

Notes on Some Species of the  
*Falcatus* Group of *Gonodactylus*  
(Crustacea: Stomatopoda:  
Gonodactylidae)

RAYMOND B. MANNING

## SERIES PUBLICATIONS OF THE SMITHSONIAN INSTITUTION

Emphasis upon publication as a means of “diffusing knowledge” was expressed by the first Secretary of the Smithsonian. In his formal plan for the Institution, Joseph Henry outlined a program that included the following statement: “It is proposed to publish a series of reports, giving an account of the new discoveries in science, and of the changes made from year to year in all branches of knowledge.” This theme of basic research has been adhered to through the years by thousands of titles issued in series publications under the Smithsonian imprint, commencing with *Smithsonian Contributions to Knowledge* in 1848 and continuing with the following active series:

*Smithsonian Contributions to Anthropology*  
*Smithsonian Contributions to Astrophysics*  
*Smithsonian Contributions to Botany*  
*Smithsonian Contributions to the Earth Sciences*  
*Smithsonian Contributions to Paleobiology*  
*Smithsonian Contributions to Zoology*  
*Smithsonian Studies in Air and Space*  
*Smithsonian Studies in History and Technology*

In these series, the Institution publishes small papers and full-scale monographs that report the research and collections of its various museums and bureaux or of professional colleagues in the world of science and scholarship. The publications are distributed by mailing lists to libraries, universities, and similar institutions throughout the world.

Papers or monographs submitted for series publication are received by the Smithsonian Institution Press, subject to its own review for format and style, only through departments of the various Smithsonian museums or bureaux, where the manuscripts are given substantive review. Press requirements for manuscript and art preparation are outlined on the inside back cover.

S. Dillon Ripley  
Secretary  
Smithsonian Institution

SMITHSONIAN CONTRIBUTIONS TO ZOOLOGY • NUMBER 258

Notes on Some Species of the  
*Falcatus* Group of *Gonodactylus*  
(Crustacea: Stomatopoda:  
Gonodactylidae)

*Raymond B. Manning*



SMITHSONIAN INSTITUTION PRESS

City of Washington

1978

## ABSTRACT

Manning, Raymond B. Notes on Some Species of the *Falcatus* Group of *Gonodactylus* (Crustacea: Stomatopoda: Gonodactylidae). *Smithsonian Contributions to Zoology*, number 258, 15 pages, 13 figures, 1978.—Five species of the *Falcatus* group of *Gonodactylus* are described and illustrated. *Gonodactylus glabrous* Brooks, *G. mutatus* Lanchester, and *G. ternatensis* De Man are removed from the synonymy of *G. falcatus* (Forskål) and are redescribed from type-specimens; *G. falcatus* is redescribed from topotypical material; and *G. randalli*, new species, is described. *Gonodactylus rotundus* Borradaile is considered a synonym of *G. mutatus* Lanchester.

OFFICIAL PUBLICATION DATE is handstamped in a limited number of initial copies and is recorded in the Institution's annual report, *Smithsonian Year*. SERIES COVER DESIGN: The coral *Montastrea cavernosa* (Linnaeus).

---

### Library of Congress Cataloging in Publication Data

Manning, Raymond B.

Notes on some species of the *Falcatus* group of *Gonodactylus* (Crustacea, Stomatopoda, Gonodactylidae).

(Smithsonian contributions to zoology ; no. 258)

Bibliography: p.

1. *Gonodactylus*. 2. Crustacea—Classification. I. Title. II. Series: Smithsonian Institution. Smithsonian contributions to zoology ; no. 258.

QL1.S54 no. 258 [QL444.M375] 591'.08s [595'.382] 77-10754

# Contents

	<i>Page</i>
Introduction .....	1
<i>Gonodactylus falcatus</i> (Forskål, 1775) .....	4
<i>Gonodactylus glabrous</i> Brooks, 1886 .....	5
<i>Gonodactylus mutatus</i> Lanchester, 1903 .....	7
<i>Gonodactylus randalli</i> , new species .....	9
<i>Gonodactylus ternatensis</i> De Man, 1902 .....	10
Literature Cited .....	14



# Notes on Some Species of the *Falcatus* Group of *Gonodactylus* (Crustacea: Stomatopoda: Gonodactylidae)

*Raymond B. Manning*

## Introduction

In an earlier paper (Manning, 1968:42), I pointed out that the Indo-West-Pacific species of *Gonodactylus* comprise three groups of species: the *Chiragra* group, containing *G. chiragra* (Fabricius, 1781) and its allies, large species with broad ocular scales and three mid-dorsal carinae on the telson; the *Demanii* group, including *G. demanii* Henderson, 1893 and its allies, small species with narrow ocular scales and three mid-dorsal carinae on the telson; and the *Falcatus* group, containing *G. falcatus* (Forskål, 1775) and related species, moderate to large species with narrow ocular scales and five mid-dorsal carinae on the telson. The American species form the fourth group, the *Oerstedii* group, containing species related to *G. oerstedii* Hansen, 1895, all of which have an accessory carina on the mesial margin of the intermediate carina of the telson.

The *Demanii* group may well include representatives of two distinct groups, one with *G. demanii* and allies, containing species that often have modified telsons and uropods, and one with *G. affinis* De Man and related species, in which the telson closely resembles that found in the *Chiragra* group but in which the size at maturity is reduced.

---

*Raymond B. Manning, Department of Invertebrate Zoology, National Museum of Natural History, Smithsonian Institution, Washington, D. C. 20560.*

Only two species currently are recognized in the *Falcatus* group: *G. falcatus* sensu lato, reported to have a wide distribution from the Red Sea and South Africa to Hawaii and Japan, and *G. graphurus* Miers, 1875, known only from Australasian waters. Until recently, *G. falcatus* had been known as *G. glabrous* Brooks, although the epithets *glaber* (Henderson, 1893 and others), *graphurus* (Müller, 1887 and others), and *glabrus* (Roxas and Estampador, 1930) also had been used for this species. Holthuis (1941) pointed out that the oldest available name for this species was *G. falcatus* (Forskål, 1775), a name generally overlooked or mistakenly thought to be a synonym of the distantly related *G. chiragra* (Fabricius).

Both Brooks (1886) and Kemp (1913) illustrated the major difference between *G. falcatus* (as *G. glabrous*) and *G. graphurus*, i.e., the transversely grooved abdominal somites in the latter species. In general, since 1913 the specific epithet *graphurus* has been applied to the grooved species that Ingle (1971) correctly attributed to Miers (1875) and that now is known to be restricted to Australasian waters (Manning, 1966). Inasmuch as this species is relatively well known and described (Manning, 1966; references to 1965), it is not treated in detail here. The grooved abdominal somites are shown below in Figure 2b.

The identity of *G. falcatus* is less clear, for it now is certain that several species are being con-

fused under that name. The following names are available for species in the *Falcatus* group other than *G. graphurus*: *G. falcatus* (Forskål, 1775); *G. glabrous* Brooks, 1886; *G. glabrous* var. *ternatensis* De Man, 1902; *G. chiragra* var. *mutatus* Lanchester, 1903; *G. glaber* var. *rotundus* Borradaile, 1907; and *G. bossorotundus* Roxas and Estampador, 1930.

With the exception of *G. falcatus*, all of those names published before 1913 were synonymized with *G. glabrous* by Kemp (1913), and virtually all subsequent authors followed Kemp in recognizing a single taxon that Holthuis (1941) called *G. falcatus*. One exception to this was Serène (1954), who recognized two taxa from Viet Nam, *G. falcatus* and a dwarf variety ("race Naine"), which he called *G. falcatus* var. *ternatensis* (De Man).

The identity of *G. bossorotundus* Roxas and Estampador, 1930, found in a collection of *G. falcatus* sensu lato, from the Philippines, cannot be determined from their account; it appears to be a member of the *Falcatus* group with a damaged telson. According to E. Estampador (pers. comm.), the unique holotype was lost during World War II, so the problem may never be resolved.

While studying the biology of stomatopods in Thailand in 1974, H. Dingle, University of Iowa, and R. Caldwell, University of California, recognized that two distinct species of *Gonodactylus*, both identifiable on morphological grounds with *G. falcatus*, occurred there. Representatives of the two forms were sent to me for identification, and, in order to provide those identifications, I had to reexamine available types of species in the *Falcatus* group. As a result, I recognized five species of that group in addition to *G. graphurus*: *G. falcatus* (Forskål, 1775), *G. glabrous* Brooks, 1886, *G. mutatus* Lanchester, 1903, *G. ternatensis* De Man, 1902, and a new species, *G. randalli*.

In their study of two species of the *Falcatus* group from Thailand, Dingle and Caldwell noted differences in color between males and females of the same species, and differences in color, size, and biology between two species living on the same tidal flat. This kind of information is badly needed for all members of the *Falcatus* group. Study series documented with information on habitat and color in life would be most welcome.

