

Two New Species and a Key to *Simodactylus* of Fiji, with a Tribal Reassignment to Physorhinini, and a Distribution Record for *S. delfini* (Coleoptera: Elateridae)

Paul J. Johnson

Research Associate, Bernice P. Bishop Museum, Honolulu; mailing address: Insect Research Collection, Box 2207A, South Dakota State University, Brookings, South Dakota 57007

Abstract. *Simodactylus vanualevu* new species and *S. gagneorum* new species are described from Viti Levu, Fiji. A key is presented to separate the species of *Simodactylus* recorded from the Fiji Archipelago. *Simodactylus delfini* is newly recorded from American Samoa. A reassignment of *Simodactylus* to Physorhinini is given on the basis of larval characters.

Simodactylus Candèze is a diverse genus of click beetles with 46 ascribed species, including those described herein. The species of this genus are found throughout the central and southwestern Pacific, with the majority of species found in Melanesia, Polynesia, and Micronesia, and a few species in the Philippines and Borneo (Ôhira 1973, 1974; Van Zwaluwenburg 1932a, 1936, 1940, 1957). Geographically, Fiji is notable for its relatively high number of endemic species and frequency of relatively ancestral character expressions in *Simodactylus* species and other click beetles (Johnson 1997).

The genus was assigned to Pachyderinae prior to Fleutiaux's (1929) listing of this subfamily as a synonym of Conoderinae, now Oophorini¹ in Agrypninae. Van Zwaluwenburg (1932a,b; 1957) referred the genus to Pachyderinae, but then (Van Zwaluwenburg 1959) arranged it in Conoderinae. This pattern of conflicting assignment between Conoderinae and Pachyderinae continued through the mid-1970s (Ôhira 1973, 1974). Stibick (1979) noted that *Simodactylus* is not conoderine in structure and assigned the genus to Elaterinae, Megapenthini, with little discussion. Larval characters provided by Van Zwaluwenburg (1939) and my examinations of *Simodactylus* species, including adults and larvae attributable to *S. cinnamomeus* (Boisduval), type species of *Simodactylus*, support Stibick's assignment to Elaterinae. However, its reassignment to Physorhinini is suggested here based on the following larval characters that are shared with *Physorhinus* Germar and related genera: striate areas on anterolateral portions of abdominal terga absent; nasale with a single median tooth; tergite 9 with terminal extension trilobed; and abdominal terga lacking large primary setae along anterior margin.

Previously, three species of *Simodactylus* were known to be endemic to Fiji: *S. acutus* Van Zwaluwenburg (1933), *S. bryani* Van Zwaluwenburg (1940) and *S. obscurus* Van Zwaluwenburg (1940). Other congeners recorded from Fiji are *S. cinnamomeus* and *S. tasmani* Candèze, the latter species was described from this archipelago (Candèze 1893, Van Zwaluwenburg 1932a, 1940). Here, two undescribed species of Fijian *Simodactylus* identified from the collections of the Bernice P. Bishop Museum (BPBM) and Mississippi State University (MSUC) are treated.

1. Alonso-Zarazaga and Lyal (1999) resurrected Conoderinae Schönherr (1833), which has priority over Conoderinae Fleutiaux (1919 (1859)). Already, Sánchez Ruiz (1996) chose Oophorini Gistel (1856) to replace Conoderinae Fleutiaux.

Mensural traits presented are length, measured as body length from frontal margin to apex of elytra; width, the widest portion of the body on a transverse line through elytral humeri. The ocular index (Campbell & Marshall 1964) is the minimum distance between the eyes measured across the frons divided by the maximum width across the eyes on the same line and multiplied by 100. Antennal and metatarsomere length ratios are measured along the dorsum of each segment. Terminology for genital structures follows Lawrence and Britton (1991), and Kukulová-Peck and Lawrence (1993) for wing venation. Geographic names were modified when necessary to conform to Motteler's (1986) list.

