

THE GENUS HALOBATES (Hemiptera: Gerridae)

By Jon L. Herring¹

INTRODUCTION

Relatively few insects inhabit the sea. Certain Diptera, Coleoptera and a half dozen genera of Hemiptera may be considered marine because they occupy saline situations, such as rocky beaches, intertidal flats, mangrove swamps and the like, but only the water striders have invaded the open ocean.

Little is known of the distribution of the veliid, *Halovelgia*, or the gerrid, *Hermatobates*, although both of these water striders have been taken in lagoons, coral reefs and harbors. It appears that these two genera, although exclusively halophilous, are confined to coastal situations.

Water striders of the genus *Halobates*, however, are truly oceanic in habit. Several species maintain their entire existence hundreds of miles from the nearest land and have been taken on or near shore only after storms.

The early workers considered all species of this genus to have an open-ocean distribution since the attention of the early voyagers was attracted to these silvery gray insects only on the open sea. We now know, however, that only a few of the species maintain this existence. Most of them are endemic to particular islands or island groups.

In this study all previous work has been reviewed. Much new material has been studied, and biological observations were made at the Marine Biological Station of the University of Hawaii. The resulting revision is the first since that of Buchanan-White 75 years ago.

ACKNOWLEDGMENTS

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Dr. Å. Vedel Tåning and the Carlsberg Foundation have placed the entire "Dana" material at my disposal, and allowed me to use their splendid maps for plotting distribution.

Gratitude is due the University of California and the University of Hawaii for a research grant that enabled me to spend five months in Hawaii collecting material and studying the biologies of the Hawaiian species. Dr. Robert Hiatt and the other members of the Coconut Island Marine Laboratory were most congenial and encouraging in my research. I would like to thank particularly Charlie Nakamoto for aid in assembling collecting gear and cooperation in keeping the necessary rearing equipment in operation.

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The following persons have also aided me by generously lending material from their private collections or from material in their care: E. S. Brown, Commonwealth Institute of Entomology, London; H. Weidner, Hamburg Zoological Museum; S. L. Tuxen, University Zoological Museum, Copenhagen; J. W. Evans, Australian Museum, Sydney; T. E. Woodward, University of Queensland, Brisbane; members of the Pacific Oceanic Fisheries Investigations, Honolulu; H. B. Hungerford and G. W. Byers, Snow Entomological Museum, University of Kansas; Carl J. Drake, U. S. National Museum; Reece I. Sailer, Entomology Research Service, Beltsville, Maryland; Cadet Hand and G. F. Papenfuss, University of California, Berkeley; J. B. McDaniel, Stanford University; and the crew of Fishing Vessel No. 9, George Vanderbilt Foundation.

HISTORY

In 1822, the talented Estonian naturalist Johann Friedrich Eschscholtz described the genus *Halobates* and the species *micans*, *sericeus* and *flaviventris*. Eschscholtz served as physician and naturalist on the ship "Rurik" which sailed around the world under the command of Otto von Kotzebue during the years 1815 to 1818. It was on this voyage that these three species were collected. The second voyage with Kotzebue was made in the ship "Predpriaetie" ("Enterprise") during the years 1823 to 1826; Eschscholtz was chief naturalist on this voyage but apparently did not collect any additional material of the genus.

Sixty years elapsed between the publication of Eschscholtz's Entomographien and White's revision. The only interim descriptions of species were those of Templeton (1836) and Frauenfeld (1867). Each described a single species from the Atlantic ocean, *H. streatfieldana* and *H. wullerstorffi*, respectively. Unfortunately, both species are synonyms of *H. micans*. However, during this time several important contributions were made. Laporte (1833) designated *H. micans* as type of the genus. Fairmaire (1848), Frauenfeld (1867) and Giglioli (1870) contributed to the meager knowledge of the biology of this group. Murray, the narrator for the voyage of the Challenger, made many interesting observations on these insects. He was the first to attempt to define the distribution of the genus and observed that some of these insects fed on dead *Porpita*, *Physalia*, *Salpa* and other creatures floating on the surface of the sea.

In 1883, F. Buchanan-White's classic Challenger Report appeared. He simplified research

for all future students of the group by reproducing in chronological order all of the pertinent literature of the genus. He redescribed the known species, added six new ones and illustrated all 11 in color. Also in this monograph, he described two new genera of only passing concern here, *Halobatodes* [= *Metrocoris* Mayr 1865] and *Stephania* [= *Trepobates* Uhler 1894, *Stephania* preoccupied]. Certain of the species included in these genera were originally described as *Halobates*. All of these are listed below.

Following White's work, many entomologists published papers on the group. Most notable of these workers was the late Teiso Esaki. His descriptions were well executed and illustrated but later he synonymized most of his own species as well as several of those of others. I am resurrecting most of these. Both Lundbeck (1914) and Delsman (1926), have materially added to the knowledge of the eggs and egg-laying habits of *Halobates*. Imms (1936), Usinger (1937) and China (1957) added additional systematic, biological and morphological knowledge.

The literature on *Halobates* is replete with misidentifications. As an example, any medium-sized or large species was identified as *H. princeps* White. Therefore, according to the literature, the range of this species is from the Indian Ocean to Samoa and northwest to include Korea. The Indian Ocean and Korean records are referable to two described species. The Samoan material represents a new species, described later. *H. princeps* is a SW Pacific species occurring primarily in the Celebes Sea.

Certain species were incorrectly described as *Halobates*. They have been transferred as follows: *H. albinervis* Amyot & Serville (*Brachymetra*); *lituratus* Stål and *stali* Dohrn (*Metrocoris*); *orientalis* Distant (*Chimarrhometra*); *pictus* and *platensis* (*Trepobates*).

GEOGRAPHICAL DISTRIBUTION

The genus *Halobates* is circumtropical in distribution; only one or two species occur beyond the limits of this zone. Since it seems indubitable that temperature is the most important factor controlling the distribution of faunas, the borders of the tropical and subtropical zones have been identified with particular isotherms (Ekman, 1953). The tropical fauna would thus occupy a region between the isotherms for 20° C. water temperature at the coldest time of the year, while the subtropical faunas are limited by a yearly minimum temperature of approximately 16°–18°. The tropical fauna is the richest, containing the largest proportion of the warm-water animal world. It includes numerous elements that do not penetrate into the subtropical regions that border it and is therefore characterized by numerous endemic organisms.

Of the large number of genera, families and systematic groups of higher order that are wholly or almost entirely confined to the tropics, the corals and mangroves occupy a dominant position. However, there is a rather remarkable contrast between the fauna of the Atlantic as opposed to that of the Indo-Pacific regions. It must be noted, however, that the Atlantic and the Indo-Pacific are not comparable in size. The contrast in faunas is expressed primarily in the fact that the latter region is much richer in species. Not only is this true for *Halobates* (there is only a single species in the Atlantic), but for many other groups of animals. The coral reefs are rather poorly developed in the Atlantic even though sea temperatures and other conditions appear to be the same. Wells (1957) states that the reef fauna of the Atlantic includes only 26 genera and some 35 species, compared

with 80 genera and about 700 species in the Indo-Pacific. *Acropora* and *Porites*, the two most important coral genera, are represented by only six species in the Atlantic in contrast to over 180 in the Indo-Pacific. Also many important Indo-Pacific genera are not represented by ecologic equivalents: *Pocillopora*, *Stylophora*, *Seriatopora*, *Montipora*, *Goniopora*, *Goniastrea*, *Hydnophora* and *Astreopora*, although all occur in the tertiary faunas of both regions. Wells further points out the absence of many characteristic reef-coral associates; there are no such great pelecypods as *Tridacna* and *Hippopus*, no coral gall crabs, no giant anemones with commensal fish and crustaceans and no representatives of the alcyonarian corals, *Heliopora* and *Tubipora*. Ekman (*l. c.*) states that the prawn genus *Lucifer*, like other genera, has more species in the Indo-Pacific than in the Atlantic. Numerous other examples could be cited.

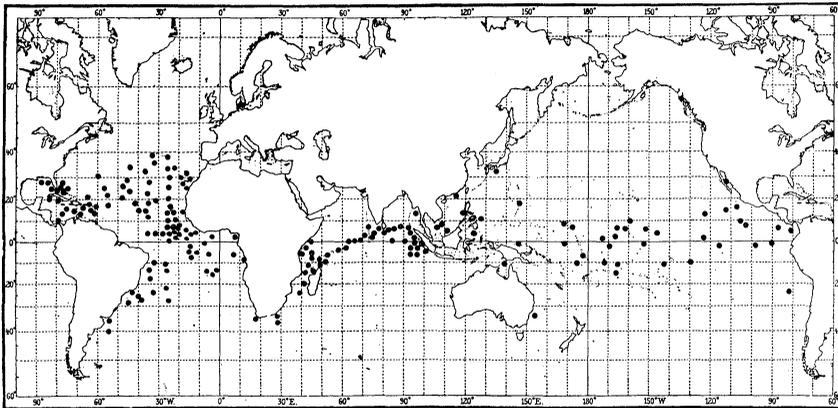
Ekman explains the difference between these faunas as due to late Tertiary climatic changes. Apparently the tropical character of the former central Atlantic fauna changed considerably in the later Tertiary, due mostly to the colder climate. This is evidenced by the immigration of northern forms that took place simultaneously with the disappearance of tropical forms. Ihering (1927) has shown that genera and species of the tropical Atlantic had disappeared with but few exceptions and elements of the colder water fauna of the temperate zone replaced it. Further he has shown that the tropical forms did not return to Florida and Georgia until the Pliocene, some not until the Pleistocene. Even in the Greater Antilles, signs of a climatic change have been found. In the Caribbean the temperature seems to have sunk from 26°-27° C. to 19°-20° C. (Ihering, *l. c.*)

As opposed to the climatic changes in the Atlantic tropic zone, Dickerson (1921), (1925) and Martin (1917) have shown that no climatic change took place either in the Tertiary or Quaternary Periods of the Indo-Pacific. Therefore, the tropical fauna of the Cretaceous and Eocene maintained itself in all of its tropical abundance and developed until our own time.

The above explanation is controversial. Von Ihering overlooked the fact that extremely little is known of the central tropics late Tertiary faunas. Most of the Atlantic material is from the northern Caribbean while that of the Pacific is from Java.

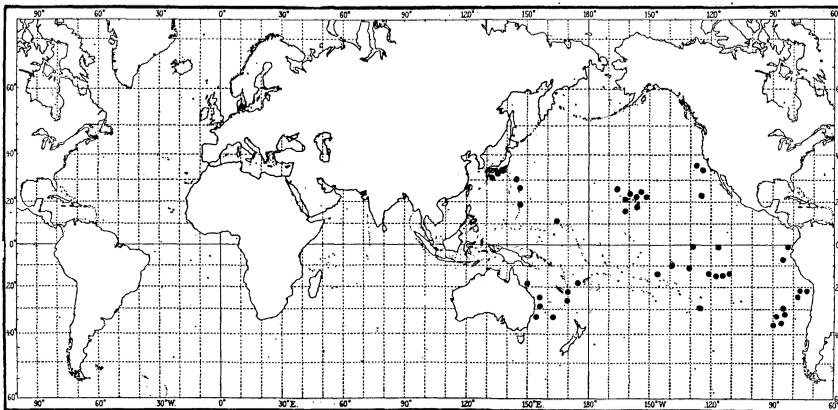
If, according to Ihering (*l. c.*), the tropical fauna of the Atlantic disappeared during the late Tertiary and did not return until Pliocene or Pleistocene time, then the re-entry must have been by way of the Cape of Good Hope, inasmuch as the seaway across Central America was closed for the last time in the middle Miocene. Carrying this assumption further: If *Halobates sericeus* (map 2) and *H. sobrinus* (map 5), both common on the Pacific side of Central America, migrated through the seaway into the Atlantic and were driven out by the cool climate of the late Tertiary, then they were unable to return to the Atlantic because of the land barrier. The only species in a position to migrate around the Cape of Good Hope is *H. micans*. Present distribution of this species (map 1) shows that it occurs completely around the coast of Africa, and throughout the Atlantic Ocean.

It is unfortunate, in the light of possibilities presented by the distribution of the genus for adding to our knowledge of zoogeography, that I am able to record such few facts about the actual specific limits of distribution of any of the species concerned. It is obvious, after examining the maps, particularly numbers 1, 2 and 5, that the patterns of distribution are nothing more than the routes of the collecting vessels. On map 1, the route of the "Dana" (1928-30) can be traced across the Indian Ocean. On maps 2 and



MAP 1

Map 1. Distribution of *Halobates micans* Eschscholtz.

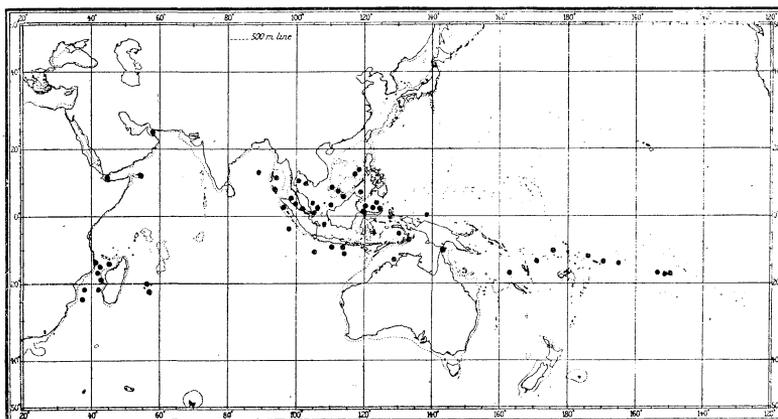


MAP 2

Map 2. Distribution of *H. sericeus* Eschscholtz.

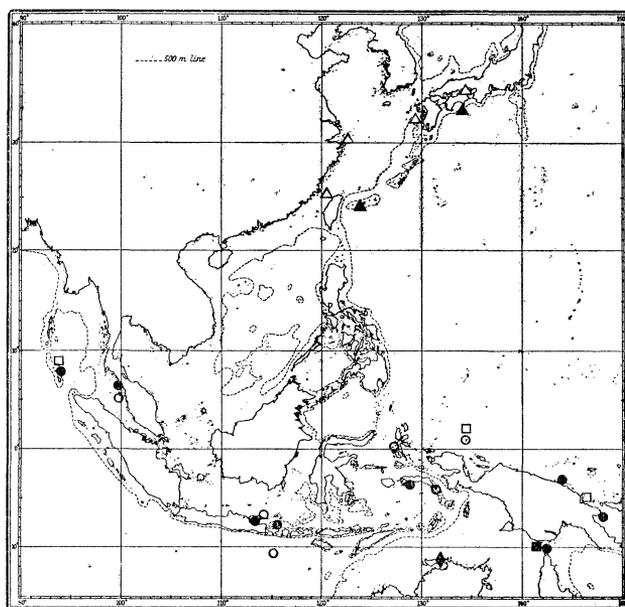
5, the Carnegie and Peking voyages are shown by the distribution of *H. splendens* and *sericeus* off the coast of South America.

Certain patterns, however, do appear to be clear. The open-ocean group of species, as characterized elsewhere, comprises six species. Most of these are seldom seen close to shore. They inhabit the open sea, sometimes hundreds of miles from the nearest land, and are taken along shore only after storms. One species, *micans* is circumtropical. In the Atlantic Ocean, where there is no competition from other species, it occurs over a wide range, primarily between the latitudes of 30° N. to 30° S. In the Pacific, its range is much more restricted. It occurs in greatest abundance along the equator between the latitudes of 10° N. to 10° S., being replaced by *sericeus* from 10° N. to 35° N. and below the equator from 10° S. to 35° S. (see maps 1 and 2). In the Indian Ocean the picture is less clear due to lack of collecting. *H. sericeus* has not been taken in the Indian Ocean and *micans*



MAP 3

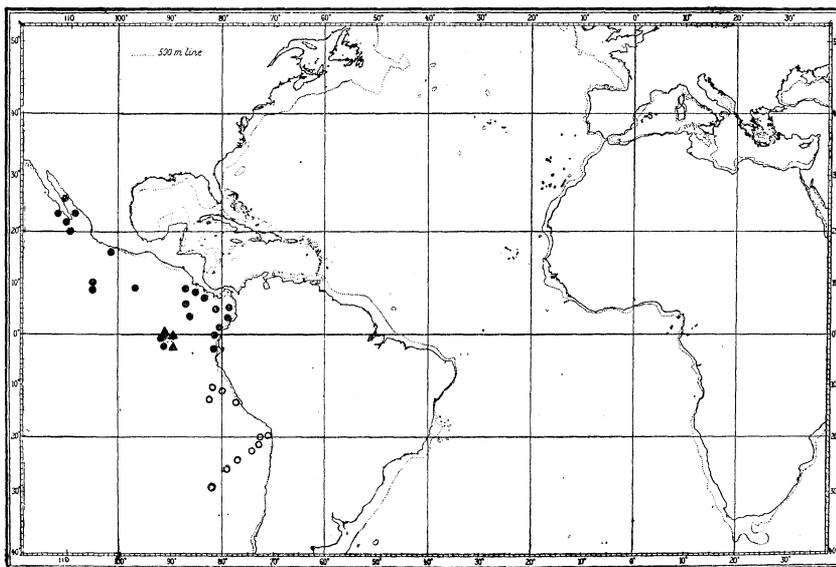
Map 3. Distribution of *H. germanus* white.



MAP 4

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|---|-------------------------------|
| Map 4. ● <i>Halobates hayanus</i> White | □ <i>H. nereis</i> n. sp. |
| ○ <i>H. princeps</i> White | ■ <i>H. regalis</i> Carpenter |
| ▲ <i>H. japonicus</i> Esaki | ◆ <i>H. darwini</i> n. sp. |
| △ <i>H. matsumurai</i> Esaki | |

is known only from a series of collections taken by the "Dana" expeditions. However, *micans* probably is widespread throughout this ocean. Along the west coast of the Americas, two other open-ocean species occur. *H. sobrinus* occurs from the equator to 25° N. latitude.



MAP 5

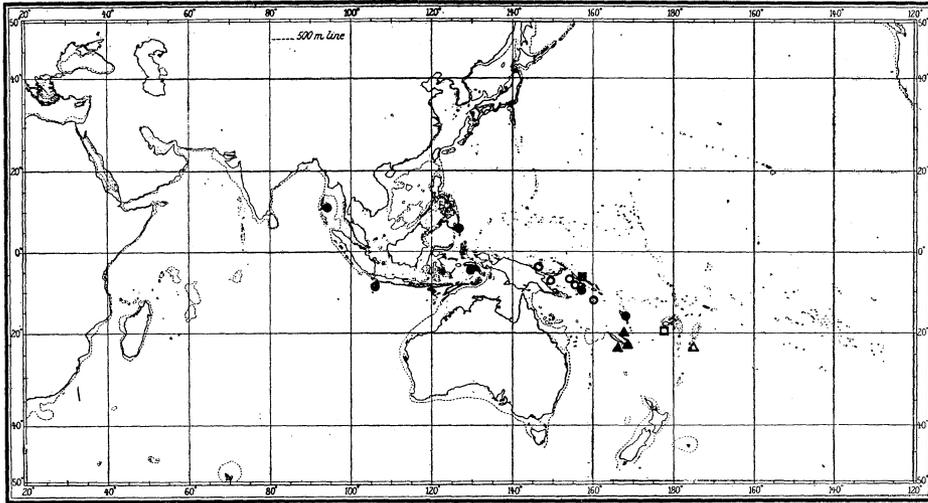
Map 5. ● *Halobates sobrinus* White

○ *H. splendens* Witlaczil

▲ *H. robustus* Barber

H. splendens, a close relative of *micans*, replaces that species in a broad band along the coast of South America (map 5). *H. eschscholtzi*, another sibling species of *micans* is known at present only from Zanzibar on the east coast of Africa.

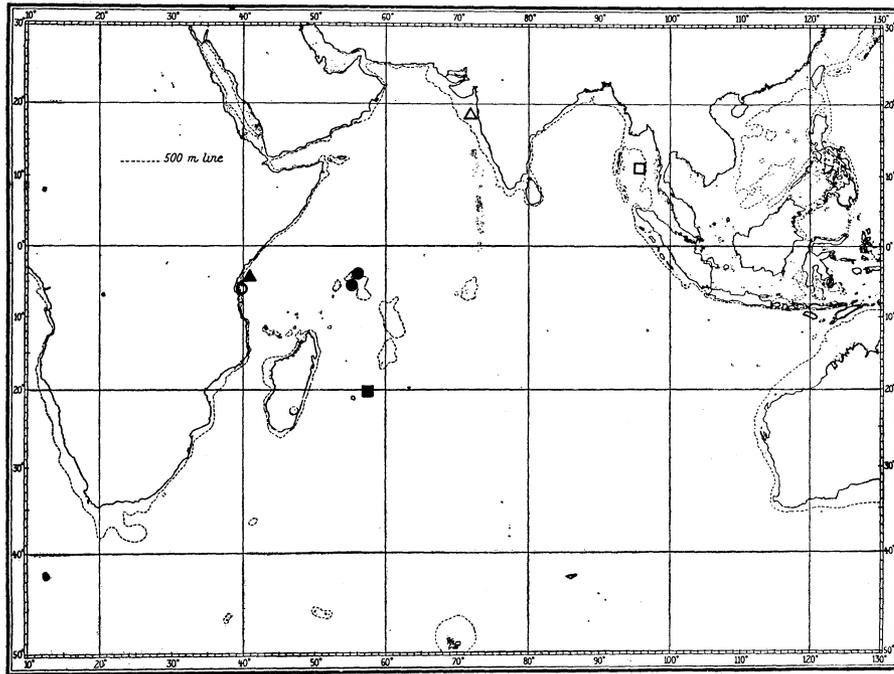
H. germanus displays a distributional pattern that is in part reflected by many other species. It occurs in the Indian Ocean, throughout the Indo-Malayan region, and as far east as the Society Islands. This extremely wide geographical range is certainly influenced by ocean currents. From the available data (Schott 1935, Sverdrup, Johnson and Fleming, 1942), it will be seen that the occurrence of *germanus* in the Red Sea and near the Gulf of Oman in the Indian Ocean and throughout the Indo-Malayan region to the Society Islands is on the direct course of the prevailing marine currents. The North Equatorial Current is of prime importance. Before the current reaches the western boundary of the Pacific Ocean, it begins to branch, mainly to the north but partly to the south. On the eastern side of the Philippines a definite division takes place, one branch turns south along the coast of Mindanao to western New Guinea and then feeds the Counter Current. The north branch follows closely the east side of the northern Philippine Islands and then is partly deflected south of Formosa into the South China Sea, to Sumatra, Java and into the Arafura Sea. The character of the Equatorial Counter Current, according to Schott (*l. c.*), is complicated, both at its origin between the Philippines and New Guinea, and its termination against the American coast. Large seasonal changes take place to the north of New Guinea. From June to August, the South Equatorial Current follows the north coast of this island, converging sharply with the North Equatorial Current in approximately latitude 5° N., where the counter current begins. From December to February, part of



MAP 8

Map 8. ● *Halobates proavus* White
 ○ *H. maculatus* Schadow
 ■ *H. browni* n. sp.

□ *H. fijiensis* Herring
 ▲ *H. katherinae* Herring
 △ *H. salotae* n. sp.



MAP 9

Map 9. ● *Halobates alluaudi* Bergroth
 ○ *H. eschscholtzi* n. sp.
 ▲ *H. poseidon* n. sp.

△ *H. galatea* n. sp.
 ■ *H. tethys* n. sp.
 □ *H. formidabilis* Distant

In the Indian Ocean, a similar situation exists. From December to February the North Equatorial Current flows west from Sumatra to the coast of Africa and is then deflected southward where it joins the South Equatorial Current which flows around the Cape of Good Hope. From June to August, the North Equatorial Current is in the reverse direction.

The distribution of several other species reflects the importance of these currents: *H. calyptus* and *peronis* (map 6), *proavus* and its sibling *maculatus* (map 8) and particularly the distribution of *flaviventris* (map 7) which almost duplicates that of *germanus* except for its eastern limits.

H. hawaiiensis, a close relative of *flaviventris*, replaces that species to the east. There appear to be four populations of this species in Polynesia. The population-range, shown in the map 6, is the variation in the size of males. In each sample the vertical line indicates the total variation of the sample; the broad portion of the line, one standard deviation on each side of the mean; the hollow rectangle, twice the standard error on each side of the mean; and the crossbar, the mean. I can find no characters to separate these populations except size. Since the islands of Oahu and Hawaii are relatively close to each other, yet their populations are distinct in size, it appears that these islands, as well as Hao Island, were populated independently from a center in the Marquesas or Society groups.

Very little can be said concerning the distribution of the remaining species. All are island or island group endemics, as far as is known. For the distribution of these species see Maps 4-9.

LIFE HISTORY AND DEVELOPMENTAL STAGES

Very little is known of the life history of *Halobates*, although several workers have studied the eggs and egg-laying habits. Foremost among these workers was Japetus Steenstrup who had a whole staff of collectors, especially sea-captains, whom he had managed to interest in collecting floating debris which contained eggs. Even though Steenstrup never published this material, he kept it well preserved and had a colored plate drawn up to illustrate examples. He had planned to monograph the genus with Meinert but the plan was never realized. After Steenstrup's death, Lundbeck (1914) published a paper on this material in the Steenstrup Memorial Volumes. The first description of an egg is that of Fairmaire (1848), but to what species it belonged is unknown. Buchanan White (1883) described the egg of *H. micans*. Finally Delsman (1926) described eggs in great detail and also observed hatching.

Many of the earlier workers, Moseley (1879), Walker (1893), Sharp (1899) and Heidemann (1901), believed that females carried the eggs attached to the end of the abdomen. I have seen one or two specimens with eggs supposedly attached to the end of the abdomen but upon closer examination it could be seen that these eggs were in the process of being laid when the specimens were killed, inasmuch as they are partially enclosed in the genital track. Lundbeck (1914) suggested that the females carry the eggs around for a short time only, i. e., until a suitable place for deposition is found.

Halobates eggs have been noted deposited on all kinds of floating material. Lund-

beck (*l. c.*) examined eggs that were glued to sea-weed, *Spirula* shells, corks, *Sepia* shells, floating timber, and bird feathers and presents a photograph of a living Noddy (*Anous stolidus*) with a multitude of eggs on the tail feathers. I have examined some of this same material and have also seen eggs collected by the Dana expeditions that were attached to bits of coal, leaves, twigs and the bladder-like floats of seaweed. In addition, the Scripps Institution "Shellback Expedition" collected dozens of pieces of pumice with the eggs of *H. sobrinus* near San Benedicto I. in 1952, shortly after the violent volcanic activity that took place there.

It has been pointed out (Herring, 1958) that there are two ecologically distinct groups of *Halobates*. One, the so-called "open-ocean" group, occurs at considerable distances from land and individuals are taken near shore only after severe storms. The other group, coastal in habit, includes species that are highly endemic to islands or island groups. It appears that most of this latter group lay their eggs in coral rocks near shore. In my study of a life history of *H. hawaiiensis*, I was not able to induce females to lay their eggs on any type of floating material, yet hundreds of eggs were laid in the cracks of a concrete tank in which they were living. Whether this is a characteristic of all coastal species is not known. It appears doubtful since I have seen eggs that were deposited on floating debris that appear to be quite distinct from any of the open-ocean species. Furthermore, they were collected in a coastal area where no open-ocean species are known.

Lundbeck (*l. c.*) first pointed out that the eggs of *Halobates* could be divided into several groups on the basis of the structure of the chorion. He figured and described the various types of structure, some of which had branched processes, crenulations or finger-like spines. Only recently have I been able to verify this difference in structure. Many of the species (*H. micans*, *sericeus*, *sobrinus*, *hawaiiensis*, *kelleni*) have smooth eggs. In a few species that I have examined, *hayanus*, *calyptus* and *germanus*, the chorion is covered with a fine polygonal pattern. This pattern is plainly visible on eggs dissected from gravid females. I have seen the eggs of an unknown species from south of the Caroline Is. that are highly sculptured. The sculpturing is strongest on the upward curved ventral surface and tends to disappear on the flattened surface. It consists of branched thorn-like processes which are quite pronounced on the anterior end, becoming less pronounced posteriorly and disappearing dorsally.

My attempt to rear *H. hawaiiensis* in small aquaria failed completely. Adults and nymphs of various stages were collected and introduced into a small 25×45 cm aquarium but none survived more than a week. Pieces of cork were placed on the surface in the hope of obtaining eggs; and bits of tuna were added in the belief that they might feed on this material. A few individuals passed through a single instar but at the end of 7 days all were dead. Two factors appear to be significant in this respect, confinement to a small area and positive phototropism of these insects. Most of the individuals seemed to have difficulty remaining on the surface. A small hose delivering water to the aquarium caused a fine misty spray to be present at one end. This spray collected on the bugs and they finally lost contact with the surface film. They struggled about beneath the water until they made contact again and regained the surface after which the process was repeated and finally they became exhausted and drowned. The time not spent in regaining the surface and brushing the moisture from their appendages was spent in dashing themselves against the glass of the aquarium toward the light source. These two factors undoubted-

ly account for the failure to rear these striders.

My next rearing attempts were more successful. I collected several hundred specimens at Waikiki Beach and introduced them into a large concrete tank on the shore of Coconut Island. The tank measured 2.1 m in diameter and had an approximate depth of 1 m. The tank was equipped with a pump and two inlet valves which supplied continuous running sea water direct from the nearby bay. At first the pump was used only once every week or so to change the water but this did not prove to be sufficient. Even though the colony appeared to thrive, feeding on ants and pupae, they laid no eggs and were all dead in approximately 20 days. Without a continuous flow of water, the surface film became contaminated with debris such as food refuse and dust. This so changed the surface film that the bugs' legs became entangled and they were not able to skate about over the surface. After this the pump was operated continuously and this difficulty did not arise. Several hundred first instar nymphs were collected from a small rocky area at low tide. These were placed in the tank and reared to the adult stage. It was not possible to confine and rear a single individual so that all of my estimates of time are based upon the entire colony and are approximate. The nymphs fed upon ant pupae, small flies and other small insects from leaf mold. In later instars they fed upon practically any insects that I would throw into the water, with the exception of earwigs or earwig eggs. Never during any stage of development did they make an attempt to capture any material beneath the surface film. As the water was pumped directly from the bay there was much plankton but I never observed them feeding on this. In addition, I added hundreds of mosquito larvae and pupae, but I never saw one captured by a *Halobates*. They did feed on mosquito adults, however.

In the course of rearing *H. hawaiiensis*, a large colony of *sericeus*, an open-ocean species, appeared in Kaneohe Bay after a Kona storm. I found the individuals feeding on small coelenterates. I was able to keep some of these alive for several weeks in an aquarium by feeding them sea-anemones. I placed chopped pieces of the coelenterate on bits of cork on the surface of the water. I never observed any individual feeding on the small flies, ant pupae or other insects that I placed there. It has been observed by several workers that the open-ocean species of *Halobates* feed on many coelenterates. I was unable to induce *hawaiiensis* to feed on such material. It appears that the open-ocean and coastal groups have different feeding as well as egg-laying habits.

By keeping the screened outlet cleared of debris, I could keep track of the sudden appearance of cast skins and thus make rough estimates of the length of each instar. The later instars lasted 10 to 12 days, the earlier ones being somewhat shorter, 8 to 10 days. The total time elapsed from the date of bringing the first instars into the tank until they all reached adulthood was 44 days. That the nymphs were of almost identical age is evidenced by the fact that all transformed from the fifth instar to the adult within a period of 3 or 4 days.

Copulation occurred frequently but the females never laid eggs on any wood, cork, feathers, etc. that was provided. The sudden appearance of dozens of newly hatched nymphs indicated that large numbers of eggs had been laid but it took several days of very careful searching to discover any eggs, since they matched so closely the yellowish-green coloration of the algae-covered walls of the tank. They were found in small clusters glued in the crevices of the wall. Some were at the water level and others were found a half-

inch or more above the surface. Some eggs with developing embryos were taken from an area near the inlet valve where they had been continuously under a thin stream of water. All of the eggs discovered had reached a stage of development in which the ruby eye spots were plainly visible. What appeared to be the youngest of the lot was kept in a watch glass and development noted. At first the egg appeared bright yellow with the abdomen and thorax visible as a yellow-green mass. The eyes were very prominent as two ruby-red spots. The length of the egg was 1.3 mm and the width .5 mm. The chorion was smooth and shining with only an extremely faint shagreen under high magnification. In a few days the structure of the body was perfectly clear (fig. 116). The antennae were bent downward and rested between the forelegs; the middle and hind legs, however, were crossed posteriorly and rested on the back between the hind acetabula. In a few days the entire embryo became covered with a greyish bloom. The characteristic black setae on the middle and hind acetabula were visible at this time. In the next few days the embryo changed to a much darker color and hatched about a week later. Eclosion is accomplished by a splitting of the chorion longitudinally from the anterior end 1/2 the length of the egg. The emerging nymph is encased in the embryonic membrane which bears the "egg-burster" on the anterior end. The nymph is almost completely free of the shell before the embryonic membrane splits and allows it to escape (fig. 117). Twelve days were required for the egg to hatch. It may be seen that somewhat more than 56 days are required for total development from egg to adult.

PHYLOGENY

In the absence of paleontological and cytological evidence, phylogeny must be based on the morphology of the living species. No fossil material is known. Berendt (1856) described and figured an insect from Baltic amber that he considered to be a nymph of *Halobates* or some allied genus. However, it is not a *Halobates* and probably does not belong to the subfamily Halobatiinae. Therefore, we have no positive evidence as to which characters are primitive and which are derived.

The genus *Halobates*, which occurs throughout the tropical oceans, probably originated from an *Asclepios*-like ancestor in southeast Asia. *Asclepios* looks very promising as the intermediate link between the fresh-water Halobatiinae and *Halobates*. It resembles most of the fresh-water species in coloration, extremely short first anterior tarsal segment, simple, almost tubular ninth segment of the male and the presence of a prominent meso-metathoracic suture. Ecologically, it is an intermediate, as it inhabits the brackish water of coastal marshes rather than the more saline coral reefs or open-ocean situations. In such structural characteristics as the presence of the styliform process on the eighth segment of the male, the long dense fringe of hairs on the middle tibia, longer middle femur and complete loss of wings, it is closely related to *Halobates*.

The genus *Asclepios* Distant (1915) was described from the Salt Lakes near Calcutta and from the backwaters at Ennar. The type species is *A. annandalei*. The three other species in the genus, two of which were originally described as *Halobates*, are known from Taiwan, Korea and Japan. The following characters may be regarded as criteria for separating it from *Halobates*.

1. The ♂ tergum 9 is more or less cylindrical and slender while in *Halobates* it is

always dilated laterally, assuming various shapes.

