hard, elongate-triangular, tapering posteriorly; one pair of long setae present at anterior corners and one pair of long setae asymmetrically seated near posterior end of plate.

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[2] The following recent terminology for the three main parts of the labium has merit and may possibly be applied in future descriptions: (1) "prementum" (=stipites labii, labiostipites, labium proper, or mentum); (2) "intermentum" (mentum of most authors, the present authors included); and (3) "submentum." When intermentum and submentum are fused, the term suggested for this joined part is "postmentum."

Prementum (fig. 9) dark and hard, subtrapezoidal, with anterior margin about as long as one of converging lateral margins, separated from mentum (intermentum) by light membranous skin.

Labial palpus (fig. 2) 2-jointed. Basal joint cylindrical, about as long and one third as wide as prementum; apical joint thimble-shaped, half as long and half as wide as basal joint. Inner side of basal joint dorsally beset with numerous long, fine, stiff setae. Apical joint without setae, sculptured with longitudinal lines and terminally provided with minute tactile papillae.

Ligula (fig. 2) vestigial, with a pair of long bristles inserted between bases of palpi.

Prehypopharynx (*hx*, fig. 2), or fore part of hypopharynx above prementum, membranous, with minute, posteriorly pointing asperities and a pair of short, strong setae. Posthypopharynx (*pohx*, fig. 2), or hind part of hypopharynx above mentum, posteriorly limited by hypopharyngeal sclerome, membranous, medially furnished with a dense tuft of silky hairs (*tu*, fig. 2). Hypopharyngeal sclerome (*hc*, fig. 2) dark and strong; laterally connected both with anterior ends of hypostoma (*hy*, fig. 2) by a pair of strong, rod-shaped braces (*hb*, fig. 2) and with frons near antennal ring by another pair of rod-shaped but somewhat weaker braces (*hr*, fig. 2). Mandible movable in V-shaped interspace between two sets of hypopharyngeal rods, and connected with these by a folded membrane. Anterior margin of an infolding of hypopharynx (*f*, fig. 2) in front of hypopharyngeal sclerome furnished with a transverse series of silky hairs. Maxillulae (*mxl*, fig. 2) situated on each side of median hair tuft of posthypopharynx, lobe-shaped, and completely covered with long, fine, branched hairs.

Prothorax (figs. 5, 7, and 9) covered dorsally with a subrectangular shield, which is somewhat wider than long, glabrous, with slightly sinuate transverse wrinkles and provided with a sagittal suture throughout its entire length. Anterior and posterior margins of shield membranous and longitudinally striate. Fine setae sparsely distributed in a row along anterior and posterior margins and on sides of shield. Epipleural areas (*epp*, fig. 9*a*) subtriangular and membranous. Episternal plates (*eps*, fig. 9*a*) large, reaching the sides of the presternal plate (*pst*, fig. 9*a*) anteriorly; epimeron (*em,* fig. 9*a*) without distinct scleromes. Presternal area sclerotized, triangular, and large; eusternum (*est,* fig. 9*a*), in front of suture between furcal pits, membranous and small; sternellum (*stl,* fig. 9*a*) and post-sternellum (*post,* fig. 9*a*) small and membranous.

Mesothorax and metathorax each about half as long and nearly as wide as prothorax. Mesothorax dorsally covered with a glabrous shield, with only posterior margin membranous and longitudinally striate; sagittal suture posteriorly indistinct; row of sparse, fine setae along anterior, posterior, and lateral margins of shield. Metathorax slightly sclerotized dorsally, sagittal suture almost absent, and surface asperate with numerous short, strong, pointed setulae arranged densely in a median and two lateral patches (*mtt,* fig. 8). Mesothoracic and metathoracic epipleural and sternal areas of usual type; each triangular epipleural area carrying a small circular pore leading into a sac (fig. 5*a*).

Legs (fig. 4) of moderate size, strong, and the pairs approximate. Coxa (*cx,* fig. 4) sessile, oval with a shallow depression for receiving trochanter, proximally with a small, dark articulating cup, and distally with a large, obtuse projection; depression for trochanter flanked with long setae in a single row distally continued in a group of short, strong, thick, almost egg-shaped setae; a few typical setae scattered over entire surface. Trochanter (*tr,* fig. 4) cylindrical, more than half as long as coxa, longer on inner side than on outer side, beset with short, strong, almost egg-shaped setae in a dense patch on outer surface and in a more sparsely set patch on inner surface, ventrally with a series of long setae between patches. Femur (*fe,* fig. 4) obliquely attached to trochanter; not quite so long and wide as this joint; with a patch of short setae and a few long hairs, similar in form to those found on coxa and trochanter, both on inner and outer faces, each of these patches only half as large as on the more proximal joints. Tibiotarsus (*ti-ta,* fig. 4) subcylindrical, tapering somewhat distally, about half as long and half as thick as femur, with 2 or 3 egg-shaped setae and a few long hairs. Ungula (*u,* fig. 4) hard and rather dark; straighter and blunter than usual in elaterid larvae; movably inserted in a small, membranous part bearing a ventral seta.

First to eighth abdominal segments about as wide as thoracic segments, tapering slightly in width posteriorly from seventh segment; thinly sclerotized, without tergal shields, and without the transverse and longitudinal impressions[3] present in so many other elaterid larvae. Each segment directly in front of spiracles provided with a light-colored, rather fleshy, bilobed protuberance (*fpr*, fig. 8), each lobe of which carries terminally from 3 to 5 stiff, dark, pointed setae; setae from half as long as spiracles to longer. Terga bearing a sparse row of thin setae along the posterior margins.

First abdominal segment (*1abd*, fig. 8) with anterior two thirds of tergum densely beset with very short, strong, pointed setulae, arranged in a pattern as on metathorax.

Second and third abdominal terga (*2abd* and *3abd*, fig. 8) carrying similar but smaller patches of setulae. Fourth to eighth abdominal segments with only 2 or 3 setulae on each side near the spiracles.

Abdominal epipleural and pleural (hypopleural) areas (*epp* and *hp*, fig. 9*a*) well defined and separated by a distinct ventro-lateral suture (*vl*, fig. 9*a*). Both areas with 2 or 3 setae at each end, and pleural area with an additional median seta. Epipleural lobe posteriorly with a distinct ring-shaped pore opening into a sac (fig. 5*a*). Sternal areas feebly sclerotized and carrying few setae.

Ninth abdominal segment dorsally (fig. 7) with a pair of paramedian and parallel furrows limiting a median rectangular region twice as long as wide. Anterior half of this region with about 25 short setae, posterior half with about 7 irregularly placed, small, dark asperities; each asperity with 1, rarely 2, moderately long setae at base. Dorsal surface laterad of furrows covered with fine, short setae and a few asperities with a seta at base; dorsal surface posterior to the rectangular region with 2 paramedian pairs of rather large asperities with star-shaped bases and 5 setae regularly arranged around the base of each; dorsal surface posterior to the regions laterad of the furrows with 2 asperities with star-shaped bases and about 5 setae at the base of each, and also with a few smaller asperities with 1 or 2 setae at the base. Ventral surface of

[3] Usually, but erroneously, termed "muscular impressions." No muscles are attached to these areas.

ninth tergite (*9tg*, fig. 9) with fine, moderately long, or long setae. Each pleuron (*9p*, fig. 9), with strong retractor muscles attached to the invaginated proximal part (*e*, text figs. A and B), the distal and exposed part (*d*, text figs. A and B) with numerous fine setae at the end. Sternum (*9st*, figs. 5 and 9; *e*, text figs. A and B) proximally glabrous, distally with many fine setae.

Urogomphi (fig. *7a*) separate; each dorsally with 2 long setae (*l* and *m*, fig. *7a*) on outer prong and 1 long seta (*t*, fig. *7a*) at base of inner prong close to outer prong; ventraly with 1 long seta (*v*, fig. *7a*) at base of inner prong; with some additional minor setae both dorsally and ventrally.

Tenth abdominal segment (10, figs. 5 and 9) with ring-shaped proximal part glabrous and without hooks (*b*, text figs. A to D).

Spiracles (fig. 8) bifore,[4] each situated in a membranous field which is limited by an indistinct, low, ring-shaped wall (*r*, fig. 8); the respiratory air tubes long, slender, slightly sinuate, almost parallel, adjacent and directed backward; the spiracular orifice itself closed by a callus (*cal*, fig. 8) situated anteriorly in a circular, membranous disk, the tectum (*tec*, fig. 8), in front of the respiratory tubes.

Phylogenetic Position

The systematic position of the genus *Tetrigus* seems perfectly clear according to its larval form. It approaches closely the larva of the genus *Hemirhipus*,[5] of the subtribe Hemirhipina, of the tribe Pyrophorini. The two genera have a very characteristic general habitus and many anatomical features in common, but represent two well-defined generic forms.

It has been a matter of discussion between systematists working exclusively with the adults whether the genus *Alaus* should be placed in the Hemirhipina or in the Chalcolepidina. Thus, *Alaus* is included in the Hemirhipina by Candeze[6] and the South American species are separated out under the generic name *Calais*. The

[4] The term "bifore" (altered by different authors to "biforous" or "biforate") is derived from the Latin adjective "biforis," meaning "with two entrances." The term was originally introduced by J. C. Schiodte, "De Metamorphosi Eleutheratorum Observationes. Pars II," Naturhist. Tidsskr. (3) 3:150, 1864 (spiracula biforia).

[5] The larva of *Hemirhipus* is mentioned by the senior author in "Phylogeny of the Elateridae based on larval characters," Ann. Ent. Soc. Amer. 10:252, 1917, and is figured by him in "An illustrated synopsis of the principal larval forms of the order Coleoptera," by A. G. Böving and F. C. Craighead, 1931, plate 84, A-G (see footnote 1).

[6] Candeze, M. E. Monographie des Elaterides, v. 1, p. 201, 1857.

North American species of *Alaus* are not congeneric with those of South America, Asia, and Africa; the latter may possibly be in the subtribe Hemirhipina. The North American species belong to the Chalcolepidina.

In common with the other larvae of the tribe Pyrophorini, the larvae of the subtribe Hemirhipina have a smooth head without numerous long scales, a body without a furlike covering, a pointed mandible without retinaculum or other teeth, and a triangular, posteriorly pointed mentum with converging sides.

Besides these common characters the larvae of the Hemirhipina possess the following special subtribal characters: The nasale and subnasale form together a rosette-like mass with 4 leaves; the first to eighth abdominal segments are very thinly sclerotized with no dorsal shields, but with short, strong asperities arranged in definite pattern, at least on the first 3 segments; and the spiracles have long, closely contiguous respiratory tubes.

In comparison, the larvae of the Chalcolepidina have a nasale with 3 denticles in the same plane and an anteriorly convex, finely serrate, and ridge-shaped subnasale, which is considerably longer transversally than the nasale and does not unite with it laterally; the first to eighth abdominal segments are somewhat sclerotized on the exposed parts but bear no definite shields, are glabrous, shining, and provided with only a few silky hairs; and the spiracles have the respiratory tubes widely diverging anteriorly.

The following key may serve for the determination of the larvae of the two genera *Tetrigus* and *Hemirhipus:*

Frontal sutures obliterated; dorsal patches of small asperities present on the terga of the first to eighth abdominal segments; bilobed, fleshy processes lacking in front of the spiracles; urogomphi fused into a thick, biramous process; scansorial hooks present on the ring-shaped sclerome of the tenth abdominal segment.............. *Hemirhipus* [*H. fascicularis* (Fab.)]

Frontal sutures distinct; dorsal patches of small asperities present on the terga of the first to third abdominal segments; bilobed, fleshy processes present in front of the spiracles, each lobe carrying 4 to 5 long, stiff, and spinelike setae; urogomphi short, paired, each urogomphus terminally biramous; scansorial hooks absent on the ring-shaped sclerome of the tenth abdominal segment.................................. *Tetrigus* (*T. fleutiauxi* Van Zwaluw.)

