PHILIPPINE
JOURNAL
OF
SCIENCE

74
JAN-APRIL
1941

THE PHILIPPINE JOURNAL OF SCIENCE

VOLUME 74

JANUARY TO APRIL, 1941

WITH 58 PLATES AND 19 TEXT FIGURES

MANILA
BUREAU OF PRINTING
1941

52057

Exch. - Philippine Journal of Science

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No. 1, January, 1941

[Issued February 24, 1941.]

No. 2, February, 1941

[Issued May 10, 1941.]

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[Issued June 18, 1941.]

ERRATA

Page 166:
In Table 1, column 2, **103.62** ***should read*** 103.26.

Page 170:
In Table 5, column 4, **+ 37.69** ***should read*** + 37.68.

THE PHILIPPINE JOURNAL OF SCIENCE

VOL. 74 JANUARY, 1941 NO. 1

A REVIEW OF PHILIPPINE CARANGIDÆ [1]

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TWELVE PLATES

The present paper deals with the systematic account of Philippine Carangidæ, based on the numerous specimens in the ichthyological collection of the Division of Fisheries, Department of Agriculture and Commerce, Manila, collected by various persons since 1907. Part of the collection has been worked out by Seale,(138–140) and Herre.(71, 72) Cuvier and Valenciennes,(36) Günther,(67) Bleeker,(23) Kner,(104) Meyer,(115) Jordan and Seale,(137, 138) Smith and Seale,(142) Evermann and Seale,(45) Seale and Bean,(141) Jordan and Richardson,(97) Jordan and Snyder,(96) Fowler,(50, 52) Fowler and Bean,(58) McCulloch,(112) Borodin,(28) Weber and de Beaufort,(152) Herre,(74–77) and Normann,(117) mentioned or described a considerable number of species of this family.

The family includes the cavallas or pampanos, known as *talakitok* and *taratokan* in the Ilocos provinces; as *atoloy* in the

[1] This article is based on worked done while the senior author was connected with the Division of Fisheries, Department of Agriculture and Commerce, Manila.

Bicol provinces; as *talakitok, muslo, pipikat, maliputo,* and *simbad* in the Tagalog provinces; and as *ampahan, bagudlon, baulo, lambiao, lison, mamsa, pac-an, pagapa,* and *momsa* in the Visayan provinces. They are highly carnivorous fishes that abound in coral reefs; some travel in large schools, often at some distance from the shore. While they are mostly caught by *baclad,* some may be obtained by hook and line. They may be captured also by trolling along the edge of reefs.

Carangoid fishes are mostly marine fishes of large or medium size, usually equipped for rapid swimming, pelagic or coastal. A few species ascend rivers and fresh-water lakes. Due to the practice in some parts of the Philippines of damming rivers completely with fish corrals and preventing the up-and-down movement of fishes, some migratory members of this family are now either very scarce or on the verge of extinction. This depletion is most striking in the case of *Caranx* (*Caranx*) *sexfasciatus,* known as *muslo* in Taal Lake and Pansipit River, Batangas Province, and as *simbad* in Naujan Lake and Lumangbayan River, Mindoro. About ten years ago this fish was available in large numbers in Batangas and Mindoro Provinces; now it is scarce or nonavailable.

CARANGIDÆ

Body more or less compressed, oblong or elongate, or short and deep, with well-developed cycloid scales, or scales reduced and embedded in skin, or scales entirely absent. Caudal peduncle slender. Lateral line complete, arched anteriorly, armed with scutes in its entire length or restricted to straight posterior portion. Scutes may be totally absent. Head more or less compressed. Mouth moderate, more or less oblique, usually protractile. Dentition varied, complete or incomplete, sometimes wanting. Eyelids often well developed. Nostrils paired. Gill openings wide; gill membranes usually not united, free from isthmus. Branchiostegals 7. Gills 4, a slit behind last. Two dorsals; first dorsal short, spinous, with slender or short spines, usually connected by a membrane, depressible in a groove, generally preceded by a subcutaneous spine; second dorsal long, soft. Anal about equal to soft dorsal, preceded by 2 preanal spines that may be united in young. Detached finlets at the posterior portion of soft dorsal and anal sometimes present. Pectorals usually falcate, long or short. Ventrals thoracic, with one spine and five rays. Caudal forked. Air bladder present. Pyloric cæca usually numerous.

Members of this family are known to inhabit all warm seas of the temperate as well as tropical regions. In the Philippines the family is represented by 4 subfamilies, 15 genera and subgenera, and 36 species as follows:

- Family Carangidæ
  - Subfamily Caranginæ
    - Genus *Megalaspis*
      - *Megalaspis cordyla*
    - Genus *Decapterus*
      - *Decapterus macrosoma*
    - Genus *Caranx*
      - Subgenus *Selar*
        - *Caranx (Selar) mate*
        - *Caranx (Selar) boops*
        - *Caranx (Selar) crumenophthalmus*
        - *Caranx (Selar) malam*
        - *Caranx (Selar) djedaba*
        - *Caranx (Selar) kalla*
      - Subgenus *Carangoides*
        - *Caranx (Carangoides) compressus*
        - *Caranx (Carangoides) auroguttatus*
        - *Caranx (Carangoides) præustus*
        - *Caranx (Carangoides) fulvoguttatus*
        - *Caranx (Carangoides) gymnostethoides*
        - *Caranx (Carangoides) armatus*
        - *Caranx (Carangoides) oblongus*
        - *Caranx (Carangoides) chrysophrys*
        - *Caranx (Carangoides) malabaricus*
        - *Caranx (Carangoides) dinema*
      - Subgenus *Caranx*
        - *Caranx (Caranx) sexfasciatus*
        - *Caranx (Caranx) stellatus*
        - *Caranx (Caranx) ignobilis*
        - *Caranx (Caranx) carangus*
      - Subgenus *Selaroides*
        - *Caranx (Selaroides) leptolepis*
      - Subgenus *Gnathanodon*
        - *Caranx (Gnathanodon) speciosus*
    - Genus *Ulua*
      - *Ulua mandibularis*
    - Genus *Alectis*
      - *Alectis ciliaris*
      - *Alectis indica*
    - Genus *Hynnis*
      - *Hynnis momsa*

Family Carangidæ—Continued

Subfamily Scomberoidinæ

Genus *Scomberoides*

Scomberoides lysan

Scomberoides toloo-parah

Scomberoides tala

Scomberoides tol

Subfamily Trachinotinæ

Genus *Trachinotus*

Trachinotus blochi

Trachinotus bailloni

Subfamily Seriolinæ

Genus *Elagatis*

Elagatis bipinnulatus

Genus *Seriola*

Seriola nigrofasciata

Key to the Philippine subfamilies of Carangidæ.

a^1. Lateral line more or less arched anteriorly, straight portion partly or wholly armed with scutes. Maxillary with a supplemental bone. Pectorals long, falcate. Anal about as long as soft dorsal. CARANGINÆ.

a^2. Lateral line without scutes.

b^1. Maxillary without distinct supplemental bone. Pectorals short, not falcate. Dorsal and anal of equal length.

c^1. With several finlets behind soft dorsal and anal; scales ovate, lanceolate or needlelike .... SCOMBEROIDINÆ.

c^2. Without finlets, scales small, rounded .... TRACHINOTINÆ.

b^2. Maxillary with a distinct supplemental bone. Anal much shorter than soft dorsal, its base not longer than abdomen. Pectorals short, not falcate. With or without a single finlet .... SERIOLINÆ.

CARANGINÆ

Body oblong, ovate or rhombic in shape, generally strongly compressed, covered with small cycloid scales. Cheeks, top of head, and opercular apparatus scaled; scales sometimes wanting on breast. In one genus, body scales minute, embedded in the skin. Teeth in villiform bands in jaws, vomer, palatines and tongue. Maxillary and mandibulary teeth consisting of several rows of which the outer row is composed of enlarged conical teeth, or reduced to a single series. Lateral line strongly curved anteriorly. Scutes on lateral line much larger than scales covering body, usually keeled posteriorly with spines. Dorsals 2, separate, spinous, with 7 connected weak spines, preceded by a single subcutaneous spine. Soft dorsal nearly equal to anal; in some genera one or more posterior rays of soft dorsal and anal detached as finlets. Pectorals long and falcate. Ventrals thoracic, with one spine and five rays. Gillrakers normal in shape, sometimes transformed to long featherlike filaments.

Key to the Philippine genera of Carangingæ.

a^1. One or more finlets behind soft dorsal and anal.
  b^1. Several finlets behind soft dorsal and anal.......................... *Megalaspis.*
  b^2. One finlet behind soft dorsal and anal.................................. *Decapterus.*
a^2. No true finlets behind soft dorsal and anal.
  b^1. Dorsal spines present.
    c^1. Dorsal spines VII or VIII, connected by membrane. Scales small but apparent, not embedded in skin. Anterior rays of soft dorsal and anal not equalling length of body.
      d^1. Gillrakers of moderate length and normal shape............ *Caranx.*
      d^2. Gillrakers extremely long, featherlike, reaching into mouth. *Ulua.*
    c^2. Dorsal spines less than VII, rudimentary, not connected by membrane; scales not apparent, embedded in skin. Anterior rays of soft dorsal and anal at least equalling length of body. *Alectis.*
  b^2. Dorsal spines wanting. Scales totally absent. Anterior rays of soft dorsal and anal short .... *Hynnis.*

Genus MEGALASPIS Bleeker, 1851

Megalaspis BLEEKER, Nat. Tijdschr. Ned. Ind. 1 (1851) 352; 8 (1855) 417; Verh. Batav. Gen. 24 (1852) 24, 49.
Trachurus GRONOW, Cat. Fish. (1854) 124.

Body oblong-elongate, slightly compressed, covered with small scales. Head pointed, compressed. Jaws, vomer, palatines, and tongue toothed. Anterior and posterior adipose eyelids well developed. Anterior part of lateral line shortly arched, posterior portion with very high scutes. Spinous dorsal moderately high, preceded by a subcutaneous spine. Soft dorsal and anal about equal in size, with six to ten finlets. Pectorals long, falcate.

MEGALASPIS CORDYLA (Linnæus). Oriles. Plate 1, fig. 1.

Scomber cordyla LINNÆUS, Syst. Nat. Paris ed. 10 1 (1758) 298; BLOCH and SCHNEIDER, Syst. Ichthyol. (1801) 23.
Scomber rottleri BLOCH and SCHNEIDER, Syst. Ichthyol. (1801) 25.
Caranx rottleri RÜPPELL, Atlas zu der Reise im Nördlichen Afrika. Zoologie 2 (1828) 102; CANTOR, Journ. Roy. Asiat. Soc. Bengal 18 (1849) 1106; GÜNTHER, Cat. Fish. Brit. Mus. 2 (1860) 424; Fische der Südsee 2 (1876–1881) 130; DAY, Fishes of Malabar (1865) 80; Fishes of India. Text 1 (1878–1888) 213; Fauna of British India. Fishes 2 (1889) 150; KNER, Zool. Fische 1–3 (1865–1867) 150; PLAYFAIR and GÜNTHER, Fishes of Zanzibar. London (1866) 58; KLUNZINGER, Verh. Kaiserl. Königl. Zool.-Bot. Ges. Wien 21 (1871) 453; ELERA, Cat. Syst. Fauna Filipinas.

Vertebrados 1 Peces (1895) 509; DUNCKER, Mitt. Naturh. Mus. Hamburg **21** (1904) 155; GILCHRIST and THOMPSON, Ann. South African Mus. **6** (1908) 239; VINCIGUERRA, Ann. Mus. Civ. Storia Nat. Genova **50** (1921–1926) 560; BORODIN, Bull. Vanderbilt Mar. Mus. art. 3 **1** (1932) 77.

Caranx rottleri CUVIER and VALENCIENNES, Hist. Nat. Poiss. **9** (1833) 22.

Megalaspis rottleri BLEEKER, Nat. Tijdschr. Ned. Ind. **1** (1851) 342; **2** (1851) 213, 475; **3** (1852) 745; **8** (1855) 393, 398; **16** (1858–1859) 407; Verh. Bat. Gen. **24** (1852) 24, 49; **25** (1853) 44; Versl. Akad. Amsterdam **12** (1861) 53, 75; Ned. Tijdschr. Dierk. **4** (1873) 131; BEAN and WEED, Proc. U. S. Nat. Mus. **42** (1912) 598.

Megalaspis cordyla JORDAN and EVERMANN, Proc. U. S. Nat. Mus. **25** (1903) 336; FOWLER, Proc. Acad. Nat. Sci. Phila. **57** (1905) 66; **77** (1925) 214; **79** (1927) 268; Copeia no. 58 (1918) 63; Mem. B. P. Bishop Mus. **10** (1928) 143; JORDAN and SEALE, Bull. U. S. Bur. Fish. **25** [1905 (1906)] 229; SEALE and BEAN, Proc. U. S. Nat. Mus. **33** (1907) 242; EVERMANN and SEALE, Bull. U. S. Bur. Fish. **26** [1906 (1907)] 65; JORDAN and RICHARDSON, Bull. U. S. Bur. Fish. **27** [1907 (1908)] 250; SEALE, Philip. Journ. Sci. § A **3** (1908) 517; WAKIYA, Ann. Carnegie Mus. **15** (1923–1924) 147; OSHIMA, Philip. Journ. Sci. **26** (1925) 354; WHITLEY, Rec. Aust. Mus. **15** (1926–1927) 298; **17** (1929–1930) 121; BARNARD, Ann. South African Mus. **21** (1927) 533; JORDAN, EVERMANN, and TANAKA, Proc. Cal. Acad. Sci. **16** (1927–1928) 655; MCCULLOCH, Mem. Aust. Mus. pt. 2 **5** (1929–1930) 183; WEBER and DE BEAUFORT, Fish. Indo-Aust. Arch. **6** (1931) 193; HERRE, Notes on Fishes in the Zoological Museum of Stanford University (1934) 34; Field Museum Nat. Hist. Chicago **21** (1936) 110; HARDENBERG, Treubia **15** (1936) 246.

Head 4; depth 3.7 to 4; dorsals VIII, I, 10 (preceded by one procumbent spine); pectoral I, 21 or 22; ventral I, 5; anal II, I, 8 or 9; 50 to 58 strong scutes in straight lateral line, largest 2.3 to 2.6 in height of body; 8 or 9 dorsal finlets; ventral finlets 7. Lateral line well arched, straightening posteriorly below seventh dorsal spine.

Body subelongate, slightly compressed; dorsal and ventral contours even; greatest depth at base of soft dorsal and anal spines; dorsoventrally flattened from region below sixth dorsal finlet towards caudal base. Breast naked.

Head large. Rostrodorsal profile weakly convex. Mouth terminal, oblique. Cleft of mouth slightly below eye. Maxillary broad posteriorly, terminating below center of eye. Lower jaw protruding beyond upper. Upper jaw with minute teeth in bands; two series anteriorly above symphysis, single row on each ramus of lower; vomer, palatines, and tongue with minute teeth. Chin slightly prominent. Snout short, 3.4 to 4.1 in head. Eyes large, 3.5 to 4.2 in head, equal to snout. Adipose eyelid well developed, covering pupil anteriorly and posteriorly. Interorbital space convex, greater than eye, 3.4 to 3.8 in head. Seven branchiostegal rays. Gillrakers 20 to 23, flat and horny.

Spinous dorsal with a scaly groove, 2 to 2.4 in head. Spines long, third and fourth spines longest. Pectorals longer than head, 2.8 in standard length. Ventrals inserted below pectorals, 2.1 to 2.4 in head. Soft dorsal base nearly equal to anal, both with low basal sheath.

A dark spot on upper posterior part of opercle.

Above description based on specimen No. 10381, 346 mm long, collected from Aparri, Cagayan Province, Luzon, May 22, 1923.

LUZON, Bataan Province, Mariveles, No. 10169, 401 mm, April 24, 1922: Manila, Manila market, No. 273, 165 mm, June 14, 1907, No. 31955, 183 mm, October 7, 1930: Batangas Province, Nasugbu, Barrio Papaya, No. 13320, 330 mm, January 13, 1927: Camarines Sur, San Miguel Bay, No. 14822, 211 mm, July 11, 1924: Sorsogon Province, Bulan, No. 4156, 362 mm, 1904: Marinduque Province, Balanacan, No. 12907, 295 mm, February 25, 1925. PANAY, Iloilo Province, Estancia, No. 10850, 363 mm, July, 1922. CEBU, Cebu Province, Bantayan, No. 555, 315 mm, No. 20597, 310 mm, April, 1909. BOHOL, Bohol Province, Loay, No. 14734, 135 mm, No. 20648, 134 mm, November 20, 1926. MINDANAO, Davao Province, Davao, No. 3306, 198 mm, April 23, 1908: Zamboanga Province, Sangali, No. 31956, 103 mm. JOLO, Sulu Province, Jolo, No. 4112, 206 mm, 1904.

Genus DECAPTERUS Bleeker, 1851

Decapterus BLEEKER, Nat. Tijdschr. Ned. Ind. 1 (1851) 352; 8 (1855) 417; Verh. Bat. Gen. 24 (1852) 24, 49.

Eustomatodus GILL, Proc. Acad. Nat. Sci. Phila. 14 [1862 (1863)] 261.

Evepigymnus GILL, Proc. Acad. Nat. Sci. Phila. 14 [1862 (1863)] 261.

Gymnepignathus GILL, Proc. Acad. Nat. Sci. Phila. 14 [1862 (1863)] 261.

Body elongate, more or less compressed-fusiform or subcylindrical. Head pointed, less compressed. Adipose eyelids well developed. Teeth fine, dentition various. Maxillary broadened posteriorly with a supplemental bone terminating before or below front border of eye. Dorsal fins distant; spinous fins with a procumbent anterior spine, and 8 free spines; soft dorsal with a spinelet and 27 to 35 rays. Anal with 2 detached anterior spines and a spinelet connected with 23 to 30 rays. Dorsal and anal with a single finlet. Pectorals short, falcate, shoulder girdle crossed by a shallow furrow at its junction with the isthmus. Ventrals much shorter than pectorals, originating below base of pectorals. Caudal short, deeply concave, lobes acute. Lateral line slightly arched, passing over below soft dorsal into straight part which is wholly or partly provided wtih armed scutes. About 35 to 38 gillrakers on lower part of anterior arch.

DECAPTERUS MACROSOMA Bleeker. Galonggong. Plate 1, fig. 2.

Decapterus macrosoma BLEEKER, Nat. Tijdschr. Ned. Ind. 1 (1851) 342, 358; WAKIYA, Ann. Carnegie Mus. 15 (1923–1924) 153; BARNARD, Ann. South African Mus. 21 (1927) 535; MCCULLOCH, Mem. Aust. Mus. pt. 2 5 (1929–1930) 184; WEBER and DE BEAUFORT, Fishes Indo-Aust. Arch. 6 (1931) 197; NORMAN, Ann. & Mag. Nat. Hist. 16 (1935) 262.

Caranx macrosoma GÜNTHER, Cat. Fish. Brit. Mus. 2 (1860) 425.

Decapterus macrosomus JORDAN and EVERMANN, Proc. U. S. Nat. Mus. 25 (1903) 337; EVERMANN and SEALE, Bull. U. S. Bur. Fish. 26 [1906 (1907)] 63; OSHIMA, Philip. Journ. Sci. 26 (1925) 363; FOWLER, Proc. Acad. Nat. Sci. Phila. 79 (1927) 269.

Head 3.9 to 4.1; depth 5.3 to 6.2; dorsals VIII, I, 31 to 33 (preceded by one procumbent spine); pectoral 21 to 23; ventral 6; anal II, I, 27 to 29; 52 to 62 scales in straight portion of lateral line, 26 to 29 of which are distinct scutes; caudal peduncle with one dorsal and one ventral finlet. Lateral line slightly arched anteriorly, straightening below tenth or eleventh soft dorsal ray.

Body elongate, subcylindrical, scarcely compressed, dorsal and ventral profiles almost equal; greatest depth at level of base of first soft dorsal ray and anterior spines of anal. Head pointed, its depth greater than its width. Profile from nape to snout arched to an angle of about 30°. Mouth terminal, slightly oblique. Cleft of mouth opposite eye. Maxillary terminating before front border of eye. Upper jaw toothless, lower with a single series of minute feeble teeth anteriorly. Vomerine teeth apparently absent. Palatines edentulous. Tongue triangular with a narrow strip of teeth at median posterior two-thirds. Upper lip with a thin transverse flap ventrally, concealing anterior portion of roof of mouth. Chin slightly prominent. Eyes large, 3.9 to 4.9 in head, almost equal to snout, situated mostly on anterior half of head. Adipose eyelid prominent. Anterior and posterior nostrils nearly confluent, posterior larger, midway between tip of snout and middle of upper border of eye. Interorbital space equal to eye diameter. Operculum wide and carried anteriorly to a point below posterior border of maxillary. Opercle and preopercle scaled. Six branchiostegal rays, none visible externally. Gillrakers 35 to 38, filamentous and horny.

Scales minute, particularly so at interorbital space. Scales at infraorbital and postorbital large. Lateral line only slightly arched anteriorly, straightening below tenth or eleventh soft dorsal ray. Scales at posterior portion of straight lateral line modified scutes, the first commencing below twenty-fifth or twenty-sixth soft dorsal ray.

Spinous dorsal 1.9 in head. Spines slender, soft and pointed, third longest, shorter than base. Soft dorsal origin more advanced than anal, first ray longest. Pectorals about 2 in snout. Ventrals 2.8 in head, origin slightly posterior of that of pectorals. Base of anal 1.2 in that of soft dorsal.

LUZON, Manila, No. 31616, 297 mm, No. 31617, 269 mm, No. 31618, 235 mm, No. 31619, 275 mm, no date. SULU, Bongao, No. 20639, 277 mm, No. 20637, 381 mm, No. 20638, 300 mm, August 28, 1924.

Genus CARANX Lacépède, 1802

Caranx[2] (Commerson) LACÉPÈDE, Hist. Nat. Poiss. 3 (1802) 57.

Trichopterus[3] RAFINESQUE, Caratteri Nuov. An. Sicil. (1810) 41.

Carangus[4] GRIFFITH, The Class Pisces in Cuvier Animal Kingdom 10 (1834) 325.

Selenia[5] (not Hubner, 1816) BONAPARTE, Cat. Method. Europei (1846) 75.

Leioglossus BLEEKER, Nat. Tijdschr. Ned. Ind. 1 (1851) 352; 8 (1855) 418; Verh. Bat. Gen. 24 (1852) 29, 70.

Selaroides BLEEKER, Nat. Tijdschr. Ned. Ind. 1 (1851) 352; 8 (1855) 418; Verh. Bat. Gen. 24 (1852) 71.

Leptaspis BLEEKER, Verh. Bat. Gen. 24 (1852) 30, 71.

Carangichthys BLEEKER, Nat. Tijdschr. Ned. Ind. 3 (1852) 760; 3 (1855) 418.

Uraspis BLEEKER, Nat. Tijdschr. Ned. Ind. 8 (1855) 417, 418.

Paratractus GILL, Proc. Acad. Nat. Sci. Phila. 14 [1862 (1863)] 432.

Elaphrotoxon FOWLER, Proc. Acad. Nat. Sci. Phila. 57 (1905) 76.

Vexillicaranx FOWLER, Proc. Acad. Nat. Sci. Phila. 57 (1905) 76.

Longirostrum WAKIYA, Am. Carnegie Mus. 15 (1924) 164, 202.

[2] Jordan and Evermann, Genera of Fishes pts. 1–4 (1917–1920) 60.

[3] Ibid., p. 70.

[4] Ibid., p. 180.

[5] Ibid., p. 226.

Leucoglossa (Jordan and Evermann) JORDAN, EVERMANN, and TANAKA, Proc. Calif. Acad. Sci. (4) 16 (1927) 660.
Usa WHITLEY, Rec. Aust. Mus. (5) 15 (1927) 299.
Xurel JORDAN and EVERMANN, Proc. Calif. Acad. Sci. (4) 16 (1927) 505.
Carangulus JORDAN and EVERMANN, Proc. Calif. Acad. Sci. (4) 16 (1927) 505.
Elaphotoxon JORDAN, EVERMANN, and CLARK, Rep. U. S. Comm. Fish. pt. 2 [1928 (1930)] 271.
Usacaranx WHITLEY, Aust. Zool. pt. 2 6 (1931) 316.
Zamora WHITLEY, Rec. Aust. Mus. (3) 18 (1931) 108.
Turrum WHITLEY, Rec. Aust. Mus. (6) 18 (1932) 337.

Body compressed, oblong, elongate or ovate, covered with small but conspicuous scales. Lateral line more or less arched anteriorly, posterior part straight with armed scutes in its entire length or confined only to posterior portion. Breast totally scaled or to some extent variably naked. Dentition complete or incomplete. Gillrakers normal in shape and of moderate length. First dorsal with 7 or 8 spines, connected by a membrane; anterior soft dorsal and anal rays elevated, forming a falcate lobe; some of the rays prolonged and filiform, but not equalling length of body. Soft dorsal and anal without finlets. Pectoral long, falciform, ventral usually shorter than head. Caudal with acute lobes. Shoulder girdle usually not crossed by a furrow at its junction with isthmus.

Key to the Philippine subgenera of Caranx.

a^1. Dentition complete, sometimes absent on tongue.
  b^1. Teeth on lower jaw uniseriate.
    c^1. Upper jaw also uniseriate, often pluseriate anteriorly; present on vomer, palatines, and usually on tongue. Adipose eyelid well developed. Soft dorsal and anal low, little if at all, falcate. Soft rays not produced into filaments. Shoulder girdle usually crossed with a deep furrow at its junction with isthmus.... *Selar.*
    c^2. Teeth in upper jaw in a villiform band with an outer series of stronger teeth; with 2 to 4 more or less caniniform teeth anteriorly. Anterior rays of soft dorsal and anal forming a falcate lobe; no produced filaments.. *Caranx.*
  b^2. Teeth on lower jaw in pluseriate band. Upper teeth also pluseriate, except some of anterior outer teeth, which are stronger; vomer, palatine, and tongue toothed. Adipose eyelid rudimentary. Anterior rays of soft dorsal and anal in adult more or less elevated, sometimes falcate; none of the rays filamentous........ *Carangoides.*
a^2. Upper jaw edentulous.
  b^1. Lower jaw with a single series of minute teeth; more or less rudimentary on tongue.. *Selaroides.*
  b^2. Teeth apparently absent on lower jaw in young; absolutely wanting in adult .... *Gnathanodon.*

Subgenus SELAR Bleeker, 1851

Selar BLEEKER, Nat. Tijdschr. Ned. Ind. 1 (1851) 352; 8 (1855) 417; Verh. Bat. Gen. 24 (1852) 25, 50.

Body oblong, elongate, slightly compressed. Head pointed, lower jaw somewhat prominent or both jaws subequal. Adipose eyelid well developed. Teeth small, evenly uniseriate in both jaws, although often pluriseriate anteriorly in upper jaw; teeth persistent on vomer, palatines, and tongue. Lateral line strongly or moderately arched anteriorly, posterior portion straight, with armed scutes in its entire length or at least posteriorly. Soft dorsal and anal low, slightly elevated anteriorly. No dorsal and anal rays produced into a filament. Shoulder girdle crossed or not crossed with a deep furrow at its junction with isthmus.

Key to the Philippine species of Selar.

a^1. Last dorsal and anal ray finletlike, somewhat separated. Lateral line slightly arched anteriorly, becoming straight below sixth to eighth dorsal ray, with 43 to 47 scutes posteriorly.................................. *S. mate.*

a^2. Last dorsal and anal ray not finletlike, not separated.

b^1. Eye 3 or less in head. Anterior eyelid narrow, posterior broad. Upper border of operculum with a rounded incision.

c^1. Anterior portion of lateral line subhorizontal, curving downwards below level of last spinous dorsal spine. Posterior portion with 43 to 46 scutes.. *S. boops.*

c^2. Anterior portion of lateral line poorly arched, straightening below level of eighth to tenth dorsal ray. Straight portion with 32 to 36 scutes.. *S. crumenophthalmus.*

b^2. Eye 3 to 4 in head. Posterior adipose eyelid broad or narrow. Opercular border entire.

c^1. Anterior portion of lateral line strongly arched, straightening below base of soft dorsal, with 43 to 57 scutes in straight portion.

d^1. Shielded part of lateral line with 54 to 57 scutes. Maxillary terminating below anterior border of eye, or slightly beyond. Ventral profile subcarinate... *S. malam.*

d^2. Shielded portion of lateral line with 43 or 44 scutes. Maxillary terminating below first third of eye........................ *S. djedaba.*

c^2. Lateral line moderately arched anteriorly, becoming straight below fourth to sixth dorsal ray, with 40 or more scutes. Broadest scutes 6 to 7 times in depth of body. Maxillary terminating below first third of eye. Ventral profile more convex and trenchant .... *S. kalla.*

CARANX (SELAR) MATE Cuvier and Valenciennes. Plate 1, fig. 3.

Coranx mate CUVIER and VALENCIENNES, Hist. Nat. Poiss. 9 (1833) 40; CANTOR, Journ. Roy. Asiat. Soc. Bengal 18 (1849) 1107; DAY, Fishes of Malabar (1865) 82; Proc. Zool. Soc. London (1870) 689; FOWLER, Proc. Acad. Nat. Sci. Phila. 57 (1905) 74; 79 (1927) 269; Mem. B. P. Bishop Mus. 10 (1928) 145; FOWLER and BEAN, Proc. U. S. Nat. Mus. Art. 2 62 (1923) 19; GILTAY, Mem. Mus. Roy. Hist. Nat. Belg. Hors V fasc. 3 (1933) 58.

Selar hasseltii BLEEKER, Nat. Tijdschr. Ned. Ind. 1 (1851) 343, 359; 2 (1851) 213; 3 (1852) 745; 8 (1855) 393, 398; Verh. Bat. Gen. 24 (1852) 26, 53; 25 (1853) 44; Versl. Akad. Amsterdam 12 (1861) 53, 75.

Caranx affinis RÜPPELL, Neue Wirbelthiere zu der Fauna von Abyssinien gehörig (1835–1840) 49; KNER, Zool. Fische 1–3 (1865–1867) 151; KLUNZINGER, Verh. Kaiserl. Königl. Zool.-Bot. Ges. Wien 21 (1871) 459; DAY, Fishes of India. Text 1 (1878–1888) 219; Fauna of British India. Fishes 2 (1889) 158; STEINDACHNER, Sitzungsber. Kaiserl. Akad. Wiss. Wien 83 (1881) 211; JORDAN and SEALE, Bull. U. S. Bur. Fish. 25 [1905 (1906)] 232; EVERMANN and SEALE, Bull. U. S. Bur. Fish. 26 [1906 (1907)] 64; JORDAN and RICHARDSON, Bull. U. S. Bur. Fish. 27 [1907 (1908)] 250; VINCIGUERRA, Ann. Mus. Civ. Stor. Nat. Genova 50 (1921–1926) 561; BORODIN, Bull. Vanderbilt Mar. Mus. art. 3 1 (1932) 77.

Caranx hasseltii GÜNTHER, Cat. Fish. Brit. Mus. 2 (1860) 430; PLAYFAIR and GÜNTHER, Fishes of Zanzibar. London (1866) 59; WEBER, Semon, Zoologische Forschungreisen in Australien und dem Malayischen Archipel 5 (1895) 266; JORDAN and SEALE, Proc. U. S. Nat. Mus. 28 (1905) 776; Bull. U. S. Bur. Fish. 25 [1905 (1906)] 232; 26 [1906 (1907)] 13; FOWLER, Copeia No. 58 (1918) 63.

Carangus politus JENKINS, Bull. U. S. Fish Comm. 22 [1902 (1904)] 445; JORDAN and EVERMANN, Bull. U. S. Fish Comm. 23 [1903 (1905)] 194.

Carangus affinis JENKINS, Bull. U. S. Fish Comm. 22 [1902 (1904)] 446; SNYDER, Bull. U. S. Fish Comm. 22 [1902 (1904)] 523; BORODIN, Bull. Vanderbilt Mar. Mus. art. 1 1 (1928) 18.

Decapterus lundini JORDAN and SEALE, Bull. U. S. Bur. Fish. 25 [1905 (1906)] 229.

Selar affinis JORDAN and STARKS, Ann. Carnegie Mus. 11 (1917) 443; OSHIMA, Philip. Journ. Sci. 26 (1925) 380; BARNARD, Ann. South African Mus. 21 (1927) 538.

Caranx affinis lundini NICHOLS, Am. Mus. Novit. No. 50 (1922) 1.

Atule lundini JORDAN and JORDAN, Mem. Carnegie Mus. 10 (1922–1925) 38.

Caranx (Atule) affinis WAKIYA, Ann. Carnegie Mus. 15 (1923–1924) 200.

Atule affinis MCCULLOCH, Mem. Aust. Mus. pt. 2 5 (1929–1930) 190.

Caranx (Selar) mate WEBER and DE BEAUFORT, Fish. Indo-Aust. Arch. 6 (1931) 207.

Atule mate HERRE, Journ. Pan-Pacific Res. Inst. (4) 8 (1933) 7; Notes on fishes in the Zoological Museum of Stanford University (1934) 34.

Alepes mate FOWLER, Monog. No. 2 Acad. Nat. Sci. Phila. (1938) 221.

Head 3.6 to 3.8; depth 3 to 3.2; dorsals VIII, I, 23 or 24 (preceded by one procumbent spine); pectoral 21 to 23; ventral I, 5; anal II, I, 19 or 20; 43 to 47 scutes in straight lateral line.

Body oblong, compressed; dorsal and ventral profile almost equally convex. Greatest depth at level of base of soft dorsal and that of first anal spine. Lateral line weakly arched, straightening posteriorly below sixth to eighth soft dorsal ray.

Head obtuse, longer than high. Rostronuchal outline declivous. Mouth terminal, its cleft opposite lower margin of eye. Maxillary triangular, terminating below or slightly beyond front border of eye. Teeth uniseriate in both jaws, pluseriate anteriorly in upper; in narrow villiform band in vomer, palatines, and tongue. Snout equal to or greater than eye. Eye 3.4 to 3.7 in head. Adipose eyelid well developed. Interorbital greater than eye, quite convex transversely, with a slight median frontonuchal keel. Nostrils slitlike at anterior tip of frontal, posterior larger. Scales larger in postorbital; smaller in cheeks and upper portion of opercle. Rows of minute mucous canals traversing almost entire length of preopercle. Operculum wide, extending anteriorly below level of anterior border of eye. Gillrakers 26 or 27, at times as many as 31.

Spinous dorsal with a base 2 in head. Spines weak, pointed, fourth longest. Soft dorsal origin more advanced than anal. Pectorals falcate, longer than head. Ventrals short, 2.3 in head, concealing vent when depressed. Both soft dorsal and anal with scaly basal sheath, that of spinous dorsal less developed.

Six black transverse bands, faintly indicated; a large dark blotch on posterior margin of opercle and upper portion of shoulder girdle. Alcoholic specimens vinaceous-brown above and silvery below.

The above description is based on specimen No. 12357, collected from San Pedro Bay, Basey, Samar, September 17, 1925. Length, 150 millimeters.

LUZON, Manila market, No. 96, 134 mm, No. 97, 123 mm, June 1, 1907, No. 6916, 235 mm, October 12, 1911: Batangas Province, Balayan Bay, No. 2269, 112 mm, No. 2276, 197 mm: Albay Province, Legaspi, No. 20731, 139 mm, No. 20732, 148 mm, September 21, 1924. POLILLO ISLANDS, No. 12594, 218 mm, September 25, 1925. SAMAR, Calbayog, No. 15063, 192 mm, No. 20551, 184 mm, December 8, 1926, No. 14974, 191 mm, No. 20776, 192 mm, No. 20777, 181 mm, December 17, 1926; San Pedro Bay, Basey, No. 12357, 150 mm, September 17, 1925. LEYTE, Burauen, No. 15060, 153 mm, December 3, 1926; Cabalian, No. 9641, 227 mm, May 25, 1921. MINDANAO, Zamboanga Province, Zamboanga, No. 4271, 159 mm, No. 20749, 150 mm, June 2, 1908.

Foreign example: Honolulu, Hawaii, No. 7492, 124 mm, no date.

CARANX (SELAR) BOOPS Cuvier and Valenciennes. Plate 2, fig. 1.

Caranx boops CUVIER and VALENCIENNES, Hist. Nat. Poiss. 9 (1833) 35; GÜNTHER, Cat. Fish Brit. Mus. 2 (1860) 431; BLEEKER, Ned. Tijdschr. Dierk. 1 (1863) 235; DAY, Fishes of India. Text 1 (1878–1888) 218; Fauna of British India. Fishes 2 (1889) 157; MEYER, Ann. Soc. Españ. Hist. Nat. Madrid 14 (1885) 24; JORDAN and SEALE, Bull. U. S. Bur. Fish. 25 [1905 (1906)] 232; EVERMANN and SEALE, Bull. U. S. Bur. Fish. 26 [1906 (1907)] 63; WEBER, Die Fische der Siboga Expedition. Leiden (1913) 395.

Selar boops BLEEKER, Nat. Tijdschr. Ned. Ind. 1 (1851) 343; 3 (1852) 740, 745; 8 (1855) 393, 398; Verh. Bat. Gen. 24 (1852) 26, 51; FOWLER, Copeia No. 58 (1918) 63; Proc. Acad. Nat. Sci. Phila. 79 (1927) 269; Mem. B. P. Bishop Mus. 10 (1928) 144; MCCULLOCH, Mem. Aust. Mus. pt. 2 5 (1929–1930) 190; HERRE, Notes on fishes in the Zoological Museum of Stanford University (1934) 34.

Caranx freeri EVERMANN and SEALE, Bull. U. S. Bur. Fish. 26 [1906 (1907)] 63.

Caranx (*Selar*) *boops* WEBER and DE BEAUFORT, Fish. Indo-Aust. Arch. 6 (1931) 209.

Head 3 to 3.3; depth 3.1 to 3.2; dorsals VIII, I, 24 (preceded by one procumbent spine); pectorals 20 to 21; ventrals 5; anal II, I, 20; posterior lateral line scutes 43 to 46, 40 to 42 in straight portion.

Body oblong, dorsal and ventral profiles equally convex; greatest depth at level of base of soft dorsal and that of first preanal spine. Lateral line very slightly arched, posterior portion straightening below spine of soft dorsal. Highest scute 4.1 to 4.5 in body height.

Head pointed, its length greater than its depth. Mouth terminal, its cleft opposite lower margin of lens of eye. Maxillary broadly triangular, extending to below middle of eye. Lower jaw more prominent than upper; teeth in a single series in both jaws; in three elongate patches in vomer; in bands in palatines and tongue. Snout equal to or less than interorbital. Eyes very large, 2.8 to 3 in head. Adipose eyelid well developed, anterior and posterior portions almost coalescing at center of eye. Opercle with an upper posterior notch. Operculum wide, extending anteriorly below level of front border of eye. Shoulder girdle crossed by a furrow at its junction with isthmus. Gillrakers 26.

Spinous dorsal with a base 2.4 in head. Spines weak, second longest. Origin of soft dorsal slightly ahead of anal. Soft dorsal and anal with scaly basal sheath, penultimate ray quite apart from rest, thus appearing finletlike. Pectorals falcate, shorter than head. Reaching a point midway between base of free anal spines and that of soft dorsal. Ventrals inserted behind pectorals. Soft dorsal base 1.1 in anal base.