Taxonomy

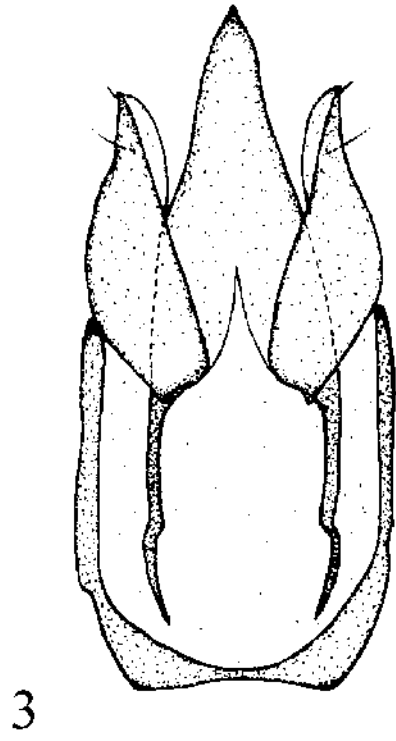
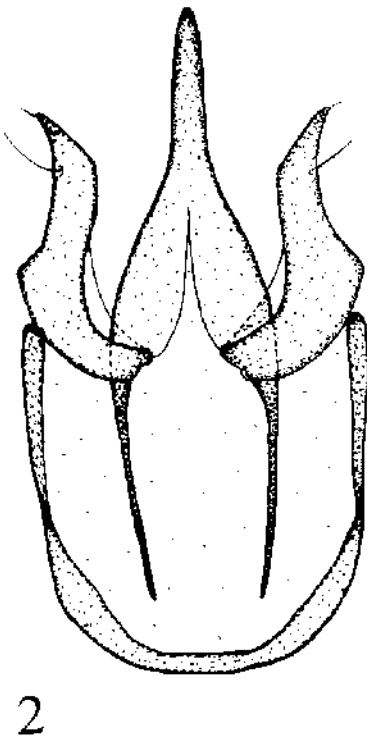
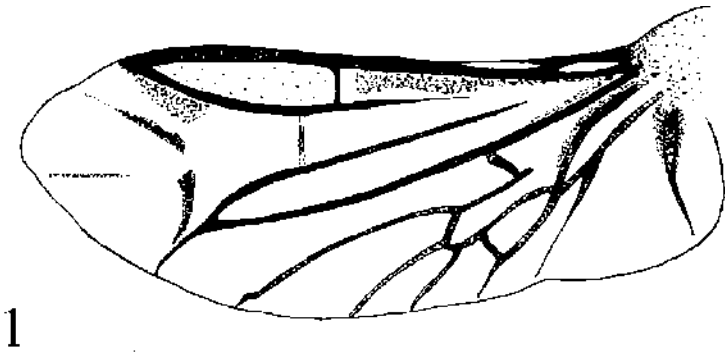
Simodactylus vanualevu Johnson, NEW SPECIES (Figs. 1, 2, 4, 6)

Length 8.1–9.1 mm, width 2.2–2.8 mm; elongate, subparallel, moderately convex. Integument shining; rufocastaneus to castaneus; head with evanescent to distinct, piceous, circular macula on vertex and frons, supra-ocular margins occasionally infusate, frontal margin piceous; pronotum with piceous median vitta, evanescent mediolateral vittae, and margin; elytron with stria punctures piceous basally, concolorous with intervals apically, and an evanescent infusate vitta extending from humerus to midlength of interval 5; epipleuron rufotestaceous; hypomeron with disc infusate to piceous, lateral margin rufotestaceous; prosternum piceous; mesosternum, mesepimeron, mesepisternum, and mesocoxal margin piceous. Pubescence moderately long, decumbent, suberect laterally, forming spreading or whorled patterns on head and pronotum.

Head evenly convex, becoming depressed anteriorly; frontal margin evenly arcuate, impunctate, polished; frons moderately-coarsely punctured, punctures separated by 0.5X diameter, becoming sparser towards vertex. Compound eyes large, coarsely faceted; ocular index = 66. Antenna short, reaching to base of pronotal posterior angles, moderately serrate from segment 4, each segment evenly punctured, without lateral carina; segment 2 short, cylindrical; segment 3 subclavate; segment 2-11 length ratio = 1.0:1.5:1.8:1.8:1.8:1.7:1.6:1.6:1.6:2.2.