Species recognition in *Gonodactylus* is hampered by the paucity of clearly defined characters in mem-

bers of this genus, coupled with the masking effects of aging as well as secondary sexual changes, especially in males. Although most stomatopods can be identified through meristic features, in *Gonodactylus* species discrimination is based largely on subjective features, including: relative length of the apical spine and shape of the rostral plate, size and shape of the ocular scales, ornamentation and shape of the telson, and structure and armature of the uropods. Rarely are there such clear, distinctive characters as the transverse grooves on the abdomen of *G. graphurus* or the accessory carina of the telson in the American *G. oerstedii* Hansen.

Representatives of the *Falcatus* group have been cited in the literature more than 100 times, and since few records include descriptive notes or figures, virtually none of them can be identified with certainty without reexamination of the material cited. For this reason and because synonymies are being compiled by L. B. Holthuis, Rijksmuseum van Natuurlijke Historie, Leiden, for the *Crustaceorum Catalogus*, I have included here only the original citation for each species and selected subsequent citations. Much more material will have to be studied before the ranges, synonymies, and extent of morphological and geographical variation of these species can be worked out. The accounts given here have been restricted to descriptions, illustrations of types of four previously named species, illustrations of topotypic material for one species, and the account of a new species.

Additional species in the *Falcatus* group may be recognized in the future. A. Michel (in litt.), Centre National pour l'Exploitation des Océans, Tahiti, has been studying stomatopod larvae from the central Pacific for several years and can recognize the larvae of six separate species of the *Falcatus* group of *Gonodactylus* occurring in that area.

Further, with our current state of knowledge, not all of the material of the *Falcatus* group available for study can be identified with certainty. The population of this group from Hawaii, identified with *G. falcatus* and thought to be a recent introduction there (Kinzie, 1968), cannot now be identified with any of the species described below. Kinzie (1968, fig. 3) has shown the sixth abdominal somite and telson of a male and a female from Hawaii: the female has a sharp median carinule on the sixth abdominal somite, but the male lacks it. This carinule is present in both sexes of *G. fal-*



*catus* from the Red Sea and, indeed, is characteristic of only *G. falcatus*, *G. graphurus*, and *G. randalli*, new species, in the *Falcatus* group. This carinule is not apparent in the limited material from Hawaii in the collection of the National Museum of Natural History. This may prove to be a variable feature of *G. falcatus*, but such variation is not found in topotypic material of that species.

Serène (1954:82) pointed out that five morphological changes accompanied aging in *G. mutatus* (as *G. falcatus* var. *ternatensis*) from Viet Nam, and his comments probably are applicable to members of the *Falcatus* group in general: (a) thickening of the margins of the telson, resulting in blunter teeth with less space between them; (b) comparative inflation of the carinae of the sixth abdominal somite and the telson, relatively accentuated in males; (c) enlargement of the intermediate tooth of the telson; (d) reduction of the number of submedian marginal denticles on the telson; and (e) reduction in size and number of posterior spines on the carinae of the sixth abdominal somite and telson. Serène also illustrated differences in rostral plates of males and females (fig. 13) and telsons (pls. 9, 10). All of these changes must be taken into account in any study of members of the *Falcatus* group.

Because such changes are less drastic in females than in males, figures given herein are, with one exception, based on adult females of similar size. Females show less change with age than do males, especially in inflation of the carinae of the sixth abdominal somite and telson. In adult males the inflation of these carinae may completely mask other morphological features. Figure 5, based on a male of *G. rotundus* Borradaile, shows the extent of inflation of the carinae of the telson in males of that species. The median carina of the telson is so inflated in that specimen that the knob, clearly bilobed in juveniles and females, is scarcely or not at all discernible.

In addition to the traditional illustrations included in the species accounts below, comparative outline drawings in a stylized format also are presented for the five species reported here (Figures 9–13). The format is designed after that used very effectively by Hobbs (1974) for North American crayfishes, and will be used in the future to supplement species accounts whenever possible. Eventually I hope to prepare an identification manual for

the Indo-West-Pacific stomatopods using this technique.

I have not included a key to the species of the *Falcatus* group, even though such a key could easily be constructed for the six species of the complex now recognized. In view of the uncertain status of some of the population of the *Falcatus* group, I believe that a key would be more misleading than helpful at this time.

Terms and measurements used in the accounts below have been explained in earlier papers (Manning, 1966, 1968). All measurements are in millimeters (mm).

The institutions in which the material reported here is deposited are identified by the following acronyms:

BMNH	British Museum (Natural History), London
MZC	University Museum of Zoology, Cambridge, England
SMF	Natur-Museum und Forschungsinstitut Senckenberg, Frankfurt am Main, West Germany
USNM	National Museum of Natural History, Smithsonian Institution, Washington (formerly United States National Museum)

ACKNOWLEDGMENTS.—H. Dingle, Department of Zoology, University of Iowa, and R. Caldwell, Department of Zoology, University of California, Berkeley, initiated this study by forwarding material for identification and further helped by sharing their field observations on these and other species of stomatopods. Marjorie Reaka, Department of Zoology, University of Maryland, also discussed various aspects of the biology of stomatopods based on her field observations. A. Michel, Centre National pour l'Exploitation des Océans, Tahiti, commented on his studies on stomatopod larvae, forwarded copies of illustrations of larvae, and loaned specimens. At the Natur-Museum und Forschungsinstitut Senckenberg, Frankfurt am Main, West Germany, the late R. Bott provided working space and accommodations in 1971 and, more recently, M. Türkay loaned the syntypes of *G. ternatensis* De Man. R. W. Ingle, Department of Zoology, British Museum (Natural History), London, loaned the holotype of *G. glabrous* Brooks. C. B. Goodhart, University Museum of Zoology, Cambridge, England, loaned the syntypes of *G. mutatus* Lanchester and *G. rotundus* Borradaile. The illustrations were prepared by my wife Lilly. Anne Cohen and Cynthia Hemming aided in proof-

reading and checking references and L. S. Kornicker reviewed the manuscript.

Part of this study was supported by the Smithsonian Institution through its Research Awards Program.

*Gonodactylus falcatus* (Forskål, 1775)

FIGURES 1, 2a, 9

*Cancer falcatus* Forskål, 1775:96.

*Gonodactylus falcatus*.—Holthuis, 1967:31, 41 [complete synonymy for Red Sea].

**MATERIAL.**—SW tip of Umm Aabak, N of Nocra, Dahlak Archipelago, Eritrea, Ethiopia, Red Sea; 0-2 m deep, among corals, sandy bottom; Israel South Red Sea Expedition no. 1447; 5-6 Apr 1962: 4♂, TL (total length) 47-62 mm; 7♀, TL 46-59 mm (USNM 119278).

**DESCRIPTION.**—Rostral plate (Figures 1a, 9c) as long as broad or slightly broader than long, median spine relatively short; anterior margins of plate straight, perpendicular to body line or sloping posteriorly; anterolateral angles of plate acute but broadly rounded. Ocular scales (Figures 1a, 9c)

small, breadth of both about one-fourth plate width, erect, set transversely to body line, apices rounded. Anterior 5 abdominal somites (Figure 2a) lacking transverse grooves, transverse rows of light black spots present in some specimens. Sixth abdominal somite (Figures 1b, 9a) with sharp median carinule and with 6 dorsal carinae, variously inflated, usually armed posteriorly; apical spinules often obsolete, especially in adult males; submedian and intermediate carinae flattened dorsally, with posterior excavation under each spine. Pair of small black spots (usually visible in preserved specimens) present anteriorly between submedian and intermediate carinae. Telson (Figures 1b, 9a) with length and width subequal or width slightly greater, appearing broad. Dorsal carinae of telson usually sharp, more inflated in adult males, median and accessory medians each usually with apical spinule flanked ventrally by rounded excavation. Knob strongly bilobed. Three pairs of marginal teeth present, submedians broad, with movable apices, intermediates broader, apices sharp, laterals short, apices sharp. Well-marked black spot