ABBREVIATIONS USED FOR THE FIGURES OF PLATE I

abd, abdominal segment
aed, dorsal antero-epicranial seta
af, antero-frontal seta
b, basal part of mandible
c, cardo
cal, callus closing opening of spiracular mouthpiece
col, collum
cx, coxa
cxl, coxal lobe
dis, dististipes
ds, dorsal sulcus
dss, dorso-sulcal setae
em, epimeron
epp, epipleuron
eps, episternum
est, eusternum
f, membrane in front of hypopharyngeal sclerome
fe, femur
fpr, fleshy furcate process in front of abdominal spiracles
ga, galea
hb, hypopharyngeal bracon, or rod-shaped brace between hypopharyngeal sclerome and hypostoma
hc, hypopharyngeal sclerome
hp, pleuron (= hypopleuron)
hr, rod between hypopharyngeal sclerome and frons near antenna
hx, prehypopharynx
hy, hypostoma
l, exterior seta of outer prong of urogomphus
lac, lacinia
led, dorsal latero-epicranial seta
lev_1, ventral anterior latero-epicranial seta
lev_2, ventral posterior latero-epicranial seta
lf_1, interior latero-frontal seta
lf_2, exterior latero-frontal seta
m, interior seta of outer prong of urogomphus
mst, mesothorax
mtt, metathorax
mxl, maxillulae
n, nasale
p, pleura of ninth abdominal segment
ped, dorsal postero-epicranial seta
pf, postero-frontal seta
pge, paragenal area
pn, paranasal lobe
pohx, posthypopharynx
post, post-sternellum
pst, presternum

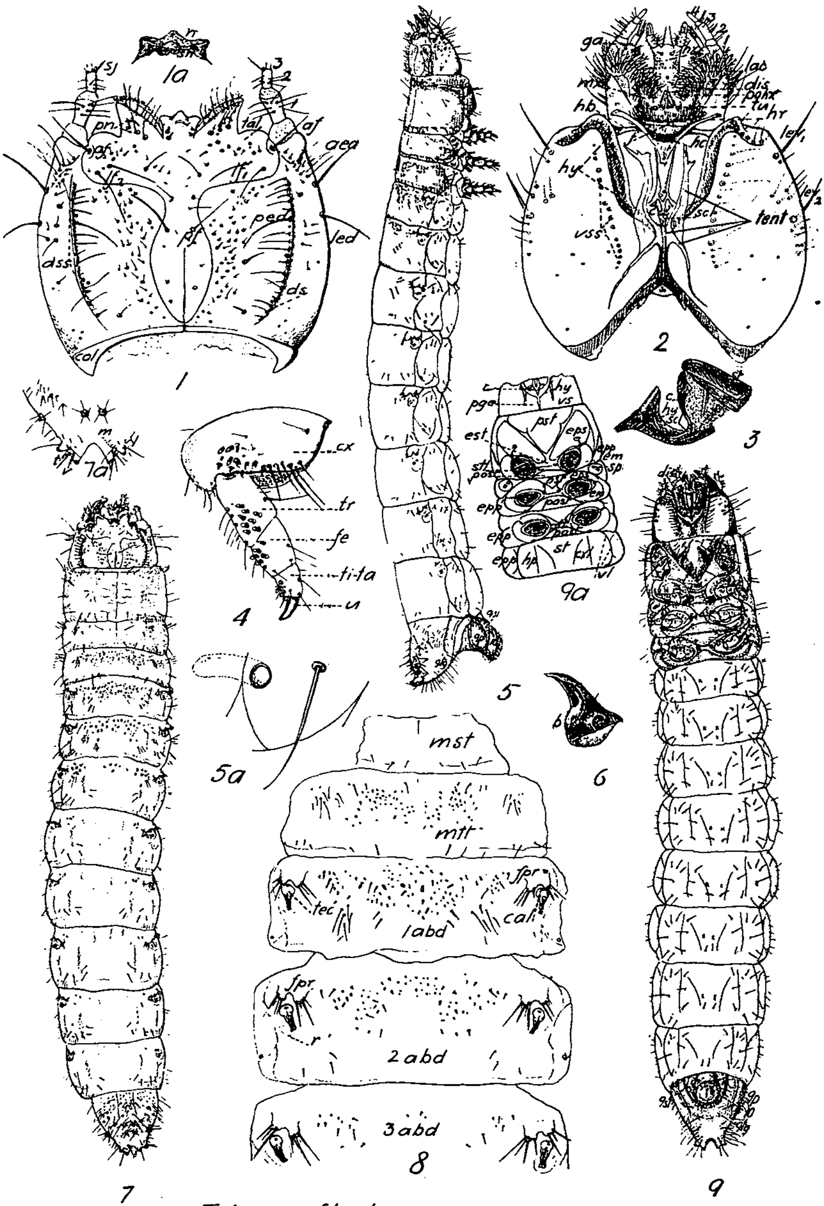
r, ring-shaped wall around membranous field in which spiracle is seated
scl, sclerome carrying cardines
sj, sensory appendix (= supplementary joint)
sn, subnasale
sp, spiracle
st, sternum
stl, sternellum
t, dorsal seta of inner prong of urogomphus
tal, talus
tec, tectus, or membranous disk with spiracular opening
tent, tentorium with bridge, anterior and posterior arms
tg, tergum of ninth abdominal segment
ti-ta, tibio-tarsus
tr, trochanter
tu, hair tuft on posthypopharynx
u, ungula (= dactylopodite of Snodgrass)
v, ventral seta of inner prong of urogomphus
vl, ventro-lateral suture
vs, ventral sulcus of cranium
vss, ventro-sulcal setae

EXPLANATION OF PLATE I

(Drawn by A. G. Böving)

Tetrigus fleutiauxi Van Zwaluwenburg

Fig. 1—Head, dorsal view
Fig. 1a.—Nasale and subnasale, ventral view
Fig. 2.—Head, inner view of ventral side of cranium
Fig. 3.—Diagram demonstrating horizontal movements of ventral mouth parts with cardines acting as hinges (see p....)
Fig. 4.—Left prothoracic leg, exterior view
Fig. 5.—Larva, lateral view
Fig. 5a.—Epipleural sac
Fig. 6.—Right mandible, dorsal view
Fig. 7.—Larva, dorsal view
Fig. 7a.—Tip of urogomphi, dorsal view
Fig. 8.—Metathorax and first three abdominal segments, dorsal view
Fig. 9.—Larva, ventral view
Fig. 9a.—Anterior part of fig. 9, with areas marked



Tetrigus fleutiauxi van Zwaluwenburg

Adam G. Böving del.

New Species of Hawaiian Lepidoptera*

BY EDWARD MEYRICK
Marlborough, England

(Presented by title by O. H. Swezey at the meeting of November 1, 1934)

DIPLOSARIDAE

Aphthonetus triaula n. sp.

♂ ♀. 9-11 mm. Head white, a brownish-ochreous central stripe on crown. Palpi white, partially variably infuscated, second joint smooth. Antennae white, apex infuscated. Thorax brownish, two white stripes. Forewings brownish; a slender white costal streak from towards base to costal cilia, another supramedian from base to beyond middle, sometimes coalescing with first posteriorly, and a third broader along dorsum from base to tornus; obscure whitish lines more or less indicated on veins posteriorly: cilia white, on termen slightly tinged yellowish, on tornal area tinged greyish. Hindwings grey, disc sometimes tinged whitish; cilia whitish-grey.

Hawaii: (Prof. S. Issiki) ; 3 examples.

Aphthonetus praefracta n. sp.

♂ ♀. 14-16 mm. Head, palpi, thorax white, slightly sprinkled or irregularly tinged pale greyish, second joint of palpi with roughly expanded hairs at apex above. Antennae light greyish. Abdomen grey-whitish, two or three basal segments with ochreous-yellowish dorsal blotches. Forewings white, variably and irregularly sprinkled light grey or brownish-grey; markings dark grey more or less suffused brownish; one or two dots and sometimes a dorsal spot near base; a somewhat oblique streak from costa at ⅓ to near dorsum, interrupted above middle; four more or less distinctly developed spots on posterior half of costa, one on tornus, one on middle of termen, one or two in disc towards apex, and dots representing stigmata, plical very obliquely beyond first discal: cilia grey-whitish, base obscurely spotted grey. Hindwings grey; cilia pale greyish.

Kauai: Kumuweia, March 10, 1928, 6 examples bred from bark of Pipturus; also 2 Kokee, August 28, 1921 (O. H. Swezey). Nearest *exsul* Walsm.

Neelysia palmifera n. sp.

♂ ♀. 11-12 mm. Head ochreous-whitish, sometimes tinged grey. Palpi ochreous-whitish, second joint blackish except tip, terminal joint with fine black anterior line. Antennae ochreous-whitish ringed grey. Thorax ochreous-whitish, shoulders dark grey. Abdomen ochreous-whitish, suffusedly mixed light grey. Forewings ochreous-whitish; a blackish costal streak, nar-

* The types of the new species described in this paper are in the type collection of the Hawaiian Entomological Society. [Ed.]

row at base and expanding to ⅓, where it covers half wing, thence to ⅔, where it terminates, its edge forming five oblique projections separated by acute teeth of ground colour; from near beyond this a wedge-shaped black streak, pointed anteriorly, along costa to apex, where it meets a similar terminal streak, these cut by two fine white bars on costa, one at apex, and three on termen, a black longitudinal streak in disc from ¾ to near apex; some irregular variable fuscous dorsal suffusion throughout; a short blackish linear mark beneath middle of wing (plical stigma), and two or three dark fuscous interneural lines posteriorly: cilia grey, base blackish, with white bars from costal and terminal markings. Hindwings light bluish-grey; cilia light grey.

Oahu: Pauoa Flats, bred April 23, 1934, from dead Wikstroemia (O. H. Swezey); 4 examples. Allied to *cleodorella* Walsm.

Neelysia mormopica n. sp.

♀. 13 mm. Head, palpi, thorax whity-yellowish, base of palpi grey. Antennae grey, towards base yellow-whitish. Forewings light yellowish-fulvous; costal and dorsal edge dark fuscous near base; an irregular suffused fuscous fascia from ¼ of costa to middle of dorsum, enclosing a short longitudinal dark fuscous mark on fold (plical stigma); a round whitish discal blotch beyond this, and another at ¾, connected by a fuscous median stripe, second blotch indistinctly edged fuscous, veins posteriorly partially lined fuscous; a dark fuscous streak on costa above second blotch, and one on dorsum beyond fascia: cilia grey, its basal half dark fuscous except on tornus, outer half whitish on upper part of termen. Hindwings and cilia whitish-yellowish.

Oahu: Punaluu (O. H. Swezey); 1 example. Allied to *cuprea* Walsm.

Neelysia erebogramma n. sp.

♂. 10 mm. Head, antennae, thorax dark fuscous. Palpi whitish, terminal joint dark fuscous. Abdomen grey mixed whitish, anal tuft whitish. Forewings brownish sprinkled dark fuscous; stigmata blackish, discal remote, plical slightly before first discal; obscure blackish neural streaks on costal half, one between discal stigmata, one along fold, and a broader blackish dorsal streak from base to tornus: cilia grey strongly barred blackish. Hindwings light slaty grey; cilia light brownish grey.

Oahu: Kahuku, bred April 5, 1925, from Hesperomannia (O. H. Swezey); 1 example.

Euperissus catapyrrha n. sp.

♂. 25 mm. Head, palpi, thorax ochreous suffused ferruginous. Forewings rather elongate-oblong, costa gently arched, apex obtuse, termen obliquely rounded; golden-ochreous suffused ferruginous; stigmata moderate, cloudy, ferruginous-brown, plical rather before first discal, second discal forming a transverse mark: cilia greyish, tinged ferruginous towards base. Hindwings and cilia pale grey.

Maui: Olinda, bred January 14, 1926, from Rubus (O. H. Swezey); 1 example.

Phthoraula new genus

Head smooth. Antennal scape elongate, slender, without pecten. Labial palpi very long, recurved, smooth, slender, terminal joint much longer than second, acute. Forewings: 2 from 4/5, 3 from angle, 7 to costa, 8 absent, 9 very near 7, 11 from middle. Hindwings 4/5, very elongate-ovate, cilia 1 2/3; 2 from 3/5, 3 from towards angle, 4 from angle, 5 little approximated, 6 and 7 rather approximated anteriorly.

A derivative of Hyposmocoma, from which it is distinguished by the absence of vein 8 of forewings, and the exceptionally long terminal joint of palpi.

Phthoraula homopyrrha n. sp.

♀. 15 mm. Head, thorax pale ochreous partially suffused ferruginous. Palpi second joint whitish-ochreous, terminal joint whitish with very fine dark fuscous line. Forewings very elongate, narrowed posteriorly, obtuse-pointed, termen extremely obliquely rounded; fulvous-ochreous, without markings: cilia pale ochreous, basal half suffused fulvous. Hindwings and cilia whitish-ochreous.

Oahu: Nuuanu, bred September 7, 1919, from dead ohia wood (J. C. Bridwell); 1 example.

Hyposmocoma oxypetra n. sp.

♂ ♀. 9-10 mm. Head whitish, centrally suffused brownish. Palpi whitish, subapical ring of second joint and basal and apical rings of terminal suffused dark fuscous. Antennae ochreous-whitish, ringed fuscous. Thorax brown, tegulae whitish. Forewings whitish, disc suffused pale ochreous-yellowish; markings dark brown; a gradually dilated costal streak from base to middle, and an elongate semioval blotch on costa from beyond middle to ¾; an acute-triangular spot in disc about ⅓, an oblique interrupted mark beyond middle, and a spot at 4/5, these connected by variable irregular patches of suffusion along dorsum; several small irregular variable spots on apical and terminal area: cilia whitish, within a dark fuscous subbasal line yellow, a dark fuscous apical line on costa to apex, tornal area grey. Hindwings grey, darker posteriorly, cilia grey; in ♂ an expansible whitish hair-pencil lying along costa from base to middle.

Oahu: Pacific Heights, Tantalus, Palolo (O. H. Swezey); 4 examples. Also 1 ♂ from Kilauea, Kauai, bred April 15, 1909, from Pandanus, deformed from imperfect development but apparently the same species. Probably allied to *petroscia* Meyr.

Hyposmocoma trimelanota n. sp.

♂. 10 mm. Head white. Palpi second joint dark grey, tip white, terminal joint white, fine black basal and subapical rings. Antennae white, ringed dark grey. Thorax white, humeral edge black. Forewings white, slightly sprinkled dark brown anteriorly, this irroration becoming denser in median portion of disc and nearly complete suffusion on apical third; narrow elongate black spots on costa at base, ⅓, and beyond middle; an oblique triangular dark brown spot from dorsum near base; stigmata slightly indicated but absorbed in discal irroration: cilia whitish, basal third grey. Hindwings grey; cilia pale greyish.

Hawaii: Kilauea, July 20, 1934 (O. H. Swezey); 1 example. Nearest *arenella* Walsm.

Hyposmocoma hygroscopa n. sp.