2. There is a distinct, almost complete, suture between the mesonotum and metanotum, while in *Halobates*, if present at all, it is represented by no more than a pair of V-shaped pits.

3. The first anterior tarsal segment is always very short, scarcely longer than thick.

4. The silver-gray coloration of the dorsal surface of the body is always more limited in area than in *Halobates*, usually with striking yellow markings.

5. The anterior femur of the ♂ has a pronounced spine-like angulation beyond the middle.

The phylogenetic chart (fig. 115) indicates degree of structural differentiation only, and does not necessarily indicate relative age of the species. The position of the groups is governed by available space but succession from left to right and from group to group indicates affinity of adjacent forms.

The most primitive group of *Halobates* is the *mjobergi* group. Members of this group exhibit, in varying degree, many of the characteristics of *Asclepios*. They are predominantly brown and yellow, have a very short first anterior tarsal segment and are of small size. Four of the species are local endemics in Australia, the fifth is rather wide spread from the Philippines to the British Solomon Islands. The last *H. robustus*, from the Galapagos, appearing closest to this group, may not belong here at all. It may be a member of the *micans* group. The next closely-related group, with its offshoot the open-ocean or *micans* group is the *proavus* group. There is still retained here certain structural characteristics such as small size and short first anterior tarsal segment. This group, containing certain peculiar forms as *sexualis* from Malaya and *bryani* from Fiji, is generally more widespread throughout the SW Pacific. The open-ocean group, widely distributed throughout the tropical oceans, appears to be monophyletic. The rather flattened body with small eyes and concolorous venter are the characteristic features. *H. micans*, which has spread through almost the entire tropics of the world, is probably a modern descendent of the more primitive *sericeus*. It has given rise to at least two species that are relatively limited in distribution, *splendens* along the west coast of South America and *eschsoltzi* along the east coast of Africa.

H. sobrinus may well be a fourth sibling species to these three. The females are quite similar to *micans* but the males are rather distinct structurally. The next two groups are usually considered to be the more typical members of the genus. Characteristic features are longer first anterior tarsal segment, more streamlined body with silver-gray pubescence, often with stout, black, posteriorly directed bristles on the thorax and usually with bright yellow markings ventrally. The most specialized member of the group is *princeps* which exceeds 6 mm in length and has the first anterior tarsal segment 1.5× as long as the second segment. The last and most remarkable group is the *katherinae* group which contains three highly specialized species. The seventh segment of the male is elongate and completely encloses the eighth segment and the right styliiform process is very short and deformed. The females have a ventral longitudinal groove extending forward to the anterior coxae and a pocket formed by an indentation of the first few ventral abdominal segments into which the apex of the abdomen may be fitted.

MATERIAL AND METHODS

The latest checklist of the species of *Halobates* with their synonyms is that of Usinger (1937). He records 25 species. Of these, one belongs to the genus *Asclepios*, and four are junior synonyms. I am resurrecting two names from synonymy. In my systematic index I have accounted for all names and have indicated their present status with identifying symbols.

Unfortunately, I have not had the opportunity to examine any of the holotypes. However, a majority of these, especially those of Buchanan White, are in the British Museum and Dr. China has been most cooperative and has compared material with types, executed drawings of type material as well as loaned paratype material to me. Also Usinger ran types through my manuscript key in London in 1958. I have also examined paratypes of the species described by Usinger and Bergroth and most of the species of Esaki. The type of Schadow's *H. maculatus* was destroyed during World War II and it seems that the types of Eschscholtz's three species, as well as Nasanov's *kudrini*, may have suffered a similar fate. It may be seen, after an examination of the following pages, that many species are known to me from one or a few specimens; in other cases, I have examined hundreds of individuals. All but 2 species have been placed.

Collecting of the coastal species is easily accomplished with a light-weight net with a nylon or other rapid-drying bag. One of the most productive methods is the use of a light at night suspended over the side of a boat or from the end of a pier. *Halobates* are strongly phototropic and may be collected in great numbers. The few open-sea species may be collected from a boat, preferably by using a "night-lite", or they may be picked up after storms when hundreds of individuals are stranded on the beaches. Almost the only time that *H. sericeus* is seen close to the Hawaiian Islands, is after the "Kona" storms of the winter and early spring. Alcohol is the best preserving medium, although formalin may be just as good. Both of these preservatives have the advantage of keeping the insects flexible. Then, when they are brought in from the field, they should be rinsed in several changes of tap water to remove any debris that may be clinging to them and particularly to dissolve the fine layer of salt that they often have over the surface of the body. It is practically impossible to collect material from the surface of the ocean without including some salt water, which when evaporated, leaves a white film. This is very difficult to remove from a dried specimen without damaging it. *Halobates* may be readily identified while in alcohol or formalin; this is particularly useful since many marine laboratories keep series of these insects in liquid preservative, there being, usually, no facilities for the storage of dried and pinned material.

Descriptions were made of all of the species by the same plans so that they are all comparable. The combination of objectives on the ordinary binocular dissecting scopes will suffice to show pubescence and other fine characters but a magnification of 54 × is desirable for studying the details of the black bristles encountered on the meso-metathorax of many species. Wherever possible, the males are described first then the female characters and finally any points of difference.

The average variation between the sexes and the coefficient of variability in a fairly widespread species are shown below. The table was made from measurements of 15 males and 15 females of *H. sobrinus* collected near the Revilla Gigedo Islands. All measure-

ments, except that of size, are given in units to simplify comparison. The abbreviations are as follows: at, anterior tarsal ratio; mf, middle femur; pf, posterior femur; pt, posterior tibia.

All measurements were made with an eye-piece micrometer. For the lengths of the intermediate and posterior femur and tibiae, one unit equals 0.100 mm (10 units = 1 mm); for all other measurements one unit equals 0.052 mm (19 units = 1 mm). Specimens were measured by tipping the insects until the desired part was in a single plane. The manner in which the specimens were measured is self-explanatory except for the following: The antennal segments were measured individually and then added together for total length, the small secondary segment between the second and third segment is included in the measurement of the latter segment; interocular width to width of an eye was measured on an imaginary line straight across the posterior margin of the head as shown in fig. 108; the length of the pronotum on median line to length of head was measured on the plane of the median line of the pronotum since there is only a small amount of flexibility between these parts; the length of the head when compared with breadth of head between eyes, however, is greatest length measurable in a single plane.

The general coloration of the body, usually described as silver gray or black must be considered with caution. Many species vary in color according to the manner in which they have been preserved. It is possible, in many cases, to bring out the silvery gray pubescence by cleaning the specimen in xylene or other solvent. A drop of alcohol is often useful to bring out the extent and pattern of the yellow markings of the head.

The terminology, with few exceptions, is that used by most hemipterists.

Detailed locality and collector records are given for all but a few species. These few are so widespread that it seems unnecessary to list all records. These few species are open-ocean forms, and the localities can be recorded only by degrees, minutes and seconds of latitude and longitude. They have all been plotted on the maps referred to at the end of the descriptions. These maps show only the material examined by me.

To avoid confusion the many collectors names have been listed in as complete form as possible. The names of the institutions or individuals that own the material examined have been abbreviated and included in parentheses at the end of each listing. These are as follows: AM, Australian Museum (Sydney); AMNH, American Museum of Natural History; BISHOP, B. P. Bishop Museum (Honolulu); BM, British Museum (Nat. Hist.); CJD, Carl J. Drake; DANA, Carlsberg Foundations "Dana" Collections; HBH, H. B. Hungerford; HM, Hamburg Museum; JLH, J. L. Herring; KANSAS, Snow Entomological Museum (University of Kansas); KØBENHAVN, Universitets Zoologiske Museum København; MCZ, Museum of Comparative Zoology; POFI, Pacific Ocean Fisheries Investigations (Honolulu); QM, Queensland Museum (Brisbane); UQ, University of Queensland (Brisbane); RLU, R. L. Usinger; SAM, South Australian Museum (Adelaide); USNM, U. S. National Museum.

The synonymical bibliographies under the systematic headings cite the original reference to each name including synonyms and any additional papers that give useful descriptions, figures, morphological or biological information. No attempt has been made to cite every reference inasmuch as it is almost impossible to determine actually what species were involved. The most obvious omissions are those papers that simply give new geographical records without accompanying diagnosis of the species. The references cited are repeated

♂ ♂	Table							size
	Antennae	at	mf	mt	pf	pt		
1.	25 : 9 : 7 : 11	21 : 29	55	32	48	20	4.5	
2.	25 : 9 : 6 : 12	22 : 31	53	32	47	21	4.4	
3.	23 : 9 : 7 : 11	23 : 29	56	32	48	22	4.4	
4.	23 : 9 : 7 : 12	21 : 30	55	32	49	21	4.3	
5.	25 : 9 : 7 : 12	22 : 31	54	30	47	21	4.5	
6.	24 : 10 : 7 : 12	21 : 30	55	32	48	22	4.5	
7.	24 : 9 : 6 : 13	23 : 30	53	32	46	20	4.5	
8.	24 : 10 : 7 : 13	23 : 30	53	30	44	20	4.5	
9.	22 : 9 : 7 : 12	23 : 30	55	31	48	22	4.5	
10.	24 : 10 : 6 : 13	22 : 30	55	32	48	21	4.5	
11.	24 : 10 : 7 : 12	23 : 31	54	32	48	22	4.5	
12.	25 : 9 : 7 : 13	22 : 30	53	30	46	20	4.6	
13.	24 : 10 : 7 : 13	22 : 29	52	30	45	20	4.5	
14.	25 : 10 : 7 : 13	23 : 31	56	33	48	22	4.5	
15.	24 : 9 : 7 : 13	21 : 30	54	32	48	22	4.5	
	24 : 9 : 7 : 12	22 : 30	54	31.5	47	21	4.48	Mean
	23/25 : 9/10 : 6/7 : 11/13	21/23 : 29/31	52/56	30/33	46/49	20/22	4.3/4.5	Range
	.79 : .43 : .21 : .64	.71 : .50	1.5	.98	1.93	.79	.0046	V
	.89 : .66 : .46 : .80	.84 : .71	1.22	.99	1.39	.89	.0680	S. D.
	3.7 : 7.3 : 6.5 : 6.6	3.8 : 2.3	2.3	3.1	2.9	4.2	1.3	C. V.
♀ ♀	Antennae	at	mf	mt	pf	pt	size	
1.	22 : 9 : 8 : 13	26 : 35	50	31	42	22	4.0	
2.	20 : 8 : 7 : 13	25 : 36	52	31	42	22	3.9	
3.	20 : 8 : 7 : 13	26 : 35	52	31	42	22	4.0	
4.	20 : 9 : 7 : 13	25 : 34	52	32	42	22	4.0	
5.	20 : 9 : 7 : 12	25 : 36	50	30	40	22	4.1	
6.	20 : 9 : 7 : 13	25 : 35	52	31	42	21	4.3	
7.	20 : 9 : 8 : 13	25 : 35	52	30	42	20	4.0	
8.	20 : 9 : 7 : 13	23 : 33	50	30	42	20	4.0	
9.	20 : 9 : 7 : 12	24 : 34	50	32	41	20	4.0	
10.	20 : 9 : 7 : 13	25 : 35	50	30	40	20	4.0	
11.	20 : 9 : 7 : 12	25 : 36	50	30	42	21	4.0	
12.	21 : 9 : 7 : 13	25 : 34	52	32	42	21	4.0	
13.	20 : 9 : 7 : 13	25 : 36	50	32	42	21	4.1	
14.	20 : 8 : 7 : 13	23 : 34	50	31	43	20	4.0	
15.	20 : 8 : 7 : 13	25 : 35	52	31	42	21	4.0	
	20 : 9 : 7 : 13	25 : 35	51	31	42	21	4.03	Mean
	20/22 : 8/9 : 7/8 : 12/13	23/26 : 34/36	50/52	30/32	40/43	20/22	3.9/4.3	Range
	.36 : .29 : .14 : .21	.79 : .86	1.1	.64	.71	.71	.0078	V
	.60 : .54 : .37 : .46	.89 : .92	1.05	.80	.84	.84	.0880	S. D.
	3.0 : 6.0 : 5.2 : 3.5	3.5 : 2.6	2.0	2.6	2.0	4.0	2.1	C. V.

in the formal bibliography at the end, which is annotated. The references to this genus that are found in textbooks, encyclopedias and the like are omitted.

The line drawings (except for a few that were kindly drawn for me by Dr. W. E. China) were all drawn to exactly the same scale. They were made directly onto one-ply Strathmore board, using an ocular grid in the microscope and an enlarged grid beneath the one-ply board.

A list of species and synonyms precedes the systematic section. They are arranged and numbered in series as nearly as possible from the most primitive to the most complex or derived. For further discussion of phylogenetic relationships see page 235.

Systematic Arrangement

Genus *Halobates*

	Page		Page
1. mjobergi Hale	274	18. sexualis Distant.....	299
2. zephyrus n. sp.	276	19. bryani n. sp.	286
3. whiteleggei Skuse.....	277	20. poseidon n. sp.	287
4. darwini n. sp.	278	21. panope n. sp.	295
5. peronis n. sp.	278	22. galatea n. sp.	294
6. regalis Carpenter	283	23. tethys n. sp.	273
7. robustus Barber	282	24. nereis n. sp.	272
8. splendens Witlaczil= <i>streatfield-</i> <i>anus</i> var. <i>magentae</i> Griffini.....	248	25. japonicus Esaki.....	293
9. eschscholtzi n. sp.	254	26. formidabilis Distant.....	272
10. micans Eschscholtz= <i>streatfield-</i> <i>anus</i> Templeton= <i>wullerstorffi</i> Frauenfeld= <i>inermis</i> Dahl.....	246	27. matsumurai Esaki.....	271
11. sobrinus White	251	28. browni n. sp.	270
12. germanus White= <i>sewelli</i> Imms =? var. <i>bankae</i> Griffini	253	29. kudrini Nasanov	297
13. sericeus Eschscholtz.....	252	30. flaviventris Eschscholtz= <i>herd-</i> <i>mani</i> Carpenter	290
14. proavus White	279	31. hawaiiensis Usinger	288
15. maculatus Schadow= <i>rotundatus</i> Esaki	281	32. kelleni n. sp.	266
16. calyptus n. sp.	285	33. alluaudi Bergroth	264
17. hayanus White= <i>frauenfeldanus</i> White= <i>incanus</i> Witaczil	284	34. mariannarum Esaki	262
		35. princeps White	267
		36. fijiensis Herring.....	259
		37. katherinae Herring	255
		38. salotae n. sp.	260

Genus *Halobates* Eschscholtz

Halobates Esch., 1822, Entomographien, p. 106; 1823, Nat. Abh. Dorpat 1, p. 162.—Laporte, 1832, Essai Classif. Syst. Hémip. p. 24 (names *micans* type).—Burmeister, 1835, Handb. d. Ent. 2: 208.—Spinola, 1840, Essai sur les Hémip. p. 63.—Blanchard, 1840, Hist. Nat. des Ins. Hémip. p. 98.—Amyot & Serville, 1843, Hémip. p. 411.—Herrich-

Schäffer, 1848, Wanz. Ins. 8: 108.—Fairmaire, 1848, Soc. Ent. France, Ann. p. 26.—Spinola, 1850, Tavola Sinot. p. 42.—Frauenfeld, 1867, Zool.-Bot. Gesell. Wien, Verh. 17: 456.—Mayr, 1868, Reise Freg. Novara, Zool. 2: 169.—Giglioli, 1870, Soc. Ent. Ital., Bull. 2: 260.—White, 1883, Rept. Voy. Challenger, Zool. 7 (19): 23.—Uhler, 1884, Stand. Nat. Hist. 2: 269.—Bianchi, 1896, M. Z. St. Pet., Ann. p. 70.—Lethierry & Severin, 1896, Cat. Gén. Hémip. 3: 65.—Bergroth, 1902, Ent. Mon. Mag. 13: 258.—Distant, 1903b, Fauna India, Rhyn. 2: 186.—Kirkaldy, 1906, Amer. Ent. Soc., Trans. 32: 156.—Oshanin, 1906, Verz. Palae. Hemip. 1: 500.—Lundbeck, 1914, Mind. J. Steenstrup. Kobenhavn 2 (art. 27): 1.—Van Duzee, 1917, Univ. Calif. Pub. 2: 431.—Schadow, 1922, Hamburg Univ. Diss., Auszug p. 1.—Blatchley, 1926, Heterop. E. N. Amer. p. 986.—Delsman, 1926, Treubia 8: 384.—Esaki, 1929, Ann. Mag. Nat. Hist. ser. 10, 4: 416 (= *Euratas* Distant).—Esaki, 1930a, Ent. Mon. Mag. 65: 161.—Imms, 1936, J. Murray Exped., Sci. Repts. 4 (2): 77.—Usinger, 1938, Hawaii. Ent. Soc., Proc. 10 (1): 82.—China, 1957, Linn. Soc. Jour. Zool. 43 (291): 342.

Euratas Distant, 1910a, Ann. Mag. Nat. Hist. ser. 5, 8: 146 (type *formidabilis*) 1910b, Fauna India, Rhyn. 5: 154.—Annandale & Kemp 1915, Ind. Mus., Mem. 5: 183 (= *Fabatus* Distant).

Fabatus Distant, 1910a, Ann. Mag. Nat. Hist. ser. 5, 8: 147 (type *servus*); 1910b, Fauna India, Rhyn. 5: 155.

Body oval or oblong. Head triangular; eyes globular, situated at base of head and resting partly on pronotum; rostrum short and stout. Antenna with segment 1 longest and segment 4 longer than 3. Prothorax transverse, much broader than long. Meso- and metathorax together large, without apparent suture, sometimes with a pair of pits delimiting boundary. Wings always absent. Front leg rather stout; tarsus 2-segmented. Mid leg very long and slender, tibia and usually segment 1 of tarsus provided with fringe of long hairs. Hind leg shorter than mid leg; hind femur subequal to, or shorter than, mid femur; tarsus usually 1-segmented, sometimes 2-segmented. Abdomen of ♂ with pair of conspicuous styliform processes on hind margin of segment 8; tergum 9 dilated laterally, broader than segment 8.

Type species: *H. micans* Eschscholtz, Laporte 1832.

KEY TO THE SPECIES OF HALOBATES²

1. Head between eyes distinctly broader than long, interocular width about 4 × width of an eye, yellow markings on head not extensive (fig. 108). Seldom with yellow or brown markings on venter, body usually unicolorous 2
- Head between eyes not distinctly broader than long, interocular width never 4 × width of an eye. Yellow markings on head more extensive, either a crescent-shaped mark extending forward toward the eyes or yellow coloration covering

2. After completing the manuscript, the British Museum sent me 2 ♂♂ and 2 ♀♀ of *H. formidabilis* from the Maldive Is. I had not seen this species before and had tentatively placed it in the key. The ♂♂ present no difficulty because of the peculiar structure of the anterior tibiae and the ♀♀ run to the proper couplet if the body lengths listed in couplets 21 and 24 are not considered critical.

- almost entire head, leaving only an arrow-shaped dark area in center. (figs. 109-110). Conspicuous yellow or brown marking on some part of venter..... 7
- 2 (1). Smaller species, ♂♂ under 4.0 mm, ♀♀ 3.8 mm or smaller 3
 Larger species, ♂♂ 4.4 mm or larger, ♀♀ 4.0 mm or larger..... 4
- 3 (2). Antennal segment II, 1/2 length of segment IV. Anterior tarsal segment I, approximately 1/3 length of segment II. ♂ styliform processes and tergum 9 as in figs. 4-6 **sericeus**
 Antennal segment II much greater than 1/2 length of segment IV. Anterior tarsal segment I 2/3 length of segment II. ♂ terminalia as in figs. 7-9... **germanus**
- 4 (3). Antennal segment IV distinctly longer than II, usually twice or more the length of segment III..... 5
 Antennal segment IV only slightly longer than II and III. ♂ unknown.. **eschscholtzi**
- 5 (4). Posterior femur short, only reaching 3/4 length of mid femur, not twice as long as posterior tibia 6
 Posterior femur long, reaching 8/9 length of mid femur and at least twice as long as posterior tibia. ♂ tergum 9 with a pair of prominent spines (fig. 10) **sobrinus**
- 6 (5). Anterior tarsal segment I shorter than tarsal segment II. Left styliform process of ♂ bent abruptly upwards at a right angle (figs. 1-2) **micans**
 Anterior tarsal segment I subequal to (or slightly longer than) segment II. Left styliform process of ♂ bowed outward, not right angled (fig. 13)..... **splendens**
- 7 (1). Anterior tarsal segment I subequal to or greater than II 8
 Anterior tarsal segment I shorter than II..... 28
- 8 (7). Male with abdominal segment 8 enclosed within the enlarged, tubular segment 7. Right styliform process very short and deformed as in figs. 99, 102, 105. ♀ with a triangular pocket on the venter into which apex of abdomen may be fitted. Venter often with a longitudinal fold, sometimes extending forward to anterior limb bases (fig. 107) 9
 Male with abdominal segment 8 clearly visible, never enclosed within a tubular segment 7. Right styliform process may be short, but not deformed as above. ♀ without triangular pocket and longitudinal fold 11
- 9 (8). Male with tergum not parallel-sided, more or less shield shaped (figs. 97, 100). Anterior tarsal segment I much longer than II. ♀ connexiva not as above, black bristles may be present on meso-metanotum 10
 Male with tergum 9 almost parallel-sided (fig. 103). Anterior tarsal segment I only slightly longer than II (13:11). ♀ with the connexivum formed as 2 large triangles (fig. 106). No black bristles on the anterior margin of meso-metanotum **salotae**
- 10 (9). Right styliform process of ♂ decurved at apex, reflexed at base and visible from above (fig. 100). ♀ very broad posteriorly, width of body through hind coxae wider than head through eyes. Stout black bristles present on anterior margin of meso-metanotum..... **katherinae**
 Right styliform process of ♂ flattened, its apex lanceolate, not visible from above (fig. 97). ♀ only as broad through hind coxae as width of head through eyes. No stout black bristles on meso-metanotum **fijiensis**
- 11 (8). Males 12

- Females 20
- 12 (11). Male with tergum 9 parallel-sided 13
 Male with tergum 9 not parallel-sided 16
- 13 (12). Right styliform process quite short and directed outward (fig. 91)..... **mariannarum**
 Right styliform process not as above, similar to left 14
- 14 (13). Tergum 9 with a pointed prominence on each anterolateral angle of the disc
 (fig. 70). A large species, over 6 mm **princeps**
 Tergum 9 without pointed prominences. Smaller species, not over 5.5 mm 15
- 15 (14). Tergum 9 about as broad as long, anterolateral angles rounded (fig. 73)...**alluaudi**
 Tergum 9 much longer than broad, anterolateral angles angulate (fig. 94)... **kelleni**
- 16 (12). Large species, 6.0 mm or over 17
 Smaller species, much less than 6.0 mm 18
- 17 (16). Cylindrical, parallel-sided species, hardly, if at all, wider at bases of middle
 and hind legs than at anterior margin of mesonotum. ♂ terminalia (figs.
 76-8) **browni**
 Oval species, much wider at bases of legs than at anterior margin. ♂ termi-
 nalia (figs. 67-9)..... **matsumurai**
- 18 (16). A long prominent spine in middle of anterior femur. Anterior tarsal segments
 subequal. ♂ terminalia (figs. 113-4) **formidabilis**
 No spine on anterior femur. Anterior tarsal segments not subequal 19
- 19 (18). Scattered black bristles on sides of thorax. ♂ terminalia (figs. 82-4).....**nereis**
 No black bristles on sides of thorax. ♂ terminalia (figs. 79-81)..... **tethys**
- 20 (11). Thorax in side view strongly arched and abruptly slanted downward to abdom-
 inal segments. Connexiva directed inwards, their edges posteriorly diver-
 gent **kelleni**
 Thorax and connexiva of the usual form, not as above..... 21
- 21 (20). Hind coxae subequal or longer than acetabula. Larger species over 4.5 mm ... 22
 Hind coxae much shorter than acetabula. A small species, not over 4.0 mm
 **mariannarum**
- 22 (21). Black bristles of meso-metanotum, if present, not extending laterally to bases
 of acetabula 23
 Black bristles on meso-metanotum quite dense and covering all but mid-dorsal
 area, extending laterally over sides to bases of acetabula **alluaudi**
- 23 (22). Anterior tarsal segment 1 much less than 1.5 × as long as segment 2 24
 Anterior tarsal segment 1 at least 1.5 × as long as segment 2 **princeps**
- 24 (23). Stout black bristles present on some part of meso-metanotum. Smaller species,
 approximately 5 mm 25
 Stout black bristles absent on meso-metanotum. Larger species over 5.0 mm ... 26
- 25 (24). Stout black bristles on the anterior 1/2 of meso-metanotum. Antennal seg-
 ments II and IV not subequal. Anterior tarsal segments in ratio of 18: 14
 **tethys**
 Stout black bristles absent on anterior 1/2 of meso-metanotum, only a small
 patch on sides of posterior 1/2. Antennal segments II and IV subequal. An-
 terior tarsal segments in ratio of 16: 14 **nereis**
- 26 (24). Body oval, greatest width well in front of hind margin of hind acetabula.
 Smaller species, much less than 6.0 mm 27

- Body elongate-cylindrical, greatest width through hind margin of hind acetabula. A large species, approximately 6.0 mm..... **browni**
- 27 (26). Anterior tarsal segment I much longer than segment II **matsumurai**
 Anterior tarsal segments subequal **formidabilis**
- 28 (7). Anterior tarsal segment I, 2/3 or less length of segment II 29
 Anterior tarsal segment I, more than 2/3 the length of II..... 42
- 29 (28). Yellow coloration of head extensive, extending uninterrupted to bases of antennae (fig. 110), leaving a lyre- or arrow-shaped spot in center..... 30
 Yellow coloration of head usually crescent-shaped, never reaching bases of antennae (fig. 109), occasionally with a yellow spot at bases of antennae 34
- 30 (29). A very small, yellow and brown species usually with a stripe on anterior and posterior margin of prothorax as well as major portion of ♂ tergum 9, pleura and much of legs, yellow. Anterior tarsal segment II, 5 × (♂), 4 × (♀) as long as segment I. ♂ terminalia (figs. 25-7)..... **mjobergi**
 Not as small nor as prominently yellow and brown. No yellow stripes on prothorax. ♂ tergum 9 not predominantly yellow. Anterior tarsal segment I not so short 31
- 31 (30). Anterior tarsal segment II not more than 2.5 × as long as segment I. ♂ styliform processes not slender, tapering and pointed at apices, either rounded or flattened and boot-shaped in side view 32
 Anterior tarsal segment II, 3.5 × as long as segment I. ♂ styliform processes slender, tapering and pointed at apices (fig. 30)..... **zephyrus**
- 32 (31). Males not completely yellow beneath. Styliform processes boot-shaped in side view. ♀ not as above [♀ of *darwinii* unknown]..... 33
 Males completely yellow beneath. Styliform processes more or less rounded (fig. 32). ♀ approximately 4.5 mm; hind coxae distinctly longer than hind acetabula. Many stout black bristles on meso-metanotum **whiteleggei**
- 33 (32). Anterior tarsal segment II approximately 2 × as long as segment I. ♂ tergum 9 triangular and longer than broad (fig. 34). [♀ unknown] **darwinii**
 Anterior tarsal segment II, 2.5 × as long as segment I. ♂ tergum 9 not longer than broad. Styliform processes constricted, then greatly enlarged at apices (figs. 22-3). [♀ without black bristles on meso-metanotum. Hind coxae not longer than hind acetabula] Size approximately 4.0 mm **peronis**
- 34 (29). Tergum 9 of ♂ triangular (figs. 37, 40). Anterior tarsal segment II of ♂ almost 3 × as long as I. ♀ with anterior tarsal segment II at least 2.5 × as long as I..... 35
 Tergum 9 of ♂ more or less shield-shaped, never triangular. Anterior tarsal segment II never as long as above..... 36
- 35 (34). Males with stout black bristles along side of meso-metanotum. Male styliform processes fairly slender (fig. 39). ♀ with a prominent mid-dorsal groove and an orange stripe, the groove with many stout black spines along sides **proavus**
 Males without stout black bristles along side of meso-metanotum. Styliform processes stouter and left one strongly curved (fig. 42). ♀ without groove and stripe but with scattered black bristles along anterior margin of meso-metanotum **maculatus**

- 36 (34). Male and ♀ with scattered black bristles on meso-metanotum..... 37
 Male and ♀ without scattered black bristles on meso-metanotum 38
- 37 (36). Male terminalia (figs. 16–18). Size of ♂ approximately 4.0 mm, ♀ 4.5 mm.
 Anterior tarsal segment II twice as long as I. Black bristles usually present
 on pronotum as well as on meso-metanotum..... **robustus**
 Male terminalia (figs. 19–21). Size of ♂ 4.7 mm, ♀ 5.5–6.0 mm. Anterior
 tarsal segment II less than twice as long as I. Black bristles present on
 meso-metanotum only..... **regalis**
- 38 (36). Tergum 9 of ♂ with a patch of stout black bristles on each side, styliform
 processes almost symmetrical, their apices diverging (figs. 45, 48). ♀ 4.2 mm
 or larger..... 39
 Tergum 9 of ♂ without a patch of stout black bristles, styliform processes not
 symmetrical nor diverging apically. ♀ under 4.0 mm in length 40
- 39 (38). A pair of prominent V-shaped sutures delimiting mesonotum from metanotum.
 Posterolateral margin of pronotum of ♂ swollen. ♂ terminalia (figs. 43–5).
 ♀ elongate cylindrical, over twice as long as broad, bases of antennae dark,
 no pale yellow stripe on anterior femur..... **calyptus**
 No sutures delimiting mesonotum from metanotum. Posterolateral margin of
 pronotum of ♂ not swollen. ♂ terminalia (figs. 46–8). ♀ more robust,
 hardly twice as long as broad, base of antenna yellow, a pale yellow stripe
 on anterior femur..... **hayanus**
- 40 (38). Tergum 9 of ♂ without spines, left styliform process not greatly shorter than
 right nor blunt at apex..... 41
 Tergum 9 of ♂ with a pair of prominent spines on anterolateral margins,
 left styliform process short and blunt at apex (fig. 112). ♀ unknown.. **sexualis**
- 41 (40). Left styliform process of ♂ visible from above, both diverging posteriorly
 (figs. 49–51). ♀ without black spines on the hind acetabula. A small brown
 species, 3.3–3.5 mm **bryani**
 Left styliform process of ♂ not visible above, both processes converging, their
 inner faces flattened and shining (figs. 52–54). Female with a group of
 stout black bristles on hind acetabula. Size 3.7–4.0 mm..... **poseidon**
- 42 (28). Left styliform process of ♂ curved outward and visible from above (figs. 85,
 88). ♀ with yellow coloration of venter limited to abdominal segments
 and sometimes middle acetabula..... 43
 Left styliform process of ♂ not curved outward and visible from above. ♀
 with yellow coloration more extensive, usually extending forward to bases
 of front legs. Underside of head, anterior coxae and anterior acetabula ex-
 tensively marked with yellow or brown 44
- 43 (42). Dense, stiff black bristles on posterior acetabula. Undersurface of intermedi-
 ate acetabula without a wide yellow band. ♂ terminalia (figs. 88–90).
 Hind coxae of ♀ elongate and curved, at least 1.5 × as long as anterior
 tarsal segment 1 **hawaiiensis**
 No dense, stiff black bristles on posterior acetabula. Undersurface of inter-
 mediate acetabula with a wide yellow band. ♂ terminalia (figs. 85–7). Hind
 coxae of ♀ much shorter and straight, never 1.5 × as long as anterior tar-
 sal segment 1..... **flaviventris**

- 44 (42). Right styliform process of ♂ curved outward and visible from above (fig. 61). ♀ approximately 5.0 mm, body rather broad posteriorly, over 1/2 as broad as long; entire venter and stripe on anterior femora, yellow **galatea**
 Right styliform process of ♂ not curved outward nor visible from above. ♀ not so broad posteriorly, approximately 1/2 as broad as long; yellow coloration of venter more limited, no stripe on anterior femora 45
- 45 (44). A rather large species, 5.0-5.2 mm in length. ♂ terminalia (figs. 64-6). ♀ without stiff black bristles on meso-metanotum; anterior tarsal segments in ratio 12 : 14 **japonicus**
 A smaller species, under 5.0 mm in length. ♂ terminalia (figs. 58-60). ♀ usually with stiff black bristles on meso-metanotum; anterior tarsal segments in ratio 10 : 11 **panope**

Halobates micans Eschscholtz

Halobates micans Esch., 1822, Entomographien p. 107, pl. 2, fig. 3.—White, 1883, Voy. Challenger, Rept. Zool. 7 (19): 43, pl. 1, fig. 2.—Dahl, 1893, Plankton-Exped., Ergeb. 2, G. a : 6 (= *wullerstorffi* Frau.).—Schadow, 1922, Hamburg Univ. Diss., p. 1 (= *inermis* Dahl).—Barber, 1943, Carnegie Inst. Wash. Publ. 555 : 80, pl. 1, fig. B.

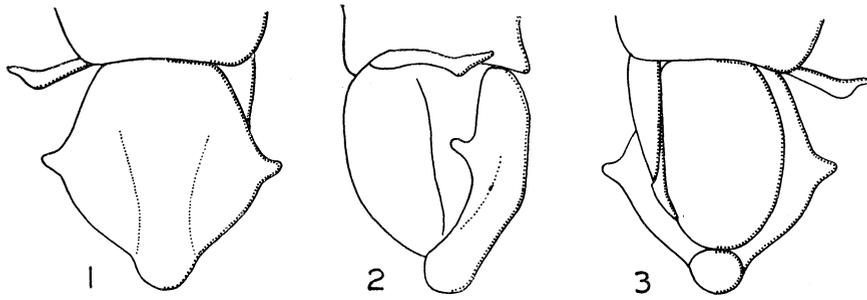
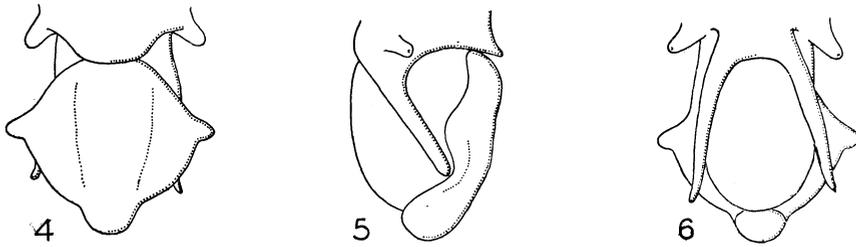
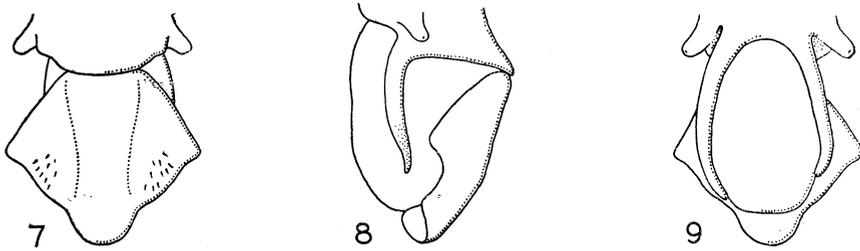
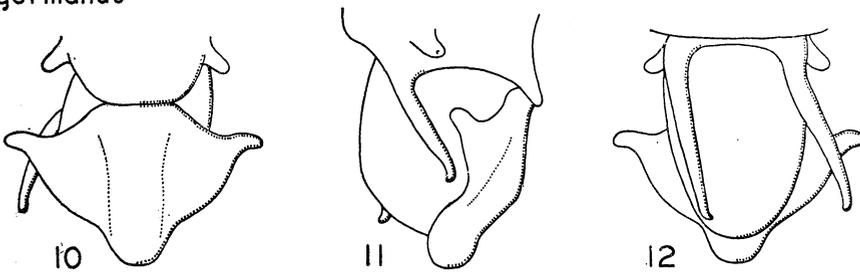
Halobates streatfieldanus Templeton, 1836, Ent. Soc. Lond., Trans. 1 : 230, pl. 22, fig. A.
New Synonymy.