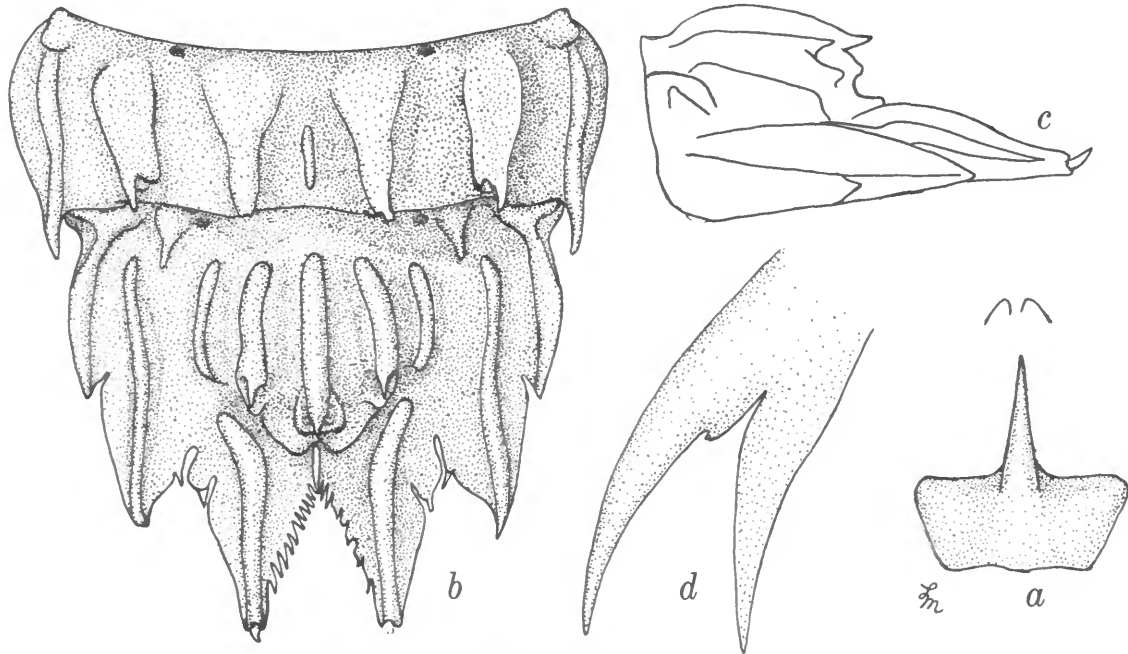


FIGURE 1.—*Gonodactylus falcatus* (Forskål), female, TL 50 mm, Red Sea: a, rostral plate and ocular scales; b, sixth abdominal somite and telson, dorsal view; c, telson, lateral view; d, basal prolongation of uropod, ventral view.

present on anterior surface anterior to each dorsal submedian carina. Ventral surface of telson with low postanal ridge and longer ventral carina on each submedian tooth. Uropodal endopod with single line of marginal setae, those on outer margin directed dorsally. Basal prolongation of uropod (Figures 1d, 9d) with 1 lobe proximally on inner margin of outer spine.

MEASUREMENTS.—Males (4), TL 47–62 mm; females (7), TL 46–59 mm. Holthuis (1967) recorded males as large as 70 mm and females as large as 66 mm from the Red Sea. Other measurements of female, TL 59 mm: carapace length 13.0; rostral plate length 3.6, width 3.8; fifth abdominal somite width 10.0; telson length 8.3, width 8.5.

REMARKS.—This account of *Gonodactylus falcatus* is based on material from the Red Sea, the type-locality. Forskål's types were not traced; they probably are not extant. Although this appears to be the common species of the *Falcatus* group in the Red Sea, it is known now that *G. mutatus* also occurs there, as discussed below in the account of that species.

*Gonodactylus falcatus* is a distinctive species, one of three in the *Falcatus* group with a sharp median carinule on the sixth abdominal somite; the carinule is present in all of the material I have examined of this species from the Red Sea. The median carinule on the sixth abdominal somite is present also in *G. graphurus* and *G. randalli*, new species, described below. *Gonodactylus falcatus* differs from *G. graphurus* in numerous features, the most important of which is the absence of fine, transverse grooves on the abdominal somites, as noted by several authors, including Kemp (1913). Sketches of the abdomen of both species are shown in Figure 2. Differences between *G. falcatus* and *G. randalli* are discussed under the account of the latter species.

Both *G. glabrous* and *G. mutatus* lack the median carinule on the sixth abdominal somite, but both resemble *G. falcatus* and differ from *G. ternatensis* in having a distinctly bilobed knob as well as in having a relatively short apical spine on the rostral plate (Figures 9–13). The dorsal carinae of the telson of *G. falcatus* are not so sharp as those of *G. glabrous* and are never so tumid as in adult males of *G. mutatus* (Figure 5).

*Gonodactylus falcatus*, like *G. ternatensis*, is a relatively large species of *Gonodactylus*, attaining

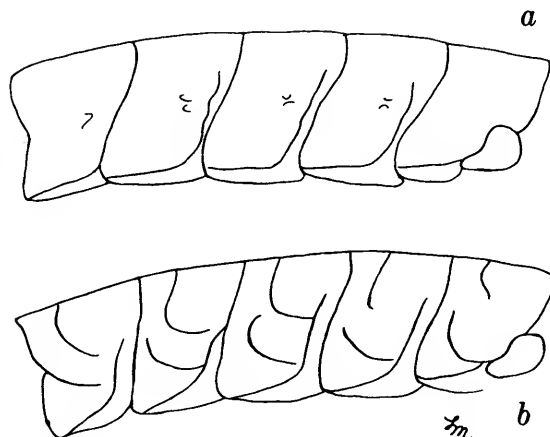


FIGURE 2.—Abdomen, lateral view: a, *Gonodactylus falcatus* (Forskål); b, *Gonodactylus graphurus* Miers.

a comparatively much greater size than does *G. mutatus* (TL 60 mm or less adults) and perhaps *G. glabrous* and *G. randalli* as well.

DISTRIBUTION.—Known with certainty from the Red Sea; Holthuis (1967) has summarized all records from that area. Its distribution outside of the Red Sea remains to be determined. Despite persistent reports of the occurrence of *G. falcatus* in the Mediterranean, there are no verified records of adults from that sea (Manning, in press).

### *Gonodactylus glabrous* Brooks, 1886

FIGURES 3, 10

*Gonodactylus glabrous* Brooks, 1886:22, 62, pl. 14: fig. 5, pl. 15: figs. 7, 9.

*Gonodactylus glabrous* var. *ternatensis* De Man, 1902:914, pl. 27: fig. 67 [part, figure of female only].

MATERIAL.—Samboangan Reefs, Philippine Islands; *Challenger*, leg.; holotype: 1 ♀, TL 50 mm (BMNH).—Ternate, Molucca Islands, Indonesia; Kükenthal, leg.; 1894; paralectotype of *G. glabrous* var. *ternatensis* De Man: 1 ♀, TL 51 mm (ex SMF 5779).

DESCRIPTION.—Rostral plate (Figures 3a, 10c) as long as broad or slightly broader than long, median spine appearing short; anterior margins of plate sloping anteriorly; anterolateral angles of plate acute but rounded, appearing angled. Ocular scales (Figures 3a, 10c) small, breadth of both slightly less than one-third rostral plate width, erect, set

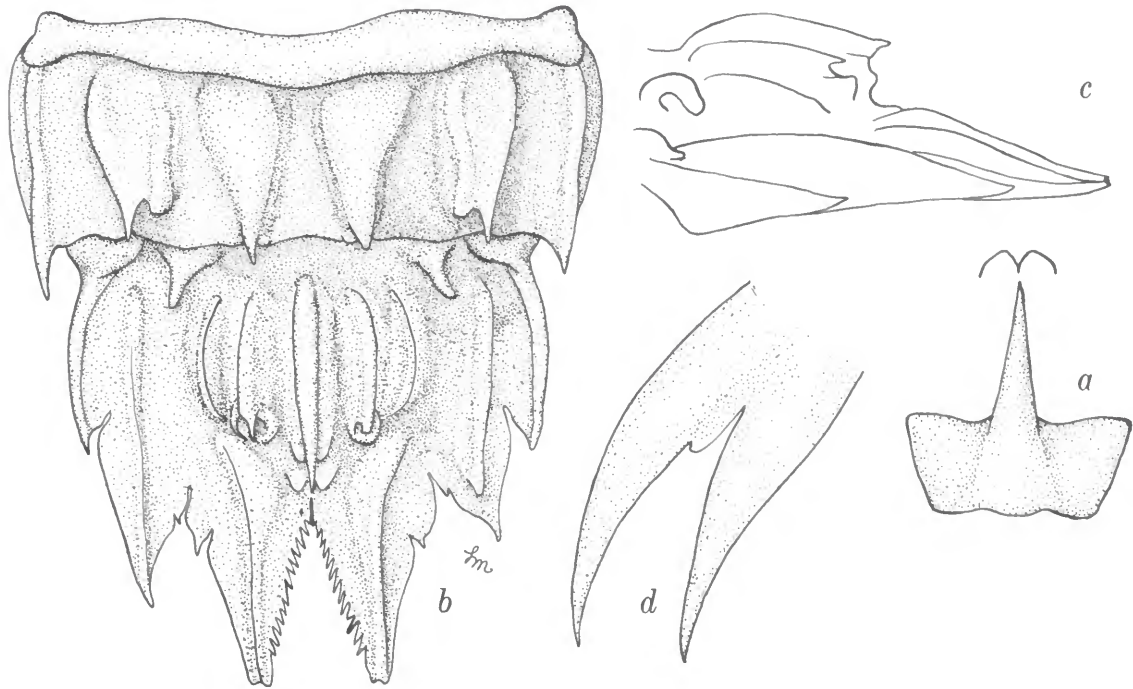


FIGURE 3.—*Gonodactylus glabrous* Brooks, female holotype, TL 50 mm, Philippines: *a*, rostral plate and ocular scales; *b*, sixth abdominal somite and telson; *c*, telson, lateral view; *d*, basal prolongation of uropod, ventral view.