♂. 12-13 mm. Head white, lower part of face fuscous. Palpi white, second joint black except tip, terminal joint with black subapical ring. Antennae white, ringed fuscous, scape blackish. Thorax white, slightly speckled brownish. Abdomen grey, anal tuft whitish-ochreous, or ochreous with base whitish. Forewings white speckled light brownish; a suboblong blackish spot on costa at ⅓ and larger one beyond middle, sometimes also one at base; an oblique-triangular blackish grey spot from dorsum towards base, reaching fold; stigmata blackish, plical obliquely before first discal, which sometimes forms an elongate mark, sometimes an additional dot before this; a cloudy grey or blackish-grey spot on dorsum before tornus; two or three cloudy dots of blackish-grey irroration on apical margin: cilia orchreous-whitish speckled brownish. Hindwings and cilia grey; a greyish expansible hairpencil lying along costa from base to middle.

Kauai: Halemanu, bred August 27, 1921, from Eucalyptus bark (O. H. Swezey); 4 examples. Allied to *carbonenotata* Walsm.

Hyposmocoma centronoma n. sp.

♀. 15 mm. Head, palpi, antennae, thorax white. Forewings shining white, tinged grey on costal area except basally; discal stigmata minute, black, plical somewhat larger, obliquely before first discal, an additional dot above fold midway between first and second discal; some grey suffusion at apex: cilia whitish-ochreous. Hindwings grey; cilia whitish-ochreous.

Oahu: Kawaihapai, bred April 9, 1930, from larva feeding on bark of lehua (O. H. Swezey); 1 example.

Hyposmocoma nipholoncha n. sp.

♂ ♀. 14-16 mm. Head snow-white, eyes ♂ crimson. Palpi dark grey, apical ¼ of second joint and basal ¾ in ♂, basal half in ♀ white. Antennae dark grey. Thorax white, tegulae dark fuscous. Abdomen light grey. Forewings rather dark brownish-fuscous; extreme dorsal edge white near base; a moderate white pointed dorsal streak beginning at ½ and running to tornus; plical stigma blackish, on edge of dorsal streak, second discal dark fuscous: cilia fuscous, towards tornus suffused whitish. Hindwings and cilia whitish-grey; ♂ apparently with costal hairpencil.

Oahu: Mt. Tantalus, bred April 22, 1934, from dead stems of Euphorbia (O. H. Swezey); 2 examples. Probably nearest *divisa* Walsm.

Hyposmocoma argomacha n. sp.

♂ ♀. 20 mm. Head, thorax white with faint brownish tinge, tegulae fuscous. Palpi white, second joint dark fuscous except tip, posterior edge of terminal joint dark fuscous. Antennae fuscous. Abdomen grey. Forewings rather dark fuscous; a moderately broad pointed white dorsal stripe from base to tornus: cilia fuscous-grey, becoming whitish-grey at tornus, a basal series of obscure blackish dots on termen. Hindwings light slaty-grey; cilia pale greyish.

Hawaii: Kilauea, bred June 19, 1934, from larvae and pupae in dead stems of Smilax (O. H. Swezey); 2 examples. Also allied to *divisa*.

Hyposmocoma thiatma n. sp.

♀. 11-12 mm. Head, thorax greyish, tegulae sometimes ochreous-whitish. Palpi ochreous-whitish, terminal joint and upper part of second lined blackish. Antennae fuscous. Forewings rather dark brownish-fuscous; a broad suffused pale yellowish or yellow-whitish streak from base along fold to tornus and lower part of termen: cilia fuscous, subdorsal streak sometimes extending through it beneath apex. Hindwings grey, darker posteriorly; cilia grey.

Maui: Olinda, May 13, 1926 (O. H. Swezey); 4 examples. Taken with these on the same day is a single male, which, I think, is probably the other sex of the same species; it is similar, but has the subdorsal streak white, not extending into cilia, and also has a suffused white elongate costal spot about middle and a shorter one about ¾.

Hyposmocoma anisoplecta n. sp.

♂ ♀. 11-13 mm. Head ochreous-yellowish fading to whitish, sometimes centrally suffused grey. Palpi yellow-whitish, terminal joint posteriorly or wholly suffused dark fuscous. Antenae grey. Thorax grey, tegulae orchreous-yellow except shoulders. Abdomen grey. Forewings dark fuscous; a slender yellowish or ochreous-whitish costal streak from towards base to apex or nearly; a broad ochreous-yellow streak (fading to whitish) from base along fold to tornus, sometimes extending to dorsum except for some partial grey suffusion: cilia light yellowish, on tornus and round apex pale greyish. Hindwings dark grey; cilia pale greyish; in ♂ an expansible grey hairpencil from base lying along costa to middle.

Oahu: Mt. Kaala, Waianae, May 11, 1924 (O. H. Swezey); also 1 ♀ from Maui, Kula Pipe Line, August 16, 1929, appears truly conspecific. Very near *bilineata* Walsm., but distinct by uniform grey antennae (not ringed), dark terminal joint of palpi, and costal hairpencil of hindwings in ♂.

Hyposmocoma hemicasis n. sp.

♂ ♀. 10-11 mm. Head yellow-whitish, sides of crown yellow. Palpi yellow-whitish, a more or less developed blackish lateral streak. Antennae grey. Thorax yellow, more or less infuscated anteriorly. Abdomen grey, anal tuft ♂ yellow-whitish or whitish-yellow. Forewings dark fuscous; a slender yellow-whitish costal streak from towards base nearly or quite to apex; a moderately broad yellowish or yellow-whitish dorsal streak from base to tornus, upper edge irregularly notched or excavated in middle of wing: cilia yellow-whitish, tinged greyish about tornus and apex. Hindwings grey; cilia whitish-grey.

Oahu: Mt. Kaala, Waianae, May 11, 1924 (O. H. Swezey); 4 examples. Apparently allied to preceding but distinct, yet taken together on the same day; also near *latiflua* Meyr.

Hyposmocoma filicivora n. sp.

♂ ♀. 15-18 mm. Head, thorax orange-ochreous, tegulae fuscous. Palpi orange-whitish, second joint fuscous except towards tip. Antennae grey. Abdomen light grey, anal tuft ♂ whitish-ochreous. Forewings rather dark ferruginous-fuscous, becoming lighter and ochreous tinged towards apex; a rather outwards-oblique narrow streak of yellow-ochreous suffusion from dorsum before tornus reaching half across wing: cilia greyish. Hindwings light slaty-grey; cilia greyish.

Oahu: Konahuanui, bred February 22, 1914, from flat cases in dead frond stems of the tree fern *Cibotium chamissoi* (Cyatheaceae) (O. H. Swezey); 2 examples.

On Some Terrestrial "Sandhoppers" from the Marquesas Islands

BY EDWARD P. MUMFORD

(Presented by Mr. Pemberton at the meeting of October 4, 1934)

The discovery in the Marquesan native forests of a new species of "sandhopper" of the genus Orchestia Leach is of some interest to this Society as all four of our Hawaiian species are known elsewhere, and the only other terrestrial species which may perhaps be peculiar to the Oceanic islands of Polynesia is *Talorchestia rectimana* (Dana) which we collected in the Society Islands, and which may be apodemic. *O. gambariensis* Chevreux, at present known only from its type locality, Rikitea, Mangareva, is, of course, littoral. No Amphipods have yet been described from Samoa, but it is possible that some of the Hawaiian entomologists or perhaps Professor Buxton collected them, in which case I should greatly appreciate the privilege of looking over them.

Dr. Stephensen's description of the Orchestia, which was taken from eighteen hundred feet upwards, in wet vegetation, on the principal islands—Nukuhiva, Uapou, and Uahuka—in the northwestern group of the Marquesan archipelago, together with some notes on a rather peculiar form of the widespread *O. floresiana* (Max Weber) is being published in the Survey Series by the Bishop Museum. The latter species, which is now known to range from as far as the Seychelles in the Indian Ocean, commonly occurs throughout the inhabited Marquesas Islands from the lowlands to the cloud zones, but its peculiar form is characterized by the long marginal spine on the outer ramus of uropod I, is as yet known only from high altitudes on Uapou and Uahuka. The only species yet found to be common to the Marquesas and Hawaii—*Talitrus sylvaticus* Haswell, a migrant from Australia and Tasmania—was not infrequently met with in the former group up to about two thousand five hundred feet.

In New Zealand and the adjacent islands, which though geologically and geographically "continental" are faunistically almost "oceanic," there are a number of peculiar terrestrial "sandhoppers" such as O. *aucklandiae* Spence Bate, *O. bollonsi* Chilton, *Parorchestia improvisa* Chilton, *P. insularis* Chilton, *P. maynei* Chilton, *P. parva* Chilton, and *P. sylvicola* (Dana), but all four of our Hawaiian species, as I have already said, are known elsewhere; *Orchestia pickeringi* (Dana), also recorded from the Tuamotus, ranges right across the Pacific from New South Wales to California, *T. sylvaticus* Haswell is recorded from Australia and Tasmania, as well as having been taken in the Marquesas and Hawaii, *Parorchestia hawaiiensis* (Dana) is known from the Loyalty Islands (Lifu), and *O. platensis* Kroyer, also known from the Tuamotus, ranges from the East Indies and Asia.

Until more is known of the Polynesian representatives of this interesting though difficult group, lying in the "no-man's-land" between Entomology and Zoology, it would be absurd to pronounce either the Marquesan or Society Island species as autochthonous, yet it is hoped that the discovery of this new Orchestia, and the rediscovery of *Parorchestia rectimana* may stimulate further interest in this fascinating Order.

Notes on Oodemas, with Descriptions of New Forms (Col.—Curculionidae)

BY DR. R. C. L. PERKINS

(Presented by O. H. Swezey at the meeting of August 2, 1934)

This short paper is based on mostly recent material sent for examination by Mr. O. H. Swezey, nearly all the specimens having been collected by himself, though a few, as duly noted under the species, were captured by others. I am very much indebted to him for giving me the opportunity of studying this very interesting collection, which contains a number of species still very imperfectly known and some that appear to have been undescribed previously, amongst which is one very remarkable new form. In the course of this study I have examined Blackburn's paratypes of such species as it was necessary to compare with the recent captures and also a large number of the specimens collected by myself and described or enumerated in the "Fauna Hawaiiensis." In the case of a few species my friend Dr. Hugh Scott of the British Museum has compared Blackburn's actual types with the paratypes examined by me, or else (in the case of unique types) with specimens that I considered to be the same as Blackburn's species and he has given me definite information on special points about which I had enquired. Dr. Scott's knowledge of their variability, and the difficulty attending the discrimination of species in the large genera of endemic Hawaiian beetles renders his assistance of great value.

Although I have given a very large amount of time to the study of the species of this genus, the result is far from satisfactory to me. As in other genera of the endemic beetles this is due to the variability of the species, the structures from which the specific characters have to be drawn being so frequently variable. Thus I have felt it necessary, as did Blackburn, to consider the lengths of the two basal joints of the funicle of the antennae as a character of great importance, but in some species there is certainly variation in the length of these joints and in some cases there is a distinct tendency to greater elongation either of both or of the second joint

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in the female sex. Such variations render the tabulation and description of the species extremely difficult, for in the case of certain species some individuals which are said to have the first joint shorter than the second, would, if the former were fully displayed, be found to have the joints little if at all different in length on actual measurement. Similarly characters taken from the size, sculpture, form, etc., are all variable in most species. There is no doubt that Blackburn realized these difficulties though in a lesser degree than if he had had larger series of the species he described and these from more diverse stations. One might, I think, collect large numbers of individuals of some species without obtaining one that is practically identical in structure with the actual type. The late Dr. Sharp after making a rather careful survey of the specimens collected by me in the course of the six years 1892-97 wrote to me that he considered these to represent about 60 species, but in the "Fauna" I treated them as belonging to 41* only. As he considered a very large number of the 60 species to be represented by single specimens, it is probable that I treated many of these uniques as aberrations of other species. For a long time I have considered the species of some of these large genera of beetles to be in a condition very similar to that of those in some of the large genera of endemic flowering plants. The great variability of these and the difficulty of discriminating species, so that very diverse views may be held as to their number, can be gathered from various statements made by the eminent botanist and explorer, Dr. Joseph F. Rock, in his work on the "Indigenous Trees of the Hawaiian Islands." I should infer that many of the great genera of endemic land-shells show similar features. In striking contrast are the many species of Odynerus, so easy to distinguish by constant structural or even color differences; the many fulgorid leafhoppers with definite specific characters in the male genitalia; and the species of agrionid dragonflies easily separated, however they may vary otherwise, by the abdominal appendages, of the males. So far as we have examined them, the male genital characters in the beetles have been of little or no help in separating difficult species.

Although some of the species of Oodemas certainly have special habits, many, so far as we can tell, are not at all particular as

* Species collected by Blackburn, but not by myself, were not considered in the numbers given above.

to the kind of wood on which they live. For instance, *Oodemas aenescens* may be found on the hardest and softest of forest trees, in pith cavities of shrubs, in tree ferns, in dry stems of herbaceous plants and according to Blackburn even under stones. As with many of the other endemic beetles of the forest such as live on dead wood, one is astonished at the scarcity of many species when food, apparently suitable, is unlimited. Only a few species seem to be really abundant, e.g. *O. nivicola* and *O. borrei,* often found in numbers under stones at high elevations on Haleakala, Maui; *O. infernum* (*multiforme*) of which we many times noticed from a score to a hundred specimens under a single log or in other situations on Hawaii, with a few others. The birds of the genus Heterorhynchus and Hemignathus are adepts at finding these beetles, the former particularly so, as nearly all the individuals examined contained some and often very many of these weevils in their stomachs. In other birds they are rarely, if ever, found, but the localities frequented by Heterorhynchus were always rich in individuals and generally also in species of Oodemas.