A small dark blotch along upper concavity of opercle.

This description is based on No. 3895, collected from Samal Island, Davao, May 3, 1908. Total length, 187 millimeters.

This species differs from *Caranx* (*Selar*) *mate* Cuvier and Valenciennes in having relatively larger eyes and conspicuously large scutes in the posterior lateral line.

POLILLO, No. 20622, 167 mm, September 25, 1925. SAMAR, Catbalogan, No. 31793, 169 mm, March 5, 1932. PANAY, Iloilo Province, Iloilo, No. 20704, 154 mm, February 8, 1925. PALAWAN, Puerto Princesa, No. 5460, 121 mm, No. 20558, 118 mm, August 21, 1908. CULION, No. 11409, 107 mm, No. 20712, 100 mm, December 16, 1921. MINDANAO, Misamis Oriental Province, No. 1757, 100 mm, September 17, 1907; Zamboanga Province, Zamboanga, No. 4144, 230 mm, May 23, 1908, No. 4102, 188 mm, May 21, 1908. SAMAL, Davao Province, No. 3895, 187 mm, May 3, 1908, No. 3625, 175 mm, May 1, 1908, No. 3810, 220 mm, May 2, 1908. SULU, Bungau, No. 13537, 266 mm; No. 13559, 272 mm; No. 20618, 240 mm; No. 20619, 262 mm; No. 20620, 253 mm, April 9, 1926.

CARANX (SELAR) CRUMENOPHTHALMUS (Bloch). Matang baca. Plate 2, fig. 2.

Scomber crumenophthalmus BLOCH, Ichthyol. Hist. Nat. Poiss. pt. 10 (1797) 65.

Scomber plumierii BLOCH, Ichthyol. Hist. Nat. Poiss. pt. 10 (1797) 67; BLOCH and SCHNEIDER, Syst. Ichthyol. (1801) 30.

Scomber balantiophthalmus BLOCH and SCHNEIDER, Syst. Ichthyol. (1801) 29.

Caranx mauritianus QUOY and GAIMARD, Voyage autour du monde. Paris (1824) 359; CUVIER and VALENCIENNES, Hist. Nat. Poiss. 9 (1833) 45.

Caranx macrophthalmus RÜPPELL, Atlas zu der Reise im Nördlichen Afrika. Zoologie 2 (1828) 97; KLUNZINGER, Verh. Kaiserl. Königl. Zool.-Bot. Ges. Wien 21 (1871) 458.

Caranx crumenophthalmus CUVIER and VALENCIENNES, Hist. Nat. Poiss. 9 (1833) 46; GÜNTHER, Cat. Fish. Brit. Mus. 2 (1860) 429; Fische der Südsee 2 (1876–1881) 131; BLEEKER, Nat. Verh. Holl. Maatsch. (2) 18 (1863) 14; DAY, Fishes of India. Text 1 (1878–1888) 217; Fauna of British India. Fishes 2 (1889) 156; JORDAN and GILBERT, Proc. U. S. Nat. Mus. 6 [1883 (1884)] 196; MEYER, Ann. Soc. Españ. Hist. Nat. Madrid **14** (1885) 25; BOULENGER, Proc. Zool. Soc. London (1887) 660; SAUVAGE, Hist. Phys. Nat. Pol. Madagascar **16** (1891) 327; PELLEGRIN, Bull. Soc. Zool. France **37** (1912) 291; WEBER, Die Fische der Siboga Expedition. Leiden (1913) 398; BORODIN, Bull. Vanderbilt Mar. Mus. art. 3 **1** (1932) 77.

Selar torvus BLEEKER, Nat. Tijdschr. Ned. Ind. **1** (1851) 343; **2** (1851) 210, 213; **3** (1852) 745; **8** (1855) 393, 398; Verh. Bat. Gen. **24** (1852) 25, 51; WAKIYA, Ann. Carnegie Mus. **15** (1923–1924) 162.

Caranx torvus GÜNTHER, Cat. Fish. Brit. Mus. **2** (1860) 431; BLEEKER, Ned. Tijdschr. Dierk. **1** (1863) 235, 242.

Carangus crumenophthalmus GOODE, Bull. U. S. Fish Comm. **1** [1881 (1882)] 33.

Trachurops crumenophthalmus GILL, Proc. Acad. Nat. Sci. Phila. **14** [1862 (1863)] 432; JORDAN and EVERMANN, Bull. U. S. Nat. Mus. **47** (1896) 911; Rept. U. S. Fish Comm. **21** [1895 (1896)] 345; JENKINS, Bull. U. S. Fish. Comm. **22** [1902 (1904)] 443; FOWLER, Proc. Acad. Nat. Sci. Phila. **57** (1905) 69; SEALE, Occ. Pap. B. P. Bishop Mus. **4** (1906) 30; OSHIMA, Philip. Journ. Sci. **26** (1925) 369; WALFORD, Marine game fishes of the Pacific coast from Alaska to the equator (1937) 81.

Trachurops torvus JORDAN and SNYDER, Proc. U. S. Nat. Mus. **23** (1901) 352.

Trachurops crumenophthalma SNYDER, Bull. U. S. Fish Comm. **22** [1902 (1904)] 523; JORDAN and EVERMANN, Bull. U. S. Fish Comm. **23** [1903 (1905)] 187; JORDAN and SEALE, Bull. U. S. Bur. Fish. **25** [1905 (1906)] 230; **26** [1906 (1907)] 13; JORDAN and RICHARDSON, Bull. U. S. Bur. Fish. **27** [1907 (1908)] 250; KENDALL and GOLDSBOROUGH, Mem. Mus. Comp. Zool. Harvard **26** (1911) 268; BORODIN, Bull. Vanderbilt Mar. Mus. art. 1 **1** (1928) 18; JORDAN, EVERMANN, and CLARK, Rept. U. S. Comm. Fish. pt. 2 (1930) 271.

Trachurops torva JORDAN and EVERMANN, Proc. U. S. Nat. Mus. **25** (1903) 337.

Selar crumenophthalmus FOWLER, Copeia No. 58 (1918) 63; Proc. Acad. Nat. Sci. Phila. **77** (1925) 214; **79** (1927) 269; Mem. B. P. Bishop Mus. **10** (1928) 144; Bull. Amer. Mus. Nat. Hist. pt. 2 **70** (1936) 689; Monog. No. 2 Acad. Nat. Sci. Phila. (1938) 220, 254; BARNARD, Ann. South African Mus. **21** (1927) 536; HERRE, Journ. Pan-Pacific Res. Inst. (2) **10** (1935) 164.

Selar mauritianus JORDAN and JORDAN, Mem. Carnegie Mus. **10** (1922-1925) 38; WAKIYA, Ann. Carnegie Mus. **15** (1923–1924) 159.

Selar macrophthalmus WAKIYA, Ann. Carnegie Mus. **15** (1923–1924) 160; HERRE, Journ. Pan-Pacific Res. Inst. (4) **8** (1933) 8; Notes on fishes in the Zoological Museum of Stanford University (1934) 34.

Trachurops mauritiana JORDAN, Proc. U. S. Nat. Mus. art. 33 **66** (1925) 18.

Caranx (*Selar*) *crumenophthalmus* WEBER and DE BEAUFORT, Fish. Indo-Aust. Arch. **6** (1931) 210.

Trachurops macrophthalmus HERRE, Field Mus. Nat. Hist. Chicago **21** (1936) 112.

Head 3 to 3.1; depth 3.2 to 3.4; dorsals VIII, I, 25 (preceded by a procumbent spine); pectoral 19 to 21; ventral I, 5; anal II, I, 22; 32 to 36 scutes in straight lateral line, highest 6.8 to 7.5 in body height.

Body elongate, dorsal and ventral outlines almost equally convex; greatest depth at level of base of soft dorsal and that of anal. Lateral line barely curved, straightening posteriorly below level of eighth to tenth dorsal rays.

Head pointed, about as long as high. Mouth terminal, its cleft opposite lower margin of eye. Maxillary triangular, terminating below anterior margin of lens of eye. Teeth uniserial in both jaws, in triaxial patches in vomer, in narrow patches in palatines and tongue. Snout shorter than eye; eye quite large, 3 in head; interorbital less than snout. Adipose eyelid well developed, posterior portion broader. Nostrils nearer eye than tip of snout. Infraorbital prominent, longer than eye. Cheek, postorbital, and upper opercle scaled. Preopercle convex. Operculum wide and carried forward below anterior border of eye. A deep narrow groove at junction of shoulder girdle with isthmus. Gillrakers 27 or 28.

Spinous dorsal with a base 2.3 to 2.5 in head. Spines weak, third longest. Soft dorsal origin slightly advanced to that of anal. Soft dorsal and anal with scaly basal sheath. Pectoral falcate, shorter than head. Ventral inserted below pectoral, its tips reaching vent. Base of soft dorsal 1.10 in that of anal.

A small, dark, opercular spot; spinous dorsal, soft dorsal, anal, and caudal with numerous tiny spots.

The above description is based on No. 12462, collected from Malangas, Zamboanga Province, September 5, 1925. Total length, 154 millimeters.

This species closely resembles *Caranx* (*Selar*) *boops* Cuvier and Valenciennes, except for the more elongate body, and the fewer and less developed scutes.

LUZON, Ilocos Sur Province, Bangui, No. 14313, 142 mm, No. 20643, 144 mm, August 19, 1926: Bataan Province, Orion, No. 31361, 193 mm, November 23, 1934: Manila market, No. 938, 160 mm, No. 21611, 157 mm, September, 1907, No. 52, 168 mm: Sorsogon Province, Bulan, No. 3346, 138 mm, 1904. MINDORO, Mindoro Province, Calapan, No. 31478, May 1, 1933. NEGROS, Negros Oriental Province, Tolong, No. 13887, 164 mm, No. 20717, 162 mm, February 28, 1926. PALAWAN, Palawan Province, Puerto Princesa, No. 5454, 120 mm, August 2, 1908, No. 5456, 145 mm, August 21, 1908. CAMIGUIN, No. 585, 122 mm, No. 589, 117 mm, July, 1907. MINDANAO, Oriental Misamis Province, Cagayan, No. 1623, 216 mm, September 13, 1907: Zamboanga Province, Zamboanga, No. 20703, 176 mm, June 3, 1908; Malangas, No. 12462, 189 mm, September 5, 1925. JOLO, Sulu Province, No. 2394, 141 mm, February, 1908.

CARANX (SELAR) MALAM Bleeker. Plate 2, fig. 3.

Selar malam BLEEKER, Nat. Tijdschr. Ned. Ind. 1 (1851) 343, 355, 362; 2 (1851) 471; Verh. Bat. Gen. 24 (1852) 27, 55; Versl. Akad. Amsterdam 12 (1861) 53.

Caranx malam GÜNTHER, Cat. Fish. Brit. Mus. 2 (1860) 434; KNER, Zool. Fische 1–3 (1865–1867) 154; BLEEKER, Ned. Tijdschr. Dierk. 4 (1873) 116, 131; BEAN and WEED, Proc. U. S. Nat. Mus. 42 (1912) 600; WEBER, Die Fische der Siboga Expedition. Leiden (1913) 397; MCCULLOCH, Mem. Aust. Mus. pt. 2 5 (1929–1930) 188.

Caranx nigripinnis DAY, Fishes of India. Text 1 (1878–1888) 225; Fauna of British India. Fishes 2 (1889) 168; JORDAN and SEALE, Bull. U. S. Bur. Fish. 26 [1906 (1907)] 14.

Alepes melanoptera FOWLER, Proc. Acad. Nat. Sci. Phila. 57 (1905) 70; 79 (1927) 269.

Caranx (Atule) malam WAKIYA, Ann. Carnegie Mus. 15 (1923–1924) 200.

Caranx (Selar) malam WEBER and DE BEAUFORT, Fishes Indo-Aust. Arch. 6 (1931) 213.

Atule malam HERRE, Notes on fishes in the Zoological Museum of Stanford University (1934) 34.

Head 3.9; depth 3.1 to 3.4; dorsals VIII, I, 25 (with one procumbent spine); pectoral I, 22; anal II, I, 21; scutes 54 to 57 in a straight lateral line.

Body oblong, dorsal and ventral outline equally convex. Mouth terminal, its cleft oblique. Jaws nearly equal. Maxillary terminating slightly beyond front border of eye. Teeth in jaws in single series, small but conspicuous, a few on vomer, minute in palatines and tongue. Snout somewhat blunt, equal to eye diameter. Eye large, 3.7 to 4 in head. Adipose eyelid moderately developed, covering pupil posteriorly. Interorbital space convex, greater than eye. Opercular wide. Angle of mouth, postorbital, upper portions of preopercular and opercular scaled. Gillrakers 24 or 25, short and blunt.

Spinous dorsal with a base 1.93 to 1.98 in head. Spines weak, fourth longest, flexible in a groove. Base of soft dorsal 2.3 in standard length, its rays gradually decreasing in length posteriorly. Pectorals falcate, longer than head, extending beyond vertical through origin of anal. Anal base shorter than that of soft dorsal. Caudal widely forked, 3.9 in total length.

The alcoholic specimens brownish above, with a light-purplish tint, silvery below. Upper opercle with a dusky spot.

Above description is based on specimen No. 10197, 410 mm, collected from Monja Island, Corregidor, April 24, 1922.

LUZON, Corregidor, Monja Island, No. 20576, 432 mm, April 28, 1922. PALAWAN, Palawan Province, No. 31304, 265 mm, October, 1930.

CARANX (SELAR) DJEDABA (Forskål). Salay-salay lalaki. Plate 3, fig. 1.

Scomber djedaba FORSKÅL, Descriptiones Animalium. Pisces (1775) 56.

Caranx djeddaba RÜPPELL, Atlas zu der Reise im Nördlichen Afrika. Zoologie 2 (1828) 97; CUVIER and VALENCIENNES, Hist. Nat. Poiss. 9 (1833) 38; GÜNTHER, Cat. Fish. Brit. Mus. 2 (1860) 432; PLAYFAIR and GÜNTHER, Fishes of Zanzibar. London (1866) 59; DAY, Proc. Zool. Soc. London (1870) 689; Fishes of India. Text 1 (1878–1888) 218; KLUNZINGER, Verh. Kaiserl. Königl. Zool.-Bot. Ges. Wien 21 (1871) 458; BOULENGER, Proc. Zool. Soc. London (1887) 660; DUNCKER, Mitt. Naturh. Mus. Hamburg 21 (1904) 156; EVERMANN and SEALE, Bull. U. S. Bur. Fish. 26 [1906 (1907)] 65; JORDAN and RICHARDSON, Bull. U. S. Bur. Fish. 27 (1908) 250; GILCHRIST and THOMPSON, Ann. South African Mus. 6 (1908) 242; FOWLER, Copeia No. 58 (1918) 63; Proc. Acad. Nat. Sci. Phila. 79 (1927) 270; VINCIGUERRA, Ann. Mus. Civ. Stor. Nat. Genova 50 (1921–1926) 562; HORA, Mem. Asiat. Soc. Bengal (2) 6 (1924) 485; BARNARD, Ann. South African Mus. 21 (1927) 546.

Caranx vari CUVIER and VALENCIENNES, Hist. Nat. Poiss. 9 (1833) 36; CANTOR, Journ. Roy. Asiat. Soc. Bengal 18 (1849) 1107.

Selar djeddaba BLEEKER, Nat. Tijdschr. Ned. Ind. 1 (1851) 343; Versl. Akad. Amsterdam 12 (1861) 75; OSHIMA, Philip. Journ. Sci. 26 (1925) 379.

Selar vari BLEEKER, Verh. Bat. Gen. 25 (1853) 44; Versl. Akad. Amsterdam 12 (1861) 75.

Caranx djedaba DAY, Fauna of British India. Fishes 2 (1889) 158; BEAN and WEED, Proc. U. S. Nat. Mus. 42 (1912) 599.

Caranx (Atule) djeddaba WAKIYA, Ann. Carnegie Mus. 15 (1923–1924) 199.

Caranx (Selar) djedaba WEBER and DE BEAUFORT, Fish. Indo-Aust. Arch. 6 (1931) 214.

Head 3.3 to 3.8; depth 2.8; dorsals VIII, I, 24 (with a procumbent spine); pectoral I, 20 or 21; anal I, 19 to 20. Scutes, 43 to 44 in a straight lateral line.

Body oblong, dorsal and ventral outline evenly convex. Mouth terminal, its cleft oblique, extending to front margin of eye. Lower jaw slightly prominent, maxillary terminating below first third of eye. Uniserial fine teeth in jaws, a patch in vomer, a narrow band on palatines and tongue. Snout pointed, about equal to eye. Eye 3.6 to 4 in head. Adipose eyelid well developed, occupying posterior half of eye. Interorbital space narrower than eye diameter. Opercular wide, extending to below level of anterior margin of eye. Gillrakers 29 (31).

Spinous dorsal base 2 in head. Spines moderately strong, third slightly the longest. Base of soft dorsal 2.1 in standard length. Anterior rays high, decreasing in length posteriorly. Pectorals long, falciform, longer than head. Anal base 2.4 in standard length. Soft dorsal and anal with low basal membrane.

Alcoholic specimens vinaceous brown above, whitish below. A dusky spot in upper border of opercle.

Here described from specimen No. 31917, 187 mm long, collected from Divisoria Market, Manila, Luzon, Philippines.

PANAY, Iloilo Province, Estancia, No. 20633, 223 mm, June 16, 1922.

Foreign example: China, Hongkong, No. 7761, 167 mm.

CARANX (SELAR) KALLA Cuvier and Valenciennes. Salay-salay aso. Plate 3, fig. 2.

Caranx kalla CUVIER and VALENCIENNES, Hist. Nat. Poiss. 9 (1833) 37; DAY, Fishes of Malabar (1865) 83; Fishes of India. Text 1 (1878–1888) 219; Fauna of British India. Fishes 2 (1889) 160; DUNCKER, Mitt. Naturh. Mus. Hamburg 21 (1904) 156; EVERMANN and SEALE, Bull. U. S. Bur. Fish. 26 [1906 (1907)] 65; JORDAN and SEALE, Proc. Davenport Acad. Sci. 10 (1907) 6; BEAN and WEED, Proc. U. S. Nat. Mus. 42 (1912) 599; WEBER, Die Fische der Siboga Expedition. Leiden (1913) 398; FOWLER, Copeia No. 58 (1918) 63; Proc. Acad. Nat. Sci. Phila. 77 (1925) 215; 79 (1927) 270; Mem. B. P. Bishop Mus. 10 (1928) 148; VINCIGUERRA, Ann. Mus. Civ. Stor. Nat. Genova 50 (1921–1926) 560; MCCULLOCH, Mem. Aust. Mus. pt. 2 5 (1929–1930) 185; CHEVEY, Inst. Oceanog. l'Indochine (1932) 26; Trav. l'Inst. Oceanog. l'Indochine 4° Memoire (1932) 110.

Caranx xanthurus CUVIER and VALENCIENNES, Hist. Nat. Poiss. 9 (1833) 41; KNER, Zool. Fische 1–3 (1865–1867) 154.

Caranx cambon CUVIER and VALENCIENNES, Hist. Nat. Poiss. 9 (1833) 45.

Caranx parra BLEEKER, Nat. Tijdschr. Ned. Ind. 1 (1851) 346.

Selar kuhlii BLEEKER, Nat. Tijdschr. Ned. Ind. 1 (1851) 343, 355, 360; 2 (1851) 210, 213; 3 (1852) 740, 745; 8 (1855) 393, 398; Verh. Bat. Gen. 24 (1852) 26, 54; Versl. Akad. Amsterdam 12 (1861) 53, 75.

Selar brevis BLEEKER, Nat. Tijdschr. Ned. Ind. 1 (1851) 343, 355, 361; Verh. Bat. Gen. 24 (1852) 27, 54.

Selar para BLEEKER, Nat. Tijdschr. Ned. Ind. 1 (1851) 343; 16 (1858–1859) 407; Verh. Bat. Gen. 24 (1852) 27, 56; 25 (1853) 44; Versl. Akad. Amsterdam 12 (1861) 53.

Selar kalla BLEEKER, Verh. Bat. Gen. 25 (1853) 44; BARNARD, Ann. South African Mus. 21 (1927) 537.

Caranx calla GÜNTHER, Cat. Fish. Brit. Mus. 2 (1860) 433; BLEEKER, Ned. Tijdschr. Dierk. 4 (1873) 131; DAY, Proc. Zool. Soc. London (1870) 689; MEYER, Ann. Soc. Españ. Hist. Nat. Madrid 14 (1885) 25; ELERA, Catalogo Systematico de toda la Fauna de Filipinas. Vertebrados 1 Peces (1895) 509; GILCHRIST and THOMPSON, Ann. South African Mus. 6 (1908) 243; JORDAN and RICHARDSON, Bull. U. S. Bur. Fish. 27 [1907 (1908)] 250.

Caranx brevis GÜNTHER, Cat. Fish. Brit. Mus. 2 (1860) 435; EVERMANN and SEALE, Bull. U. S. Bur. Fish. 26 [1906 (1907)] 65; SEALE, Philip. Journ. Sci. § D 5 (1910) 271.

Caranx para DAY, Fishes of Malabar (1865) 85; KNER, Zool. Fische 1–3 (1865–1867) 153.

Alepes kalla OGILBY, Mem. Queens. Mus. 3 (1915) 62.

Selar calla JORDAN and STARKS, Ann. Carnege Mus. 11 (1917) 443.

Caranx kuhlii JORDAN, Proc. U. S. Nat. Mus. art. 33 66 (1925) 16; FOWLER, Mem. B. P. Bishop Mus. 10 (1928) 145.

Caranx (*Selar*) *kalla* WEBER and DE BEAUFORT, Fishes Indo-Aust. Arch. 6 (1931) 216; HARDENBERG, Treubia 15 (1936) 246.

Atule kalla HERRE, Journ. Pan-Pacific Res. Inst. (4) 8 (1933) 3; Notes on fishes in the Zoological Museum of Stanford University (1934) 34.

Head 3.5 to 3.7; depth 2.3 to 2.5; dorsals VIII, I, 25 (with one procumbent spine); pectoral I, 20; anal II, I, 20; scutes 40 to 41 in straight lateral line commencing below fourth to sixth ray of soft dorsal.

Body ovate, tapering posteriorly, ventral contour much more convex than dorsal and sharp till anal. Mouth terminal, its cleft oblique, terminating below front border of eye. Maxillary reaching first third of eye. Jaws subequal, lower jaw slightly prominent. Teeth even, conical, in single series in both jaws, in triangular patch on head of vomer, in narrow band in palatines, and in broad band on tongue. Snout blunt and short, 1.4 in eye. Eye large, 2.8 to 2.9 in head. Adipose eyelid poorly developed, not reaching pupil of eye. Interorbital gently convex and low, 1.2 in eye diameter. Preopercular border entire. Opercular opening extending anteriorly to below level of nostrils. Gill-rakers 28 to 30, slender.

Spinous dorsal base 2 in head. Spines weak and flexible, third, fourth, and fifth spines longest. Base of soft dorsal 2.2 to 2.3 in length. First six rays of soft dorsal slightly produced, gradually shortening posteriorly, first ray extending to ninth ray when depressed. Pectorals longer than head. Anal base 2.4 to 2.5 in standard length, first ray originating below fourth ray of soft dorsal. Caudal deeply forked, upper lobe longer.

Alcoholic specimens yellowish brown above, silvery below, a large blackish spot on shoulder, encroaching well on upper edge of opercle. Base of pectoral and ventral washed with dull gold.

Here described from specimen No. 9636, 152 mm, collected from Cabalian, Leyte, May 14, 1921.

LUZON, Manila Bay, No. 10920, 119 mm, No. 20741, 120 mm, No. 20739, 120 mm, No. 20736, 122 mm, No. 20742, 116 mm, No. 20737, 126 mm, April 21, 1923; Divisoria Market, No. 31928, 129 mm, No. 31929, 127 mm, January 8, 1931: Camarines Sur Province, San Miguel Bay, No. 14823, 113 mm, July 11, 1924; Calabanga, No. 31930, 156 mm, No. 31931, 105 mm, No. 31932, 124 mm, No. 31933, 152 mm, No. 31934, 138 mm. SAMAR, Samar Province, Calbayog, No. 15007, 145 mm, No. 20705, 136 mm, December 18, 1926. PANAY, Capiz Province, Capiz, No. 20724, 142 mm, No. 20727, 141 mm, No. 20726, 139 mm, No. 20725, 152 mm, July 30, 1925.

Subgenus CARANGOIDES Bleeker, 1815

Carangoides BLEEKER, Nat. Tijdschr. Ned. Ind. **1** (1851) 352; **8** (1855) 418; Verh. Bat. Gen. **24** (1852) 27, 59.

Body oblong or ovate. Breast scaly, or ventrally and laterally naked to some extent. Adipose eyelid rudimentary. Lateral line moderately curved anteriorly, straight portion armed posteriorly. Upper and lower jaws with pluriseriate band of small teeth, except for a few stronger teeth anteriorly. Anterior rays of soft dorsal and anal more or less elevated, sometimes falcate in adult; none of the rays filiform.

Key to the Philippine species of Carangoides.

*a*¹. Persistent dentition on jaws, vomer, palatines, and tongue.
  *b*¹. Breast totally scaled, except for a median naked area ventrally. Anterior rays of soft dorsal and anal not elevated into a lobe. Scales more or less conspicuous.
    *c*¹. Lateral line straightening below eleventh to thirteenth ray of soft dorsal. Dorsals VIII, I, 22 to 26, anal II, I, 19 to 23.
      *d*¹. Dorsals VII, I, 22 to 24; anal II, I, 19 or 20, 12 or 13 scutes posteriorly .... *C. compressus.*
      *d*². Dorsals VIII, I, 25 or 26; anal II, I, 19 or 20, 15 to 20 feeble scutes posteriorly .... *C. auroguttatus.*
    *c*². Lateral line straightening below eighth ray of soft dorsal. Dorsals VIII, I, 23 or 24; anal II, I, 19 or 20, 25 to 30 scutes on posterior part of lateral line .... *C. præustus.*
  *b*². Breast naked.
    *c*¹. Naked area not reaching base of pectorals. Cleft of mouth below level of eye. Dorsals VIII, I, 26 to 28; anal II, I, 22 to 24.

Lateral line straightening below fifteenth ray of soft dorsal; 15 to 20 scutes posteriorly.. *C. fulvoguttatus.*

c[2]. Naked area extending to or surpassing base of pectorals and ventrals.

d[1]. Cleft of mouth opposite eye or its lower border.

e[1]. Dorsals VII or VIII, I, 30 or 31; anal II, I, 25 or 26. Lateral line straightening below twenty-fourth ray of soft dorsal; 23 to 25 scutes.. *C. gymnostethoides.*

e[2]. Dorsals VIII, I, 20 or 21; anal II, I, 16 or 17. Lateral line straightening below thirteenth ray of soft dorsal; 20 feeble scutes .... *C. armatus.*

d[2]. Cleft of mouth below level of eye.

e[1]. Dorsals VIII, I, 21 or 22; anal II, I, 18 to 20. Straight lateral line commencing below level of seventh ray of soft dorsal. 36 to 40 scutes... *C. oblongus.*

e[2]. Dorsals VIII, I, 21 to 23; anal II, I, 18 or 19. Lateral line becomes straight below twelfth ray of soft dorsal.

f[1]. Twenty scutes in posterior portion of lateral line. Gillrakers 15 or 16... *C. chrysophrys.*

f[2]. Twenty-one to 28 scutes in posterior part of lateral line. Gillrakers 25 or 26... *C. malabaricus.*

a[2]. Dentition not persistent. Teeth on jaws becoming uniseriate; teeth on vomer, palatines, and tongue disappearing with age. Dorsals VIII, I, 18 to 21; anal II, I, 17 or 18. Breast ventrally, and partially also laterally, naked. Straight lateral line beginning below level of twelfth ray of soft dorsal; 23 to 25 scutes.............................. *C. dinema.*

CARANX (CARANGOIDES) COMPRESSUS Day. Plate 3, fig. 3.

Caranx ferdau RÜPPELL, Atlas zu der Reise im Nördlichen Afrika. Zoologie **2** (1828) 99; CUVIER and VALENCIENNES, Hist. Nat. Poiss. **9** (1833) 42; GÜNTHER, Cat. Fish. Brit. Mus. **2** (1860) 439.

Caranx compressus DAY, Proc. Zool. Soc. London (1870) 689; Fishes of India. Text 1 (1878–1888) 221; Fauna of British India. Fishes 2 (1889) 161; BORODIN, Bull. Vanderbilt Mar. Mus. art. 2 **1** (1930) 49; HERRE, Notes on fishes in the Zoological Museum of Stanford University (1934) 35.

Caranx brevicarinatus KLUNZINGER, Verh. Kaiserl. Königl. Zool.-Bot. Ges. Wien **21** (1871) 461.

Caranx (Carangoides) ferdau WAKEIYA, Ann. Carnegie Mus. **15** (1923–1924) 165.

Caranx (Carangoides) compressus WEBER and DE BEAUFORT, Fishes Indo-Aust. Arch. **6** (1931) 223.

Head 3.3; depth 2.5; dorsals VIII, I, 24 (with one procumbent spine); pectoral I, 19; anal II, I, 20; lateral line arched anteriorly, straightening below thirteenth ray of soft dorsal, with 13 small scutes that form a carina on caudal peduncle.

Body oblong, elongate, compressed, dorsal and ventral profiles equally convex. Head large, its rostro-occipital outline convex.

Mouth oblique, its cleft opposite lower third of eye. Maxillary triangularly broad posteriorly, terminating beyond front border of eye. Lower jaw projecting strongly beyond upper. Teeth minute, in bands on jaws, palatines, vomer, and tongue. Preorbital slightly longer than eye. Snout somewhat pointed, 3.3 in head. Eye 3 in head. Adipose eyelid poorly developed, a mere rim around eye socket. Interorbital space less than snout. Cheeks, postorbital, preopercle, upper opercle, and nuchal region scaly. Opercular opening extending anteriorly below level of posterior nostrils. Gillrakers 22, slender, increasing in length posteriorly. Breast scaled, except for a very narrow naked area ventrally.

Spinous dorsal with a base 7.2 in body length. Spines weak, fourth spine longest. Soft dorsal inserted closer to caudal base than to tip of snout. Pectorals longer than head. Anal origin below level of fifth ray of soft dorsal. Soft dorsal and anal with low scaly sheaths, whose anterior rays are quite elevated. Caudal forked broadly.

Alcoholic specimens sorghum-brown dorsally, pale olive-gray ventrally. Five vinaceous buff crossbars on sides, not extending to ventral contour. Opercular spot and margin of preopercular dusky.

Above description based on specimen No. 13350, 207 mm, collected from Bennett Island, Masbate, March 27, 1926.

BANTAYAN, Cebu Province, No. 20728, 275 mm, December 25 to 28, 1926. CANIPO, Palawan Province, No. 15504, 275 mm, No. 20775, 195 mm, June 19, 1927.

CARANX (CARANGOIDES) AUROGUTTATUS Cuvier and Valenciennes. Plate 4, fig. 1.

Caranx fulvoguttatus RÜPPELL, Atlas zu der Reise im Nördlichen Afrika. Zoologie 2 (1828) 100; GÜNTHER, Cat. Fish. Brit. Mus. 2 (1860) 439; KLUNZINGER, Verh. Kaiserl. Königl. Zool.-Bot. Ges. Wien 21 (1871) 460.

Caranx auroguttatus CUVIER and VALENCIENNES, Hist. Nat. Poiss. 9 (1833) 54; BOULENGER, Proc. Zool. Soc. London (1887) 660; HERRE, Notes on fishes in the Zoological Museum of Stanford University (1934) 35.

Carangoides aureoguttatus BLEEKER, Versl. Akad. Amsterdam 12 (1861) 53.

Caranx (*Carangoides*) *auroguttatus* WEBER and DE BEAUFORT, Fishes Indo-Aust. Arch. 6 (1931) 225.

Head 3.5; depth 2.4; dorsals VIII, I, 25 (with one procumbent spine); pectoral I, 20; anal II, I, 22; lateral line arched anteriorly, straightening below the eleventh ray of soft dorsal with 20 scutes posteriorly.

Body oblong, elongate, dorsal profile convex, ventral profile less so. Head longer than high, rostrofrontal outline somewhat protruding anteriorly. Mouth oblique. Maxillary broad posteriorly, not reaching front border of eye. Lower jaw slightly longer than upper. Teeth small, pluriseriate in both jaws, minute, villiform bands in vomer, palatines, and tongue. Posterior part of preorbital less than eye diameter. Snout somewhat pointed, 2.4 in head. Eye 4.1 in head length, situated on middle of head above longitudinal axis of body. Adipose eyelid poorly developed. Interorbital with a prominent fronto-occipital ridge, less than snout. Cheek, postorbital, upper opercular, nuchal region, and interopercle scaled. Opercular opening wide, extending anteriorly below level of posterior border of nostrils. Gillrakers 19, first rudimentary. Breast scaled, except for a small, narrow, naked area in median line.

Spinous dorsal with a base 5.7 in standard length, spines weak, thirteenth spine longest, 3.4 in body depth. Soft dorsal inserted nearer caudal base than snout tip. Pectorals longer than head, extending posteriorly to second ray of anal when depressed. Ventral origin below pectoral base, longer than snout. Anal originating below level of third ray of soft dorsal. Anterior rays of soft dorsal and anal elevated. Caudal forked.

Alcoholic specimens vetiner-green above, deep colonial-buff below, all fins tawny-olive.

Here described from specimen No. 15557, 295 mm long, collected from Calapan, Mindoro Province, June 19, 1927.

MINDORO, Mindoro Province, Calapan, No. 20562, 278 mm, June 19, 1927.

CARANX (CARANGOIDES) PRÆUSTUS Bennett. Salay-salay. Plate 4, fig. 2.

Caranx ire CUVIER and VALENCIENNES, Hist. Nat. Poiss. 9 (1833) 43; GÜNTHER, Cat. Fish. Brit. Mus. 2 (1860) 436; DAY, Fishes of India. Text 1 (1878–1888) 220; Fauna of British India. Fishes 2 (1889) 160; JORDAN and SEALE, Proc. U. S. Nat. Mus. 28 (1905) 776; JORDAN and RICHARDSON, Bull. U. S. Bur. Fish. 27 [1907 (1908)] 250; SEALE, Philip. Journ. Sci. § D 5 (1910) 271; BEAN and WEED, Proc. U. S. Nat. Mus. 42 (1912) 599.

Carangoides præustus BLEEKER, Nat. Tijdschr. Ned. Ind. 1 (1851) 343, 363; 2 (1851) 471; Verh. Bat. Gen. 24 (1852) 27, 60; 25 (1853) 46; Versl. Akad. Amsterdam 12 (1861) 53.

Selar ire BLEEKER, Verh. Bat. Gen. 25 (1853) 44; JORDAN and STARKS, Ann. Carnegie Mus. 11 (1917) 443.

Caranx præustus GÜNTHER, Cat. Fish. Brit. Mus. 2 (1860) 436; Fische der Südsee 2 (1876–1881) 134; FOWLER, Proc. Acad. Nat. Sci. Phila. 79 (1927) 271; HERRE, Journ. Pan-Pacific Res. Inst. (4) 8 (1933) 3, 7.

Caranx melanostethos DAY, Proc. Zool. Soc. London (1865) 23; Fishes of Malabar (1865) 83.

Caranx (*Carangoides*) *præustus* WEBER and DE BEAUFORT, Fishes Indo-Aust. Arch. 6 (1931) 224; HARDENBERG, Treubia 15 (1936) 247.

Head 3; depth 2.7; dorsal VIII; soft dorsal, I, 22 (with one procumbent spine); pectoral, I, 19; anal II, I, 20; lateral line arched anteriorly, becoming straight below level of eighth ray of soft dorsal, with 27 small scutes posteriorly.

Body oblong, compressed; dorsal profile more convex than that of ventral. Head a little longer than high, its rostrofrontal portion ascending in nearly straight line. Mouth oblique, its cleft opposite lower border of eye. Maxillary quite broad posteriorly, terminating below anterior third of eye. Teeth in villiform bands in jaws; in upper jaw somewhat enlarged anteriorly; in a semilunar patch in head of vomer with narrow median patch posteriorly; in narrow bands in palatines and tongue. Snout pointed, equal to eye. Preorbital less than eye. Eye 3.5 in head, situated more on anterior half of head. Adipose eyelid poorly developed. Interorbital equal to snout. Cheeks, postorbital nuchal region, and upper opercular scaled. Opercular opening wide, extending anteriorly below level of front border of eye. Gillrakers 24. Breast entirely scaled, except a minute anterior naked patch ventrally.

Spinous dorsal base 5.4 in standard length. Spines weak, depressible in a groove, third spine longest. Soft dorsal origin closer to caudal base than to tip of snout. Pectorals falcate, shorter than head. Ventrals short, 2.7 in head. Anal inserted below level of third ray of soft dorsal. Soft dorsal and anal with high basal scaly sheath. Caudal lobes equal.

Alcoholic specimens deep brownish drab above, olive-buff below. Anterior portion of soft dorsal with blackish patch.

Here described from No. 739, 80 mm, collected from Malabon, Rizal, July 18, 1907.

Other examples: Sandakan, Borneo, No. 2613, 120 mm, No. 2738, 130 mm, February, 1908, No. 14173, 151 mm, November 21, 1925.

CARANX (CARANGOIDES) FULVOGUTTATUS (Forskål). Plate 4, fig. 3.

Scomber fulvo-guttatus FORSKÅL, Descriptiones Animalium. Fishes (1775) 56.

Caranx fulvoguttatus CUVIER and VALENCIENNES, Hist. Nat. Poiss. 9 (1833) 57; HERRE, Notes on fishes in the Zoological Museum of Stanford University (1934) 35.

Carangoides fulvoguttatus BLEEKER, Nat. Tijdschr. Ned. Ind. 2 (1851) 178; Verh. Bat. Gen. 24 (1852) 89.

Caranx bleekeri KLUNZINGER, Verh. Kaiserl. Königl. Zool.-Bot. Ges. Wien 21 (1871) 461; BAMBER, Journ. Linn. Soc. London 31 (1907–1915) 480.

Caranx (*Carangoides*) *fulvoguttatus* WEBER and DE BEAUFORT, Fishes Indo-Aust. Arch. 6 (1931) 227.

Head 3.2; depth 2.5; dorsals VIII, I, 26 (with one procumbent spine); pectoral I, 20; anal II, I, 23; lateral line arched anteriorly, straightening below fifteenth dorsal ray; 15 small scutes posteriorly.

Body oblong, dorsal profile convex, ventral profile almost straight from isthmus to base of anal, thence acclivous to caudal peduncle. Head almost as long as high, fronto-occipital outline convex. Mouth oblique. Maxillary broad, terminating in front of anterior border of eye. Jaws almost equal. Teeth minute, in villiform bands in jaws, vomer, palatines, and tongue. Snout pointed, 2.5 in head length. Posterior part of preorbital less than eye. Eye 3.9 in head. Adipose eyelid poorly developed. Interorbital space greater than eye, somewhat convex, with a fronto-occipital keel. Cheeks, postorbital, upper opercular, and nuchal region with scales. Gill opening wide, extending anteriorly below level of nostrils. Gillrakers 19, set quite wide apart on lower anterior arch, first gillrakers rudimentary. Naked area of breast extending laterally upwards midway between ventral line and base of pectorals, and continued posteriorly to about middle of ventral.