Pronotum with lateral margins subparallel in posterior half; median length 0.85X width at base of posterior angles; shallowly impressed along median line; punctures as on head, becoming sparser and finer posteromedially; carina of lateral margin fine, obsolescent before anterior margin; posterior angles slightly divergent, attenuate, narrowly rounded at apex, dorsum bicarinate, lateral carina obsolescent, carinae subequal in length. Hypomeron with punctures coarse and umbilicate anteriorly, grading to fine and sparse posteriorly. Prosternum moderately punctured; intercoxal process deeply impressed and with strongly beaded margins posterior of coxa, preapical tooth subacute. Mesosternum with intercoxal process flattened, coarsely punctured; mesepimeron coarsely and rugosely, umbilicately punctured. Elytral striae shallowly impressed and punctured, striae 2–8 obsolescent subapically; intervals flat, setal punctures scabriculate; apex truncate to shallowly emarginate, sutural angle minutely denticulate; epipleuron sparsely scabriculate. Metathoracic wing (Fig. 1) with 3 preapical sclerotizations. Metasternum finely and moderately-sparsely punctured. Tarsi slender, tarsomere length ratio along dorsum = 1.0:0.5:0.4:0.3:0.6; segments 3 and 4 each with ventral lobe narrow, densely setose; segment 4 with apex oblique and ventral lobe emarginate.

Abdominal ventrites finely, moderately–densely punctured. Male with aedeagus as in Fig. 2; paramere arcuate, apically attenuate; median lobe strongly constricted at midlength; ventrite 5 with apex evenly rounded. Female gonocoxites lightly sclerotized; styli fusiform,



Figures 1–3. *Simodactylus* species; Figure 1, metathoracic wing of *S. vanualevu* n.sp.; Figure 2, aedeagus of *S. vanualevu* n.sp.; Figure 3, aedeagus of *S. gagneorum* n.sp.

slightly eccentric at apex of gonocoxite; vagina (Fig. 4) narrow, with pair of dorsal and saccate colleterial glands; bursa copulatrix with darkly sclerotized semicircular bursal collar (Fig. 4a) bearing 8 sharp teeth along mesal surface, and anterior portions extended and narrowly tubular; spermatheca short, entering accessory gland duct at right angle; accessory gland duct "J" shaped; baculi long, reaching to anterior margin of ventrite 1 when retracted; ventrite 5 (Fig. 6) broadly emarginate.

Type data: Holotype ♀ (BPBM # 15343), FIJI: VANUALEVU I., Nakawanga, 9.X.1955 (J.L. Gressitt) (BPBM). Paratypes, 3 ♂, 1 ♀, VITILEVU I., Naraiyawa, 178°5'E, 17°56'S, 20–23.XI.1986, blacklight trap (R.L. Brown) (2, MSUC); same data, except 28–30.XI.1986 (2, MSUC).

Remarks: The specific epithet is a noun in apposition, referring to Vanua Levu, the island of provenance of known specimens.

Simodactylus vanualevu is readily distinguished from all other known Fijian congeners by its small size, coarse punctation, and aedeagal structure. In size this species is approached by the following new species and relatively diminutive examples of *S. bryani*, but *S. bryani* is readily distinguished by its carinate antennal segments, longer tarsal segment 4 with a large ventral lobe, and aedeagal structure (cf. Van Zwaluwenburg 1940, Fig. 5b).