transversely to body line, apices rounded dorsally. Anterior 5 abdominal somites lacking transverse grooves but each with transverse rows of dark spots (at least in females). Sixth abdominal somite (Figures 3*b*, 10*a*) lacking median carinule, with 6 short, sharp carinate spines, carinae of submedian and intermediate spines flattened dorsally. Pair of small black spots not present anteriorly on sixth somite (not visible on either specimen examined). Telson (Figures 3*b*, 10*a*) broader than long, appearing slender. Dorsal carinae of telson sharp, median with long apical spine and accessory medians each with short apical spine, apex of each flanked ventrally by rounded excavation. Knob bilobed, emarginate in midline. Three pairs of marginal teeth present, submedians slender, with movable apices, intermediates broader, apices sharp, laterals short, sharp. Anterior part of telson lacking black spot anterior to each dorsal submedian carina. Ventral surface of telson with postanal ridge and long, sharp ventral carina on each submedian tooth. Uropodal

endopod with single line of marginal setae, those on outer margin directed dorsally. Basal prolongation of uropod (Figures 3*d*, 10*d*) with 1 lobe proximally on inner margin of outer spine.

MEASUREMENTS.—Only females (2) examined, TL 50–51 mm. Other measurements of larger specimen: carapace length 11.8; rostral plate length 3.6, width 3.8; fifth abdominal somite width 10.0; telson length 7.7, width 8.2.

REMARKS.—I have examined only two specimens of this species, which I believe should be recognized as distinct from the others in the *Falcatus* group. *Gonodactylus glabrous* lacks the median carinule on the sixth abdominal somite that is found in *G. falcatus* and *G. randalli*, new species (described below), and is larger and has much sharper carinae on the telson in adults than do specimens of *G. mutatus*. *Gonodactylus glabrous* differs from *G. ternatensis* in having a bilobed rather than single knob, and a much shorter spine on the rostral plate. *Gonodactylus glabrous* resem-

bles these species and differs from *G. graphurus* in lacking transverse grooves on the abdomen.

Paired black spots on the sixth abdominal somite and on the anterior part of the telson are characteristic of most species of the *Falcatus* group. Even if they are not visible in preserved material, their position often is indicated by distinct, shallow pits. *Gonodactylus glabrous* may be ornamented with transverse lines of dark spots on the anterior five abdominal somites rather than the paired spots on the sixth abdominal somite and telson. Brooks (1886) clearly showed and described the transverse rows on the anterior abdominal somites, and De Man (1902) commented on the occurrence of similar rows of spots on the abdomen of the female of his *G. ternatensis*, identified here with *G. glabrous*. He also noted the absence of these anterior abdominal spots but remarked on the presence of the paired spots on the sixth abdominal somite and telson in his other specimen, that selected here as the lectotype of *G. ternatensis*. Inasmuch as De Man's specimens came from the same collection, it seems unlikely that the observed differences in the position of the spots are the results of preservation techniques.

**DISTRIBUTION.**—Known with certainty from the Philippines and from the Molucca Islands; its depth range and habitat preferences are unknown.

### *Gonodactylus mutatus* Lanchester, 1903

FIGURES 4, 5, 11

*Gonodactylus chiragra* var. *mutatus* Lanchester, 1903:450.

*Gonodactylus glaber* var. *rotundus* Borradaile, 1907:211 [key], 212, pl. 22: fig. 2.—Dollfus, 1938, fig. 20.

*Gonodactylus falcatus* var. *ternatensis*.—Serène, 1954:6, 7, 10, 74, 48, 80, fig. 13–7,8, pl. 4: figs. 7–12, pl. 10 [not *Gonodactylus ternatensis* De Man, 1902].

**MATERIAL.**—Phuket, Thailand; H. Dingle and R. L. Caldwell, leg.; Jun–Aug 1974: 7♂, TL 21–33 mm; 14♀, TL 24–41 mm (USNM 168516). Furnadu Velu, Miladumadulu Atoll, Maldives Islands; J. S. Gardiner, leg.; lectotype of *G. mutatus*: 1♀, TL 44 mm (MZC). Data same; paralectotype of *G. mutatus*: 1♂, TL 38 mm (MZC). Goidu, Coifurfehendu Atoll, Maldives Islands; J. S. Gardiner, leg.; paralectotypes of *G. mutatus*: 2♂, TL 24–32 mm; 1♀, TL 34 mm (MZC). Hulule, Male Atoll, Maldives Islands; J. S. Gardiner, leg.; paralectotype of *G. mutatus*: 1♂, TL 22 mm (MZC). Coetivy, Seychelles Islands; J. S. Gardiner, M. A. Caius, leg.; syntype of *G. rotundus*: 1♂, TL 44.5 mm (MZC). Zanzibar; C. Crossland, leg.; 1901; syntype of *G. rotundus*: 1♂, TL 36 mm (MZC).

An additional lot of syntypes of *G. rotundus* from Coetivy was examined; the specimen(s) have completely disintegrated.

**DESCRIPTION.**—Rostral plate (Figures 4a, 5a, 11c) with length and width subequal or width greater, median spine relatively short; anterior margins of plate straight, direction of slope variable; anterolateral angles acute but broadly rounded. Ocular scales (Figures 4a, 11c) small, breadth of both about one-third rostral plate width, erect, set transversely to body line, apices rounded dorsally. Anterior 5 somites lacking transverse grooves or rows of dark spots. Sixth abdominal somite (Figures 4b, 5b, 11c) lacking median carinule, with 6 variously inflated carinae, each usually with posterior spine; spines of submedian and intermediate carinae often missing in large specimens of both sexes. Pair of small black spots present anteriorly on sixth somite, each set lateral to submedian carina. Telson (Figures 4b, 5b, 11c) with length and width subequal or width greater, appearing broad. Dorsal carinae of telson variously inflated, tumid in adults of both sexes, especially so in males, median and accessory medians each with posterior spinule, often missing in large specimens of both sexes; dorsal carinae may be so inflated that they almost merge (Figure 5). Knob bilobed medially emarginate (indistinct in large males). Three pairs of broad marginal teeth present, submedians with movable apices, laterals bluntly pointed. Well-marked black spot present anterior to each dorsal submedian carina. Ventral surface of telson with obscure postanal ridge and longer carina on each submedian tooth. Uropodal endopod with single line of marginal setae, those on outer margin directed dorsally. Basal prolongation of uropod (Figures 4d, 11d) with 1 lobe proximally on inner margin of outer spine.

**MEASUREMENTS.**—Males (13), TL 21–44.5 mm; females (16), TL 24–44 mm. The largest specimen recorded by Serène (1954) was a female 57 mm long; he noted that representatives of this species rarely attained 60 mm in length. Other measurements of female lectotype, TL 44 mm: carapace length 9.2; rostral plate length 2.8, width 2.8; fifth abdominal somite width 7.7; telson length 5.4, width 6.5.

**REMARKS.**—*Gonodactylus mutatus* is a relatively small species of *Gonodactylus* in which the dorsal carinae of the telson tend to be very tumid. The tumidity of these carinae was noticed and figured by Serène (1954, pl. 10: fig. 5) and was one of the