Spinous dorsal base 6.7 in standard length. Spines weak, third spine longest. Origin of soft dorsal closer to middle of caudal peduncle than to tip of snout. Pectorals falcate, longer than head. Ventrals abdominal, equal to snout. Anal inserted below level of seventh dorsal ray. Anterior rays of soft dorsal elevated; anal quite lower, both having high scaly sheaths. Caudal with equal lobes.

Alcoholic specimens brownish drab dorsally, silvery below.

Here described from a single specimen, No. 31939, 254 mm, collected from Landiok, Zamboanga Province, Mindanao, August 2, 1932.

CARANX (CARANGOIDES) GYMNOSTETHOIDES Bleeker. Plate 5, fig. 1.

Carangoides gymnostethoides BLEEKER, Nat. Tijdschr. Ned. Ind. 1 (1851) 343, 355, 364; Verh. Bat. Gen. 24 (1852) 28, 61; JORDAN and EVERMANN, Bull. U. S. Fish Comm. 23 [1903 (1905)] 199; JORDAN and JORDAN, Mem. Carnegie Mus. 10 (1922–1925) 40;

FOWLER, Mem. B. P. Bishop Mus. 10 (1928) 150; Monog. No. 2 Acad. Nat. Sci. Phila. (1938) 92.

Caranx gymnostethoides GÜNTHER, Cat. Fish. Brit. Mus. 2 (1860) 431; KNER, Zool. Fische 1–3 (1865–1867) 153; DAY, Fishes of India. Text 1 (1878–1888) 217; Fauna of British India. Fishes 2 (1889) 155; JORDAN and SEALE, Bull. U. S. Bur. Fish. 25 [1905 (1906)] 232; PELLEGRIN, Bull. Soc. Zool. France 39 (1914) 228; MCCULLOCH, Rec. Aust. Mus. 15 (1926–1927) 31; Mem. Aust. Mus. pt. 2 5 (1929–1930) 187.

Carangoides gymnostethoides evermanni NICHOLS, Am. Mus. Novit. no. 50 (1922) 3.

Ferdauia evermanni JORDAN, EVERMANN, and TANAKA, Proc. Cal. Acad. Sci. 16 (1927–1928) 662.

Caranx (Carangoides) gymnostethoides WEBER and DE BEAUFORT, Fishes Indo-Aust. Arch. 6 (1931) 231.

Head 3.2; depth 3.2; dorsals VII, I, 30 (preceded by one procumbent spine); pectoral I, 19; anal II, I, 25; lateral line straightening below twenty-fourth ray of soft dorsal, with 23 scutes posteriorly.

Body elliptical, compressed, dorsal contour more convex than ventral profile. Mouth terminal, its cleft opposite level of preopercle. Maxillary terminates below anterior border of eye. Lower jaw slightly lower than upper.

Teeth in villiform bands in jaws, vomer, palatines, and tongue. Snout obtuse, 2.5 in head. Preorbital length 1.3 in snout. Eye 4.9 in head, situated along horizontal axis of body, mostly on anterior half of head. Adipose eyelid poorly developed. Interorbital space somewhat convex, crossed by a fronto-occipital keel. Infraorbital, postorbital, upper opercular, and nuchal region scaled. Opercular opening wide, extending anteriorly below anterior margin of eye. Gillrakers 20. Breast without scales; naked triangular area extending beyond base of ventrals posteriorly, dorsally reaching base of pectoral.

Spinous dorsal base 6.8 in standard length. Spines weak, depressible in a groove; third spine longest. Origin of soft dorsal nearer caudal base than tip of snout. Pectoral falcate, longer than head. Ventral short, 2.8 in head, inserted below base of second spine of spinous dorsal. Anal base shorter than that of soft dorsal, its origin below ninth ray of latter. Anterior rays of soft dorsal and anal not elevated into falcate lobe. Last ray of soft dorsal and anal finletlike and longer than preceding ray. Caudal widely forked. Alcoholic specimens generally brownish, the breast whitish.

Here described from a single specimen, No. 13979, 459 mm long, collected from Jolo, Sulu, May 25, 1926.

CARANX (CARANGOIDES) ARMATUS (Forskål). Buensang-sapse. Plate 5, fig. 2.

Sciæna armata FORSKÅL, Descriptiones Animalium. Pisces (1775) 53.

Scomber armatus BLOCH and SCHNEIDER, Syst. Ichthyol. (1801) 38.

Citula plumbea QUOY and GAIMARD, Voyage autour du monde. Paris (1824) 361.

Citula ciliaria RÜPPELL, Atlas zu der Reise im Nördlichen Afrika. Zoologie 2 (1828) 102.

Citula armata RÜPPELL, Atlas zu der Reise im Nördlichen Afrika. Zoologie 2 (1828) 103; BLEEKER, Ned. Tijdschr. Dierk. 1 (1863) 242; 4 (1873) 131; FOWLER, Proc. Acad. Nat. Sci. Phila. 57 (1905) 83; JORDAN and STARKS, Ann. Carnegie Mus. 11 (1917) 443; OSHIMA, Philip. Journ. Sci. 26 (1925) 396.

Caranx citula CUVIER and VALENCIENNES, Hist. Nat. Poiss. 9 (1833) 94; BLEEKER, Nat. Tijdschr. Ned. Ind. 1 (1851) 346; KNER, Zool. Fische 1–3 (1865–1867) 156.

Caranx armatus CUVIER and VALENCIENNES, Hist. Nat. Poiss. 9 (1833) 95; CANTOR, Journ. Roy. Asiat. Soc. Bengal 18 (1849) 1113; GÜNTHER, Cat. Fish. Brit. Mus. 2 (1860) 453; DAY, Proc. Zool. Soc. London (1865) 25; Fishes of Malabar (1865) 89; Fishes of India. Text 1 (1878–1888) 223; Fauna of British India. Fishes 2 (1889) 165; PLAYFAIR and GÜNTHER, Fishes of Zanzibar. London (1866) 61; KLUNZINGER, Verh. Kaiserl. Königl. Zool.-Bot. Ges. Wien 21 (1871) 455; Sitzgsber. Akad. Wien 80 (1880) 377; MACLEAY, Descr. Cat. Aust. Fish. Sydney 1 (1881) 171; MEYER, Ann. Soc. Españ. Hist. Nat. Madrid 14 (1885) 24; ELERA, Catalogo Systematico de toda la Fauna de Filipinas. Vertebrados 1 Peces (1895) 511; DUNCKER, Mitt. Naturh. Mus. Hamburg 21 (1904) 156; JORDAN and SEALE, Bull. U. S. Bur. Fish. 25 [1905 (1906)] 232; 26 [1906 (1907)] 14; EVERMANN and SEALE, Bull. U. S. Bur. Fish. 26 [1906 1907)] 65; JORDAN and RICHARDSON, Bull. U. S. Bur. Fish. 27 [1907 (1908)] 250; BAMBER, Journ. Linn. Soc. London 31 (1907–1915) 480; BEAN and WEED, Proc. U. S. Nat. Mus. 42 (1912) 600; WEBER, Die Fische der Siboga Expedition. Leiden (1913) 394; FOWLER, Proc. Acad. Nat. Sci. Phila. 77 (1925) 217; BARNARD, Ann. South African Mus. 21 (1927) 542; PARADICE and WHITLEY, Mem. Queens. Mus. 9 (1927–1929) 83; MCCULLOCH, Mem. Aust. Mus. pt. 2 5 (1929–1930) 189; BORODIN, Bull. Vanderbilt Mar. Mus. art. 3 1 (1932) 77.

Carangoides citula BLEEKER, Nat. Tijdschr. Ned. Ind. 1 (1851) 343; 2 (1851) 210, 213, 475; 3 (1852) 745; 8 (1855) 393, 398; 16 (1858–1859) 407; Verh. Bat. Gen. 24 (1852) 29, 65; 25 (1853) 14, 44.

Carangoides armatus BLEEKER, Versl. Akad. Amsterdam 12 (1861) 53, 74; FOWLER, Proc. Acad. Nat. Sci. Phila. 79 (1927) 272; Mem. B. P. Bishop Mus. 10 (1928) 151; Monog. No. 2 Acad. Nat. Sci. Phila. (1938) 279.

Citula ciliaris BLEEKER, Ned. Tijdschr. Dierk. 1 (1863) 235; 4 (1873) 132; HERRE, Notes on fishes in the Zoological Museum of Stanford University (1934) 34.

Caranx plumbeus JORDAN and SEALE, Bull. U. S. Bur. Fish. 25 [1905 (1906)] 233; 26 [1906 (1907)] 14.

Caranx rastrosus JORDAN and SNYDER, Mem. Carnegie Mus. (2) 4 (1908) 37.

Citula armatus SEALE, Philip. Journ. Sci. § D 5 (1910) 272; HERRE, Pan-Pacific Res. Inst. (4) 8 (1933) 3; Notes on fishes in the Zoological Museum of Stanford University (1934) 34.

Caranx (Citula) armatus WAKIYA, Ann. Carnegie Mus. 15 (1923–1924) 169.

Caranx (Citula) plumbeus WAKIYA, Ann. Carnegie Mus. 15 (1923–1924) 171.

Caranx (Citula) ciliaris WAKIYA, Ann. Carnegie Mus. 15 (1923–1924) 172.

Citula rastrosus OSHIMA, Philip. Journ. Sci. 26 (1925) 393.

Caranx (Carangoides) armatus WEBER and DE BEAUFORT, Fishes Indo-Aust. Arch. 6 (1931) 233.

Citula plumbea HERRE, Notes on fishes in the Zoological Museum of Stanford University (1934) 35.

Head 3.2; depth 1.8; dorsals VIII, I, 20 (with one procumbent spine); pectoral I, 20; anal II, I, 16; lateral line moderately arched anteriorly; 20 scutes posteriorly.

Body ovate, strongly compressed. Dorsal and ventral profiles equally convex. Head large, higher than long, its rostro-occipital outline convex, with a slight concavity in front of nostrils. Mouth oblique. Maxillary broad posteriorly, terminating below center of eye. Jaws almost equal. Teeth in narrow villiform bands, in jaws, vomer, palatines, and tongue. Snout blunt, 3 in head. Posterior pair of nostrils larger than anterior. Eye equal to snout, 3 in head, situated in anterior half of head, crossed by longitudinal axis of body. Adipose eyelid poorly developed. Interorbital somewhat angular, 5.7 in body depth. Postorbital and anterosuperior angle of opercle with scales. Opercular opening wide, extending anteriorly below level of nostrils. Gillrakers 16, short and slender, first knoblike. Breast with a naked triangular patch which extends behind base of ventrals.

Spinous dorsal with a base 6.8 in standard length. Spines weak, third spine longest. Soft dorsal inserted midway between caudal peduncle and middle of eye. Pectorals falcate, longer than head. Ventrals short, almost equal to spinous dorsal base. Anal originating below sixth dorsal ray. Anterior rays of soft dorsal and anal filiform; seven middle rays of soft dorsal and anal filamentous in male specimen. Caudal widely forked.

Alcoholic specimens cinnamon-brown above, silvery below; fins buck-thorn brown; pectoral base black medially; opercular spot narrow.

Above description based on No. 41127, 249 mm, collected from West Coast of Guimaras Island, November 18, 1933.

LUZON, Manila Bay, No. 31548, 122 mm, December 21, 1934.

CARANX (CARANGOIDES) OBLONGUS Cuvier and Valenciennes. Plate 5, fig. 3.

Caranx oblongus CUVIER and VALENCIENNES, Hist. Nat. Poiss. **9** (1833) 96; CANTOR, Journ. Roy. Asiat. Soc. Bengal **18** (1849) 1114; GÜNTHER, Cat. Fish. Brit. Mus. 2 (1860) 452; DAY, Proc. Zool. Soc. London (1870) 689; Fishes of India. Text 1 (1878–1888) 222; Fauna of British India. Fishes 2 (1889) 163; PETERS, Monats. Akad. Berlin [1875 (1876)] 836; DUNCKER, Mitt. Naturh. Mus. Hamburg **21** (1904) 156; JORDAN and SEALE, Bull. U. S. Bur. Fish. **25** [1905 (1906)] 232; BEAN and WEED, Proc. U. S. Nat. Mus. **42** (1912) 600; McCULLOCH, Rec. Aust. Mus. **15** (1926–1927) 31; Mem. Aust. Mus. pt. 2 **5** (1929–1930) 189.

Carangoides oblongus BLEEKER, Nat. Tijdschr. Ned. Ind. **1** (1851) 343; Verh. Bat. Gen. **24** (1852) 28, 62; Versl. Akad. Amsterdam **12** (1861) 53, 74; FOWLER, Proc. Acad. Nat. Sci. Phila. **57** (1905) 83; Copeia No. 58 (1918) 63; Proc. Acad. Nat. Sci. Phila. **79** (1927) 272; Mem. B. P. Bishop Mus. **10** (1928) 151.

Citula gracilis OGILBY, Mem. Queens. Mus. **3** (1915) 75.

Caranx (Citula) oblongus WAKIYA, Ann. Carnegie Mus. **15** (1923–1924) 175.

Caranx (Carangoides) oblongus WEBER and DE BEAUFORT, Fishes Indo-Aust. Arch. **6** (1931) 235.

Head 3.3; depth 2.1; dorsals VIII, I, 22 (with one procumbent spine); pectoral I, 21; anal II, I, 18; lateral line anteriorly arched, straightening below seventh ray of soft dorsal; 36 scutes posteriorly.

Body oblong, compressed, dorsal profile convex from snout to caudal peduncle, ventral profile oblique from chin to anal, then ascending posteriorly to beyond last ray of anal. Head large, its rostro-occipital outline convex. Mouth oblique, cleft below level of eye. Maxillary broad posteriorly, terminating below anterior half of eye. Jaws almost equal. Teeth in villiform bands in jaws, broadest anteriorly, some of outer series enlarged and conical; small patch of teeth on vomer, in a band on palatines and tongue. Snout blunt, slightly greater than eye diameter. Preorbital length equal to snout. Eye 3.7 in head, situated mostly on anterior half of head close to frontal profile. Interorbital space slightly less than eye diameter. Cheeks, temporal region, and upper portion of operculum scaly. Opercular opening wide, extending anteriorly below level of anterior border of eye. Gillrakers 19, the first four much shorter than the succeeding gillrakers. Scales wanting on breast, naked area extending beyond base of ventrals.

Spinous dorsal with a base 6 in body length. Spines slender, depressible in a groove, third spine longest. Soft dorsal origin closer to caudal base than to tip of snout. Pectoral broadly falciform, longer than head. Ventrals short, 3 in head. Anal inserted below level of sixth ray of soft dorsal. Anterior rays of soft dorsal and anal forming falcate lobes, second anterior ray of the former produced into a long filament, extending a little beyond caudal base posteriorly. Caudal widely forked, upper lobe slightly longer.

Alcoholic specimens deep brownish drab dorsally, olive-buff ventrally. Opercular spot obliterated.

Here described from specimen No. 2870, 150 mm in length, collected from Zamboanga, Mindanao, April 9, 1938.

CARANX (CARANGOIDES) CHRYSOPHRYS Cuvier and Valenciennes. Plate 6, fig. 1.

Caranx chrysophrys CUVIER and VALENCIENNES, Hist. Nat. Poiss. 9 (1833) 58; KNER, Zool. Fische 1–3 (1865–1867) 155; BOULENGER, Proc. Zool. Soc. London (1887) 661; SAUVAGE, Hist. Phys. Nat. Madagascar 16 (1891) 328; PELLEGRIN, Bull. Soc. Zool. France 39 (1914) 228; BARNARD, Ann. South African Mus. 21 (1927) 540; McCULLOCH, Mem. Aust. Mus. pt. 2 5 (1929–1930) 186.

Carangoides chrysophryoides BLEEKER, Nat. Tijdschr. Ned. Ind. 1 (1851) 343, 366; Verh. Bat. Gen. 24 (1852) 28, 63.

Caranx chrysophryoides GÜNTHER, Cat. Fish. Brit. Mus. 2 (1860) 452; PERUGIA, Ann. Mus. Civ. Stor. Nat. Genova II 7 (1889) 274; GILCHRIST and THOMPSON, Ann. South African Mus. 6 (1908) 242; FOWLER, Ann. Natal Mus. pt. 3 7 (1934) 423.

Citula chrysophrys BLEEKER, Ned. Tijdschr. Dierk. 4 (1873) 132; OGILBY, Mem. Queens. Mus. 3 (1915) 77.

Caranx nigrescens DAY, Proc. Zool. Soc. London (1867) 704; Fishes of India. Text 1 (1878–1888) 223; Fauna of British India. Fishes 2 (1889) 164.

Carangus armatus JORDAN and EVERMANN, Proc. U. S. Nat. Mus. 25 (1903) 338.

Caranx (Citula) chrysophrys WAKIYA, Ann. Carnegie Mus. 15 (1923–1924) 180.

Caranx (Carangoides) chrysophrys WEBER and DE BEAUFORT, Fishes Indo-Aust. Arch. 6 (1931) 239.

Head 2.9; depth 2; dorsals VIII, I, 21 (with one procumbent spine); pectoral I, 18; anal II, I, 18; lateral line arched anteriorly, quite parallel to dorsal contour of body, straightening below twelfth ray of soft dorsal, with 20 small scutes posteriorly.

Body ovate, strongly compressed; dorsal profile evenly rounded and more elevated than ventral, which is linear and moderately declivous between tip of mandible and ventral fins, feebly emarginate between ventrals and anal, thence acclivous to caudal peduncle. Head large, fronto-occipital profile convex. Mouth oblique, its cleft below level of eye. Maxillary broad, terminating below anterior border of eye. Lower jaw slightly protruding. Teeth villiform, in broad bands in jaws, outer series slightly enlarged, head of vomer with angular band of similar teeth, its shaft smooth; teeth in narrow bands in palatines and tongue. Snout rather blunt, greater than eye diameter. Preorbital length about equal to snout. Eye 3.3 in head. Adipose eyelid poorly developed. Interorbital space equal to diameter of eye. Cheeks, temples, and upper edge of opercles scaly. Opercular opening extending anteriorly below level of front margin of eye. Gillrakers 15, on outer anterior arch, first knoblike. Breast with naked area extending posteriorly beyond base of ventrals.

Spinous dorsal base 6 in standard length, spines feeble, third spine longest. Soft dorsal origin nearer to caudal base than to tip of snout. Pectorals falcate, longer than head. Ventrals about equal to snout. Anal inserted below level of eighth ray of soft dorsal. Anterior rays of soft dorsal and anal elevated into falcate lobes. Caudal deeply forked with equal lobes.

Alcoholic specimens brownish drab dorsally, olive-buff ventrally. Opercular spot dusky, diffused.

Above description based on specimen No. 31940, 225 mm long, collected from Malanao, Zamboanga Province, Mindanao, August 2, 1932.

This species closely resembles *Caranx* (*Carangoides*) *malabaricus* in general body form, but differs from the latter in having different fin formulæ, a less elevated nape, and a smaller number of gillrakers.

MINDANAO, Zamboanga Province, Dapitan, No. 15062, 195 mm, March 14, 1927.

CARANX (CARANGOIDES) MALABARICUS (Bloch and Schneider). Plate 6, fig. 2.

Scomber malabaricus BLOCH and SCHNEIDER, Syst. Ichthyol. (1801) 31.

Caranx cæruleopinnatus RÜPPELL, Atlas zu der Reise im Nördlichen Afrika. Zoologie 2 (1828) 100; Neue Wirbelthiere zu der Fauna von Abyssinien gehörig (1835–1840) 47.

Caranx malabaricus CUVIER and VALENCIENNES, Hist. Nat. Poiss. 9 (1833) 91; CANTOR, Journ. Roy. Asiat. Soc. Bengal 18 (1849) 1110; GÜNTHER, Cat. Fish. Brit. Mus. 2 (1860) 436; KNER, Zool. Fische 1–3 (1865–1867) 155; PLAYFAIR and GÜNTHER, Fishes of Zanzibar. London (1866) 60; KLUNZINGER, Verh. Kaiserl. Königl. Zool.-Bot. Ges. Wien 12 (1871) 463; DAY, Fishes of India. Text 1 (1878–1888) 221; Fauna of British India. Fishes 2 (1889) 163; MAC-

LEAY, Descr. Cat. Aust. Fishes. Sydney **1** (1881) 167; ELERA, Catalogo Systematico de toda la Fauna de Filipinas. Vertebrados 1 Peces (1895) 510; DUNCKER, Mitt. Naturh. Mus. Hamburg **21** (1904) 156; BEAN and WEED, Proc. U. S. Nat. Mus. 42 (1912) 600; WEBER, Die Fische der Siboga Expedition. Leiden (1913) 394; VINCIGUERRA, Ann. Mus. Civ. Stor. Nat. Genova **50** (1921–1926) 562; FOWLER and BEAN, Proc. U. S. Nat. Mus. art. 2 **62** (1923) 20; BARNARD, Ann. South African Mus. **21** (1927) 541; MCCULLOCH, Mem. Aust. Mus. pt. 2 **5** (1929–1930) 187; BORODIN, Bull. Vanderbilt Mar. Mus. art. 3 **1** (1932) 77; HERRE, Lingnan Sci. Journ. (3) **11** (1932) 434; Notes on fishes in the Zoological Museum of Stanford University (1934) 35.

Carangoides talamparah BLEEKER, Nat. Tijdschr. Ned. Ind. **1** (1851) 343; **2** (1851) 475; **3** (1852) 740, 745; Verh. Bat. Gen. **24** (1852) 29, 64; **25** (1853) 46.

Carangoides malabaricus BLEEKER, Nat. Tijdschr. Ned. Ind. **16** (1858–1859) 407; Versl. Akad. Amsterdam **12** (1861) 53, 74; FOWLER, Proc. Acad. Nat. Sci. Phila. **57** (1905) 83; **77** (1925) 216; **79** (1927) 272; Hongkong Naturalist **2** (1931) 293; OSHIMA, Philip. Journ. Sci. **26** (1925) 390.

Citula malabaricus BLEEKER, Ned. Tijdschr. Dierk. **4** (1873) 132.

Carangus malabaricus JORDAN and EVERMANN, Proc. U. S. Nat. Mus. **25** (1903) 337.

Caranx (Citula) malabaricus WAKIYA, Ann. Carnegie Mus. **15** (1923–1924) 178.

Caranx (Citula) cæruleopinnatus WAKIYA, Ann. Carnegie Mus. **15** (1923–1924) 179.

Caranx (Carangoides) malabaricus WEBER and DE BEAUFORT, Fishes Indo-Aust. Arch. **6** (1931) 237.

Caranx cæruleo-pinnatus HERRE, Notes on fishes in the Zoological Museum of Stanford University (1934) 35.

Head 2.8 to 3; depth 2; dorsals VIII, I, 22 or 23 (with one procumbent spine); pectoral I, 18 or 19; anal II, I, 18 or 19; lateral line arched anteriorly, straightening below twelfth dorsal ray; 21 to 28 weak scutes posteriorly.

Body oblong, dorsal profile strongly convex, ventral profile less convex from chin to base of anal. Head short, higher than long. Rostro-occipital profile convex, with a slight concavity in front of nostrils. Mouth oblique, its cleft commencing below level of eye. Maxillary extending beyond front border of eye. Lower jaw slightly prominent. Teeth in villiform bands on jaws, vomer, palatines, and tongue. Snout blunt, slightly greater than diameter of eye. Preorbital equal to eye. Eye large, 3 in head. Adipose eyelid poorly developed. Interorbital space less than eye with fronto-occipital keel. Infraorbital and postorbital scaled. Opercular opening terminating anteriorly below level of nostrils. Gillrakers 26 on lower anterior arch.

Breast broadly naked, posterior boundary of naked area formed by a line from base of pectorals to a point far beyond base of ventrals.

Spinous dorsal with a base 6.2 in standard length. Spines moderate, third spine longest. Soft dorsal origin nearer to caudal peduncle than to tip of snout. Pectorals broad-falcate, equal to or shorter than head. Ventrals rounded, equal to eye diameter. Soft dorsal inserted below level of fifth ray of soft dorsal. Anterior rays of soft dorsal and anal elevated. Caudal broadly forked.

Alcoholic specimens brownish drab dorsally, naples yellow ventrally. Opercular spot blackish.

Here described from specimen No. 6754, 135 mm long, collected from Manila, September 15, 1910.

LEYTE, Leyte Province, Carigara, No. 7839, 194 mm, No. 7882, 174 mm, No. 7883, 191 mm, No. 7884, 192 mm, November 10, 1913.

Foreign examples: Hongkong, No. 7764, 118 mm, No. 10978, 198 mm, August, 1910.

CARANX (CARANGOIDES) DINEMA Bleeker. Plate 6, fig. 3.

Carangoides dinema BLEEKER, Nat. Tijdschr. Ned. Ind. 1 (1851) **343**, 355, 365; Verh. Bat. Gen. 24 (1852) 28, 63.

Leioglossus carangoides BLEEKER, Nat. Tijdschr. Ned. Ind. 1 (1851) 343, 355, 367; Verh. Bat. Gen. 24 (1852) 30, 70; Versl. Akad. Amsterdam 12 (1851) 53.

Caranx lioglossus GÜNTHER, Cat. Fish. Brit. Mus. 2 (1860) **432**; KNER, Zool. Fische 1-3 (1865-1867) 156; BOULENGER, Proc. Zool. Soc. London (1892) 135.

Caranx dinema GÜNTHER, Cat. Fish. Brit. Mus. 2 (1860) 452.

Caranx (*Citula*) *dinema* WAKIYA, Ann. Carnegie Mus. 15 (1923-1924) 178.

Caranx carangoides FOWLER, Mem. B. P. Bishop Mus. 10 (1928) 146.

Caranx (*Carangoides*) *dinema* WEBER and DE BEAUFORT, Fishes Indo-Aust. Arch. 6 (1931) 241.

Head 3.2; depth 2.1; dorsals VIII, I, 19 (with one procumbent spine); pectoral I, 20; anal II, I, 17; lateral line straightening below twelfth dorsal ray with 23 scutes posteriorly.

Body oblong, dorsal profile convex, ventral almost straight from isthmus to origin of anal, thence acclivous to caudal peduncle. Head large, its rostro-occipital contour nearly in a straight line. Mouth oblique. Maxillary broad, posteriorly terminating about below center of eye. Lower jaw slightly longer. Teeth pluriseriate in jaws in young, in bands in vomer, palatines, and tongue. Posterior portion of preorbital half diameter of eye.

Snout pointed, 3.2 in head. Eye 3.6 in head length. Adipose eyelid poorly developed. Cheek and upper opercular scaled. Interorbital less than diameter of eye, with a prominent fronto-occipital ridge. Gillrakers 17. Breast inferiorly and partly on its sides naked.

Spinous dorsal base 6 in standard length, third spine longest, 3.3 in depth of body. Soft dorsal inserted midway between front margin of eye and root of caudal. Pectoral falcate, greater than body depth. Ventral short, longer than snout. Anal origin below eighth dorsal ray. Anterior rays of soft dorsal and anal produced into long filaments, anal extending beyond caudal peduncle. Caudal widely forked.

Alcoholic specimens brownish drab dorsally, forehead wood-brown, olive-buff ventrally. Fins gray except pectoral which is paler. Opercular spot dusky, almost obliterated.

This species in general shape of body closely resembles *Caranx* (*Carangoides*) *oblongus* Cuvier and Valenciennes, but differs from the latter in having fewer scutes in the lateral line.

Here described from specimen No. 14724, 250 mm long, collected from Inabañga, Bohol, December 10, 1926.

MINDORO, Mindoro Province, Naujan, Barrio Estrella, No. 31945, 280 mm, May 19, 1939.

Subgenus CARANX Bleeker, 1851

Caranx BLEEKER, Nat. Tijdschr. Ned. Ind. **1** (1851) 352; **8** (1855) 417; Verh. Bat. Gen. **24** (1852) 56.

Body oblong, compressed, occipital region elevated. Lower jaw prominent, upper jaw terminating below or beyond center of eye. Adipose eyelid slightly developed. Breast totally scaled, or ventrally naked, with a small central patch of minute scales in front of base of ventrals. Lateral line moderately or strongly arched anteriorly. Straight portion entirely armed with scutes. Teeth in upper jaw in a villiform band, with an outer series of stronger teeth; lower jaw with a single series of middle-sized teeth, two to four anterior teeth strong and canine-like. Vomer, palatines, and tongue toothed. Anterior rays of soft dorsal and anal forming a falcate lobe; none of the rays filiform.

Key to the Philippine species of subgenus Caranx.

a[1]. Breast totally scaled.

b[1]. Dorsals VIII, I, 20 to 22; anal II, I, 16 or 17. Straight lateral line commencing below fourth or fifth ray of soft dorsal; 30 to 33 scutes. *C. sexfasciatus*.

b[2]. Dorsals VIII, I, 23 or 24; anal II, I, 18 to 20. Straight lateral line starting below seventh ray of soft dorsal, armed with 30 to 34 scutes. Numerous dark spots profusely scattered on sides.
C. stellatus.

a[2]. Breast ventrally and partly laterally naked, with a small median patch of minute scales before ventrals.

b[1]. Dorsals VIII, I, 19 or 20; anal II, I, 16 or 17. Straight lateral line beginning below sixth or seventh ray of soft dorsal; 28 to 32 scutes.
C. ignobilis.

b[2]. Dorsals VIII, I, 21 or 22; anal II, I, 16 to 18. Straight lateral line starting below fifth or sixth ray of soft dorsal; 33 to 37 scutes.
C. carangus.

CARANX (CARANX) SEXFASCIATUS Quoy and Gaimard. Simbad, muslo. Plate 7, fig. 1.

Caranx sexfasciatus QUOY and GAIMARD, Voyage autour du Monde. Paris (1824) 358; CUVIER and VALENCIENNES, Hist. Nat. Poiss. 9 (1833) 83; JORDAN and SEALE, Bull. U. S. Bur. Fish. 25 [1905 (1906)] 231; 26 [1906 (1907)] 14; EVERMANN and SEALE, Bull. U. S. Bur. Fish. 26 [1906 (1907)] 65; SEALE and BEAN, Proc. U. S. Nat. Mus. 33 (1907) 241; SEALE, Philip. Journ. Sci. § D 5 (1910) 270; FOWLER, Copeia No. 58 (1918) 63; Proc. Acad. Nat. Sci. Phila. 77 (1925) 216; 79 (1927) 270; Mem. B. P. Bishop Mus. 10 (1928) 149; Monog. No. 2 Acad. Nat. Sci. Phila. (1938) 278; WAKIYA, Ann. Carnegie Mus. 15 (1923–1924) 184; HERRE, Journ. Pan-Pacif. Res. Inst. (4) 8 (1933) 3; (2) 10 (1935) 164; Notes on fishes in the Zoological Museum of Stanford University (1934) 35; Field Mus. Nat. Hist. Chicago 21 (1936) 115.

Caranx forsteri CUVIER and VALENCIENNES, Hist. Nat. Poiss. 9 (1833) 81; RICHARDSON, Ann. & Mag. Nat. Hist. 11 (1843) 28; CANTOR, Journ. Roy. Asiat. Soc. Bengal 18 (1849) 1109; BLEEKER, Nat. Tijdschr. Ned. Ind. 1 (1851) 342, 346; 2 (1851) 210, 213; 3 (1852) 741; 8 (1855) 170, 393, 398, 447; Verh. Bat. Gen. 24 (1852) 25, 57; 25 (1853) 44; Versl. Akad. Amsterdam 12 (1861) 52, 74; KNER, Zool. Fische 1–3 (1865–1867) 158; SAUVAGE, Hist. Phys. Nat. Pol. Madagascar 16 (1891) 329; JORDAN and SEALE, Proc. U. S. Nat. Mus. 28 (1905) 775; Bull. U. S. Bur. Fish. 25 [1905 (1906)] 230; 26 [1906 (1907)] 13; SEALE, Occ. Pap. B. P. Bishop Mus. 4 (1906) 30; SMITH and SEALE, Proc. Biol. Soc. Washington 19 (1906) 76; JORDAN and RICHARDSON, Bull. U. S. Bur. Fish. 27 [1907 (1908)] 250; KENDALL and GOLDSBOROUGH, Mem. Mus. Comp. Zool. Harvard 26 (1911) 268; BEAN and WEED, Proc. U. S. Nat. Mus. 42 (1912) 598; WEBER, Die Fische der Siboga Expedition. Leiden (1913) 395; OSHIMA, Philip. Journ. Sci. 26 (1925) 377; BARNARD, Ann. South African Mus. 21 (1927) 543; PARADICE and WHITLEY, Mem. Queens. Mus. 9 (1927–1929) 82; MCCULLOCH, Mem. Aust. Mus. pt. 2 5 (1929–1930) 188; HERRE, Journ. Pan-Pacif. Res. Inst. (4) 8 (1933) 3, 7; (2) 10 (1935) 164.

Caranx belengerii CUVIER and VALENCIENNES, Hist. Nat. Poiss. 9 (1833) 87; BLEEKER, Verh. Bat. Gen. 25 (1853) 44; PETERS, Monats. Akad. Wiss. Berlin (1855) 438.

Caranx flavocæruleus TEMMINCK and SCHLEGEL, Fauna Japonica **3** (1842) 110; BLEEKER, Veıh. Bat. Gen. **25** (1853) 14.

Caranx hippos GÜNTHER, Cat. Fish. Brit. Mus. **2** (1860) 449; Fische der Südsee **2** (1876–1881) 131; DAY, Proc. Zool. Soc. London (1865) 23; (1870) 688; Fishes of Malabar (1865) 86; Fishes of India. Text 1 (1878–1888) 216; Fauna of British India. Fishes 2 (1889) 154; PLAYFAIR and GÜNTHER, Fishes of Zanzibar. London (1866) 61; MACLEAY, Descr. Cat. Aust. Fishes. Sydney **1** (1881) 170; JORDAN and GILBERT, Proc. U. S. Nat. Mus. **6** [1883 (1884)] 200; MEYER, Ann. Soc. Españ. Hist. Nat. Madrid **14** (1885) 25; BOULENGER, Proc. Zool. Soc. London (1887) 661; SAUVAGE, Hist. Phys. Nat. Pol. Madagascar **16** (1891) 325; ELERA, Catálogo Systematico de toda la Fauna de Filipinas. Vertebrados **1** Peces (1895) 510; JORDAN and EVERMANN, Bull. U. S. Nat. Mus. **47** (1896) 920; Rept. U. S. Fish Comm. **21** [1895 (1896)] 346; DUNCKER, Mitt. Naturh. Mus. Hamburg **21** (1904) 156; FOWLER, Proc. Acad. Nat. Sci. Phila. **57** (1905) 76; **79** (1927) 270; Bull. Amer. Mus. Nat. Hist. pt. 2 **70** (1936) 696; GILCHRIST and THOMPSON, Ann. South African Mus. **6** (1908) 240; PELLEGRIN, Bull. Soc. Zool. France **39** (1914) 228; VINCIGUERRA, Ann. Mus. Civ. Stor. Nat. Genova **50** (1921–1926) 561; OSHIMA, Philip. Journ. Sci. **26** (1925) 374; BORODIN, Bull. Vanderbilt Mar. Mus. art. 1 **1** (1928) 18; JORDAN, EVERMANN, and CLARK, Rept. U. S. Comm. Fish. pt. 2 (1930) 273.

Carangus hippos GILL, Proc. Acad. Nat. Sci. Phila. **14** [1862 (1863)] 434; BLEEKER, Ned. Tijdschr. Dierk. **4** (1873) 131; GOODE, Bull. U. S. Fish Comm. **1** [1881 (1882)] 34.

Caranx hippus KLUNZINGER, Verh. Kaiserl. Königl. Zool.-Bot. Ges. Wien **21** (1871) 465; Sitzgsber. Akad. Wien **80** (1880) 377; GOODE and BEAN, Proc. U. S. Nat. Mus. **5** (1882) 237.

Caranx marginatus JORDAN and EVERMANN, Bull. U. S. Nat. Mus. **47** (1896) 922; Rept. U. S. Fish Comm. **21** [1895 (1896)] 346; FOWLER, Proc. Acad. Nat. Sci. Phila. **57** (1905) 81; JORDAN and SEALE, Bull. U. S. Bur. Fish. **25** [1905 (1906)] 231; JORDAN and JORDAN, Mem. Carnegie Mus. **10** (1922–1925) 39; JORDAN, Proc. U. S. Nat. Mus. art. 33 **66** (1925) 15; HERRE, Philip. Journ. Sci. **34** (1927) 294, 303; WALFORD, Marine game fishes of the Pacific coast from Alaska to the equator (1937) 74.

Caranx flavocæruleus JORDAN and SNYDER, Proc. U. S. Nat. Mus. **23** (1901) 353.

Carangus sexfasciatus JORDAN and EVERMANN, Proc. U. S. Nat. Mus. **25** (1903) 337.

Carangus elacate JORDAN and EVERMANN, Bull. U. S. Fish Comm. **22** [1902 (1904)] 177; **23** [1903 (1905)] 190.

Carangus marginatus JENKINS, Bull. U. S. Fish Comm. **22** [1902 (1904)] 444; JORDAN and EVERMANN, Bull. U. S. Fish Comm. **23** [1903 (1905)] 191.

Carangus rhabdotus JENKINS, Bull. U. S. Fish Comm. **22** [1902 (1904)] 444; JORDAN and EVERMANN, Bull. U. S. Fish Comm. **23** [1903 (1905)] 192.

Caranx elacate JORDAN and SEALE, Bull. U. S. Bur. Fish. 25 [1905 (1906)] 231; JORDAN and JORDAN, Mem. Carnegie Mus. 10 (1922–1925) 40; FOWLER, Mem. B. P. Bishop Mus. 10 (1928) 147.

Tricropterus forsteri JORDAN and STARKS, Ann. Carnegie Mus. 11 (1917) 442.

Caranx rhabdotus JORDAN and JORDAN, Mem. Carnegie Mus. 10 (1922–1925) 39.

Selar sexfasciatus OSHIMA, Philip. Journ. Sci. 26 (1925) 382.

Caranx (*Caranx*) *sexfasciatus* WBBER and DE BEAUFORT, Fish. Indo-Aust. Arch 6 (1931) 243; HARDENBERG, Treubia 15 (1936) 246.

Head 3.2; depth 2.5 to 2.9; dorsals VIII, I, 20 to 22 (with one procumbent spine); pectoral I, 19; anal II, I, 16; lateral line strongly arched, straightening below fourth or fifth dorsal ray; 30 to 33 scutes.

Body oblong, compressed, dorsal profile more convex than ventral. Head large, rostronuchal contour slightly convex. Mouth oblique, its cleft opposite pectoral base. Maxillary broad, terminating below posterior border of pupil. Lower jaw prominent. Teeth in narrow band in upper jaw with an outer series of larger teeth, in single series in lower. Teeth in triangular patch in vomer, in narrow bands in palatines and tongue. Snout rather pointed, 3.3 to 3.7 in head. Eye 4 in head. Posterior portion of adipose eyelid fairly developed, barely covering posterior margin of pupil. Interorbital convex, with a low frontonuchal keel. Cheek, postorbital, and upper anterior border of opercular scaled. Opercular opening extending to below level of front margin of eye. Gillrakers slender, anteroposteriorly flattened, 16 or 17, first gillraker rudimentary or tuberclelike.