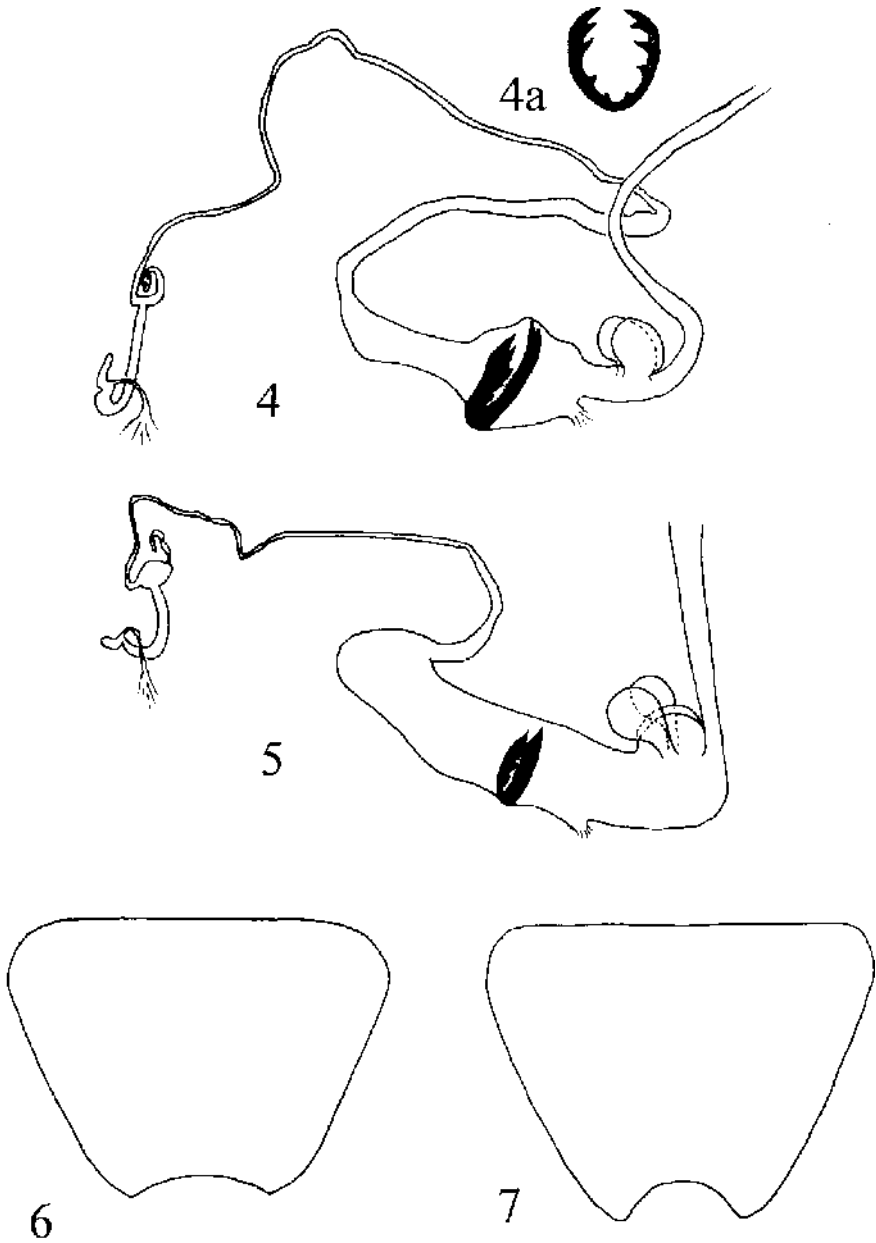
Simodactylus gagneorum Johnson, NEW SPECIES (Figs. 3, 5, 7)

Length 7.8–8.9 mm, width 2.2–2.3 mm; elongate, subparallel, moderately convex. Integument shining; rufobrunneous; head, antenna, anterior margin and posterior angle of pronotum, scutellum, and elytral base brunneopiceous; legs and mesosternum infusate. Pubescence moderately long, decumbent, directed posteriorly throughout.

Head depressed anteriorly, shallowly impressed each side anteriorad of eyes; frontal margin subangular mediolaterally, sparsely punctate medially, polished; frons finely, sparsely punctured, punctures separated by 2.0X diameter, becoming slightly denser mediovertically. Compound eyes moderately large, coarsely faceted; ocular index = 82. Antenna short, reaching nearly to apex of posterior angles, narrowly serrate from segment 4, each segment evenly punctured, without lateral carina; segment 2 short, cylindrical; segment 3 subcylindrical; segment 2–11 length ratio = 1.0:2.5:2.5:2.5:2.3:2.3:2.3:2.3:3.0.

Pronotum with lateral margins gradually convergent anteriorly, subparallel at midlength, shallowly concave at base of posterior angles; median length 0.88X width at base of posterior angles; punctures as on head, evenly distributed; carina of lateral margin fine, obsolescent before anterior margin; posterior angles slightly divergent, attenuate, narrowly rounded at apex, dorsum bicarinate, lateral carina distinct and subequal or longer than mesal carina. Hypomeron with punctures fine and sparse posteriorly and mesally, larger and denser anterolaterally. Prosternum finely, moderately–densely punctured; intercoxal process with strongly beaded margins posterior of coxa, preapical tooth obtuse. Mesosternum with intercoxal process flattened, coarsely punctured; mesepimeron coarsely and rugosely, umbilicately punctured. Elytral striae shallowly impressed and with shallow and subequally spaced punctures, striae 2–8 obsolete before apex; intervals flat, setae arising from 3–4 irregular rows of minute punctures; apex broadly rounded, sutural angle obtuse; epipleuron smooth, minutely punctured. Metathoracic wing similar to Fig. 1. Metasternum finely and moderately–sparsely punctured. Tarsi slender, tarsomere length ratio along dorsum = 1.0:0.5:0.3:0.2:0.7; segments 3 and 4 each with ventral lobe narrow, densely setose; segment 4 with apex oblique and ventral lobe emarginate.