Halobates wullerstorffi Frauenfeld, 1867, K. K. Zool.-Bot. Gesell. Wien, Verh. 17 : 458, pl. 12, fig. 5.

Halobates inermis Dahl, 1893, Plankton-Exped., Ergeb. 2, G. a : 6, figs. 4, 5, 7, 8.

A rather short, oval, dark gray to black species with apical 3 antennal segments in proportion 9 : 7 : 13 in ♂ and 9 : 7 : 14 in ♀. Basal segment of anterior tarsus shorter than 2nd, 9 : 13 in ♂, 10 : 14 in ♀. Middle and hind femora very stout. No black bristles on meso-metanotum of either sex. Left styliform process of ♂ with an abrupt right angle bend; the right process elongate cylindrical (fig. 3). Entire venter of ♂ and ♀ concolorous, no yellow markings. Legs with an iridescent metallic sheen.

Male. Head. Antenna about 2/3 as long as body, 59 : 90; proportion of segments I-IV, 30 : 9 : 7 : 13. Head broader than long between eyes, disc evenly swollen. Eyes quite small, interocular width slightly over 4× width of an eye. **Thorax.** Pronotum with sides subrounded and diverging posteriorly, shorter than head on median line, 8 : 18; anterior margin rather deeply, posterior margin shallowly, concavely arcuate. Meso-metanotum anteriorly abruptly roundly angled; width just behind anterior angles subequal to width of head including eyes, 32 : 32, abruptly increasing in width posteriorly, greatest width anterior to bases of middle and hind acetabula, 32 : 48; sides distinctly rounded. No black bristles present on thorax or acetabula. **Legs.** Anterior femur incrassate; length (excluding trochanter) about 1/5 longer than tibia, 35 : 30. Anterior tarsus with basal segment distinctly shorter than apical segment, 9 : 13. First segment of intermediate tarsus 4× as long as 2nd, 44 : 11. Hind tarsus 1-segmented. Intermediate femur much longer than posterior femur, 58 : 40. Intermediate tibia slightly shorter than posterior tibia, 28 : 30. **Abdomen.** Styliform processes (fig. 3) very asymmetrical, left process short, bent abruptly at right angles and extending outward, visible from above. Right styliform process al-

*micans**sericeus**germanus**sobrinus*

Figs. 1-12. 1, *H. micans*, dorsal view of ♂ terminalia; 2, same, lateral view; 3, same, ventral view; 4, *H. sericeus*, dorsal view of ♂ terminalia; 5, same, lateral view; 6, same, ventral view; 7, *H. germanus*, dorsal view of ♂ terminalia; 8, same, lateral view; 9, same, ventral view; 10, *H. sobrinus*, dorsal view of ♂ terminalia; 11, same, lateral view; 12, same, ventral view.

most straight, extending posteriorly beyond level of lateral flanges at middle of segment 9. Tergum 9 symmetrical, about as broad as long (fig. 1). *Coloration.* Uniformly blue-black with very fine gray pubescence. Rostrum, antennae, legs and tergum 9 glistening black with an iridescent metallic sheen, particularly anterior femur. The pair of pale markings of head not extensive, only faintly visible as small triangles at base of head, not extending forward to middle of eyes. Venter much as above, unicolorous; bases of appendages brownish. *Size.* Length 4.5 mm; greatest width 2.5.

Female. Very similar to ♂ but more oval in form; shorter but not noticeably broader than ♂. Antenna proportionately longer than in ♂, about 3/4 as long as body, 55 : 73; proportion of segments I-IV, 25 : 9 : 7 : 14. First anterior tarsal segment shorter than 2nd, 10 : 14. Intermediate femora to posterior femora, 55 : 35. Intermediate tibia subequal to posterior tibia, 25 : 25. Coloration as in ♂. Length 4.0 mm; greatest width 2.5.

Recorded by Eschscholtz from the South Atlantic and South Pacific Oceans. The types were probably deposited in the University of Dorpat collections but I have been unable to verify this. Templeton described *streatfieldanus* from the Mid-Atlantic. I have seen hundreds of specimens from this area, all of which prove to be *micans*. I therefore feel justified in synonymizing Templeton's species. The pair described above were collected by POFI at Kingman Reef, Pacific Ocean on 31 May 1951.

Variation. In addition to variation in body size, there is some variation in the ratio of antennal segments and in the ratio of leg segments, particularly intermediate to posterior tibiae. In some specimens intermediate femur is slightly longer than posterior femur, in some they are subequal and some material shows posterior femur slightly longer. This is a surprisingly small amount of variation if the wide distribution of this species is considered.

This species belongs to the open-ocean group which can be distinguished by the broad head and the interocular width being four times or more the width of an eye. *H. micans* is most closely related to *splendens* Witslaczil. Both males and females can be distinguished by the shorter first tarsal segment of anterior legs. The males can be distinguished from all others by the shape and structure of the terminalia (fig. 1). The females can be separated from *sericeus* Eschscholtz and *germanus* White by their larger size and proportionately longer tarsal segment 1, from *eschscholtzi* n. sp. by the longer antennal segment 4, which is twice or more the length of segment 3, and from *H. sobrinus* White by the short posterior femur which only reaches 3/4 of the length of the intermediate femur.

Material examined: I have examined hundreds of specimens from all the tropical seas. For distribution see map 1.

Halobates splendens Witslaczil

Halobates splendens Witsl., 1886, Wien Ent. Ztg. 5 : 178, fig. 1.—Barber, 1943, Carnegie Inst. Wash. Pub. 555 : 80, fig. 1c.

Halobates streatfieldanus var. *magentae* Griffini 1895, Mus. Torino, Boll. 10 (213) : 4. **New Synonymy.**

A robust, oval, dark gray to black species with apical 3 antennal segments in proportion 10 : 7 : 16 in ♂ and 9 : 7 : 14 in ♀. First segment of anterior tarsus slightly longer than 2nd 14 : 13 in ♂, subequal in ♀, 14 : 14. Middle and hind femora stout. No

black bristles on meso-metanotum of either sex. Left styliform process of ♂ shorter than right process, sinuate, directed outward and visible from above. Right process swollen at base, directed inward (fig. 15). Entire venter of ♂ and ♀ concolorous, no yellow markings. Legs with an iridescent metallic sheen.

Male. Head. Antennae about 2/3 as long as body, 63 : 95; proportion of segments I-IV, 30 : 10 : 7 : 16. Head broader than long between eyes, disc evenly swollen. Eyes quite small, interocular width slightly over 4× width of an eye. **Thorax.** Pronotum with sides subrounded and diverging posteriorly, shorter than head on median line, 9 : 18; anterior margin rather deeply, posterior margin, shallowly, concavely arcuate. Meso-metanotum anteriorly, abruptly roundly angled; width just behind anterior angles greater than head including eyes, 31 : 39, abruptly increasing in width posteriorly, greatest width anterior to bases of middle and hind acetabula, 31 : 50, sides distinctly rounded. No black bristles present on thorax or acetabula. **Legs.** Anterior femur strongly incrassate; length (excluding trochanters) about 1/8 longer than tibiae, 40 : 35. Anterior tarsus with segment 1 longer than 2, 14 : 13. First segment of intermediate tarsus 6× as long as 2nd, 60 : 10. Hind tarsus 2-segmented. Intermediate femur much longer than posterior femur, 66 : 42. Intermediate tibiae shorter than posterior tibiae, 32 : 34. **Abdomen.** Styliform processes (fig. 15) asymmetrical; left process sinuate, curved outwards and visible from above; right process curved inwards. Segment 9 symmetrical, slightly longer than broad; greatest width at proximal 1/3 (fig. 13). **Coloration.** Uniformly blue-black with very fine gray pubescence. Rostrum, antennae, legs and tergum 9 glistening black with an iridescent metallic sheen, particularly anterior femur. The pair of yellow markings of head not extensive, faintly visible as small triangles at base of head, not extending forward to middle of eyes. Venter much as above, unicolorous; bases of appendages, brownish. **Size.** Length 5.0 mm; greatest width 2.7.

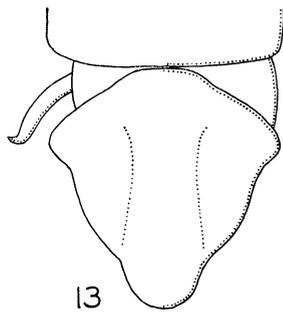
Female. Very similar to ♂ but more oval in form; shorter but not noticeably broader than ♂. Antenna about 2/3 as long as body, 57 : 90; proportion of segments I-IV, 27 : 9 : 7 : 14. Anterior tarsal segments subequal, 14 : 14. Intermediate femur to posterior femur, 60 : 38; intermediate and posterior tibiae subequal, 30 : 30. Coloration as in ♂. Length 4.5 mm; greatest width 2.8.

Witlaczil recorded this species from the W. coast of America between the equator and the Tropic of Capricorn. The types are in the Vienna Museum. The pair described above were collected by the crew of the SS Peking at 24° S, 78° W (near San Ambrosio I., Chile) in 1931.

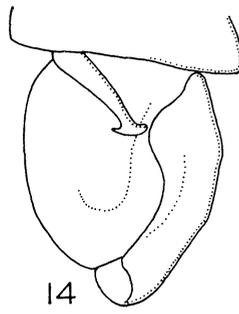
Since Griffini's description of *streatfieldanus* var. *magentae* agrees in all particulars with *splendens* Witlaczil, I am synonymizing it under this species.

This species belongs to the open-ocean group as discussed under *micans*. It is most closely related to that species but ♂ and ♀ can be distinguished by longer first tarsal segment of anterior leg. The ♂ has a much differently constructed tergum 9 and styliform processes (fig. 13). The ♀ can be separated from *sericeus*, *germanus* and *sobrinus* by larger size and proportionately longer anterior tarsal segment 1; from *eschschoeltzi* by the longer antennal segment 4.

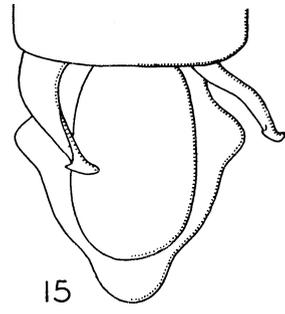
Material examined (map 5):



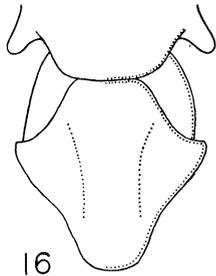
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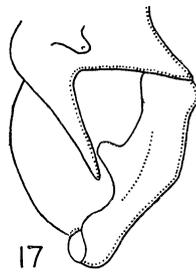
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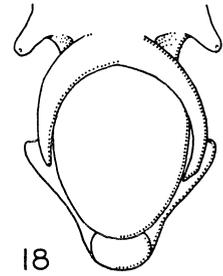
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splendens

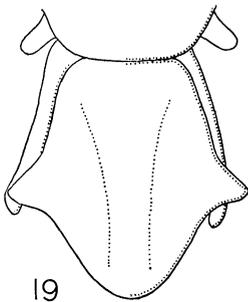
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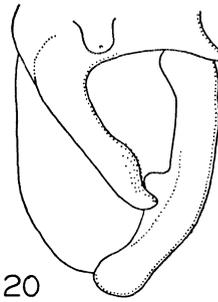
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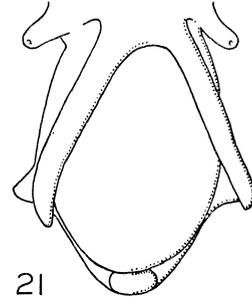
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robustus

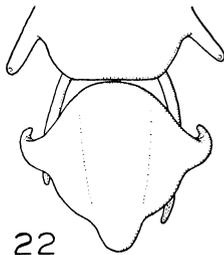
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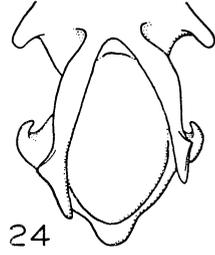
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regalis

22



23



24

peronis

Figs. 13-24. 13, *H. splendens*, dorsal view of ♂ terminalia; 14, same, lateral view; 15, same, ventral view; 16, *H. robustus*, dorsal view of ♂ terminalia; 17, same, lateral view; 18, same, ventral view; 19, *H. regalis*, dorsal view of ♂ terminalia; 20, same, lateral view; 21, same, ventral view; 22, *H. peronis*, dorsal view of ♂ terminalia; 23, same, lateral view; 24, same, ventral view.

Locality	Date	No. Specimens	Collector	Collection
9°58' S, 82°10' W	8-ii-29	1♀, 2 nymphs	Carnegie Plankton	USNM
8-10° S, 84-85° W	25-vii-52	9♂♂, 6♀♀	L. Berner	JLH
10°51' S, 85° W	25-vii-52	2♂♂, 3♀♀	L. Berner	JLH
20° S, 71° W	28-vii-29	1♂	SS Peking	HM
20° S, 73° W	23-iv-01	1♂, 2♀♀	" "	"
21° S, 74° W	1931	4♂♂, 6♀♀	" "	"
22° S, 76° W	"	5♂♂, 9♀♀	" "	"
24° S, 78° W	"	5♂♂, 4♀♀	" "	"
26°30' S, 80°30' W	3-vii-29	1♀	" "	"
Callao, Peru	—	1♂, 1♀	—	CM

Halobates sobrinus White

Halobates sobrinus White, 1883, Voy. Challenger, Rept. Zool. 7 (19): 46, pl. 1, fig. 5.

A relatively slender, dark gray to black species with apical 3 antennal segments in proportion 10 : 7 : 13 in ♂ and 9 : 7 : 13 in ♀. Basal segment of anterior tarsus shorter than apical segment, 7 : 9 in ♂, 7 : 10 in ♀. Middle and hind femora quite slender. No black bristles on meso-metanotum of either sex. Left styliform process curved outward and visible from above; ♂ tergum 9 with a pair of prominent antero-laterally directed flanges in front of middle (fig. 10). Entire venter of ♂ and ♀ concolorous, no yellow marking. Legs dark brown to black, occasionally with a metallic sheen.

Male. Head. Antenna a little less than 2/3 as long as body, 52 : 85; proportion of segments I-IV, 22 : 10 : 7 : 13. Head broader than long between eyes, disc flattened on sides, only slightly swollen in middle. Eyes small, interocular width not quite 4× width of an eye (16 : 62). **Thorax.** Pronotum with sides subrounded, slightly diverging posteriorly, shorter than head on median line, 8 : 15; anterior and posterior margins shallowly, concavely arcuate. Meso-metanotum anteriorly, abruptly roundly angled; width just behind anterior angles subequal to width of head including eyes, 29 : 29; gradually increasing in width posteriorly, greatest width at bases of middle and hind acetabula, 29 : 38; sides gently rounded. No black bristles present on thorax or acetabula. **Legs.** Anterior femur moderately incrassate; length (excluding trochanter) about 1/5 longer than tibia, 35 : 28. Anterior tarsus with basal segment distinctly shorter than apical segment, 7 : 9. First segment of intermediate tarsus 3.5× as long as 2nd, 35 : 10. Hind tarsus 1-segmented. Intermediate femur only moderately longer than posterior femur, 55 : 47. Intermediate tibia much longer than posterior tibia, 34 : 22. **Abdomen.** Styliform processes (fig. 12) asymmetrical; left process as long as right, curved outwards and visible from above. Right process almost straight. Tergum 9 (fig. 10) symmetrical; much broader than long and with a pair of prominent antero-laterally directed flanges in front of middle. **Coloration.** Uniformly blue-black with very fine silver-gray pubescence. Rostrum, antenna, legs, tergum 9 and styliform processes, black. Yellow markings of head quite small, barely visible on each side of posterior margins. Venter unicolorous, no yellow markings. **Size.** Length 4.4 mm; greatest width 2.0.

Female. Much more robust in form than ♂, particularly through hind acetabula. Antenna about 2/3 as long as body, 51 : 75; proportion of segments I-IV, 22 : 9 : 7 : 13. An-

terior tarsal segments in ratio of 7 : 10. Intermediate to posterior femur, 50 : 42. Intermediate tibia much longer than posterior tibia, 29 : 20. Coloration as in ♂. Length 4.0 mm; greatest width 2.3.

White described this species from material in the Stockholm Museum bearing the label "Taiti, Kinb." Usinger verified the identity of the type in 1958. Kinberg was the collector on the frigate "Eugenie." It has been pointed out by Kirkaldy (1907) and others that the "Eugenies Resa" collections labelled "Taiti, Kinb." are notoriously mixed and could just as easily come from the coast of California or Mexico. Judging from extensive collections it now appears certain that *sobrinus* is confined to the west coast of the Americas and that Kinberg's label of Tahiti is in error. The pair described above were collected by D. Ganssle at 10°31' N, 86°12' W. (off Costa Rica) on 27 Mar. 1954 (Kansas).

This species belongs to the open-ocean group and is related to *micans* (q. v.). The ♂ can be easily distinguished from all other species by the structure of the terminalia (fig. 10). The ♀ may be separated from *micans* by the much longer posterior femora. They differ from *sericeus* and *germanus* by their larger size and different antennal proportions.

Material examined: I have examined five or six hundred specimens of this species. For distribution of this material see map 5.

Halobates sericeus Eschscholtz

Halobates sericeus Esch., 1822, Entomographien p. 108, pl. 2, fig. 4.—White, 1883, Voy. Challenger, Rept. Zool. 7 (19): 47, pl. 1, fig. 7.—Barber, 1943, Carnegie Inst. Wash. Pub. 555: 79, fig. 1a.

A very small, fusiform, silver gray species with apical 3 antennal segments in proportion 6 : 5 : 12 in both sexes. Basal segment of anterior tarsus shorter than apical, 4 : 10 in both sexes. Middle and hind femora very slender. No black bristles on meso-metanotum of either sex. Styliform processes almost symmetrical, left one slightly shorter than right one; both diverging at apex and visible from above (fig. 4). Entire venter concolorous, no yellow markings. Appendages brownish-black.

Male. *Head.* Antenna short, little more than 1/2 as long as body, 38 : 73; proportion of segments I-IV, 15 : 6 : 5 : 12. Head broader than long between eyes, disc only slightly depressed on each side. Eyes quite small, interocular width over 4× width of an eye (fig. 108). *Thorax.* Pronotum with sides subrounded, much shorter than head on median line, 5 : 13; a distinct depression on either side of middle; anterior and posterior margins prominently, concavely arcuate. Meso-metanotum anteriorly abruptly roundly angled; width just behind anterior angles greater than head including eyes, 27 : 23, gradually increasing in width posteriorly; greatest width near middle of meso-metanotum, 27 : 32; sides scarcely rounded. No black bristles present on thorax or acetabula. *Legs.* Anterior femora incrassate; length (excluding trochanters) about 1/5 longer than tibiae, 26 : 21. Anterior tarsi with basal segment distinctly shorter than apical segment, 4 : 10. First segment of intermediate tarsus 6 × as long as 2nd, 31 : 5. Hind tarsus 1 segmented. Intermediate femur longer than posterior femur, 39 : 30. Intermediate tibia slightly longer than posterior tibia, 18 : 16. *Abdomen.* Styliform processes slender, almost symmetrical; left process slightly shorter than right process; both diverging at apices and visible from above (fig. 6). Tergum 9 broader than long (fig. 4). *Coloration.* Uniformly blue-black with very fine gray pubes-

cence. Rostrum, antennae, legs and tergum 9 reddish brown. Middle coxa, hind acetabulum and posterior margins of ventral abdominal segments somewhat paler. Yellow markings of head quite small, not extending forward to middle of eyes. *Size.* Length 3.6 mm; greatest width 1.7.

Female. Very similar to ♂ but more robust. Antenna proportionately longer than in ♂, 38 : 65; proportion of segments I-IV, 15 : 6 : 5 : 12. Anterior tarsal ratio, 4 : 11. Intermediate femur longer than posterior femur, 36 : 28. Intermediate tibia only slightly longer than posterior tibia, 17 : 16. Coloration as in ♂. Length 3.4 mm; greatest width 1.8.

Eschscholtz recorded this species from the N. Pacific in the vicinity of the equator. As mentioned under *micans* the types are probably in the collections of the University of Dorpat. The pair described above were collected by me at Coconut Island, Oahu, Hawaii, on 14 Feb. 1955.

This species belongs to the open-ocean group as discussed under *micans* and is most closely related to *germanus*. It may be distinguished from all species by the very short antennal segment II which is only 1/2 as long as segment IV, the short tarsal segment 1 and the small body size. In addition, the ♂ terminalia are distinctive.

Material examined: I have examined several hundred specimens of this widespread Pacific species. For the distribution of this material see map 2.

Halobates germanus White

Halobates germanus White, 1883, Voy. Challenger, Rept. Zool. 7 (19) : 50, pl. 1, fig. 6.

Halobates sewelli Imms, 1936, J. Murray Exped., Sci. Repts. 4 (2) : 71. **New Synonymy.**

A very small, oval, silver gray species with apical 3 antennal segments in proportion 10 : 8 : 13 in ♂, 8 : 7 : 13 in ♀. Basal segment of anterior tarsus shorter than apical segment, 6 : 10 in ♂, 7 : 11 in ♀. Middle and hind femora very slender. No black spines on meso-metanotum of either sex. Styliform processes asymmetrical, left process shorter than right process, both converging at apices, neither process visible from above (fig. 9). Venter concolorous, no yellow markings. Appendages brownish-black.

Male. *Head.* Antenna long, about 3/4 as long as body, 54 : 70; proportion of segments I-IV, 23 : 10 : 8 : 13. Head broader than long between eyes; disc evenly swollen, hardly depressed on sides. Eyes rather large, interocular width over 4× width of an eye. *Thorax.* Pronotum with sides subrounded, distinctly raised above level of head and meso-metanotum, much shorter than head on median line, 6 : 12 and with a distinct depression on either side of middle. Both anterior and posterior margins distinctly, concavely arcuate. Meso-metanotum anteriorly, roundly angled; width just behind anterior angles slightly narrower than head including eyes, 26 : 27, gradually increasing in width posteriorly, greatest width at bases of middle and hind acetabula, 26 : 35; sides evenly rounded. No black bristles present on thorax or acetabula. *Legs.* Anterior femur only moderately incrassate; length (excluding trochanters) about 1/5 longer than tibia, 30 : 24. Anterior tarsus with basal segment distinctly shorter than apical, 6 : 10. First segment of intermediate tarsus 4× as long as 2nd, 32 : 8. Hind tarsus 1-segmented. Intermediate femur longer than posterior femur, 48 : 40. Intermediate tibia longer than posterior tibia, 30 : 20. *Abdomen.* Styliform processes slender, asymmetrical, left process distinctly shorter than right process; both pro-

cesses converging at their apices, neither process visible from above (fig. 9). Tergum 9 a little broader than long with a few black bristles on each lateral flange. *Coloration*. Uniformly blue-black with very fine gray pubescence. Rostrum, antennae, legs, tergum 9 and styliform processes brownish-black to black. Bases of middle and hind legs and posterior margins of ventral abdominal segments, reddish-brown. Pale markings of head quite small, not reaching middle of eyes (fig. 108). *Size*. Length 3.9 mm; greatest width 1.9.

Female. Very similar to ♂ but much more robust. Antenna proportionately shorter than in ♂, approximately $\frac{2}{3}$ as long as body, 48 : 70, proportion of segments I-IV, 20 : 8 : 7 : 13. Anterior tarsal ratio, 7 : 11. Intermediate femur to posterior femur 50 : 40. Intermediate tibia longer than posterior tibia, 30 : 22. Coloration as in ♂. Length 3.6 mm; greatest width 2.3.

White described this species from the N. Pacific Ocean and the Celebes Sea and recorded a specimen from the China Sea. I have seen some specimens of *sewelli* determined by Imms, and that species is clearly synonymous with *germanus*. In Imms' paper, he failed to compare his species with *germanus*. The pair described above were collected by Martin W. Johnson at 19°36' S, 154°54' W (near Cook Is.) on 15 Jan. 1953.

This species belongs to the open-ocean group as discussed under *micans*. It is most closely related to *sericeus* but differs in having a longer antennal segment 2, a longer anterior tarsal segment 1 and its larger size. In addition, the ♂ terminalia are quite distinctive.

Material examined: This species is widespread throughout the SW Pacific. For distribution of the material examined see map 3.

Halobates eschscholtzi Herring n. sp.

A rather large, oval, silver gray species with the apical 3 antennal segments in proportion 10 : 8 : 11 in ♀. Anterior tarsal segments subequal, 13 : 13 in ♀. Middle and hind femora slender. No black bristles on meso-metanotum. Venter concolorous silver-gray except posterior margins of abdominal segments and middle of hind acetabula, yellow. ♂ unknown.

Female. *Head*. Antenna relatively short, less than $\frac{2}{3}$ as long as body, 56 : 95, proportion of segments I-IV, 27 : 10 : 8 : 11. Head broader than long between eyes; disc rather evenly swollen. A prominent narrow keel extending along posterior margin of head in contact with anterior margin of pronotum and becoming obsolete on postero-lateral angles of head behind eyes. Eyes rather large, interocular width approximately 4 × width of an eye. *Thorax*. Pronotum with sides subrounded, scarcely diverging posteriorly, shorter than head on median line, 7 : 16; anterior margin shallowly, concavely arcuate, posterior margin almost straight. Meso-metanotum anteriorly, roundly angled; width just behind anterior angles only slightly wider than head including eyes 30 : 29, greatly increasing in width posteriorly, greatest width just anterior to bases of middle and hind acetabula, 30 : 50, sides distinctly rounded. No black bristles present on thorax or acetabula. *Legs*. Anterior femora slender, length (excluding trochanters) $\frac{1}{8}$ longer than tibiae, 40 : 35. Anterior tarsal segments subequal, 13 : 13. First segment of intermediate tarsus 3 × as long as 2nd, 39 : 13. Hind tarsus 1-segmented. Intermediate femur longer than posterior femur, 62 : 49. Intermediate tibia longer than hind tibia, 40 : 27. *Abdomen* of usual form. *Coloration*. Uni-

formly blue-black with very fine gray pubescence. Rostrum, antennae and legs, brownish black. Yellow markings of head not interrupted posteriorly but continuous across posterior margin along the keel and extending forward laterally to middle of eyes. Venter much as above except for posterior margins of abdominal segments and hind acetabula, yellowish. *Size.* Length 5.0 mm; greatest width 2.6.

Holotype ♀ (BM) and 6 ♀ paratypes (BM, JLH), Latham I., Zanzibar, Dec. 1955, F. L. van der Plank, Com. Inst. Ent. Coll. No. 14825 (BM).

Diagnosis. This species belongs to the open-ocean group (see *micans*). It appears to be most closely related to *micans* although in many features such as the ratio of anterior tarsal segments and size it resembles *splendens*. It can be distinguished from both of these species by the much longer intermediate tibiae, which are longer than the posterior tibiae, and by the proportion of the antennal segments, segment II being almost subequal to IV, which is only slightly longer than segment III. It can be separated from the other open-ocean species by its larger size and antennal structure.

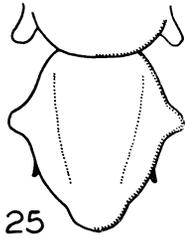
Halobates katherinae Herring

Halobates katherinae Herr., 1958, Dana Report 44: 8, fig. 4.

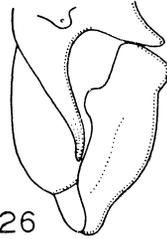
A very large, relatively slender, dark gray to black species with apical 3 antennal segments in proportion 12.5 : 9 : 12 in ♂ and 11 : 9 : 12 in ♀. Basal segment of anterior tarsus longer than 2nd, 16 : 12 in ♂, 20 : 13.5 in ♀. Meso-metanotum of ♀ bearing short, scattered, stiff, black bristles on either side of middle, none present in ♂. Abdominal segment 7 of ♂ enlarged and tubular, completely enclosing segment 8. Styliform processes asymmetrical³ (fig. 102), the right process very short. Yellow markings of ventral surface of ♂ confined to middle of abdomen and acetabular sutures, female venter almost entirely yellow, having form of a large yellow triangle with apex at fore coxae. Remainder of ventral surface, concolorous.

Male. Head. Antennae less than 2/3 as long as body, 70.5 : 125; proportion of segments I-IV, 37 : 13.5 : 9 : 12. *Thorax.* Pronotum with sides subrounded, shorter than head on median line, 9 : 16; hind margin shallowly, concavely arcuate; lateral angles swollen, raised considerably above level of head and meso-metanotum. Meso-metanotum anteriorly abruptly roundly angled; width just behind anterior angles subequal to width of head including eyes, 31 : 31, gradually increasing in width posteriorly, greatest width at bases of middle and hind acetabula, 31 : 42; sides subrectilinear and appearing subparallel. No black bristles present on thorax or acetabula. *Legs.* Anterior femora moderately incrassate, length (excluding trochanter) about 1/5 greater than tibiae, 45 : 37. Anterior tarsi with basal segment distinctly longer than second, 16 : 12. First segment of intermediate tarsus 3 × as long as 2nd, 36 : 12. Hind tarsus 2-segmented, 1st segment 1/2 as long as 2nd. Intermediate femur much longer than posterior femur, 70 : 54. Intermediate tibia longer than posterior tibia, 46 : 29. *Abdomen.* Enlarged tubular segment 7 completely enclosing segment 8, former longer than the hind coxa, 15 : 13. Styliform processes (fig.

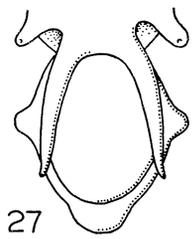
3. It should be noted that in this species group, which includes *H. fijiensis* Herr. and *salotae* n. sp., segments 8-9 of the ♂ are rotated 90° to the left so that the terminalia are at right angles to the body. However, they have been drawn as if they were in the normal position, i. e., parallel to the body.



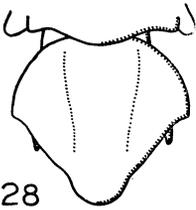
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mjobergi

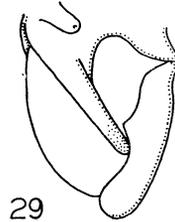
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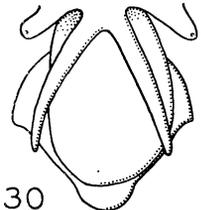
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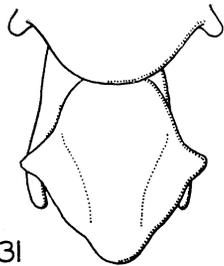
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zephyrus

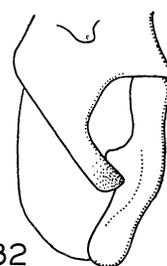
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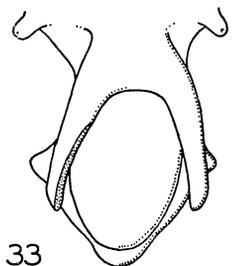
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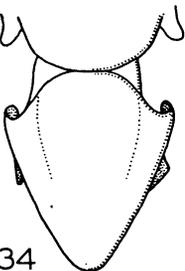
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whiteleggei

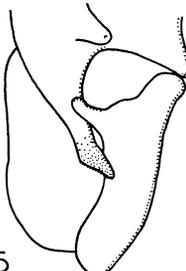
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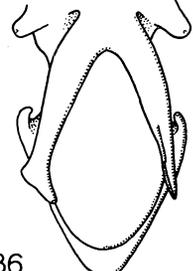
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34

darwini

35



36

Figs. 25-36. 25, *H. mjobergi*, dorsal view of ♂ terminalia; 26, same, lateral view; 27, same, ventral view; 28, *H. zephyrus*, dorsal view of ♂ terminalia; 29, same, lateral view; 30, same, ventral view; 31, *H. whiteleggei*, dorsal view of ♂ terminalia; 32, same, lateral view; 33, same, ventral view; 34, *H. darwini*, dorsal view of ♂ terminalia; 35, same, lateral view; 36, same, ventral view.

102) very asymmetrical, right process extremely short, decurved at base and reflexed at apex, scarcely protruding beyond posterior margin of segment 8, visible from above. Left styliform process extending posteriorly beyond level of lateral flanges at middle of segment 9, directed outward at apex, not visible dorsally. Segment 9 (fig. 100) much longer than broad, distinctly asymmetrical, left side more gently and evenly rounded than right. *Coloration*. In great part blue-black with very fine gray pubescence; abdominal segment 7 reddish brown, its apex pale yellow. Abdominal 9 brown, except lateral and posterior margins yellow. Rostrum, antennae and legs black. The pair of yellow crescent-shaped markings of head extending forward to level of middle of eyes. Yellow coloration of venter confined to center and posterior margins of abdominal segments and edges of acetabular sutures. Sides of abdominal segments and styliform processes brown. *Size*. Length, 6.5 mm; greatest width 2.2.