Spinous dorsal with a base, 6 in standard length. Spines weak, third spine longest, last spine stout and quite isolated from preceding spines. Soft dorsal origin midway between middle of eye and caudal base. Pectoral falcate, longer than head, its tip reaching fifth or sixth anal ray when depressed. Ventrals short, concealing vent in young, its tips scarcely reaching anus in adult. Anal inserted below sixth dorsal ray.

Here described from specimen No. 20613, 242 mm long, collected in Lake Bato, Camarines Sur, September 22, 1924.

LUZON, Pangasinan Province, Alaminos, No. 9669, 70 mm. No. 20701, 69 mm, 1921: Rizal Province, Malabon, No. 738, 70 mm, July 18, 1907; Pasay, No. 12134, 175 mm: Batangas Province, Lake Bombon, No. 12525, 211 mm, No. 20589, 222 mm, November 8, 1925; San Nicolas, Pansipit, No. 12968, 139 mm, January 9, 1926, No. 12955, 245 mm, January 10, 1926:

Camarines Sur Province, Lake Bato, No. 11221, 222 mm, No. 20613, 242 mm, September 22, 1924; Barrio Sibubu, San Miguel Bay, No. 20711, 215 mm, January 17 to 19, 1926. MINDORO, Mindoro Province, Calapan, No. 10341, 210 mm, January 9, 1923, No. 12492, 215 mm, February, 1925; Butas River, Naujan, No. 20593, 308 mm, No. 20594, 310 mm, April 8, 1927; Naujan, No. 11509, 178 mm, No. 20755, 93 mm, 1913. BOHOL, Bohol Province, Loay, No. 20751, 142 mm, No. 20752, 102 mm, No. 15059, 116 mm, November 19, 1926. NEGROS, Oriental Negros Province, Tolong, No. 13913, 211 mm, March 1, 1926. SIQUIJOR, No. 1406, 73 mm, No. 1407, 94 mm, September 16, 1927. SAMAR, Samar Province, Catbalogan, No. 31794, 210 mm, March 3, 1932. PANAY, Iloilo Province, Estancia, No. 10438, 365 mm, June 6, 1922. MINDANAO, Agusan Province, Butuan, No. 1803, 160 mm, September 19, 1907: Davao Province, Davao, No. 3466, 110 mm, No. 3359, 96 mm, April 24 to 26, 1908: Zamboanga Province, Caldera Bay, No. 4040, 105 mm, May 20, 1908.

Foreign specimens: Hongkong, No. 10805, 150 mm, No. 20560, 135 mm, 1910; Honolulu, No. 7412, 115 mm, No. 7407, 92 mm, No. 7415, 92 mm, No. 7416, 70 mm, No. 20556, 58 mm.

CARANX (CARANX) STELLATUS Eydoux and Souleyet. Talakitok. Plate 7, fig. 2.

Caranx stellatus EYDOUX and SOULEYET, Voyage autour du monde execute pendant les annees 1836 et 1837 sur la corvette "La Bonite" commandee par M. Vaillant (1841) 167; GÜNTHER, Cat. Fish. Brit. Mus. 2 (1860) 436; JORDAN and JORDAN, Mem. Carnegie Mus. 10 (1922–1925) 40; JORDAN, Proc. U. S. Nat. Mus. art. 33 66 (1925) 15; MCCULLOCH, Rec. Aust. Mus. 15 (1926–1927) 33; Mem. Aust. Mus. pt. 2 5 (1929–1930) 187; JORDAN, EVERMANN, and TANAKA, Proc. Cal. Acad. Sci. 16 (1927–1928) 655; HERRE, Journ. Pan-Pacif. Res. Inst. (4) 8 (1933) 7; Field Mus. Nat. Hist. Chicago 21 (1936) 116; WALFORD, Marine game fishes of the Pacific coast from Alaska to the equator (1937) 75; FOWLER, Monog. No. 2 Acad. Nat. Sci. Phila. (1938) 278.

Caranx punctatus CUVIER and VALENCIENNES, Hist. Nat. Poiss. 9 (1833) 29; BLEEKER, Verh. Bat. Gen. 25 (1853) 44.

Caranx melampygus GÜNTHER, Fische der Südsee 2 (1876–1881) 133; DAY, Fishes of India. Text 1 (1878–1888) 214; JORDAN and SEALE, Bull. U. S. Bur. Fish. 25 [1905 (1906)] 230.

Carangus melampygus JORDAN and EVERMANN, Bull. U. S. Fish Comm. 23 (1903–1905) 192.

Xurel melampygus JORDAN, EVERMANN, and CLARK, Rept. U. S. Comm. Fish. pt. 2 (1930) 272.

Xurel stellatus JORDAN, EVERMANN, and CLARK, Rept. U. S. Comm. Fish. pt. 2 (1930) 273.

Caranx (Caranx) stellatus WEBER and DE BEAUFORT, Fish. Indo-Aust. Arch. 6 (1931) 253.

Head 3.3; depth 2.7; dorsals VIII, I, 23 (preceded by a procumbent spine); pectoral I, 20; anal II, I, 19; lateral line straightening below seventh ray of soft dorsal, with 34 scutes posteriorly.

Body somewhat short, compressed; dorsal profile elevated, in middle more or less straight to soft dorsal, thence descending to caudal peduncle; ventral profile nearly straight to anal base, ascending posteriorly. Head large, its length nearly equal to its depth; rostro-occipital outline nearly straight. Mouth terminal, its cleft opposite junction of interopercle and subopercle. Maxillary reaching middle of eye or slightly beyond. Lower jaw slightly greater than upper. Teeth in upper jaw in a narrow villiform band with an outer row of conical teeth; a single row of somewhat weak conical teeth in lower jaw; a triangular patch on vomer, in broad band in palatines, and in narrow median band in tongue. Snout blunt, 2.6 in head. Eye 6 in head length, situated above axis of body in middle of head. Interorbital space convex and trenchant, shorter than snout. Infraorbital, postorbital, upper opercular, and nuchal region scaled. Opercular opening extending anteriorly below level of anterior margin of eye. Gillrakers 17. Breast totally scaled.

Spinous dorsal base 5.9 in body length. Spines weak, third spine longest, about 4 in head. Soft dorsal base nearer caudal base than tip of snout. Anal origin inserted below third ray of soft dorsal. Anterior rays of soft dorsal and anal forming an elevated lobe, both with a scaly sheath. Pectoral falcate, longer than head. Ventrals short, inserted below pectorals. Caudal widely forked.

Alcoholic specimens olive-brown, with numerous dusky spots dorsally.

Above description based on specimen No. 13977, 500 mm, collected from Bungao, Sulu, April 9, 1926.

CARANX (CARANX) IGNOBILIS (Forskål). Maliputo. Plate 7, fig. 3.

Scomber ignobilis FOWLER, Descriptiones Animalium. Pisces (1775) 55.

Caranx sansun RÜPPELL, Atlas zu der Reise im Nördlichen Afrika. Zoologie 2 (1828) 101; Neue Wirbelthiere zu der Fauna von Abyssinien gehörig (1835–1840) 48; GÜNTHER, Cat. Fish. Brit. Mus. 2 (1860) 447; KLUNZINGER, Verh. Kaiserl. Königl. Zool.-Bot. Ges. Wien 21 (1871) 466; DAY, Fishes of India. Text 1 (1878–1888) 216; Fauna of British India. Fishes 2 (1889) 155.

Caranx ignobilis KLUNZINGER, Sitzgsber. Akad. Wien 80 (1880) 377; JORDAN and SEALE, Bull. U. S. Bur. Fish. 25 [1905 (1906)] 231; 26 [1906 (1907)] 14; JORDAN and RICHARDSON, Bull. U. S. Bur.

Fish. 27 [1907 (1908)] 250; SEALE, Philip. Journ. Sci. § A 3 (1908) 517; KENDALL and GOLDSBOROUGH, Mem. Mus. Comp. Zool. Harvard 26 (1911) 269; WEBER, Die Fische der Siboga Expedition. Leiden (1913) 398; FOWLER, Copeia No. 58 (1918) 63; Proc. Acad. Nat. Sci. Phila. 77 (1925) 215; Mem. B. P. Bishop Mus. 10 (1928) 148; Monog. No. 2 Acad. Nat. Sci. Phila. (1938) 221; JORDAN and JORDAN, Mem. Carnegie Mus. 10 (1922–1925) 39; WAKIYA, Ann. Carnegie Mus. 15 (1923–1924) 193; JORDAN, Proc. U. S. Nat. Mus. art. 33 66 (1925) 16; BARNARD, Ann. South African Mus. 21 (1927) 545; HERRE, Philip. Journ. Sci. 34 (1927) 294; Journ. Pan-Pacif. Res. Inst. (4) 8 (1933) 3, 7; Notes on fishes in the Zoological Museum of Stanford University (1934) 35; Field Mus. Nat. Hist. Chicago 21 (1936) 113; MCCULLOCH, Mem. Aust. Mus. pt. 2 5 (1929–1930) 186; JORDAN, EVERMANN, and CLARK, Rept. U. S. Comm. Fish. pt. 2 (1930) 273; GILTAY, Mem. Mus. Roy. Hist. Nat. Belg. Hors. V 3 (1933) 59.

Carangus hippoides JENKINS, Bull. U. S. Fish Comm. 22 [1902 (1904)] 443.

Carangus ignobilis JORDAN and EVERMANN, Bull. U. S. Fish Comm. 23 [1903 (1905)] 188.

Selar ignobilis OSHIMA, Philip. Journ. Sci. 26 (1925) 383.

Caranx (*Caranx*) *ignobilis* WEBER and DE BEAUFORT, Fish. Indo-Aust. Arch. 6 (1931) 255; HARDENBERG, Treubia 15 (1935) 135.

Head 3; depth 2.2; dorsals VIII, I, 19 (with one procumbent spine); pectoral I, 19; anal II, I, 16; lateral line moderately arched, straightening below seventh dorsal ray; 32 scutes.

Body oblong, compressed, dorsal profile strongly convexed, ventral profile almost straight from below symphysis of mandible to base of anal, thence acclivous to caudal peduncle. Head higher than long, its rostro-occipital contour convex. Mouth oblique, its cleft far below level of eye, opposite base of pectoral. Maxillary broad posteriorly, terminating beyond middle of eye. Jaws nearly equal. Teeth villiform, upper jaw with an outer row of enlarged teeth, lower jaw with a single row of irregularly sized teeth with a pair of small canines at symphysis; villiform in vomer, palatines, and tongue. Snout obtuse, 2.9 in head. Posterior part of preorbital 1.4 in eye. Eye 3.4 to 4.1, mostly on anterior half of head, above longitudinal axis of body. Interorbital convex, greater than eye. Adipose eyelid moderately developed. Cheeks, postorbital, upper opercular, and nuchal region with minute scales. Opercular opening wide, extending in front of vertical line through nostrils and anterior border of eye. Gillrakers 16, first three knoblike and rudimentary. Breast naked ventrally with a very small patch of minute scales in front of base of ventrals.

Spinous dorsal base 5.8 in standard length, third spine longest. Soft dorsal originating midway between nostrils and caudal base. Pectorals longer than head, falcate, reaching fourth anal ray when depressed. Ventrals short, 2.2 in head. Anal inserted below fifth ray of soft dorsal. Anterior rays of soft dorsal and anal elevated, somewhat falciform. Caudal widely forked, with 22 rays.

Alcoholic specimens cinnamon-drab dorsally, silvery below. Opercular spot obscure.

Above description based on specimen No. 20754, 170 mm long, collected from Mangarin, Mindoro, 1913.

LUZON, Manila Bay, off Pasay, No. 15259, 55 mm, December, 1920: Manila, Legaspi Landing, No. 12929, 321 mm, November, 1924: Batangas Province, Taal, Lake Bombon, No. 15259, 540 mm, March 9, 1927. MINDORO, Mindoro Province, Calapan, No. 14104, 185 mm, December, 1925, No. 9426, 290 mm, January 27, 1921, No. 14831, 230 mm, January, 1921.

CARANX (CARANX) CARANGUS Bloch. Plate 8, fig. 1.

Scomber carangus BLOCH, Ichthyologie. Hist. Nat. Poiss. pt. 10 (1797) 58; BLOCH and SCHNEIDER, Systema Ichthyologiae (1801) 28; BENNETT, Narrative of a whaling voyage round the globe from 1833 to 1836. Fishes 2 (1840) 282.

Caranx carangue LACÉPÈDE, Hist. Nat. Poiss. Paris 3 (1819) 227.

Caranx carangus CUVIER and VALENCIENNES, Hist. Nat. Poiss. 9 (1833) 68; GÜNTHER, Cat. Fish. Brit. Mus. 2 (1860) 448; KNER, Zool. Fische 1–3 (1865–1867) 157; PETERS, Monatsb. Akad. Berlin [1875 (1876)] 914; DAY, Fishes of India. Text 1 (1878–1888) 215; Fauna of British India. Fishes 2 (1889) 153; MEYER, Ann. Soc. Españ. Hist. Nat. Madrid 14 (1885) 25; SAUVAGE, Hist. Phys. Nat. Pol. Madagascar 16 (1891) 325; SMITH and SEALE, Proc. Biol. Soc. Washington 19 (1906) 76; SEALE and BEAN, Proc. U. S. Nat. Mus. 33 (1907) 242; GILCHRIST and THOMPSON, Ann. South African Mus. 6 (1908) 241; REGAN, Trans. Zool. Soc. London 20 (1914) 276; HORA, Mem. Asiat. Soc. Bengal (2) 6 (1924) 484; BERNARD, Ann. South African Mus. 21 (1927) 545.

Caranx xanthopygus CUVIER and VALENCIENNES, Hist. Nat. Poiss. 9 (1833) 82; WAKIYA, Ann. Carnegie Mus. 15 (1923–1924) 186; JORDAN, Proc. U. S. Nat. Mus. art. 33 66 (1925) 16.

Caranx ekala CUVIER and VALENCIENNES, Hist. Nat. Poiss. 9 (1833) 88; BLEEKER, Nat. Tijdschr. Ned. Ind. 1 (1851) 343; 8 (1855) 398; Verh. Bat. Gen. 24 (1852) 25, 59; 25 (1853) 44; Versl. Akad. Amsterdam 12 (1861) 52; Ned. Tijdschr. Dierk. 4 (1873) 116, 131.

Caranx (*Caranx*) *carangus* WEBER and DE BEAUFORT, Fishes Indo-Aust. Arch. 6 (1931) 257

Head 4.3; depth 3.5; dorsals VIII, I, 21 or 22 (with one procumbent spine); pectorals I, 19; anal II, I, 17; lateral line arched anteriorly, straightening below sixth dorsal ray, with 34 to 36 scutes.

Body oblong, compressed, dorsal profile convex from nape to caudal peduncle, ventral profile almost straight from isthmus to origin of anal, thence ascending obliquely to caudal peduncle. Mouth oblique, its cleft below level of eye. Maxillary broad, terminating beyond center of eye. Lower jaw slightly longer than upper. Teeth in narrow band, in upper jaw with an outer row of larger teeth; in lower jaw with a single series, intermixed with large teeth, two pairs of caniniform teeth at symphysis; vomer with triangular patch of villiform teeth, in narrow bands in palatine and tongue. Snout pointed, 3 in head. Eye 4.4 to 5.5. Adipose eyelid poorly developed. Posterior portion of preorbital less than eye diameter. Cheeks, postorbital, upper opercular scaled. Interorbital space convex, less than snout. Opercular opening wide, extending in front of level of anterior margin of eye. Gillrakers 18. Breast with elongate, narrow, ventral, naked area; circular patch of scales in front of base of ventrals present.

Spinous dorsal base 7.4 in standard length. Spines weak, fourth spine longest. Soft dorsal origin nearer base of caudal than tip of snout. Anterior rays of soft dorsal like those of anal, forming a falciform lobe. Pectorals longer than head, its tip reaching fourth ray of anal when depressed. Ventrals 2 in head, extending to middle of vent. Anal inserted below level of seventh soft dorsal ray. Preanal spines unequal, second spine stouter and longer than first. Caudal lobes acute and equal.

Alcoholic specimens generally brown. Opercular spot indistinct.

Above description based on specimen No. 13978, 582 mm, collected from Bungao, Sulu Province, Mindanao, April 9, 1926.

Subgenus SELAROIDES Bleeker, 1851

Selaroides BLEEKER, Nat. Tijdschr. Ned. Ind. 1 (1851) 352; Verh. Bat. Gen. 24 (1852) 71, 87.

Body oblong, elongate, compressed. Head pointed. Lower jaw slightly prominent. Upper jaw, vomer, and palatines without teeth; lower jaw with a single series of minute teeth; teeth on tongue rudimentary. Breast scaled. Lateral line only very slightly arched anteriorly, becoming straight below tenth ray of soft dorsal; 23 to 30 scutes. Anterior rays of soft dorsal and anal somewhat elevated.

CARANX (SELAROIDES) LEPTOLEPIS Cuvier and Valenciennes. Salay-salay batan; Salay-salay habagat. Plate 8, fig. 2.

Caranx leptolepis CUVIER and VALENCIENNES, Hist. Nat. Poiss. 9 (1833) 48; CANTOR, Journ. Roy. Asiat. Soc. Bengal 18 (1849) 1108; BLEEKER, Nat. Tijdschr. Ned. Ind. 1 (1851) 346; GÜNTHER, Cat. Fish. Brit. Mus. 2 (1860) 440; MACLEAY, Descr. Cat. Aust. Fishes. Sydney 1 (1881) 168; DAY, Fishes of India. Text 1 (1878–1888) 225; Fauna of British India. Fishes 2 (1889) 167; BOULENGER, Proc. Zool. Soc. London (1889) 240; ELERA, Catalogo Systematico de toda la Fauna de Filipinas. Vertebrados 1 Peces (1895) 510; DUNCKER, Mitt. Naturh. Mus. Hamburg 21 (1904) 156; JORDAN and RICHARDSON, Bull. U. S. Bur. Fish. 27 [1907 (1908)] 250; BEAN and WEED, Proc. U. S. Nat. Mus. 42 (1912) 599; WEBER, Die Fische der Siboga Expedition. Leiden (1913) 397; FOWLER, Copeia No. 58 (1918) 63; MCCULLOCH, Mem. Queens. Mus. 8 (1924–1926) 72; Mem. Aust. Mus. pt. 2 5 (1929–1930) 188.

Selaroides leptolepis BLEEKER, Nat. Tijdschr. Ned. Ind. 1 (1851) 343; 2 (1851) 213, 475; 3 (1852) 741, 745; Versl. Akad. Amsterdam 12 (1861) 53; HERRE, Notes on fishes in the Zoological Museum of Stanford University (1934) 35.

Leptaspis leptolepis BLEEKER, Verh. Bat. Gen. 24 (1852) 30, 71; OSHIMA, Philip. Journ. Sci. 26 (1925) 387.

Caranx cheverti MACLEAY, Descr. Cat. Aust. Fishes. Sydney 1 (1881) 169.

Carangus leptolepis JORDAN and EVERMANN, Proc. U. S. Nat. Mus. 25 (1903) 337.

Caranx (Selaroides) leptolepis WAKIYA, Ann. Carnegie Mus. 15 (1923–1924) 208; WEBER and DE BEAUFORT, Fishes Indo-Aust. Arch. 6 (1931) 262.

Gnathanodon leptolepis FOWLER, Proc. Acad. Nat. Sci. Phila. 79 (1927) 271; Mem. B. P. Bishop Mus. 10 (1928) 150.

Head 3.4; depth 2.7; dorsals VIII, I, 24 or 25 (with one procumbent spine); pectoral I, 19; ventral I, 5; anal II, I, 21; caudal 20; lateral straightening below tenth dorsal ray, with 23 scutes posteriorly.

Body oblong-elongate, dorsal profile and ventral contour equally convex; head pointed, its length greater than its height. Mouth oblique, cleft opposite center of eye. Maxillary reaches a little beyond front border of eye. Teeth wanting in upper jaw, vomer, and palatines; lower jaw with a single series of minute teeth; more or less rudimentary in tongue. Posterior margin of preorbital less than diameter of pupil. Snout pointed, almost equal to eye. Eye moderate, 3 to 3.6 in head. Interorbital space convex, about equal to eye diameter. Adipose eyelid fairly developed, pupil partly covered posteriorly. Opercular opening wide, extending in front of level of anterior margin of eye. Gillrakers slender and finely tuberculated, 31 on anterior arch.

Spinous dorsal base 8.5 in standard length, spines weak, third spine longest, 2.6 in depth of body. Soft dorsal origin slightly ahead of anal. Anal inserted below second dorsal ray. Dorsal and anal with scaly basal sheath. Pectorals falcate, longer than head. Ventrals short, 2.6 in head length, tip extending midway between its base and origin of anal. Caudal forked, lobes equal.

Fresh specimens Russian green above and silvery below, with a wax-yellow band running subhorizontally from upper border of eye to caudal peduncle. Basal scaly sheath of dorsal and anal with minute dusky spots. Fins hyaline. A distinct opercular spot encroaching well on shoulder.

Above description based on specimen No. 41336, 126 mm long, collected on the west coast of Guimaras Island, November 18, 1933.

LUZON, Manila, Divisoria market, No. 6752, 143 mm, June, 1910, No. 10790, 123 mm, No. 11052, 124 mm, No. 20623, 118 mm, No. 20624, 121 mm, No. 20769, 116 mm, No. 20770, 123 mm, No. 20771, 128 mm, No. 20772, 130 mm, No. 20773, 119 mm, No. 20774, 119 mm, June 12, 1924, No. 15052, 128 mm, No. 20568, 148 mm, No. 20569, 135 mm, April 7, 1927. SAMAR, Samar Province, Basey, San Pedro Bay, No. 12361, 103 mm, No. 20649, 98 mm, September 17, 1925. LEYTE, Leyte Province, Carigara, No. 15056, 156 mm, December 1, 1926. PANAY, Antique Province, No. 41122, 141 mm, December 15, 1933. CEBU, Cebu Province, Cebu, No. 12238, 100 mm, No. 20691, 99 mm, No. 20692, 105 mm, No. 20693, 107 mm, No. 20694, 106 mm, No. 20695, 95 mm, No. 20696, 98 mm, No. 20697, 105 mm, No. 20698, 103 mm, No. 20699, 97 mm, No. 20700, 94 mm, September 15, 1925. NEGROS, Occidental Negros Province, Sicaba, Cadiz Nuevo, No. 31942, 136 mm.

Subgenus GNATHANODON Bleeker, 1851

Gnathanodon BLEEKER, Nat. Tijdschr. Ned. Ind. 1 (1851) 352; 8 (1855) 418; Verh. Bat. Gen. 24 (1852) 30, 72.

Body oblong, compressed. Head large. Eye above longitudinal axis of body, in middle of head. Lower jaw slightly shorter, upper jaw strongly protractile into a subhorizontal tube. Teeth wanting in both jaws; tongue rough, with minute denticulation. Scales small. Lateral line moderately arched anteriorly, posterior part with 15 feeble scutes. Anterior dorsal and anal rays forming elevated but not falcate lobe.

CARANX (GNATHANODON) SPECIOSUS Forskål. Talakitok. Plate 8, fig. 3.

Scomber rim, speciosus FORSKÅL, Descriptiones Animalium. Pisces (1775) 54.

Scomber speciosus BLOCH and SCHNEIDER, Systema Ichthyologiae (1801) 31.

Caranx speciosus RÜPPELL, Atlas zu der Reise im Nördlichen Afrika. Zoologie 2 (1828) 96; CUVIER and VALENCIENNES, Hist. Nat. Poiss. 9 (1833) 97; RICHARDSON, Ann. & Mag. Nat. Hist. 11 (1843) 28; Ichthyol. Voy. H.M.S. "Erebus" and "Terror." London (1844) 136; CANTOR, Journ. Roy. Asiat. Soc. Bengal 18 (1849) 1115; PETERS, Monatsb. Akad. Wiss. Berlin (1855) 438; GÜNTHER, Cat. Fish. Brit. Mus. 2 (1860) 444; DAY, Proc. Zool. Soc. London (1865) 25; (1870) 689; Fishes of Malabar (1865) 84; Fishes of India. Text 1 (1878–1888) 226; Fauna of British India. Fishes 2 (1889) 168; PLAYFAIR and GÜNTHER, Fishes of Zanzibar. London (1866) 61; KLUNZINGER, Verh. Kaiserl. Königl. Zool.-Bot. Ges. Wien 21 (1871) 455; Sitzgsber. Akad. Wien 80 (1880) 377; MACLEAY, Descr. Cat. Aust. Fishes. Sydney 1 (1881) 169; JORDAN and GILBERT, Proc. U. S. Nat. Mus. 6 [1883 (1884)] 201; MEYER, Ann. Soc. Españ. Hist. Nat. Madrid 14 (1885) 25; BOULENGER, Proc. Zool. Soc. London (1887) 661; ELERA, Catalogo Systematico de toda la Fauna de Filipinas. Vertebrados 1 Peces (1895) 510; JENKINS, Bull. U. S. Fish Comm. 22 [1902 (1904)] 447; DUNCKER, Mitt. Naturh. Mus. Hamburg 21 (1904) 156; SNYDER, Bull. U. S. Fish Comm. 22 [1902 (1904)] 525; JORDAN and EVERMANN, Bull. U. S. Fish. Comm. 23 [1903 (1905)] 197; JORDAN and SEALE, Bull. U. S. Bur. Fish. 25 [1905 (1906)] 232; 26 [1906 (1907)] 14; EVERMANN and SEALE, Bull. U. S. Bur. Fish. 26 [1906 (1907)] 64; SEALE and BEAN, Proc. U. S. Nat. Mus. 33 (1907) 241; SEALE, Philip. Journ. Sci. § D 5 (1910) 270; WEBER, Die Fische der Siboga Expedition. Leiden (1913) 397; PELLEGRIN, Bull. Soc. Zool. France 39 (1914) 228; OGILBY, Mem. Queens. Mus. 3 (1915) 67; BARNARD, Ann. South African Mus. 21 (1927) 548; PARADICE and WHITLEY, Mem. Queens. Mus. 9 (1927–1929) 82; MCCULLOCH, Mem. Aust. Mus. pt. 2 5 (1929–1930) 185; BORODIN, Bull. Vanderbilt Mar. Mus. art. 2 1 (1930) 49.

Gnathanodon speciosus BLEEKER, Nat. Tijdschr. Ned. Ind. 2 (1851) 471, 475; 3 (1852) 740, 745; 8 (1855) 398; Verh. Bat. Gen. 24 (1852) 30, 72; 25 (1853) 46; Versl. Akad. Amsterdam 12 (1861) 53, 74; Ned. Tijdschr. Dierk. 1 (1863) 235; JORDAN and EVERMANN, Bull. U. S. Nat. Mus. 47 (1896) 928; Rept. U. S. Fish Comm. 21 [1895 (1896)] 347; JORDAN and JORDAN, Mem. Carnegie Mus. 10 (1922–1925) 41; OSHIMA, Philip. Journ. Sci. 26 (1925) 402; FOWLER, Proc. Acad. Nat. Sci. Phila. 79 (1927) 271; Mem. B. P. Bishop Mus. 10 (1928) 149; Monog. No. 2 Acad. Nat. Sci. Phila. (1938) 279; JORDAN, EVERMANN, and CLARK, Rept. U. S. Comm. Fish. pt. 2 (1930) 273; HERRE, Journ. Pan-Pacific Res. Inst. (4) 8 (1933) 3; Notes on fishes in the Zoological Museum of Stanford University (1934) 35; WALFORD, Marine game fishes of the Pacific coast from Alaska to the equator (1937) 77.

Caranx edentulus MACLEAY, Descr. Cat. Aust. Fish. Sydney 1 (1881) 169; JORDAN and SEALE, Bull. U. S. Bur. Fish. 25 [1905 (1906)] 232.

Caranx (*Gnathanodon*) *speciosus* WAKIYA, Ann. Carnegie Mus. 15 (1923–1924) 209; Fishes Indo-Aust. Arch. 6 (1931) 264.

Head 2.7 to 3.1; depth 2.2; dorsals VII, I, 18 or 19 (with one procumbent spine); pectoral I, 21; anal II, I, 16; caudal 22; lateral line posteriorly with 15 to 17 scutes.

Body oblong, dorsal contour evenly convex from snout to caudal peduncle; ventral profile almost sublinear from isthmus to origin of anal, beyond which it becomes acclivous. Head large, infra-orbital to angle of mouth, postorbital, upper opercular, occiput, and nuchal region scaled. Mouth oblique, its cleft opposite pectoral base. Maxillary broad, terminating beyond front border of eye. Upper jaw strongly protractile, slightly longer than lower. Teeth absent, tongue rough with very minute denticulation. Snout blunt, 2.7 in head. Posterior part of preorbital slightly less than eye diameter. Eye small, 3.7 to 4.7 in head, depending upon age. Adipose eyelid poorly developed. Opercular opening wide, extending anteriorly to a vertical between anterior margin of eye and nostrils. Gillrakers slender, 19 to 21.

Spinous dorsal base 7.3 in standard length. Spines weak, second spine longest; seventh spine shortest, stouter than preceding spines. Soft dorsal with a base 2.4 in standard body length, its origin a little nearer to base of caudal than to tip of snout. Pectoral falcate, shorter than head in young, equal to or longer than head in adult. Anal inserted below seventh dorsal ray. Anterior rays of soft dorsal and anal elevated but not forming a falciform lobe. Caudal widely forked, lobes equal.

Alcoholic specimens cinnamon-drab dorsally, pale olive-buff ventrally, with 8 to 11 alternating wide and narrow natal-brown crossbands which do not quite reach ventral edge of trunk; first crossband passing through eye obliquely, second crossing back and posterior part of operculum; crossbands more pronounced in young, gradually disappearing with age.

Here described from specimen No. 15118, 307 mm long, collected in Subic Bay, Zambales Province, April 9, 1927.

LUZON, Manila market, Nos. 9663, 171 mm, October 28, 1910, No. 562, 116 mm, June 15, 1907. MINDORO, Mindoro Province, Mangarin, No. 6165, 109 mm, 1913. MASBATE, No. 9957, 111 mm, No. 20585, 95 mm, June 2, 1922. PANAY, Iloilo Province, Estancia, No. 11758, 141 mm, February 11, 1925. GUIMARAS ISLAND, west coast, No. 41152, 143 mm, November 18, 1933. NEGROS, Occidental Negros Province, Cadiz Nuevo, No. 16189, 142 mm, No. 20596, 115 mm, August, 1929: Oriental Negros Province, Dumaguete, No. 14821, 159 mm, March 5, 1922. BOHOL, Inabanga, No. 14728, 159 mm, No. 20702, 116 mm, December 3, 1926. PALAWAN, Taytay, Guinlo, No. 31387, 167 mm, No. 31943, 132 mm, No. 31944, 147 mm, November 8, 1934.

Genus ULUA Jordan and Snyder, 1908

Ulua JORDAN and SNYDER, Mem. Carnegie Mus. **4** (1908) 39.

Body oblong, compressed. Head large; mouth oblique, with sharp-edged lips. A single row of minute teeth in jaws; a patch of very fine teeth on vomer and a narrow band on each palatine. Gillrakers very numerous, exceedingly long, featherlike in shape, projecting into the mouth on each side of tongue. Breast scaleless, naked area extending posteriorly to a line between the pectoral and ventral fins.

ULUA MANDIBULARIS (Macleay). Plate 9, fig. 1.

Caranx mandibularus JORDAN and SEALE, Bull. U. S. Bur. Fish. **25** [1905 (1906)] 234; FOWLER and BEAN, Proc. U. S. Nat. Mus. art. 2 **62** (1923) 20.

Ulua mandibularis MCCULLOCH, Mem. Aust. Mus. **8** (1924–1926) 75; pt. 2 **5** (1929–1930) 190; PARADICE and WHITLEY, Mem. Queens. Mus. **9** (1927–1929) 83; WEBER and DE BEAUFORT, Fishes Indo-Aust. Arch. **6** (1931) 266.

Carangoides mandibularis FOWLER, Proc. Acad. Nat. Sci. Phila. **79** (1927) 272; Mem. B. P. Bishop Mus. **10** (1928) 151.

Head 2.6; depth 1.8; dorsal VII, I, 20; pectorals I, 18; anal II, I, 17; lateral line arched anteriorly, becoming straight below ninth or tenth soft dorsal ray, with 28 scutes posteriorly.

Body strongly compressed, somewhat ovate in young, oblong in adult, dorsal profile more arched than ventral. Head higher than long, frontonuchal outline convex, with a slight rostrofrontal concavity in smaller specimens, more pronounced in large specimens. Mouth oblique, large, its cleft opposite lower third of eye. Snout slightly pointed. Maxillary with acute triangular supplemental bone, terminating below center of eye. Jaws almost equal. Chin projecting anteriorly in advance of upper jaw, forming an obtuse angle. Teeth minute, in single row in jaws, a small patch on vomer. Palatines and tongue apparently edentulous. Preorbital length greater than snout. Eye 4.2 in head, equal to or greater than snout. Adipose eyelid poorly developed in young, developing fairly with age. Interorbital space less or greater than eye diameter. Infraorbital, postorbital, and upper opercular scaled. Opercular opening extending anteriorly below level of nostrils. Gillrakers 58, extraordinarily long, on lower anterior arch. Breast without scales, posterior margin of naked area extending from base of pectorals to beyond base of ventrals.

Spinous dorsal base 6.8 in standard length. Spines weak, third spine longest. Origin of soft dorsal almost midway between tip of snout and caudal base. Anterior rays of soft dorsal forming a falcate lobe, first ray produced. Pectorals falcate, longer than head, extending to about middle of anal when depressed. Ventrals short, equal to or less than snout. Anal inserted below level of seventh ray of soft dorsal, its anterior rays forming falcate lobe; first ray filiform. Caudal forked, with equal lobes; base of each lobe with two crestlike ridges.

Alcoholic specimens grayish olive dorsally, pale orange-yellow ventrally.

Here described from specimen No. 31938, 510 mm long, collected from the Royal Fish Landing, Manila, January 20, 1937.

PANAY, Iloilo Province, Estancia, No. 20632, 275 mm, June 16, 1922.

Genus ALECTIS Rafinesque, 1815

Alectis[6] RAFINESQUE, Analyse de la Nature (1815) 84.
Blepharis CUVIER, Regne Animal. ed. 1. Poissons (1817) 135.
Scyris CUVIER, Regne Animal. ed. 1. Poissons (1817) 135.
Gallichthys CUVIER and VALENCIENNES, Hist. Nat. Poiss. 9 (1833) 125.
Blepharichthys GILL, Proc. Acad. Nat. Sci. Phila. 14 [1862 (1863)] 431, 436.

Body elevated, strongly compressed, dorsal and ventral contours angular. Lateral line strongly curved to below middle of soft dorsal, straight portion with 8 to 15 weak scutes posteriorly. Scales minute and deeply embedded. Head large and deep. Pectoral long and falciform. Caudal deeply forked.

Key to the Philippine species of Alectis.

a[1]. Snout short and rounded; eye large; maxillary terminating beyond front border of eye; gillrakers 14 or 15, long and slender; vent about midway between ventrals and anal .... *Alectis ciliaris.*

a[2]. Snout long and pointed; eye small; maxillary not extending to front border of eye; gillrakers 23, short and stout; vent much nearer ventrals than anal .... *Alectis indica.*

[6] Jordan and Evermann, Genera of Fishes pts. 1–4 (1917–1920) 88.

ALECTIS CILIARIS (Bloch). Plate 9, fig. 2.

Zeus ciliaris BLOCH, Ichtyol. Hist. Nat. Poiss. pt. 6 (1788) 27; BLOCH and SCHNEIDER, Systema Ichthyologiae (1801) 94.

Scomber filamentosus BLOCH and SCHNEIDER, Systema Ichthyologiae (1801) 34.

Blepharis fasciatus RÜPPELL, Atlas zu der Reise im Nördlichen Afrika (1828) 129.

Caranx ciliaris CUVIER and VALENCIENNES, Hist. Nat. Poiss. 9 (1833) 97; TEMMINCK and SCHLEGEL, Fauna Japonica 3 (1842) 112; GÜNTHER, Cat. Fish. Brit. Mus. 2 (1860) 454; Fische der Südsee 2 (1876–1881) 135; PLAYFAIR and GÜNTHER, Fishes of Zanzibar. London (1866) 62; KLUNZINGER, Verh. Kaiserl. Königl. Zool.-Bot. Ges. Wien 21 (1871) 454; MACLEAY, Descr. Cat. Aust. Fishes. Sydney 1 (1881) 172; WEBER, Semon, Zoologische Forschungreisen in Australia und dem Malayischen Archipel 5 (1895) 267; DAY, Proc. Zool. Soc. London (1865) 25; (1870) 689; Fishes of Malabar (1865) 90; Fishes of India. Text 1 (1878–1888) 224; Fauna of British India. Fishes 2 (1889) 166; GILCHRIST and THOMPSON, Ann. South African Mus. 6 (1908) 240.

Blepharis indicus TEMMINCK and SCHLEGEL, Fauna Japonica 3 (1842) 113.

Carangoides blepharis BLEEKER, Nat. Tijdschr. Ned. Ind. 1 (1851) 343; 3 (1852) 741, 745; 8 (1855) 398; Verh. Bat. Gen. 24 (1852) 29, 67; 25 (1953) 15.

Alectis ciliaris JORDAN and EVERMANN, Bull. U. S. Nat. Mus. 47 (1896) 931; Rept. U. S. Fish Comm. 21 [1895 (1896)] 347; Proc. U. S. Nat. Mus. 25 (1903) 338; Bull. U. S. Fish Comm. 23 [1903 (1905)] 200; JENKINS, Bull. U. S. Fish Comm. 22 [1902 (1904)] 447; SNYDER, Bull. U. S. Fish Comm. 22 [1902 (1904)] 525; JORDAN and SEALE, Bull. U. S. Bur. Fish. 25 [1905 (1906)] 235; 26 [1906 (1907)] 14; SEALE and BEAN, Proc. U. S. Nat. Mus. 33 (1907) 242; OGILBY, Mem. Queens. Mus. 3 (1915) 85; MCCULLOCH, Aust. Zool. 2 (1921–1922) 63; Mem. Aust. Mus. pt. 2 5 (1929–1930) 191; NICHOLS, Am. Mus. Novit. No. 50 (1922) 3; WAKIYA, Ann. Carnegie Mus. 15 (1923–1924) 213; JORDAN and JORDAN, Mem. Carnegie Mus. 10 (1922–1925) 41; OSHIMA, Philip. Journ. Sci. 26 (1925) 401; BARNARD, Ann. South African Mus. 21 (1927) 549; WEBER and DE BEAUFORT, Fishes Indo-Aust. Arch. 6 (1931) 269; HERRE, Notes on fishes in the Zoological Museum of Stanford University (1934) 35.

Alectis temmincki WAKIYA, Ann. Carnegie Mus. 15 (1923–1924) 215.

Alectis breviventralis WAKIYA, Ann. Carnegie Mus. 15 (1923–1924) 216.