Abdominal ventrites finely, moderately–densely punctured. Male ventrite 5 apex evenly rounded; aedeagus as in Fig. 3. Female gonocoxites lightly sclerotized; styli fusiform, slightly



Figures 4–7. *Simodactylus* species; Figure 4, *S. vanualevu* n.sp., vagina and bursa copulatrix, Figure 4a, bursal collar in anterior aspect; Figure 5, *S. gagneorum*, vagina and bursa copulatrix; Figure 6, *S. vanualevu*, female ventrite 5; Figure 7, *S. gagneorum*, female ventrite 5.

eccentric at apex of gonocoxite; internal reproductive structures (Fig. 5) as in preceding species, except vagina bilobately swollen dorsally and between colleterial glands, bursa copulatrix strongly arcuate before narrowing and forming base of accessory gland duct, and juncture of spermatheca and accessory gland duct is bulbous; baculi long, reaching to anterior margin of ventrite 1 when retracted; ventrite 5 (Fig. 7) deeply emarginate.

Type data: Holotype ♂ (BPBM #15342), FIJI: VITI LEVU I: Foster's Pk.: 16 km N of Suva, 335m, 4.XI.1981, shrubbery (B.H. & W.C. Gagne) (BPBM). Paratypes, 5 ♂, 1 ♀; all same island, Nandarivatu, 7.X.1937, at light (J.M. Valentine) (1, BPBM); Navai Mill, 13.X.1937 (J.M. Valentine) (1, BPBM); Naraiyawa, 178°5'E, 17°56'S, 28–30.XI.1986, blacklight trap (R.L. Brown) (2, MSUC); same data, except 20–23.XII.1986 (2, MSUC).

Remarks: I take pleasure in naming this species in honor of Betsy H. Gagné and the late Wayne C. Gagné, in recognition of their efforts and dedication to the pursuit of natural history and environmental conservation in the Pacific.

Simodactylus gagneorum is unlike any other *Simodactylus* species in the combination of small size, fine and sparse punctation, and aedeagal form. Only *S. vanualevu* and diminutive *S. bryani* are similar in size, but all differ considerably in aedeagal structure, sculpture, integumental and pubescence coloration, and other traits included in the descriptions and in the following key.

Key to Adult *Simodactylus* of Fiji

1. Antennae with segments 4–6 bearing a strong carina on anterior face; tarsomere 4 strongly reduced dorsally, broadly bilobed ventrally 2
 Antennal segments ecarinate; tarsomere 4 longer than wide, narrowly bilobed ventrally 6
2. Elytral apices evenly rounded to obliquely subtruncate 3
 Elytral apices broadly emarginate 4
3. Frons with punctation approximate, punctures large, umbilicate; disc of pronotum with median macula; length 10.4–12.5 mm *tasmani* Candèze
 Frons with punctation distinctly separated, punctures moderately large, simple; disc of pronotum immaculate; length 12.4–16.2 mm *cinnamomeus* (Boisduval)
4. Elytral apices deeply emarginate, medial angle denticulate and with large triangular mucronate extension of interval 3 5
 Elytral apices shallowly emarginate, medial angle and apex of interval 3 angular to minutely denticulate; length 9.5–12.0 mm *obscurus* Van Zwaluwenburg
5. Rufobrunneous, infuscate on head, pronotal disc, elytra, and prosternal disc; pronotum with lateral dorsal carina of posterior angle strong; lateral lobes of aedeagus with obtuse tubercle at midlength, median lobe gradually narrowing to broadly rounded apex; length 10.5–11.3 mm *acutus* Van Zwaluwenburg
 Rufobrunneous throughout; pronotum with lateral dorsal carina obsolescent; aedeagus with lateral lobes attenuate from midlength, median lobe laterally compressed; length 11.0–11.8 mm *bryani* Van Zwaluwenburg
6. Head rufocastaneous with an infuscate median macula; pronotum with infuscate median and sublateral vittae, punctures coarse and moderately dense anteriorly and laterally; aedeagus as in Fig. 5; length 8.1–9.1 mm *vanualevu* **new species**
 Head piceous throughout; pronotum unicolored or with small anteromedian area infuscate, punctures fine and sparse throughout; aedeagus as in Fig. 6; length 7.8–8.9 mm
 *gagneorum* **new species**

***Simodactylus delfini* Fleutiaux**

Simodactylus delfini Fleutiaux (1907) was originally described from Isla de Pascua, or Easter I, (ca. Long. 119°W, Lat. 27°S), and until recently it was only known from that island (Fleutiaux 1922, Van Zwaluwenburg 1932a). Although Easter I is biogeographically part of Polynesia, it politically belongs to Chile. Because of the latter, Blackwelder's (1944) inclusion of *S. delfini* provides an unfortunate suggestion that the genus occurs in the neotropical region.