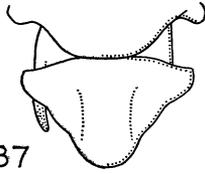
Female. Very much broader in form than ♂; sides of thorax more strongly dilated posteriorly and more rounded throughout. Short, stiff, postero-laterally directed black bristles rather thickly scattered along sides of meso-metanotum, extending 1/2 distance to bases of posterior acetabula, none on disc. Apex of abdomen at level of posterior margins of acetabula abruptly turned under and fitted into a triangular depression of ventral abdominal segments; a longitudinal sulcus extending forward from the triangular depression to anterior coxae. Antenna proportionately longer than in ♂, about 2/3 as long as body, 62 : 95; proportion of segments I-IV, 30 : 11 : 9 : 12. Anterior femur but little longer than tibia, 42 : 40. Segment 1 of anterior tarsus proportionately longer than in ♂, 20 : 13.5. Intermediate femur longer than posterior femur, 70 : 52; intermediate to posterior tibiae, 47 : 29. Width of body through hind coxae broad, much wider than head through eyes, 40 : 31. Color much as in ♂ but triangular yellow area of venter extending forward to anterior coxae. Posterior margin of meso-metanotum in middle with a rounded reddish brown area. Length 5.0 mm; greatest width well in front of bases of middle and hind acetabula, 2.5.

Known from type series as follows: Holotype, ♂ (KANSAS), Nouville, New Caledonia, 8 Aug. 1940, F. X. Williams. Allotype, ♀ (KANSAS), same data as holotype. Paratypes: 2 ♂♂ (KANSAS), same data as above; 1 ♀, Prony Bay, New Caledonia, 22 Oct. 1940, Williams. Two ♂♂, Loyalty Is., E. Lifu I., Cap des Pins, 18 Nov. 1949-18 Jan. 1950, L. E. Cheesman (BM); 2 ♀♀, Noumea Harbor, New Caledonia, 30 Nov.-4 Dec. 1928 (Dana). In addition I have seen 2 other specimens (♂♀) from Loyalty Islands, same data as paratypes above (JLH).

This species belongs to the same group as *fijiensis* and *salotae*. This group can be distinguished from all others by the tubular segment 7 of ♂ which completely encloses segment 8. Also the ♀ abdomen is abruptly turned under, fitted into a triangular pocket ventrally and has a longitudinal sulcus which extends forward to anterior coxae. Both ♂ and ♀ of *katherinae* can be distinguished from *fijiensis* by their larger size, proportionately longer tarsal segment 1 and dark gray to black color with black appendages. The ♀ differ from *salotae* by the normal structure of the acetabula (see fig. 106). In addition, the ♂ styliform processes differ from those of both *fijiensis* and *salotae*; the right process is decurved at base, reflexed at apex and visible from above.

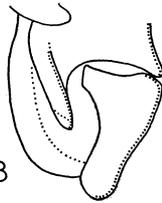
Halobates fijiensis Herring

Halobates fijiensis Herr., 1958, Dana Report 44: 10, fig. 5.

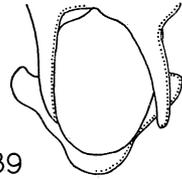


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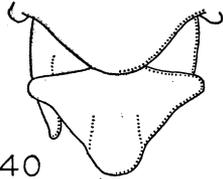
proavus



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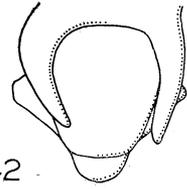


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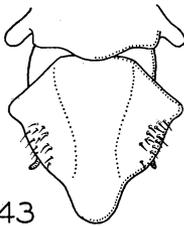
maculatus



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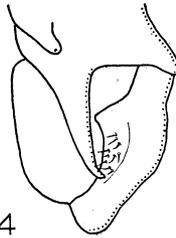


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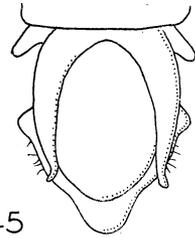


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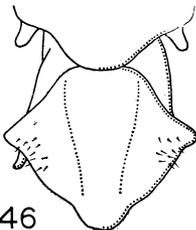
calyptus



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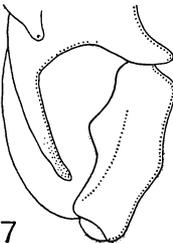


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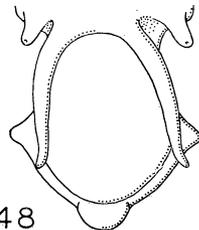


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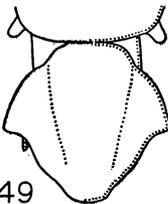
hayanus



47

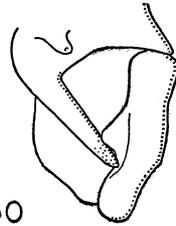


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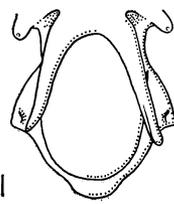


49

bryani



50



51

A very large, relatively robust, steel-gray species with apical antennal segments in proportion of 12 : 9 : 13 in ♂ and 11 : 9 : 12 in ♀. Segment 1 of anterior tarsus longer than 2nd, 13 : 11 in ♂, 16 : 13 in ♀. No black bristles on meso-metanotum of either sex. Abdominal segment 7 of ♂ tubular, enclosing segment 8. Styliform processes asymmetrical (fig. 99), the right process very short. Yellow markings of ventral surface of ♂ occupying middle 1/3 of abdominal segments including sternum 9 and underside of tergum 9, and acetabular sutures. ♀ venter almost entirely yellow, coloration having the form of a large triangle with apex between fore coxae. Remainder of ventral surface concolorous.

Male. Head. Antennae almost 2/3 as long as body, 60 : 108; proportion of segments I-IV, 35 : 12 : 9 : 13. **Thorax.** Pronotum with sides subrounded, shorter than head on median line, 8 : 15; hind margin shallowly, concavely arcuate; lateral angles depressed, not raised above level of head and meso-metanotum. Meso-metanotum anteriorly abruptly roundly angled; width just behind anterior angles greater than width of head including eyes, 31 : 29; gradually increasing in width posteriorly, greatest width well in front of bases of middle and hind acetabula 31 : 43; sides broadly rounded and strongly dilated posteriorly. No black bristles present on notum or acetabula. **Legs.** Anterior femur moderately incrassate; length (excluding trochanters) about 1/5 longer than tibiae 42 : 34. Anterior tarsus with segment 1 distinctly longer than 2, 13 : 11. First segment of intermediate tarsus 3 × as long as 2nd, 33 : 11. Hind tarsus 2-segmented, 1st segment 1/2 as long as 2. Intermediate femur much longer than posterior femur, 68 : 56. Intermediate tibia twice as long as hind tibia, 45 : 22. **Abdomen.** Tubular segment 7 completely inclosing segment 8 but not as long as the hind coxae, 8 : 12. Styliform processes (fig. 99) very asymmetrical, right process very short, less than 1/2 length of left, almost completely hidden beneath segment 7, constricted at base, the antero-laterally directed apical 1/2 lanceolate. Left styliform process gently curved dorsally, its apical 1/2 flattened and blade-like, apex rounded, reaching almost to postero-lateral margin of tergum 9. Tergum 9 (fig. 97) much broader than long, distinctly asymmetrical. **Coloration.** In great part, blue-black with very fine steel-gray pubescence; abdominal segment 7 rich reddish-brown except lateral margins, yellow-orange. Rostrum, antennae and legs, brown to reddish brown. The pair of yellow, crescent-shaped markings of head extending forward to beyond level of middle of eyes, almost reaching middle pair of trichobothria. Yellow coloration of venter occupying middle 1/3 of all abdominal segments and along edges of acetabular sutures. Sides of abdominal segments and styliform processes reddish-brown. **Size.** Length 5.8 mm; greatest width 2.3.

Female. Very similar in form to ♂ but meso-metanotum more strongly arched, no stiff black bristles present. Apex of abdomen at level of posterior margins of acetabula abruptly turned under and fitted into a triangular depression of ventral abdominal segments; a longitudinal sulcus extending forward from the triangular depression to anterior coxae.

Figs. 37-51. 37, *H. proavus*, dorsal view of ♂ terminalia; 38, same, lateral view; 39, same, ventral view; 40, *H. maculatus*, dorsal view of ♂ terminalia; 41, same, lateral view; 42, same, ventral view; 43, *H. calyptus*, dorsal view of ♂ terminalia; 44, same, lateral view; 45, same, ventral view; 46, *H. hayanus*, dorsal view of ♂ terminalia; 47, same, lateral view; 48, same, ventral view; 49, *H. bryani*, dorsal view of ♂ terminalia; 50, same, lateral view; 51, same, ventral view.

Antenna proportionately longer than in ♂, over 2/3 as long as body, 62 : 84; proportion of segments I-IV, 30 : 11 : 9 : 12. Anterior femur more slender than in ♂ but proportion of femur to tibia essentially the same, 43 : 34. Basal segment of anterior tarsi proportionately little longer, 16 : 13. Intermediate to posterior tibiae, 68 : 54, intermediate tibia over twice as long as posterior tibia, 46 : 22. Width of body through hind coxae very narrow, about as wide as head through eyes, 30 : 29. Color much the same but triangular yellow area of venter extending forward between anterior coxae. Apex of abdomen yellow. Length 4.5 mm; greatest width 2.3.

Known only from type series as follows: Holotype, ♂, Suva Harbor, Fiji Is. 12-19 Nov. 1938 (Dana). Allotype, ♀, same data. Two paratypes, ♂, ♀, same data. Holotype, allotype and one paratype in the Dana collections. One paratype in my collection.

In the ♀ paratype, antennal segment IV on right is shorter than III, proportion of segments I-IV, 28 : 11 : 8 : 7. The antennal IV on left is missing. Proportion of segments: 29 : 11 : 9 : -.

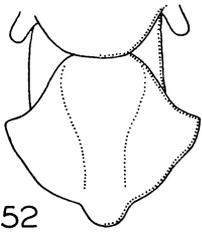
This species belongs to the same group as *katherinae* and *fijiensis*. These 3 species can be distinguished from all others, as mentioned above, by the tubular segment 7 of the ♂, which encloses segment 8; the form of the ♀ abdomen which is abruptly turned under, fitted into a triangular pocket ventrally, and with a longitudinal sulcus which extends forward to the anterior coxae. Both ♂ and ♀ of *fijiensis* can be distinguished from *katherinae* by their size, proportionately shorter tarsal segment 1 and steel-gray color with brown appendages. Females differ from *salotae* by the normal structure of the acetabula (see fig. 103). In addition, the styliform processes of the ♂ differ from those of *katherinae* and *H. salotae*, the right styliform process is flattened, its apex lanceolate.

Halobates salotae Herring, n. sp.

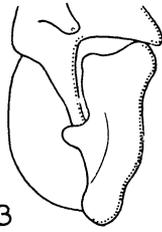
A large, relatively slender, dark gray to black species with apical 3 antennal segments in proportion, 12 : 9 : 12 in ♂ and 11 : 9 : 12 in ♀. Segment 1 of anterior tarsus longer than 2nd, 13 : 11 in ♂, 15 : 13 in ♀. Meso-metanotum without black bristles. Abdominal segment 7 of ♂ enlarged and tubular, completely enclosing segment 8. Styliform processes asymmetrical (fig. 105), right process very short, hooklike, visible from above. Yellow markings of ventral surface of ♂ extensive, covering all abdominal segments, acetabular sutures and middle of thorax; ♀ venter almost entirely yellow, coloration in form of a large triangle with apex at fore coxae.

Male. *Head*. Antennae. Less than 2/3 as long as body, 66 : 110, proportion of segments I-IV, 33 : 12 : 9 : 12. *Thorax*. Pronotum with sides subrounded, shorter than head on median line, 8 : 15; anterior and posterior margins shallowly concavely arcuate; lateral margins not diverging posteriorly. Meso-metanotum anteriorly abruptly roundly angled; width just behind anterior angles subequal to width of head including eyes, 29 : 29, gradually increasing in width posteriorly, greatest width at bases of intermediate and posterior

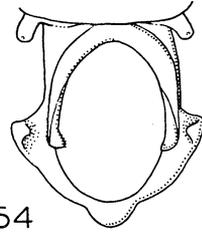
Figs. 52-63. 52, *H. poseidon*, dorsal view of ♂ terminalia; 53, same, lateral view; 54, same, ventral view; 55, *H. panope*, dorsal view of ♂ terminalia (holotype); 56, same, lateral view; 57, same, ventral view; 58, *H. panope*, (SE New Caledonia), dorsal view; 59, same, lateral view; 60, same, ventral view; 61, *H. galatea*, dorsal view of ♂ terminalia; 62, same, lateral view; 63, same, ventral view.



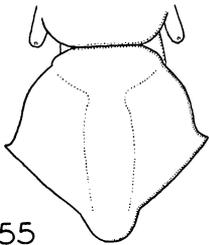
52
poseidon



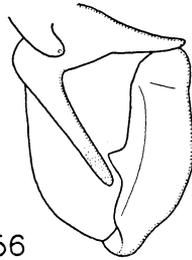
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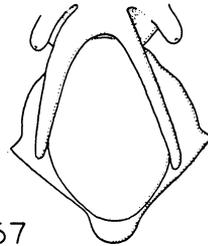
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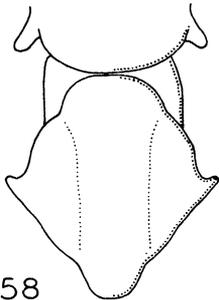
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panope



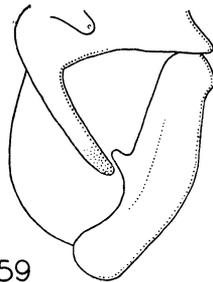
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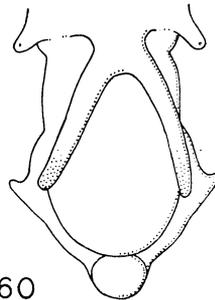
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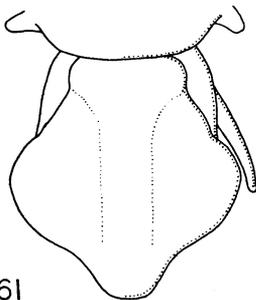
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panope (ssp.?)



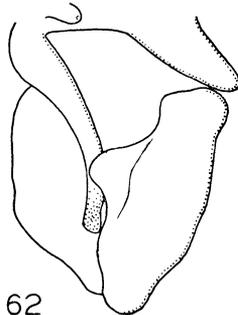
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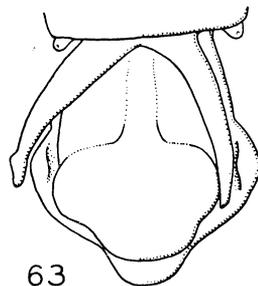
60



61
galatea



62



63

acetabula, 29 : 38, sides gently rounded. No black bristles present on thorax or acetabula. *Legs.* Anterior femur hardly incrassate; length (excluding trochanter) $1/4$ longer than tibia, 40 : 30. Anterior tarsus with basal segment distinctly longer than apical, 13 : 11. First segment of intermediate tarsus $3\times$ as long as 2nd, 33 : 11. Hind tarsus 2-segmented, segment 1 slightly less than $1/2$ as long as 2. Intermediate femur much longer than posterior femur, 62 : 52. Intermediate tibia much longer than posterior tibia, 43 : 25. *Abdomen.* Enlarged tubular segment 7 completely enclosing segment 8, the former almost as long as hind coxae, 12 : 13. Styliform processes (fig. 105) very asymmetrical, right process extremely short, decurved at base and curved posteriorly at apex, scarcely protruding beyond antero-lateral margin of tergum 9, visible from above. Left styliform gently curved and spatulate at apex, not visible dorsally. Tergum 9 (fig. 103) much longer than broad, sides subrectilinear and appearing subparallel. *Coloration.* In great part blue-black with very fine gray pubescence; tergum 9 brown, except lateral and posterior margins, yellow. Rostrum, antennae and legs, dark brown. Pair of yellow triangular markings of head extending forward almost to anterior margins of eyes. Ventral abdominal segments, acetabula, anterior trochanters, middle of thorax and bases of antennae, yellow. Styliform processes, brown. *Size.* Length 5.5 mm, greatest width 2.0.

Female (figs. 106-7). Very much broader in form than ♂, sides of thorax more strongly dilated posteriorly and more rounded throughout. No black bristles on meso-metanotum. Connexiva extremely large and triangular. Apex of abdomen at level of bases of connexiva abruptly turned under and fitted into a triangular depression of ventral abdominal segments, a longitudinal sulcus extending forward half the distance to anterior coxae. Antenna proportionately longer than in ♂, about $3/4$ as long as body, 61 : 80; proportion of segments I-IV, 29 : 11 : 9 : 12. Anterior femur about $1/5$ longer than tibia, 40 : 32. Basal segment of anterior tarsus proportionately longer than in ♂, 15 : 13. Width of body through hind acetabula narrower than head through eyes, 28 : 30. Color much as in ♂ but yellow coloration of venter more extensive, including underside of head, anterior limb bases and posterior margins of anterior femur. Length 4.4 mm, greatest width near middle of meso-metanotum, 2.1.

Holotype ♂ (BISHOP 3008). Tongatabu, Tonga Is. 24 Dec. 1952, M. W. Johnson. Allotype ♀ (BISHOP), same data as holotype. Paratypes: two ♂♂, one ♀ (JLH), same data. This species is named for Her Majesty, Queen Salote of Tonga.

Diagnosis: This species belongs to the *katherinae* group. It appears to be more closely related to *fijiensis* in size, anterior tarsal proportions and lack of black bristles on meso-metanotum, but is readily distinguishable from both species by the structure of the ♂ terminalia and the greatly enlarged connexiva of the ♀ (fig. 106).

Halobates mariannarum Esaki

Halobates mariannarum Esaki, 1937, *Tenthredo* 1 (3) : 357, pl. 31, fig. 1, textfig. 2.

A medium-sized, slender, silvery gray species with apical 3 antennal segments in proportion, 10 : 8 : 10 in ♂ and 9 : 7 : 10 in ♀. Basal segment of anterior tarsus only slightly longer than apical, 10 : 9 in ♂, 12 : 11 in ♀. Black bristles on meso-metanotum of ♀, none in ♂. Right styliform process of ♂ very short, flattened, visible from above. Left process rather broad and flat, only reaching about $1/2$ distance to apex of tergum 9 (fig.

93); tergum longer than broad, sides straight and diverging posteriorly. Yellow coloration of venter of ♂ limited to middle of abdominal segments and acetabula, more extensive in ♀.

Male. *Head.* Antenna about $\frac{2}{3}$ as long as body, 58 : 85; proportion of segments I-IV, 30 : 10 : 8 : 10. Head about as long as broad between eyes, disc evenly swollen and with an obscure keel along middle of posterior margin. Eyes quite large, interocular width less than $3 \times$ width of an eye (fig. 109). *Thorax.* Pronotum with sides subrounded, not diverging posteriorly; shorter than head on median line, 6 : 15. Anterior and posterior margins shallowly, concavely arcuate. Meso-metanotum anteriorly abruptly roundly angled; width just behind anterior angles subequal to width of head including eyes, 27 : 27, gradually increasing in width posteriorly, greatest width through middle acetabula, 27 : 36; sides subrectilinear and appearing subparallel. No black bristles present on thorax or acetabula. *Legs.* Anterior femur only moderately incrassate; length (excluding trochanters) about $\frac{1}{7}$ longer than tibia, 35 : 30. Anterior tarsus with basal segment only slightly longer than apical, 10 : 9. First segment of intermediate tarsi over $3 \times$ as long as 2nd, 30 : 9. Hind tarsus 2-segmented, segment 1 is $\frac{1}{3}$ length of segment 2. Intermediate femur much longer than posterior femur, 56 : 46. Intermediate tibia much longer than posterior tibia, 38 : 22. *Abdomen.* Styliform processes (fig. 93) very asymmetrical, right process very short and flat, its apex visible from above. Left styliform process only moderately long, fairly broad and flat; slightly surpassing middle of tergum 9; not visible from above. Tergum 9 much longer than broad, sides straight, diverging posteriorly (fig. 91). *Coloration.* Uniformly blue-black above with fine gray pubescence. Rostrum, antennae, legs and tergum 9 reddish-brown. Yellow markings of head crescent-shaped, extending forward to middle pair of trichobothria, not continuous on posterior margin. Venter with extensive yellow coloration. Middle of abdominal segments, intermediate and posterior acetabula and middle of sternum, bright yellow. Margins of abdominal segments, and styliform processes reddish brown. *Size.* Length 4.5 mm; greatest width 1.8.

Female. Very similar to ♂ but slightly more robust. Meso-metanotum with stout black, posteriorly-directed bristles along sides and across anterior $\frac{1}{4}$. Antenna $\frac{5}{8}$ as long as body, 51 : 80; proportion of segments I-IV, 25 : 9 : 7 : 10. Anterior tarsal segments in ratio of 12 : 11. Intermediate to posterior femora, 57 : 45; intermediate to posterior tibiae, 38 : 23. Coloration as in ♂. *Size.* Length 4.0 mm; greatest width 2.0.

Esaki described this species from the Mariana Is. (Coast of Rota). The types are in the Esaki Collection at Fukuoka, Japan. The pair described above was collected by R. L. Usinger at Piti, Guam on 22 May 1936.

The material before me from Guam differs somewhat from Esaki's description. The anterior tarsi are closer to being subequal. I have examined a ♂ from the type locality and the ratio is the same as my figures above. Furthermore, I have not seen a specimen that is as broad as the measurement of 2.2 mm that he gives.

Variation. There is some variation in the extent of the stiff black bristles of the sides of the thorax. In material from Yap Island and the Marshalls, there are females with only one or two bristles along the sides of the thorax as well as specimens in which these bristles are completely absent.

This species belongs to the group with subparallel-sided ninth tergum of male: *alluaudi* Bergroth, *kelleni* n. sp. and *princeps* White. It is the smallest species of the group. The

distinctive shape of the ninth tergum and the very short right styliform process which is visible from above, will readily distinguish the males. The females are much smaller than the other species and have proportionately much shorter first anterior tarsal segments.

Material examined: I have examined material from Guam and Rota (type locality) in the Marianas, Yap, Ponape and Kusaie in the Carolines and Arno Atoll in the Marshalls. For distribution of the material examined see map 7.

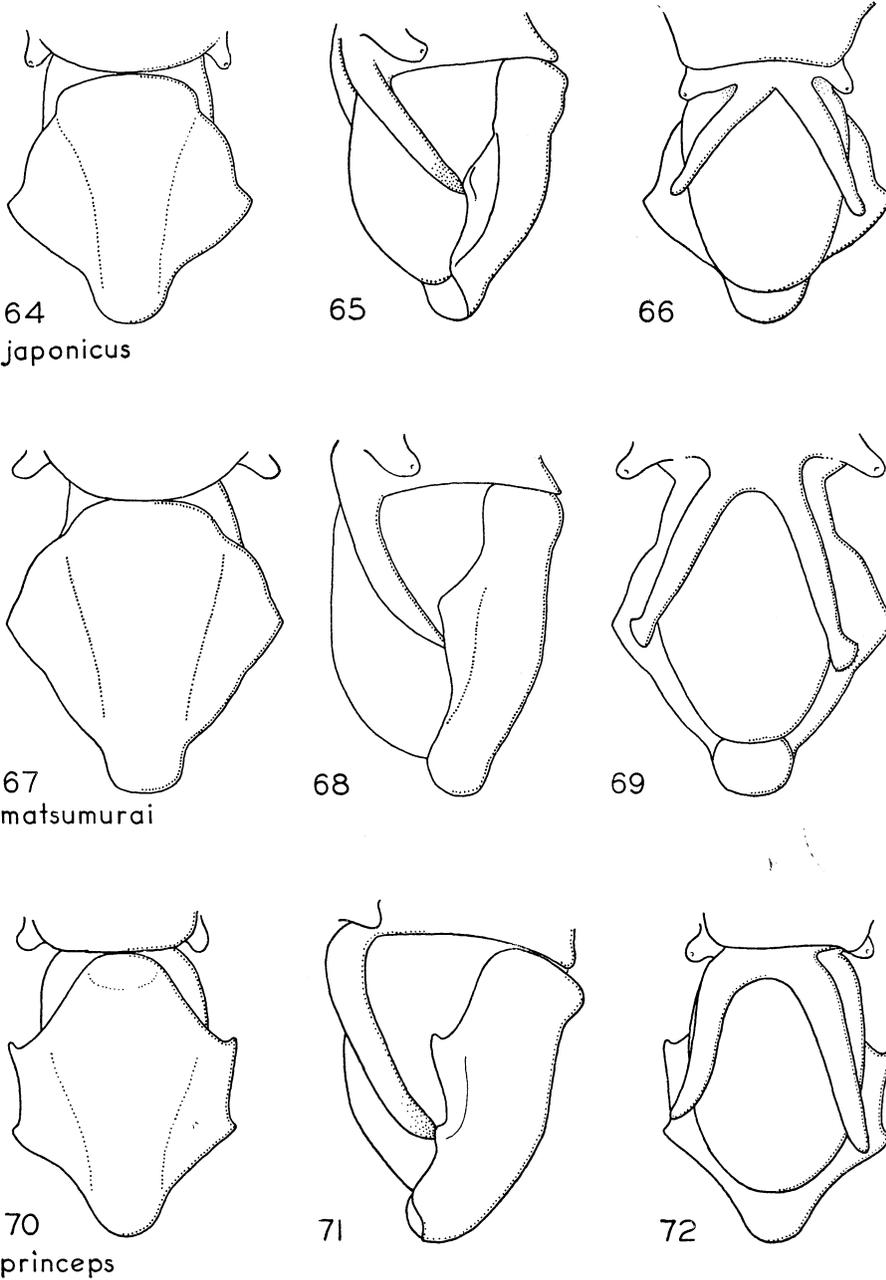
Halobates alluaudi Bergroth

Halobates alluaudi Bergroth, 1893, Rev. Ent. France 12: 204.

A large, slender, silver-gray to black species with apical 3 antennal segments in the proportion, 13 : 9 : 15 in ♂ and 11 : 10 : 13 in ♀. Basal segment of anterior tarsus longer than apical, 16 : 11 in ♂ and 20 : 15 in ♀. Almost entire meso-metanotum of ♀, except median line, bearing stiff black posterior directed bristles, none present in ♂. Styliform processes of ♂ rather broad, flat, and blunt at apices (fig. 74); the right process slightly shorter than left process, neither process visible from above. Yellow markings of ventral surface of ♂ confined to abdominal segments and acetabula. ♀ venter with a large yellow triangle extending forward to fore coxae.

Male. Head. Antenna about 2/3 as long as body, 75 : 110; proportion of segments I-IV, 38 : 13 : 9 : 15. Head about as broad as long between eyes, disc evenly swollen. Eyes quite large, interocular width about 3 × width of an eye. **Thorax.** Pronotum with sides subrounded, not diverging posteriorly; shorter than head on median line, 8 : 17. Anterior and posterior margins shallowly concavely arcuate. Meso-metanotum anteriorly abruptly roundly angled; width just behind anterior angles slightly less than width of head including eyes, 28 : 30, gradually increasing in width posteriorly; greatest width at bases of middle acetabula, 28 : 40, the sides subrectilinear. No black bristles present on thorax or acetabula. **Legs.** Anterior femur moderately incrassate; length excluding trochanters only 1/8 longer than tibia, 41 : 37. Anterior tarsal segment 1 longer than segment 2, 16 : 11. First segment of intermediate tarsus 3 × as long as 2nd, 36 : 12. Hind tarsus 2-segmented, segment 1 about 2/5 length of 2. Intermediate femur much longer than posterior femur, 70 : 54. Intermediate tibia much longer than posterior tibia, 45 : 29. Styliform processes (fig. 74) broad, flat, appressed to sternum 9, right process somewhat shorter than left; neither process visible from above. Tergum 9 (fig. 73) slightly longer than broad, sides subparallel at middle. **Coloration.** Uniformly blue-black above with fine gray pubescence. Rostrum, antennae and legs, black; tergum 9 with a reddish brown spot at each posterolateral angle. Yellow markings of head triangular, extending forward beyond middle of eye, not reaching middle pair of trichobothria nor continuous on posterior margin. Yellow coloration of venter limited to middle of abdominal segments, sternum 9 and acetabula. Styliform processes reddish brown. **Size.** Length 5.8 mm; greatest width 2.1.

Female. Much more robust than ♂. Meso-metanotum except median line densely clothed in stout, black, posteriorly directed bristles. Antennae 2/3 as long as body, 64 : 96; proportion of segments I-IV, 30 : 11 : 10 : 13. Anterior tarsal ratio I-II, 20 : 15. Intermediate femur to posterior femur, 72 : 55; intermediate tibia to posterior tibia, 46 : 30. Yellow coloration of venter much more extensive than in ♂, abdominal segments, acetabula and a large triangle extending forward to anterior coxae, pale yellow. Length 5.0 mm;



Figs. 64-72. 64, *H. japonicus*, dorsal view of ♂ terminalia; 65, same, lateral view; 66, same, ventral view; 67, *H. matsumurai*, dorsal view of ♂ terminalia; 68, same, lateral view; 69, same, ventral view; 70, *H. princeps*, dorsal view of ♂ terminalia; 71, same, lateral view; 72, same, ventral view.

greatest width 2.5.

Bergroth described this species from material collected in the Seychelles by C. Alluaud. The types are in the Paris Museum. The pair described above was collected by E. S. Brown at Mahe, Seychelles Is. 21 Dec. 1952. This species, as well as other valid species, has been synonymized with *princeps* by Esaki. I have examined one of Bergroth's specimens of *alluaudi* and it is only necessary to point out here that it differs in a multitude of characteristics such as tarsal ratios, body size, antennal proportions and structural details of the thorax.

This species belongs to the *mariannarum* group with the subparallel-sided tergum 9 of ♂. The distinctive shape of tergum 9 and styliform processes (figs. 73-75) will readily separate the males. The more extensive distribution of black bristles, body size and anterior tarsal ratio will distinguish the females.

Material examined: Seychelles: Pointe an Sel, 21 Dec. 1952, E. S. Brown, 1 ♂ (RLU); Mahe I. 29 Mar. 1951, Galathea crew, 2 ♂♂, 1 ♀ (KØBENHAVN); Praslin I. no date, Noualhier, 4 nymphs (USNM); Indian Ocean, no date, E. Bergroth, 1 ♂ (USNM). The distribution of this species is shown on map 9.

Halobates kelleni Herring, n. sp.

A medium-sized, rather robust species with apical 3 antennal segments in proportion 10 : 7 : 11 in both sexes. Basal segment of anterior tarsus distinctly longer than apical, 12 : 10 in ♂, 17 : 13 in ♀. Black bristles present on sides of meso-metanotum of ♀, none in ♂. Right styliform process of ♂ shorter than left, curved at apex; both processes flattened (figs. 95-96). Tergum 9 (fig. 94) longer than broad, appearing subparallel-sided at middle. Yellow coloration of venter in ♂ limited to abdominal segments and acetabula, more extensive in ♀.

Male. *Head*. Antenna almost 3/4 as long as body, 61 : 88; proportion of segments I-IV, 33 : 10 : 7 : 11. Head about as long as broad between eyes, disc evenly swollen. Eyes quite large, interocular width 3× width of an eye. *Thorax*. Pronotum with sides subrounded, not diverging posteriorly; shorter than head on median line, 6 : 15. Anterior and posterior margins shallowly, concavely arcuate. Meso-metanotum anteriorly abruptly roundly angled; width just behind anterior angles subequal to head including eyes, 28 : 28, gradually increasing in width posteriorly, greatest width in front of middle acetabula, 28 : 39, the sides distinctly rounded. No black bristles present on thorax or acetabula. *Legs*. Anterior femur not strongly incrassate; length (excluding trochanters) only slightly longer than tibia, 34 : 30. Anterior tarsus with basal segment distinctly longer than apical segment, 12 : 10. First segment of intermediate tarsus 3.5 × as long as 2nd, 35 : 10. Hind tarsus 2-segmented, 1st segment 1/2 length of 2nd. Intermediate femur much longer than posterior femur, 63 : 50. Intermediate tibia much longer than posterior tibia, 40 : 23. *Abdomen*. Styliform processes asymmetrical (figs. 95-96) right process short, curved at apex, left process longer and straight, surpassing middle of tergum 9; neither process visible from above. Tergum 9 much longer than broad, sides subparallel at middle (fig. 94). *Coloration*. Uniformly blue-black above with very fine silver-gray pubescence. Yellow coloration of venter limited to abdominal segments and acetabula. Yellow markings of head not reaching middle pair of trichobothria. *Size*. Length 4.5 mm; greatest width 2.0.

Female. Similar in form to ♂ but thorax much differently constructed. Meso-metanotum at level of acetabular bases abruptly right-angled, appearing subquadrate in side view. Connexiva directed inward and converging to base of meso-metanotum, then subparallel along inner edges of hind acetabula, hardly diverging posteriorly. A patch of stiff, black, posteriorly directed bristles on anterior 2/3 of meso-metanotum. Posterior margin of pronotum flattened and closely appressed to meso-metanotum. Antenna about 5/8 as long as body, 56 : 90; proportion of segments I-IV, 28 : 10 : 7 : 11. First anterior tarsal segment much longer than 2nd, 17 : 13. Intermediate femur to posterior femur, 64 : 50. Intermediate tibia to posterior tibia, 42 : 25. Coloration much as in ♂ but sternum extensively suffused with yellow. Length 4.7 mm; greatest width across hind margin of meso-metanotum 2.2.

Holotype ♂ (BISHOP 3009), Tutuila Island, Samoa, 10 June 1957, W. R. Kellen collector. Allotype, ♀ (BISHOP), same data as holotype. Paratypes, Samoa: Tafuna, Tutuila, 14 Feb. 1957, 3 ♀♀; 25 Feb. 1957, 4 ♂♂, 1 ♂; 8 July 1957, 1 ♀; 29 July 1957, 4 ♂♂; 5 Aug. 1957, 2 ♂♂, 3 ♀♀; 3 Sept. 1957, 10 ♂♂; 13 Sept. 1957, 10 ♂♂, 21 ♀♀ (BISHOP, BM, KANSAS, USNM, RLU, JLH), all collected by W. R. Kellen. Tutuila, 1 July 1957, 9 ♂♂, 4 ♀♀, Kellen. Falepuga, Upolu I., 28 July 1940, 1 ♂, 3 ♀♀, E. C. Zimmerman (BISHOP). Pago Pago Harbor, 6 Jan. 1953, 2 ♂♂, 1 ♀, M. W. Johnson. Satapuala, Upolu I., Oct. 1955, 1 ♂, 4 ♀♀, R. A. Cumber (QM).

Diagnosis. Belongs to the *mariannarum* group but easily separated from all species by the structure of the ♂ tergum 9 and styliform processes and the peculiar right angle bend to the meso-metanotum of the female.

Halobates princeps White

Halobates princeps White, 1883, Voy. Challenger, Rept. Zool. 7 (19): 44, pl. 1, fig. 3.