Blepharis ciliaris FOWLER, Proc. Acad. Nat. Sci. Phila. 77 (1925) 218; Mem. B. P. Bishop Mus. 10 (1928) 151; Acad. Nat. Sci. Phila. Monog. No. 2 (1938) 221, 254; HERRE, Journ. Pan-Pacific Res. Inst. (2) 10 (1935) 164; WALFORD, Marine game fishes of the Pacific coast from Alaska to the equator (1937) 78.

Head 2.4 to 3; depth 1.2 to 1.4; dorsals VII, I, 19 or 20 (preceded by one procumbent spine); pectoral 19; ventral 6;

anal II, I, 16 or 17, 14 or 15 feeble scutes on posterior part of lateral line.

Body somewhat ovate, almost angular, well compressed. Dorsal contour elevated, nearly equal to ventral profile; greatest depth at level of base of soft dorsal and base of anal. Caudal peduncle 4.9 to 6 in head. Head large and deep; dorsal profile of head convex, with slight concavity resulting from a marked occipitonuchal gibbosity. Mouth terminal, oblique. Cleft of mouth below eye. Maxillary terminates beyond front border of eye. Lower jaw slightly declivous. Upper and lower jaws with villiform teeth, intermixed with somewhat larger teeth anteriorly; vomer with triangular patch of villiform teeth; tongue and palatines with similar bands of teeth. Chin slightly prominent. Snout short and rounded, 3.4 to 3.8 in head. Eyes large, 2.3 to 3.2 in head, smaller than snout. Adipose eyelid poorly developed. Interorbital space 1.2 to 1.4 in eye. Opercular opening wide, extending anteriorly to below posterior third of lower jaw. Preopercular border entire. Five branchiostegal rays, all concealed. Gillrakers 14 or 15, moderately long and slender.

Lateral line strongly curved, straightening posteriorly below the twelfth or thirteenth ray of soft dorsal. Straight portion of lateral line 1.3 to 1.6 in curved portion.

Spinous dorsal 3.2 to 3.4 in head. Spines short and strong, last two spines strongest. First seven rays of soft dorsal filiform, fifth, sixth, and seventh rays longest, extending far beyond tip of caudal. Pectoral equal to or slightly longer than head, its tip reaching base of tenth or eleventh ray of anal. Ventrals 1.4 to 2 in head, inserted in advance of pectoral, 4 outer rays filamentous. Base of anal 1 to 1.1 in base of soft dorsal. Vent midway between origin of ventrals and anal.

A narrow dark suffused spot on opercle. A dark blotch on anterior soft dorsal at base of fourth, fifth, and sixth rays.

LUZON, Manila, No. 31364, 124 mm, No. 31365, 151 mm, August 28, 1934. LEYTE, Tacloban, No. 9591, 109 mm, May 7, 1921.

ALECTIS INDICA (Rüppell). Damis lawin. (Tag.). Plate 9, fig. 3.

Scyris indicus RÜPPELL, Atlas zu der Reise im Nördlichen Afrika (1828) 128; CANTOR, Journ. Roy. Asiat. Soc. Bengal **18** (1849) 1116.

Gallichthys major CANTOR, Journ. Roy. Asiat. Soc. Bengal **18** (1849) 1118.

Carangoides gallichthys BLEEKER, Nat. Tijdschr. Ned. Ind. 1 (1851) 343; 2 (1851) 471, 475; 8 (1855) 393, 398; Verh. Bat. Gen. 24 (1852) 29, 68; 25 (1853) 44.

Caranx gallus GÜNTHER, Cat. Fish. Brit. Mus. 2 (1860) 455; Fische der Südsee 2 (1876–1881) 135; DAY, Proc. Zool. Soc. London (1865) 25; Fishes of Malabar (1865) 91; Fishes of India. Text 1 (1878–1888) 224; Fauna of British India. Fishes 2 (1889) 166; PLAYFAIR and GÜNTHER, Fishes of Zanzibar. London (1866) 62; KLUNZINGER, Verh. Kaiserl. Königl. Zool.-Bot. Ges. Wien 21 (1871) 454; Sitzgsber. Akad. Wien 80 (1880) 377; MACLEAY, Descr. Cat. Aust. Fishes. Sydney 1 (1881) 173; MEYER, Ann. Soc. Españ. Hist. Nat. Madrid 14 (1885) 25; BOULENGER, Proc. Zool. Soc. London (1887) 661; ELERA, Catalogo Systematico de toda la Fauna de Filipinas. Vertebrados 1 Peces (1895) 512; DUNCKER, Mitt. Naturh. Mus. Hamburg 21 (1904) 156; VINCIGUERRA, Ann. Mus. Civ. Stor. Nat. Genova 50 (1921–1926) 561.

Carangoides gallus BLEEKER, Versl. Akad. Amsterdam 12 (1861) 53, 74.

Citula gallus BLEEKER, Ned. Tijdschr. Dierk. 1 (1863) 242; 4 (1873) 132.

Scyris indica FOWLER, Proc. Acad. Nat. Sci. Phila. 57 (1905) 86; 77 (1925) 217; Mem. B. P. Bishop Mus. 10 (1928) 151.

Alectis major JORDAN and RICHARDSON, Bull. U. S. Bur. Fish. 27 [1907 (1908)] 251; WAKIYA, Ann. Carnegie Mus. 15 (1923–1924) 217; OSHIMA, Philip. Journ. Sci. 26 (1925) 400.

Alectis indicus BEAN and WEED, Proc. U. S. Nat. Mus. 42 (1912) 600; JORDAN and JORDAN, Mem. Carnegie Mus. 10 (1922–1925) 41; WAKIYA, Ann. Carnegie Mus. 15 (1923–1924) 214; BARNARD, Ann. South African Mus. 21 (1927) 550; BORODIN, Bull. Vanderbilt Mar. Mus. art. 1 1 (1928) 18.

Alectis gallus WEBER, Die Fische der Siboga Expedition. Leiden (1913) 400; HORA, Mem. Asiat. Soc. Bengal (2) 6 (1924) 484; OSHIMA, Philip. Journ. Sci. 26 (1925) 399; HERRE, Lingnan Sci. Journ. (3) 11 (1932) 434.

Alectis indica OGILBY, Mem. Queens. Mus. 3 (1915) 83; MCCULLOCH, Aust. Zool. 2 (1921–1922) 62; Mem. Aust. Mus. pt. 2 5 (1929–1930) 191; PARADICE and WHITLEY, Mem. Queens. Mus. 9 (1927–1929) 83; WEBER and DE BEAUFORT, Fishes Indo-Aust. Arch. 6 (1931) 271; HERRE, Notes on fishes in the Zoological Museum of Stanford University (1934) 36; HARDENBERG, Treubia 15 (1936) 247.

Head 2.5 to 2.9; depth 1.2 to 1.4; dorsals VI, I, 19 or 20 (preceded by a procumbent spine); pectoral 18; ventral 6; anal II, I, 16; 8 to 12 weak scutes in straight lateral line.

Body strongly compressed, angular and rhombic. Dorsal profile elevated, greater than ventral contour; greatest depth at level of base of soft dorsal and base of anal. Caudal peduncle 4.4 to 5.3 in head. Head large and rather deep, occipital contour gibbous, anterior profile strongly acclivous. Mouth terminal, cleft opposite point midway between supraorbital and base of ventral. Maxillary extending slightly beyond halfway along snout. Lower jaw strongly declivous. Upper jaw, vomer, palatines, and tongue with minute teeth; lower jaw with slightly larger teeth. Chin prominent. Snout long and pointed, 2 to 2.2 in head. Eyes small, 3 to 3.7 in head. Adipose eyelid almost wanting. Interorbital space 1.3 to 1.5 in eye diameter. Operculum extending anteriorly to posterior border of lower jaw. Five branchiostegal rays, all hidden. Gillrakers 23, short and stout.

Lateral line strongly arched, straightening posteriorly below tenth or eleventh soft dorsal ray. Curved portion 1 to 1.2 in straight lateral line.

Spinous dorsal 3.1 to 3.8 in head. Spines short, last two spines stouter and shorter than four preceding spines. First 7 or 8 rays of soft dorsal filamentous, first three extending beyond tip of caudal. In older specimens filaments shorter, never reaching tip of caudal. Pectoral longer than head, its tip reaching base of tenth anal ray. Ventral inserted slightly ahead of pectoral; second, third, and fourth rays filiform, its tips reaching caudal base. Filaments of ventral become shorter with age. Anal base 1.2 in that of soft dorsal. Vent much nearer base of ventral than base of anal.

Opercular spot inconspicuous or absent. Five or six broad, dark, transverse bands extending from back to middle of sides. Filiform rays of dorsal, pectoral, and anal blackish.

Here described from specimen No. 11642, 130 mm, collected from Estancia, Iloilo, February 13, 1925.

LUZON, Ilocos Norte, Bangui, No. 14316, 38 mm, August 20, 1926: Manila, Divisoria market, No. 31872, 175 mm, March 13, 1931; Manila Bay, No. 31468, 207 mm, December 21, 1924. MARINDUQUE, Marinduque Province, Balanacan, No. 12904, 450 mm, February 25, 1925. PANAY, Capiz Province, Capiz, No. 12723, 92 mm, July 20, 1925. GUIMARAS, Iloilo Province, Guimaras, No. 31857, 133 mm, December 18, 1933.

Genus HYNNIS Cuvier and Valenciennes, 1833

Hynnis CUVIER and VALENCIENNES, Hist. Nat. Poiss. 9 (1833) 145.

Body naked, rather elongate, angular, compressed. Lateral line strongly arched, with few scutes posteriorly. Mouth moderate, with villiform teeth on jaws, vomer, palatines, and tongue. Spinous dorsal wanting; soft dorsal and anal quite elevated in front, without filamentous rays. Soft dorsal with a spine and 18 to 20 rays; anal with a spine and 15 or 16 rays.

HYNNIS MOMSA Herre.[7] **Damis.**

Hynnis momsa HERRE, Philip. Journ. Sci. 34 (1927) 235.

Dorsal I, 20; anal I, 16; about 10 scutes in lateral line, last 5 scutes much enlarged, very broad and high, last scute much smaller than the four preceding scutes.

Body naked, angular, elongate-rhomboid, roughly pentagonal, very deep and strongly compressed laterally; greatest depth at origin of dorsal, 2.37 times in length. Head higher than long, very narrow from side to side; its depth through center of eye 3.65, its length 3.92 times in total length; eye 4.77 times in head, 2.28 times in snout which is 2.09 times in head; interorbital very high and narrow, its height 1.81 times eye, its thickness about 1.25 times eye; profile descending abruptly from origin of dorsal to sharp angle just beyond eye, then at an angle of about 45° to mouth; ventral profile sharply angulate at origin of anal; mouth slightly oblique, maxillary 3.1 times in head, chin full, heavy, lower jaw slightly longer than upper; suborbital very deep, nearly equal to snout; dorsal low, first ray highest, a tenth higher than first anal ray which is 1.86 times in head, dorsal and anal otherwise nearly identical; arch of lateral line high and very long, its diameter greater than length of straight part of fifth enlarged scute from end; depth of elongate caudal peduncle less than its breadth, about 3.66 times in its length, 7.9 times in head; the very long, narrow, falcate pectoral reaching beyond a vertical from base of tenth dorsal ray, 2.68 times in length; origin of short ventral much in advance of pectoral and beneath opercle, its length 0.95 times height of first anal ray, a little less than twice in that of head; caudal deeply and widely forked, about 3.84 times in length.

Body silvery, chin pearl-white, with a black bar on upper posterior margin of opercle and a black spot in axil of pectoral; a short distance below dorsal a dark steel-blue bar about 25 millimeters wide, extending back to top of caudal peduncle and along it to caudal fin; on upper half of body, above pectoral and posteriorly, dusky spots like thumb marks; fins without markings. Seen from above the fish is very dark steel-blue, with a metallic luster.

The above description is that of Herre.(72)

[7] Herre's type specimen could not be located.

SCOMBEROIDINÆ

Body oblong, elongate, strongly compressed, covered with lanceolate or rhombic scales embedded in the skin. Head trenchant at top, compressed, pointed. Mouth cleft moderate or wide. Jaws subequal, premaxillary not protractile. Maxillary without supplemental bone. Teeth in jaws in villiform bands when young, in one or two series in adult. Gillrakers moderate. Lateral line slightly arched anteriorly; scutes wanting. Dorsals two, separate, a spinous dorsal with 6 to 7 spines, preceded by one procumbent spine; spines with basal membrane, flattened, overlapping, reaching or not reaching base of succeeding spine when depressed. Soft dorsal and anal not falcate. Anal almost equal to soft dorsal; posterior rays of soft dorsal and anal slightly detached, forming finlets. Pectoral short, not pointed; ventrals also short, depressible in a deep median groove on abdomen.

Genus SCOMBEROIDES [8] Lacépède, 1802

Scomberoides [9] LACÉPÈDE, Hist. Nat. Poiss. 3 (1802) 50.
Orcynus [10] RAFINESQUE, Analyse de la Nature (1815) 84.
Chorinemus CUVIER and VALENCIENNES, Hist. Nat. Poiss. (1831) 270.
Thynnus GRONOW, Cat. Fish. (1854) 121.
Rhaphiolepis FOWLER, Proc. Acad. Nat. Sci. 62 (1905) 59.

Body strongly compressed, elongate, oblong or nearly ovate, dorsal and ventral contour about equally convex. Head naked, short, less than depth of body. Maxillary terminating below eye or far beyond hind border of eye. Scales small, ovate, lanceolate or needlelike. Anterior portion of lateral line angulate or curved below level of anterior spinous dorsal, straightening below last spine of spinous dorsal or first spine of soft dorsal. Scutes absent. Teeth villiform in upper jaw, followed by a row of larger teeth. Lower jaw with a pair of caniniform teeth anteriorly, followed by two rows of teeth with a groove between them. Villiform teeth in vomer, in longitudinal bands in palatines, pterygoids, and tongue. Spinous dorsal with 6 to 7 spines

[8] "*Scomberoides* as employed by Jordan, Wakiya, Fowler, and others, and by Bleeker in some of his papers up to 1863, and in all of them subsequent to that year, dates from volume III of Lacépède's work published in 1802, in which the form of the generic and specific names fully conforms to modern nomenclatorial propriety."—Hugh M. Smith, Ichthyological Notes. Copeia No. 3 (1932) 156.

[9] Jordan and Evermann, Genera of Fishes pts. 1–4 (1917–1920) 60.

[10] Ibid., 89.

preceded by a strong spine directed forward; soft dorsal with a spine and 19 to 21 rays; anal with a spine and 17 to 19 rays preceded by two strong distant spines. In both soft dorsal and anal the posterior rays connected by a low, thin membrane, making them appear penicillate.

Key to the Philippine species of Scomberoides.

*a*¹. Scales ovate or lanceolate.
  *b*¹. Snout blunt, equal to eye or slightly shorter. Maxillary extending far beyond eye. Elevated dorsal and anal rays without black blotches. Scales broadly lanceolate or ovate. Gillrakers 11. *S. lysan.*
  *b*². Snout pointed, equal to or greater than eye. Maxillary extending to posterior third or slightly behind hind border of eye. Scales lanceolate-pointed.
    *c*¹. Body elongate, its depth greater than length of head, scales rhombic. Soft dorsal with a black blotch anteriorly. Gillrakers 17, flattened and pointed .... *S. toloo-parah.*
    *c*². Body deep, nearly ovate. Scales lanceolate. Soft dorsal without dark blotch anteriorly. Gillrakers 10, tapering but rather blunt. *S. tala.*
*a*². Scales needle-shaped or threadlike. Snout pointed, greater than eye. Maxillary terminating slightly beyond hind border of pupil. Gillrakers 18 (16) elongate .... *S. tol.*

SCOMBEROIDES LYSAN (Forskål). Dorado; talapia. Plate 10, fig. 1.

Scomber lysan FORSKÅL, Descriptiones Animalium. Pisces (1775) 54.

Scomber forsteri BLOCH and SCHNEIDER, Systema Ichthyologiae (1801) 26.

Scomberoides commersonien LACÉPÈDE, Hist. Nat. Poiss. (1819) 184.

Lichia lysan RÜPPELL, Atlas zu der Reise im Nördlichen Afrika. Zoologie 2 (1828) 91.

Chorinemus commersonianus CUVIER and VALENCIENNES, Hist. Nat. Poiss. 8 (1831) 272; BLEEKER, Nat. Tijdschr. Ned. Ind. 1 (1851) 342, 345; 2 (1851) 475; 3 (1852) 740, 745; Verh. Bat. Gen. 24 (1852) 23, 44; 25 (1853) 42.

Chorinemus lyzan CUVIER and VALENCIENNES, Hist. Nat. Poiss. 8 (1831) 284.

Chorinemus forsteri RICHARDSON, Ann. & Mag. Nat. Hist. (1843) 24.

Chorinemus lysan CANTOR, Journ. Roy. Asiat. Soc. Bengal 18 (1849) 1100; GÜNTHER, Cat. Fish. Brit. Mus. 2 (1860) 471; BLEEKER, Versl. Akad. Amsterdam 12 (1861) 52, 74; DAY, Proc. Zool. Soc. London (1865) 25; (1870) 689; Fishes of Malabar (1865) 92; Fishes of India. Text 1 (1878–1888) 231; Fauna of British India. Fishes 2 (1889) 175; KNER, Zool. Fische 1–3 (1865–1867) 163; PLAYFAIR and GÜNTHER, Fishes of Zanzibar. London (1866) 63; KLUNZINGER, Verh. Kaiserl. Königl. Zool.-Bot. Ges. Wien 21 (1871) 448; Sitzgsber. Akad. Wien 80 (1880) 378; MACLEAY, Descr. Cat. Aust. Fishes. Sydney 1 (1881) 178; MEYER, Ann. Soc. Españ.

Hist. Nat. Madrid 14 (1885) 25; BOULENGER, Proc. Zool. Soc. London (1887) 661; ELERA, Catalogo Systematico de toda la Fauna de Filipinas. Vertebrados 1 Peces (1895) 513; DUNCKER, Mitt. Naturh. Mus. Hamburg 21 (1904) 156; WEBER, Die Fische der Siboga Expedition. Leiden (1913) 390; PELLEGRIN, Bull. Soc. Zool. France 39 (1914) 229; VINCIGUERRA, Ann. Mus. Civ. Stor. Nat. Genova 50 (1921–1926) 562; HORA, Mem. Asiat. Soc. Bengal (2) 6 (1924) 484; BARNARD, Ann. South African Mus. 21 (1927) 563; WEBER and DE BEAUFORT, Fishes Indo-Aust. Arch. 6 (1931) 277; HARDENBERG, Treubia 15 (1936) 247.

Chorinemus sancti petri BLEEKER, Nat. Tijdschr. Ned. Ind. 1 (1851) 345.

Scomberoides lysan JORDAN and SEALE, Bull. U. S. Bur. Fish. 25 [1905 (1906)] 229; SEALE, Philip. Journ. Sci. § D 5 (1910) 272; BEAN and WEED, Proc. U. S. Nat. Mus. 42 (1912) 601; FOWLER, Proc. Acad. Nat. Sci. Phila. 77 (1925) 213; 79 (1927) 268; Mem. B. P. Bishop Mus. 10 (1928) 140; WAKIYA, Ann. Carnegie Mus. 15 (1923–1924) 238; MCCULLOCH, Mem. Aust. Mus. pt. 2 5 (1929–1930) 181; HERRE, Journ. Pan-Pacific Res. Inst. (4) 8 (1933) 3.

Head 4.2 to 4.9; dorsals VII (VI), I, 19 or 20 (preceded by a procumbent spine); pectoral I, 17 or 18; ventral I, 5; anal II, I, 17 or 18.

Body oblong, compressed; ventral contour slightly more angular than dorsal; greatest depth at level of base of soft dorsal and anal. Head small. Rostronuchal profile declivous in a straight line, becoming slightly concave in adult. Mouth terminal, its cleft opposite lower margin of eye, maxillary slender, terminating far beyond hind border of eye. Jaws equal, upper jaw with an outer row of large conical teeth, followed by a band of viliform teeth, lower with one pair of symphysial canines directed outward, and two rows of pointed teeth, of about the same size. Snout short and blunt, 4 to 4.4 in head. Eye small, 3.2 to 4.1 in head. Adipose eyelid poorly developed. Gillrakers 11, flattened and tapering.

Spinous dorsal 1.1 to 1.4 in head. Spines flattened, nearly overlapping, each with a groove. Pectorals short, 1.4 to 1.7 in head. Ventrals inserted below pectorals, 1.6 in head without snout. Base of soft dorsal almost equal to that of anal.

Six to eight dark oval spots above lateral line, the first two touching it.

LUZON, Rizal Province, Navotas, No. 15189, 235 mm, No. 20716, 183 mm, No. 20715, 164 mm, April 11, 1927: Manila market, No. 95, 291 mm, June 1, 1907, No. 282, 191 mm, June 14, 1907. MINDORO, Mindoro Province, Mangarin, No. 10444, 171 mm, 1913. LEYTE, Leyte Province, Tacloban, No. 14772, 222 mm.

Foreign examples: Borneo, Sandakan, No. 2484, February, 1908, No. 14184, 218 mm, November 25, 1925, No. 2501, 246 mm, No. 2459, 168 mm, February, 1908; China, Hainan, Haihow, No. 10090, 162 mm, 1922.

SCOMBEROIDES TOLOO-PARAH (Rüppell). Cassisung. Plate 10, fig. 2.

Lichia toloo-parah RÜPPELL, Atlas zu der Reise im Nördlichen Afrika. Zoologie 2 (1828) 91.

Chorinemus mauritianus CUVIER and VALENCIENNES, Hist. Nat. Poiss. 8 (1831) 281.

Chorinemus tolooparah RÜPPELL, Neue Wirbelthiere zu der Fauna von Abyssinien gehörig (1835–1840) 44; WEBER and DE BEAUFORT, Fishes Indo-Aust. Arch. 6 (1931) 278; BORODIN, Bull. Vanderbilt Mar. Mus. art. 3 1 (1932) 77; GILTAY, Mem. Mus. Roy. Hist. Nat. Belg. Hors. V 3 (1933) 60.

Chorinemus sancti-petri BLEEKER, Nat. Tijdschr. Ned. Ind. 1 (1851) 342; 2 (1851) 212; 3 (1852) 741, 745; 16 (1858–1859) 407; Verh. Bat. Gen. 24 (1852) 24, 45; 25 (1853) 44; Versl. Akad. Amsterdam 12 (1861) 52; PETERS, Monats. Akad. Wiss. Berlin (1855) 437; GÜNTHER, Cat. Fish. British Mus. 2 (1860) 473; Fische der Südsee 2 (1876–1881) 138; KLUNZINGER, Sitzgsber. Akad. Wien 80 (1880) 378; SAUVAGE. Hist. Phys. Nat. Pol. Madagascar 16 (1891) 331.

Scomberoides sancti petri BLEEKER, Ned. Tijdschr. Dierk. 1 (1863) 235; 2 (1865) 31.

Chorinemus toloo KLUNZINGER, Verh. Kaiserl. Königl. Zool.-Bot. Ges. Wien 21 (1871) 447.

Scomberoides tolooparah JORDAN and EVERMANN, Bull. U. S. Fish Comm. 23 [1903 (1905)] 180; JORDAN and SEALE, Bull. U. S. Bur. Fish. 25 [1905 (1906)] 229; 26 [1906 (1907)] 13; SMITH and SEALE, Proc. Biol. Soc. Washington 19 (1906) 76; EVERMANN and SEALE, Bull. U. S. Bur. Fish. 26 [1906 (1907)] 62; SEALE and BEAN, Proc. U. S. Nat. Mus. 33 (1907) 241; JORDAN and RICHARDSON, Bull. U. S. Bur. Fish. 27 [1907 (1908)] 249; KENDALL and GOLDSBOROUGH, Mem. Mus. Comp. Zool. Harvard 26 (1911) 267; FOWLER, Copeia No. 58 (1918) 63; Proc. Acad. Nat. Sci. Phila. 79 (1927) 268; Mem. B. P. Bishop Mus. 10 (1928) 140; JORDAN and JORDAN, Mem. Carnegie Mus. 10 (1922–1925) 37; JORDAN, Proc. U. S. Nat. Mus. art. 33 66 (1925) 18; BORODIN, Bull. Vanderbilt Mar. Mus. art. 2 1 (1930) 49; HERRE, Journ. Pan-Pacific Res. Inst. (4) 8 (1933) 3, 12; Notes on fishes in the Zoological Museum of Stanford University (1934) 36; Field Museum Nat. Hist. Chicago 21 (1936) 110.

Chorinemus moadetta WEBER, Die Fische der Siboga Expedition. Leiden (1913) 390.

Scomberoides moadetta WAKIYA, Ann. Carnegie Mus. 15 (1923–1924) 235.

Head 4.3 to 4.6; depth 3.3 to 3.4; dorsals VII, I, 20 (preceded by one procumbent spine); pectorals 17 or 18; ventral 5; anal II, I, 18.

Body oblong elongate, compressed; dorsal and ventral profile almost equal; greatest depth at level of base of soft dorsal and anal. Head small. Rostronuchal contour slightly concave above eyes. Mouth terminal, its cleft opposite middle of eye. Lower jaw slightly prominent: Maxillary narrow, extending to posterior third, or almost to hind margin, of eye. Teeth in upper jaw in a villiform band anteriorly, followed by two series of teeth; lower jaw with two caninelike teeth at symphysis, and two series of teeth with tips directed inward. Ovate patch in vomer, and in bands in palatines, pterygoids, and tongue. Snout obtuse, 3.5 to 4 in head. Eyes small, equal to snout, adipose eyelid poorly developed. Interorbital equal to or slightly greater than eye. Nostrils opposite upper third of eye, somewhat midway along snout, but mostly on posterior half. Opercular opening wide, extending anteriorly below level of posterior pair of nostrils. Gillrakers 17, pointed and flattened.

Spinous dorsal 1.2 to 1.4 in head. Spines flattened, fifth and sixth spine longest. Posterior rays of soft dorsal, like those of anal, connected by low, thin membrane, making rays appear finletlike. Pectorals short, 1.7 in head. Ventrals inserted below posterior extremity of pectoral base, shorter than pectorals. Base of soft dorsal equal to that of anal. Anterior rays of soft dorsal with a dark blotch. Six to eight series of dusky blotches above and below lateral line.

LUZON, Ilocos Sur Province, Bangui, No. 14380, 375 mm, August 19, 1926: La Union Province, Damortis, No. 14322, 170 mm, August 4, 1926: Manila, No. 6774, 262 mm, June, 1910: Rizal Province, Pasay, No. 13381, 200 mm, March 4, 1926: Batangas Province, Nasugbu, Papaya, No. 13264, 178 mm, January 10, 1926. LEYTE, Leyte Province, Cabalian, No. 9643, 160 mm, May 25, 1925. MINDANAO, Surigao Province, Gigaquit, No. 11175, 112 mm, No. 20604, 78 mm, June 5, 1921: Zamboanga Province, Sangali, No. 31753, 178 mm, July 28, 1932.

This species resembles *S. tol* very closely, but has no frontal concavity and its scales are rhombic, not needlelike.

SCOMBEROIDES TALA (Cuvier and Valenciennes). Plate 10, fig. 3.

Chorinemus tala CUVIER and VALENCIENNES, Hist. Nat. Poiss. **8** (1931) 277; BLEEKER, Verh. Bat. Gen. **25** (1853) 44; GÜNTHER, Cat. Fish. Brit. Mus. **2** (1860) 473; DAY, Proc. Zool. Soc. London (1865) 25; (1870) 689; Fishes of Malabar (1865) 93; Fishes of India. Text **1** (1878–1888) 231; Fauna of British India. Fishes **2** (1889) 176; WEBER, Die Fische der Siboga Expedition. Leiden (1913) 391; HORA, Mem. Asiat. Soc. Bengal (2) **6** (1924) 484;

WEBER and DE BEAUFORT, Fishes Indo-Aust. Arch. **6** (1931) 281; HARDENBERG, Treubia **15** (1936) 247.

Chorinemus toloo BLEEKER, Nat. Tijdschr. Ned. Ind. **1** (1851) 342; Verh. Bat. Gen. **24** (1852) 23, 45; **25** (1853) 44; DAY, Fishes of India. Text 1 (1878–1888) 232; Fauna of British India. Fishes 2 (1889) 176; MACLEAY, Descr. Cat. Aust. Fishes. Sydney **1** (1881) 179; VINCIGUERRA, Ann. Mus. Civ. Stor. Nat. Genova **50** (1921–1926) 563.

Scomberoides toloo BLEEKER, Ned. Tijdschr. Dierk. **1** (1863) 235; FOWLER, Proc. Acad. Nat. Sci. Phila. **57** (1905) 56.

Scomberoides tala BLEEKER, Ned. Tijdschr. Dierk. **4** (1873) 116; JENKINS, Bull. U. S. Fish Comm. **22** [1902 (1904)] 441; SMITH and SEALE, Proc. Biol. Soc. Washington **19** (1906) 76; JORDAN and SEALE, Bull. U. S. Bur. Fish. **26** [1906 (1907)] 13; SEALE and BEAN, Proc. U. S. Nat. Mus. **33** (1907) 241; JORDAN and STARKS, Ann. Carnegie Mus. **11** (1917) 441; FOWLER, Copeia No. 58 (1918) 63; HERRE, Journ. Pan-Pacific Res. Inst. (4) **8** (1933) 8; Notes on fishes in the Zoological Museum of Stanford University (1934) 36.

Eleria philippina JORDAN and SEALE, Proc. U. S. Nat. Mus. **28** (1905) 774.

Eleria tala JORDAN and RICHARDSON, Bull. U. S. Bur. Fish. **27** [1907 (1908)] 249; MCCULLOCH, Mem. Aust. Mus. pt. 2 **5** (1929–1930) 181.

Head 3.8 to 4; depth 2.9; dorsals VII, I, 20 (preceded by a procumbent spine); pectoral I, 18 or 19; ventral 5; anal II, I, 18.

Body oblong, somewhat ovate, dorsal and ventral profiles both angular; greatest depth at level of base of dorsal and anal. Head small. Rostronuchal outline somewhat concave posteriorly. Mouth terminal, its cleft opposite center of or slightly above eye. Maxillary narrow, terminating at or slightly beyond hind border of eye. Chin slightly prominent. Upper jaw with a single series of teeth, lower jaw with two series, inner series composed of longer and larger teeth set far apart, outer series consisting of smaller teeth inclined forward. An elliptical patch of villiform teeth in vomer; in bands in palatines, pterygoids, and tongue. Snout pointed, equal to or greater than eye. Eye small, 3.8 to 4 in head. Interorbital greater than snout. Opercular opening terminating anteriorly below level of nostrils. Gillrakers 10, tapering, but with quite blunt tips.

Spinous dorsal 1.2 in head. Spines barely overlapping, each depressible in a groove. Anterior rays of soft dorsal and anal elevated half height of body. Pectoral short, 1.6 in head. Ventrals inserted below anterior extremity of pectoral base. Base of soft dorsal slightly greater than that of anal. Four to eight oblong, dark blotches intersecting the lateral line.

This species is close to *Scomberoides lysan* but has a shorter maxillary and a smaller number of gillrakers.

The above description is based on No. 6767, 252 mm total length, from Manila, collected in June, 1910.

LUZON, Manila, No. 34, 186 mm, May 21, 1907, No. 184, 218 mm, June 12, 1907, No. 10788, 350 mm, June 12, 1924, No. 6767, 252 mm, No. 6770, 115 mm, No. 6772, 160 mm (June, 1910: Rizal Province, Pasay, No. 11701, 258 mm, No. 31623, 262 mm, March 4, 1926: Camarines Sur Province, Sibubu, San Miguel Bay, No. 13210, 254 mm, No. 20600, 240 mm, January 17, 1926. SAMAR, Samar Province, Calbayog, No. 14961, 275 mm, No. 20786, 306 mm, December 17, 1926. PALAWAN, Palawan Province, Balabac, No. 5109, 182 mm, August 7, 1908.

SCOMBEROIDES TOL (Cuvier and Valenciennes). Plate 11, fig. 1.

Chorinemus tol CUVIER and VALENCIENNES, Hist. Nat. Poiss. 8 (1831) 283; CANTOR, Journ. Roy. Asiat. Soc. Bengal 18 (1849) 1101; BLEEKER, Nat. Tijdschr. Ned. Ind. 1 (1851) 342; 2 (1851) 475; 16 (1858–1859) 407; Verh. Bat. Gen. 24 (1852) 23, 43; 25 (1853) 36, 44; Versl. Akad. Amsterdam 12 (1861) 52, 74; GÜNTHER, Cat. Fish. Brit. Mus. 2 (1860) 473; DAY, Fishes of Malabar (1865) 93; KNER, Zool. Fische 1–3 (1865–1867) 162; WEBER, Die Fische der Siboga Expedition. Leiden (1913) 390; BARNARD, Ann. South African Mus. 21 (1927) 564; WEBER and DE BEAUFORT, Fishes Indo-Aust. Arch. 6 (1931) 283; GILTAY, Mem. Mus. Roy. Hist. Nat. Belg. Hors. V 3 (1933) 60; HARDENBERG, Treubia 15 (1936) 247.

Chorinemus moadetta RÜPPELL, Neue Wirbelthiere zu der Fauna von Abyssinien gehörig (1835–1840) 45; KLUNZINGER, Verh. Kaiserl. Königl. Zool.-Bot. Ges. Wien 21 (1871) 448.

Scomberoides tol FOWLER, Proc. Acad. Nat. Sci. Phila. 57 (1905) 59; 79 (1927) 268; JORDAN and RICHARDSON, Bull. U. S. Bur. Fish. 27 [1907 (1908)] 249; BEAN and WEED, Proc. U. S. Nat. Mus. 42 (1912) 601; FOWLER and BEAN, Proc. U. S. Nat. Mus. art. 2 62 (1923) 19; OSHIMA, Philip. Journ. Sci. 26 (1925) 351; HERRE, Journ. Pan-Pacific Res. Inst. (4) 8 (1933) 8; Notes on fishes in the Zoological Museum of Stanford University (1934) 36; Field Museum Nat. Hist. Chicago 21 (1936) 110.

Head 4.6 to 4.8; depth 4 to 4.2; dorsals VII, I, 21 (preceded by one procumbent spine); pectoral 17 or 18; ventral 5; anal II, I, 19.

Body oblong and elongate. Dorsal outline of body more convex than ventral, greatest depth at level of base of soft dorsal and anal. Rostronuchal profile concave, frontal with slight anterior concavity. Mouth terminal, its cleft opposite lower margin of pupil. Maxillary somewhat truncate, terminating at or slightly beyond hind border of pupil. Chin slightly prominent. Upper jaw with bands of villiform teeth anteriorly followed by an outer row of somewhat large teeth; lower jaw with two rows of teeth of almost equal size, in oval, somewhat acuminate patch in vomer, and in longitudinal bands in palatines, pterygoids, and tongue. Snout obtuse, 3.4 to 3.6 in head. Eye small, shorter than snout, 4.1 to 4.3 in head. Interorbital wide, with a slight keel, 3.2 to 3.6 in head. Nostrils slitlike, almost of equal size, somewhat halfway along snout, but mostly on posterior half. Opercular opening wide, extending anteriorly below level of anterior border of eye. Gillrakers 18 (16), elongate.

Spinous dorsal 1.2 in head. Spines flattened, quite overlapping, except sixth spine which does not reach base of seventh when depressed. Pectorals short, 1.9 in head. Ventrals shorter than pectoral, inserted below posterior extremity of base of pectoral. Base of soft dorsal slightly shorter than that of anal. Vent about midway between base of ventral and that of anal.

Anterior portion of soft dorsal blackish. Four to eight vertical oblong blotches along lateral line, first four blotches intersecting it.

Above description based on No. 15769, taken from Balabac, Palawan, November 22, 1927. Total length, 343 millimeters.

This species closely resembles *S. toloo-parah*, but differs from it in having needlelike or threadlike scales.

LUZON, Manila, No. 6773, 254 mm, June, 1911: Camarines Sur Province, San Miguel Bay, No. 10429, 190 mm, No. 20602, 194 mm, No. 2063, 198 mm, December 27, 1919. PANAY, Iloilo Province, Iloilo, No. 10359, 259 mm, July, 1922; Estancia, No. 10850, 276 mm, July, 1922. CEBU, Cebu Province, Bantayan, No. 5580, 320 mm, No. 5587, 337 mm, April, 1909. SAMAR, Samar Province, Calbayog, No. 20785, 280 mm, No. 20787, 289 mm, December 17, 1926. BALABAC, Palawan Province, No. 5061, 301 mm, August 5, 1908, No. 5142, 261 mm, August 8, 1908, No. 15769, 343 mm, November 22, 1927.

TRACHINOTINÆ

Body oblong or elevated, breast and belly rounded, with small and adherent cycloid scales, almost wanting on head. Lateral line nearly straight or only slightly arched, without scutes. Head small, opercles entire; preoperculum in young with spines. Mouth rather small; snout obtuse, intermaxillaries protractile. No pseudobranchiæ. Gillrakers of normal shape. Teeth small on jaws, vomer, and palatines, generally lost with age. Dorsals two, a spinous with 5 to 6 spines preceded by a subcutaneous spine; spines well developed and connected by membrane, becoming rudimentary in adult. Soft dorsal and anal of similar form, their bases nearly equal, anterior rays of each forming a falcate lobe. Pectorals short and rounded; ventrals short, caudal deeply forked, with pointed lobes. Finlets absent.

Genus TRACHINOTUS Lacépède, 1802

Trachinotus[11] LACÉPÈDE, Hist. Nat. Poiss. 3 (1802) 78.
Cæsiomorus[12] LACÉPÈDE, Hist. Nat. Poiss. 3 (1802) 92.
Acanthinion[13] LACÉPÈDE, Hist. Nat. Poiss. 4 (1803) 499.
Hipodys[14] RAFINESQUE, Caratteri Nouv. An. Sicil. (1810) 41.
Baillonus[15] RAFINESQUE. Analyse de la Nature (1815) 85.
Bothrolæmus[16] HOLBROOK, Ichth. South Carolina (1855) 80.
Doliodon[17] GIRARD, Proc. Acad. Nat. Sci. Phila. 10 (1859) 168.
Trachynotus GÜNTHER, Cat. Fish. Brit. Mus. 2 (1860) 480.
Campogramma REGAN, Ann. & Mag. Nat. Hist. (2) 12 (1903) 350.
Pampanoa FOWLER, Proc. Acad. Nat. Sci. Phila. 58 (1906) 116.
Glaucus (Klein) FOWLER, Proc. Acad. Nat. Sci. Phila. 58 (1906) 116.
Glaucus (Klein) JORDAN and HUBBS, Ann. Carnegie Mus. 11 (1917) 463.

Characters of the genus are the same as those of the subfamily Trachinotinæ.

Key to the Philippine species of Trachinotus.

*a*¹. Height twice or less in length; cleft of mouth opposite lower level of eye; body without spots .... *T. blochi.*
*a*². Height more than twice in length. Cleft of mouth opposite middle or lower third of eye; body with 2 to 6 lateral round spots.... *T. bailloni.*

TRACHINOTUS BLOCHI (Lacépède). Plate 11, fig. 2.