In 1995 specimens of *S. delfini* were determined by me from samples collected on Henderson I (ca. Long. 128°W, Lat. 24°S), in the Pitcairn Is of southeastern Polynesia. This occurrence was reported by Benton (1995). Subsequently, an additional 4 specimens from Tutuila, American Samoa (ca. Long. 171°W, Lat. 14°S), were found in a series of undetermined *Simodactylus* from the Bishop Museum. These latter specimens examined bear the following data: AMERICAN SAMOA, TUTUILA, Taputimu Farm, 17.XII.1963 (N.R. Spencer) (1 ♂, BPBM); same island, Pago Pago, 23.I.1957 (W.R. Kellan) (1 ♀, BPBM); same island, Vailoatai, 1947 (F.A. Bianchi) (1 ♀, BPBM); same island, XI.17, 1920-401 (H. Swale) (1 ♀, BPBM). All specimens were compared with a possible syntype (♀) of *S. delfini* held at the Bishop Museum and the Henderson I specimens, and do not differ by any significant degree.

The recording of *S. delfini* from Henderson I and Tutuila provides significant range extensions for this species, up to approximately 6700 km northwestward of Easter I. Henderson I is approximately 2000 km west-northwest of Easter I, and Tutuila is approximately 4700 km northwest of Henderson I. With available records of this species there appears to be a disjunction that excludes all of French Polynesia and the Cook Is, both archipelagos lying between the Pitcairn Is and Samoa. However, such lack of records may be a sampling problem. The recognition of *S. delfini* from Henderson I and Tutuila supports speculation by Desender and Baert (1997) for a "Polynesian connection" for the Easter I entomofauna, be it adventitious or natural. *Simodactylus cinnamomeus* is the only species of the genus thus far recorded from all of these islands, except Easter I, and this species and *S. delfini* can be confused without reference to male genitalic structures (Van Zwaluwenburg 1957, Fig. 7a).

Acknowledgements

My thanks to S.E. Miller, G.A. Samuelson, G. Nishida and K. Kami, B.P. Bishop Museum (BPBM), for support, access to the collections under their care, and technical assistance; and to T. Scheifer and R.L. Brown, Mississippi State University (MSUC), for lending a number of important Fijian click beetles. Travel and study for this paper was supported by the Ernst Mayr Grant Committee, Museum of Comparative Zoology, Harvard University, and the Valentine Property Fund, B.P. Bishop Museum.

Literature Cited

- Alonso-Zarazaga, M.A. and C.H.C. Lyal 1999. A world catalogue of families and genera of Curculionoidea (excepting Scolytidae and Platypodidae). Entomopraxis, Barcelona, 315 p.
- Benton, T.G. 1995. Biodiversity and biogeography of Henderson Island's insects. Biol. J. Linn. Soc., 56: 245-259.
- Blackwelder, R.E. 1944. Checklist of the Coleopterous Insects of Mexico, Central America, the West Indies, and South America, part 2. U.S. Nat. Mus., Bull. 185. Campbell, J.M. and J.D. Marshall. 1964. The ocular index and its application to the taxonomy of the Alleculidae (Coleoptera). Coleopt. Bull., 18: 42.
- Candèze, E. 1859. Monographie des Élatérides, tome deuxième. Mém. Soc. Roy. Sci., Liege, 14: 1-