I have attempted to tabulate the numerous species found on Oahu and Maui, but the tables are not very satisfactory. The species on Kauai are many of them still too imperfectly known, and those of Hawaii not numerous enough to make it worth while to attempt their tabulation at present. The species on Molokai and Lanai are evidently so closely allied to, when not actually identical with, the Maui species, that they should later be included in a table with these.

Species from Oahu

Oodemas dilatatipes Perkins.

The single female of this species captured by myself some ten years after the type (which was a male) is readily distinguished from *O. olindae* by the much more slender funicle of the antennae, the third and fourth of these seven joints being quite elongate and comparatively slender, and by the simple basal margin of the elytra (i.e., they are not evidently margined) while the interstices are simple, not raised so as to form shallow grooves for the serial punctures. The latter are not all coarser than those of the female *olindae* I have examined. Hence, the sculpture of the elytra of this female differs considerably from that of the male (Fauna Hawaiiensis, II, p. 156, 1900) but probably both are variable.

Oodemas williamsi sp. nov.

Size moderate to large, conspicuously aeneous, the elytra and sometimes the pronotum brightly shining, the antennae and tarsi rufescent. Rostrum rather finely punctured, antennae rather slender, the first funicle joint elongate and equal to the second in length, or in some aspects it may even appear a trifle longer. Pronotum with fine and feeble, but quite distinct punctures. Elytra without definite striae, but with rows of mostly remote punctures, which are somewhat fine considering the size of the insect and are more or less ill-defined or changeable in outline. The interstices have a very conspicuous shallow puncturation and are not at all convexly raised between the serial punctures, while the interstitial ones remain distinct right to the apex of the elytra. The abdomen at the base beneath is remotely, finely and feebly punctate, while the metasternum also is sparsely and feebly punctured.

This species seems to me to be quite distinct from the others on Oahu, the characters afforded by the antennae, the sculpture of the elytra and of the abdomen beneath being sufficient together to distinguish it from any other.

Hab.—Oahu, Mt. Kaala, 4030 ft., VII-22-29, two specimens, the larger being the type (F. X. Williams); Mt. Kaala, V-18-20, two specimens of smaller size (O. H. Swezey).

Oodemas halticoides Blackburn

This species varies considerably in size, form and sculpture, but its narrow form and bright metallic color aid in its recognition. It seems to have occurred chiefly or only in the mountains at the Honolulu end of the Koolau range and to be rather uncommon. Swezey has sent two examples from Wailupe taken from dead Smilax and two from Mt. Tantalus, one of these from *Pipturus albidus,* the other probably found dead as it is black and has lost its antennae. Most of the specimens that I myself collected were from the dried stems of low or herbaceous plants, but I also noted it on Pipturus trees. I have seen three examples collected by Blackburn.

Oodemas aenescens Boheman

A series of a dozen specimens captured by Swezey during recent years in the Koolau range at no great distance from Honolulu was obtained, as usual, from very different trees or plants: Scaevola, *Broussaisia arguta,* Cheirodendron, bamboo, Cibotium and under logs. It is also found in the dead wood of many other trees and shrubs. Two older specimens sent were collected in 1906 on the windward side of the island at Maunawili by the late F. W. Terry.

Oodemas aenescens var. **kahanae** v. nov.

A fine series of an Oodemas consisting of about three dozen specimens captured on various occasions at Kahana exhibits much variability and is very difficult to deal with. Some of the individuals approach very closely to *O. aenescens* as represented by specimens from the mountains near Honolulu, but rather to aberrant ones than to the most typical examples. As a rule Kahana specimens are distinguished by the less coarse strial punctures of the elytra, the less convex, sometimes nearly flat interstices, and the less coarse but often more numerous punctures at the base of the abdomen beneath. As a whole the specimens are less robust or more elongate than typical *aenescens,* the pronotum is often dull from the stronger development of the surface sculpture, and even the elytra may be more or less dull. As I am unable to separate some individuals from more ordinary *aenescens,* although taken at the same time and from the same species of tree as the most aberrant individuals, I consider the Kahana form to be a local race of *aenescens.*

The following data on the Kahana specimens should be noted: Twelve on II-8-31, eleven from Broussaisia, one from Xanthoxylum; eleven on XI-29-31 from Broussaisia; three on IV-15-28 from Cheirodendron; ten without note of food plant, one of which was collected by E. M. Ehrhorn, all the others by Swezey.

Oodemas robustum Blackburn

This species was described by Blackburn from two specimens which he collected in the Waianae mountains, as stated in his final enumeration of the Hawaiian beetles, when he corrected an earlier statement that it had occurred on Oahu or Maui. The card on which the paratype is mounted does bear the cross line by which he indicated the locality as Maui, while that of the type has a different marking and not the one used to indicate Oahu generally, though possibly it may have been used to distinguish specimens from the western range of mountains. Consequently one cannot feel sure that Blackburn's specimens both came from the same island.

The specimens now sent for examination and referred by me to this species have the strial punctures of the elytra generally less coarse than in the type, but they themselves vary considerably in sculpture, size and other respects. The specimens that I collected in the Waianae mountains were very small examples, but robust and as coarsely punctured as Blackburn's, though so inferior in size. One or two specimens collected by me 40 years ago on Molokai are also very small, but agree closely with some of Swezey's specimens. *O. robustum* is extremely like *O. insulare* Blackburn in most respects, but in the latter the funicle of the antennae is altogether stouter, with the second joint shorter and more robust, and it is no longer than the first. Blackburn collected *insulare* in the Koolau range, no doubt in the lower forest, as he says it is found on *Jambosa malaccensis*. Although I specially searched for this beetle I found no trace of it, the trees of the "ohia ai," where I examined them, being overrun with the ant *Pheidole megacephala,* and native beetles entirely absent.

Hab.—Oahu, Waianae mountains; Mt. Kaala, three on Broussaisia; Puu Kalena, four on Metrosideros, one on Cibotium; Mt. Kaala, two on Metrosideros, one on *Acacia koa*; Haleauau, one on *Ipomoea bona-nox*; all these collected by Swezey. Also one on the summit of Kaala (F. X. Williams). Evidently occurs at all seasons of the year. Molokai, Kalae, VIII-7-93 (Perkins).

Oodemas angustum Blackburn

This species was described on a single specimen from the Waianae mountains and compared by Blackburn with his *O. obscurum* of Maui. Later, I described, also on a single specimen, a small species from the same locality, which seemed to be distinct from *angustum* and was named *parallelum*. Finally, in Fauna Hawaiiensis, III, p. 654, 1910, I referred a number of specimens, forming a variable series with many highly aberrant examples, to the latter. The specimens now received from Swezey are numerous and show perhaps still greater diversity in form and sculpture, though some of them are quite similar to individuals captured by myself. All this variability renders it highly probable that *parallelum* should be considered a synonym of *angustum* Blkb., as some individuals of the series I have examined might as well be referred to the one as to the other. Amongst the large number of specimens examined by me there remain a few concerning which I feel quite uncertain as to whether they are extreme aberrations or belong to other species. These highly aberrant examples are mostly represented by single specimens and rarely, if ever, are two of them so alike in all details that one can be sure that they belong to a single species. I have considered that the large front and middle tarsi in the male is an important character for distinguishing *angustum* (*parallelum*) but I do not feel sure that all the individuals with small tarsi are certainly females, and even in the males the tarsi appear to vary somewhat in size. Some examples with wide pronotum and above the average in size greatly resemble *O. ramulorum*, but the pronotum is more shining and the tarsi smaller; also one or two, captured singly, might possibly be very small depauperated individuals of *O. halticoides*.

As the species stands at present it is chiefly recognized by its small size and its habitat—the Waianae mountains—and the fact that it differs in some point of structure from all the other species in those mountains.

Swezey's specimens bear the following data: fourteen from Mt. Kaala, on Broussaisia; four, Puu Kaua, on this same tree; six, Puu Kaua, on Smilax, one very immature, having been bred from the pupa; two on Coprosma, one on Byronia and one on Metrosideros from Mt. Kaala; one, Kanehoa on Alyxia; one, Hapapa on Campylotheca; three, Haleauau, from lehua, Ipomoea and Pipturus, singly; three from Kaala without note of plant; one Kamokuiki Valley on sedge (F. X. Williams). My own specimens were obtained from Broussaisia, Alyxia, Pelea and other small trees. Most of Swezey's were obtained from November to May, some in August, and it no doubt occurs throughout the year. A few of my specimens without data came, I believe, from the lower part of the forest of the Koolau range, which formerly was continuous with that of the Waianae mountains across the base of the plateau now dividing them.

TABLE OF OAHU SPECIES

1. Rostrum conspicuously widened on the apical half; male with the second joint of the front and intermediate tarsi very wide, about as wide as the lobate third joint........2
   Rostrum rarely a little widened on the apical half (or in front of the insertion of the antennae), in most species with the sides parallel or even slightly convergent from base to apex........3
2. Rostrum long, twice or more than twice as long as its width near the base in the female; first funicle joint of the antennae strongly elongate, subequal to, but slightly stouter than the second; elytra with rows of moderately large punctures and fine interstitial ones........*dilatatipes* Perkins
   Rostrum shorter; first funicle joint stout, the second longer than this, but not strongly elongated; elytra with copious fine punctures, the serial ones hardly stronger than the interstitial........*punctulatissimum* Perkins

3. Antennae with the first funicle joint very elongate and twice as long as the second........*nitidissimun* Perkins
Antennae with the first joint at most a little longer than the second, sometimes equal to or shorter than the latter........4
4. Antennae with the first joint of the funicle elongate and subequal to the second........5
Antennae with the first joint of the funicle short and stout, appearing often hardly longer than wide or ovate and shorter than the more slender second joint........8
5. Antennae with short and stout funicle, the first and second joints of about equal length, the latter rather more slender than the first; elytra striate, striae strongly or coarsely punctured, the sculpture not becoming much obliterated apically; a robust species (length, fide Blackburn, 4.75 mm.)........*insulare* Blackburn
Funicle not notably stout; striation and puncturation of the elytra often becoming subobsolete or much finer apically, in some species the striation is feeble and the interstices nearly flat, or the serial punctures may be feeble or fine........6
6. Punctures of the basal abdominal segment beneath strong and deep, sometimes very coarse, on its basal portion........7
Punctures of basal abdominal sternite fine and feeble, at most with a few of rather large size, but shallow, at the extreme base........ *williamsi* sp. nov.
7. Elytra very coarsely punctured on the basal half or more, appearing strongly striate, owing to the convex interstices; abdomen with a few extremely large punctures at the base of the first sternite........ *aenescens* Boheman
Elytra with the serial punctures less strong, the interstices less convex, often nearly flat, so that striation is hardly evident, the basal abdominal sternite deeply, strongly punctured, the punctures usually more numerous but less coarse than in typical *aenescens*........var. *kahanae*
8. Rostrum distinctly widened on its apical portion; elytra with deep narrow striae in which are remote, fine or ill-defined punctures, the interstices hardly convex, the funicle of the antennae usually stout, the lobate joint of front tarsi large........*striatipenne* Perkins
Rostrum usually not widened, in some species with the sides slightly convergent from the base or parallel, if widened the sculpture of elytra and the antennae are not as above........9
9. Medium-sized, moderately robust species (about the size of *aenescens*) elytra with the strial punctures coarse or moderate, the striae more or less distinct throughout; basal abdominal sternite strongly punctured over a large part of its surface, though the punctures become finer towards the apex........*robustum* Blackburn
Small species or of moderate-sized narrow, elongate form with a brassy yellow metallic color; punctures of basal sternite finer and often feebly impressed........10
10. A brassy-yellow, metallic species, shining and of narrow form, of much larger average size than the following, the serial punctures moderately large but the striation of the elytra variable........ *halticoides* Blackburn
Species small or very small........11

11. As a rule shining aeneous, the pronotum often very shining as well as the elytra, a very variable species in size, form and sculpture, found in the Waianae range..*angustum* Blackburn
Elytra black with a more or less distinct purple reflection; pronotum dull or not very shining, lobate joint of front tarsi large for the size of the insect, which is found in the Koolau range.........*ramulorum* Perkins

In the Waianae range there occur specimens very similar in general appearance to *ramulorum,* but the tarsi are smaller. It is not clear whether these are a form of the female of *angustum* (the male of which has large tarsi for its size) or belong to another species.

Species from Maui

Oodemas nivicola Blackburn

Eight specimens collected under stones at 8,500 ft. on Haleakala, Maui, and two at 7,000 ft. on "greensword" were taken by R. R. Whitten on VIII-17-29 and VIII-18-29, respectively, are mostly males; another male on *Argyroxiphium virescens* (greensword) at 6,000 ft., VI-15-27, was collected by Swezey. Blackburn recorded it as occurring from 4,000-10,000 ft., but I never myself found it below 5,000 ft., though in various localities above this it was very common. No doubt its food is varied, as it even occurred where only bunches of grass were present. It is often found in company with the equally common *O. borrei.*

Oodemas molokaiense Perkins

This species is very imperfectly known by me, few specimens having been examined. As stated in Fauna Hawaiiensis, II, p. 158, 1900, I had doubts as to the specific identity of the specimens taken on Lanai with those on Molokai. Swezey obtained a female in the Iao Valley, Maui (II-28-26) on Perrottetia and considered it to be this species. It is brightly shining with the serial punctures of the elytra very fine and, owing to the convexity of the interstices, placed in wide feeble grooves which extend almost to the base; the puncturation of the interstices is practically wanting. The first funicle joint of the antennae is not much shorter than the second, and although there is some variation in these joints in the Molokai and Lanai examples, the relative length of the second is greater in these than in the Maui form. The latter may prove specifically distinct, but at present may be named *molokaiense* var. *iaoense.*

Oodemas borrei Blackburn

Blackburn appears to have been rather uncertain as to the elevation, at which he captured this species and I suspect that it was not found so low down as 4,000 ft., but more probably at 6,000 or more. In his original description he says the serial punctures are fine, but in his final paper (Trans. Dublin Soc., p. 257, 1885) that they are strong. In reality they vary a good deal in size, number and strength, and often change in appearance in different aspects. The specimen now sent to me was found under a stone at 8,500 ft. by R. R. Whitten. It is shining, with the serial punctures of the elytra mostly remote and the interstitial ones more distinct than in many specimens, but much more feeble and fine than the serial. The latter disappear towards the apex of the elytra. This species with *nivicola* used to be very abundant on the upper open country of Haleakala and throughout the crater.