A very large, silver-gray species; ♂ slender, ♀ much broader and rounded throughout. Apical 3 antennal segments in proportion, 12 : 9 : 12 in both sexes. Basal segment of anterior tarsus much longer than apical, 20 : 12 in ♂, 25 : 15 in ♀. Meso-metanotum of ♀ bearing few short, scattered, stiff black bristles along sides, none present in ♂. Tergum 9 of ♂ longer than broad (fig. 70) and appearing subparallel-sided at middle. Styliform processes bent asymmetrically (figs. 71-72). Yellow markings of ventral surface of ♂ confined to posterior margins of abdominal segments and acetabular sutures.

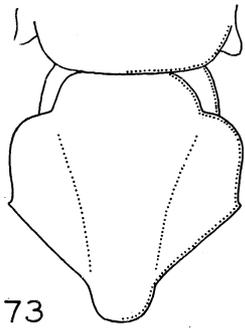
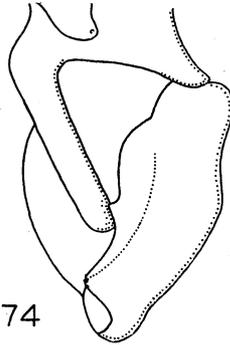
Male. *Head.* Antennae less than 2/3 as long as body, 67 : 124; proportion of segments I-IV, 34 : 12 : 9 : 12. Head a little broader than long between eyes, disc evenly swollen. Eyes large, interocular width about 3.5× width of an eye. *Thorax.* Pronotum with sides subrounded, not diverging posteriorly; shorter than head on median line, 9 : 19. Anterior and posterior margins shallowly concavely arcuate. Meso-metanotum anteriorly, abruptly roundly angled; width just behind anterior angles slightly narrower than head including eyes, 34 : 36, gradually increasing in width posteriorly, greatest width anterior to bases of acetabula, 34 : 46, sides slightly rounded. No black bristles present on thorax or acetabula. *Legs.* Anterior femur incrassate with a prominent angle on posterior margin just beyond basal 1/3, length (excluding trochanters) only slightly longer than tibiae, 42 : 40. Anterior tarsi with basal segment distinctly longer than apical segment, 20 : 12. Intermediate femur much longer than hind femur, 80 : 60. First segment of intermediate tarsus 3.5× as long as 2nd, 43 : 12. Intermediate tibia much longer than posterior tibia, 46 : 30. Hind tarsus

2-segmented, segment 1 is $1/2$ as long as 2. *Abdomen.* Styliform processes asymmetrical (figs. 71-72), broad and flattened, left process considerably longer than right process, almost straight and reaching postero-lateral margin of tergum 9. Neither process visible from above. Tergum 9 (fig. 70) longer than broad. Sides at middle slightly concave, superficially appearing parallel; a pair of postero-laterally directed prominences on antero-lateral and postero-lateral angles. *Coloration.* In great part blue-black with very fine gray pubescence. Rostrum, antennae, tergum 9 and legs, black. The pair of yellow, crescent-shaped markings of head extending forward to level of middle of eyes, not reaching middle pair of trichobothria. Yellow coloration of venter confined to posterior margins of abdominal segments 2-6; segments 7-9, including styliform processes, reddish brown. Acetabular sutures appearing only slightly pale while rest of mesosternum and acetabula concolorous. *Size.* Length 6.2 mm; greatest width 2.5.

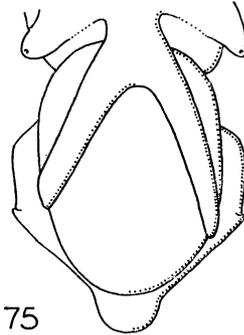
Female. Very much broader in form than ♂, sides of thorax more strongly dilated posteriorly and much more rounded throughout. Meso-metanotum scattered black bristles along sides. Antenna $2/3$ as long as body, 67 : 100; proportion of segments I-IV, 34 : 12 : 9 : 12. Head a little broader than long between eyes. Eyes quite large, interocular width $3.5 \times$ width of an eye. *Thorax.* Pronotum with sides subrounded, slightly diverging posteriorly; shorter than head on median line, 10 : 21. Anterior margin shallowly, posterior margin more deeply, concavely arcuate; hind margin flat and closely appressed to meso-metanotum in middle. Meso-metanotum anteriorly abruptly, roundly angled; width just behind anterior angles subequal to width of head including eyes, 35 : 35, gradually increasing in width posteriorly, greatest width at bases of middle acetabula, 35 : 55, sides rounded. Stiff, black, posteriorly-directed bristles along sides of thorax. *Legs.* Anterior femur hardly incrassate; length (excluding trochanters) only slightly longer than tibiae, 45 : 40. First anterior tarsal segment over $1.5 \times$ as long as 2nd, 25 : 15. First segment of intermediate tarsus over $3 \times$ as long as 2nd, 48 : 15. Hind tarsus 2-segmented, segment 1 is $1/2$ length of 2. Intermediate femur much longer than posterior femur, 80 : 60. Intermediate tibia much longer than posterior tibia, 51 : 34. *Coloration.* Uniformly blue-black above with silvery pubescence. Rostrum, antennae and legs, reddish brown. Yellow markings of head not reaching middle pair of trichobothria nor continuous on posterior margin of head. Yellow coloration of venter limited to posterior margins of abdominal segments. Length 6.5 mm; greatest width, 2.8.

White described this species from a single ♀ from the Celebes Sea. The type is in the British Museum. The ♂ described above was collected at Ternate I., Halmahera by J. J. Walker, no date (BM). It was compared with the type by R. L. Usinger (1958). The ♀ described above is from Penang, Malaya, no date or collector (KϕBENHAVN).

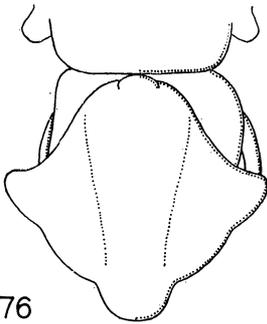
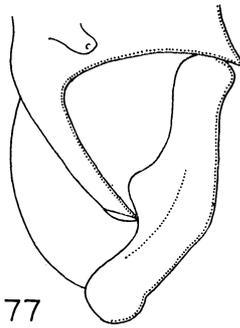
Variation. Superficially, there appears to be a great deal of variation in this species, particularly in the females. Because of the inconsistency between the size of the female material at my disposal and the size of the female type of this species, I had considered my material to represent a new species. However, further study of my material and further description of the type by R. L. Usinger (personal communication) has shown that 1, the type is shriveled to a large degree, and 2, the flexibility of the abdominal segments allows expansion of more than 1 mm beyond the normal size. I have female specimens before me that range from 5.2-6.5 mm. The latter specimens all have the abdomen abnormally expanded. The type of *princeps* being quite shriveled measures only 5.2 mm. The

73
alluaudi

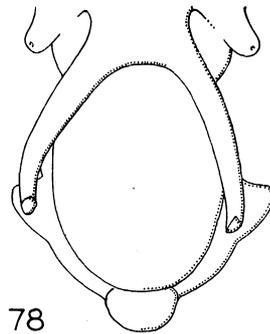
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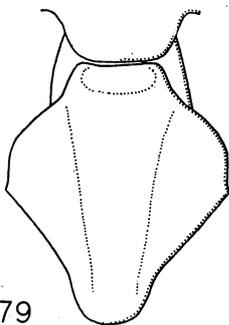
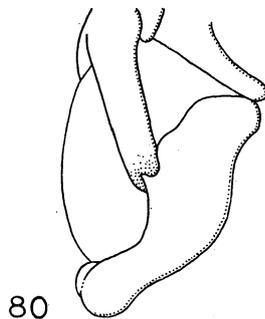
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browni

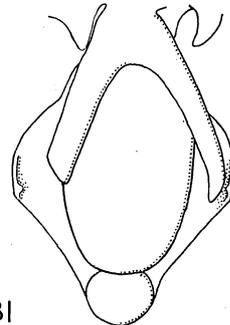
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tethys

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Figs. 73-81. 73, *H. alluaudi*, dorsal view of ♂ terminalia; 74, same, lateral view; 75, same, ventral view; 76, *H. browni*, dorsal view of ♂ terminalia; 77, same, lateral view; 78, same, ventral view; 79, *H. tethys*, dorsal view of ♂ terminalia; 80, same, lateral view; 81, same, ventral view.

probable normal size range for females of this species is 5.8–6.0 mm, while normal males measure 6.4 to 6.6 mm. This is borne out by the fact that there is a remarkable lack of variation in the ratio of the various parts of the body; even the smallest specimens before me have the same absolute head width and anterior tarsal lengths as those that measure 6.5 mm.

H. princeps falls into the *mariannarum* group. It is the largest species in the group as well as in the genus. The very large size, extra-long first anterior tarsal segment and the structure of the male terminalia will readily distinguish it.

Material examined: Varbusi, New Guinea, 1895, 1 ♂, Beccari, (USNM); Ternate I., Halmahera, no date, 2 ♂♂, J. J. Walker (BM); Palau Is., no date, no collector, 1 ♂ (BM); Goram I., 1872, 1 ♂, D'Albertis, (USNM); [probably Palau], 1 ♀ (BM); Biaro I., 5 July 1929, 1 ♀, Dana Exped. (Dana); "Nord Ocean, 103–120 E", no date, 1 ♀, Andria, (K ϕ BENHAVN); Madoera I., 1870, 1 ♀, Andria (K ϕ BENHAVN); Penang, Malaya, no date, 1 ♀, Cornelius (K ϕ BENHAVN). For the distribution pattern of this species see map 4.

Halobates browni Herring, n. sp.

A very large, slender, dark gray to black species, ♂ subparallel-sided, ♀ stouter. Apical 3 antennal segments in the proportion, 12 : 9 : 11 in ♂ and 11 : 9 : 11 in ♀. Basal segment of anterior tarsus longer than apical, 13 : 11 in ♂, 16 : 13 in ♀. No black bristles on meso-metanotum of either sex. Styliform processes of ♂ flared outward, flattened and shining at apices, neither process visible from above. Tergum 9 (fig. 76) a little broader than long. Yellow coloration of venter of ♂ limited to most of abdominal segments and acetabula; more extensive in ♀.

Male. *Head*. Antenna short, slightly over 1/2 as long as body, 66 : 122, proportion of segments I–IV, 34 : 12 : 9 : 11. Head almost as broad as long between eyes; disc evenly swollen and with an obscure crescent-shaped keel along posterior margin. Eyes quite large, interocular width scarcely 2.5 × width of an eye. *Thorax*. Pronotum with sides subrounded, gradually diverging posteriorly; shorter than head on median line, 9 : 18. Anterior and posterior margins only slightly, concavely arcuate, appearing subrectilinear. Meso-metanotum anteriorly, abruptly roundly angled; width just behind anterior angles slightly greater than head including eyes, 32 : 30, hardly increasing in width posteriorly, greatest width just anterior to middle acetabula, 32 : 38; sides subrectilinear and appearing subparallel. No black bristles present on thorax or acetabula. *Legs*. Anterior femur incrassate; length (excluding trochanters) 1/5 longer than tibia, 40 : 33. Basal segment of anterior tarsus distinctly longer than apical, 13 : 11. Segment 1 of intermediate tarsus about 3 × as long as 2. Intermediate femur longer than posterior femur, 70 : 56. Intermediate tibia much longer than posterior tibia, 45 : 26. *Abdomen*. Styliform processes asymmetrical, the right process more divergent (figs. 77–78), both processes flattened and shining at apices. Tergum 9 (fig. 76) slightly broader than long, prominently flared at middle. *Coloration*. Uniformly blue-black above with fine gray pubescence. Rostrum, antennae, legs, tergum 9 and styliform processes, dark brownish black. Yellow markings of head triangular, not reaching middle pair of trichobothria nor continuous across keel on posterior margin. Venter with posterior margin of abdominal segments 1–5, middle of segment 6, central area of segment 7 and acetabula, dull yellow. Remainder of venter

reddish-brown to black. *Size.* Length 6.5 mm; greatest width 2.0.

Female. Similar to ♂ but more robust posteriorly. Meso-metanotum without stout black bristles. Antenna short, less than 2/3 as long as body, 63 : 110; proportion of segments I–IV, 32 : 11 : 9 : 11. First anterior tarsal segment distinctly longer than 2nd, 16 : 13. Ratio of intermediate to posterior femora, 68 : 52; intermediate to posterior tibiae, 45 : 25. Coloration as in ♂ except yellow coloration of venter more extensive, meso-metanotum with a prominent yellow stripe extending forward to anterior coxae. Length 6.0 mm; greatest width 2.3.

Holotype, ♂ (BM), and allotype, ♀ (BM), Webster Cove, Kolombangara I., British Solomons, 12 Oct. 1954, E. S. Brown.

Diagnosis. This species is related to *matsumurai* Esaki, *formidabilis* Distant, *neris* n. sp. and *tethys* n. sp. The elongate cylindrical shape, structure of the tergum 9 and styliform processes will readily distinguish the males. The large size, lack of black bristles on meso-metanotum, and elongate cylindrical shape with greatest width through hind margin of hind acetabula will separate the females.

Halobates matsumurai Esaki

Halobates matsumurai Esaki, 1924, *Psyche* 31 : 117, pl. 5, fig. D.

A large dark species with apical 3 antennal segments in proportion, 14 : 10 : 11 in ♂, 10 : 9 : 11 in ♀. Basal segment of anterior tarsus distinctly longer than 2nd segment 14 : 12 in ♂, 20 : 17 in ♀. A few very obscure black bristles along sides of meso-metanotum of ♀, none in ♂. Styliform processes of ♂ almost symmetrical, both spatulate at apices (figs. 68–69). Tergum 9 a little longer than broad (fig. 67). Yellow coloration of venter of ♂ limited to abdominal segments, acetabula and anterior coxae and trochanters; coloration of ♀ venter much more extensive.

Male. *Head.* Antenna almost 2/3 as long as body, 70 : 110; proportion of segments I–IV, 35 : 14 : 10 : 11. Head about as long as broad between eyes, disc evenly swollen. Eyes large, interocular width about 3.5× width of an eye. *Thorax.* Pronotum with sides subrounded, diverging posteriorly; shorter than head on median line, 8 : 18. Anterior and posterior margins shallowly concavely arcuate. Meso-metanotum anteriorly abruptly roundly angled; width just behind anterior angles slightly wider than head including eyes, 33 : 32, gradually increasing in width posteriorly, greatest width at bases of middle acetabula, 33 : 46, sides broadly rounded. No black bristles on meso-metanotum. *Legs.* Anterior femur strongly incrassate; length (excluding trochanter) about 1/8 longer than tibia, 40 : 35. Basal segment of anterior tarsus distinctly longer than apical, 14 : 12. First segment of intermediate tarsus 3× as long as 2nd, 40 : 13. Hind tarsus 2-segmented, segment 1 is 1/2 length of 2. Intermediate femur longer than posterior femur, 65 : 50. Intermediate tibia much longer than hind tibia, 40 : 30. *Abdomen.* Styliform processes (figs. 68–69) almost symmetrical, both spatulate at apices, neither visible from above. Tergum 9 (fig. 67) little longer than broad. *Coloration.* Uniformly blue-black with silver gray pubescence. Rost- rum, antennae, legs, middle of tergum 9, dark reddish-brown, lateral and posterior margins of tergum 9, bright yellow-orange. Yellow markings of head crescent-shaped, extending well beyond middle of eyes but not reaching middle pair of trichobothria, almost continuous on posterior margin. Yellow coloration of venter limited to abdominal segments, ace-

tabula and anterior coxae and trochanters. *Size.* Length 6.0 mm; greatest width 2.4.

Female. Similar to ♂ in form but much more oval in outline. A few, very obscure, black bristles along sides of thorax. Antenna about 4/7 as long as body, 60 : 105; proportion of segments I-IV, 30 : 10 : 9 : 11. First anterior tarsal segment distinctly longer than 2nd, 20 : 17. Intermediate to posterior femora, 67 : 49. Intermediate to posterior tibia, 42 : 31. Yellow coloration of venter much more extensive than in ♂, almost entire venter including acetabula, anterior coxa, trochanter and basal 1/2 of anterior femur, pale yellow. Length 5.6 mm; greatest width 2.9.

Esaki described this species from material collected from the coast of Tansui, near Taihoku, N. Formosa. He also designated paratypes from the inland sea of Japan and the coast of East China Sea. The types are in the Esaki Collection at Fukuoka, Japan. The pair described above was collected by S. Shoji at Amminto (Chushin-Nando) Korea, 27 July 1929 (CJD).

This species, as well as others mentioned elsewhere, has been synonymized with *princeps* by Esaki. About the only characteristic that it has in common with that species is size. *H. matsumurai* is most closely related to *browni*. The males may be readily distinguished from all species by the structure of tergum 9 and styliform processes. The combination of size, and body shape, which is oval and much broader at bases of the legs than at the anterior margin of the meso-metanotum, will separate the females.

Material examined: In addition to the pair described above, I have seen 1 ♂ and 2 ♀♀ from Chusan I., China, collected by J. J. Walker in 1892 (BM).

Halobates formidabilis (Distant)

Euratas formidabilis Dist., 1910a, Ann. Mag. Nat. Hist. ser. 8, 5: 146; 1910b, Fauna India, RHYN. 5: 154.—Annandale & Kemp 1915, Ind. Mus., Mem. 5: 183 (= *Fabatus servus* (Dist.))

Halobates formidabilis, Esaki, 1929, Ann. Mag. Nat. Hist. ser. 10, 4: 417.

Fabatus servus Distant, 1910a, *op. cit.* ser. 8, 5: 147; 1910b, Fauna India, RHYN. 5: 155.

I have not seen this species but the structure of the terminalia and particularly the long spines on the anterior tibiae will readily separate the males from all known species. The females are unknown to me. Dr. W. E. China has furnished me with figs. 113 and 114 of the male terminalia of the type as well as the following measurements: (24 units = 1 mm). Antennal segments I-IV, 49 : 15 : 11 : 13; anterior tarsal segments, 15 : 15; middle femora, 153, hind femora, 98. Total length of body, 5.1 mm. No black spines on dorsum of male genital plate. I have tentatively placed *formidabilis* females in the key, using the characters of size and subequal anterior tarsal segment. I am assuming that the anterior tarsal segments of the female are subequal as in the male. Distant recorded *formidabilis* from the Andaman Sea and Annandale and Kemp found it in Chilka Lake on the Bay of Bengal.

Halobates nereis Herring, n. sp.

A medium-sized silver gray species with apical 3 antennal segments in the proportion, 11 : 9 : 10 in ♂ and 10 : 8 : 10 in ♀. Basal segment of anterior tarsus longer than apical,

11 : 10 in ♂, comparatively longer in ♀, 16 : 14. Stiff, black bristles sparsely scattered over sides of meso-metanotum of both sexes. Styliform processes almost symmetrical, both processes flattened and shining at apices, neither process visible from above (fig. 84). Tergum 9 about as broad as long (fig. 82). Yellow coloration of venter of ♂ limited to abdominal segments and acetabula; more extensive in ♀.

Male. *Head.* Antenna $5/8$ as long as body, 60 : 96, proportion of segments I-IV, 30 : 11 : 9 : 10. Head about as broad as long between eyes, disc evenly swollen. Eyes quite large, interocular width $3\times$ width of an eye. *Thorax.* Pronotum with sides subrounded, slightly diverging posteriorly; shorter than head on median line, 7 : 17. Anterior and posterior margins shallowly, concavely arcuate. Meso-metanotum anteriorly, abruptly roundly angled; width just behind anterior angles subequal to width of head including eyes, 29 : 29, gradually increasing in width posteriorly, greatest width through middle acetabula, 29 : 40; sides almost straight. Sparse, stiff black bristles scattered over postero-lateral margins of meso-metanotum. *Legs.* Anterior femur moderately incrassate; length (excluding trochanter) $1/6$ longer than tibia, 40 : 33. Anterior tarsus with basal segment distinctly longer than apical, 11 : 10. First segment of intermediate tarsi slightly over $3\times$ as long as 2nd, 35 : 11. Hind tarsus 2-segmented, segment 1 is $1/2$ length of 2. Intermediate femur much longer than posterior femur, 63 : 47. Intermediate tibia much longer than posterior tibia, 38 : 23. *Abdomen.* Styliform processes almost symmetrical (fig. 84), both processes with shiny, flattened, triangular areas at apices; neither process visible from above. Tergum 9 as long as broad and with characteristic lateral flanges at middle (fig. 82). *Coloration.* Uniformly blue-black above with fine gray pubescence. Rostrum, antennae, legs and tergum 9 shining black. Yellow markings of head crescent-shaped, continuous on hind margin. Yellow coloration of venter limited to abdominal segments and acetabula. *Size.* Length 5.0 mm; greatest width 2.0.

Female very similar to ♂ but more robust posteriorly. Meso-metanotum with scattered black bristles, as in ♂. Antenna much less than $2/3$ as long as body, 54 : 96; proportion of segments I-IV, 26 : 10 : 8 : 10. First anterior tarsal segment distinctly longer than 2nd, 16 : 14. Intermediate to posterior femora, 65 : 46; intermediate to posterior tibiae, 40 : 25. Coloration as in ♂ except venter extensively suffused with yellow. Length 5.0 mm; greatest width, 2.5.

Holotype ♂ (BISHOP 3010), allotype ♀ (BISHOP), Koror, Palau Islands, 28 June 1956, collected by B. McDaniel. Paratypes, (KANSAS, CJD-USNM, JLH), same data as above, 3 ♂♂, 2 ♀♀; Ngaremlengui (Arumonogui), Babelthuap, Palau Is., 14 Mar. 1936, 1 ♂, 1 ♀, T. Esaki; Madang Territory, NE New Guinea, 6 May 1929, 1 ♂, K. P. Schmidt.

Diagnosis: This species belongs to the *browni* group and seems to be most closely related to *tethys*. The males can be distinguished from all species by the structural characteristics of the tergum 9 and styliform processes (figs. 82-84). The females can be distinguished from *tethys* by the proportionately shorter first anterior tarsal segment, second and fourth antennal segment, subequal, and the pattern of black bristles on mesometanotum.

Halobates tethys Herring, n. sp.

A medium-sized silver gray species with apical 3 antennal segments in the proportion

11 : 9 : 12 in ♂ and 10 : 9 : 12 in ♀ Basal segment of anterior tarsus longer than apical, 13 : 11 in ♂, 18 : 14 in ♀. Prominent, stiff, black posteriorly directed bristles along sides of meso-metanotum of ♀, none in ♂. Styliform processes short, flat and rounded at apices; neither visible from above (fig. 81). Tergum 9 longer than broad (fig. 79).

Male. *Head.* Antenna less than $2/3$ as long as body, 65 : 106; proportion of segments I-IV, 33 : 11 : 9 : 12. Head about as long as broad between eyes, disc evenly swollen. Eyes large, interocular width about $3\times$ width of an eye. *Thorax.* Pronotum with sides subrounded, not diverging posteriorly; shorter than head on median line; 8 : 17. Anterior margin shallowly, concavely arcuate; posterior margin hardly arcuate, almost straight. Meso-metanotum anteriorly, abruptly roundly angled; width just behind anterior angles subequal to width of head including eyes, 28 : 28, gradually increasing in width posteriorly, greatest width through middle acetabula, 28 : 40; sides rounded. No black bristles on meso-metanotum. *Legs.* Anterior femur only moderately incrassate; length (excluding trochanter) $1/8$ longer than tibia, 40 : 35. First anterior tarsal segment distinctly longer than 2nd, 13 : 11. Intermediate and posterior tibiae and tarsi missing. Intermediate femur longer than posterior femur, 65 : 52. *Abdomen.* Styliform processes relatively short (fig. 81), neither process surpassing postero-lateral angles of tergum 9 nor visible from above; both flattened and broadly rounded at their apices. Tergum 9 longer than broad (fig. 79). *Coloration.* Uniformly blue-black above with fine gray pubescence. Rostrum, antenna, legs and middle of tergum 9, shining black. Lateral margins of tergum 9, ventral abdominal segments and acetabula, yellow. Yellow markings of head, crescent shaped, not reaching middle pair of trichobothria. *Size.* Length 5.3 mm; greatest width 2.0.

Female. Much more robust than ♂. Meso-metanotum with conspicuous black, posteriorly directed bristles along sides. Antenna less than $2/3$ as long as body, 61 : 98, proportion of segments I-IV, 30 : 10 : 9 : 12. First anterior tarsal segment distinctly longer than 2nd, 18 : 14. First segment of intermediate tarsus almost $3\times$ as long as 2nd, 37 : 13. Hind tarsus 2-segmented, segment 1 is $1/2$ length of 2. Intermediate femur longer than posterior femur, 68 : 55; intermediate to posterior tibiae, 45 : 27. Coloration as in ♂ except venter much more extensively suffused with yellow. Almost entire abdominal segments, sternum except lateral margins, anterior coxa, trochanter and basal $1/2$ of anterior femur below, bright yellow. Length 5.0 mm; greatest width through middle acetabula, 2.5.

Holotype, ♂ (KANSAS), Pointe aux Sables, Mauritius, Aug. 1949, M. Marot; allotype, ♀ (KANSAS), Black River, Mauritius, 14 Nov. 1948, L. P. Regnard. One paratype, (JLH), same data as holotype.

Diagnosis. This species belongs to the *browni* group and appears to be most closely related to *nereis*. The males can be distinguished from all species by the structural characteristics of the tergum 9 and styliform processes (figs. 79-81). The females can be separated from *nereis* by the proportionately longer first anterior tarsal segment, unequal second and fourth antennal segments, pattern of black bristles on meso-metanotum and the more extensive yellow coloration of the venter, particularly the anterior femora.

Halobates mjobergi Hale

Halobates mjobergi Hale, 1925, Arkiv Zool. 17 A (20) : 12, fig. 7.—China, 1957, Linn. Soc. Lond., Jour. Zool. 43 (291) : 342 (subgenus *Hilliella*).

A very small brown and yellow species with apical 3 antennal segments in the proportion 9 : 9 : 10 in ♂ and 10 : 10 : 10 in ♀. Basal segment of anterior tarsus very short, 1.5 : 8 in ♂, 2.25 : 9 in ♀. No stiff black bristles on meso-metanotum of either sex. Styli-form processes symmetrical; long and slender; both processes visible from above. Tergum 9 (figs. 25-27) about as long as broad.

Male. *Head.* Antenna over 2/3 as long as body, 53 : 47, proportion of segments I-IV, 25 : 9 : 9 : 10. Head about as long as broad between eyes, disc evenly swollen. Eyes large, interocular width about 3× width of an eye. *Thorax.* Pronotum with sides subrounded, hardly diverging posteriorly; shorter than head on median line, 5 : 12. Anterior and posterior margins prominently, concavely arcuate. Meso-metanotum anteriorly not abruptly roundly angled, width just behind posterior margins of pronotum almost subequal to width of head including eyes, 22 : 23, gradually increasing in width posteriorly, greatest width through middle acetabula, 22 : 28; sides rounded. No black bristles on meso-metanotum. *Legs.* Anterior femur only slightly incrassate; length (excluding trochanter) much longer than tibia, 32 : 20. First anterior tarsal segment very short, only 1/5 as long as 2nd, 1.5 : 8. Intermediate tarsi missing. Hind tarsus 1-segmented. Intermediate femur only slightly longer than posterior femur, 42 : 40. Intermediate tibia missing. *Abdomen.* Styli-form processes almost symmetrical, long, slender and diverging at apices, Both processes visible from above. Tergum 9 about as broad as long (figs. 25-27). *Coloration.* Predominantly brown and yellow, with grayish shining pubescence. Head, yellow, with a central dark stripe. Antennae dark brown with base of each segment yellow. Pronotum brown, with lateral edges, and an anterior and posterior marginal fascia, yellow. Meso-metanotum brown; segments 7-9 pale yellow. Anterior femur and tibia, and intermediate and posterior femora, yellow with longitudinal stripe and apices, dark brown; remaining limb segments dark brown. Entire venter, bright yellow, except apical 1/2 of rostrum and styliform processes, black. *Size.* Length 3.8 mm; greatest width 1.4.

Female. Very similar to ♂ but much more triangular in form. Meso-metanotum with obscure, slender, pale bristles scattered over disc. Antenna 4/5 as long as body, 58 : 70, proportion of segments I-IV, 28 : 10 : 10 : 10. First anterior tarsal segment very short, only 1/4 as long as 2nd, 2.25 : 9. Intermediate to posterior femora, 45 : 44. Intermediate to posterior tibiae 35 : 19. Coloration as in ♂. Length 3.6 mm; greatest width 2.2.

Described from a pair of paratypes, Broome, NW Australia, 16 June 1911, Mjoberg (KANSAS).

Variation. I have seen only the pair of specimens described above, but Hale (1925) states that there is some variation in color; the pronotum sometimes lacks the posterior yellow fascia, only the anterior angles being pale, or the whole of the posterior and lateral margins may be edged with yellow; and occasionally almost the whole of the dorsum of the tergum 9 of the male is brown.

This species belongs to a group with extensive yellow coloration of the head and very short, first anterior tarsal segment. The striking color pattern, extremely short first anterior tarsal segment, small size, antennal formula and structure of the male terminalia will readily distinguish it.

China (1957) described the subgenus *Hilliella* for the reception of *mjobergi* and "*H. apicalis*." Unfortunately he overlooked the fact that the latter species as well as *shiranui* have been transferred to the genus *Asclepios*. After pointing this out to Dr. China, he

agreed that his subgenus would have to sink as a synonym of *Asclepios* but that he believed that *mjobergi* should be transferred to that genus, a belief that I do not share. The criteria for separating these two genera have been discussed earlier. If *mjobergi* were transferred to *Asclepios* there would be only color pattern to differentiate the two genera. *H. mjobergi* is known only from the type locality which is shown on map 7.

Halobates zephyrus Herring, n. sp.

A small brown species with much yellow coloration. Apical 3 antennal segments in the proportion 11 : 9 : 10 in ♂ and 11 : 9 : 12 in ♀. Obscure brown bristles scattered over meso-metanotum of ♀, none visible in ♂. Styliform processes slender, almost symmetrical, apices of both processes visible from above, tergum 9 broader than long (figs. 28-30).

Male. *Head.* Antennae over 2/3 as long as body, 58 : 80, proportion of segments I-IV, 28 : 11 : 9 : 10. Head about as broad as long between eyes, disc evenly swollen. Eyes large, interocular width about 3× width of an eye. *Thorax.* Pronotum with sides subrounded, postero-lateral angles swollen, raised considerably above level of anterior margin of meso-metanotum; shorter than head on median line, 7 : 14. Anterior and posterior margins prominently concavely arcuate. Meso-metanotum anteriorly abruptly roundly angled, width just behind anterior angles subequal to width of head including eyes, 27 : 27, gradually increasing in width posteriorly, greatest width through middle acetabula, 27 : 37; sides rounded. No prominent bristles on meso-metanotum. *Legs.* Anterior femur moderately incrassate, length (excluding trochanter) much longer than tibia, 35 : 26. First anterior tarsal segment very short, less than 1/3 as long as 2nd, 3 : 11. First segment of intermediate tarsus about 3× as long as 2nd, 35 : 12. Posterior tarsus 1-segmented. Intermediate femur somewhat longer than posterior femur, 50 : 46. Intermediate tibia almost twice as long as posterior tibia, 40 : 21. *Abdomen.* Styliform processes slender, almost symmetrical, apices of both processes visible from above (figs. 28, 30). Tergum 9 broader than long (fig. 28). *Coloration.* Predominantly brown to black above with yellow markings. Head yellow with a central dark stripe. Antenna dark brown with base of segment I yellow. Legs brown except for broad triangular stripe on anterior and posterior margin of anterior femur, yellow. Posterior margins of abdominal segments 5-8 yellow. Tergum 9 brown with paler lateral margins. Almost entire venter yellow, except for a spot on each anterior trochanter and apices of styliform processes, brown. *Size.* Length 4.0 mm; greatest width 1.8.

Female. Similar to ♂ but more robust. Meso-metanotum with obscure, slender brown bristles scattered over disc. Antenna 2/3 as long as body, 61 : 90, proportion of segments I-IV, 29 : 11 : 9 : 12. Anterior tarsal segment 1 very short, 4.5 : 15. Intermediate femur relatively longer than in ♂, ratio to posterior femur, 56 : 48. Intermediate tibia much longer than posterior tibia, 44 : 24. Coloration as in ♂. Length 4.5 mm; greatest width 2.4.

Holotype ♂ (CJD-USNM), and allotype ♀ (CJD-USNM), Bribie I., Queensland, Australia, 26 Dec. 1930, H. Hacker (CJD). Paratypes: same date as above, 2 ♂♂, 3 ♀♀ (CJD); Moolooak, Australia, 6 Apr. 1912, 1 ♂, H. Hacker (CJD); Moreton Bay, SE Queensland, 1 Jan. 1953, 3 ♂♂, 4 ♀♀, T. E. Woodward (QM).

Diagnosis. This species belongs to the *mjobergi* group. It is most closely related to that species but may be distinguished by the lack of yellow fasciae on pronotum, proportionately longer first anterior tarsal segment and antennal ratio. In addition, the male terminalia are quite distinctive. It can be separated from *whiteleggei* Skuse, *darwini* n. sp. and *peronis* by the different antennal and tarsal proportions and the cylindrical styliform processes.

Halobates whiteleggei Skuse

Halobates whiteleggei Skuse, 1891, Austr. Mus., Rec. 1 (8): 174, pl. 27, figs. 1-10; 1893, *op. cit.* 2 (1): 44.

A small dark brown to black species with prominent yellow stripes on head. Apical 3 antennal segments in proportion 9 : 7 : 9 in ♂, 11 : 8 : 11 in ♀. Basal segment of anterior tarsus short, 4 : 11 in ♂, 9 : 17 in ♀. Stiff black bristles scattered over meso-metanotum of ♀, none present in ♂. Styliform processes relatively short, stout and flattened; apices of both processes visible from above, tergum 9 little broader than long (figs. 31-33).

Male. Head. Antennae about 2/3 as long as body, 53 : 80; proportion of segments I-IV, 28 : 9 : 7 : 9. Head about as broad as long between eyes, disc somewhat depressed laterally. Eyes large, interocular width about 3× width of an eye. **Thorax.** Pronotum with sides subrounded, hardly diverging posteriorly, shorter than head on median line, 7 : 14; anterior and posterior margins shallowly, concavely arcuate. Meso-metanotum anteriorly, abruptly roundly angled, width just behind posterior margins of pronotum subequal to width of head including eyes, 26 : 26, gradually increasing in width posteriorly, greatest width through middle acetabula, 26 : 80; sides rounded. No black bristles on meso-metanotum. **Legs.** Anterior femur only moderately incrassate; length (excluding trochanter) much longer than tibia, 35 : 25. First anterior tarsal segment short, less than 1/2 as long as 2nd, 4 : 11. First segments of intermediate tarsus 3× as long as 2nd, 36 : 12. Intermediate femur longer than posterior femur, 50 : 44. Intermediate tibia longer than posterior tibia, 35 : 22. **Abdomen.** Styliform processes relatively short, stout and flattened; apices of both processes visible from above (fig. 31). Tergum 9 about as long as broad. **Coloration.** Dark brown to black with prominent yellow stripes along sides of head between eyes. Base of antennal segment 1, base of anterior femur and lateral margins of tergum 9, yellow. Entire venter yellow except apices of styliform processes brown. **Size.** Length 4.0 mm; greatest width 1.9.