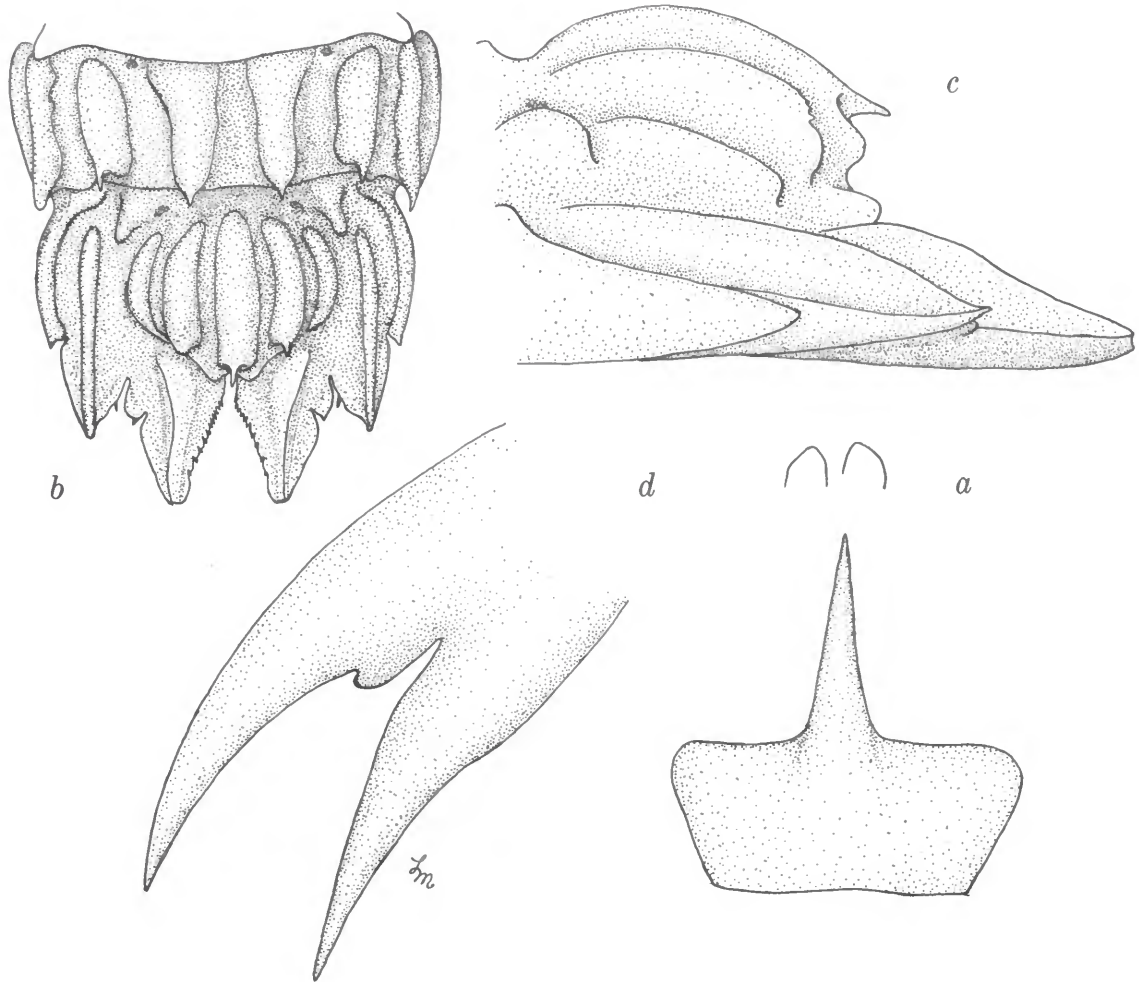


FIGURE 4.—*Gonodactylus mutatus* Lanchester, female lectotype, TL 44 mm, Maldives Islands: *a*, rostral plate and ocular scales; *b*, sixth abdominal somite and telson; *c*, telson, lateral view; *d*, basal prolongation of uropod, ventral view.

characteristics stressed by Borradaile (1907) in his account of *G. rotundus*. Lanchester (1903) did not illustrate his material of *G. mutatus*, but the female lectotype is illustrated here (Figure 4). The telson of a male syntype of *G. rotundus*, here considered to be a synonym of *G. mutatus*, also is shown here (Figure 5) to show the difference in tumidity of the telson carinae in the two sexes. The knob is indistinctly bilobed in adult males as shown in Figure 5. The telson of a male, TL 47 mm, from the Red Sea was illustrated by Dollfus

(1938, fig. 20); it resembles that shown here in Figure 5.

I can find no major differences between representatives of this species from the western Indian Ocean and the single lot available from Thailand. The anterior margins of the rostral plate tend to slope forward in the eastern specimens (see Serène, 1954, fig. 13-7,8) and are perpendicular to the body line or slope posteriorly in the western specimens. The dorsal carinae of the telson appear to be slightly less tumid in eastern specimens. Geo-

graphic variation in such features is not known at this time for any species of *Gonodactylus*.

This species agrees with *G. glabrous* and *G. ternatensis* and differs from *G. falcatus*, *G. graphurus*, and *G. randalli* in lacking the median carinule on the sixth abdominal somite. It differs from *G. ternatensis* in having a much shorter spine on the rostral plate, a much slenderer telson, and a bilobed knob; in addition, it is a much smaller species. *Gonodactylus mutatus* resembles *G. glabrous* in many respects, but in the latter species the carinae of the telson are quite sharp even in adult females (the males are unknown) and the rostral plate is more angled anterolaterally.

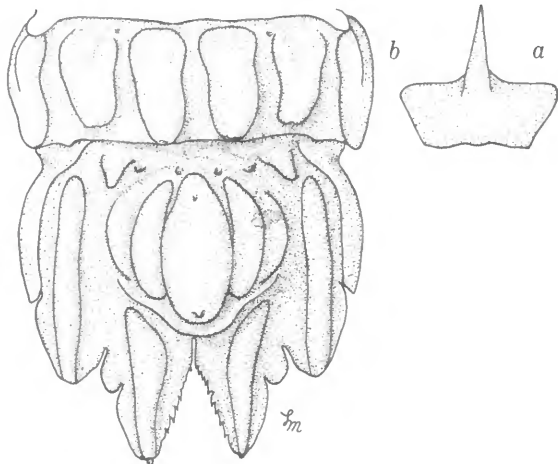


FIGURE 5.—*Gonodactylus mutatus* Lanchester, male, TL 44.5 mm. syntype of *G. rotundus* Borradaile, Coetivy, Seychelles Islands: *a*, rostral plate; *b*, sixth abdominal somite and telson.

The largest specimen from Lanchester's type-series, a female 44 mm long from Furnadu Velu, is here selected as the lectotype of *G. mutatus*.

**DISTRIBUTION.**—Indo-West-Pacific region. It is known with certainty from Viet Nam, Thailand, the Maldive Islands, the Seychelles Islands, Zanzibar, and from one locality in the Red Sea. The extent of its distribution within the region remains to be determined. It apparently lives in shallow water, on coral or coral rubble.

### *Gonodactylus randalli*, new species

FIGURES 6, 12

**MATERIAL.**—ARNO Atoll, Marshall Islands; R. W. Hiatt, leg.; sta E2-377; 1950; paratype: 1 ♀, TL 20 mm (USNM 124365). Canton Island, Phoenix Islands; from coral head in lagoon; 20–25 ft (6–8 m); C. A. Ely, leg.; 2 Nov 1941; paratype: 1 ♀, TL 39 mm (USNM 124362). Outside barrier reef, 200 yds (ca. 180 m) E of pass of Papetoai Bay, Moorea, Society Islands; 70 ft; J. E. Randall, leg.; 15 May 1957; holotype: 1 ♀, TL 51 mm (USNM 124372).

**DESCRIPTION.**—Rostral plate (Figures 6*a*, 12*c*) with length and width subequal or length slightly greater, median spine appearing short; anterior margins of plate almost straight, perpendicular to body line; anterolateral angles of plate broadly rounded. Ocular scales (Figures 6*a*, 12*c*) very small, erect, apices rounded, width of scales about one-third plate width. Anterior abdominal somites lacking transverse grooves and transverse rows of dark spots. Sixth abdominal somite (Figures 6*b*, 12*a*) with prominent median carinule and 6 carinate spines, submedians and intermediates distinctly flattened dorsally. Pair of small black spots present anteriorly on sixth somite (on 1 paratype, not visible in others), each spot situated lateral to submedian carina. Telson (Figures 6*b*, 12*a*) appearing elongate, length and width subequal or width slightly greater. Dorsal carinae of telson sharp, slender, median and accessory medians each with long apical spine, each spine flanked ventrally by carinate excavation. Knob indistinctly bilobed in holotype, distinctly bilobed in paratypes. Three pairs of sharp, slender marginal teeth present, submediates and laterals spiniform (left lateral tooth missing in holotype). Anterior margin of telson with pair of black spots (on 1 paratype), one lateral to each dorsal submedian carina. Ventral surface of telson with sharp postanal ridge and sharp longitudinal carina on each submedian tooth. Uropodal endopod with multiple rows of setae, some of those on lateral margin directed dorsally. Basal prolongation of uropod (Figures 6*d*, 12*d*) with 2 proximal lobes between spines.

**MEASUREMENTS.**—Only females (3) known, TL 29–51 mm. Other measurements of female holotype, TL 51 mm; carapace length 10.9; rostral plate length 3.4, width 3.4; fifth abdominal somite width 8.6; telson length 6.8, width 7.0.