Oodemas sculpturatum Blackburn

This species is generally recognizable by its short, broad form, the elytra being unusually wide for their length. The sculpture in some specimens does not greatly differ from some varieties of *borrei.* The interstices of the elytra are as a rule distinctly subconvex, so that viewed from the apex, the large serial punctures appear to be placed in shallow grooves. I did not myself ever find this species in the same abundance as *nivicola, borrei* and *corticis* and like the latter it is only found in the forest, usually under bark. Three specimens, one of which is immature, were taken in August, 1929, at Olinda by R. R. Whitten; three at Olinda in July, 1906, by Swezey.

Oodemas corticis Perkins

Three specimens from koa, Waikamoi, Maui, 4,500 ft., in January and one under bark of the same tree at Olinda in February, collected and determined by Swezey.

TABLE OF MAUI SPECIES

1. Rostrum, antennae and legs all long, the former strongly dilated on the part in front of the antennae, about twice as long as its basal width or still longer in the female; elytra conspicuously margined at the base; front tarsi of male with the second joint very large, hardly less wide than the lobate third joint.................... *olindae* Blackburn
Without some or without any of the above characters.................................2

2. Robust species with longish slender antennae, the rostrum notably dilated on the part in front of the antennae; second joint of front tarsi of male hardly less wide than the lobate third joint, which is small for the size of the insects..3
Species with the apical part of the rostrum rarely dilated and if so they are not robust forms..4
3. Large species with the eyes not, or hardly convex.........*nivicola* Blackburn
Smaller species, with more convex eyes.................*molokaiense* var. Perkins
4. Color shining golden-brown; elongate-ovate species with the rostrum somewhat widened in front of the antennae; the sculpture of the elytra very feeble or indefinite; second joint of front tarsi of male large, the lobes of the third joint also largely developed............ *chrysodorum* Perkins
Not as above..5
5. Bright metallic copper-colored, elongate, the elytra with regular rows of moderately strong punctures, sometimes more or less distinctly striate; funicle of the antennae with very short joints, the second hardly elongate and not longer than the first; eyes convex; rostrum not widened apically..*cupreum* Perkins
Not as above..6
6. Antennae with the first funicle joint slender and very long, much longer than the second..*mauiense* Blackburn
First funicle joint not longer than the second and often shorter than the latter..7
7. Small to medium-sized ovate species, not particularly robust; male with the second and third joints or one of these joints of the front and middle tarsi much longer than in the female..8
Much larger species—though, as throughout the genus, small or starved specimens occur—sometimes of robust, wide form.........................10
8. Elytra with the serial or strial punctures much more developed than those of the interstices, and very distinct, though closer in some specimens than in others; second joint of front tarsi large in the male, but the lobate third joint rather small.................*obscurmu* Blackburn
Elytra with the punctures of the series often very fine and remote, or with the interstitial punctures so developed as to render the others inconspicuous..9
9. Elytral punctures feebly developed, subobsolete or feeble; front tarsi of male less large..*haleakalae* Perkins
Elytral punctures on basal half dense, the interstitial ones strongly developed and very conspicuous; male with larger lobate third joint of front tarsi..*tardum* Blackburn
10. Usually large and very robust—"ovate, almost subquadrate" (Blackburn)—elytra very wide with rows of foveae or large punctures, and often appearing fluted owing to convexity of the interstices; eyes convex; rostrum not dilated, strigose-punctate.............................. *sculpturatum* Blackburn
Large species of more elongate or ordinary form...11
11. Elytra with the serial punctures strong and deep, generally closely set and regular in the rows, usually distinctly striate, the interstices being convex, rarely flat..*solidum* Perkins

Elytra with the serial punctures fine and more or less shallow or feeble; if large, the serial punctures are usually remote from one another or irregular, often shallow or indefinite in outline........................12

12. Serial punctures of elytra always fine, the sculpture variable, these punctures sometimes fairly close and regular, but in some specimens much sparser and not very noticeable amongst the interstitial puncturation which is copious and conspicuous. The average size is larger than that of the next species..*corticis* Perkins

Serial punctures large and not confused with the interstitial ones, generally remote from one another in the rows, often irregular or with the punctures of indefinite outline, the interstitial punctures generally feebly impressed, sometimes obsolete. The largest specimens are about equal to moderate-sized *corticis*................*borrei* Blackburn

Species from Kauai

Oodemas comitans sp. nov.

Nigroaeneus, shining, the pronotum sometimes less so than the elytra or even dull, the antennae, tarsi and sometimes the tibiae more or less red. An elongate, somewhat narrow species, the elytra being much less rounded at the sides than most, to a considerable extent approaching a subparallel condition. Antennae with the first funicle joint short and stout, the second more slender and elongate. The rostrum, looked along from the base, has usually the sides slightly convergent to the apex and is more or less rugulosely punctured, at least towards the sides. The pronotum is always distinctly and copiously and more or less evenly punctured and although the punctures vary somewhat in strength in different specimens, they are as a rule strong for a by-no-means large species of the genus. The elytra are copiously punctured, the serial punctures, often of indefinite outline, are as a rule remote from one another in the rows that are nearest to the suture, and they are much larger than the conspicuous interstitial punctures. The interstices in some aspects appear slightly and narrowly raised so that the serial punctures appear to be in wide and excessively shallow grooves, but in some specimens this grooving is hardly or not at all evident. Beneath, the abdomen has strong punctures at the base and in some specimens, especially in larger ones, the puncturation is coarse even so far back as the small intermediate segments, while in others it becomes fine, sparse or obsolete. I am not certain whether this great difference in sculpture is not connected with sex. Length 3-4.25 mm.

All the specimens but one are labeled "Kumuweia" and are collected from Bidens and Lobelia. On the same dates and from the same plants the next following species seems always to have been collected with this. One specimen labeled "Halemanu" was collected from kauila (Alphitonia) and from this tree on the same date the following species also was collected. Nevertheless, variable as these two species of Oodemas are, they appear to be quite distinct from one another. This species was collected by myself at Halemanu, Kauai, in May, 1895, when I was chiefly engaged in investigating the avifauna of that locality. Probably it was left undescribed for want of sufficient material to satisfy me that it was distinct from some other of the Kauai species.

Hab.—Kauai, Kumuweia, six on *Bidens cosmoides* in June, five on Bidens in March, six on *Lobelia yuccoides* in June and two in March (Swezey). Halemanu, one on kauila in March (Swezey) and in May, 1895, without other data (Perkins).

Oodemas leiothorax Perkins

The species described by me under this name was very imperfectly known, only three examples having been taken, and one of these, supposed to be the female sex of the others, differed considerably and in an unusual manner in the antennal characters from the male. In one of the original specimens of this sex the first funicle joint is fully as long as the second. Swezey has collected on Kauai a series of specimens of which some appear to be almost identical with what I considered the male of *leiothorax*. The individuals representing his series exhibit considerable variation in size and sculpture and some in form. I do not think they can be the same species as the original female assigned by me to *leiothorax*. As mentioned under the last species, the specimens he captured were from the same localities and from the same species of plants as that one. Without an adequate series of specimens from the original locality for comparison with those from Halemanu and that neighborhood, the specific identity of the two must remain doubtful. Some of the specimens from Lobelia come nearest to the type; those from kauila are large but elongate. Length 3.25-4.25 mm.

Hab.—Kauai, Kumuweia, III-10-28, eight on *Lobelia yuccoides* and three on *Bidens cosmoides*; Halemanu, III-9-28, three on kauila (Swezey).

Oodemas dubiosum Perkins

Two large-sized Oodemas were obtained at Kumuweia from ohia lehua, III-9-28. Both specimens are more or less mutilated, possibly in extracting them from the wood, and consequently I have not subjected them to any manipulation. One of these agrees in many respects with the female which I assigned to *dubiosum*, but its specific identity is not certain. The second specimen is apparently different and referable to the following species.

Oodemas pachysoma Perkins

Besides the mutilated example, above mentioned, collected by Swezey, I have received two large specimens collected at Halemanu by H. T. Osborn, without note of food-plant. Except for the larger size these do not appear to differ in any important manner from the original specimens, captured elsewhere.

Oodemas swezeyi sp. nov.

Reddish brown, thorax and head sometimes more or less infuscate, submetallic, shining, of elongate form, the elytra unusually long and from a little behind the shoulders nearly parallel-sided to the narrow apical portion. Rostrum shining, very slightly narrowing to the apex and very delicately punctured, the eyes subconvex, the antennae with the second funicle joint not at all strongly elongate, the first if fully extended being stouter, but as long as, or even longer than the second. Pronotum rather small and narrow, considering the development of the elytra, and varying in the intensity of the puncturation. Elytra subcylindrical, with the strial punctures distinct and the interstitial punctures much finer, but more or less copious. Middle coxae much less widely separated than in typical Oodemas (such as *aenescens*), but there is considerable difference between these and some of the other species. The sculpture of the basal abdominal segments shows considerable variation, being much less developed in one of the smaller than in the largest example. Length 3.75 to nearly 5 mm.

This remarkable species in several respects approaches the genus Anotheorus, as suggested to me by its discoverer, after whom I have named it. Although it might not unreasonably be separated generically from Oodemas, I think it is better for the present that it should be placed there. Naturally the condition of the eyes excludes it from Anotheorus.

Hab.—Kauai, Alakai swamp, VII-11-32, three specimens from the tree fern *Cibotium chamissoi* (Swezey).

Two New Hawaiian Beetles

BY DR. R. C. L. PERKINS

Recently I received from Mr. O. H. Swezey a small box containing four species of endemic beetles, which, as is usual with his sendings, are of great interest. Two of the species sent appear to me to be undescribed and the others may be looked on as being rare or little known.

Holcobius

The comparatively small number of species placed in this genus are a varied assembly and probably might form several distinct genera, but until a thorough revision of the very numerous and difficult species of the Anobiidae is made, I have thought it better to keep to the same arrangement as in the "Fauna Hawaiiensis."

Holcobius hawaiiensis Perkins

This species is very closely allied to *H. haleakalae* Perkins, or it may be only a variety of the Maui species. It varies greatly in size and to some extent otherwise. Swezey found its borings numerous in the *Suttonia lessertiana* trees at Kilauea, Hawaii, obtaining adults and larvae by cutting up portions of a dead tree July 20, 1934. From a section of the tree taken to the laboratory, mature beetles issued in October. The two or three specimens obtained by myself by beating dead fronds of tree ferns were probably merely resting there. In such an environment they would be perfectly concealed during the day.

Holcobius pikoensis sp. nov.

Dark brown or piceous, length 5 mm. Closely allied to *H. minor* Perkins, but more elongate and with the interstices of the elytra much more strongly sculptured. The two specimens sent are very much alike and of similar size, but some small difference in the apical abdominal sternite leads me to suspect that these represent the sexes. If so, the species is no doubt larger than *H. minor*. The pronotum is shining above and finely punctured, but at the sides has a dense, granulate or rough sculpture, and in the one example the sculpture of the disc is rather different from that of the other, the punctures tending to become granulate. In color, clothing and form of the antennal joints the species resembles *H. minor*.

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Hab.—Oahu, Waianae Mts., on the Piko trail in Makua Valley. Bred by Swezey from dead branches of *Neowawraea phyllanthoides* Rock, an extremely rare endemic tree.

Holcobius frater Perkins

The typical specimens were from Kauai; those from Oahu differ somewhat in sculpture. It was a form of this species that was taken from native dead wood near the Waianae coast and not *H. minor* as was recorded in the "Fauna Hawaiiensis." The examples from Oahu, which I considered to be the same species as *H. minor* of Molokai were found very far back in the mountains behind Waimea. A small, narrow, generally pale-colored form of *H. frater* was not rare in the mountains behind Honolulu.