Scomber falcatus FORSKÅL, Descriptiones Animalium. Pisces (1775) 57.
Cæsiomorus blochii LACÉPÈDE, Hist. Nat. Poiss. (1819) 245.
Trachinotus falcatus RÜPPELL, Atlas zu der Reise im Nördlichen Afrika (1828) 88.
Trachinotus mookalee CUVIER and VALENCIENNES, Hist. Nat. Poiss. 8 (1831) 311; BLEEKER, Nat. Tijdschr. Ned. Ind. 1 (1851) 346; 3 (1852) 745; 8 (1855) 169, 170, 447; Verh. Bat. Gen. 24 (1852) 24, 47; 25 (1853) 44.

[11] Jordan and Evermann, Genera of Fishes, pts. 1–4 (1917–1929) 61.
[12] Ibid., 61.
[13] Ibid., 64.
[14] Ibid., 79.
[15] Ibid., 89.
[16] Ibid., 265.
[17] Ibid., 291.

Trachinotus blochii CUVIER and VALENCIENNES, Hist. Nat. Poiss. 8 (1831) 313; BLEEKER, Versl. Akad. Amsterdam 12 (1861) 52; (1861) 74.

Trachynotus mookalee CANTOR, Journ. Roy. Asiat. Soc. Bengal 18 (1849) 1102.

Trachynotus ovatus GÜNTHER, Cat. Fish. Brit. Mus. 2 (1860) 481; Fische der Südsee 2 (1876–1881) 139; BLEEKER, Ned. Tijdschr. Dierk. 1 (1863) 242; GILL, Proc. Acad. Nat. Sci. Phila. 14 [1862 (1863)] 438; DAY, Proc. Zool. Soc. London (1865) 25; (1870) 689; Fishes of India. Text 1 (1878–1888) 234; Fauna of British India. Fishes 2 (1889) 179; KNER, Zool. Fische 1–3 (1865–1867) 164; PLAYFAIR and GÜNTHER, Fishes of Zanzibar. London (1866) 64; KLUNZINGER, Verh. Kaiserl. Königl. Zool.-Bot. Ges. Wien 21 (1871) 449; Sitzgsber. Akad. Wien 80 (1880) 378; MACLEAY, Descr. Cat. Aust. Fishes. Sydney 1 (1881) 180; GOODE, Bull. U. S. Fish Comm. 1 [1881 (1882)] 39; GOODE and BEAN, Proc. U. S. Nat. Mus. 5 (1882) 237; MEYER, Ann. Soc. Españ. Hist. Nat. Madrid 14 (1885) 25; SAUVAGE, Hist. Phys. Nat. Pol. Madagascar 16 (1891) 332; ELERA, Catalogo Systematico de toda la Fauna de Filipinas. Vertebrados 1 Peces (1895) 514; DUNCKER, Mitt. Naturh. Mus. Hamburg 21 (1904) 156; GILCHRIST and THOMPSON, Ann. South African Mus. 6 (1908) 187; BARNARD, Ann. South African Mus. 21 (1927) 553; BORODIN, Bull. Vanderbilt Mar. Mus. art. 3 1 (1932) 78.

Trachynotus falcatus LÖNNBERG, Bihang Handl. Svensk. Vet. Akad. 22 (1896) 44.

Trachinotus ovatus JORDAN and SEALE, Bull. U. S. Bur. Fish. 25 [1905 (1906)] 235; FOWLER, Proc. Acad. Nat. Sci. Phila. 58 (1906) 116; Mem. B. P. Bishop Mus. 10 (1928) 152; KENDALL and GOLDSBOROUGH, Mem. Mus. Comp. Zool. Harvard 26 (1911) 271; OGILBY, Mem. Queens. Mus. 5 (1916) 154; MCCULLOCH, Aust. Zool. 2 (1921–1922) 63; Mem. Aust. Mus. pt. 2 5 (1929–1930) 192; OSHIMA, Philip. Journ. Sci. 26 (1925) 409; PARADICE and WHITLEY, Mem. Queens. Mus. 9 (1927–1929) 83; WHITLEY, Rec. Aust. Mus. 16 (1927–1929) 16.

Trachinotus blochi WEBER and DE BEAUFORT, Fishes Indo-Aust. Arch. 6 (1931) 286; GILTAY, Mem. Mus. Roy. Hist. Nat. Belg. Hors. V 3 (1933) 61; HERRE, Journ. Pan-Pacific Res. Inst. (4) 8 (1933) 8; Notes on fishes in the Zoological Museum of Stanford University (1934) 36.

Head 3 to 3.3; depth 1.5 to 1.7; dorsals VI, I, 18 (preceded by a strong procumbent spine); pectoral 18 or 19; ventral 5; anal II, I, 16.

Body ovate, elevated, well compressed; dorsal profile slightly greater than ventral; anterior contour slightly convex in young, straightening vertically with age; greatest depth at base of soft dorsal and anal. Head small. Rostrodorsal outline declivous. Mouth subterminal. Cleft of mouth below eye. Maxillary terminating beyond anterior third of eye. Lower and upper jaws almost equal; teeth minute in jaws and palatines, almost wanting in vomer. Snout blunt and short, equal to or shorter than eye. Nostrils in front of eye, posterior pair a trifle larger. Eyes large, 3 to 4 in head. Adipose eyelid poorly developed. Interorbital elevated, 2.5 to 3 in head. Five branchiostegal rays. Gillrakers 8 or 9, gradually shortening anteriorly. Lateral line poorly arched, sometimes slightly undulating.

Spinous dorsal 2 to 2.3 in head. Spines strong, last three spines longest. Soft dorsal falcate, extending beyond caudal base. Pectorals short, 1.3 to 1.8 in head. Ventrals inserted slightly beyond pectorals, 2 to 2.3 in head. Anterior rays of anal produced, not extending as far as tip of soft dorsal. Base of anal almost equal to that of soft dorsal.

This species is represented in the collection by only one specimen, No. 2373, 198 mm, collected from Jolo, February, 1908.

Foreign examples: GUAM, No. 7773, 94 mm, No. 7774, 101 mm, No. 7775, 107 mm, No. 7776, 99 mm, No. 7777, 85 mm, September, 1911.

TRACHINOTUS BAILLONI Lacépede. Plate 11, fig. 3.

Cæsiomorus bailloni LACÉPÈDE, Hist. Nat. Poiss. (1819) 244.

Cæsiomorus quadripunctatus RÜPPELL, Atlas zu der Reise im Nördlichen Afrika (1828) 90.

Trachinotus baillonii CUVIER and VALENCIENNES, Hist. Nat. Poiss. **8** (1831) 317; BLEEKER, Nat. Tijdschr. Ned. Ind. **1** (1851) 342, 345; **3** (1852) 741, 745; Verh. Bat. Gen. **24** (1852) 24, 46; Versl. Akad. Amsterdam **12** (1861) 74; EVERMANN and SEALE, Bull. U. S. Bur. Fish. **26** [1906 (1907)] 66; KENDALL and GOLDSBOROUGH, Mem. Mus. Comp. Zool. Harvard **26** (1911) 271; OSHIMA, Philip. Journ. Sci. **26** (1925) 407; PARADICE and WHITLEY, Mem. Queens. Mus. **9** (1927–1929) 83; WHITLEY, Rec. Aust. Mus. **16** (1927–1929) 16; FOWLER, Mem. B. P. Bishop Mus. **10** (1928) 152; MCCULLOCH, Mem. Aust. Mus. pt. 2 **5** (1929–1930) 192.

Trachinotus quadripunctatus CUVIER and VALENCIENNES, Hist. Nat. Poiss. **8** (1831) 320.

Trachynotus quadripunctatus CANTOR, Journ. Roy. Asiat. Soc. Bengal **18** (1849) 1104.

Trachynotus baillonii GÜNTHER, Cat. Fish. Brit. Mus. **2** (1860) 484; BLEEKER, Ned. Tijdschr. Dierk. **1** (1863) 242: PLAYFAIR and GÜNTHER, Fishes of Zanzibar. London (1866) 64; KLUNZINGER, Verh. Kaiserl. Königl. Zool.-Bot. Ges. Wien **21** (1871) 449; PETERS, Monats. Akad. Berlin [1875 (1876)] 440; MACLEAY, Descr. Cat. Aust. Fishes. Sydney **1** (1881) 180; BOULENGER, Proc. Zool. Soc. London (1887) 661; DAY, Fishes of India. Text 1 (1878–1888) 233; Fauna of British India. Fishes **2** (1889) 178.

Trachynotus bailloni DAY, Proc. Zool. Soc. London (1865) 25; GÜNTHER, Fische der Südsee **2** (1876–1881) 139; DUNCKER, Mitt. Naturh. Mus. Hamburg 21 (1904) 157; WAKIYA, Ann. Carnegie Mus. 15 (1923–1924) 219.

Trachinotus bailloni JORDAN and SEALE, Bull. U. S. Bur. Fish. 25 [1905 (1906)] 235; WEBER, Die Fische der Siboga Expeditie. Leiden (1913) 400; OGILBY, Mem. Queens. Mus. 5 (1916) 149; JORDAN and STARKS, Ann. Carnegie Mus. 11 (1917) 443; WEBER and DE BEAUFORT, Fishes Indo-Aust. Arch. 6 (1931) 288; GILTAY, Mem. Mus. Roy. Hist. Nat. Belg. Hors. V 3 (1933) 61; HERRE, Journ. Pan-Pacific Res. Inst. (4) 8 (1933) 8; Notes on fishes in the Zoological Museum of Stanford University (1934) 36; Field Mus. Nat. Hist. Chicago 21 (1936) 117.

Head 3.3 to 4.5; depth 2.2 to 2.6; dorsals VI, I, 22 to 23 (preceded by a strong procumbent spines); pectoral 17 or 18; ventral I, 5; anal II, I, 22 to 23.

Body oblong-ovate, well compressed; ventral profile more angular than dorsal; greatest depth at base of soft dorsal and anal. Head small, its depth greater than its width. Rostrodorsal profile slightly convex. Mouth terminal. Cleft of mouth opposite lower border of pupil. Maxillary extending to anterior border of pupil. Jaws, vomer, and palatines with villiform teeth; tongue edentulous. Snout rounded, nearly equal to eye. Nostrils opposite upper border of eye anteriorly, posterior twice as large as anterior. Eyes large, 3.2 to 3.4 in head. Adipose eyelid poorly developed. Interorbital moderately elevated, 3 to 3.3 in head. Branchiostegal rays 7, first branched. Gillrakers 14 or 15, short and slender.

Spinous dorsal 1.5 in head. Spines strong, last four longest. First four anterior rays of soft dorsal produced, extending to caudal peduncle. Pectorals short, 1.5 in head. Ventrals inserted beyond pectorals. Anterior rays of anal produced, much longer than produced rays of soft dorsal. Base of anal greater than that of soft dorsal.

Two dark spots or blotches on lateral line, first spot below gap between last spine of spinous dorsal and first spine of soft dorsal; second spot below ninth or tenth ray of soft dorsal.

MINDORO, Mindoro Province, Mangarin, No. 20612, 330 mm, No. 4503, 275 mm, 1913. PANAY, Iloilo Province, Estancia, No. 11753, 257 mm, February 13, 1925. COMIRAN, Palawan Province, No. 15629, 165 mm, No. 20607, 74 mm, No. 20608, 158 mm, No. 20609, 102 mm, No. 20610, 161 mm, November 20, 1927. JOLO, Sulu Province, No. 11297, 240 mm, September 9, 1924.

SERIOLINÆ

Body oblong, or long and slender, slightly compressed, with rounded abdomen. Head without trenchant keel. Scales small, cycloid. Lateral line without scutes, weakly arched anteriorly, on caudal peduncle with a more or less distinct cutaneous keel. Mouth terminal, its cleft small or wide. Intermaxillaries protractile. Gill membranes free from isthmus; gillrakers of moderate size, in moderate or small numbers. Preoperculum and operculum entire in adults. Teeth in villiform bands in jaws, vomer, palatines, and usually on tongue. Dorsals two; a spine with six to seven spines which are connected by a membrane and depressible in a groove in youth, becoming weak and reduced in number or becoming obsolete with age. Soft dorsal with somewhat elevated anterior rays. Anal nearly half length of soft dorsal, preceded by two weak spines, which may disappear with age. Soft dorsal and anal with or without finlets. Pectorals short, not falcate; ventral inserted behind base of pectorals, usually longer than pectorals. Caudal deeply incised.

Key to the Philippine genera of Seriolinæ.

a[1]. Soft dorsal and anal with a single two-rayed finlet.................. *Elagatis*.
a[2]. Soft dorsal and anal without finlet.. *Seriola*.

Genus ELAGATIS Bennett, 1835

Elagatis BENNETT, Narrative Whaling Voy. 2 (1835) 283.
Seriolichthys BLEEKER, Nat. Tijdschr. Ned. Ind. 6 (1854) 196.
Decaptus[18] POEY, Poissons de Cuba, Mem. de Cuba 2 (1861) 291.
Irex VALENCIENNES, C. R. Acad. Sci. Paris 54 (1862) 1204.

Body long and slender, slightly compressed. Head long and pointed. Mouth terminal, small. Intermaxillary protractile, maxillary posteriorly triangular, with an elongate supplemental bone the major portion of which slips inside the preorbital. Preoperculum and operculum entire. Gill opening wide, extending forward to below eye. Gillrakers in moderate number. Body scales somewhat large, with truncate or rounded hind margins, slightly denticulate, surrounded by smaller cycloid scales. Lanceolate cycloid scales on cheeks, postorbital, and upper opercular. Lateral line slightly curved, becoming straight above origin of anal. First dorsal with six low spines. Soft dorsal and anal long, somewhat elevated anteriorly with scaly basal sheath, both with a distant two-rayed finlet posteriorly. Preanal spines small, free, visible or covered by skin. Pec-

[18] Jordan and Evermann, Genera of Fishes. pts. 1–4 (1917–1920) 309.

toral short and broad; ventral inserted behind base of pectorals, superficially depressible into a narrow shallow groove. Caudal deeply incised, its lobes acute.

ELAGATIS BIPINNULATUS (Quoy and Gaimard). "Salmon." Plate 12, fig. 1.

Seriola bipinnulata QUOY and GAIMARD, Voyage autour du monde. Paris (1824) 363.

Elagatis bipinnulatus BENNETT, Narrative of a whaling voyage round the globe from 1833 to 1836. Fishes 2 (1840) 283; MEEK and BOLLMAN, Proc. Acad. Nat. Sci. Phila. 41 (1889) 42; JORDAN and EVERMANN, Bull. U. S. Nat. Mus. 47 (1896) 906; Rept. U. S. Fish Comm. 21 [1895 (1896)] 344; Bull. U. S. Fish Comm. 23 [1903 (1905)] 185; FOWLER, Proc. Acad. Nat. Sci. Phila. 57 (1905) 65; Mem. B. P. Bishop Mus. 10 (1928) 143; Acad. Nat. Sci. Phila. Monog. No. 2 (1938) 254; JORDAN and SEALE, Bull. U. S. Bur. Fish. 25 [1905 (1906)] 229; SEALE, Occ. Pap. B. P. Bishop Mus. 4 (1906) 30; WEBER, Die Fische der Siboga Expeditie. Leiden (1913) 393; McCULLOCH, Aust. Zool. 2 (1921–1927) 63; Mem. Aust. Mus. pt. 2 5 (1929–1930) 183; JORDAN and JORDAN, Mem. Carnegie Mus. 10 (1922–1925) 37; OSHIMA, Philip. Journ. Sci. 26 (1925) 357; BARNARD, Ann. South African Mus. 21 (1927) 562; WEBER and DE BEAUFORT, Fishes Indo-Aust. Arch. 6 (1931) 293; HERRE, Notes on fishes in the Zoological Museum of Stanford University (1934) 36; Journ. Pan-Pacific Res. Inst. (2) 10 (1935) 164; WALFORD, Marine game fishes of the Pacific coast from Alaska to the equator (1937) 65.

Seriolichthys bipinnulatus BLEEKER, Nat. Tijdschr. Ned. Ind. 6 (1854) 196; 8 (1855) 171, 448; GÜNTHER, Cat. Fish. Brit. Mus. 2 (1860) 468; Fische der Südsee 2 (1876–1881) 136; PLAYFAIR and GÜNTHER, Fishes of Zanzibar. London (1866) 62; KLUNZINGER, Verh. Kaiserl. Königl. Zool.-Bot. Ges. Wien 21 (1871) 452; PETERS, Monats. Akad. Wissen. Berlin (1876) 836; MEYER, Ann. Soc. Españ. Hist. Nat. Madrid 14 (1885) 25; BOULENGER, Proc. Zool. Soc. London (1887) 661; DAY, Fishes of India. Text 1 (1878–1888) 228; Fauna of British India. Fishes 2 (1889) 171; GILCHRIST and THOMPSON, Ann. South African Mus. 6 (1908) 245.

Seriolichthys lineolatus DAY, Proc. Zool. Soc. London (1867) 559.

Elagatis pinnulatus GOODE, Bull. U. S. Fish Comm. 1 [1881 (1882)] 43; GOODE and BEAN, Proc. U. S. Nat. Mus. 5 (1882) 237.

Elagatis bipinnulata WAKIYA, Ann. Carnegie Mus. 15 (1923–1924) 233.

Head 3.8; depth 4; dorsals VI, I, 24 or 25; pectoral I, 19; ventral I, 5; anal II, I, 17 or 18; 2-rayed finlets, one dorsal and one ventral; scales of lateral line, 100 to 104.

Body long and slender, slightly compressed. Dorsal and ventral contours almost equal; greatest depth at level of base of soft dorsal and midway between base of ventral and vent. Head large, rostronuchal profile moderately declivous with a slight concavity anteriorly. Mouth terminal. Cleft of mouth opposite lower margin of pupil. Maxillary with broad triangular supplemental bone terminating below vertical line passing between nostrils and eye. Chin very slightly prominent. Jaws, vomer, and palatines with villiform teeth. Snout long and pointed, 2.8 in head. Nostrils about midway between tip of snout and middle of supraorbital. Eye small, 4 to 4.6 in head. Adipose eyelid poorly developed. Gillrakers 26 to 28, tapering and flattened.

Spinous dorsal 2.5 to 3 in head. Spines strong, depressible in a groove; second, third, and fourth spines longest. Pectoral broad and short, 1.8 to 2 in head. Ventral inserted beyond pectoral base, 2 in head. Anal spines incorporated in the muscle, first almost wanting, second partially exposed. Base of soft dorsal 1.5 to 1.7 in base of anal.

MARINDUQUE, Marinduque Province, No. 11681, 393 mm, March 11, 1925, May 25, 1908. JOLO, Sulu Province, No. 11339, 392 mm, No. 20592, 371 mm, September 10, 1924.

Genus SERIOLA Cuvier, 1817

Seriola CUVIER, Regne Animal. ed. 1 2 (1817) 129.
Zonichthys[19] SWAINSON, Nat. Hist. Animals 2 (1839) 248.
Naucratopsis GILL, Proc. Acad. Nat. Sci. Phila. 14 [1862 (1863)] 441.
Halatractus GILL, Proc. Acad. Nat. Sci. Phila. 14 [1862 (1863)] 442.
Lepidomegas[20] THOMINOT, Bull. Soc. Philom. Paris (7) 4 (1880) 173.
Seriolina WAKIYA, Ann. Carnegie Mus. 15 [1924 (July)] 230.
Regificola WHITLEY, Aust. Zool. pt. 4 6 (1931) 316.

Oblong to long and slender, slightly compressed, abdomen usually rounded. Head conical with somewhat pointed snout. Gape of mouth usually wide. Intermaxillaries protractile; maxillary with a large supplemental bone, reaching front border or middle of eye. Gill opening wide, extending anteriorly to below mandibles. Preoperculum entire, denticulated only in young.

Scales small. Lateral line slightly curved above pectorals. Scutes absent. Caudal peduncle with a cutaneous keel. Gillrakers in moderate number, normal in shape or transformed into rudimentary tubercles. Spinous dorsal with seven weak spines connected by membrane, preceded by a more or less obsolete spine. Soft dorsal and anal quite elevated anteriorly.

[19] Jordan and Evermann, Genera of Fishes. pts. 1–4 (1917–1920) 200.
[20] Ibid., 406.

Anal much shorter than soft dorsal, preceded by two weak spines, which disappear with age. Finlets absent. Pectoral broad, shorter than head; ventrals longer. Caudal deeply notched.

SERIOLA NIGROFASCIATA (Rüppell). Plate 12, fig. 2.

Nomeus nigrofasciatus RÜPPELL, Atlas zu der Reise im Nördlichen Afrika, Zoologie 2 (1928) 92.

Seriola binotata CUVIER and VALENCIENNES, Hist. Nat. Poiss. 9 (1833) 160; CANTOR, Journ. Roy. Asiat. Soc. Bengal 18 (1849) 1119; BLEEKER, Verh. Bat. Gen. 25 (1853) 46; Versl. Akad. Amsterdam 12 (1861) 52, 74.

Seriola rüppelli CUVIER and VALENCIENNES, Hist. Nat. Poiss. 9 (1833) 161; BLEEKER, Nat. Tijdschr. Ned. Ind. 1 (1851) 343; 3 (1852) 741, 745; Verh. Bat. Gen. 24 (1852) 30, 73.

Seriola nigrofasciata RÜPPELL, Neue Wirbelthiere zu der Fauna von Abyssinien gehörig (1835–1840) 52; GÜNTHER, Cat. Fish. Brit. Mus. 2 (1860) 465; PLAYFAIR and GÜNTHER, Fishes of Zanzibar. London (1866) 62; KLUNZINGER, Verh. Kaiserl. Königl. Zool. Bot. Ges. Wien 21 (1871) 450; BLEEKER, Ned. Tijdschr. Dierk. 4 (1873) 116; DAY, Fishes of India. Text 1 (1878–1888) 227; Fauna of British India. Fishes 2 (1889) 170; MACLEAY, Descr. Cat. Aust. Fishes. Sydney 1 (1881) 174; DUNCKER, Mitt. Naturh. Mus. Hamburg 21 (1904) 156; EVERMANN and SEALE, Bull. U. S. Bur. Fish. 26 [1906 (1907)] 63; FOWLER, Proc. Acad. Nat. Sci. Phila. 79 (1927) 268; Mem. B. P. Bishop Mus. 10 (1928) 142; Ann. Natal Mus. pt. 3 7 (1934) 419; WEBER and DE BEAUFORT, Fishes Indo-Aust. Arch. 6 (1931) 295.

Seriola intermedia TEMMINCK and SCHLEGEL, Fauna Japonica 3 (1842) 115; BLEEKER, Verh. Bot. Gen. 25 (1853) 15.

Zonichthys nigrofasciata BARNARD, Ann. South African Mus. 21 (1927) 557.

Head 3.2 to 3.5; depth 3 to 3.5; dorsals VII, I, 31 or 32 (preceded by a procumbent spine); pectoral I, 17 to 19; ventral I, 5; anal I, I, 15 or 16.

Body oblong, slightly compressed; dorsal profile more convex than ventral; greatest depth at base of soft dorsal and anterior portion of abdomen, behind attachment of last rays of ventral. Head large. Rostrodorsal outline convex, with a slightly prominent rostronuchal keel in young, disappearing with age. Mouth terminal, its cleft opposite lower border of eye. Maxillary narrow, extending to below middle of eye. Chin slightly protruding. Jaws, vomer, and palatines with villiform teeth. Tongue with a median narrow patch of minute teeth. Snout somewhat blunt anteriorly. Nostrils slitlike, opposite eye, about midway along snout; posterior pair larger. Eye large, 3.1 to 3.7 in head. Adipose eyelid poorly developed. Interorbital greater than eye.

2.7 to 2.9 in head. Gill opening large, extending to below anterior border of eye. Gillrakers 3 to 9, rudimentary or knoblike.

Spinous dorsal 3 to 3.9 in head. Spines weak, third spine longest. Pectoral broad and short, 1.2 to 1.6 in ventral. Ventral inserted below pectoral base, longer than pectoral, 1.1 to 1.4 in head. Origin of anal behind middle of soft dorsal. Soft dorsal rays connected by a thick fleshy membrane. Preanal spine hidden. Base of anal 2 to 2.2 in that of soft dorsal.

About six dark transverse bands, first below nuchal, second below spinous dorsal, third, fourth, and fifth below soft dorsal, sixth in caudal peduncle.

LUZON, Manila, No. 300, 170 mm, No. 423, 145 mm, June 14 and 28, 1904, No. 6895, 320 mm, June 10, 1910, No. 15969, 124 mm, March 19, 1929, No. 31621, 168 mm, October, 1930: Camarines Sur Province, Bicol River, No. 6832, 152 mm, 1918. PANAY, Iloilo Province, Dumangas, No. 9926, 139 mm, June 2, 1922.

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ILLUSTRATIONS

PLATE 9

FIG. 1. *Ulua mandibularis* (Macleay).
2. *Alectis ciliaris* (Bloch).
3. *Alectis indica* (Rüppell).

PLATE 10

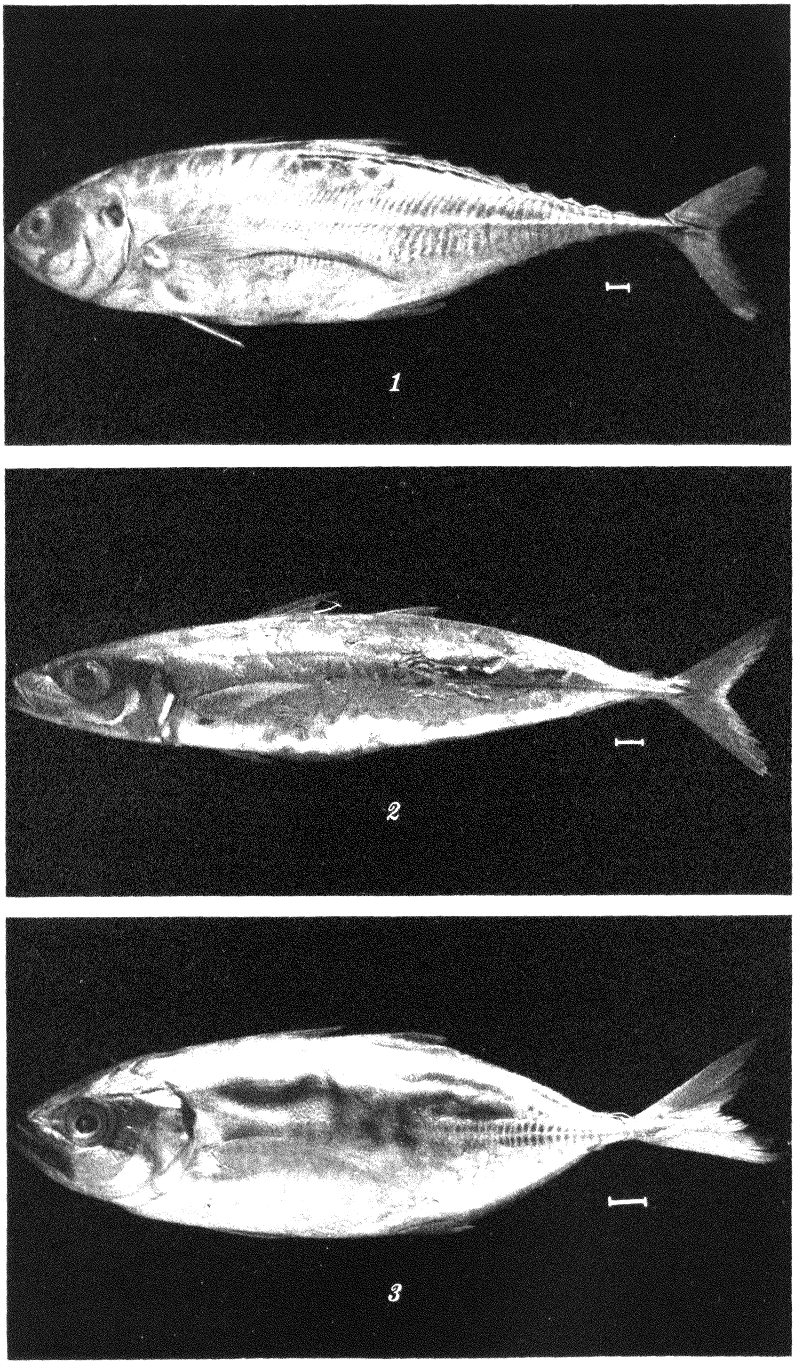
FIG. 1. *Scomberoides lysan* (Forskål).
2. *Scomberoides toloo-parah* (Rüppell).
3. *Scomberoides tala* (Cuvier and Valenciennes) Day.

PLATE 11

FIG. 1. *Scomberoides tol* Cuvier and Valenciennes.
2. *Trachinotus blochi* (Lacépède).
3. *Trachinotus bailloni* Lacépède.

PLATE 12

FIG. 1. *Elagatis bipinnulatus* (Quoy and Gaimard).
2. *Seriola nigrofasciata* (Rüppell).



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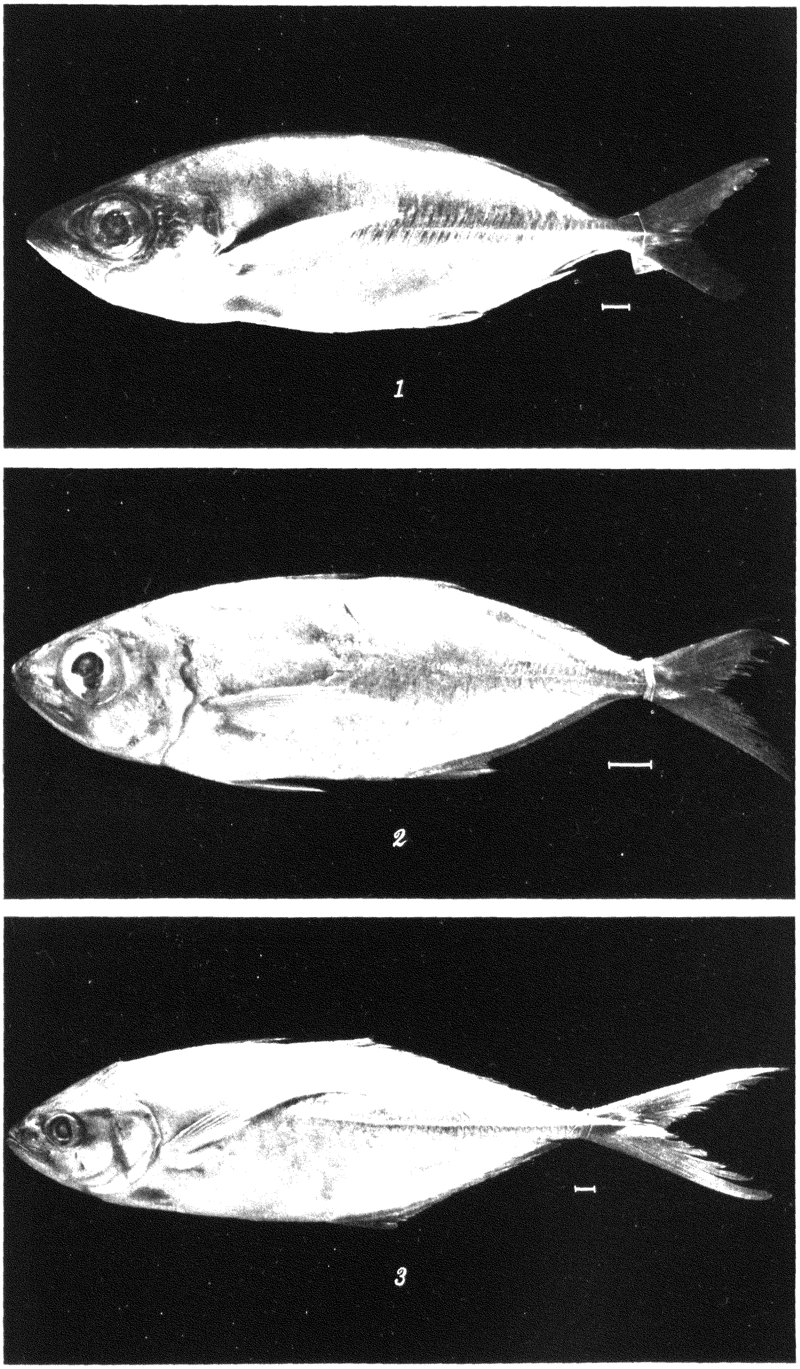

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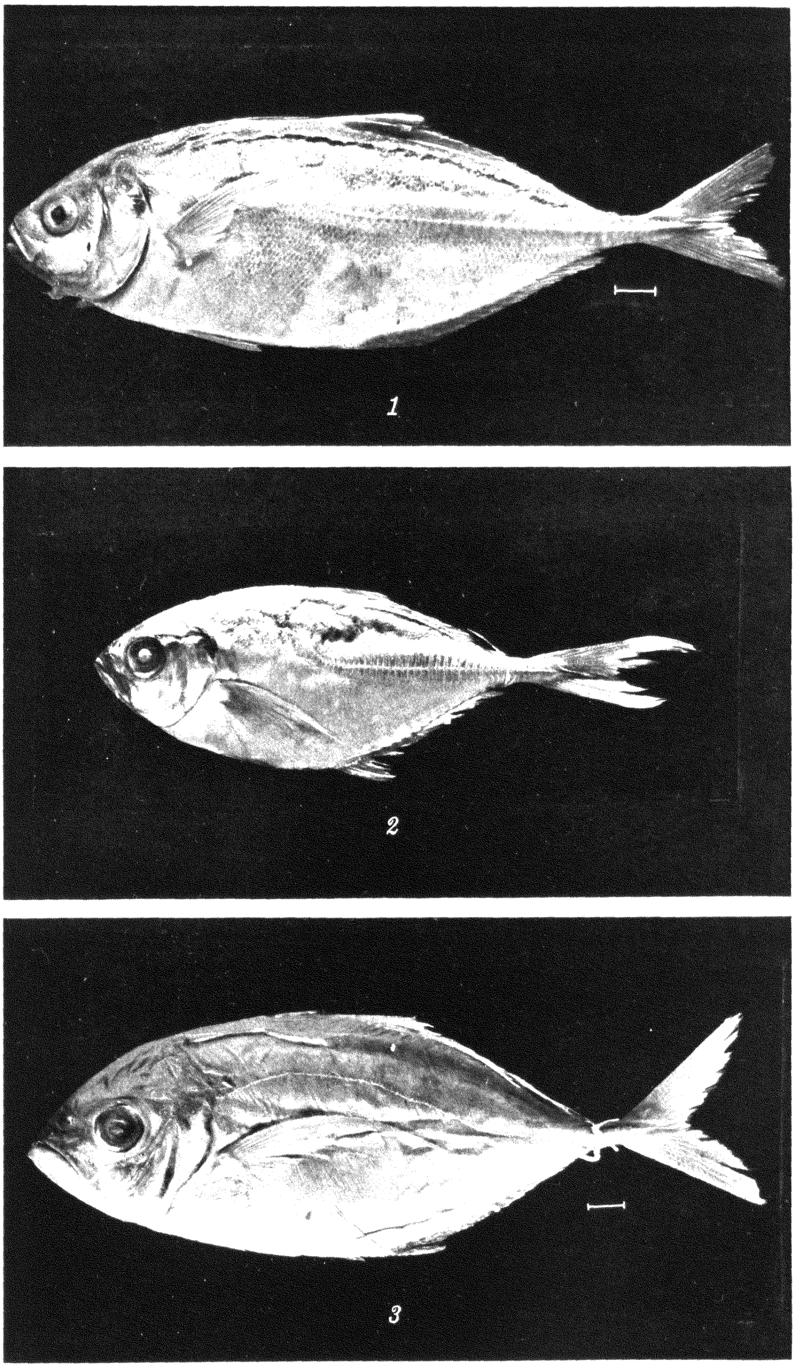

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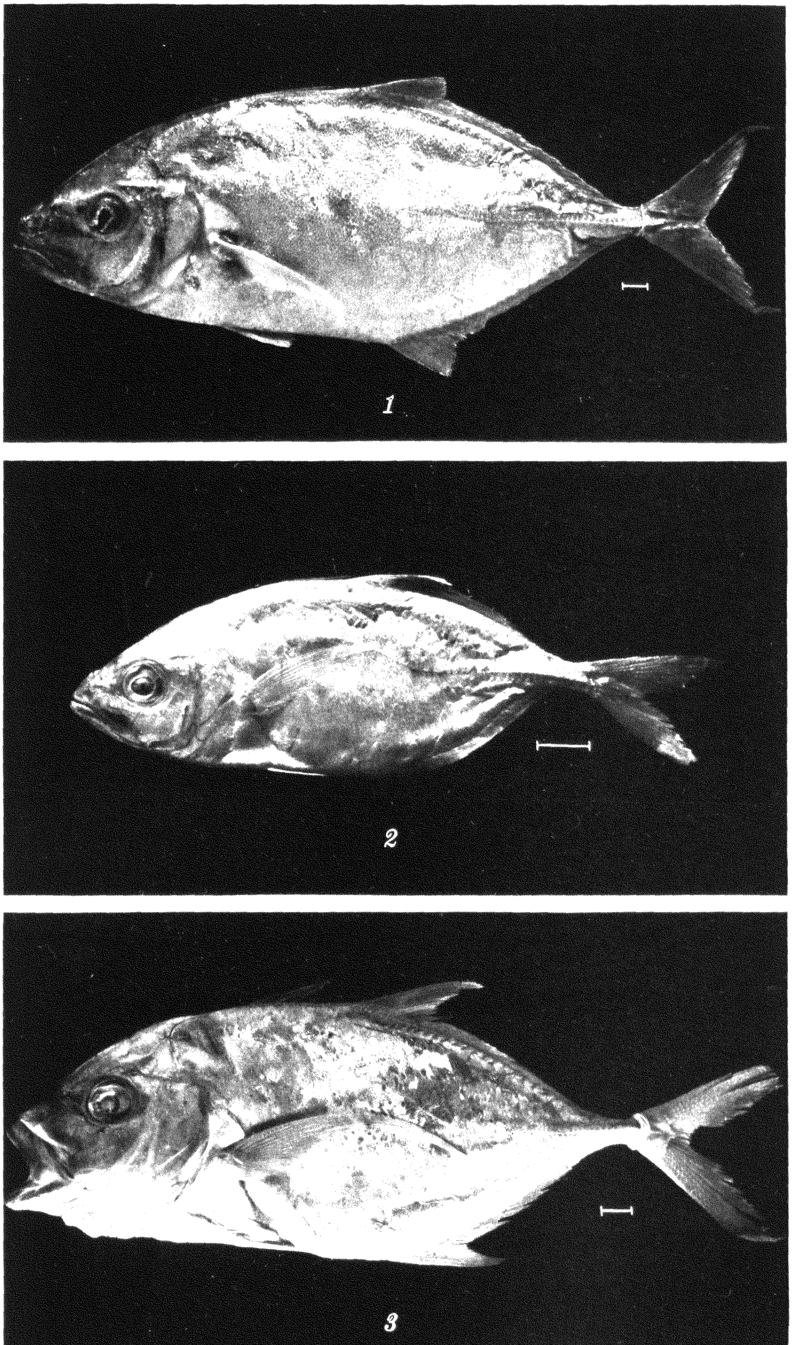