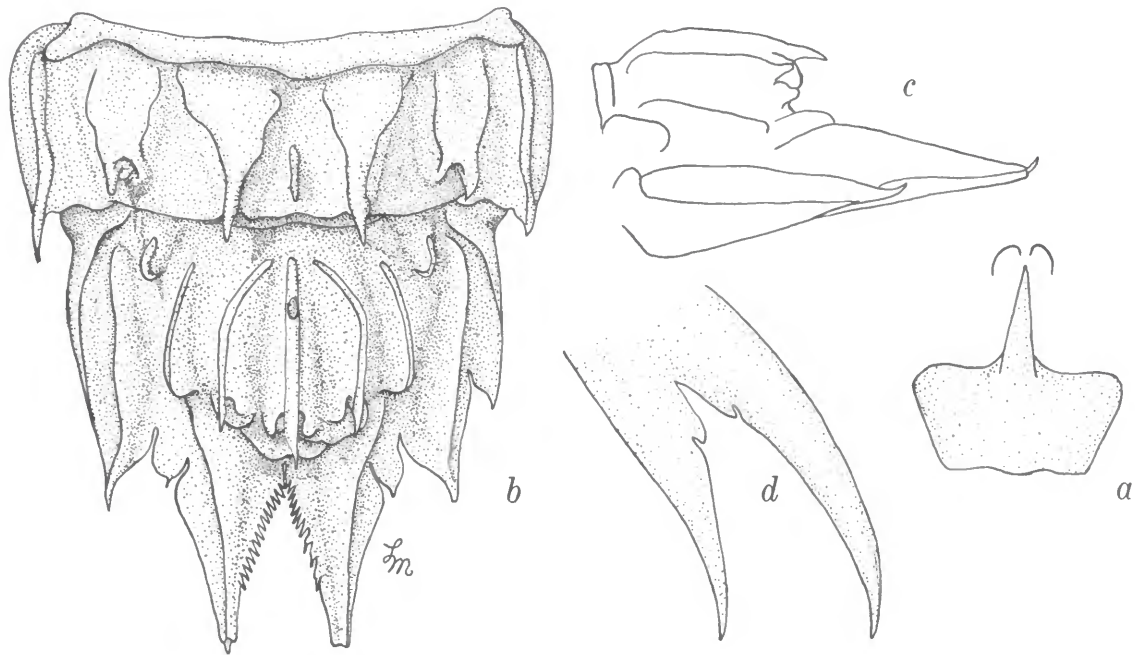


FIGURE 6.—*Gonodactylus randalli*, new species, female holotype, TL 51 mm, Moorea: *a*, rostral plate and ocular scales; *b*, sixth abdominal somite and telson (left lateral tooth missing); *c*, telson, lateral view; *d*, basal prolongation of uropod, ventral view.

**REMARKS.**—*Gonodactylus randalli*, like *G. falcatus* and *G. graphurus*, has a strong median carinule on the sixth abdominal somite. That carinule, the short, broad rostral plate, the presence of 2 distinct lobes between the spines of the basal prolongation of the uropod, and the multiple marginal setae on the uropodal endopod distinguish *G. randalli* from all of the species of the *Falcatus* group that lack the transverse grooves on the abdomen.

One of the paratypes shows the dark spots on the telson that are characteristic of most species of the *Falcatus* group; these are not visible in the other specimens although their position is marked by faint, unpigmented pits. The spots are not shown in Figure 6*b*, based on the holotype.

**ETYMOLOGY.**—This species is named for the collector of the holotype, John E. Randall.

**DISTRIBUTION.**—Pacific Ocean, from the Marshall Islands, the Phoenix Islands, and the Society Islands, in depths between 20 and 70 ft (12–21 m).

### *Gonodactylus ternatensis* De Man, 1902

FIGURES 7, 8, 13

*Gonodactylus glabrous* var. *ternatensis* De Man, 1902:914 [part; not figured specimen].

*Gonodactylus glabrous*.—Bigelow, 1931:127, fig. 1 [part; specimens from Samoa?] [not *Gonodactylus glabrous* Brooks, 1886].

*Gonodactylus falcatus*.—Serène, 1954:6, 79, fig. 13–6, pl. 9 [not *Gonodactylus falcatus* (Forskål, 1775)].

**MATERIAL.**—Apia, Upolu Island, Samoa Islands; D. S. Jordan, leg.; Jul 1902: 1 ♀, TL 50 mm (USNM 64853). Phuket, Thailand; H. Dingle and R. Caldwell, leg.; 1974: 5 ♂, TL 43–68 mm; 9 ♀, TL 23–66 mm (USNM 156252). Ternate, Molucca Islands, Indonesia; Kükenthal, leg.; 1894: lectotype: 1 ♀, TL 56.5 mm (SMF 5779).

**DESCRIPTION.**—Rostral plate (Figures 8*a*, 13*a*) longer than broad, median spine relatively long; anterior margins of plate sloping anteriorly; anterolateral angles of plate acute but rounded. Ocular scales (Figures 8*a*, 13*a*) small, breadth of both about one-third rostral plate width, erect, set obliquely



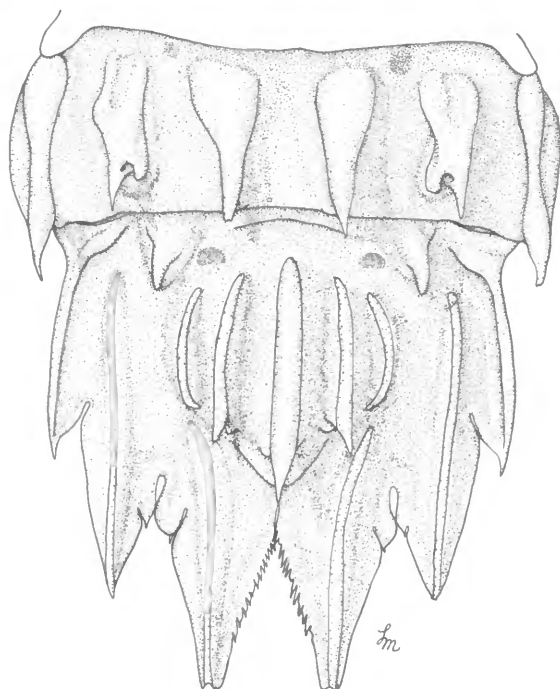


FIGURE 7.—*Gonodactylus ternatensis* De Man, female lectotype, TL 56.5 mm, Ternate: sixth abdominal somite and telson.

to body line, apices rounded or slightly flattened dorsally. Anterior abdominal somites lacking transverse grooves and rows of dark spots. Sixth abdominal somite (Figures 7, 8b, 13a) lacking median carinule, with 6 long, sharp, carinate spines, carinae of submedian and intermediate spines flattened dorsally. Pair of small black spots present anteriorly on sixth somite, each situated lateral to submedian carina (faded in illustrated specimen). Telson (Figures 7, 8b, 13a) longer than broad, appearing elongate. Dorsal carinae of telson sharp, median and accessory medians each with long apical spine flanked ventrally by rounded excavation. Knob single, undivided. Three pairs of long, sharp marginal teeth present, submedians with movable apices, laterals well developed. Black spot present on anterior surface of telson lateral to each dorsal submedian carina (faded on illustrated specimen). Ventral surface of telson with postanal keel (re-

duced in some specimens) and long, sharp ventral carina on each submedian tooth. Uropodal endopod with single line of marginal setae, those on outer margin directed dorsally. Basal prolongation of uropod (Figures 8d, 13d) with 1 lobe proximally on inner margin of outer spine.

**MEASUREMENTS.**—Males (5), TL 43–68 mm; females (11), TL 23–66. Other measurements of female lectotype, TL 56.5 mm: carapace length 13.5; rostral plate length 4.4, width 4.2; fifth abdominal somite width 11.4; telson length 10.2, width 9.3.

**REMARKS.**—*Gonodactylus ternatensis* is a relatively large species of *Gonodactylus*, and, like *G. graphurus*, can be recognized readily in preserved material. The elongate rostral plate, with an anterior spine comparatively much longer than in any other species of the *Falcatus* group, the long telson, with sharply spined longitudinal carinae, and the single, undivided knob are all characteristic of the species.

The larger of the two specimens referred to this species by De Man, a female TL 56.5 mm, is here selected as the lectotype. The smaller female, the paralectotype, is identified with *G. glabrous* herein. There is little doubt that *G. ternatensis* would have been recognized sooner if De Man had illustrated his specimen of *G. ternatensis* sensu stricto rather than the *G. glabrous* in his original account.

It seems likely that most or all of the specimens reported by Bigelow (1931) from Samoa as *G. glabrous* actually are *G. ternatensis*. When Bigelow compared his material from Samoa with material from the Philippines (probably based on materials collected there by the *Albatross*, which then were being studied by Bigelow), he noted (p. 130): "In the Samoan specimens the maximum length of the rostrum is generally considerably greater than the width at antero-lateral angles. The anterior margins on each side of the spine are nearly transverse and the antero-lateral angles are broadly rounded. In the Philippine specimens the length and breadth are about equal, the anterior margins are usually directed obliquely forward from the junction with the spine and the antero-lateral angles are narrowly rounded or subacute." The anterolateral angles of the rostral plate are more acute in the two specimens of *G. glabrous* that I have examined than they are in *G. ternatensis*.