- 543, pl. i–vi.
- Candèze, E. 1893. Elaterides nouveaux, cinquieme fascicule. Mém. Soc. R. Sci., Liege, 18: 1–76.
- Desender, K. and L. Baert. 1997. Conservation of terrestrial arthropods on Easter Island as exemplified by the beetle fauna. *Conserv. Biol.*, 11(4): 836–838.
- Fleutiaux, E. 1907. Revision des Elateridae du Chili. *Rev. Chil. Hist. Nat.*, 11: 160–232.
- Fleutiaux, E. 1919. Elateridae, Trixagidae et Melasidae. *In Voyage de Ch. Alluaud et R. Jeannel en Afrique Orientale (1911–1912), Résultats Scientifiques, Coleoptera, XIII.* Lhomme, Paris, 119 p.
- Fleutiaux, E. 1922. Coleoptera-Serricornia de Juan Fernandez et de l’Ile de Pâques. *In C. Skottsberg, ed., The Natural History of Juan Fernandez and Easter Island, vol. III, Zoology, part 3.* Almqvist & Wiksells Boktryckeri-A.-B., Uppsala.
- Fleutiaux, E. 1929. Les Élatérides de l’Indo-Chine Française (Catalogue raisonné), Deuxieme Partie. *Encycl. Ent.*, 12, Coleoptera, 3(4): 103–177.
- Gistel, J.N.F.X. 1856. Die Mysterien der europäischen Insectenwelt. Dannheimer, Kempten, 12+532 p.
- ICZN (1999). International Code of Zoological Nomenclature, 4th Edition. International Trust for Zoological Nomenclature, London, 306p.
- Kukalová-Peck, J. and J.F. Lawrence. 1993. Evolution of the hind wing in Coleoptera. *Can. Entomol.*, 125: 181–258.
- Johnson, P.J. 1997. New Species of *Dioxypterus* Fairmaire from Tonga and Fiji, with New Distribution Records, a Tribal Reassignment, and Key to the Species of the Region (Coleoptera: Elateridae). *Pan-Pac. Entomol.*, 73(3): 156–167.
- Lawrence, J.F. and E.B. Britton. 1991. Coleoptera (Beetles). *In CSIRO, Insects of Australia (2nd ed.)*, vol. 2. Melbourne University Press, Melbourne, 1137 p.
- Motteler, L.S. 1986. Pacific island names. *Bishop Mus. Misc. Publ.* 34.
- Ôhira, H. 1973. Elaterid beetles from Borneo in the Bishop Museum (Coleoptera). *Pac. Insects*, 15(1): 103–137.
- Ôhira, H. 1974. Elateridae from the Philippines collected by the Noona Dan Expedition (Insecta, Coleoptera). *Steenstrupia*, 3: 163–178.
- Sánchez Ruiz, A. 1996. Catalogo Bibliografico de las Especies de la Familia Elateridae (Coleoptera) de la Peninsula Iberica e Islas Baleares. Museo nacional de Ciencias Naturales, Madrid, 265 p.
- Schönherr, C.J. 1833. Genera ete species curculionidum, cum synonymia hujus familiae. Species novae aut hactenus minus cognitae, descriptionibus a Dom. Leonardo Gyllenhal, C.H. Boheman, et entomologis aliis, Vol. 1, pt. 1. Roret, Paris, 381 p.
- Stibick, J.N.L. 1979. Classification of the Elateridae (Coleoptera): relationships and classification of the subfamilies and tribes. *Pac. Insects*, 20(2–3): 145–186.
- Van Zwaluwenburg, R.H. 1932a. Check list of the Elateridae of Oceania. *Occas. Pap. Bernice P. Bishop Mus.*, 9(23): 1–28.
- Van Zwaluwenburg, R.H. 1932b. Elateridae of the Marquesas, with a new species from Fiji. *Bernice P. Bishop Mus. Bull.* 98, pp 129–144.
- Van Zwaluwenburg, R.H. 1933. New Elateridae (Col.) from Melanesia. *Stylops*, 2(8): 176–185.
- Van Zwaluwenburg, R.H. 1936. The elaterid beetles of the Philippine Islands. *Philipp. J. Sci.*, 59(3): 393–432.
- Van Zwaluwenburg, R.H. 1939. Larvae of Hawaiian elaterid beetles. *Proc. Haw. Ent. Soc.*, 10(2): 275–279.
- Van Zwaluwenburg, R.H. 1940. New species and new records of elaterid beetles from the Pacific. *Occas. Pap. Bernice P. Bishop Mus.*, 16(5): 91–130.
- Van Zwaluwenburg, R.H. 1957. Coleoptera, Elateridae. *Insects of Micronesia*, 16(1): 1–66.
- Van Zwaluwenburg, R.H. 1959. Some type designations, with notes on Pacific Elateridae (Coleoptera). *Pac. Insects*, 1(4): 347–414.