Female. Similar to ♂ but more robust and with relatively longer appendages. Head depressed laterally between eyes. Meso-metanotum with obscure brown bristles scattered over disc. Antenna over 2/3 as long as body, 63 : 90; proportion of segments I-IV, 33 : 11 : 8 : 11. First anterior tarsal segment short, 9 : 17. Posterior coxae very long, subequal in length to width of head including eyes. Intermediate femur longer than posterior femur, 62 : 48. Intermediate tibia longer than posterior tibia, 45 : 30. Coloration as in ♂. Length 4.5 mm; greatest width 2.5.

Skuse described this species from material from Port Jackson, N. S. W., Australia. The types are in the Australian Museum. The pair described above were collected at Gundaian, Port Hacking, New South Wales, 12 Mar. 1927 by T. G. Campbell (AM) and were compared with the type by A. Musgrave.

This species belongs to the *mjobergi* group. The males can be separated from all species in the group by the structure of the styliform processes and ninth tergum (figs. 31 to 33). The females may be distinguished by the very long hind coxae, anterior tarsal ratio and antennal ratio.

Material examined: Same data as above, 2 ♂♂, 3 ♀♀ (AM); Bribie I., Queensland, 26 Dec. 1930, 1 ♀, H. Hacker (CJD); Myora, Stradbroke I., Moreton Bay, Queensland, 1 Jan. 1953, 5 ♂♂, 3 ♀♀, 1 nymph, T. E. Woodward (QM); Port Jackson, 1 ♂ (AM).

Halobates darwini Herring, n. sp.

A small dark species with prominent yellow stripes on head. Apical 3 antennal segments in proportion 10 : 8 : 10 in ♂. ♀ unknown. Basal segment of anterior tarsus short, 7 : 11. No stiff black bristles on meso-metanotum or acetabula. Styliform processes asymmetrical, stout and boot-shaped at apices (figs. 35-36). Tergum 9 triangular, longer than broad (fig. 34).

Male. *Head.* Antenna almost $\frac{2}{3}$ as long as body, 58 : 90; proportion of segments I-IV, 30 : 10 : 8 : 10. Head about as long as broad between eyes, disc slightly depressed laterally. Eyes large, interocular width slightly greater than $2.5 \times$ width of an eye. *Thorax.* Pronotum with sides subrounded, hardly diverging posteriorly; shorter than head on median line, 7 : 15. Anterior margin almost straight, posterior margin shallowly concavely arcuate. Meso-metanotum anteriorly abruptly roundly angled, width just behind anterior angles narrower than width of head including eyes, 25 : 27, gradually increasing in width posteriorly, greatest width through middle acetabula, 25 : 35, sides almost straight. No black bristles on meso-metanotum. *Legs.* Anterior femur moderately incrassate, length (excluding trochanter) about $\frac{1}{5}$ longer than tibia, 36 : 28. First anterior tarsal segment less than $\frac{1}{2}$ as long as 2nd, 5 : 11. First segment of intermediate tarsus slightly over $3 \times$ as long as 2nd, 32 : 10. Hind tarsus appears to be 1-segmented. Intermediate femur much longer than posterior femur, 58 : 48. Intermediate tibia longer than posterior tibia; 37 : 22. *Abdomen.* Styliform processes asymmetrical, stout and boot-shaped at apices; both processes visible from above (figs. 34-36). Tergum 9 triangular and longer than broad (fig. 34). *Coloration.* Dark blue-black to black with prominent yellow stripes along sides of head between eyes. Base of antennal segment 1, lateral margins of terga 8-9, yellow. Yellow coloration of venter limited to abdominal segments, acetabula, coxae and trochanters. Apices of styliform processes brown. Legs reddish brown. *Size.* Length 4.5 mm; greatest width 1.8.

Holotype ♂ (BM), Port Darwin, Northern Territory, Australia, date and collector unknown. This species is named for Charles Darwin.

Diagnosis. This species belongs to the *mjobergi* group. It is most closely related to *whiteleggei*, but can be readily distinguished from that species by the structure of the ninth tergum and styliform processes. In addition, it is larger with relatively longer intermediate and posterior femora and longer first tarsal segments.

Halobates peronis Herring, n. sp.

A small, dark brown to black species with apical 3 antennal segments in proportion 9 : 8 : 10 in both sexes. Basal segment of anterior tarsus shorter than apical segment, 3 :

8 in ♂; 4 : 10 in ♀. No black bristles on meso-metanotum of either sex. Styliform processes stout and boot-shaped at apices; both processes visible from above (figs. 23-24). Tergum 9 broader than long, with prominent antero-ventrally directed prominences in front of middle.

Male. *Head.* Antenna almost $\frac{2}{3}$ as long as body, 52 : 78; proportion of segments I-IV, 25 : 9 : 8 : 10. Head as broad as long between eyes, disc evenly swollen. Eyes very large, interocular width slightly over twice width of an eye. *Thorax.* Pronotum with sides subrounded, shorter than head on median line, 6 : 12. Anterior margin, shallowly, posterior margin strongly, concavely arcuate; postero-lateral margins strongly swollen. Meso-metanotum anteriorly abruptly roundly angled; width just behind anterior angles narrower than width of head including eyes, 22 : 24, gradually increasing in width posteriorly, greatest width through middle acetabula, 22 : 30, sides almost straight. No black bristles on meso-metanotum. *Legs.* Anterior femur moderately incrassate; length (excluding trochanter) $\frac{1}{6}$ longer than tibia, 30 : 25. First anterior tarsal segment $\frac{2}{5}$ length of 2nd, 3 : 8. Intermediate femur much longer than posterior femur, 51 : 41. Intermediate tibia longer than posterior tibia, 34 : 19. *Abdomen.* Styliform processes asymmetrical, left process shorter than right process; both greatly enlarged and boot-shaped at their apices, visible from above (figs. 22-24). Tergum 9 broader than long with a pair of prominent antero-ventrally directed flanges in front of middle (fig. 22). *Coloration.* Dark brown to black above with brown appendages. Lateral margins of tergum 9, ventral abdominal segments, acetabula, anterior coxae and trochanters, yellow-orange. Apices of styliform processes, dark brown. *Size.* Length 3.9 mm; greatest width 1.5.

Female. Very similar to ♂ but more robust posteriorly. Meso-metanotum without black bristles. Antenna slightly less than $\frac{2}{3}$ as long as body, 50 : 78; proportion of segments I-IV, 23 : 9 : 8 : 10. First anterior tarsal segment about $\frac{2}{5}$ length of 2nd, 4 : 10. Intermediate to posterior femora, 52 : 42; intermediate to posterior tibiae, 34 : 19. Coloration as in ♂ but yellow coloration of venter extending forward to anterior coxae. Length 3.9 mm; greatest width 2.0.

Holotype ♂ (BM), allotype ♀ (BM), Star Harbor, San Cristobal I., British Solomons, 24 Apr. 1955, E. S. Brown. Paratypes: Same data as above, 9 ♂♂, 14 ♀♀; Solomon Is.: Gatere, Ysabel I., 19 Feb. 1956, 2 ♂♂, 2 ♀♀, E. S. Brown (BM); Webster's Cove, Kolombangara I., 12 Oct. 1954, 1 ♂, 1 ♀, Brown (BM); Jack Harbor, Kolombangara I., 1 Oct. 1954, 5 ♂♂, 3 ♀♀, Brown (BM); Karikana, Kolombangara I., 14 Oct. 1954, 4 ♂♂, 2 ♀♀, Brown (BM); Rendova I., 8 Oct. 1954, 1 ♂, 3 ♀♀, Brown (BM); Kokorana, Rendova I., 9 Oct. 1954, 2 ♀♀, Brown (BM); Madoliana, Nggela Is., 9 Nov. 1956, 1 ♀, Brown (BM). Philippines: Dagupan, Pangasinan (Lingayen Gulf), 10 May 1936, 24 ♂♂, 16 ♀♀, R. Abalos (KANSAS).

Diagnosis. This species belongs to the *mjobergi* group. Both sexes can be separated from other members of the group by the anterior tarsal ratio and body size. There are no black bristles on meso-metanotum of either sex. The boot-shaped styliform processes of male will readily distinguish this species.

Halobates proavus White

Halobates proavus White, 1883, Voy. Challenger, Rept. Zool. 7 (19): 54, pl. 2, fig. 1.

A small, dark species with apical 3 antennal segments in the proportion 10 : 7 : 9 in

♂, 12 : 9 : 10 in ♀. Basal segment of anterior tarsus very short, 3 : 9 in ♂, 6 : 14 in ♀. Stout black bristles on meso-metanotum of both sexes. Styliform processes asymmetrical, relatively slender; left process directed outward and visible from above (figs. 37-39). Tergum 9 triangular, much broader than long (fig. 37).

Male. *Head*. Antenna over $\frac{2}{3}$ as long as body, 49 : 70; proportion of segments I-IV, 23 : 10 : 7 : 9. Head broader than long between eyes, disc evenly swollen. Eyes large, interocular width $3\times$ width of an eye. *Thorax*. Pronotum with sides subrounded, greatly diverging posteriorly; shorter than head on median line, 6 : 10. Anterior margin slightly, posterior margin hardly, concavely arcuate. Meso-metanotum anteriorly, abruptly roundly angled, width behind anterior angles greater than width of head including eyes, 32 : 24, not increasing in width posteriorly, 32 : 32, sides straight and subparallel. Prominent black posteriorly directed bristles densely scattered over lateral margins of pronotum, entire meso-metanotum, first few abdominal segments and acetabula. A pair of V-shaped pits delimiting suture between mesonotum and metanotum, and a prominent longitudinal groove extending entire length of body, somewhat obscure on pronotum. *Legs*. Anterior femur moderately incrassate; length (excluding trochanter) longer than tibia, 31 : 21. First anterior tarsal segment short, $\frac{1}{3}$ length of 2nd, 3 : 9. First segment of intermediate tarsus $3\times$ length of 2nd. Hind tarsus 1-segmented. Intermediate femur longer than posterior femur, 46 : 42. Intermediate tibia almost twice as long as posterior tibia, 31 : 16. *Abdomen*. Styliform processes asymmetrical, relatively slender; left process directed outward and visible from above (figs. 37-39). Tergum 9 triangular, much broader than long (fig. 27). *Coloration*. Uniformly dark brown to black above and below. Only markings of head, edges of ventral abdominal segments and acetabula, yellow. Appendages dark brown to black. *Size*. Length 3.5 mm; greatest width 1.5.

Female. Much larger and more robust than ♂. Meso-metanotum with a very prominent orange longitudinal groove extending from anterior edge of pronotum to abdomen, bordered by numerous stout black posteriorly directed bristles, which become less dense laterally but extend over entire meso-metanotum, acetabula and sparsely on pronotum. Antenna much less than $\frac{2}{3}$ as long as body, 55 : 90; proportion of segments I-IV, 24 : 12 : 9 : 10. First anterior tarsal segment much shorter than 2nd, 6 : 14. Intermediate to posterior femora, 52 : 44. Intermediate to posterior tibiae, 36 : 22. Coloration as in ♂. Length 4.5 mm; greatest width through middle acetabula, 2.3.

White described this species from Gilolo (Halmahera). The type is in the British Museum. The pair that I described above were collected at Calian, Davao Province, Mindanao, Philippines by C. S. Clagg (MCZ),

This species is closely related to *maculatus* Schadow. Both sexes can be differentiated by the mid-dorsal longitudinal groove, black bristles of the thorax, size and ratio of intermediate to posterior femora. The more slender styliform processes of the ♂ are also quite distinctive.

Material examined. In addition to the pair described above (part of a long series): Espiritu Santu, New Hebrides, 7 Sept. 1943, 1 ♂, 1 ♀, W. Bauer (RLU); W. Java, Oedjoeng Genteng Bay, 3 ♂♂, (Basel Museum via KANSAS); West Java, Wijnkoops Bay, 4 ♂♂, 4 ♀♀, M. E. Walsh (KANSAS); Nancovry Harbor, Nicobars, 6-7 May 1951, 4 ♀♀, Galathea and Sapparvea Buyt [Ceram], 10 Mar. 1922, 1 ♂ (KØBENHAVN); Solomon Is., Tetipari, 17 Oct. 1954, 1 ♂, E. S. Brown (BM).

Halobates maculatus Schadow

Halobates maculatus Schadow, 1922, Hamburg Univ. Diss, Auszug p. 2.

Halobates rotundatus Esaki, 1926, Mus. Hung., Ann. Hist. Nat. 23: 131, fig. 4. **New Synonymy.**

A very small, dark species with apical 3 antennal segments in proportion, 10 : 7 : 8 in ♂, 13 : 9 : 10 in ♀. Basal segment of anterior tarsus very short, 2.3 : 7 in ♂, 5 : 14 in ♀. Sparse, stiff, black, posteriorly directed bristles across anterior margin of meso-metanotum of ♀, none present in ♂. Styliform processes stout, left process visible from above (figs. 40-42). Tergum 9 triangular, much broader than long (fig. 40).

Male. *Head.* Antenna over 3/4 as long as body, 48 : 60; proportion of segments I-IV, 23 : 10 : 7 : 8. Head broader than long between eyes, disc evenly swollen, Eyes large, interocular width 3× width of an eye. *Thorax.* Pronotum with sides subrounded, greatly diverging posteriorly, shorter than head on median line, 6 : 10. Anterior and posterior margins hardly, concavely arcuate. Meso-metanotum anteriorly, abruptly roundly angled, width just behind anterior angles greater than width of head including eyes, 30 : 21, not increasing in width posteriorly, 30 : 30, sides straight and subparallel. No black bristles present on notum or acetabula. A pair of V-shaped pits, delimiting suture between meso-notum and metanotum and an obscure mid-dorsal groove on meso-metanotum. *Legs.* Anterior femur only slightly incrassate; length (excluding trochanter) longer than tibia, 30 : 18. First anterior tarsal segment short, about 1/3 as long as 2nd, 2.3 : 7. Segment 1 of intermediate tarsi 2.5× length of 2. Hind tarsus 1-segmented. Intermediate and posterior femora subequal, 38 : 38. Intermediate tibia much longer than posterior tibia, 26 : 14. *Abdomen.* Styliform processes stout, left process visible from above (figs. 40-42). Tergum 9 triangular, much broader than long (fig. 40). *Coloration.* Uniformly dark brown to black above and below. Only markings of head, edges of ventral abdominal segments and acetabula paler, yellow-orange to pale brown. Appendages dark brown to black. *Size.* Length 3.0 mm; greatest width 1.5.

Female. Much larger and more robust than ♂. Meso-metanotum with a few scattered black bristles across anterior margin of meso-metanotum. Antenna over 3/4 as long as body, 62 : 76; proportion of segments I-IV, 30 : 13 : 9 : 10. First anterior tarsal segment shorter than 2nd, 5 : 14. Intermediate to posterior femora, 52 : 48. Intermediate to posterior tibia, 35 : 24. *Coloration.* Venter much paler than in ♂. Entire surface yellow to yellow-orange. Length 3.8 mm; greatest width through middle acetabula, 2.3.

Schadow described this species from St. Matthias, Bismarck Archipelago. The types were deposited in the Hamburg Museum but were destroyed during World War II. The pair described above were collected at Kokorana, Rendova in the British Solomon Is. on 9 Oct. 1954 by E. S. Brown.

This species is closely related to *proavus*. Both males and females can be differentiated from that species by the lack of mid-dorsal stripes and groove, lack of black bristles over most of the thorax, smaller size and ratio of intermediate to posterior femora. In addition, the stouter styliform processes of the male will readily distinguish this species.

Material examined. Solomon Is.: Nggela, Mandoliana, 9 Nov. 1956, 2 ♂♂, E. S. Brown (BM); Teuhungano, Rennell I., 26-28 Nov. 1953, 2 ♂♂, 2 ♀♀, J. D. Bradley (BM); Webster Cove, Kolombangara, 12 Oct. 1954, 1 ♂, Brown (BM). New Guinea:

Madang Territory, 6 May 1929, 1 ♂, K. P. Schmidt (CJD); Dregerhafen, 1898, 1 ♂, 1 ♀, Biro (KANSAS): Finschhafen, 12 Apr. 1944, 1 ♂, E. S. Ross (CAS).

Esaki (1930), incorrectly synonymized his *rotundatus* with *proavus* White. It is a synonym of *maculatus* Schadow. The identity of *maculatus* has long been obscure since Schadow's description was lifted only partially from his University of Hamburg thesis and published in a five page abstract. The entire description amounts to only four or five lines and he failed to mention the manner in which he measured his material, and he did not include the excellent plate from his thesis. Furthermore, the type was destroyed during World War II. I have a microfilm of Schadow's thesis, thanks to the University of Hamburg. It consists of 125 pages and many plates besides the one of *H. maculatus*. In the introductory section he states that all of his measurements are ventral, from the apex of head to the hind margin of middle acetabula, thus accounting for his statement in the description, "Länge: Männchen 2.1-2.3 mm, Weibchen 3.0 mm."

Halobates robustus Barber

Halobates robustus Barber, 1925, *Zoologica* 5: 253, fig. 50.

A small, dark species with apical 3 antennal segments in the proportion, 10 : 9 : 11 in ♂, 11 : 10 : 13 in ♀. Basal segment of anterior tarsus much shorter than apical, 5 : 10 in ♂, 7 : 14 in ♀. Stiff, black bristles present on meso-metanotum of both sexes, but much denser in ♀. Styliform processes slender, almost symmetrical, broadly flared outward but not visible from above (fig. 18). Tergum 9 about as broad as long (fig. 16). Yellow coloration of venter of ♂ limited to edges of abdominal segments and acetabula.

Male. *Head.* Antenna over 3/4 as long as body, 57 : 70; proportion of segments I-IV, 27 : 10 : 9 : 11. Head about as broad as long between eyes, disc evenly rounded. Eyes large, interocular width 3× width of an eye. *Thorax.* Pronotum with sides subrounded, hardly diverging posteriorly; shorter than head on median line, 5 : 13. Anterior and posterior margins shallowly, concavely arcuate. Meso-metanotum anteriorly abruptly roundly angled; width just behind anterior angles almost subequal to width of head including eyes, 26 : 25; gradually increasing in width posteriorly, greatest width through middle acetabula, 26 : 36; sides rounded. Sparse stiff black bristles scattered along sides of meso-metanotum. *Legs.* Anterior femur only moderately incrassate, length (excluding trochanter) 1/5 longer than tibia, 35 : 28. Basal segment of anterior tarsus 1/2 as long as apical segment, 5 : 10. First segment of intermediate tarsus almost 2.5× as long as 2nd, 36 : 15. Hind tarsus 1-segmented. Intermediate femur longer than posterior femur, 50 : 45. Intermediate tibia almost twice as long as posterior tibia, 44 : 23. *Abdomen.* Styliform processes slender, arched outwards, neither process visible from above (fig. 18). Tergum 9 about as broad as long and with characteristic lateral flanges in front of middle (fig. 16). *Coloration.* Uniformly blue-black above with fine gray pubescence. Rostrum, antennae, and legs, shining black. Yellow coloration of venter limited to edges of abdominal segments and acetabular sutures. *Size.* Length 3.5 mm; greatest width 1.8.

Female. Larger and more robust than ♂. Meso-metanotum with scattered black bristles on most of meso-metanotum. Antenna 3/4 as long as body, 64 : 84; proportion of segments I-IV, 30 : 11 : 10 : 13. First anterior tarsal segment 1/2 as long as 2nd, 7 : 14. Intermediate to posterior femora, 55 : 48. Intermediate to posterior tibiae, 48 : 27. Colora-

tion as in ♂. Length 4.2 mm; greatest width 2.2.

Barber described this species from the Galapagos Islands. The types are in the American Museum of Natural History. The pair described above were collected at Floreana, Post Office Bay, Galapagos Is., 29–31, Oct. 1925 by the Wolleboeks Expedition (USNM).

This species appears to be most closely related to *regalis* Carpenter. The smaller size, proportionately shorter first anterior tarsal segment and longer first antennal segment will distinguish it from that species. The male terminalia are quite distinctive (figs. 16–18).

Material examined. Galapagos Is.: Indefatigable I., 30 Mar. 1930, 2♂♂, 1♀ (RLU); Albemarle I., 2 Jan. 1889, 1♂, 1♀ (USNM); Albemarle I., Cartago Bay, 12 Feb. 1933, 1♂, 20 nymphs, Hancock Exped. (USNM); Indefatigable I., 30 Mar. 1930, 9♂♂, 21♀♀, 7 nymphs (AMNH).

Halobates regalis Carpenter

Halobates regalis Carp., 1892, Roy. Dublin Soc., Proc. (n. s.) 7: 144, tab. 13, figs. 1–8.

A medium-sized, dark species with silver-gray pubescence. Apical 3 antennal segments in proportion 12 : 10 : 12 in ♂, 11 : 10 : 12 in ♀. Basal segment of anterior tarsus shorter than 2nd, 8 : 14 in ♂, 10 : 17 in ♀. Stiff, black bristles on meso-metanotum of both sexes but very sparse in ♂. Styliform processes asymmetrical, somewhat boot-shaped in side view; both processes visible from above (figs. 19–21). Tergum 9 about as broad as long (fig. 19). Entire venter yellow.

Male. *Head*. Antenna over 3/4 as long as body, 74 : 94; proportion of segments I–IV, 40 : 12 : 10 : 12. Head about as long as broad between eyes, disc evenly swollen. Eyes large, interocular width about 3× width of an eye. *Thorax*. Pronotum with sides subrounded, slightly diverging posteriorly; shorter than head on median line, 7 : 14. Anterior and posterior margins shallowly concavely arcuate. Meso-metanotum anteriorly abruptly roundly angled. Width just behind anterior angles subequal to width of head including eyes, 29 : 29, gradually increasing in width posteriorly, greatest width well anterior to middle acetabula, 29 : 45, sides broadly rounded. Few obscure black bristles along sides of meso-metanotum. *Legs*. Anterior femur hardly incrassate; length (excluding trochanter) 1/4 longer than tibia, 45 : 34. First anterior tarsal segment over 1/2 as long as 2nd, 8 : 14. Intermediate and posterior tibiae and tarsi missing. Intermediate femur longer than posterior femur, 60 : 55. *Abdomen*. Styliform processes asymmetrical, both processes somewhat boot-shaped in side view. Apices of both visible from above (figs. 19–21). Tergum 9 about as broad as long (fig. 19). *Coloration*. Uniformly blue-black above with fine gray pubescence. Rostrum, most of antennae, legs and middle of tergum 9, brownish black. Antenniferous tubercle, base of antennal segment 1, lateral margin of tergum 9 and entire venter, yellow. Crescent-shaped markings of head reaching middle pair of trichobothria. *Size*. Length 4.7 mm; greatest width 2.3.

Female. Larger and more robust than ♂. Meso-metanotum covered with conspicuous stiff, black bristles. Antenna about 2/3 as long as body, 71 : 104; proportion of segments I–IV, 38 : 11 : 10 : 12. First anterior tarsal segment over 1/2 as long as 2nd, 10 : 17. First segment of intermediate tarsus over 3× as long as 2nd, 43 : 13. Posterior tarsus 1-segmented. Intermediate to posterior femora, 60 : 50. Intermediate to posterior tibiae, 44 : 31. Coloration as in ♂. Length 5.2 mm; greatest width 2.8.

This species was described from the Torres Straits. The types are in the British Museum (Nat. Hist.). The pair described above are topotypes (BM).

Material examined. Besides the pair described, I have seen 6 ♀♀ from Thursday I., 30 Oct. 1922, A. R. McCulloch (AM). For distribution of this species, see map 4.

Halobates hayanus White

Halobates hayanus White, 1883, Voy. Challenger, Rept. Zool. 7 (19): 52, pl. 1, fig. 8.—
Dahl, 1893, Plankton-Exped., Ergeb. 2, G a : 6 (= *incanus* Witlaczil).

Halobates frauenfeldanus White, 1883, Voy. Challenger, Rept. Zool. 7 (19): 57, pl. 2, fig. 3.
New Synonymy.

Halobates incanus Witlaczil, 1886, Wien. Ent. Ztg. 5: 179.

A small, oval, silver gray species with apical 3 antennal segments in proportion 11 : 8 : 10 in ♂, 10 : 9 : 11 in ♀. Basal segment of anterior tarsus short, 5 : 9 in ♂, 7 : 13 in ♀. No stiff black bristles on meso-metanotum of either sex. Styliform processes almost symmetrical; long, slender and directed outward at apices (fig. 48). Tergum 9 broader than long and bearing conspicuous black bristles on sides (fig. 46). Yellow coloration of venter of ♂ limited to abdominal segments and acetabula.

Male. *Head.* Antenna almost 3/4 as long as body, 59 : 80; proportion of segments I-IV, 30 : 11 : 8 : 10. Head about as broad as long between eyes, disc evenly swollen. Eyes large, interocular width 3× width of an eye. *Thorax.* Pronotum with sides subrounded, diverging posteriorly; shorter than head on median line, 6 : 12. Anterior and posterior margins shallowly, concavely arcuate. Meso-metanotum anteriorly abruptly roundly angled; width just behind anterior angles greater than width of head including eyes, 28 : 25, gradually increasing in width posteriorly, greatest width at bases of middle acetabula, 28 : 35; sides broadly rounded. No black bristles on meso-metanotum. *Legs.* Anterior femur moderately incrassate; length (excluding trochanter) much longer than tibia, 35 : 25. Basal segment of anterior tarsus much shorter than apical segment, 5 : 9. First segment of intermediate tarsus 3× as long as 2nd, 36 : 12. Hind tarsus 1-segmented. Intermediate femur longer than posterior femur, 54 : 46. Intermediate tibia much longer than posterior tibia, 34 : 19. *Abdomen.* Styliform processes almost symmetrical; both processes slender and diverging at their apices (fig. 48). Tergum 9 broader than long and with conspicuous black bristles on sides (fig. 46). *Coloration.* Uniformly blue-black above with fine gray pubescence. Rostrum, most of antennae, legs, middle of tergum 9, and tips of styliform processes, black. Base of first antennal segment, lateral margins of tergum 9, ventral abdominal segments and acetabula, yellow. *Size.* Length 4.0 mm; greatest width 1.8.

Female. Larger and more robust than ♂. Antenna about 2/3 as long as body, 58 : 88; proportion of segments I-IV, 28 : 10 : 9 : 11. First anterior tarsal segment much shorter than 2nd, 7 : 13. Intermediate to posterior femora, 52 : 45. Intermediate to posterior tibiae, 36 : 22. Coloration as in ♂ except for a stripe extending forward to anterior coxae and entire medial surface of anterior femora, bright yellow. Length 4.4 mm; greatest width 2.5.

White described this species from the Red Sea, near Aden. The types are in the British Museum (Nat. Hist.). The pair described above were collected at Sunur, Bali, 10 Dec. 1957 by G. F. Papenfuss.

White described *frauenfeldanus* from material collected by Frauenfeld in the Indian Ocean near the Nicobars even though he did not see the material. He compiled the description from Frauenfeld's paper. Frauenfeld thought that he was describing the male of *flaviventris*. Dr. Usinger has examined some of Frauenfeld's material in the Vienna Museum and verified my suspicion that this species is synonymous with *hayanus*.

This species is very closely related to *calyptus* n. sp. Both males and females are smaller but much more robust, with proportionately longer antennae. In coloration they differ by the yellow base to the first antennal segments, and the females have the entire medial surface of the anterior femora, bright, clear yellow. The male terminalia are almost identical to *calyptus* but the apices of the styliform processes seem to be more rounded (fig. 47).

Material examined. New Guinea: Finschhafen, 12 Apr. 1944, 1 ♂, E. S. Ross (RLU); Seleo, Berlinhafen, 1896, 2 ♂♂, 1 ♀, Galathea (KANSAS); 7 May 1951, 142 ♂♂, 36 ♀♀, Galathea (KØBENHAVN). Ceram, Saparvea Bay, 10 Mar. 1922, 1 ♂, 3 ♀♀, 1 nymph, Galathea (KØBENHAVN); Java, Surabaya, 1, ♂, Andrea (KØBENHAVN); Malaya, Langkawi I., 4 Apr. 1934, 1 ♂, R. Birch (BM); Sunur Bali, 10 Dec. 1957, 19 ♂♂, 19 ♀♀, G. F. Papenfuss; Australia: Prince of Wales I., 15 Feb. 1939, 24 ♂♂, 20 ♀♀, R. G. Wind (KANSAS); Low I., Great Barrier Reef, 13-22 Aug. 1954, 3 ♂♂, 4 ♀♀, Mackerras and Marks (QM). For distribution of this species, see map 4.

Halobates calyptus Herring, n. sp.

A small, very slender, subparallel-sided species with apical 3 antennal segments in proportion 10 : 8 : 10 in ♂, 9 : 8 : 10 in ♀. Basal segment of anterior tarsus short, 5 : 9 in ♂, 7 : 12 in ♀. No black bristles on meso-metanotum of either sex. Styliform processes almost symmetrical; long, slender and directed outwards at apices (fig. 45). Tergum 9 about as broad as long, bearing conspicuous black bristles on sides (fig. 43). Yellow coloration of venter of ♂ limited to abdominal segments and acetabula.

Male. *Head*. Antenna less than 2/3 as long as body, 53 : 85; proportion of segments I-IV, 25 : 10 : 8 : 10. Head about as broad as long between eyes, disc evenly swollen. Eyes large, interocular width 3 × width of an eye. *Thorax*. Pronotum with sides subrounded, diverging posteriorly, shorter than head on median line, 6 : 12. Anterior and posterior margins shallowly, concavely arcuate. Meso-metanotum anteriorly abruptly roundly angled; width just behind anterior angles greater than width of head including eyes, 26 : 23; hardly increasing in width posteriorly, 26 : 30; sides almost straight and appearing subparallel. A pair of conspicuous triangular pits delimiting suture between mesonotum and metanotum. *Legs*. Anterior femora moderately incrassate; length (excluding trochanters) longer than tibiae, 33 : 25. Basal segment of anterior tarsus much shorter than apical segment, 5 : 9. First segment of intermediate tarsus almost 3 × as long as 2nd, 35 : 12. Hind tarsus 1-segmented. Intermediate femur longer than posterior femur, 54 : 46. Intermediate tibia much longer than posterior tibia, 34 : 18. *Abdomen*. Styliform processes almost symmetrical; both processes slender and diverging at their apices (fig. 45). Tergum 9 broader than long, with conspicuous black bristles on sides (Fig. 43). *Coloration*. Uniformly blue-black above with fine gray pubescence. Rostrum, antennae, legs, middle of tergum 9 and tips of styliform processes, brownish black. Lateral margins of tergum 9, ventral abdominal segments and acetabula, yellow. *Size*. Length 4.4 mm; greatest width 1.5.

Female. Larger and more robust than ♂. Antenna only 1/2 as long as body, 50 : 100; proportion of segments I-IV, 23 : 9 : 8 : 10. First anterior tarsal segment much shorter than 2nd, 7 : 12. Intermediate to posterior femora, 55 : 44. Intermediate to posterior tibiae, 36 : 20. Coloration as in ♂ except anterior femur are somewhat paler on basal 1/2 and venter has an indistinct yellow-brown stripe extending forward to anterior coxae. Length 5.0 mm; greatest width 2.3.

Holotype ♂ (USNM), Varadero Harbor, Mindoro I., Philippines, 22 July 1908, Albatross P. I. Exped. 1907-08; allotype ♀ (USNM), same data except 23 July 1908. Paratypes. Philippine Is.: Varadero Harbor, Mindoro, 22-23 July 1908, 5 ♂♂, 6 ♀♀, Albatross Exped. (USNM); Galian, Davao Province, 17-23 July, 2 ♂♂, 1 ♀, C. S. Clagg (MCZ via KANSAS); Dinagat I., 17 July 1951, 11 ♂♂, 4 ♀♀, Galathea (KØBENHAVN); Port Dupont, Leyte, 17 Mar. 1909, 1 ♂ (USNM); Port Binanga, nr. Luzon, 1 ♂. New Guinea: Near Mt. Gyiffrie, Apr. 1939, 15 ♂♂, 9 ♀♀, L. E. Cheesman (SAM via KANSAS).

Diagnosis. This species is very closely related to *hayanus*. Both males and females are larger and much more cylindrical, with proportionately shorter antennae. In coloration they differ by the completely dark first antennal segment and the females lack the yellow medial surface to the anterior femora. The male terminalia are almost identical to *hayanus* but the apices of the styliform processes seem to be more pointed (fig. 44). For the distribution of this species see map 6.

Halobates bryani Herring, n. sp.

A very small, brownish species with apical 3 antennal segments in proportion of 10 : 9 : 10 in ♂, 11 : 10 : 11 in ♀. Basal segment of anterior tarsus shorter than apical, 3 : 8 in ♂, 6 : 12 in ♀. No black bristles on meso-metanotum of either sex. Styliform processes slender, the left process slightly longer than right process and visible from above (figs. 49-51). Tergum 9 as broad as long (fig. 49). Yellow coloration of venter of ♂ limited to abdominal segments and acetabula. Almost entire venter of ♀ yellow.

Male. *Head*. Antenna long, over 4/5 as long as body, 54 : 64; proportion of segments I-IV, 25 : 10 : 9 : 10. Head about as long as broad between eyes, disc evenly rounded. Eyes very large, interocular width only 2.5 × width of an eye (fig. 109). *Thorax*. Pronotum with sides subrounded, hardly diverging posteriorly; shorter than head on median line, 5 : 12. Anterior and posterior margins shallowly, concavely arcuate. Meso-metanotum anteriorly abruptly roundly angled; width just behind anterior angles narrower than width of head including eyes, 20 : 23, gradually increasing in width posteriorly; greatest width through bases of hind acetabula, 20 : 30, sides rounded. No black bristles on meso-metanotum or acetabula. *Legs*. Anterior femur hardly incrassate; length (excluding trochanter) longer than tibia, 32 : 23. Basal segment of anterior tarsus much shorter than apical segment, 3 : 8. First segment of intermediate tarsus not quite 3 × as long as 2nd, 28 : 10. Hind tarsus 1-segmented. Intermediate femur slightly longer than posterior femur, 45 : 42. Intermediate tibia twice as long as posterior tibia, 38 : 19. *Abdomen*. Styliform processes slender, both diverging at apices; the left process slightly longer than right process and visible from above (figs. 49-51). Tergum 9 as broad as long (fig. 49). *Coloration*. Uniformly brownish black above. Rostrum, antennae, legs, middle of tergum 9, ventral abdominal segments and acetabula yellow-orange. Yellow markings of head trian-

gular. *Size.* Length 3.2 mm; greatest width 1.5.