The species from Viet Nam identified with *G.*

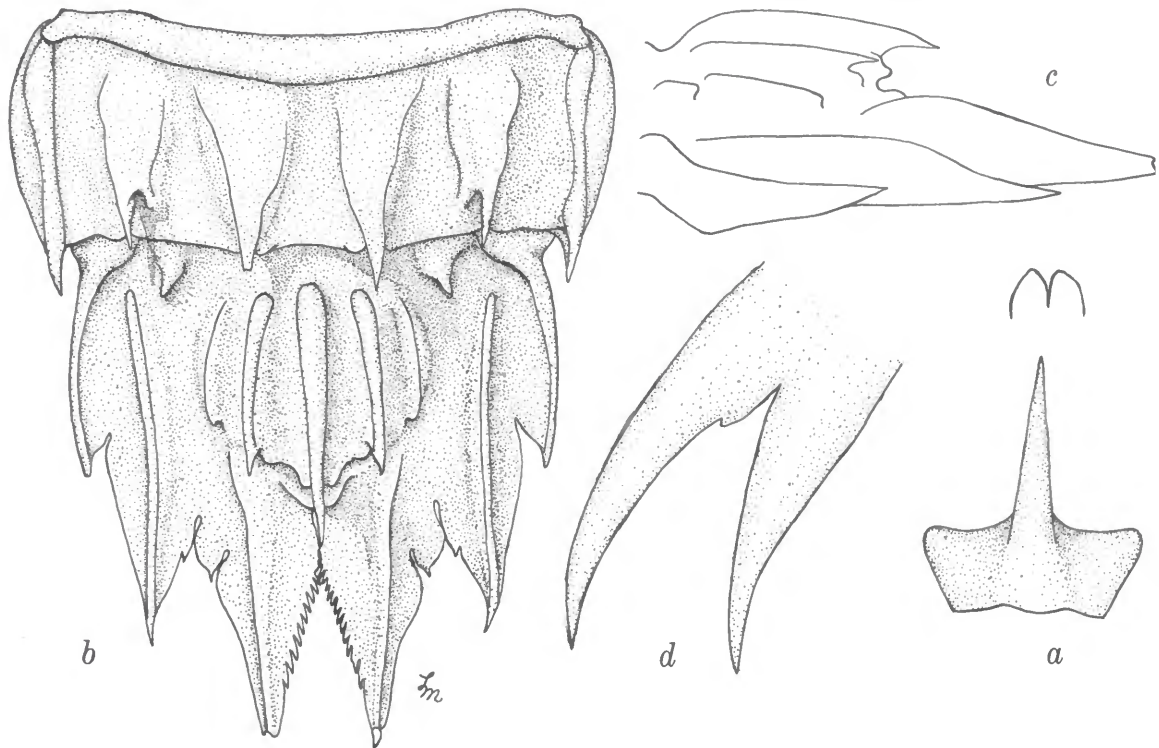
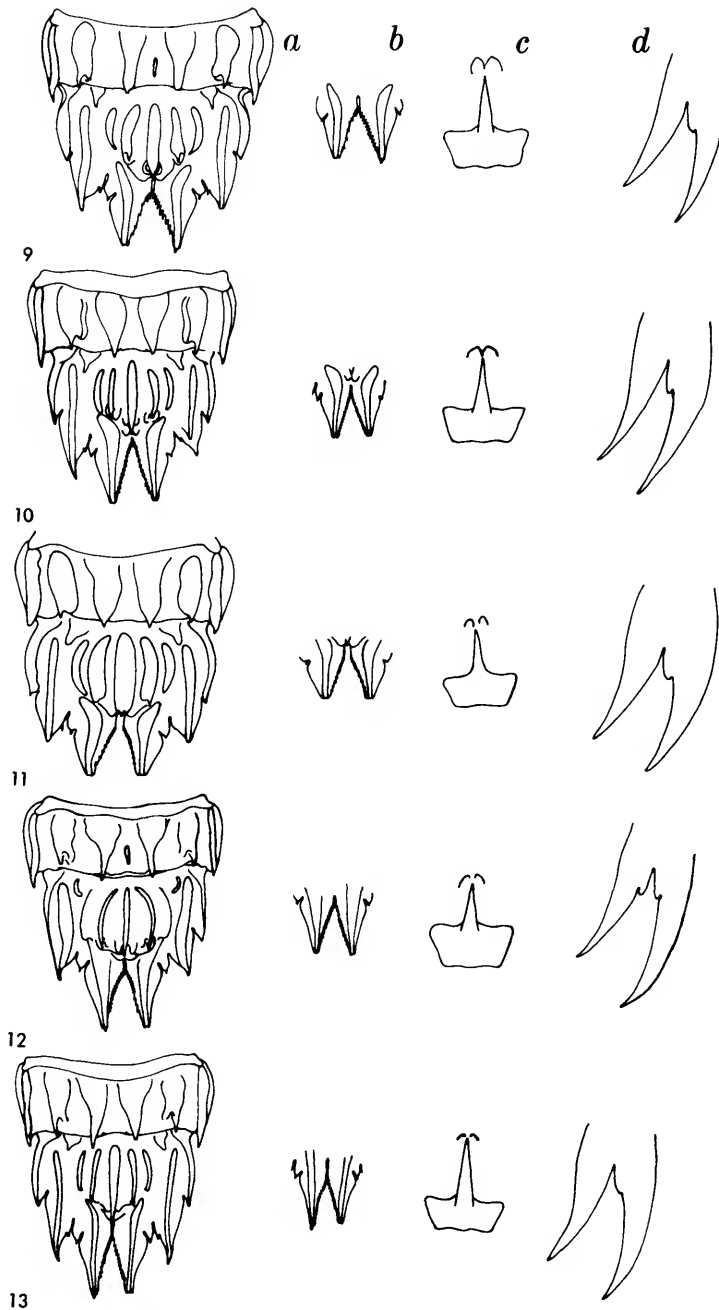


FIGURE 8.—*Gonodactylus ternatensis* De Man, female, TL 50 mm, Samoa: *a*, rostral plate and ocular scales; *b*, sixth abdominal somite and telson; *c*, telson, lateral view; *d*, basal prolongation of uropod, ventral view.

*falcatus* by Serène (1954) is, as shown by his figures of the rostral plates and telsons, *G. ternatensis* sensu stricto, whereas his material identified with *G. falcatus* var. *ternatensis* has been referred to *G. mutatus* herein.

DISTRIBUTION.—This species is known with certainty from Apia, Samoa; Phuket, Thailand; Viet Nam; and Ternate, Molucca Islands, Indonesia. Apparently *G. ternatensis* is a shallow-water species, living near shore on flats exposed at low tide.



FIGURES 9-13.—Five species of the *Falcatus* group of *Gonodactylus*: 9, *G. falcatus* (Forskål); 10, *G. glabrous* Brooks; 11, *G. mutatus* Lanchester; 12, *G. randalli*, new species; 13, *G. ternatensis* De Man. (Figures 9-13: a, sixth abdominal somite and telson; b, apices of submedian teeth of telson, ventral view; c, rostral plate and ocular scales; d, basal prolongation of uropod.)