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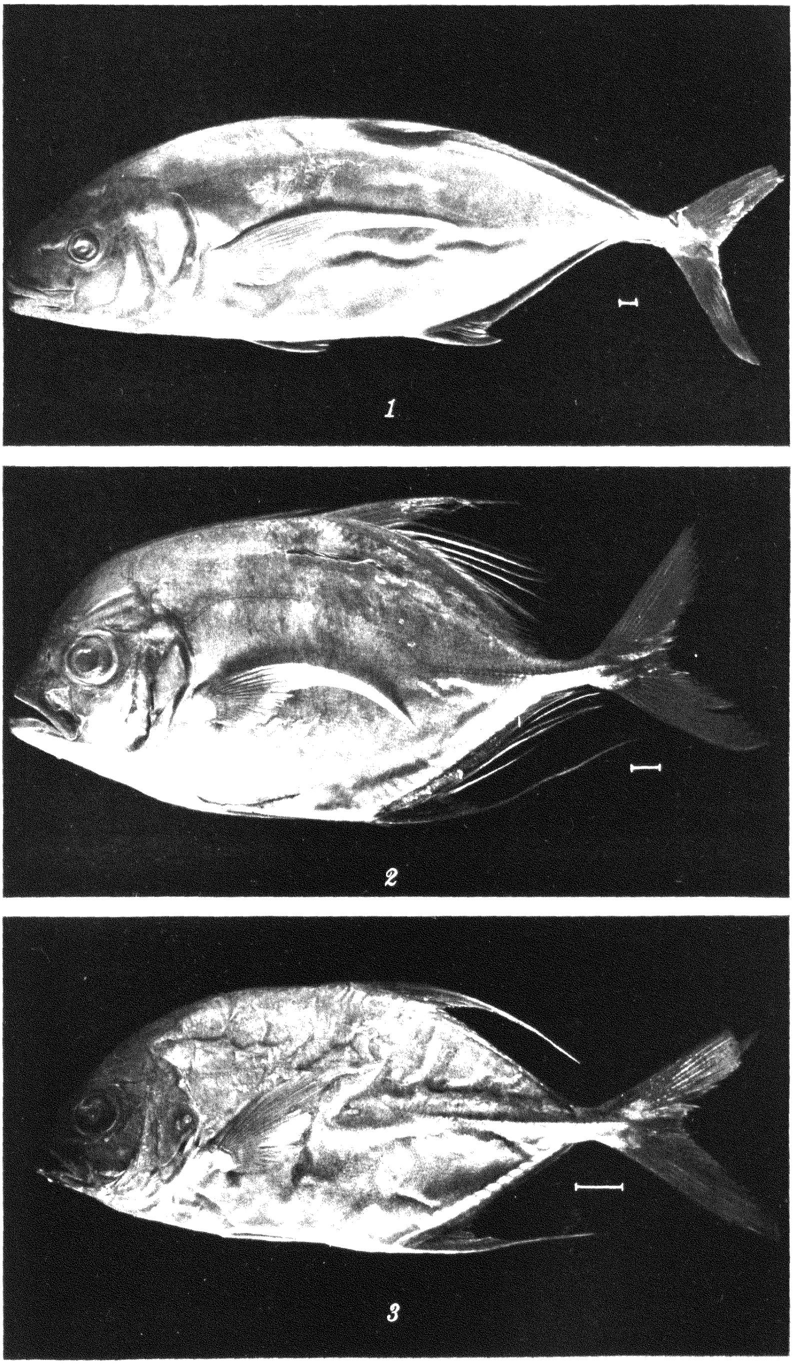

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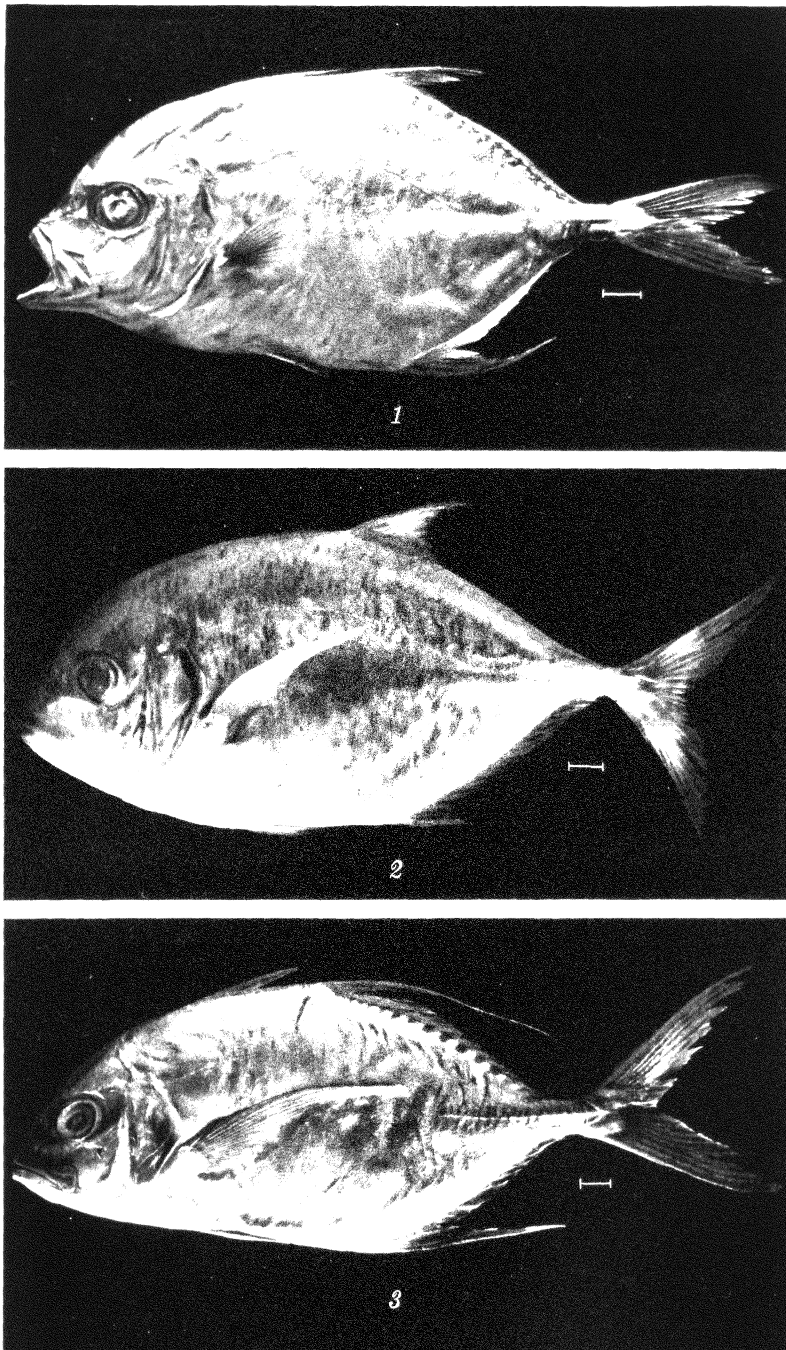

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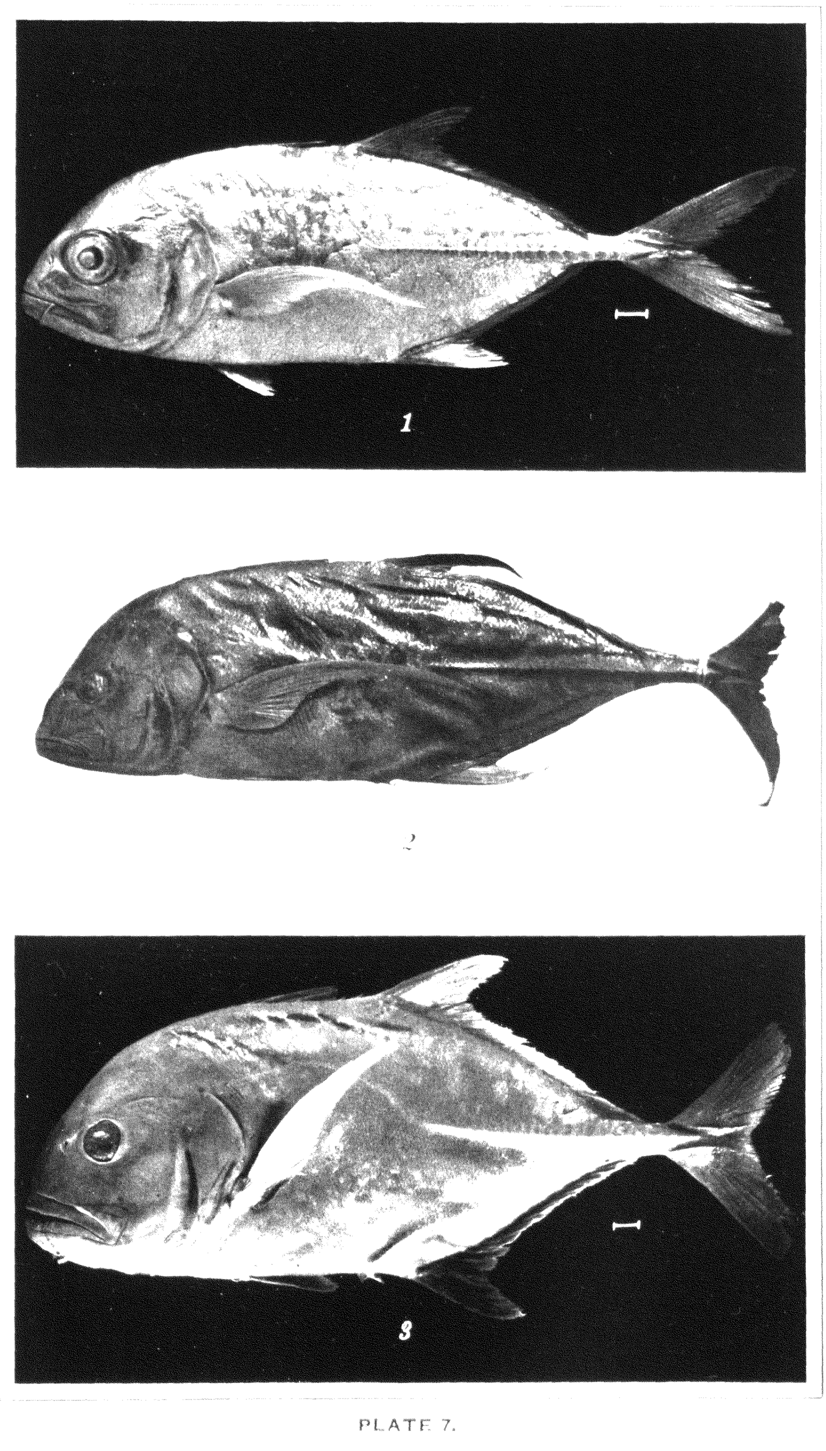

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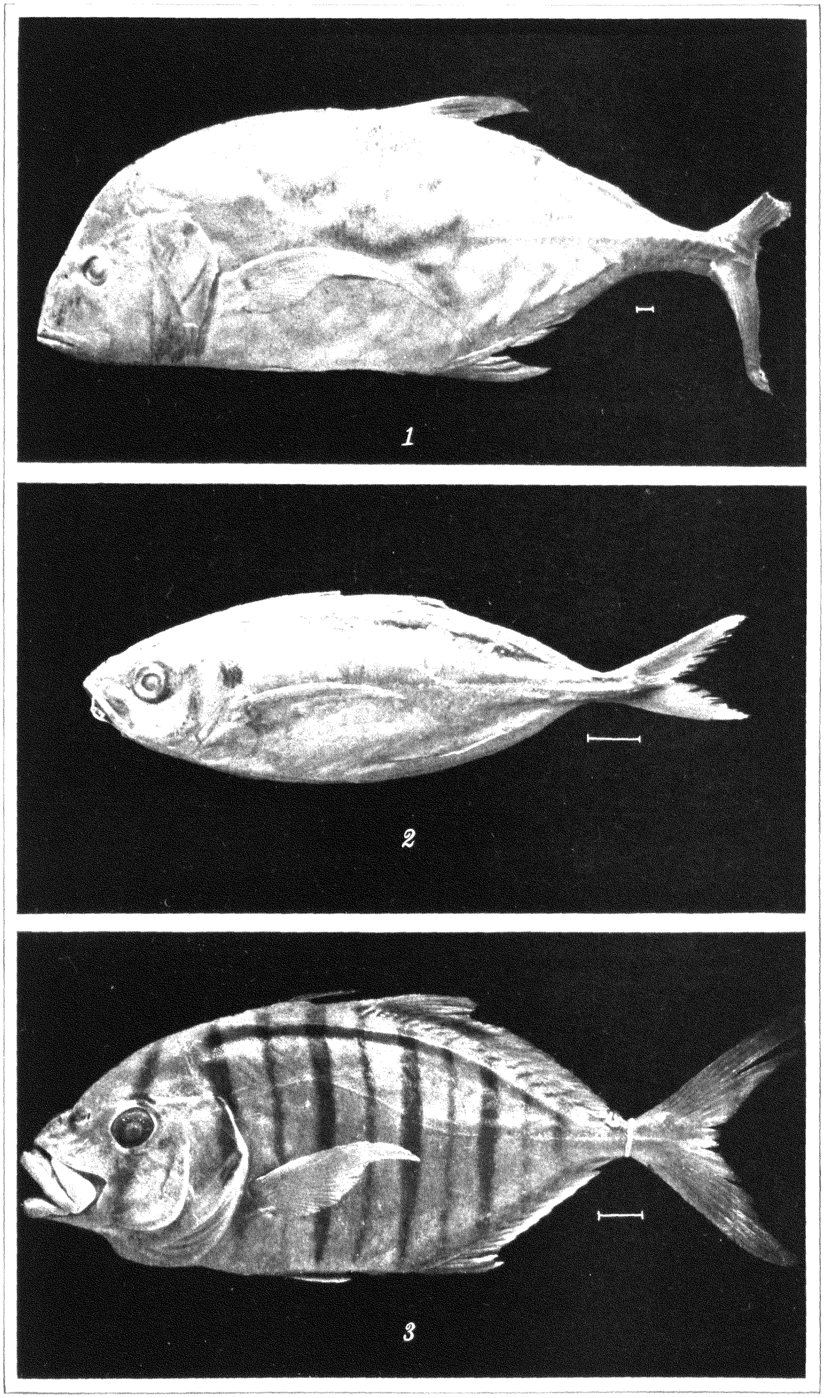

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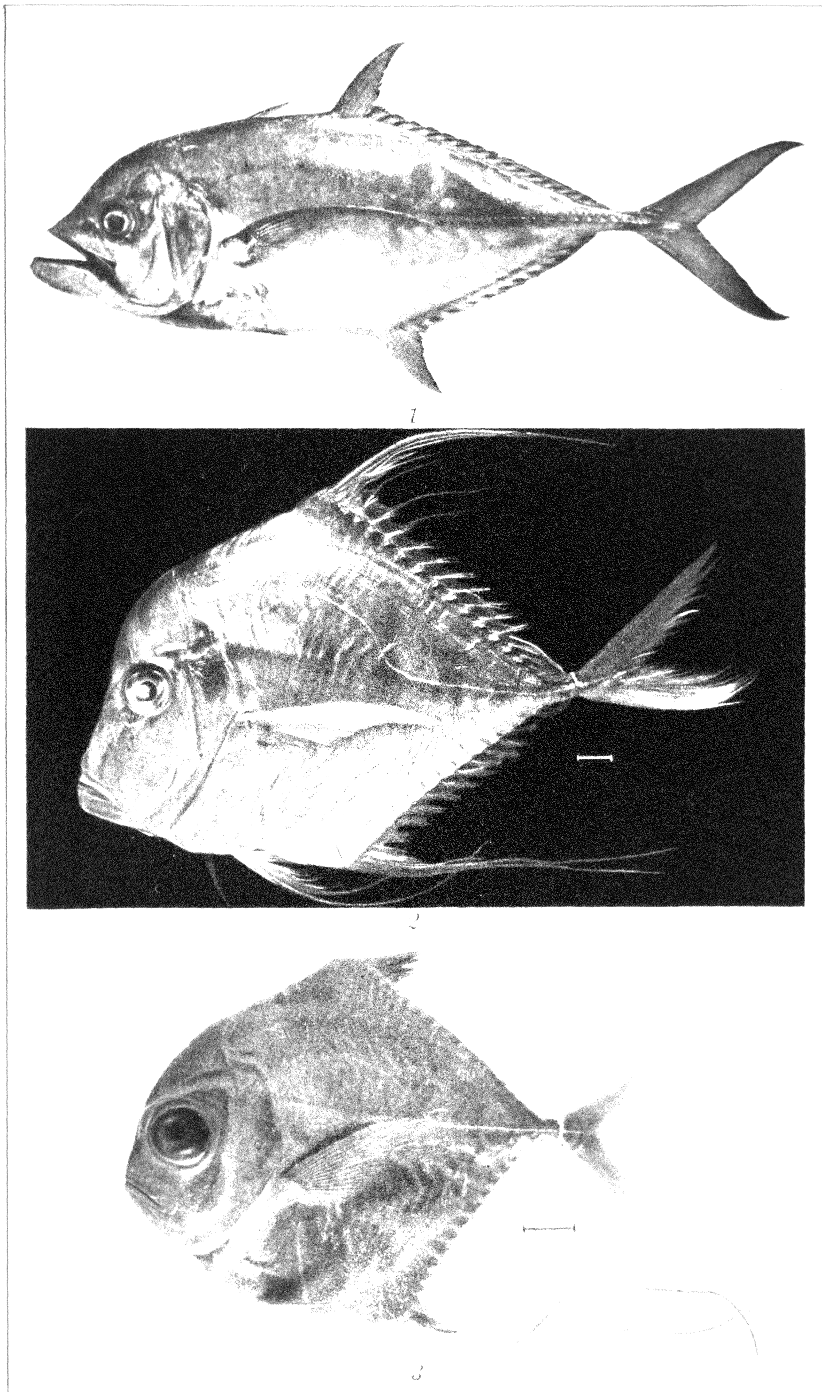

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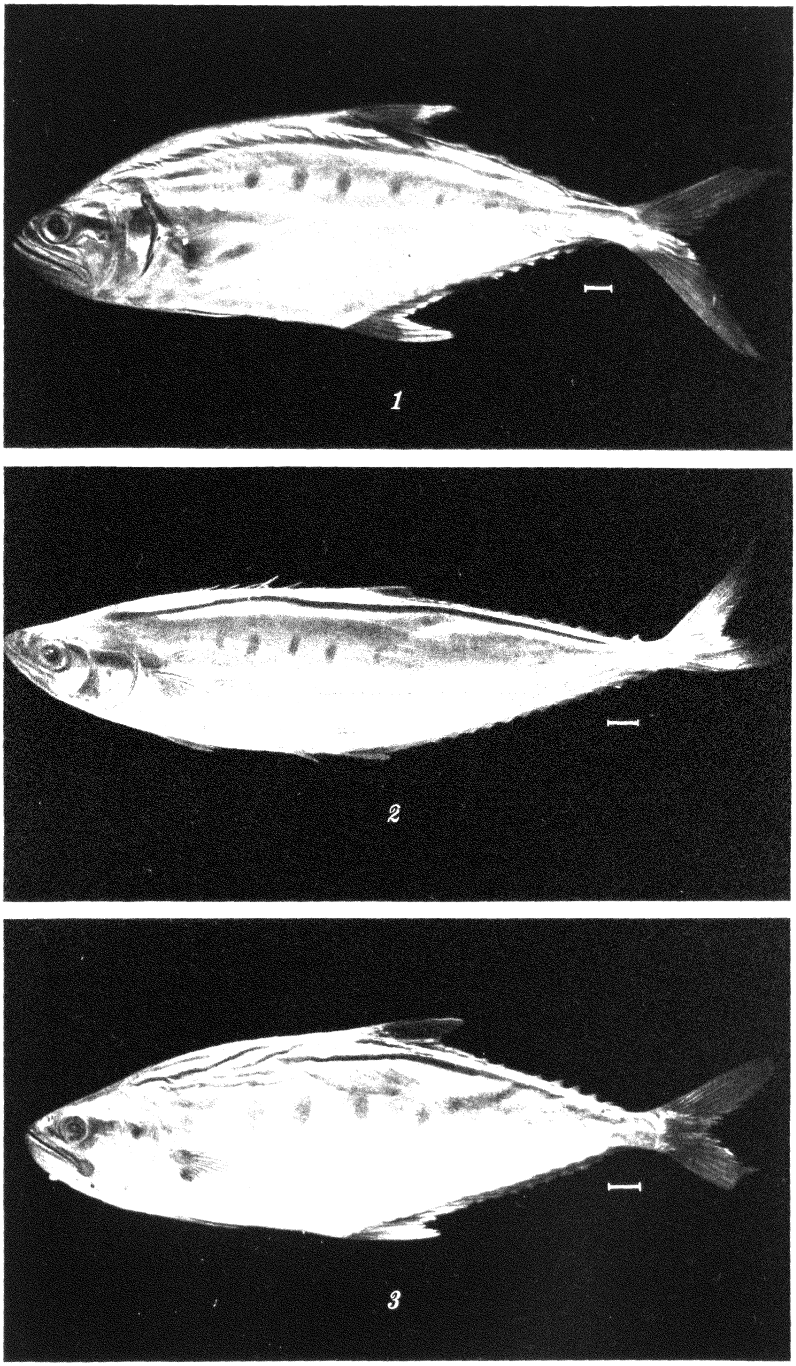

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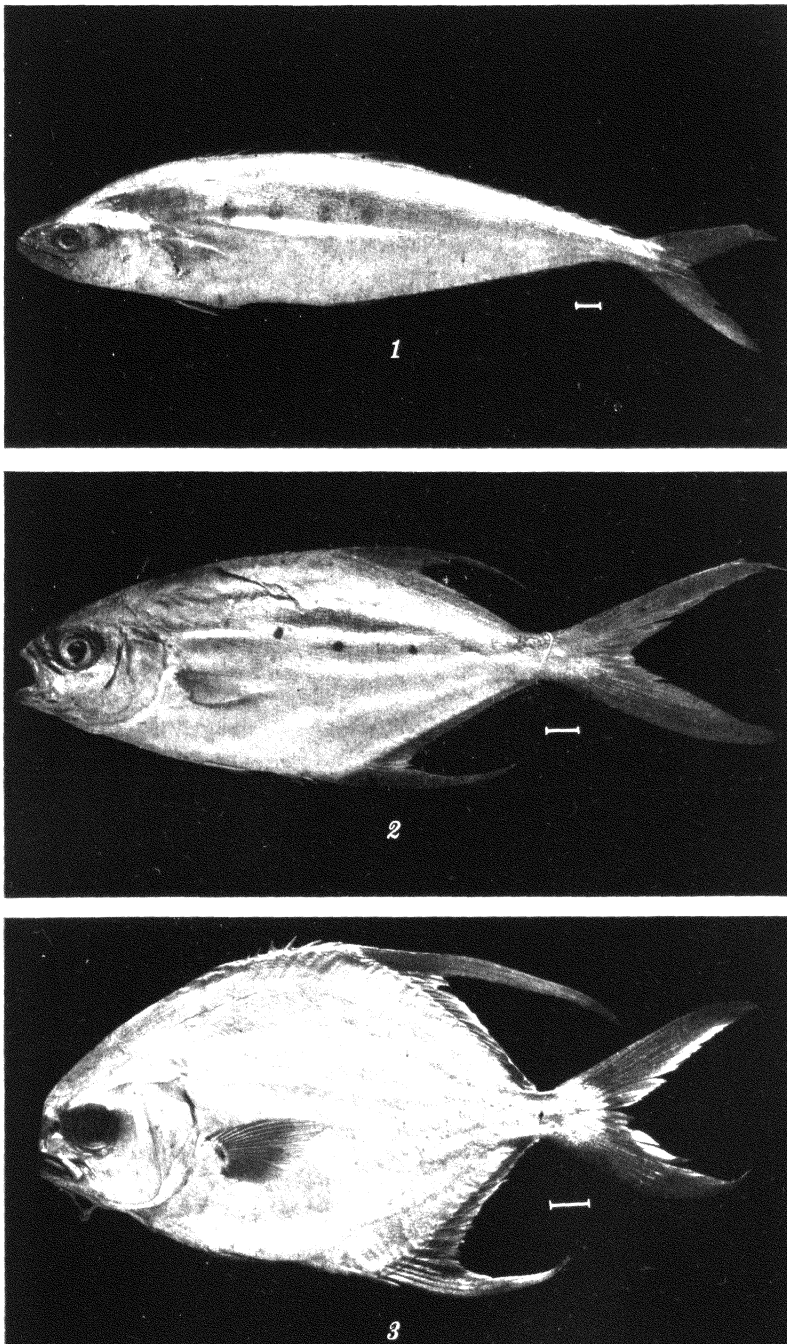

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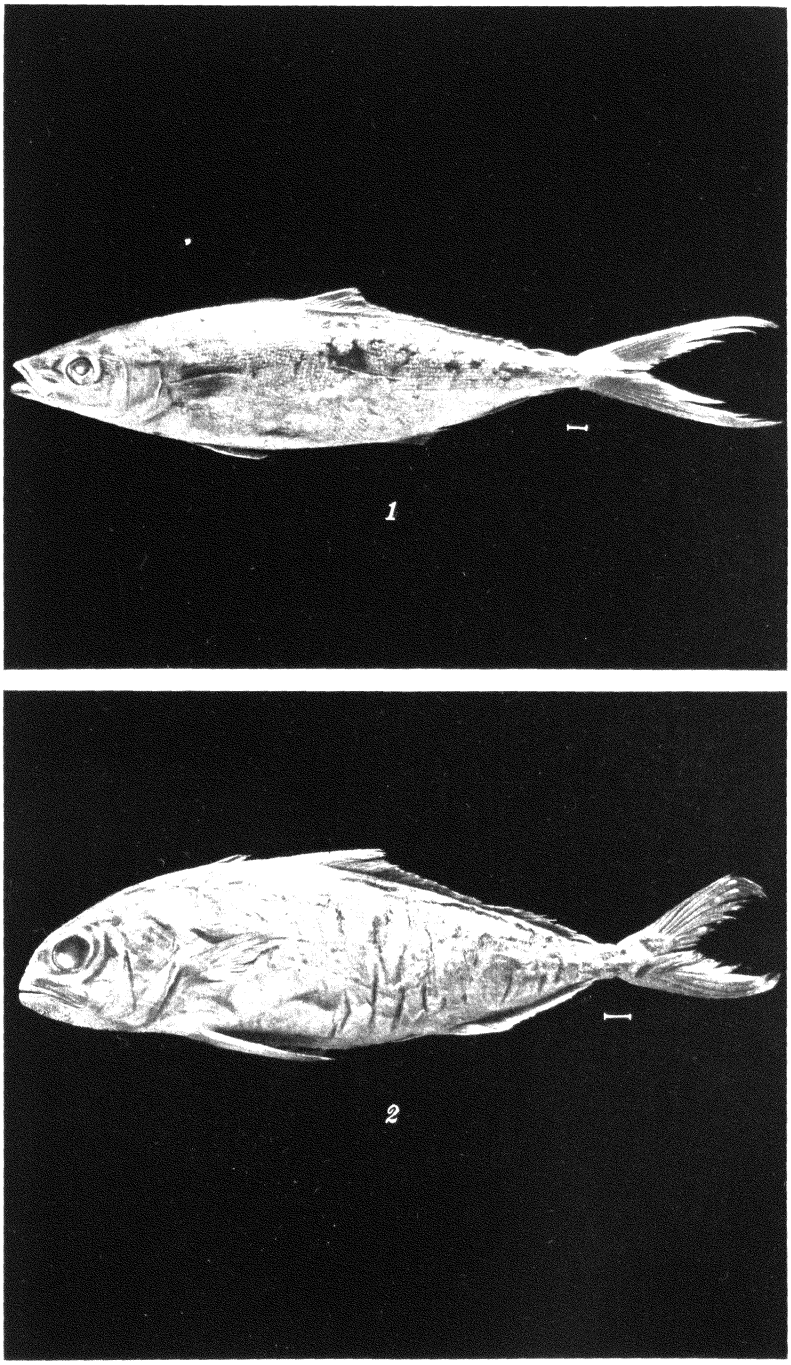

PLATE 12.

THE PHILIPPINE JOURNAL OF SCIENCE

VOL. 74 FEBRUARY, 1941 No. 2

ON TWO NEW SPECIES OF THE FAMILY HYMENOLEPIDIDÆ FUHRMANN 1907 (CESTODA) FROM A BURMESE CORMORANT, PHALACROCORAX JAVANICUS (HORSFIELD, 1821).

By L. N. JOHRI

Of University College, Rangoon, Burma

FIVE TEXT FIGURES

The material described in this paper was collected from a Burmese cormorant, *Phalacrocorax javanicus* (Horsf. 1821), from the Rubber Plantations Gyogon, Insein District. On dissection 22 cestodes were found: 5 in the stomach, 5 in the duodenum, and 12 in the intestine. Of these, 5 were *Hymenolepis gyogonka* sp. nov., and the rest *Oligorchis burmanensis* sp. nov. Forty-eight nematodes and 1 trematode were also collected from the stomach and duodenum, respectively. In the following descriptions all measurements, unless otherwise stated, are given in millimeters.

Family HYMENOLEPIDIDÆ Fuhrmann, 1907

Subfamily HYMENOLEPIDINÆ Perrier, 1891

Genus OLIGORCHIS Fuhrmann, 1906

OLIGORCHIS BURMANENSIS sp. nov. Text figs. 1, 2, and 3.

Length 32 to 46. Maximum breadth 0.89. Scolex 0.375 to 0.4 in diameter. Rostellum 0.106 to 0.12 in diameter; rostellar hooks 22, 0.109 to 0.133 and 0.163 to 0.188 long, arranged in two alternating rows. Suckers spherical, 0.165 to 0.188 in diameter, unarmed. Genital pore unilateral in anterior half of proglottis margin; genital ducts passing dorsally to longitudinal excretory vessels. Musculature with two layers of longitudinal muscles, bundles in inner layer very well developed and lined internally by feebly developed transverse muscles. Genital cloaca present. Cirrus sac 0.24 to 0.317 in maximum length in mature segments, in gravid segments up to 0.41; often with a well-marked twist and distal portion greatly curved; well past ventral longitudinal excretory vessel and extending a little over half the breadth of the proglottis. Cirrus spiny. Internal vesicula seminalis small, external vesicula seminalis not seen. Vas deferens with a few coils. Testes 0.048 to 0.083 in diameter, three of them usually in a transverse row nearly touching the posterior border of the proglottis, fourth anterior to aporal testis; poral and aporal testes partly overlapping ventral longitudinal excretory vessels. Ovary with small lobes laterally and posteriorly. Vaginal opening in genital cloaca ventral to cirrus sac (very well seen in transverse sections). Receptaculum seminis present. Uterus in early stage an irregular, branched sac, but at a later stage of development branching becoming more inconspicuous by anastomosis, extending laterally to ventral longitudinal excretory vessels. Eggs not fully developed, 0.02 by 0.026 to 0.028 by 0.034.

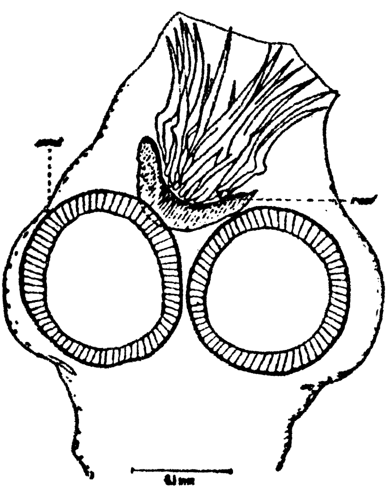

FIG. 1. *Oligorchis burmanensis* sp. nov.; scolex.

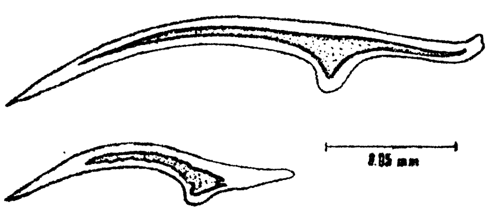

FIG. 2. *Oligorchis burmanensis* sp. nov.; rostellar hooks.

The genus *Oligorchis* Fuhrmann 1906 is stated by Baer (10, p. 76) Fuhrmann, (6, p. 158) Lühe, (12, p. 54) and Mayhew (13, p. 33) to be characterized by the possession of a single crown of the rostellar hooks. This character may be altered to admit the present form to avoid the confusion of shifting such forms to *Dilepis* Weinland 1834, which belongs to a different family. The author is of the opinion already suggested by Mayhew: (13, p.34)

The double crown of the hooks is not believed to be a character of sufficient importance to exclude it from the family Hymenolepididae. The constancy of the number of the testes in the numerous species of the several genera of the family is such an outstanding characteristic that it serves to separate this group of genera from other genera in a distinct and peculiar manner.

From the present species *O. yorkei* (Kotlan 1923) may be distinguished by difference in number and shape of the rostellar hooks; from *O. duboisi* (Hsü, 1935) and *O. heirticos* Johri, 1934, by the smaller size of the cirrus sac; while *O. toxometra* Joyeux and Baer, 1928, and *O. strangulatus* Fuhrmann, 1906, are distinguished by the smaller size of the rostellar hooks and their different shapes. *O. longivaginosus* Mayhew, 1925, is distinguished by characteristic division of the ovary into 4 to 6 knoblike lobes, an specially long vagina, and by the arrangement of the rostellar hooks in a single row and their uniform size.

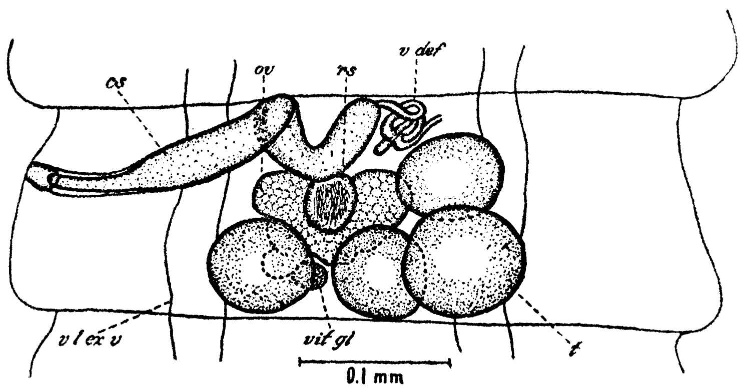

FIG. 3. *Oligorchis burmanensis* sp. nov.; mature proglottis.

O. delachauxi Fuhrmann, 1909 (which has been transferred by Joyeux and Baer to *Paradilepis macracantha*), has no scolex, but may be separated by the presence of female glands on the poral side of the segment. A new name, *Oligorchis burmanensis,* is, therefore, proposed for the present form.

In a recent paper Southwell and Lake(16) have added one more species, namely *Oligorchis kwangensis,* having 4 to 7 testes, and thus revived the discrepancy of the different genera of Hymenolepidinæ already cleared up by the writer (Report on a collection of cestodes from Lucknow (1934, p. 175) pointing out the constancy of the number of the testes. It is, therefore, fitting to transfer *O. kwangensis* to the genus *Pseudoligorchis* Johri, 1934. The point about the armed rostellum is not at all disturbing, since there are many genera (*Hymenolepis* and *Tænia*, for example) under which both armed and unarmed rostellar forms are included in the constancy of the common characters. The author is in entire agreement with Meggitt(14) in considering the anatomy of the specimens as the sole basis for their identification, irrespective of the systematic position of the host.

Genus HYMENOLEPIS Weinland, 1858

HYMENOLEPIS GYOGONKA sp. nov. Text figs. 4 and 5.

Maximum length 63, greatest breadth 0.55. Scolex 0.114 to 0.128 in diameter. Rostellum 0.182 to 0.195 long, 0.053 to 0.66 in diameter. In the scoleces the rostellar hooks are always in the lower portion of the rostellum. Rostellar hooks 10, 0.018 to 0.026 long. Suckers spherical, 0.047 to 0.073 in diameter, without acetabular hooks. Segments much broader than long. Genital pores unilateral, in the anterior third of the proglottis margin. Cirrus sac 0.108 to 0.162 by 0.012 to 0.03, crossing ventral longitudinal excretory vessel and extending up to one-third to one-half of proglottis breadth. External vescicula seminalis present. Receptaculum seminis very insignificant in mature segments, later becoming very well developed, 0.128 by 0.074. Testes 0.048 to 0.067 in diameter, two in a

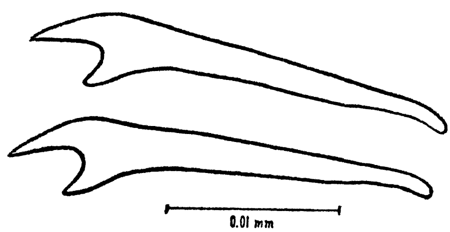

FIG. 4. *Hymenolepis gyogonka* sp. nov.; rostellar hooks.

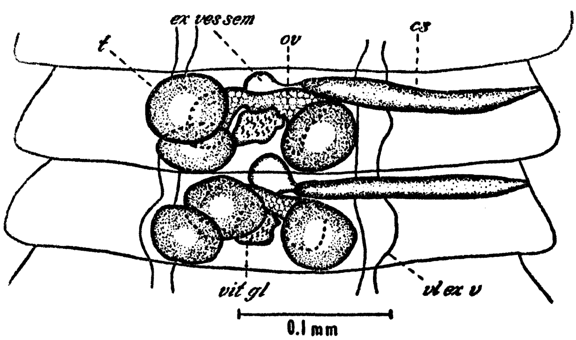

FIG. 5. *Hymenolepsis gyogonka* sp. nov.; mature proglottis.

posterior row, third exactly anterior to aporal testis, sometimes slightly between posterior testes. A portion of testes coming on ventral longitudinal excretory vessels. Uterus transversely elongated, irregular, sac-shaped, and extending laterally to longitudinal excretory vessels. Eggs not fully developed.

Of all the species of *Hymenolepis*, *H. æquabilis* (Rud., 1810), *H. amphitricha* Rud., 1819, *H. brasilense* (Fuhrmann, 1906), *H. capillaroides* Fuhrmann, 1906, *H. chionis* (Fuhrmann, 1921), *H. creplini* (Krabbe, 1869), *H. farciminosa* (Goeze, 1782), *H. filirostris* (Wed., 1855), *H. furcifera* (Krabbe, 1869), *H. hemignathi* (Shipley, 1898), *H. microscolecina* Fuhrmann, 1906, *H. multiglandularis* Baczynska, 1914, *H. podicepina* Linton, 1927, *H. victoriata* Inamdar, 1935, and *H. voluta* Linstow, 1904, have the same number of rostellar hooks (10) and the comparable size 0.018 to 0.038, but they are easily separated by the quite different shapes of their rostellar hooks. The remainder approach the number and size of rostellar hooks as shown in Table 1, in which the markedly different size of rostellar hooks differentiates groups A and B from the present form, except *H. intermedia* Clerc, 1906, which is easily distinguished by its very long cirrus sac. In groups C and D, 1/0.88 and 1/0.39, respectively, constitute sufficient difference in the shape of the rostellar hooks from group E; *H. fringillarum* (Rud., 1810), and *H. spinosa* Linstow 1906, are thus excluded, wherefore *Hymenolepis gyogonka* sp. nov. is established.