Female. Larger and more robust than ♂. Antenna over 4/5 as long as body, 58 : 70; proportion of segments I-IV, 26 : 11 : 10 : 11. First anterior tarsal segment 1/2 as long as 2nd, 6 : 12. Intermediate femur longer than posterior femur, 52 : 48. Intermediate tibia almost twice as long as posterior tibia, 43 : 22. Coloration much as in ♂ except entire ventral surface yellow-orange. Length 3.5 mm; greatest width 2.0.

Holotype ♂ (BISHOP 3011), allotype ♀ (BISHOP), 11 paratypes (5 ♂♂, 6 ♀♀ BISHOP, JLH), Fiji Is., Matuku I., 4 July 1924, E. H. Bryan, Jr.

Diagnosis. This is one of the smallest species in the genus. The males are smaller than *sericeus* and the females are only slightly larger than those of that species. The very small size, anterior tarsal ratio and antennal ratio will readily separate this species from all others. In addition, the male terminalia are quite distinctive.

Halobates poseidon Herring, n. sp.

A small, brownish-black species with apical 3 antennal segments in proportion 10 : 8 : 10 in ♂, 11 : 9 : 10 in ♀. Basal segment of anterior tarsus shorter than apical segment, 4 : 9 in ♂, 7 : 12 in ♀. A few stout black bristles on hind acetabula of ♀, none present in ♂. Styliform processes symmetrical, relatively short and converging at apices, their inner faces flattened and shining (fig. 54). Tergum 9 little broader than long (fig. 52). Yellow coloration of venter of ♂ confined to posterior margin of meso-metanotum, acetabula and abdominal segments. Almost entire venter of ♀ yellow.

Male. *Head.* Antenna almost 3/4 as long as body, 52 : 72; proportion of segments I-IV, 24 : 10 : 8 : 10. Head about as long as broad between eyes, disc evenly swollen. Eyes large, interocular width 2.5 × width of an eye. *Thorax.* Pronotum with sides subrounded, shorter than head on median line, 5 : 11; anterior margin shallowly, concavely arcuate, posterior margin almost straight. Meso-metanotum anteriorly, abruptly roundly angled; width just behind anterior angles only slightly greater than width of head including eyes, 23 : 22, gradually increasing in width posteriorly; greatest width through bases of middle acetabula, 23 : 32, sides rounded. No black bristles present on thorax or acetabula. *Legs.* Anterior femur moderately incrassate; length (excluding trochanter) longer than tibia, 28 : 23. Basal segment of anterior tarsus much shorter than apical, 4 : 9. First segment of intermediate tarsus 2.5 × as long as 2nd, 23 : 9. Hind tarsus 1-segmented. Intermediate femur longer than posterior femur, 44 : 39. Intermediate tibia much longer than posterior tibia, 33 : 18. *Abdomen.* Styliform processes symmetrical, relatively short and converging at apices, their inner faces flattened and shining (fig. 54). Tergum 9 slightly broader than long (fig. 52). *Coloration.* Uniformly brownish-black above. Rostrum, antennae, legs, tergum 9 and apical halves of styliform processes, reddish-brown. Posterior margin of meso-metanotum, acetabula, abdominal segments and basal halves of styliform processes, yellow. Yellow markings of head triangular, rather extensive, continuous across posterior margin of head and extending forward to anterior margins of eyes. *Size.* Length 3.6 mm; greatest width 1.6.

Female. Similar to ♂ but more robust. Antenna about 2/3 as long as body, 55 : 80; proportion of segments I-IV, 25 : 11 : 9 : 10. First anterior tarsal segment shorter than 2nd, 7 : 12. Intermediate to posterior femora, 54 : 45. Intermediate to posterior tibiae, 38 :

22. Posterior acetabula with scattered black bristles along sides. Coloration as in ♂ except entire venter suffused with yellow. Length 4.0 mm; greatest width 2.1.

Holotype ♂ (BM), allotype ♀ (BM), 2 paratypes (♂, ♀), Mombasa I., Port Tudor, Kenya, 10 Oct. 1953, L. F. Brown (BM, JLH).

Diagnosis. This species seems to be most closely related to *bryani*. The males may be distinguished from that species by the converging styliform processes with the flattened, shining inner faces. The females are larger and have group of black bristles on the hind acetabula.

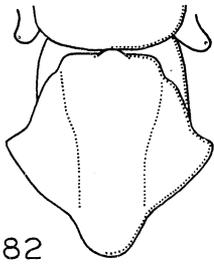
Halobates hawaiiensis Usinger

Halobates hawaiiensis Usinger, 1938, Hawaii. Ent. Soc., Proc. **10** (1): 79.

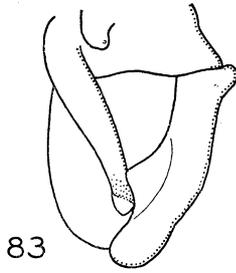
A large, relatively slender, steel-gray species with apical 3 antennal segments in proportion 10 : 8 : 10 in ♂ and 8 : 7 : 8 in ♀. Basal segment of anterior tarsus shorter than apical, 7 : 9 in ♂, 9 : 11 in ♀. Meso-metanotum with scattered black bristles on either side of middle. Posterior acetabula with long black bristles becoming quite dense posteriorly. Styliform processes asymmetrical, left process bent outward and visible from above (figs. 88-90). Yellow markings of venter confined to abdominal segments and acetabular sutures.

Male. *Head*. Antenna less than 2/3 as long as body, 61 : 96; proportion of segments I-IV, 33 : 11 : 8 : 10. Head about as broad as long between eyes, disc evenly swollen. Eyes large, interocular width about 3.5 × width of an eye. *Thorax*. Pronotum with sides subrounded, much shorter than head on median line, 7 : 14, anterior and posterior margins shallowly, concavely arcuate. Meso-metanotum anteriorly abruptly roundly angled; width just behind anterior angles subequal to width of head including eyes, 28 : 28, gradually increasing in width posteriorly, 28 : 36, sides subrectilinear and superficially appearing subparallel. Short, stiff, postero-laterally directed, black bristles sparsely scattered anteriorly and laterally on dorsal surface and sometimes extending almost to bases of posterior acetabula on either side. Posterior acetabula with longer black bristles becoming quite dense posteriorly. *Legs*. Anterior femur incrassate; length (excluding trochanter) almost 1/3 longer than tibia, 40 : 28. Basal segment of anterior tarsus distinctly shorter than apical, 7 : 9. First segment of intermediate tarsus 3 × as long as 2nd, 36 : 12. Hind tarsus 1-segmented. Intermediate femur distinctly longer than posterior femur, 62 : 53. Intermediate tibia much longer than posterior tibia, 41 : 23. *Abdomen*. Styliform processes very asymmetrical, left process scarcely longer than right, bent outward beyond level of lateral projection at middle of segment 9, sinuate and partially visible from above. Right process turned inward and not visible from above (figs. 88-90). Tergum 9 about as long, distinctly, narrowly and slightly backwardly produced (fig. 88). *Coloration*. In great part blue-black with fine gray pubescence. Rostrum, antennae, legs and tergum 9, black. Abdominal segments 3-7 yellow below. *Size*. Length 4.8 mm; greatest width 1.8.

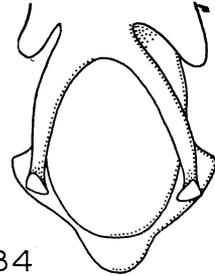
Figs. 82-93. 82, *H. nereis*, dorsal view of ♂ terminalia; 83, same, lateral view; 84, same, ventral view; 85, *H. flaviventris*, dorsal view of ♂ terminalia; 86, same, lateral view; 87, same, ventral view; 88, *H. hawaiiensis*, dorsal view of ♂ terminalia; 89, same, lateral view; 90, same, ventral view; 91, *H. mariannarum*, dorsal view of ♂ terminalia; 92, same, lateral view; 93, same, ventral view.



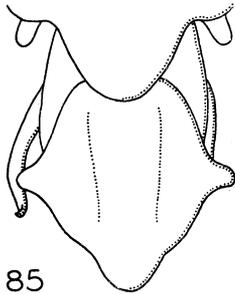
82
nereis



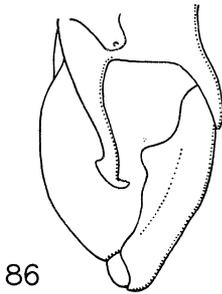
83



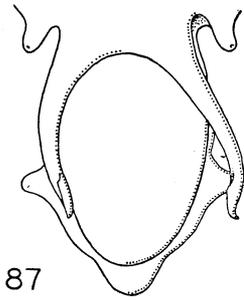
84



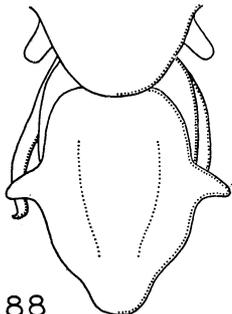
85
flaviventris



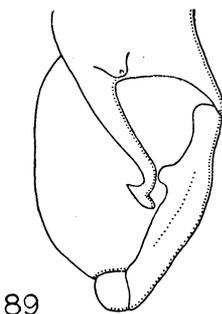
86



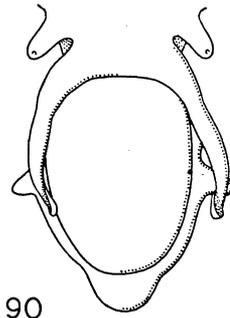
87



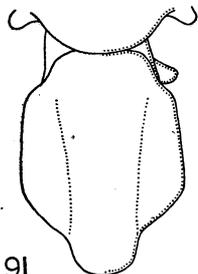
88
hawaiiensis



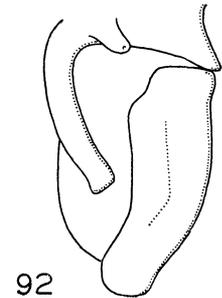
89



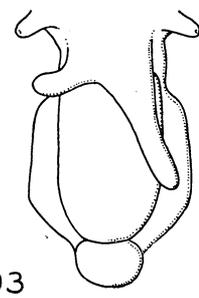
90



91
mariannarum



92



93

Female. Differs from ♂ in its very much broader form, sides of meso-metanotum more strongly dilated posteriorly and more robust throughout. Stiff, black bristles of meso-metanotum longer and more confined to anterior region. Antennae proportionately shorter than in ♂, length compared with body length, 48 : 84; proportion of segments I-IV, 25 : 8 : 7 : 8. First anterior tarsal segment distinctly shorter than 2nd, 9 : 11. Intermediate to posterior femora, 58 : 45. Intermediate to posterior tibiae, 40 : 24. Posterior trochanters densely provided with slender black hairs longer than greatest diameter of trochanters. Color much as in ♂. Length 4.2 mm; greatest width 2.0.

This species was described from Waikiki, Oahu, Hawaii. The types are in Bishop Museum. The pair described above are a ♂ paratype, Waikiki, 5 Nov. 1935 collected by R. L. Usinger (RLU); and a ♀, same locality, 8 Feb. 1955, J. L. Herring (JLH).

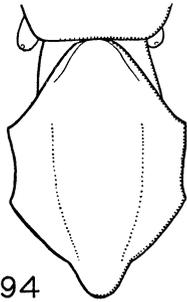
Variation. In addition to the variation in the extent of stiff black bristles on the sides of the thorax (as pointed out by Usinger), there appear to be four populations in Polynesia. The population of largest size occurs at the island of Hawaii, the males of which range from 5.1 to 5.5 mm, with a mean of 5.3 mm. The Oahu Island and Marquesas-Society populations are practically identical in size, the males range in size from 4.7 to 5.1 mm, with a mean of 4.8 mm. The Hao I. (C. Tuamotu) males are very small. They range in size from 4.3 to 4.5 mm with a mean of 4.4 mm. I can find no characters to separate these populations except size, and since the Oahu population and the Marquesas-Society population are indistinguishable from each other, it does not appear advisable to name these populations.

H. hawaiiensis is very closely related to *flaviventris* Eschscholtz. Both males and females can be distinguished by the dense, stiff, black bristles on the posterior acetabula and the lack of a wide yellow band along the undersurface of the intermediate acetabula. The structure of the styliform processes, particularly their apices, is distinct. The females have much longer and curved hind coxae which are at least one and one-half times as long as first anterior tarsal segments. In addition, I have seen no males of *flaviventris* with black bristles on the thorax; the females, however, sometimes have bristles scattered over the anterior one-third of the meso-metanotum.

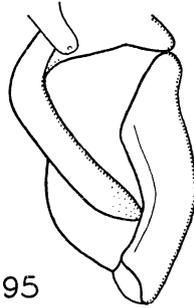
Material examined. Hawaiian Is.: Waikiki, Oahu, 8 Feb. 1955, 9♂♂, 4♀♀, 1 nymph, J. L. Herring; 6 Nov. 1935, 5♂♂, 1♀, R. L. Usinger (RLU); between Kauai and Oahu, 17 June 1902, 2 nymphs, Albatross (USNM); Kaloko, Hawaii, 23 July 1951, 2♂♂, 4♀♀, 3 nymphs, G. I. Murphy (POFI-USNM); 3-4 km off W. Hawaii, 18 Sept. 1915, 1♀, 8 nymphs, A. Busck (USNM); Kailua, Kona Coast, Hawaii, 22 July 1956, 34♂♂, 20♀♀, R. L. Usinger (RLU). Marquesas Is.: Tahuata, 1925, 1♂, L. E. Cheesman (BM); Nuku Hiva, 24 Jan. 1952, 10♂♂, M. W. Johnson (JLH). Society Is.: Tahiti, 1925, 1♂, 1♀, L. E. Cheesman (BM); Papeete, Tahiti, 16 Jan. 1953, 1♂, 5♀♀, Johnson (JLH); Tiupi Bay, Papeari, 6 Apr. 1934, 1♂, 1♀, E. C. Zimmerman (BISHOP). Tuamotu Archipelago: Hao I., 18 May 1934, 22♂♂, 8♀♀, Zimmerman (BISHOP, RLU); Fakarawa, 1925, 1♂, Cheesman (BM). For the mapped distribution of this species see map. 6.

Halobates flaviventris Eschscholtz

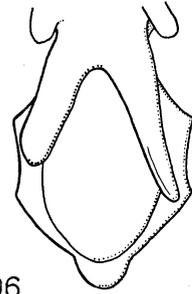
Halobates flaviventris Esch., 1822, Entomographien 1: 109, pl. 2, fig. 5.—White, 1883, Voy. Challenger, Rept. Zool. 7 (19): 55, pl. 2, fig. 2.—Esaki, 1928, Ann. Mag. Nat. Hist.



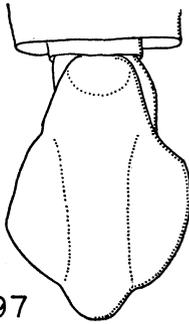
94
kelleni



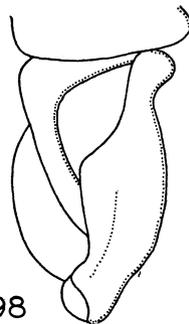
95



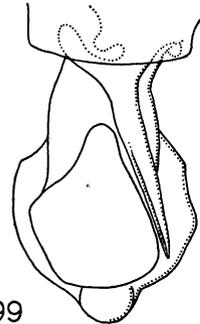
96



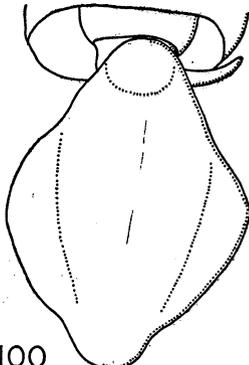
97
fijiensis



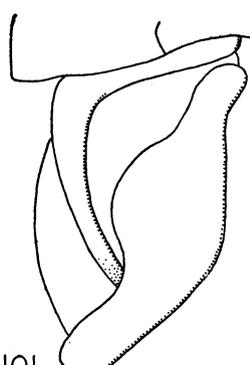
98



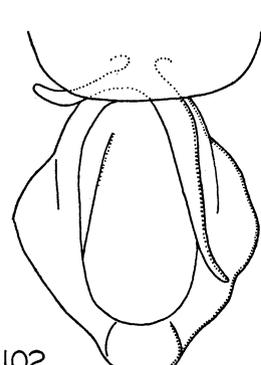
99



100
katherinae



101



102

Figs. 94-102. 94, *H. kelleni*, dorsal view of ♂ terminalia; 95, same, lateral view; 96, same, ventral view; 97, *H. fijiensis*, dorsal view of ♂ terminalia; 98, same, lateral view; 99, same, ventral view; 100, *H. katherinae*, dorsal view of ♂ terminalia; 101, same, lateral view; 102, same, ventral view.

ser. 10, 2: 513 (= *herdmani* Carpenter).

Halobates herdmani Carp., 1906, Ceylon Pearl Oyster Rept. London 5 (Suppl. rept. 32): 151, 1 plate.

A large, relatively slender, steel gray species with apical three antennal segments in proportion 11 : 8 : 10 in ♂ and 10 : 7 : 10 in ♀. Basal segment of anterior tarsus shorter than apical segment, 8 : 10 in ♂, 9 : 12 in ♀. Meso-metanotum of ♀ occasionally with black bristles on anterior one-third. None in ♂. Styliform processes asymmetrical, left process bent outward and visible from above (figs. 85-87). Yellow markings of venter confined to abdominal segments and underside of middle acetabula.

Male. *Head.* Antenna $\frac{2}{3}$ as long as body, 62 : 92, proportion of segments I-IV, 33 : 11 : 8 : 10. Head about as broad as long between, eyes, disc evenly rounded. Eyes large, interocular width about three and one-half times width of an eye. *Thorax.* Pronotum with sides subrounded, much shorter than head on median line, 7 : 14, anterior and posterior margins shallowly, concavely arcuate. Meso-metanotum anteriorly, abruptly roundly angled; width just behind anterior angles subequal to width of head including eyes, 28 : 28, gradually increasing in width posteriorly, 28 : 38, sides subrectilinear and superficially appearing subparallel. No black bristles on meso-metanotum. Posterior acetabula occasionally with a few scattered black bristles on sides. *Legs.* Anterior femur incrassate; length (excluding trochanter) $\frac{1}{4}$ longer than tibiae, 40 : 30. Basal segment of anterior tarsus distinctly shorter than apical segment, 8 : 10. First segment of intermediate tarsus $3 \times$ as long as 2nd, 35 : 11. Hind tarsus 1-segmented. Intermediate femur distinctly longer than posterior femur, 63 : 54. Intermediate tibia much longer than posterior tibia, 41 : 24. *Abdomen.* Styliform processes very asymmetrical, left process scarcely longer than right process, bent outward beyond level of lateral projection at middle of segment 9, sinuate and partially visible from above. Right process turned inward and not visible from above (figs. 85-87). Tergum 9 about as broad as long, distinctly, narrowly produced at middle (fig. 85). *Coloration.* In great part blue-black with fine gray pubescence. Rost- rum, antennae, legs and terga 8-9 reddish-brown. Abdominal segments below and under- side of middle acetabula, yellow. *Size.* Length 4.6 mm; greatest width 1.9.

Female. Differs from ♂ in its very much broader form, sides of meso-metanotum more strongly dilated posteriorly and more rounded throughout. Stiff, black bristles some- times present on anterior margin of meso-metanotum. Antenna proportionately shorter than in ♂, less than $\frac{2}{3}$ as long as body, 52 : 84; proportion of segments I-IV, 25 : 10 : 7 : 10. First anterior tarsal segment distinctly shorter than 2nd, 9 : 12. Intermediate to posterior femora 58 : 47. Intermediate to posterior tibiae, 40 : 23. Posterior trochanters with slender black hairs, longer than greatest diameter of trochanter. Color much as in ♂. Length 4.2 mm; greatest width 2.2.

Eschscholtz recorded this species from the S. Atlantic; White states that there are spe- cimens in the Berlin Museum from near St. Helena. I have not seen any specimens from the Atlantic. I am inclined to believe that these localities are in error. I am following White's interpretation of this species. As mentioned under *micans*, the types of Eschscholtz were deposited in the University of Dorpat Collections, but I have been unable to verify this. The pair described above was collected at Ngerkabesang (Arakabesan), Palau Is. by B. McDaniel on 8 Aug. 1956 (JLH).

Variation. There is some variation in the extent of black bristles on the thorax and hind acetabula. They are commonly absent on the female thorax but when present occurring less densely than in *hawaiiensis* and only on the anterior 1/3 of meso-metanotum; never present on acetabula. The bristles are always absent on the meso-metanotum of male. I have seen one or two males that have a few scattered bristles on the hind acetabula.

This species is very closely related to *hawaiiensis*. Both sexes can be distinguished by the lack of dense, stiff, black bristles on the posterior acetabula and the presence of a wide yellow triangle on the underside of the intermediate acetabula. The structure of the styliform processes, particularly their apices is distinct. The females have much shorter and straighter hind coxae which are never one and one-half times as long as first anterior tarsal segments.

Material examined. Ceylon: 1891, 3 ♂♂, Briesch (USNM); 1906, 1 ♂, W. A. Herdman (BM); Bentota, 4 Mar. 1907, 1 ♂, B. Fletcher (KANSAS); Trincomali, Nov. 1906, 1 ♂, 1 ♀, T. B. Fletcher (RLU); NW of Colombo, 12 Apr. 1951, 1 ♂, Galathea (KØBENHAVN); S. Coast, Dikwela, 19 Nov. 1907, 1 ♂, Fletcher (BM); Barberyn I., 12 Dec. 1926, 1 ♀ (BM). Bay of Bengal, 15° 54' N, 90° 17' E, 3 May 1951, 1 ♂, 2 ♀♀, Galathea (KØBENHAVN). Christmas I., Flying Fish Cove, 6 Aug. 1897, 1 ♂, C. V. Andrews (BM). Dar-es-Salaam, Tanganyika, 18 Dec. 1913, 1 ♂ (BM). Ethiopia, Magadishu Reef, 29 Apr. 1945, 1 ♂, 1 ♀, N. Hynes (BM). Gulf of Siam (10° 05' 10" N, 99° 49' 30" E), 9-10 Nov. 1957, 14 ♂♂, 51 ♀♀, Vessel No. 9. Java, 1 ♂, (KANSAS); Java, 10 ♂♂ (KØBENHAVN); New Hebrides, Aurora I., 26 Jan. 1927, 3 ♂♂, 1 ♀, F. P. Drowne (KANSAS). Santa Maria Is., Banks Is., 1 Aug. 1956, 2 ♂♂, E. S. Brown (BM). Palau Is., Ngerkabesang (Arakabesan), 8 Aug. 1956, 5 ♂♂, 1 ♀, B. McDaniel (JLH). For the distribution of this species see map 7.

Halobates japonicus Esaki

Halobates japonicus Esaki, 1924, *Psyche* 31: 115, pl. 5, fig. B.

A large, relatively slender, steel gray to black species with apical 3 antennal segments in proportion 11 : 9 : 11 in ♂ and 11 : 9 : 12 in ♀. Basal segment of anterior tarsus shorter than apical segment, 10 : 12 in ♂, 12 : 14 in ♀. Meso-metanotum without black bristles in either sex. Styliform processes relatively short, slender and nearly symmetrical. Neither process visible from above (figs. 65-6). Tergum 9 about as broad as long (fig. 64). Yellow markings of venter confined to abdominal segments and acetabula in ♂, much more extensive in ♀.

Male. *Head*. Antenna less than 2/3 as long as body, 65 : 104; proportion of segments I-IV, 34 : 11 : 9 : 11. Head about as broad as long between eyes, disc evenly rounded. Eyes large, interocular width 3 × width of an eye. *Thorax*. Pronotum with sides subrounded, much shorter than head on median line, 7 : 15, anterior and posterior margins shallowly, concavely arcuate. Meso-metanotum anteriorly, abruptly roundly angled; width just behind anterior angles subequal to width of head including eyes, 30 : 30, gradually increasing in width posteriorly, 30 : 42, sides almost straight. No black bristles on meso-metanotum. *Legs*. Anterior femur incrassate; length (excluding trochanter) longer than tibia, 40 : 33. Basal segment of anterior tarsus distinctly shorter than apical segment, 10 : 12. First segment of intermediate tarsus 3 × as long as 2nd, 36 : 12. Hind tarsus 2-seg-

mented, 1st segment $1/2$ as long as 2nd. Intermediate femur longer than posterior femur, 64 : 52. Intermediate tibia much longer than posterior tibia, 43 : 27. *Abdomen.* Styliform processes relatively short, slender and nearly asymmetrical, right process somewhat shorter than left. Both processes reaching lateral flanges of tergum 9, neither visible from above (figs. 65-6). *Coloration.* Blue-black with gray pubescence, sometimes appearing almost black. Rostrum, antennae, legs, middle of tergum 9 and styliform processes, reddish-brown. Sides of tergum 9, underside of head, anterior acetabula, coxae, trochanters, intermediate and posterior acetabula below, ventral abdominal segments, except styliform processes, yellow. *Size.* Length 5.2 mm; greatest width 2.1.

Female. Differs from ♂ in its much broader form, sides of meso-metanotum more strongly dilated posteriorly and more rounded throughout. No stiff black bristles on meso-metanotum or hind acetabula. Antenna almost $2/3$ as long as body, 64 : 100; proportion of segments I-IV, 32 : 11 : 9 : 12. First anterior tarsal segment distinctly shorter than 2nd, 12 : 14. Intermediate to posterior femora, 65 : 53. Intermediate to posterior tibiae, 45 : 28. Color much as in ♂ except for a broad yellow stripe ventrally which extends forward to anterior trochanters. Length 5.0 mm; greatest width 2.4.

Esaki described this species from Aburatsubo Creek near Misaki, Province of Sagami, Japan and listed paratypes from the provinces of Kii and Tosa. The types are in the Esaki Collection at Fukuoka, Japan. The pair described above is from Ryukyu Is., Iriomote I., Sonai-Urauchi, 17 July 1934, T. Esaki (KANSAS). I have seen another specimen, a ♂, Shikoku, Uranouchi (Tosa), 17 Aug. 1933, Y. Sugihara (CJD).

This species is related to *hawaiiensis* and *flaviventris*. Both males and females differ in the more extensive yellow coloration ventrally, their larger size and different tarsal ratio. The structure of the male styliform processes and ninth tergum is quite distinctive. It differs from *galatea* n. sp. in lacking the completely yellow venter and yellow stripe on anterior femora.

Halobates galatea Herring, n. sp.

A medium-sized, oval species with apical 3 antennal segments in proportion 12 : 9 : 12 in ♀, 12 : — : — in ♂. Basal segment of anterior tarsus distinctly shorter than apical segment, 10 : 13 in ♂, 13 : 16 in ♀. Meso-metanotum without stiff black bristles in either sex. Styliform processes very asymmetrical, right process curved outward and visible from above, its apex spatulate (figs. 61-3). Tergum 9 about as broad as long (fig. 61). Venter of both sexes with extensive yellow coloration.

Male. Head. Antennal segments 3-4 missing; proportion of segments I-II, 30 : 12. Head about as broad as long between eyes, disc evenly rounded. Eyes large, interocular width about $3 \times$ width of an eye. *Thorax.* Pronotum with sides subrounded, shorter than head on median line, 7 : 14. Anterior margin scarcely, posterior margin prominently, concavely arcuate. Width of pronotum somewhat less than width of head including eyes, 25 : 28. Meso-metanotum anteriorly, not abruptly roundly angled, gradually increasing in width posteriorly; width at posterior margin of pronotum to greatest width, 25 : 42, sides broadly rounded. No black bristles on meso-metanotum. *Legs.* Anterior femur hardly incrassate; length (excluding trochanter) about $1/4$ longer than tibia, 40 : 31. Basal segment of anterior tarsus distinctly shorter than apical segment, 10 : 13. Intermediate legs missing.

Posterior femur longer than body, 50 : 45. Posterior tibiae and tarsi missing. *Abdomen.* Styliform processes very asymmetrical, right process curved outward and visible from above, its apex spatulate (figs. 61-3). Tergum 9 about as broad as long, the sides rather broadly rounded (fig. 63). *Coloration.* Probably uniformly blue-black with gray pubescence. Holotype (only ♂ at hand) appears to be either a newly moulted specimen or one that has been poorly preserved. It is of a uniform reddish-brown with little indication of pubescence nor yellow markings on head. Most of the ventral surface, limb bases, base of anterior femur and first antennal segment, yellowish. *Size.* Length 4.5 mm; greatest width 2.1.

Female. Much more robust and uniformly blue-black above with gray pubescence. Sides of meso-metanotum posteriorly, much more strongly dilated and more rounded throughout. No stiff black bristles on meso-metanotum. Antenna almost 2/3 as long as body, 64 : 100; proportion of segments I-IV, 31 : 12 : 9 : 12. First anterior tarsal segment shorter than 2nd, 13 : 16. First segment of intermediate tarsus little more than 3 × as long as 2nd, 39 : 12. Intermediate to posterior femora, 62 : 42. Intermediate to posterior tibiae, 35 : 31. *Color.* Uniformly blue-black above with gray pubescence. Yellow markings of head triangular and continuous across posterior margin. Entire ventral surface, medial surface of anterior femur, base of first antennal segment and antennal sockets, yellow. Length 5.0 mm; greatest width 2.8.

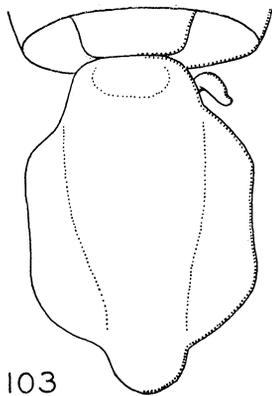
Holotype ♂ (BM). Arabian Sea, Marine Survey of India, Distant Collection. Allotype ♀ (USNM), Bombay, India, Jan. 1926, J. C. Bridwell.

Diagnosis. The structural characteristics of the styliform processes and ninth tergum will readily distinguish the males from all species. The females are very robust, being over 1/2 as broad as long. It differs from *japonicus* and *panope* n. sp. in size, color, and ratio of leg segments. Further, it differs from *panope* in lacking the dense black bristles of the thorax.

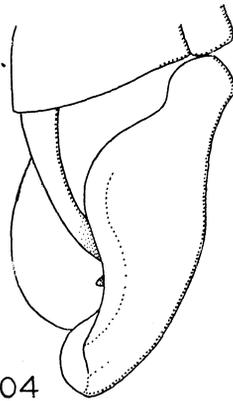
Halobates panope Herring, n. sp.

A small, black, rather oval species with apical 3 antennal segments in the proportion 9 : 8 : 9 in ♂, 8 : 7 : 11 in ♀. Basal segment of anterior tarsus shorter than apical segment 7 : 9 in ♂, 10 : 11 in ♀. Meso-metanotum of ♀ with abundant, stiff black bristles. Styliform processes long, slender and asymmetrical, the left process somewhat longer than right process; neither process visible from above (figs. 56-7). Yellow markings of venter confined to abdominal segments and acetabular sutures; somewhat more extensive in ♀.

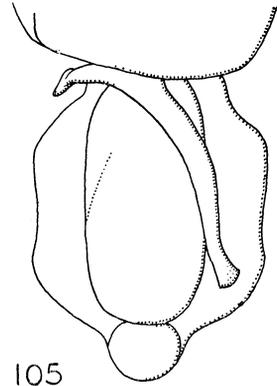
Male. *Head.* Antenna about 2/3 as long as body, 53 : 80; proportion of segments I-IV, 27 : 9 : 8 : 9. Head about as broad as long between eyes, disc evenly rounded. Eyes large, interocular width 3 × width of an eye. *Thorax.* Pronotum with sides subrounded, much shorter than head on median line, 6 : 12; both anterior and posterior margins shallowly, concavely arcuate. Meso-metanotum hardly, roundly angled anteriorly; width at posterior margin of thorax to width of head through eyes, 20 : 24, gradually increasing in width posteriorly, 20 : 35, sides distinctly rounded. *Legs.* Anterior femur moderately incrassate, length (excluding trochanter) about 1/4 longer than tibia, 33 : 25. Basal segment of anterior tarsus distinctly shorter than apical segment, 7 : 9. First segment of intermediate tarsus 3 × as long as 2nd, 30 : 10. Hind tarsus 1-segmented. Intermediate femur longer than posterior femur, 52 : 43. Intermediate tibia twice as posterior tibia, 40 : 20. *Abdomen.* Styliform processes long, slender and asymmetrical, left process longer than right



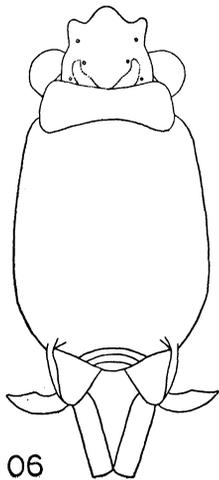
103
salotae



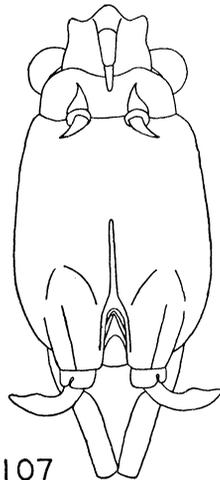
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105

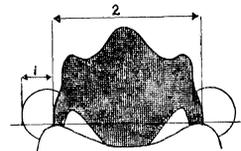


106

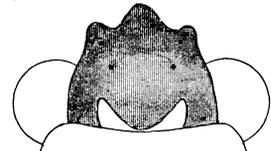


107

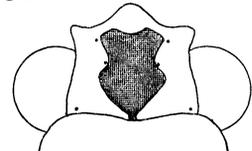
salotae ♀



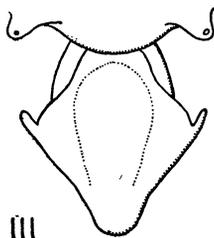
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109



110

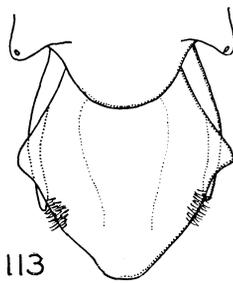


111

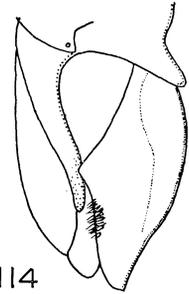


112

sexualis



113



114

formidabilis

process; neither visible from above (figs. 56-7). Tergum 9 about as broad as long with lateral flanges moderately attenuated (fig. 55). *Coloration*. Uniformly blue-black above with dark pubescence. Rostrum, antennae, legs, middle of tergum 9 and apical halves of styliform processes, black. Yellow markings of head rather large, almost reaching level of anterior margins of eyes. Yellow coloration of venter limited to abdominal segments and acetabula. *Size*. Length 4.0 mm; greatest width 1.8.