## Literature Cited

- Bigelow, R. P.  
1931. Stomatopoda of the Southern and Eastern Pacific Ocean and the Hawaiian Islands. *Bulletin of the Museum of Comparative Zoology, Harvard University*, 72(4):105-191, figures 1-10, plates 1-2.
- Borradaile, L. A.  
1907. Stomatopoda from the Western Indian Ocean. In The Percy Sladen Trust Expedition to the Indian Ocean in 1905, under the Leadership of Mr. J. Stanley Gardiner. *Transactions of the Linnaean Society of London*, (2)12:209-216, plate 22.
- Brooks, W. K.  
1886. Report on the Stomatopoda collected by *H.M.S. Challenger* during the Years 1873-76. Part xlv (116 pages) of volume 16 in *Zoology in The Voyage of H.M.S. Challenger*. 16 plates.
- Dollfus, R. Ph.  
1938. Stomatopoda, 11: Catalogue Synonymique des Espèces Jusqu'à Présent Récoltées dans la Mer Rouge, y Compris la Partie Sud du Canal de Suez et le Golfe d'Aden. In Mission Robert Ph. Dollfus en Égypte, X. *Mémoires de l'Institut d'Égypte*, 37:185-236, figures 1-8, 10, 11, 13-23.
- Fabricius, J. C.  
1781. *Species Insectorum exhibentes eorum differentias specificas, synonyma Auctorum, loca Natalia, metamorphosin adjectis observationibus, descriptionibus*. Volume 1, viii+552 pages. Hamburgii et Kolonii: Carol. Ernest Bohnii.
- Forskål, P.  
1775. *Descriptiones Animalium, Avium, Amphibiorum, Piscium, Insectorum, Vermium*. xxxiv+164 pages. Hauniae: Mölleri.
- Hansen, H. J.  
1895. Isopoden, Cumaceen und Stomatopoden der Plankton-Expedition. Volume 2 (Gc) of *Ergebnisse der Plankton-Expedition der Humboldt-Stiftung*. 105 pages, 8 plates.
- Henderson, J. R.  
1893. A Contribution to Indian Carcinology. *Transactions of the Linnaean Society of London*, (2)5(10):325-458, plates 36-40.
- Hobbs, Horton H., Jr.  
1974. A Checklist of the North and Middle American Crayfishes (Decapoda: Astacidae and Cambaridae). *Smithsonian Contributions to Zoology*, 166:1-161, figures 1-294.
- Holthuis, L. B.  
1941. The Stomatopoda of the *Snellius* Expedition. Biological Results of the *Snellius* Expedition, XII. *Temminckia*, 6:241-294, figures 1-9.
1967. The Stomatopod Crustacea Collected by the 1962 and 1965 Israel South Red Sea Expeditions. Report No. 1 in The Second Israel South Red Sea Expedition, 1965. *Israel Journal of Zoology*, 16:1-45, figures 1-7.
- Ingle, R. W.  
1971. On the Nomenclature of *Gonodactylus graphurus* White, 1847 (Nomen Nudum), Miers, 1875 (Stomatopoda, Gonodactylidae). *Crustaceana*, 21(2):220-221.
- Kemp, S.  
1913. An Account of the Crustacea Stomatopoda of the Indo-Pacific Region Based on the Collection in the Indian Museum. *Memoirs of the Indian Museum*, 4:1-217, 10 figures, plates 1-10.
- Kinzie, Robert A., III  
1968. The Ecology of the Replacement of *Pseudosquilla ciliata* (Fabricius) by *Gonodactylus falcatus* (Forskål) (Crustacea; Stomatopoda) Recently Introduced into the Hawaiian Islands. *Pacific Science*, 22(4):465-475, figures 1-5.
- Lanchester, W. F.  
1903. Stomatopoda, with an Account of the Varieties of *Gonodactylus chiragra*. Marine Crustaceans, VIII. Pages 444-459 in part 4 of volume 1 in J. S. Gardiner, *The Fauna and Geography of the Maldives and Laccadive Archipelagoes, Being the Account of the Work Carried on and of the Collections Made by an Expedition during the Years 1899 and 1900*. Plate 23.
- De Man, J. G.  
1902. Die von Herrn Professor Kükenthal im Indischen Archipel gesammelten Dekapoden und Stomatopoden. In Kükenthal, Ergebnisse einer zoologischen Forschungsreise in den Molukken und Borneo. *Abhandlungen herausgegeben von der Senckenbergischen Naturforschenden Gesellschaft*, 25: 467-929, plates 19-27.
- Manning, Raymond B.  
1966. Notes on Some Australian and New Zealand Stomatopod Crustacea, with an Account of the Species Collected by the Fisheries Investigation Ship *Endeavour*. *Records of the Australian Museum*, 27(4):79-137, figures 1-10.
1968. Stomatopod Crustacea from Madagascar. *Proceedings of the United States National Museum*, 124 (3641):1-61, figures 1-16.
- In press. A Monograph of the West African Stomatopod Crustacea. *Atlantide Reports* (Copenhagen).
- Miers, E. J.  
1875. On Some New or Undescribed Species of Crustacea from the Samoa Islands. *Annals and Magazine of Natural History*, (4)16:341-344.

Müller, F.

1887. Zur Crustaceenfauna von Trincomali. *Verhandlungen der Naturforschenden Gesellschaft in Basel*, 8:470-475, plates 4-5.

Roxas, H. A., and E. Estampador

1930. Stomatopoda of the Philippines. *University of the*

*Philippines, Natural and Applied Science Bulletin* (Manila), 1(1):93-131, plates 1-6.

Serène, R.

1954. Observations Biologiques sur les Stomatopodes. *Mémoires de l'Institut Océanographique de Nhatrang*, 8:1-93, figures 1-15, plates 1-10.



## REQUIREMENTS FOR SMITHSONIAN SERIES PUBLICATION

**Manuscripts** intended for series publication receive substantive review within their originating Smithsonian museums or offices and are submitted to the Smithsonian Institution Press with approval of the appropriate museum authority on Form SI-36. Requests for special treatment—use of color, foldouts, casebound covers, etc.—require, on the same form, the added approval of designated committees or museum directors.

**Review** of manuscripts and art by the Press for requirements of series format and style, completeness and clarity of copy, and arrangement of all material, as outlined below, will govern, within the judgment of the Press, acceptance or rejection of the manuscripts and art.

**Copy** must be typewritten, double-spaced, on one side of standard white bond paper, with 1 $\frac{1}{4}$ " margins, submitted as ribbon copy (not carbon or xerox), in loose sheets (not stapled or bound), and accompanied by original art. Minimum acceptable length is 30 pages.

**Front matter** (preceding the text) should include: **title page** with only title and author and no other information, **abstract page** with author/title/series/etc., following the established format, **table of contents** with indents reflecting the heads and structure of the paper.

**First page of text** should carry the title and author at the top of the page and an unnumbered footnote at the bottom consisting of author's name and professional mailing address.

**Center heads** of whatever level should be typed with initial caps of major words, with extra space above and below the head, but with no other preparation (such as all caps or underline). Run-in paragraph heads should use period/dashes or colons as necessary.

**Tabulations** within text (lists of data, often in parallel columns) can be typed on the text page where they occur, but they should not contain rules or formal, numbered table heads.

**Formal tables** (numbered, with table heads, boxheads, stubs, rules) should be submitted as camera copy, but the author must contact the series section of the Press for editorial attention and preparation assistance before final typing of this matter.

**Taxonomic keys** in natural history papers should use the aligned-couplet form in the zoology and paleobiology series and the multi-level indent form in the botany series. If cross-referencing is required between key and text, do not include page references within the key, but number the keyed-out taxa with their corresponding heads in the text.

**Synonymy** in the zoology and paleobiology series must use the short form (taxon, author, year:page), with a full reference at the end of the paper under "Literature Cited." For the botany series, the long form (taxon, author, abbreviated journal or book title, volume, page, year, with no reference in the "Literature Cited") is optional.

**Footnotes**, when few in number, whether annotative or bibliographic, should be typed at the bottom of the text page on which the reference occurs. Extensive notes must appear at the end of the text in a notes section. If bibliographic footnotes are required, use the short form (author/brief title/page) with the full reference in the bibliography.

**Text-reference system** (author/year/page within the text, with the full reference in a "Literature Cited" at the end of the text) must be used in place of bibliographic footnotes in all scientific series and is strongly recommended in the history and technology series: "(Jones, 1910:122)" or ". . . Jones (1910:122)."

**Bibliography**, depending upon use, is termed "References," "Selected References," or "Literature Cited." Spell out book, journal, and article titles, using initial caps in all major words. For capitalization of titles in foreign languages, follow the national practice of each language. Underline (for italics) book and journal titles. Use the colon-parentheses system for volume/number/page citations: "10(2):5-9." For alinement and arrangement of elements, follow the format of the series for which the manuscript is intended.

**Legends** for illustrations must not be attached to the art nor included within the text but must be submitted at the end of the manuscript—with as many legends typed, double-spaced, to a page as convenient.

**Illustrations** must not be included within the manuscript but must be submitted separately as original art (not copies). All illustrations (photographs, line drawings, maps, etc.) can be intermixed throughout the printed text. They should be termed **Figures** and should be numbered consecutively. If several "figures" are treated as components of a single larger figure, they should be designated by lowercase italic letters (underlined in copy) on the illustration, in the legend, and in text references: "Figure 9 $\underline{b}$ ." If illustrations are intended to be printed separately on coated stock following the text, they should be termed **Plates** and any components should be lettered as in figures: "Plate 9 $\underline{b}$ ." Keys to any symbols within an illustration should appear on the art and not in the legend.

**A few points of style:** (1) Do not use periods after such abbreviations as "mm, ft, yds, USNM, NNE, AM, BC." (2) Use hyphens in spelled-out fractions: "two-thirds." (3) Spell out numbers "one" through "nine" in expository text, but use numerals in all other cases if possible. (4) Use the metric system of measurement, where possible, instead of the English system. (5) Use the decimal system, where possible, in place of fractions. (6) Use day/month/year sequence for dates: "9 April 1976." (7) For months in tabular listings or data sections, use three-letter abbreviations with no periods: "Jan, Mar, Jun," etc.

**Arrange and paginate sequentially EVERY sheet of manuscript**—including ALL front matter and ALL legends, etc., at the back of the text—in the following order: (1) title page, (2) abstract, (3) table of contents, (4) foreword and/or preface, (5) text, (6) appendixes, (7) notes, (8) glossary, (9) bibliography, (10) index, (11) legends.