TABLE OF SPECIES OF HOLCOBIUS

1. A highly polished black species, glabrous, the elytra with rows of coarse punctures, the interstices subconvex........................*glabricollis* Sharp
   Facies very different from that of the above species........................2
2. Pronotum covered all over with dense, strong, raised granulations........3
   Pronotum on the disc with at most very feeble or subobsolete granulations, sometimes merely punctate........................4
3. Shining black with the pubescence less conspicuous.........*granulatus* Sharp
   At least the elytra are brown (varying to pitchy black) the yellowish pubescence very conspicuous........................*affinis* Perkins
4. Pronotum in dorsal aspect of the insect appearing conspicuously emarginate or notched at the sides (owing to the surface being impressed from the front angles); terminal joint of the palpi conspicuously emarginate or excised apically........................5
   Pronotum simple in outline or almost so; terminal joint of palpi not excised........................10
5. Small species (length of unique specimen 6 mm.); elytra not densely tomentose........................*diversus* Perkins
   Large species, often 8-11 mm.; if less than 8 mm. in length, the insect is densely covered all over with appressed tomentose pubescence....6
6. Large, elongate species, usually from 9 to 11 mm.; the disc of the pronotum not densely covered with appressed pile or tomentum................7
   Disc of the pronotum, as also the whole of the insect above, densely covered with tomentum (males usually less than 9 mm. and females usually less than 11 mm.)........................8
7. Pronotum shining in the middle, the sculpture very feeble....*major* Sharp
   Pronotum entirely dull, distinctly sculptured........................*simulans* Perkins
8. Very large and robust species, female 11 mm........................*insignis* Perkins
   Smaller species........................9
9. The granulate sculpture of the pronotum more extensive and usually stronger, extending from the sides across the whole surface in front and behind........................*haleakalae* Perkins

The frontal granulations generally less distinct, and behind towards the middle of the pronotum wanting; in front towards the middle the granulation becomes indistinct or absent, or the sculpture is rather subrugose than with granulation like that of the sides.......... *hawaiiensis* Perkins

10. Pronotum shining and simply punctate, without faint granulations or granulate punctures even at the sides, the punctures there being dense but distinct.......... *simplex* Perkins

Pronotum with more or less granulation or feeble granulate punctures at least at the sides or with roughish sculpture there..........11

11. Interstices of the elytra with a dense and comparatively coarse subgranulate or rough sculpture; length of two examples 5 mm....... *pikoënsis* sp. nov.

Interstices much more finely sculptured; length rarely 5 mm..........12

12. Pronotum on the disc finely punctured, not at all roughened; antennae with the funicle joints mostly more elongate.......... *minor* Perkins

Pronotum on the disc with more or less evident but very feeble granulations or granulate punctures; funicle joints of the antennae mostly shorter.......... *frater* Perkins

Xyletobius aleuritis Perkins

This species was described by me from two examples found dead at a low elevation in the Waianae Mts. more than 40 years ago, and I did not meet with it subsequently. These were dug out of a dead kukui tree. The species is very different from any other and is not really congeneric with any Hawaiian Anobiid. In some respects it would appear intermediate between Holcobius and Xyletobius, while the mouthparts are unlike any of these. Six examples were sent by Swezey.

Hab.—Oahu, Makaleha Valley, February 1, 1931, 4 specimens from dead kukui; Kamokunui Valley, October 1, 1933, 2 specimens under bark of Pipturus. All collected by Swezey.

Proterhinus tantali sp. nov.

A red species, clothed with golden or whitish appressed setae which form more or less distinct maculations on the elytra. These are almost without any erect setae and have only sparse black or fuscous markings. The antennae have a strongly marked club of three joints, the funicle joints being somewhat stout.

Rostral portion of the head in the male well-developed, about twice as wide as long, the female rostrum smooth, its sulci deep. Antennae somewhat robust, scape seen from above elongate triangular, second joint robust, shorter and much stouter than the third, which is subelongate, with the base narrow, the three-jointed club very distinct, its basal joint being very large compared with the subrotundate preceding funicle joint. Eyes prominent, but not large. Pronotum large and somewhat long, the elytra along the suture being 1½ times its length or less, only the anterior median impression, which is more or less shallow, being present; the clothing golden but not dense enough to conceal the sculpture, generally forming denser stripes along the sides or especially dense about the hind angles. Elytra with distinct humeral angles, which, however, are little or not at all produced, red, generally with a pair of dark markings about the middle, others sometimes along the lateral margins, the suture also sometimes with more or less infuscation. The clothing in mature examples forms more or less evident pale maculations, while the usual erect setae are either absent, or represented at most by a very few short and inconspicuous ones. The basal part of the abdomen beneath is copiously and strongly punctured. Length, 3 mm. or less.

This species in its color closely resembles some half dozen others, which are known to feed on Euphorbia. Of these it is most like *P. impressiscutis* Perkins, there being a tendency to an impression in the scutellar region such as is seen in the male of that species, but the stouter antennae of *P. tantali* and other structural characters distinguish it easily.

Hab.—Oahu, Mt. Tantalus, May 20, 1934 (Swezey). A series of 16 examples has been sent me by Mr. O. H. Swezey who bred them from dead twigs and branches of *Euphorbia.*

Notes on Cerambycidae on the Island of Hawaii, 1934 (Col.)

BY O. H. SWEZEY

(Presented at the meeting of September 6, 1934)

While conducting a course in Forest Entomology at the Volcano Branch of the University of Hawaii Summer Session, June 18 to July 27, in Hawaii National Park, Kilauea, Hawaii, opportunity was had for the following observations on the Cerambycidae of the region.

Plagithmysus varians Sharp

Probably this is the most prevalent species of Plagithmysus in the region. It is attached to *Acacia koa.* Many koa trees of the region lying to the west and northwest from the Volcano House are in a dying condition. There are some standing dead trees and there are fallen trees in all stages from freshly fallen partly living trees to rotten logs of all stages of decay. On the trunk and branches of the freshly fallen trees the active beetles could readily be found during the middle of the day. Of these same trees, the branches which were in dying condition were well populated with larvae of the beetle feeding beneath the bark; pupae were also found. On standing trunks and dead branches from which the bark has fallen, the surface of the dead wood shows very extensively the borings of the larvae and the exit-holes where beetles have matured and issued, indicating that this species has been present in enormous numbers.

The "giant koa," standing at an elevation of 4,450 feet on the Mauna Loa trail, furnishes a good illustration. This tree has a trunk of the largest diameter that has been seen. It is 10 feet in diameter at a height of 6 feet; has a symmetrical top of numerous diverging branches, and at the present time almost entirely dead, only a few branches on one side showing living foliage. On all of the dead branches, wherever the bark is off, there are numerous burrows and exit-holes exposed, showing that hundreds, if not thousands, of *varians* have bred on this tree. Although to the casual observer it appears that the beetle larvae have been the cause of the death of this tree, as well as the other dead koa trees of the

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vicinity, my own observations and all the previous observations of the entomologists point to the presence of the *varians* larvae as a secondary factor, the beetles only coming to oviposit in the bark of the dying branches or of the fallen trees, so that the larvae are living in the decaying or fermenting bark when it is just in the suitable stage for them.

I secured specimens of beetles from fallen trees or reared them from larvae and pupae found underneath bark of dying branches in several localities, as: Kipuka Puaulu (the Bird Park), Ohaikea, Mauna Loa trail at various places up to 5,200 feet, Puu Oo trail up to 4,500 feet, and at the golf grounds. At about 5,000 feet on the Mauna Loa trail a dead *varians* larva was found having a full-grown parasite larva on its exterior. This larva matured to *Eupelmus leptophyas* Perkins.

Plagithmysus bilineatus Sharp

This species was also found abundantly. It is a species which I had not previously collected. I first found the beetles where they were attracted to ohia lehua logs in a region about two miles northeast from the Volcano House, in Kilauea Settlement Lots, where a large area was being cleared of timber, to be used for firewood. Many freshly cut lehua logs were lying around, and there were cordwood piles. I visited this place three different times and collected beetles from the logs or woodpiles each time, 28 specimens altogether. I also found under bark of lehua stumps, from which the trees had been cut some months previously, larvae and pupae which matured as this species. In two places were cocoon masses of *Ischiogonus palliatus* (Cam.) where the larvae had fed on larvae of *bilineatus*. In one of these masses there were 14 cocoons, from which the adults issued later.

I collected *bilineatus* also from branches remaining where scattering lehua trees had recently been cut to obtain posts, in the forest about one and a half miles northwest of the Volcano House, towards the site of the old koa mill. On two occasions I visited this region and collected a few beetles each time, 10 altogether. An occasional standing dead tree with bark removed, displayed the grooves cut by the larvae of this beetle while the tree was in the dying condition. Apparently there were enough breeding in this way throughout the extensive lehua forest of the region to provide the beetles that find the recently cut trees, no matter where.

Plagithmysus bishopi Sharp

A member of the Forest Entomology class found beetles of this species on a *Pelea cinerea* tree in the Bird Park, so that each of the class was supplied with specimens. The tree looked healthy, but it had an injured place at base and a dead spot with exit-holes in it. There were also fresh borings around the dead spot, and in pulling off a piece of bark larvae were found, also a pupa, and a freshly matured beetle in a pupal cell. On a second visit to this same tree more beetles were found, some of them as high as ten feet on the trunk and branches. Probably altogether two dozen beetles were taken.

Plagithmysus giffardi Perkins

On the steam bluff trail not more than a half mile from the volcano House, dead *Smilax sandwicensis* vines were found with larvae, pupae and even a matured beetle in its pupal cell in the hollowed out vine. Search was made in other regions, but Smilax was scarce, and no evidence of the work of this beetle was found in Smilax anywhere else. It was not far from the same place that I first found this beetle breeding in dead Smilax vines in 1929. Dr. Perkins and Mr. Giffard both collected *giffardi* on kolea trees (*Suttonia lessertiana*), but did not report rearing it. This summer I examined kolea trees wherever I went in the adjacent forests without finding a trace of the beetle or its work in any of the trees. Dead trees were occasionally met with, and in all cases were well supplied with beetle borings, but they were of a large species of Holcobius, and larvae were very abundant. A number of adults of this anobiid were also found in their pupal cells, by chopping up a dead tree. A smaller anobiid was also found.

Plagithmysus perkinsi Sharp

There was much evidence of the work of this species in dead *Myoporum sandwicense* trees in the Bird Park and farther mauka. The only specimen obtained was a fine fresh beetle cut out of its pupal cell in a nearly dead tree about 3 miles up on the Puu Oo trail. This was in the Brown's ranch where cattle have run for a long time. Great numbers of dead and fallen trees are full of the burrows of *perkinsi.*

Plagithmysus vitticollis Sharp

One beetle was reared from a larva found in the stem of *Vacci-*

nium calycinum, July 3, near the Hotel's old vegetable garden site. It was thought at the time to be the larva of *Neoclytarlus atricolor,* which was reared from *Vaccinium peleanum,* Nauhi Gulch, 8,500 ft. in 1931. However, when the adult issued August 20, it proved to be *vitticollis.* On July 8, on Byron Ledge, the work of the larva was seen in *V. calycinum.* The larva works in living stems and bores somewhat spirally very similarly to what the larva of *N. atricolor* does. Previously, *vitticollis* has been collected and reared from *Rubus hawaiiensis,* in which plant it also bores in living stems.

Neoclytarlus filipes (Sharp)

One specimen was taken from a man's coat while searching for beetles among the branches of a large fallen koa tree, along the Mauna Loa trail at about 4,300 ft. It is said to be attached to *Sophora chrysophylla,* though it has also been reared from dead *Maba sandwicensis.*

Parandra puncticeps Sharp

The only specimen obtained was a dead one in a rotten koa log in the vicinity of the old koa mill site, July 15. There were enough large burrows to indicate that the larvae had been very numerous.

Aegosoma reflexum Karsch

The work of this species was found very abundant in rotten koa logs in the Brown's ranch along the Puu Oo trail about three miles. In a small amount of digging, 3 beetles were found in their pupal cells, also a couple of pupae and a half dozen large larvae. By spending time enough a good many could have been obtained.

Ceresium simplex (Gyll.)

While examining dead Pipturus trees along the road in the Panaewa forest near Olaa, July 2, larvae and pupae were found which I presumed were *Plagithmysus lamarckianus* Sharp, as this species is attached to Pipturus. However, the only one that reared to maturity proved to be *Ceresium simplex.* On July 30, the work of a cerambycid was found in dead branches of *Mezoncurum kauaiense* along the road on north side of Mt. Hualalai. By cutting up dead branches several larvae were found, and soon an adult Ceresium in a pupal cell. These are two new host records for this beetle.

The Winter Revival of Insect Life in the Arid Region at Koko Head, Oahu

BY O. H. SWEZEY

(Presented at the meeting of March 1, 1934)

In the arid region at Koko Head, for the greater part of the year, there is a scarcity of vegetation to attract insects, or upon which they could thrive. But after a few winter rains a considerable growth of various grasses and other weeds occurs on which the insect populations quickly increase to a great abundance. No doubt this is an annual occurrence, depending on the time when the rains occur. This season my attention was called to the situation when on February 4th, 1934, the full-grown larvae of *Celerio lineata* (Fab.) were observed crawling on the pavement of the Kalanianiole Highway which passes through the region. It was found that there were large patches of newly grown pigweed (*Portulaca oleracea*) scattered all over the region, and the caterpillars were numerous, having eaten off most of the weed and had become nearly full-grown. Subsequent visits were made to the place every few days during February to collect these caterpillars for feeding the recently imported toad (*Bufo marinus*) in observation cages at the Experiment Station, H.S.P.A.

Armyworms (*Cirphis unipuncta* [Haw.]) were numerous on the grasses of the region. Collections of them were made for determining parasitism. Adults of *Hyposoter exiguae* (Vier.) were very abundant, and of the armyworms collected, 32 percent were parasitized by it. A few were parasitized by the tachinids *Archytas cirphis* Curran and *Frontina archippivora* Will. The adult flies were quite common as well as *Chaetogaedia monticola* (Bigot). Other caterpillars more or less prevalent were the following:

Lycophotia margaritosa (Haw.) They were 33 percent parasitized by the three tachinids above mentioned.

Spodoptera mauritia (Boisd.) 40 percent parasitized by Frontina and Hyposoter.

Spodoptera exigua (Hüb.) 36 percent parasitized by Frontina, Chaetogaedia and Hyposoter.

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Caradrina exanimis Meyr. The stem borer in the grass *Panicum torridum.*

Chloridea obsoleta (Fab.). The caterpillars of the corn earworm were found on several kinds of weeds. One collection of them was found 60 percent parasitized by Hyposoter.