Female. Very similar to ♂ but somewhat smaller and with abundant, stiff black bristles along sides and almost continuous across anterior 1/2 of meso-metanotum. Antenna over 2/3 as long as body, 51 : 72; proportion of segments I-IV, 25 : 8 : 7 : 11. First anterior tarsal segment shorter than 2nd, 10 : 11. Intermediate to posterior femora, 54 : 44. Intermediate tibia almost twice as long as posterior tibia, 41 : 21. Color much as in ♂ except for a pale stripe on middle of sternum extending forward to anterior coxae. Length 3.6 mm; greatest width 1.8.

Holotype ♂ (KANSAS), allotype ♀ (KANSAS), New Caledonia, stream estuary between Touho and Ponerihouen, 3 Oct. 1940, F. X. Williams; paratypes, same data, 10 ♂♂, 6 ♀♀ (KANSAS, JLH, BISHOP).

Variation. I have before me a long series of specimens from the SE end of New Caledonia that I had considered to be another new species closely related to *panope*. It is consistently larger than that species and the females have only a few scattered bristles along the sides of the meso-metanotum. The male terminalia appeared at first to be distinctive (figs. 58-60), but there are several specimens in the type series and one or two from SE New Caledonia that I am able to relegate to their respective population only on the basis of size, since the terminalia are identical. The material from SE New Caledonia is as follows: Prony Bay, 22 Oct. 1940, 19 ♂♂, 8 ♀♀, F. X. Williams (KANSAS); 27 Feb. 1914, 2 ♂♂, P. D. Montague (KANSAS); Noumea 1918, 1 ♀, P. D. Montague (KANSAS); Nouville, 6 Aug. 1940, 1 ♂, Williams (KANSAS); Isle of Pines, 24 Oct. 1940, 1 ♂, Williams.

Diagnosis. This species differs from *japonicus* and *galatea* in being smaller with much differently constructed terminalia of the male. The females have stout black bristles on some part of the thorax, typically, densely covering the sides and the anterior 1/3. In addition, the first anterior tarsal segment is proportionately shorter and the intermediate tibiae are twice as long as the posterior tibiae.

Halobates kudrini Nasanov

Halobates flaviventris var. *kudrini* Nasanov, 1894, Ent. Untersuch. 1893, Warsaw Univ. No. 6, p. 2 [In Russian.]

Halobates kudrini, Esaki, 1928, Ann. Mag. Nat. Hist. ser. 10, 2 : 513.

I have not seen this species. A free translation of Nasanov's description is as follows:
 " *Halobates flaviventris* Esch. var. *kudrini* n. var.

Figs. 103-114. 103, *H. salotae*, dorsal view of ♂ terminalia; 104, same, lateral view; 105, same, ventral view; 106, same, dorsal view of ♀; 107, same, ventral view of ♀; 108, head of *H. sericeus*, showing extent of yellow coloration and manner in which ocular to interocular measurements are made; 109, head of *H. hawaiiensis*; 110, head of *H. zephyrus*; 111, *H. sexualis*, dorsal view of ♂ terminalia (after W. E. China); 112, same, lateral view; 113, *H. formidabilis*, dorsal view of ♂ terminalia (after W. E. China); 114, same, lateral view.

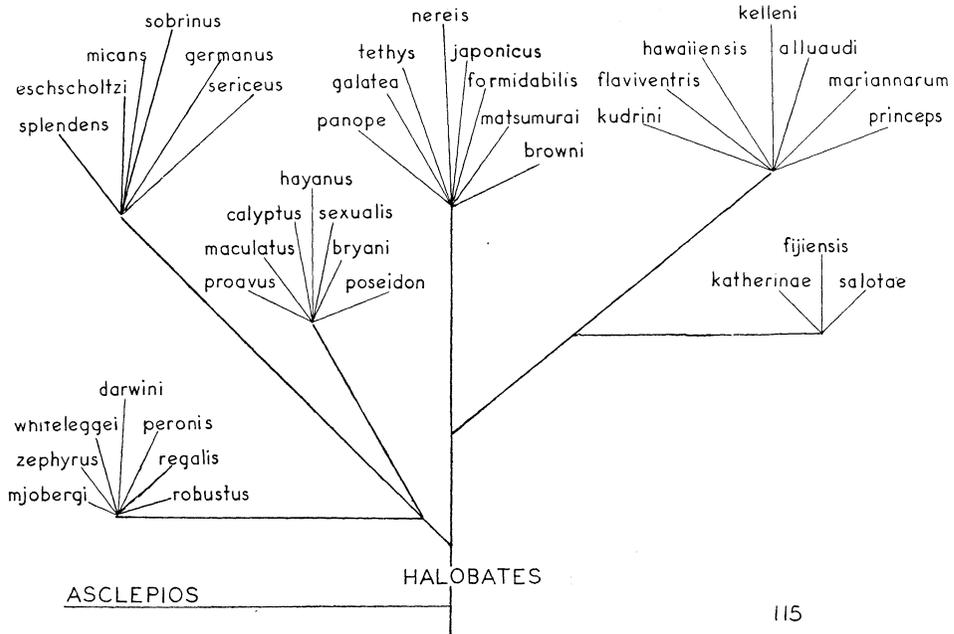


Fig. 115. Phylogeny of the genus *Halobates* and the genus *Asclepios*.

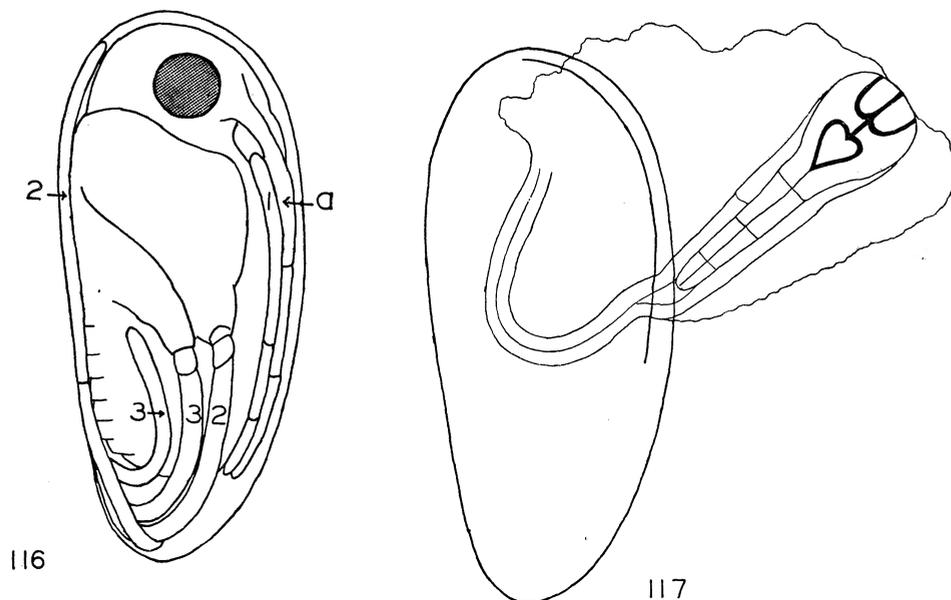
"Female. Body egg-shaped, narrowed toward front end and with a slight sharpening on broadened posterior end. Grayish black. Length of body 2.8-3.02 mm.

"The head has obliquely oblong spots on upper side near posterior margin which come together in middle of latter. Antennae and legs dark-brown. Proboscis shiny black. Eyes brown. Pronotum beneath paler, of a light brown shade. Outer edge of anterior acetabula strongly narrowed and with a brownish-black triangular spot. Ventral side of meso-metathorax with a slightly pronounced obscure brown stripe running anteriorly. Anterior to middle acetabula there is a grayish white triangular spot. Ventral abdominal segments with transverse whitish stripes. Sexual appendages yellow. Head moderately convex, disc slightly elevated in middle. Length .38 mm, width .73 mm. Antennae slender, length 2.89 mm. Length of segments I-II, in mm, 1.5 : .52 : .37 : .45. Pronotum flat dorsally, convex at middle. Length .2 mm, width .62 mm. Meso-metathorax greatly increasing in width posteriorly, greatest width 1.2 mm. Legs. Anterior femora moderately incrassate, length of femora and tibiae, 2.05 mm; 1.68 mm. Tarsal segments I-II, .62 mm : .68 mm. Intermediate femora 5.75 mm, tibiae 4.0 mm. Tarsal segments I-II, 1.7 mm : .55 mm. Posterior femora 4.8 mm, tibiae 1.6 mm.

"Male. The type of the male described here differs from typical *H. flaviventris* in that it is smaller. Length of body 2.42 mm to 2.57 mm, greatest width 1 mm. The anal segment is shorter than in *H. flaviventris*, length almost equal to width. Measurements in mm are as follows: Antennal segments I-IV, 1.65 : .55 : .35 : .43. Anterior legs: Femora 1.98, tibiae 1.55, first tarsal .45, second tarsal .05. Intermediate legs: Femora 5.55, tibiae 3.88, first tarsal 1.80, second tarsal .5. Hind legs: Femora 4.93, tibiae 2.45, tarsi .75.

"Samples collected by Dr. Davignon on the frigate, 'Memory of Asov', during its cruise in the Pacific Ocean."

There is an excellent plate in Nasanov's paper showing the details of this species. Except for the symmetrical styliform processes shown and the statement above that species is only 2.4 to 3.0 mm, I would consider *kudrini* to be a synonym of *flaviventris* since all



Figs. 116-117. 116, developing embryo of *Halobates hawaiiensis*. The legs are numbered; 117, egg after hatching with embryonic membrane still attached. Note "egg-burster".

other measurements agree very well with this species. I have not included *kudrini* in the key. I have been unable to locate the types or determine the type locality.

Halobates sexualis Distant

Halobates sexualis Distant, 1903a, Fasc. Malay. Zool. 1: 258, pl. 15, fig. 10.

I have not seen this species. The original description is practically worthless as it would apply to a half dozen or more species. However, Dr. W. E. China has kindly furnished me with a figure of ♂ terminalia and a series of measurements of the type. The measurements are as follows (44 units=1 mm): Antennal segments I-IV, 56 : 20 : 14 : 20. First anterior tarsal segment much shorter than 2nd, 12 : 22. Ratio of middle to hind femora, 241 : 182. Total length of body, 4.5 mm. Left styliiform process short, broad, blunt at apex (fig. 112). Tergum 9 a little longer than broad, with a pair of prominent antero-ventrally directed prominences in front of middle (fig. 111). The structure of the male terminalia is sufficient to separate this species from all others. The combination of tarsal ratio, size and coloration should distinguish the females. Type locality: Estuary of the Jambu River, Malaya. Type in the British Museum (Nat. Hist.).

ANNOTATED BIBLIOGRAPHY

- Amyot, C. J. B. and A. Serville. 1843. Histoire Naturelle des Insectes. Hémiptères. Paris. (Redescribes the genus but it is not that of Eschscholtz since a species of *Brachymetra* is included; repeats some of Eschscholtz's mistakes.)

- Annandale, N. 1911. Miscellanea. Insects. Notes on aquatic Rhynchota. Ind. Mus., Rec. **6**: 111-2. (Discusses *Euratas formidabilis* Distant and *Fabatus servus* Distant but does not recognize the fact that the latter genus was based upon nymphs of the former.)
- Annandale, N. and S. Kemp. 1915. Fauna of Chilka Lake. 2. Aquatic Insects. Ind. Mus., Mem. **5**: 181-7, Pl. 11, fig. 1-7. (Recognizes fact that *Euratas* and *Fabatus* are synonymous and presents some fine data on morphology and life history.)
- Barber, H. G. 1914. Hemiptera of Florida. Amer. Mus. Nat. Hist., Bull. **33**: 49. (Records *H. micans* from Lake Worth and Miami, Florida.)
- 1925. Hemiptera-Heteroptera from the Williams Galapagos Expedition. Zoologica **5**: 241-54, 4 figs. 2 maps. (Describes *H. robustus* as new.)
- 1934. The Norwegian Zoological Expedition to the Galapagos Islands 1925, conducted by Alf Wollboeck. 11. Hemiptera-Heteroptera. Zool. Mus. Oslo, Medd. **42**: 281-89. (Records *H. micans* and *robustus* from the Galapagos.)
- 1943. Biological results of the last cruise of the Carnegie, 1928-29. 6. *Halobates*. Carnegie Inst. Wash. Pub. **555**: 77-84. (Females of the 3 species collected: *micans*, *sericeus*, *splendens*, are redescribed, figured and included in a key. There is also fine checklist of literature on the 3 species.)
- Berendt, G. C. 1856. Die im Bernstein befindlichen organischen Reste. **2**: 19, fig. 8. (An insect is described and figured which Berendt considers the nymph of a *Halobates*, but it appears to be a gerrine rather than a halobatine.)
- Bergroth, E. 1893. Mission scientifique de M. Ch. Alluaud aux îles Sechelles. Hétéroptères. Rev. Ent. Franc. **12**: 197-209. (Description of *H. alluaudi* from the Seychelles.)
- Bianchi, V. 1896. On two new forms of the heteropterous family Gerridae. Mus. Zool. Acad. Sci. St. Petersburg, Ann. **1**: 69-76. (Presents a key to the genera on p. 70.)
- Blanchard, E. 1840. Histoire naturelle des Insectes, etc. Paris. Hemiptera in volume 3. (Redescription of the genus and briefly redescribes *H. micans* and *sericeus*.)
- Blatchley, W. S. 1926. Heteroptera or true bugs of Eastern North America. Nature Pub. Co. Indianapolis. 1116 pp., 12 pl. 215 figs. (Redescribes *H. micans* and records it from Florida.)
- Breitenback, W. 1884. Über pelagische Insekten. Kosmos **14**: 464-67. (Survey of literature; discussion of White's monograph.)
- Burmeister, H. 1835. Handbuch der Entomologie. Vol. 2 Hemiptera. Berlin. (Redescription of genus. Repeats many of Eschscholtz's mistakes and considers relative lengths of middle tarsal segments of generic value.)
- Carpenter, G. H. 1892. Reports on the zoological collections made in Torres Straits by Prof. A. C. Haddon. Rhynchota from Murray Island and Mabuiag. Roy. Dublin Soc., Proc. (n. s.) **7**: 137-46, pls. 12, 13. (Description of *H. regalis*, also describes new species of the allied genus, *Hermatobates*.)
- 1906. Report on the marine Hemiptera (*Halobates*) collected by Prof. Herdman at Ceylon in 1902. London. Report to the Government of Ceylon on the pearl oyster fisheries. Pub. by the Royal Society. (Description of *H. herdmani*.)
- China, W. E. 1957. The marine Hemiptera of the Monte Bello Islands, with descriptions of some allied species. Linn. Soc. Lond., Jour. Zool. **40** (291): 342-57. (Describes the subgenus *Hilliella*. Also presents keys to the species of *Hermatobates* and *Halovelvia*. Several new species described.)

- Collington, C. 1868. Rambles of a Naturalist on the shores and waters of the China Sea. John Murray, London. [Original not seen.] (p. 358, *H. sp*; ed.)
- Dahl, F. 1893. Die *Halobates*-Ausbeute der Plankton-Expedition. *Ergeb. Plankt.-Exped.* 2, G. a: 1-9. (key to species. Describes *H. inermis* and synonymizes *wullerstorffi* with *micans*.)
- Delsman, H. G. 1926. On the Propagation of *Halobates*. *Treubia* 8: 384-88, 7 figs. (Excellent description of embryological development and hatching.)
- Dickerson, R. E. 1921. Notes on a fauna of the Ugo Group and its bearing on the evolution of marine molluscan faunas. *Calif. Acad. Sci., Proc.* 11: 1. (Discusses the uniformity of the past climate of the Indo-Pacific.)
- 1925. Climate of the Philippines during the Tertiary and Quaternary Time, *In Gedenkenboek Verbeek. Geol. -mijnb Genootsch. voor Nederland en Kolonien, Verh. (Geol. Ser.)* 8.
- Distant, W. L. 1903a. Report on the Rhynchota. Part I, Heteroptera. *Fasc. Malay. Zool.* 1: 219-72, pls. 15, 16. (Description of *H. sexualis* from Malaya.)
- 1903b. The fauna of British India including Ceylon and Burma. Edited by W. T. Blanford. Rhynchota in vol. 2, part 1, Heteroptera. London. 242 pp. (Redescribes *H. frauenfeldanus*, *micans*, and *flaviventris*. Records all 3 from Indian Ocean.)
- 1910a. Some undescribed Gerrinae. *Ann. Mag. Nat. Hist. ser.* 8, 5: 140-53. (Describes *Euratas*, type *formidabilis*; *Fabatus*, type *servus*.)
- 1910b. The fauna of British India including Ceylon and Burma. Edited by A. E. Shipley and G. A. K. Marshall. Rhynchota, Vol. 5. Heteroptera: appendix. London. 362 pp. (Redescribes *H. germanus* and *herdmani* and records both from Indian Ocean. Description of *Euratas formidabilis* and *Fabatus servus* reprinted from the original.)
- 1913. Rhynchota, Part 1; suborder Heteroptera (of the Seychelles). *Linn. Soc. Lond., Trans.* 16: 139: 191. (Records *H. alluaudi* from Mahe: Long Island.)
- 1915. A few undescribed Rhynchota. *Ann. Mag. Nat. Hist. ser.* 8, 15: 503-7. (Describes the genus *Asclepios*, type *annandalei*, from Calcutta.)
- Ekman, S. 1953. Zoogeography of the sea. (translated from the Swedish by Elizabeth Palmer). Sidgwick and Jackson Lts. London. 417 pp., 121 fig., 40 tables. (A very comprehensive text on the subject.)
- Esaki, T. 1924. On the genus *Halobates* from Japanese and Formosan coasts (Hemiptera, Gerridae). *Psyche* 31: 112-18, 1 pl. (Describes *H. apicalis* (Formosa), *shiranui* (Japan), *japonicus* (Japan), *matsumurai* (Formosa, Japan, E. China Sea); records *germanus* from Malay Peninsula, *sericeus* from Admiralty Island to Japan.)
- 1926. The water-striders of the subfamily Halobatinae in the Hungarian National Museum. *Mus. Hung., Ann. Hist.-Nat.* 23: 117-64, 12 figs. (Describes *H. rotundatus* from New Guinea. Records *micans* from Formosa, *sericeus* from "Pacific Ocean", *japonicus* from Misaki, Japan, *hayanus* from New Guinea and Singapore, *alluaudi* from Dregerhafen, New Guinea.)
- 1928a. New or little-known Gerridae. 1. Ceylonese species. *Ann. Mag. Nat. Hist. ser.* 10, 2: 505-13, 5 figs. (Synonymizes *H. herdmani* with *flaviventris*. Raises var. *kudrini* (of *flaviventris*) to specific rank.)
- 1928b. Aquatic and semiaquatic Heteroptera. *Insects of Samoa. Brit. Mus. (Nat. Hist.) London.* 2: 67-80, 6 figs. (Records *H. princeps* from Apia, Upolu, Sa-

- moa. Synonymizes *alluaudi* and *matsumurai* with *princeps*.)
- 1929. New or little-known Gerridae. 2. Indian species. *Ann. Mag. Nat. Hist.* ser. 10, 4: 412-19, 4 figs. (Considers *Euratus formidabilis* and *Fabatus servus* identical and synonymous with *Halobates*. Proposes new combination, *H. formidabilis* (Distant).)
- 1930a. Marine water-striders from the Corean coast. *Ent. Mon. Mag.* 65: 158-61. (Records *H. princeps* from the east shore of Central Korea. Transfers *H. apicalis* to *Asclepios* and presents characters for the separation of *Halobates* and *Asclepios*.)
- 1930b. New or little-known Gerridae from the Malay Peninsula. *Fed. Malay Mus., Jour.* 16 (1-2): 13-24, 4 figs. (Synonymizes *H. rotundatus* with *proavus*.)
- 1933. Halophilus Hemiptera from the coasts of Japan. *Botany and Zoology, Tokyo* 1: 778, fig. 3. (Records the following: *H. micans*, *princeps*, *sericeus*, *japonicus*). I have not seen this paper.
- 1937. Die Gerroidea Mikronesiens (Hemiptera-Heteroptera). *Tenthredo* 1: 351-62, 3 pls. 3 figs. (Describes *H. mariannarum* from Rota, Mariannas. Records *H. princeps* from Palau Is.)
- Esaki, T. et al. 1954. *Iconographia Insectorum Japonicorum*. Hokuryukan, Ltd. Tokyo 1736 pp., 4968 figs. 2nd Ed. (revised). Hemiptera 179-270. [in Japanese]. (Records and figures *H. sericeus*, *princeps*, and *japonicus*. Transfers *H. shiranui* to *Aclepios*.)
- Eschscholtz, J. F. 1822. *Entomographien*. Vol. 1 (1st lief.) Berlin 128 pp. Also: *Naturwissenschaftliche Abhandlungen aus Dorpat*. 1823. (Describes the genus *Halobates* and the species *micans*, *sericeus* and *flaviventris*.)
- Fairmaire, L. 1848. Seances de la Soc. Ent. France: Communication. *Soc. Ent. France, Ann.* 17 (Bull. 3): 26. (General discussion of habits.)
- Frauenfeld, G. von 1867. *Zoologische Miscellen*. 11. Das Insektenleben zur See. K. K. Zool.-Bot. Gesell. Wien, *Verh.* 17: 456-60, Taf. 12, fig. 1-10. (An important paper with redescriptions and additional characters.)
- Giglioli, E. H. 1870. Breve cenno sulla distribuzione geografica dell' emittero *Halobates*, Eschscholtz. *Soc. Ent. Ital., Bull.* 2: 260-61. (General account of collecting.)
- Griffini, A. 1895. Gli *Halobates* del viaggio della "Magenta". *Mus. Torino, Boll.* 10 (213): 5 pp. (Records *H. wullerstorffi* from China Sea, Cape of Good Hope: *germanus* from China Sea and Bank's Strait; *streatfieldanus* from Valparaiso, Chile. Describes var. *magentae* of *streatfieldanus*.)
- Hadden, F. C. 1931. The Pelagic *Halobates*. *Hawaii. Ent. Soc., Proc.* 7: 457-59, 1 fig. (Mentions collecting *H. sericeus* at Waikiki in January.)
- Hale, H. M. 1925. Results of Dr. E. Mjoberg's Swedish Scientific Expedition to Australia 1910-1913. The aquatic and semiaquatic Hemiptera. *Arkiv Zool.* 17 A (20): 1-19. (Describes *H. mjobergi* from Broome, NW Australia. Records *micans*, *regalis*, *whiteleggei* from Australia.)
- Haller, G. 1887. Über die pälagisch lebende Gattung *Halobates* Eschscholtz. *Schweiz. Ent. Ges., Mitt.* 7 (4): 182-91. (A German translation and summary of White's monograph.)
- Heidemann, O. 1901. Papers from the Hopkins Stanford Galapagos Expedition 1898-1899. Hemiptera. *Wash. Acad. Sci., Proc.* 3: 363-70. [Records *H. wullersdorffii* (*sic*) from Galapagos.]

- Henry, G. M. 1932. Note on the diving powers of *Halobates Spolia Zeylanica* 16: 353-54. (Reports that *Halobates* dive beneath the surface and swim about during rough weather.)
- Herrich-Schäffer, G. A. W. 1848. Die Wanzenartigen Insecten. Nuremburg. Hemiptera in vol. 8. (Redescribes the genus but repeats Eschscholtz's errors.)
- Herring, J. L. 1958. The marine water-striders of the "Dana" Expeditions (Insecta: Hemiptera). Dana Report no. 44: 14 pp., 6 figs. (Describes *H. katherinae* from New Caledonia and *fijiensis* from Fiji. Distribution of the "Dana" material is shown on 3 maps.)
- Howard, L. O. 1889. Scientific results of explorations by the U. S. Fish Commission steamer "Albatross". No. 5. Annotated catalogue of the insects collected in 1887-1889. U. S. Nat. Mus., Proc. 12: 185-86. [I have not seen this paper.]
- Hungerford, H. B. 1920. The biology of aquatic and semiaquatic Hemiptera. Kansas Univ. Sci. Bull. 11 (21): 256 pp., 3 colored pl. (Erroneously records *H. sericeus* from Florida and *micans* from California.)
- Ihering, H. von 1927. Die Geschichte des Atlantischen Ozeans. Jena.
- Imms, A. D. 1936. On a new species of *Halobates*, a genus of pelagic Hemiptera. John Murray Exped., Sci. Repts. 1933-34. 4 (2): 71-78, 7 figs. (Describes *H. sewelli* from the Gulf of Oman.)
- Kirkaldy, G. W. 1899. Missions de M. Ch. Alluaud aux îles de la région Malgache. Soc. Ent. France, Ann. 68: 101-9. (Records *H. alluaudi* from Madagascar. Tentatively identifies the other species collected as *sericeus* and *flaviventris*.)
- 1901. On some Rhynchota principally from New Guinea. Mus. Civ. Stor. Nat. Genova, Ann. ser. 2, 20: 805. [Records *H. princeps* from Varbusi, N. G. (Bec-cari), Goram (D'Albertis).]
- 1906. List of the genera of the Pagiopodus Hemiptera-Heteroptera, with their type species, from 1758-1904 (and also of the aquatic and semiaquatic Trochalopoda). Amer. Ent. Soc., Trans. 32: 117-56.
- 1907. Quelques mots sur les Hémiptères Polynésiens du voyage l'Eugénie. Soc. Ent. Belg., Ann. 50: 3-5. (Discusses the Hemiptera collected by the Eugenie and lists many species that were doubtless mislabeled. The confusion exists primarily between the material collected on the W. coast of the Americas and "Taiti".)
- Kirkaldy, G. W. and J. R. de la Torre-Bueno 1909. A catalogue of American aquatic and semi-aquatic Hemiptera. Ent. Soc. Wash., Proc. 10: 173-215.
- Laporte, F. L. de 1832. Essai d'une classification systématique de l'ordre Hémiptères. (Hémiptères-Hétéroptères Latr.): 24, pl. 52, fig. 4. (Designates *H. micans* type.)
- Lethierry, L. and G. Severin 1896. Catalogue général des Hémiptères. Berlin. 3: 275 pp. (Checklist of species.)
- Lundbeck, W. 1914. Some remarks on the eggs and egg-deposition of *Halobates*. Minde-skrift for Japetus Steenstrup, København 2 (27): 13 pp., 1 pl., 3 text figs. (An excellent account of the material collected by the sea captains for Japetus Steenstrup. Most of the floating debris which contained eggs are figured on a colored plate.)
- Martin, K. 1917. Die Altmiocäne Fauna des West-Progogebirges auf Java. Leiden Saumlg. Geol. Reichmus. 2. (Discusses the uniformity of the climate of the Quaternary and Tertiary Periods of the Indo-Pacific.)
- Matsumura, S. 1913. Thousand Insects of Japan. Tokyo. Additamenta 1, 184 pp., 15 pls.

- McLachlan, R. 1871. Notes on the hemipterous genus *Halobates*. Ent. Mon. Mag. 7: 208-9. (General account of collecting, no reference to species.)
- Moseley, H. N. 1879. Notes by a naturalist on the Challenger. Macmillan & Co. London ix, 606 pp. (Mentions that *Halobates* carries the eggs attached to the end of the abdomen, but White states that Moseley had communicated to him that such statement was in error.)
- Murray, John 1879. Narrative of the voyage of the HMS Challenger. Voy. Challenger, Rept. Narrative 1 (2): 1110 pp. (Discusses distribution and feeding habits.)
- Nasanov, N. 1894. *Halobates flaviventris* var. *kudrini*, nov. var. Entomologische Untersuchungen im Jahre 1893. Warsaw. Warsaw University, Izvestia 6: 24 pp., 1 pl. [In Russian]. Zoologische Centralblatt 1: 702, 1894 gives a German translation of the morphology section. (Describes *H. flaviventris*, var. *kudrini*. Includes a fine morphology section and figures of the internal anatomy.)
- Oshanin, B. F. 1908. Verzeichnis der palaearktischen Hemipteren. St. Petersburg. 1 (2): 395-586.
- Shadow, W. 1922. Die Gattung *Halobates* Eschsch. und die Beziehung der Meeres- und Süßwasserhydrometriden zueinander. Auszug Hamburg Univ. Diss. 1922: 5 pp. Also unpublished manuscript, Hamburg, Math. -Naturwiss. vol. 27. Feb. 1922. 125 pp. with figs. and maps. (Describes *H. maculatus* from the Bismarck Archipelago. Presents morphology section and key to species.)
- Sharp, D. 1899. Insects. Pt. 2. Cambridge Nat. Hist. 6. London. 626 pp. (Figures a ♀ of *H. sobrinus* carrying 3 eggs attached to the end of the abdomen.)
- Skuse, F. A. A. 1891. Description of a new pelagic hemipteron from Port Jackson. Austrl. Mus., Rec. 1 (8): 174-77, pl. 27, 10 figs. (Describes *H. whiteleggei* from Port Jackson, N. S. W.)
- 1893. Notes on Australian aquatic Hemiptera. *op. cit.* 2 (1): 42-45.
- Spinola, M. M. 1840. Essai sur les Insectes Hémiptères Rhyngotes, ou Hétéroptères. Paris.
- Stamm, ? 1913. (Note). Dansk Nat. For. København, Vidensk. Medd. 64: 8. (Exhibited feathers of a tern containing *Halobates* eggs.)
- Sverdrup, H. U., M. W. Johnson and R. H. Fleming. 1942. The Oceans. Prentice-Hall Inc., N. Y. 1087 pp. (The best reference work on the physics, chemistry and general biology of the oceans.)
- Templeton, R. 1836. Description of a new hemipterous insect from the Atlantic Ocean. Ent. Soc. Lond., Trans. 1: 230-31, pl. 22, fig. a. (Describes *H. streatfieldanus* from midway between Africa and America.)
- Torre-Bueno, J. R. de la 1911. The gerrids of the Atlantic states (Subfamily Gerrinae). Amer. Ent. Soc., Trans. 37: 243-52. (Records *H. micans*.)
- 1923. The Reduviidae and the families of semiaquatic and aquatic Heteroptera. Hemiptera of Connecticut, State of Connecticut Geol. and Nat. Hist. Surv. Bull. 34: 391-421, 658-665, 674-692. (Mentions *H. micans*.)
- Uhler, P. R. 1884. Order 6 - Hemiptera, Suborder 3 - Heteroptera. In Standard Natural History 2: 249-96.
- Unger, R. L. 1938. Biological notes on the pelagic water-striders (*Halobates*) of the Hawaiian Islands with description of a new species from Waikiki (Gerridae-Hemiptera). Hawaii. Ent. Soc., Proc. 10: 77-84, 3 figs. (Describes *H. hawaiiensis*. Checklist of species with synonymy.)

- 1946. Insects of Guam 2. B. P. Bishop Mus., Bull. **189**: 97. (Records *H. mariannarum* from Piti, Guam.)
- Usinger, R. L. and J. L. Herring. 1956. Notes on the marine water striders of the Hawaiian Islands (Hemiptera: Gerridae). Hawaii. Ent. Soc., Proc. **16** (2): 281–83. (Notes on biology and a key to separate *H. sericeus*, *H. hawaiiensis* and *Hermatobates hawaiiensis*.)
- Van Duzee, E. P. 1917. Catalogue of the Hemiptera of America north of Mexico. Univ. of Calif. Publ. Tech. Bull. **2**: 902 pp.
- 1937. The Hemiptera of the Templeton Crocker Expedition of Polynesia in 1934–35. Calif. Acad. Sci., Proc. **22** (4): 118.
- Walker, J. J. 1883. Entomological collecting during a voyage to the Pacific. Ent. Mon. Mag. **19**: 274–78. (No species names mentioned.)
- 1893a. On the genus *Halobates* Esch., and other marine Hemiptera. *op. cit.* **29**: 227–32. (Interesting general account of collecting and notes on habits. Describes a species diving and swimming beneath the surface!)
- 1893b. Supplementary notes on *Halobates*, etc. *t. c.*, 252. (Of no concern.)
- Wells, J. W. 1957. Coral reefs. IN Treatise on marine ecology and paleoecology. Geol. Soc. Amer. Mem. **67** (1): 609–30. (In part, comparison of Atlantic and Pacific faunas.)
- White, F. B. 1883. Report on the pelagic Hemiptera. Voy. Challenger, Rept. Zool. **7** (19): 82 pp, 3 pls. (2 colored). (The classic monograph on the genus. Includes a reprint of all pertinent literature, keys, descriptions and colored figures.)
- Wickham, H. F. 1894. On the habits of some oceanic Hemiptera. Ent. News. **5**: 33–36.
- Witlaczil, E. 1886. Die Ausbeute des "Pisani" an *Halobates* während der Erdumseglung 1882–1885. Wien Ent. Ztg. **5**: 177–82, 231–34. (Describes *H. splendens* from W. coast of America; *incanus* from the Arabian Sea. Records *wullerstorffi* from many places in the Atlantic; *sericeus* from the Pacific; mentions *micans* and *frauenfeldanus*. Observations on embryology.)
- 1887. Zur Kenntniss des Gattung *Halobates*. Zool. Anz. **10**: 336–39.

RESEARCH NOTE

REDISCOVERY OF *HAEMAPHYSALIS MJOBERGI* WARBURTON, 1926 (ACARINA: IXODIDAE)

Haemaphysalis mjobergi was described by the Warburton (1926, Parasitology **18**: 57–58) from two male specimens "in a tube labelled 'Rissa equina, Borneo' in a small collection of ticks sent by Dr. E. Mjöberg from Sarawak, 7–IV–24." "Rissa" is probably a lapsus for *Rusa*, a name that has been used for the sambar or red deer, *Cervus unicolor*. The avian genus *Rissa* does not occur in Borneo. Since no further collections of this species have been reported, the finding of it again in Borneo is of interest.

Among numerous lots of ticks collected in Borneo by Mr. T. C. Maa of the Bernice P. Bishop Museum, Honolulu, Hawaii, and referred to the writer for identification was one lot containing two males of *H. mjobergi* and two females of *Amblyomma testudinarium*. The ticks were collected from grass and fallen leaves at Poi, southwest Sarawak, May 30, 1958. Dr. G. Owen Evans of the British Museum (Natural History) kindly compared these