Plusia chalcites Esp. Caterpillars feeding on basil, cocklebur, and other weeds were parasitized from 36 to 76 percent by *Litomastix floridana* (Ashm.) and Hyposoter. *Echthromorpha fuscator* (Fab.) was also present and no doubt parasitized their pupae.

Hymenia recurvalis (Fab.). This moth was very abundant, its larvae having fed on the *Portulaca oleracea.* Its two usual parasites were also present: *Casinaria infesta* (Cress.) and *Chelonus blackburni* Cam.

Platyptilia brachymorpha Meyr. Larvae were found common on basil, which had made a fresh growth and was blooming, the larvae feeding on the infloresence. They were 36 percent parasitized by *Pristomerus hawaiiensis* Perkins.

Hyposmocoma tenella Walsm. This little moth was common, but its larvae were never found.

Hyposmocoma empedota Meyr. Larval cases of this species of Hyposmocoma were common on the bark of the algaroba trees. From these, besides a few moths, three different parasites issued: *Secodella metallica* (Ashm.), *Lepideupelmus setiger* (Perkins) and *Hemiteles tenellus* (Say). The latter is normally a parasite in Chrysopa cocoons.

Vanessa cardui (Linn.). Thistle butterfly caterpillars were found feeding on Malva. They were 10 percent parasitized by Frontina.

Thecla bazochii God. The larvae of this lantana butterfly were found quite common on the infloresence of basil. No parasites were reared from them.

Other insects not mentioned above were as follows:

Paratrechina longicornis (Lat.). The crazy ant was enormously abundant under stones, dried cowdung, etc., very populous nests.

Ischiogonus pallidiceps Perk. A parasite of cerambycid beetles.

Urosigalphus bruchi Crawf. A parasite of bruchid weevils which infest the pods of the algaroba tree.

Orgillus sp. A new black braconid. Reared from *Opogona aurisquamosa* (Butl.).

Lysiphlebus testaceipes Cress. A parasite of aphids.

Habrolepis sp. A parasite whose habits are not known.

Anagyrus sp. A mealybug parasite which appears to be new.

Protaenasius sp. A recently introduced mealybug parasite from Mexico. It was reared from *Ferrisia virgata* (Ckll.) which was found at the roots of Portulaca. Probably the preceding parasite was breeding on this same mealybug.

Toxomerus marginatus (Say). Quite common flying about basil. Its larvae feed on aphids, some species of which was present.

Chaetodacus cucurbitae (Coq.) Was found infesting spiny cucumbers which were growing wild. Parasitized by *Opius fletcheri.*

Sybra alternans Wied. Adults captured and larvae found in dead stems of basil and cocklebur.

Gonocephalum seriatum (Boisd.) This tenebrionid beetle was in hundreds under stones, dried cowdung and trash.

Ammophorus insularis Boh. Another tenebrionid common in similar places.

Tenodera augustipennis Sauss. A few praying mantes were found.

Chrysopa lanatus Banks. A few of this lacewing fly.

Nysius delectus White. This and probably another species of lygaeid bug were very abundant on various weeds.

Oronomiris hawaiiensis Kirk. Abundant on grasses.

Corizus hyalinus (Fab.) Common on Malva. A proctotrypid (*Telenomus rhopali* Perk.) was reared from its eggs, which were in clusters on the leaves.

Zelus renardii Kol. The assassin bug was prevalent on basil and other weeds.

Reduviolus capsiformis (Germ.). Another predacious bug was common in grasses.

Nesosteles hospes Kirk. On grasses.

Oliarus discrepans Giffard. The nymphs were found under a stone.

Insect Fauna of Gossypium tomentosum

BY O. H. SWEZEY

(Presented at the meeting of March 1, 1934)

This native species of cotton grows in dry lowland regions of Oahu and Molokai (according to Hillebrand, on all the islands). It is not known to have any species of endemic insect particularly attached to it. Dr. Perkins has recorded *Proterhinus deceptor* Perkins as occurring on it, but this beetle occurs on several other plants also. There is quite an area of *Gossypium tomentosum* among the algaroba trees of the flats west of Makapuu Head, Oahu. On February 4th, 1934, I made the effort to obtain some *Proterhinus deceptor* from these cotton plants, and succeeded in obtaining 5 specimens. While sweeping in the efforts to secure these, I obtained 2 specimens of *Rhyncogonus simplex* Perkins, the species which occurs on Molokai, and of which Mr. F. C. Hadden discovered a small colony on Koko Head, Oahu, January 11th, 1928.

Interested in learning more of this new colony of Rhyncogonus, I visited the region again on February 11th, when 53 specimens of the beetle were collected from the cotton plants. The beetles were found over an area of 100 yards or more in extent. Subsequent visits were made to the region to make observations on the seasonal occurrence, habits, etc., of *R. simplex,* and records kept of all kinds of insects which were taken on cotton at these times. The annotated list follows:

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COLEOPTERA

**Rhyncogonus simplex* Perkins. The adult beetles feed on the leaves. The clusters of eggs are deposited between the edges of the folded-together tip of a leaf, which is cemented together for protection of the eggs. The larvae live in the ground.

**Proterhinus deceptor* Perkins. The larvae live in dead twigs.
**Hypothenemus maculicollis* Sharp. The larvae live in dead twigs.
Hypothenemus eruditus Westw. The larvae live in dead twigs,
Catorama pusilla Sharp. The larvae live in dead twigs.
Prosoplus bankii (Fab.). The larvae live in dead twigs.
Sybra alternans Wied. The larvae live in dead twigs.
Diachus auratus (Fab.). The adults and larvae are leaf-feeders.

Ladybeetles

Pullus kinbergi (Boh.) Aphis-feeding ladybeetle.
Scymnus notescens (Blkb.). Aphis-feeding ladybeetle.
Platyomus lividigaster Muls. Aphis-feeding ladybeetle.
Coelophora inequalis (Fab.). Aphis-feeding ladybeetle.
Scymnus debilis Lec. Mealybug-feeding ladybeetle.
Nephus sp. near *bipunctatus.* Mealybug-feeding ladybeetle.
Cryptolaemus montrouzieri Muls. Mealybug-feeding ladybeetle.
Rhizobius ventralis (Erich.). Mealybug-feeding ladybeetle.
Curinus coeruleus (Muls.). Mealybug-feeding ladybeetle.
Lindorus lophanthae (Blaisd.). Scale-feeding ladybeetle.
Chilocorus circumdatus Schön. Scale-feeding ladybeetle.
Azya lutiepes Muls. Scale-feeding ladybeetle.
Rhodalia cardinalis (Muls). Feeds on cottony cushion scale.

HETEROPTERA

Zelus renardii Kol. Predacious bug, feeding on many kinds of insects.

**Ithamar hawaiiensis* Kirkaldy. Plant-feeding bug.
Corizus hyalinus (Fab.). Plant-feeding bug.
Nysius delectus White. Plant-feeding bug.
Nysius coenosulus Stal. Plant-feeding bug.

HOMOPTERA

Saissetia nigra (Nietn.). Black scale.
Hemichionaspis minor (Mask.). Hibiscus scale.

Icerya purchasi Mask. Cottony cushion scale.

Pseudococcus filamentosus (Ckll.). Filamentous mealybug.

Aphis gossypii Glover. Cotton aphis.

**Oliarus discrepans* Giffard.

NEUROPTERA

Coniocompsa vesiculigera End.

ISOPTERA

Kalotermes immigrans Snyder. Colonies in dead branches.

LEPIDOPTERA

Platyedra gossypiella (Saund.). Larvae feed in seeds.

HYMENOPTERA

Lithurgus scabrosus Smith. Bee, feeding at flowers.

Megachile palmarum Perkins. Bee, feeding at flowers.

Solenopsis geminata rufa (Jerdon). The fire ant.

Paratrechina longicornis (Lat.). The crazy ant.

Plagiolepis mactavishi Wheeler. The little yellow ant.

Tapinoma melanocephalum (Fab.). The black-headed ant.

Pheidole megacephala (Fab.). The big-headed ant.

Perisierola emigrata Rohwer. Parasite on *Platyedra gossypiella*.

Glyptocolastes bruchivorus Crawf. Parasite on bruchid in algaroba beans.

Anagyrus dactylopii (How.) Parasite of *Pseudococcus filamentosus.*

Anagyrus sp. An undetermined mealybug parasite.

Bothriencyrtus insularis (Cam.). Parasite of *Ferrisia virgata.*

Protaenasius sp. A recently introduced mealybug parasite from Mexico.

**Eupelmus* sp. A male. Parasitic habits not known.

Of these 49 species of insects very few are endemic in Hawaii (those marked with an asterisk probably are), the others are immigrants, or purposely introduced parasites, and ladybeetles.

At Kanoa, Molokai, October 27, 1930, the following Coleoptera were found boring in dead stems of this Gossypium:

Amphicerus cornutus (Pallas).

Sinoxylon conigerum Gerst.

Xylopsocus castanoptera (Fairm.).

PRESIDENTIAL ADDRESS

Response of the Mediterranean Fruit Fly to Its Environmental Factors

BY O. C. McBRIDE

(Presented at the meeting of December 6, 1934)

Since the introduction of the Mediterranean fruit fly, *Ceratitis capitata* Wied., into Hawaii, many observations have been made on its response to various environmental factors. Conditions prevailing in Hawaii are most favorable for its rapid multiplicaton and spread. Suitable host fruits are present in numbers throughout the greater part of the year. Even during periods of low fruit abundance, miscellaneous fruits are available for maintaining a small fly population sufficient to build up quickly a large population when conditions are favorable. In addition to an abundance of host fruits, temperature conditions are favorable for a maximum rate of development.

For nearly 20 years field observations and laboratory studies have been made on the effect of various factors on the activity and abundance of fruit flies. In the present paper no attempt is made to give complete information on the effect of environment on this insect; but to bring together the available information, especially that derived from the more recent observations. Some of the observations were made by Dr. E. A. Back and Messrs. C. E. Pemberton, H. F. Willard, and others of the Territorial and Federal entomological staffs. A number of the earlier observations have already been published in papers covering other subjects.

The Mediterranean fruit fly infests more than 75 species of fruits, which are distributed throughout the Islands and which furnish a constant supply of suitable food. The abundance of these host fruits, however, varies with the season, and the fly population is largely determined by the quantity of available host fruits. During periods when host fruits are plentiful, the fly population builds up quickly, while a decrease in suitable host fruits is followed by a sudden decrease in the number of fruit flies, which, however, comes 3 to 5 weeks after the host fruits disappear. At elevations above 1,500 feet, fruits of the wild guava are available for a period of only 2 to 3 months each year, and then disappear. In these areas the fruit flies are present in decreasing numbers during the first 3 or 4 months following the absence of this host fruit. Mature guava fruits first appear at the lower elevations and gradually thereafter to the higher elevations. The fruit fly population also moves forward and upward with the maturing fruits. Reappearance of the flies at the higher elevations is due to flies moving in from the lower levels.

In the absence of suitable fruits, adults are capable of existing for long periods on food other than fruits. Adults have been kept alive in the laboratory for more than 3 months on caged plants infested with scales, aphids, and mealybugs, when the only food available was the honeydew secretion from the insects on the plants. Records show, further, that the females may cease egg-laying for a period of 6 months and then resume active egg deposition when suitable fruits become available.

In the long list of host fruits are many that show a partial resistance to the fly, and others that are detrimental to the development of the eggs and larvae. Mason[1] has discussed the economic importance of the Mediterranean fruit fly to Hawaiian horticulture. He shows that fruit varieties within a single species vary widely in resistance to infestation. In the mango, for example, infestation percentages range from zero in the variety Bierbach to 58.8 in the variety French. Back and Pemberton[2] have shown that the eggs deposited in the freshly made punctures in the rind of many citrus fruits suffer a high mortality. The newly hatched larvae in the egg cavity or in the rag beneath the egg cavity show a high mortality. In many citrus fruits the combined egg and larval mortalities have ranged between 89 and 99.8 percent. Mortality is due to the rupture of oil cells during oviposition, permitting the oil to flow into the freshly made punctures about the eggs. Many of the citrus fruits have a very thick rag, which the small larvae

[1] Mason, A. C. The economic importance of the Mediterranean fruit fly to Hawaiian horticulture. Hawaiian Ent. Soc., Proc., 8:163-178, 1932.

[2] Back, E. A., and Pemberton, C. E. Susceptibility of citrous fruits to the attack of the Mediterranean fruit fly. Jour. Agr. Research, 3:311-330, 1915.

are unable to penetrate. Keck[3] has found that certain pathogenic organisms enter the punctures made by the ovipositing female. These organisms work rapidly, producing fruit decay within three days. The destruction or breaking down of the fruit rag by these fungi materially aids the small larvae in penetrating the otherwise impervious fruit rag. Probably the same condition obtains for many fruits other than citrus.

Often we have noticed the flies attempting oviposition in certain fruits without any apparent success. Flies are unable to puncture, with ease, fruits possessing a smooth, waxy surface or those with tough rinds. In certain varieties of mangoes a high negative correlation exists between the toughness of the fruit skin (as measured by the resistance the skin offers to puncturing from an applied force) and the percent of infestation. Fruit odors in some fruits appear objectionable to the flies while others act as attractants. The fruit acidity, in a few cases, is detrimental to the eggs and larvae. Death of larvae by drowning occurs in very ripe fruits that possess a high percentage of water, which tends to accumulate within the fruits because of the feeding of the fruit fly larvae. Many fruits contain a milky or latex-like substance that exudes from the oviposition punctures, ejecting the eggs; and frequently the exudation dries quickly, trapping the female before she can leave the fruit. The chemical and physical properties of the fruits, therefore, are contributory factors in fruit infestation, and would constitute an interesting problem for geneticists in plant breeding and selection for fruit fly-resistant varieties.

Next to host fruits, temperature is the most important factor in regulating the spread and abundance of the Mediterranean fruit fly. No attempt has been made to determine the effect of temperature on the physical and chemical processes in the metabolism of the various stages of the fly. As found for many other insects, temperature plays an important role in the biological process. The development of all stages progresses quite normally at temperatures between 70° and 90° F. The optimum temperature for eggs is 90° F., since the incubation period is the shortest at this temperature with the highest percentage of eggs hatching. The egg

[3] Keck, C. B. Relation of oviposition punctures of the Mediterranean fruit fly to the premature dropping of citrus fruits. Jour. Econ. Ent., 28:908-914, illus., 1934.

stage ranges from 15 days at 55° F. to 38 hours at 90° F., with no eggs hatching below 52° F.

Larval development occurs between 55° and 95° F., with the shortest larval period at 85° F. At 55° F. the average time required is 38 days, while at 85° F. 6 days is required. Prolonged temperatures of 100° F. or above are fatal to the larvae. The developmental time for the pupae ranges from 55.9 days at 55° F. to 8.1 days at 90° F. Development of all stages, therefore, is greatly retarded at temperatures below 65° F., and ceases between 50° and 52° F. No fertile eggs are deposited at temperatures below 65° F. The variation in rate of development at temperatures between 75° and 95° F. is quite small, as compared with the time required to complete development at temperatures between 55° and 70° F.

The range of effective temperatures is from 55° to 95° F. Above and below this range the fruit fly is inactive and much above and below the range the inactivity is terminated by death. Although the time-temperature mortality point differs with different individuals, no adults are able to survive constant temperatures of 105° F. for 8 hours, 108° F. for 5 hours, 110° F. for 2 hours, or 115° F. for one-half hour. At low temperatures there are no survivals after 25 hours' exposure at 26° F., 100 hours at 30° F., or 12 days at 45° F. Since no activity or feeding occurs at 45° F., the mortality for this period is largely due to starvation. During exposures to high temperatures (100-110° F.) the flies are inactive, but on removal to normal temperatures before the fatal period is attained the adults will resume normal activity within 1 hour and show no apparent permanent effect from the high-temperature exposure.

Constant temperatures of 23° F. for 12 hours, 28° F. for 30 hours, 32° F. for 4 days, and 42° F. for 10 days are fatal to the pupae. However, pupae buried in soil at 20° F. survived 25 hours. No pupae were able to survive temperatures of 105° F. for 15 hours, 107° F. for 10 hours, 109° F. for 2 hours, 110° F. for 1½ hours, or 112° F. for 1 hour.

These data show that all stages of the Mediterranean fruit fly must be subjected to prolonged exposures to moderately high or low temperature to insure their mortality. The various stages show less resistance to sudden changes of temperature than to gradual temperature change. There are evidences on record that there may be either an increase or a decrease in the fly's resistance to extremes of temperature depending upon the particular host species infested. The particular season of the year appears to have little or no effect in modifying the fly's resistance to changes in temperature. Individual differences in resistance to high or low temperatures are more pronounced than are the differences produced by environmental conditions. In Hawaii, however, the fruit fly never encounters the temperature extremes necessary to kill it, except in the case of eggs and larvae in fruits that have dropped to the ground and are exposed to the direct rays of the sun.

Owing to the fact that the egg and larval stages are spent within the fruit and the pupal stage in the soil, light plays a minor role in the metabolism. Other factors being equal, the rate of development of eggs, larvae, and pupae in total darkness approximates that attained in a strong light. No measurable differences are noted in the size of individuals reared in darkness and those reared in diffused sunlight. Adults, however, show a positive reaction to light and avoid entrance into dark locations. In trapping for the fruit fly, traps of dark, dirty, or rusty tin always catch fewer flies than bright tin traps, glass traps, or traps painted a light color. A tin trap painted with aluminum paint on the inside and on the cover gives excellent results in trapping. The fact that this paint reflects ultra-violet light suggests that the response of the fly to light rays is in the range of the ultra-violet wave length.

The response of the adults to light under orchard conditions is an important point to consider in the promotion of control measures. During the winter months the adults frequent the lighted or even sunny portions of the tree, but during the summer months they seek the well-lighted parts not exposed to the sun's rays. In locating bait traps or in placing poisoned baits on the foliage, an effort should be made to select the part of the tree frequented by the largest number of flies. Because of light or other determined factors the adult flies show a marked preference for certain trees in the orchard. These should be located and taken advantage of, in trapping or in spraying for the control of the Mediterranean fruit fly.

We have already stated that the presence of a continuous food supply and favorable temperatures have largely determined the spread and abundance of the Mediterranean fruit fly in Hawaii. Under such favorable conditions an opportunity for determining the effect of the environment on the species would appear to be quite remote. However, this is far from the case. By virtue of the fact that the fly is distributed in both the cultivated and the wild areas, we can have available, within 1 hour's drive, experimental areas possessing widely varying physical characteristics—for example, marshes, semidesert regions of low humidity, low rainfall, and high temperatures, and mountainous areas with lower temperatures, high humidity, high rainfall, and limited sunlight, and with all intermediate variations as ascent is made from sea level to the limits of the fruit fly range. Furthermore, both continuous and interrupted host sequences are available which serve to break up the distribution into areas having different periodic fluctuations in abundance. Thus, it is possible to have available for study in the various environments any number of interrelationships which may influence directly or indirectly the biological equilibrium. Such a study was completed during the period from April 1931 to March 1933.[4]

The counts of the fly populations and the climatological records were summarized weekly from four experimental plots. Plot 1 was a cultivated area consisting of citrus fruits, of many varieties, and mangoes, located at an elevation of 200 feet. Plots 2, 3, and 4 consisted principally of wild guavas, located at elevations of 250, 1,000 and 1,800 feet, respectively. For comparison with the field data, laboratory tests were made under controlled conditions. The counts of fly abundance were made by means of bait traps. Although the trap catch is more nearly a measure of fly activity than of actual population, nevertheless the traps serve as a fairly reliable index to fly abundance, i.e., the fly catch is proportional to the numbers present in the orchard. Counts of host-fruit abundance and fruit infestation were made twice a month throughout the fruiting period.

It is well understood that the maximum population level de-

[4] Plans for this work, and the first five months' observations, were made by Mr. M. McPhail. Acknowledgment is also due to Messrs. A. C. Mason and T. H. Hong for much of the field work connected with the study.

pends on the biotic potential and the maintenance of optimum environmental conditions. Deviations from the optimum affect the vital processes of the fruit fly and change the effective limits of the species. In an investigation of the influence of environment on the various stages of the Mediterranean fruit fly under field conditions, therefore, it is necessary to study the whole environmental complex. It is not possible to investigate the influence of single factors and report the results quantitatively. However, analysis of quantitative data from a unit area in one environment, compared with the results from an entirely different environment, and these, in turn, correlated with the data from controlled laboratory studies, furnishes fairly reliable means of determining the effect of the environment as a whole or the probable influence of single factors.

The factors of environment measured in these studies included temperature and relative humidity (hygrothermograph records), weekly rainfall, elevation, host-fruit abundance, percentage of fruit infestation, and fly abundance. The data from the four plots were analyzed statistically.[5] These analyses show that the variables measured represented approximately 66 per cent of the total environmental factors operating in the experimental plots. In correlating the factor of temperature with population trends, at plot No. 1 with plot No. 2, little or no significant effect is evident, as these two stations have practically the same variables except type and abundance of host fruits. As the elevation increased the mean annual temperature decreased 1° F. for approximately each 200 feet. We find, therefore, a corresponding decrease in the abundance of fruit flies at the 1,000 and 1,800-foot stations. The temperature, however, is above the minimum effective range for continuous development, and in no way do distinct generations occur, as noted for species in the temperate regions. Although the temperature fluctuates within a narrow range, sufficient differences occur between seasons and elevations to affect the metabolic rate of the immature stages. The mean time of development for eggs, larvae, and pupae, for the same seasonal period, was increased from 24.6 days at 250 feet elevation to 34.3 days at 1,800 feet. For each degree of decrease or increase in the mean annual tem-

[5] Wright, S. Correlation and causation. Jour. Agr. Research, 20:557-585, illus., 1921.

perature between 65° and 75° F., the developmental period is increased or decreased approximately 1½ days. Between 75° and 95° F. the average developmental time is changed 0.4 day for each degree of change in mean temperature. At temperatures below 65° F., the developmental time for the immature stage is increased 4 to 9 days for each degree of decrease in mean temperature. At a constant temperature of 55° F. 108 days is required for completion of the immature stages, while 17 days is required at 90° F.

The effect of temperature on the rate of development is such that fly abundance and fruit infestation at the 1,800-foot station, provided that all other conditions were at the optimum, would attain only 72 percent of the values possible for the station located at 250 feet elevation. The values attained at any time during the 2-year period, however, were only 3 percent of the population at the lower station. Host fruits were only 4 percent less abundant at 1,800-foot station than at the 250-foot station. Although this difference in the number of host fruits was small, the proportion of infested fruits for the 2-year period was 70 percent at the lower station and only 24 percent at the higher elevation. This decrease in fly abundance and fruit infestation is the result of numerous interrelated environmental conditions, all of which act as a check on normal fly activity, reproductive stimuli, and the rate of growth.

The egg and larval stages of the fruit fly are passed within the fruits, and the pupal stage in the soil. Regardless of the relative humidity of the atmosphere, the developmental rate for these stages at a given temperature is the same, provided the moisture content of their respective media remains above the point of fatal dryness. The effect, if any, of atmospheric moisture is on the adult. Since the relative humidity is tied up with other variables, it is quite difficult, under field conditions, to evaluate its influence on adult activity and longevity. However, during periods of high atmospheric moisture and rainfall, and low temperature, the percentage of fruit infested and flies caught in the bait traps shows a marked decrease. During unfavorable periods the adults are inactive, but favorable climatic conditions for periods as short as two hours during the day will stimulate the adults to activity.

Rainfall has very little effect on the developmental rate of eggs and larvae; prolonged rainy periods, however, greatly retard adult activity and oviposition. In addition, heavy rainfall accompanied by high winds has been noted to cause a decrease in the abundance of adults. One rainy period of 3 days accompanied with high winds reduced the resultant flytrap catch approximately 50 percent for the 6 weeks following the rainy period, as compared with previous records for a similar period. The principal influence of rainfall is its effect on pupal development. Wet or saturated soil retards pupal development and results in a high percentage of mortality. All in all, the net result is a decrease in fly abundance and fruit infestation.

We have little direct evidence showing that atmospheric pressure, as such, has any effect upon the development or the abundance of the Mediterranean fruit fly. Studies at the four elevations and exposures in a vacuum show that the various stages survive reduced pressure equivalent to more than three times the highest altitude attainable on earth. The differences in fly population and activity noted at the various elevations are due to factors other than pressure.

From the studies completed, it appears plausible to assume that the Mediterranean fruit fly, by feeding on the honeydew secretion from aphids and scale insects, would survive a host-free period not exceeding 3 months. Furthermore, the flies readily survive temperatures of 45° F. for a period not exceeding 10 days. In fruit-growing sections with summer temperatures of 70° to 95° F., other factors being favorable, the fly may attain an economic status. Its economic importance, however, will depend on the fly population at the onset of the host-fruit season, abundance of suitable fruits for a minimum period of 2 months, and a mean temperature above 70° F.

SUMMARY

Under field conditions there are numerous interdependent environmental factors which act simultaneously and with varying intensities on the biological processes of the various fruit fly stages. In the studies at the four stations the environmental factors, measured quantitatively, represented less than 66 percent of all the variables effecting the normal biological processes. The greatest single factor in determining the fly population is that of host-fruit abundance spread over long periods. Temperature has little or no cor-

relation with the establishment of the fly population if there are no host fruits. There are periods when, although the temperature is at an optimum for the species, the fly population is nil, owing to lack of host fruits.

Temperature affects adult activity and decreased temperatures increase the time of development of the immature stages. The difference in mean temperature between the 250-foot and 1,800-foot elevations is sufficient to account for approximately 28 percent of the reduction in fly population and fruit infestation at the higher elevation.

Rainfall, accompanied by other variables, plays an important part in affecting adult activity, oviposition, feeding, and longevity, percent of fruit infestation, pupal mortality, and host-fruit sequence and abundance.

Humidity, like temperature, has no influence on the onset of the fly population, but exerts its effect, in conjunction with lower temperatures, principally on the adults.

Atmospheric pressure and light play minor roles in the biology and normal activity of the fruit fly.

Records of Immigrant Insects for the Year 1934

BY THE EDITOR

In this issue of the Proceedings, the following new immigrant insects are recorded. Those marked with an asterisk were observed for the first time on the date mentioned. The others have been previously collected, but herein named for the first time. For details of records, etc., refer in the text to the pages given.

	Page
Phloeobius gigas horaeus Jordan (Col.)	2
**Xyleborus morigerus* Blandford (Col.)	6
**Orgillus* sp. (Hym.)	13
**Isodromus axillaris* Timb. (Hym.)	17, 21
Araecerus vieillardi (Montr.) (Col.)	17
**Cryptolucillia caesarion* (Meig.) (Diptera)	28
**Lyctus curtulus* Casey (Col.)	34
**Taeniothrips* sp. (Thysan.)	38