TABLE 1.—*Characters and measurements of species of Hymenolepis Weinland, 1858.*

Group.	Species.	Rostellar hooks.		Ratio of distance between point and guard of rostellar hook over total length of rostellar hook.	Cirrus sac.	
		Number.	Size.		Size.	Extent.
			mm.		*mm.*	
A	*H. ardæ* Linton, 1927	10	33	$\frac{1}{2}$:0.77–2:0.93	280	To venal excretory vessel.
	H. ambigua (Clerc, 1906)	10	30	$\frac{1}{3}$:0.58	180	
B	*H. intermedia* Clerc, 1906	10	22–25	$\frac{1}{3}$:0.61	360	Past long excretory vessel.
	H. magniovata Fuhrmann, 1918	10	30	$\frac{1}{2}$:0.9	100–120	Do.
C	*H. fringillarum* (Rud., 1810)	10	26–28	$\frac{1}{5}$:0.03	95–100	
D	*H. spinosa* Linstow, 1906	10	28	$\frac{1}{6}$:0.3	?	Past $\frac{1}{3}$d of proglottis.
E	*H. gyogonka* sp. nov.	10	18–26	$\frac{1}{5}$.:0.91	108–162	$\frac{1}{2}$—$\frac{1}{2}$ proglottis.

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ILLUSTRATIONS

TEXT FIGURES

[Legends: *cs*, cirrus sac; *ex ves sem*, external vesicula seminalis; *ov*, ovary; *rs*, receptaculum seminis; *rost*, rostellum; *suck*, sucker; *t*, testis; *v def*, vas deferens; *v l ex v*, *vit gl*, vitelline gland.]

FIG. 1. *Oligorchis burmanensis* sp. nov.; scolex.
2. *Oligorchis burmanensis* sp. nov.; rostellar hooks.
3. *Oligorchis burmanensis* sp. nov.; mature proglottis.
4. *Hymenolepis gyogonka* sp. nov.; rostellar hooks.
5. *Hymenolepis gyogonka* sp. nov.; mature proglottis.

MARINE PROTOZOA OF THE PHILIPPINES [1]

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SEVENTEEN PLATES AND TWO TEXT FIGURES

The general thesis that smaller plankton, both animal and vegetable, is practically the sole food of young marine fishes, has been proved beyond doubt by studies of the stomach contents of these animals. Plankton, likewise, serves as food for the adults of many species of fishes. Herrings, sardines, and mackerels are primarily plankton feeders. Even such large sea animals as the whales, and a number of sharks as well as many bivalves—the oysters, for example—subsist exclusively on plankton organisms.

Authorities estimate that nearly 90 per cent of commercial fishes have pelagic, that is, surface-floating eggs. Only in the rarest instances does a fish hatched from a buoyant egg ever grow large enough to descend to the bottom in the precise locality where the egg that gave it birth was spawned. After exhausting the yolk material of the egg, the young fish must rely on the microscopic plankton organisms available at its place of hatching for the continuation of its existence. It is, therefore, essential that we know the amount of surface plankton in our waters in order to determine the amount of pelagic fish life that it can sustain. No quantitative plankton studies, however, can be made without at least some sort of systematic qualitative studies. It is sad to admit that the Philippine seas are a *mare incognitum* as far as the microorganisms of the plankton are concerned.

The earliest work on the protozoa of the plankton in tropical Indo-Pacific waters was that of C. T. Cleve.(26) His material was collected by different individuals in 1897, 1899, and 1900 on a route from Aden to Java, a route from 45° south latitude 22° east longitude to 30° south latitude, and from the last point to 2° north latitude 94° east longitude; and in the Malay Archipelago, from Billiton to Timor. This work was followed by those of Weber Van Bosse,(102) Schmidt,(95) Schröder,(96) and Ostenfeld.(81) In later years Matzenauer(70) wrote on the dino-

[1] This article was submitted for publication in the Philippine Journal of Science while the author was chief of the Division of Fisheries, Department of Agriculture and Commerce, Manila.

flagellates of the Indian Ocean; Nielsen(76) and Böhm(12) wrote on the dinoflagellates of the south and western Pacific Ocean, while Marshall(69) wrote on the silicoflagellates and Tintinnoinea of the Great Barrier Reef. Lately Hada(44) made a comprehensive survey of the Tintinnoinea of the western tropical Pacific, obtaining his material from the Palao Islands, Yap, Saipan, Tinian, South China, Java, and Celebes. In spite, however, of several works on the marine protozoa of the tropical eastern, western, and southern Pacific, the China Sea, and the Indian Ocean, no work has been done on the protozoa of the seas in and immediately around the Philippines.

The present paper is a preliminary report on local marine protozoa, based on plankton material obtained weekly from the Bureau of Science Binakayan Experimental Station at Bacoor Bay (Manila Bay), and from one collection from the Marine Biological Station at Puerto Galera Bay, Mindoro. The study was originally undertaken with the end in view of determining the relationship between the rate of growth and fattening of oysters and the volume of planktonic organisms available from the water. Ultimately it is hoped to tie up the volume of planktonic organisms with the seasonal abundance and movement of herrings and sardines which are very important Philippine fisheries. The present report is not intended as a final work but merely as an invitation to other workers to collaborate in the huge task of solving our very numerous oceanographic and marine problems. Problems concerned with temperature, pressure, direction and force of wind, amount of rain, sunshine, clouds, specific gravity of the sea water, hydrogen-ion concentration, tides, currents, sediments, and turbidity of the water, as well as voluminous chemical, bacteriological, and botanical material, still await the attention, time, and energy of our scientists. All these data are needed if we would know the cause or causes of the distribution, abundance, and horizontal as well as vertical migration of plankton organisms and their effect on the seasonal distribution and abundance of the various fisheries.

Plankton collections were made with a townet of fine bolting cloth No. 20, of 176 mesh to the inch, from an outrigger banca. The plankton collected from each haul is transferred into a small wide-mouthed bottle with sufficient water and fixed in 10 per cent formalin solution. Qualitative studies are carried on in the laboratory.

The survey at Bacoor Bay and Puerto Galera Bay so far has yielded 68 species of marine protozoa. Of these 34 belong to the order Dinoflagellida of the class Mastigophora (Flagellata), while 32 belong to the order Heterotrichida of the class Ciliata. The genera represented are, *Peridiniopsis,* 1 species; *Diplopeltopsis,* 1 species; *Goniaulux,* 2 species; *Peridinium,* 11 species; *Podolampas,* 1 species; *Ceratium,* 11 species; *Phalocroma,* 4 species; *Dinophysis,* 3 species; *Tintinnidium,* 3 species, two of them new; *Leprotintinnus,* 2 species, one of them new; *Tintinnopsis,* 10 species, two of them new; *Codonellopsis,* 1 species; *Coxliella,* 1 species; *Favella,* 4 species, three of them new; *Epiplocylis,* 3 species; *Metacylis,* 2 species, both new; *Petalotricha,* 1 species; *Rhabdonella,* 4 species, one of them new; *Tintinnus,* 1 species. These unicellular animals are the larger forms that do not readily pass through an ordinary silk bolting cloth and do not readily disintegrate soon after the haul. A large number of salt-water and brackish-water protozoa, however, are so minute and delicate that they have to be collected with the use of filter paper and treated with standard fixing agents soon after collection. Protozoa of the latter category have not yet been touched.

The protozoa, numerous and abundant as they are in our bays and seas, only rank second to the diatoms in importance as food for other aquatic animals and fishes. We are, therefore, hoping that in the near future our rich marine unicellular plant fauna will also attract the attention of our botanists.

SYSTEMATIC ENUMERATION OF PHILIPPINE MARINE PROTOZOA

Class Mastigophora
- Order Dinoflagellida
  - Family Peridiniidæ
    - *Peridiniopsis*
      - *Peridiniopsis asymmetrica* Mangin
    - *Diplopeltopsis*
      - *Diplopeltopsis minor* Lebour
    - *Goniaulux*
      - *Goniaulux polyedra* Stein
      - *Goniaulux digitale* Pouchet
    - *Peridinium*
      - *Peridinium conicoides* Paulsen
      - *Peridinium latissimum* Kofoid
      - *Peridinium leonis* Pavillard
      - *Peridinium subinerme* Paulsen
      - *Peridinium depressum* Bailey
      - *Peridinium divergens* Ehrenberg
      - *Peridinium obtusum* Karsten
      - *Peridinium venustum* Matzenauer
      - *Peridinium africanoides* Dangeard
      - *Peridinium curtipes* Jörgensen
      - *Peridinium pellucidum* (Bergh)

Class Mastigophora—Continued.
  Order Dinoflagellida—Continued.
    Family Peridiniidæ—Continued.
      Podolampas
        Podolampas bipes Stein
      Ceratium
        Ceratium furca (Ehrenberg)
        Ceratium candelabrum (Ehrenberg)
        Ceratium pentagonum Gourret
        Ceratium dens Ostenfeld & Schmidt
        Ceratium fusus (Ehrenberg)
        Ceratium tripos (O. F. Müller)
        Ceratium breve Ostenfeld & Schmidt
        Ceratium macroceros (Ehrenberg)
        Ceratium trichoceros (Ehrenberg)
        Ceratium contrarium Gourret
        Ceratium molle Kofoid
    Family Dinophysidæ
      Phalocroma
        Phalocroma rotundatum Claparède & Lachmann
        Phalocroma cuneus Schütt
        Phalocroma mitra Schütt
        Phalocroma doryphorum Stein
      Dinophysis
        Dinophysis miles fo. *indica* Cleve
        Dinophysis caudata Kent
        Dinophysis hastata Stein
Class Ciliata
  Order Heterotrichida
    Family Tintinnididæ
      Tintinnidium
        Tintinnidium primitivum Busch
        Tintinnidium cylindrica sp. nov.
        Tintinnidium ampullarium sp. nov.
      Leprotintinnus
        Leprotintinnus nordquisti (Brandt)
        Leprotintinnus tubulosus sp. nov.
    Family Codonellidæ
      Tintinnopsis
        Tintinnopsis bacoorensis sp. nov.
        Tintinnopsis bütschlii Daday
        Tintinnopsis gracilis Kofoid & Campbell
        Tintinnopsis loricata Brandt
        Tintinnopsis manilensis sp. nov.
        Tintinnopsis major Meunier
        Tintinnopsis mortensenii Schmidt
        Tintinnopsis radix (Imhof)
        Tintinnopsis tocantinensis Kofoid & Campbell
        Tintinnopsis turgida Kofoid & Campbell

Class Ciliata—Continued.
  Order Heterotrichida—Continued.
    Family Codonellopsidæ
      Codonellopsis
        Codonellopsis ostenfeldi (Schmidt)
    Family Coxliellidæ
      Coxliella
        Coxliella longa (Brandt)
    Family Cyttarocylidæ
      Favella
        Favella simplex sp. nov.
        Favella philippinensis sp. nov.
        Favella elongata sp. nov.
        Favella azorica (Cleve)
    Family Ptychocylidæ
      Epiplocylis
        Epiplocysis exquisita (Brandt)
        Epiplocylis ralumensis (Brandt)
        Epiplocylis undella (Ostenfeld & Schmidt)
    Family Petalotrichidæ
      Metacylis
        Metacylis hemisphærica sp. nov.
        Metacylis kofoidi sp. nov.
      Petalotricha
        Petalotricha major Jörgensen
    Family Rhabdonellidæ
      Rhabdonella
        Rhabdonella amor (Cleve)
        Rhabdonella spiralis (Fol)
        Rhabdonella brandti Kofoid & Campbell
        Rhabdonella fenestrata sp. nov.
    Family Tintinnidæ
      Tintinnus
        Tintinnus perminutus Kofoid & Campbell

Family PERIDINIIDÆ Kofoid

Theca of cell composed of epitheca, girdle, and hypotheca, all divided into plates. An apical pore usually present.

In the epitheca the plates around the apical portion are the apicals, and are usually designated in the descriptions by one accent mark (′); those just above the girdle are the precingulars, designated by two accent marks (″), while those between the precingulars and the apicals are the anterior intercalaries, designated by (*a*). These intercalaries never form a complete series around the epitheca. The girdle may be composed of several girdle plates (*g*) or may be a single piece.

In the hypotheca the plates just below the girdle are the postcingulars (‴) and those at the abapical region are the antapical plates (''''). Plates between the antapicals and postcingulars, called the posterior intercalaries (*p*), may be present.

A typical member of the Peridiniidæ has the following plate formula: 4 apicals, 3 anterior intercalaries, 7 precingulars, 5 postcingulars, no posterior intercalaries, and 2 antapicals; or in the abbreviated form: 4' 3*a* 7'' 5''' 0*p* 2''''.

Genus PERIDINIOPSIS Lemmermann (1904)

Cell spherical, conical, or lenticular. Plate formula: 3 apicals, 1 or 2 anterior intercalaries, 6 precingulars, 5 postcingulars, and 2 abapicals. Epitheca and hypotheca almost equal and with rounded sides. Girdle equatorial, not displaced and not excavate; provided with lists. First anterior intercalary diamond-shaped, between precingulars 2 and 3. Second anterior intercalary large, occupying almost half of epitheca.

Marine and fresh-water.

PERIDINIOPSIS ASYMMETRICA Mangin. Plate 1, figs. 1a, 1c, and 1d.

Peridiniopsis lenticula STEIN, Org. Infusionsthiere 3 (1883) 1–81, pl. 8, figs. 12–14; pl. 9, figs. 2–4.

Peridiniopsis asymmetrica MANGIN, Intern. Rev. Hydrobiol. 4 (1911); Nouv. Arch. Mus. Hist. Nat. 5 (1913); LEBOUR, Journ. Mar. Biol. Ass. 12 (1919–1922) 798, figs. 6–10; Dinoflagellates of Northern Seas (1925) 132, figs. 1–6; (1925) 101, pl. 15, figs. 3*a*–3*e*; MATZENAUER, Bot. Arch. 35 (1933) 453, figs. 24*a*–24*c*.

Small species. Body lens-shaped, symmetrical, wide, dorsally-ventrally slightly flattened. Longitudinal furrow with 2 spinelets, very shallow, not extending far toward center of hypotheca. Intercalary striæ very prominent and well visible. Test coarsely punctate. Cell contents pink.

Longest diameter 60 to 85 μ.

Common in Manila Bay.

Genus DIPLOPELTOPSIS Pavillard (1913)

Cell lens-shaped. Plate formula: 3 apical, 2 anterior intercalaries, 7 precingulars, 5 postcingulars, and 1 abapical.

Mostly marine and estuarine.

DIPLOPELTOPSIS MINOR Lebour. Plate 1, figs. 2a, 2c, and 2d.

Diplopsalis lenticula BERGH, Morph. Jahrb. 7 (1882) figs. 77*a*, 77*b*; SCHÜTT, Peridiniaceae 1 (1896) 21, fig. 31; OKAMURA, Annot. Zool. Japon. 6 (1906–1908) 131, pl. 5, fig. 44; PAULSEN, Nordisches Plankton 17 (1908) 36; Microplancton d'Alboran (1930) 40; LINDEMANN, Natürliche Pflanzenfamilien 2 (1928) 90, fig. 77; WANG and NIE, Cont. Biol. Lab. Sci. Soc. China 8 (1932) 296, fig. 9; MATZENAUER, Bot. Arch. 35 (1933) 453.

Diplopsalis sphærica MEUNIER, Campagne Arctique de 1907 1 (1910) 47, pl. 3, figs. 19, 22; Mem. Mus. Roy. d'Hist. Nat. 8 (1919) 64, pl. 19, figs. 1–12; pl. 20, figs. 1–4.

Diplopeltopsis minor LEBOUR, Journ. Mar. Biol. Ass. 12 (1919–1922) 801, figs. 11–15; 13 (1925) 102, pl. 15, figs. *2a–2e;* LINDEMANN, Arch. f. Protist. 47 (1924) 133, figs. 11–15.

Small species with lens-shaped body. Epitheca and hypotheca subsimilar, both with rounded edges. Girdle circular, not displaced and not excavate. Longitudinal furrow with a list, deep, reaching near center of hypotheca. Small anterior intercalary on left side similar to that in *Peridiniopsis asymmetrica,* diamond-shaped between precingulars 2 and 3. Antapical plate single. Theca finely punctate. Cell contents more or less pinkish.

Cell about 53 μ in diameter and about 43 μ high.

Externally this species appears close to *Peridiniopsis asymmetrica,* but the longitudinal furrow is deep, and there is only one abapical plate instead of two.

Common in Manila Bay.

Genus GONIAULUX Diesing (1866)

Girdle equatorial, decidedly left-handed. Plates: apicals 3 to 5, anterior intercalaries 0 to 2, precingulars 6, postcongulars 6, posterior intercalary 1, antapical (1 or 3′ to 5′, 0 to 2*a* 6″ 1*p* 1″″). First apical usually narrow, bearing a platelet covering apical pore, rest with numerous closely set pores.

GONIAULUX POLYEDRA STEIN. Plate 2, figs. 3c and 3d.

Goniaulux polyedra STEIN, Org. Infusionsthiere 3 (1883) pl. 4, figs. 7–9; SCHÜTT, Peridiniaceae (1896) 21, fig. 29; OKAMURA, Annot. Zool. Japon. 6 (1906–1908) 132, pl. 5, fig. 35; KOFOID, Univ. Cal. Pub. Zool. 8 (1911) 238, pl. 12, figs. 16–20; pl. 14, figs. 28, 29, 31; pl. 17, fig. 43; MEUNIER, Mem. Mus. Roy. d'Hist. Nat. 8 (1919) 70, 71, pl. 19, figs. 20–25; FAURÉ-FREMIET and PUIGAUDEAU, Bull. Soc. Zool. 47 (1922) 456–458, fig. 17; LEBOUR, Dinoflagellates Northern Seas (1925) 97, pl. 14, figs. *3a–3d;* ABE, Sci. Rep. Tohoku Imp. Univ. 2 (1927) 390, fig. 8; PAULSEN, Micro. d'Alboran (1930) 38; MATZENAUER, Bot. Arch. 35 (1933) 451; CAMPBELL, Journ. Ent. Zool. 26 (1934) 18, fig. 4.

Small, angular, polyhedral, with ridges at sutures of plates. Girdle displaced 1 to 2 girdle widths. Surface finely porous. Plate formula 4′ 2*a* 6″ 6‴ 1*p* 1″″. Fourth apical minute, anterior intercalaries ventral. Cell content deep brown.

Length about 60 μ.

Occasionally met with in Manila Bay.

GONIAULUX DIGITALE Pouchet. Plate 2, figs. 4a and 4d.

Goniaulux digitale POUCHET, J. Annot. Physiol. (1883) 433, pl. 18, fig. 14; KOFOID, Univ. Cal. Pub. Zool. 8 (1911) 214–217, pl. 9, figs. 1–5; FAURÉ-FREMIET and PUIGAUDEAU, Bull. Soc. Zool. 47 (1922) 454–455, fig. 15; LEBOUR, Dinoflagellates Northern Seas (1925) 92, 93, fig. 28*a;* PAULSEN, Microplancton d'Alboran (1930) 39.

Goniaulux spinifera STEIN, Org. Infusionsthiere 3 (1883) pl. 14, figs. 10–14.

Small species, slightly higher than wide. Epitheca subconical, with convex, at times angular sides. Girdle displaced 2.5 girdle widths. Epitheca with stout, blunt, apical horn, hypotheca with 2 strong antapical spines. Plate formula: 3′ 0*a* 6″ 6‴ 1*p* 1⁗. Theca strongly reticulate. Girdle list narrow but with strong spines.

Length 60 μ, diameter 50 μ.

Common in Manila Bay.

Genus PERIDINIUM Ehrenberg (1832)

Cell cone-shaped, egg-shaped, or flattened. Apex usually with a distinct apical pore and apical horn. Plate formula: 4 apicals, 2 or 3 anterior intercalaries, 7 precingulars, 5 postcingulars, and 2 abapicals.

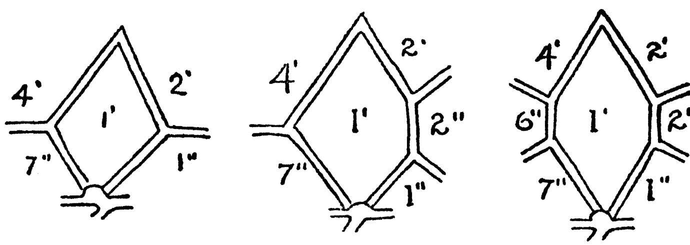

FIG. 1. Number of intercalaris and their relation to the precingulars in the groups *Orthoperidium, Metaperidinium,* and *Paraperidinium.*

The classification of this genus is based primarily on the character of the first apical and second anterior intercalary. On the basis of the first apical the members of the genus can be grouped into *Orthoperidinium, Metaperidinium,* and *Paraperidinium.* In the group *Orthoperidinium* the first apical plate is diamond-shaped and is bounded by the first and seventh precingulars and the second and fourth apicals (text fig. 1).

In the group *Metaperidinium* the first apical is pentagonal and is bounded by the first, second, and seventh precingulars and by the second and fourth apicals. In *Paraperidinium* the first apical is hexagonal and is bounded by the first, second, sixth, and seventh precingulars and by the second and fourth apicals.

The genus *Peridinium* has been divided by authors into two subgenera: *Archæperidinium,* in which there are only two anterior intercalaries, and *Peridinium* proper, in which there are three. In the latter the second anterior intercalary may be touching the fourth and fifth, the third and fourth, the third, fourth, and fifth precingulars, or only the fourth precingular. These various relationships are indicated in text fig. 2.

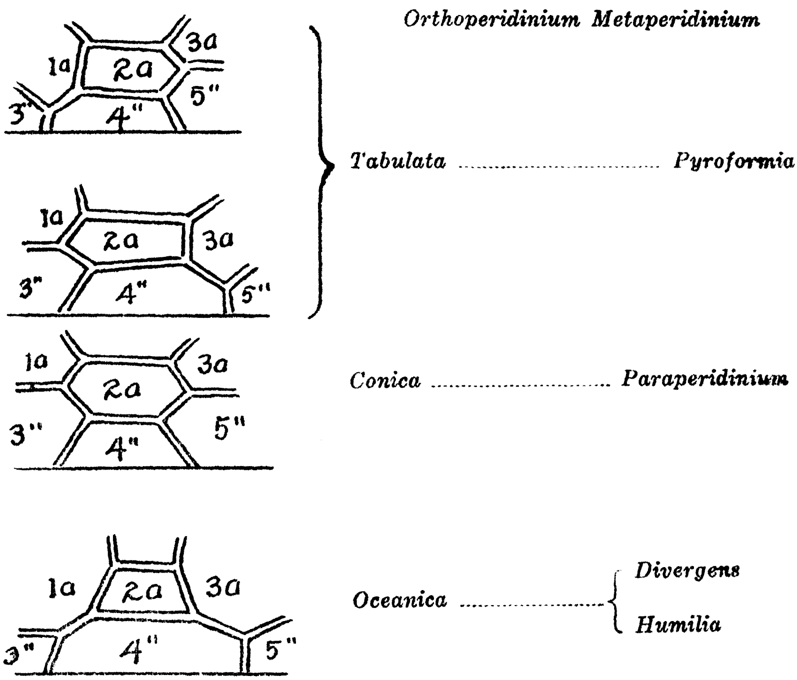

FIG. 2. Number of intercalaries and their relation to the precingulars in the subgenera of *Peridinium*.

Group ORTHOPERIDINIUM

Section CONICA

In § *Conica* the second anterior intercalary touches precingulars 3, 4, and 5.

PERIDINIUM CONICOIDES Paulsen. Plate 3, figs. 6a to 6d.

Peridinium conicoides PAULSEN, Medd. Komm. Havunders. Kopenhagen ser. plankton 1 (1905) 3, fig. 2; MEUNIER, Campagne Arctique de 1907 1 (1910) 39, pl. 1, figs. 31, 34; Mem. Mus. Roy. d'Hist. Nat. 8 (1919) 40, 41, pl. 17, figs. 23–31; LEBOUR, Dinoflagellates Northern Seas (1925) 112, pl. 20, figs. 2*a*–2*d*.

Cell almost symmetrical, dorsoventrally slightly flattened. Sides of epitheca and hypotheca straight or slightly convex. Girdle almost circular, slightly left-handed. Hypotheca with two small hollow antapical spines. Longitudinal groove prominent, extending to beyond center of hypotheca. Theca finely reticulate. A small platelet at apical pore. Cell content yellowish. Cell about 60 μ high and 62.9 μ in diameter.

Common in Manila Bay.

PERIDINIUM LATISSIMUM Kofoid. Plate 3, figs. 7a to 7e.

> *Peridinium latissimum* KOFOID, Bull. Mus. Comp. Zool. 1 (1907) MATZENAUER, Bot. Archiv 35 (1933) 456, figs. 30*a*–30*e*.
>
> *Peridinium pentagonium* fo. *depressum* ABE, Sci. Rep. Tohoku Imp. Univ. 2 (1927) 409, fig. 29.
>
> *Peridinium depressum* PAVILLARD, Resultats Campagnes Scientifiques 82 (1931).

Cell pentagonal in ventral and dorsal views, asymmetrical in apical view, right side more or less larger than left. Epitheca conical, with straight sides and a distinct apical pore. Girdle left-handed, greatly excavate, with list. Hypotheca also with straight sides. Abapical boundary concave, with two solid inconspicuous spines. Longitudinal furrow shallow, not reaching center of hypotheca. Test very finely reticulate. Contents more or less pinkish.

Length about 20 μ, breadth about 58 to 60 μ.

This species differs from *P. pentagonum* Gran (1902) in being dorsoventrally more flattened and in having a more concave boundary between the two abapical horns. Similar to *P. pentagonum* in the line separating the anterior and posterior halves of the epitheca being straight and the cell asymmetrical.

Common in Manila Bay during June and July.

PERIDINIUM LEONIS Pavillard. Plate 4, figs. 8a to 8e.

> *Peridinium leonis* PAVILLARD, Trav. Inst. Bot. 4 (1916) LEBOUR, Dinoflagellates Northern Seas (1925) 112, pl. 21, figs. 1*a*–1*d*; PAULSEN, Microplancton d'Alboran 4 (1930) 70, fig. 41; MATZENAUER, Bot. Archiv 35 (1933) 456, figs. 29*a*–29*c*; BÖHM, Bull. B. P. Bishop Mus. 137 (1936) 44.

Cell more or less pentagonal in ventral and dorsal views, but with a concave abapical side. Epitheca conical, with more or less straight sides. Girdle slightly left-handed, almost circular with a slight anterior excavation. Longitudinal groove wide, with almost straight sides. A small spinelet present at end of left side of longitudinal groove. Hypotheca with straight sides, and two pointed abapical lobes each terminating in a solid spine.

Theca reticulate and spiny, on epitheca appearing as if with more or less parallel lines. Cell contents pink.

Cell about 70 μ high and 65 μ in diameter.

Very close to *P. latissimum* and *P. pentagonum* in general shape. Differs from *P. latissimum* in having the line separating the anterior and posterior halves rugged instead of straight. Unlike the case in *P. conicum* and *P. pentagonum,* the lines separating Plates 1′, 1″ and 7″, 2′ and 2″ on one side and from 4′ and 6″ on the other are in the form of a zigzag instead of straight.

Common in Manila Bay.

PERIDINIUM SUBINERME Paulsen. Plate 4, figs. 9a to 9d.

Peridinium subinerme PAULSEN, Medd. Komm. Havunders. Kopenhagen 1 (1904) 24, fig. 10; (1907) 18, figs. 26, 27; Microplancton d'Alboran 4 (1930) 71, fig. 42; FAURÉ-FREMIET and PUIGAUDEAU, Bull. Soc. Zool. 47 (1922) 451–452, fig. 13.

Peridinium subinermis BROCH, Planktonstudien Mündung Ostsee (1908) 54, fig. 28; MEUNIER, Duc D'Orleans Campagne Arctique de 1907 8 (1910) 40, pl. 2, figs. 43, 44; Mem. Mus. Roy. d'Hist. Nat. 8 (1919) 43, pl. 17, figs. 36–40; LEBOUR, Dinoflagellates Northern Seas (1925) 114, pl. 22, figs. *2a–2f;* MATZENAUER, Bot. Archiv 35 (1933) 457; BÖHM, Bull. B. P. Bishop Mus. 137 (1936) 44, fig. 16*a*.

Cell small, epitheca more or less conical with slightly convex sides. Girdle circular, not excavate, not displaced. Hypotheca with convex sides, with a contour appearing more or less like an inverted helmet. Longitudinal furrow wide, terminating in two tiny spinelets as seen from above, apical pore off center, towards right side, plates on this side of epitheca smaller than those on left. Intercalary striæ sometimes broad. Cell contents pink. Theca finely reticulated.

Cell about 45 μ high and 56 μ in diameter.

Common in Manila Bay.

Section OCEANICA

In § *Oceanica* the second anterior intercalary touches the fourth precingular plate.

PERIDINIUM DEPRESSUM Bailey. Plate 5, figs. 10a to 10d.

Peridinium depressum BAILEY, Smith. Contr. Knowl. 7 (1855) 12, figs. 33, 34; SCHÜTT, Natürliche Pflanzenfamilien 1 (1896) 13, fig. 16; BROCH, NYT Mag. f. Natur. 44 (1906) 151, fig. 1; Planktonstudien Mündung Ostsee (1908) 52; PAULSEN, Nordisches Plankton 17 (1908) 53; Microplancton d'Alboran (1930) 68; PAVILLARD, Bull. Soc. Bot. 56 (1909) 281; OKAMURA, Rep. Imp. Bur. Fish 1 (1912) pl. 4, figs. 60–62; FAURÉ-FREMIET and PUIGAUDEAU, Bull. Soc. Zool.

47 (1922) 441–443, fig. 8; LEBOUR, Dinoflagellates Northern Seas (1925) 119, figs. 23*a*–23*f*; MATZENAUER, Bot. Archiv 35 (1933) 422, fig. 43; BÖHM, Arch. f. Protist. 80 (1933) 311, figs. 5*a*, 5*b*; Bull. B. P. Bishop Mus. 137 (1936) 42, 45, 46, fig. 17*b*; CAMPBELL, Journ. Ent. Zool. 26 (1934) 18, fig. 7.

Large species with short but broad cell; epitheca symmetrical with sides decidedly concave, provided with a well-developed and conspicuous apical horn and apical pore. Girdle projecting, left-handed, with prominent lists supported by transverse spinelets. Right antapical lobe larger than left. Both antapical horns terminating in spine and each provided on inner side with a tooth continuous with each side of longitudinal furrow. Theca finely reticulate. Cell contents light pink. Globules yellowish pink.

Cell about 142 μ in diameter and about 178 μ long.

Most common in Manila Bay in June.

Section DIVERGENS

First apical pentagonal; second intercalary touching precingular 4 only.

PERIDINIUM DIVERGENS Ehrenberg. Plate 7, figs. 14a, 14b, and 14d.

Peridinium divergens EHRENBERG, Monatsber. Akad. Wiss. (1854) 240, pl. 35*a*, fig. 24*b*; STEIN, Org. Infusionsthiere (1883) pl. 10, figs. 1–9; pl. 11, figs. 1, 2; SCHÜTT, Natürliche Pflanzenfamilien 1 (1896) 22, fig. 32; MURRAY and WHITTING, Trans. Linn. Soc. 5 (1899) 326, pl. 29, fig. 4; KARSTEN, Wiss. Ergeb. d. Deuts. Tief.-Exp. 2 (1907) 416, pl. 50, figs. 8, 10*a*–10*c*, 11; pl. 52, figs. 4*a*, 4*b*, 5*a*, 5*b*; pl. 53, figs. 1–3, 6*a*, 6*b*; FAURÉ-FREMIET, Ann. Sci. Natur. 7 (1908) 271; PAVILLARD, Bull. Soc. Bot. 56 (1909) 280; MEUNIER, Duc. D'Orleans Campagne Arctique 2 (1910) 23, pl. 1, figs. 1–4; pl. 2, figs. 45, 46; Mem. Mus. Roy. d'Hist. Nat. 8 (1919) 12–14, pl. 15, figs. 1–5; FAURÉ-FREMIET and PUIGAUDEAU, Bull. Soc. Zool. 47 (1922) 455–447, fig. 10; LEBOUR, Dinoflagellates Northern Seas (1925) 127, pl. 26, figs. 2*a*–2*e*; LINDEMANN, Natürliche Pflanzenfamilien 2 (1928) 13, figs. 2, 4; PAULSEN, Microplancton d'Alboran (1930) 63; WANG and NIE, Cont. Biol. Lab. Sci. Soc. 8 (1932) 290, figs. 1–2; MATZENAUER, Bot. Archiv 35 (1933) 466; CAMPBELL, Journ. Ent. Zool. 26 (1934) 18, fig. 8.

Cell from ventral view more or less pentagonal. Epitheca with convex sides abruptly straightening apically to form a distinct apical lobe. Girdle slightly right-handed, almost circular with a slight concavity on ventral side. Transverse groove with prominent lists. Hypotheca with more or less convexoconcave sides terminating in two hollow abapical spines. Longitudinal groove prominent, extending to center of hypotheca, with lists.

Test prominently reticulated with tiny spinelets at junction of reticulation. Cell contents pinkish, turning greenish yellow in formalin.

Length about 90 to 95 μ, breadth about 56 μ. The dominant form of *Peridinium* in Bacoor Bay (a part of Manila Bay) toward the end of July.

PERIDINIUM OBTUSUM Karsten. Plate 5, figs. 11a–11d.

Peridinium obtusum KARSTEN, Deuts. Tief.-Exp. 2 (1906); FAURÉ-FREMIET, Ann. Sci. Natur. 7 (1908) 233, fig. 9; LEBOUR, Dinoflagellates Northern Seas (1925) 121, pl. 24, figs. 2*a*–2*d;* CAMPBELL, Journ. Ent. Zool. 26 (1934) 18, fig. 10.

Cell small, more or less pentagonal in ventral view, but with concave abapical side. Epitheca with almost straight sides. Girdle not displaced or only very slightly left-handed and hardly excavate. Longitudinal furrows reaching well to the hypotheca with one small spine on each side at abapical region. Hypotheca also with straight sides, two shallow antapical horns terminating in spines which project more or less laterally. Theca more or less spiny. Cell contents pink.

Cell about 60 μ high and 70 μ in diameter.

Common in Manila Bay.

PERIDINIUM VENUSTUM Matzenauer. Plate 6, figs. 12a, 12b, 12d, and 12e.

Peridinium venustum MATZENAUER, Bot. Archiv 35 (1933) 464, fig. 45; BÖHM, Bull. B. P. Bishop Mus. 137 (1936) 45.

Cell thin, much flattened in anteroposterior direction. Epitheca appearing on ventral and dorsal view as a regular concave cone. Apical pore elongate. Hypotheca also with concave sides and two hollow abapical horns. Transverse girdle slightly left-handed, much higher on dorsal side than on ventral. Longitudinal groove with a spinelet on each side at its junction with abapical horns. First apical diamond-shaped, of the *Orthoperidinium* type, second anterior intercalary of *Oceanica* type, touching only fourth precingular. Contents light pink, turning greenish-yellow with long preservation in formalin. Theca thin, with fine, widely separate pores.

Length 103 μ, diameter 78 μ.

Quite common in Manila Bay during July.

Group METAPERIDINIUM

Section PYROFORMIA

First apical pentagonal; second anterior touching precingulars 3 and 4 or 4 and 5.

PERIDINIUM AFRICANOIDES Dangeard. Plate 6, figs. 13a, 13c, and 13d.

Peridinium africanoides DANGEARD, Ann. L'Inst. Oceanog. (1927); MATZENAUER, Bot. Archiv 35 (1933) 460, fig. 39; BÖHM, Bull. B. P. Bishop Mus. 137 (1936) 41, fig. *b*1, *b*2.

Body pear-shaped; at times slightly angular, theca with a finely reticulated surface. Epitheca with an elongate, prominent, apparently open apical horn. Girdle with prominent lists supported by transverse spines. Hypotheca with two prominent and winged antapical spines. Striæ quite prominent and wide between postcingulars and apical plates. Cell contents in life light pink.

This form is exceptional in having 4 anterior intercalaries instead of the usual 3.

Cell with a total length of about 100 μ and a diameter of around 85 μ.

Common in Manila Bay.

PERIDINIUM CURTIPES Jörgensen. Plate 7, figs. 15a to 15d.

Peridinium curtipes JÖRGENSEN, Skr. Schw. Hydrog.-biol. Komm. 4 (1912); LEBOUR, Dinoflagellates Northern Seas (1925) 128, fig. 39; PAULSEN, Microplancton d'Alboran (1930) 64; MATZENAUER, Bot. Archiv 35 (1933) 468, figs. 52*a*, 52*b*.

Peridinium crassipes PAULSEN, Medd. Komm. Havunders. 1 (1907) 27, fig. 24; Nordisches Plankton 17 (1908) 48, fig. 73; Microplancton d'Alboran (1930) 65, fig. 36; KOFOID, Univ. Cal. Pub. Zool. 3 (1907) 309, pl. 31, figs. 46, 47; FAURÉ-FREMIET, Ann. Sci. Natur. 7 (1908) 218, pl. 16, fig. 17; BROCH, Arch. f. Protist. 20 (1910) 193–195, figs. 9–10; OKAMURA, Rep. Imp. Bur. Fish 1 (1912) pl. 4, fig. 63; FAURÉ-FREMIET and PUIGAUDEAU, Bull. Soc. Zool. 47 (1922) 447, 448, fig. 11; DANGEARD, Ann. L'Inst. Oceanog. (1927) 324, figs. 18*a*–18*c*; MATZENAUER, Bot. Archiv 35 (1933) 467, figs. 50*a*–50*d*; CAMPBELL, Journ. Ent. Zool. 26 (1934) 18, fig. 6.

Cell broad but short. Epitheca conical, with distinctly concave sides. Girdle almost spherical, only slightly excavate at ventral side. Transverse furrow with prominent lists supported by spines. Longitudinal furrow narrow. Hypotheca with convexoconcave sides. Abapical region with two horns terminating in small spines. Inner side of horns with prominences and small spines. Left horn larger and wider than right. Theca finely reticulate and with very fine pores. First apical plate pentagonal, second anterior intercalary touching only precingular 4. Thus this species belongs to the *Metaperidinium divergens* type. Cell contents yellowish green.

Length about 85 μ, diameter about 90 μ.

Common in Manila Bay.

Section PARAPERIDINIUM

First apical hexagonal; second anterior intercalary touching precingulars 3, 4, and 5.

PERIDINIUM PELLUCIDUM (Bergh). Plate 8, figs. 16a to 16d.

Protoperidinium pellucidum BERGH, Morph. Jahrb. 7 (1881) 227, figs. 46–48.

Peridinium pellucidium SCHÜTT, Ergeb. Plankton Exped. 4 (1895) 45; PAULSEN, Nordisches Plankton 17 (1908) 49, fig. 61; Microplancton d'Alboran (1930) 56; BROCH, Planktonstudien Mündung Ostsee (1908) 44, 45, figs. 15, 16; Arch. f. Protist. 20 (1910) 188, 189, fig. 6; FAURÉ-FREMIET, Ann. Sci. Natur. 7 (1908) 219–221, pl. 15, fig. 9; text figs. 6, 7; MEUNIER, Duc D'Orleans Campagne Arctique 1 (1910) 30, pl. 1, figs. 26–28; Mem. Mus. Roy. d'Hist. Nat. 8 (1919) 21–23, pl. 15, figs. 30–42; PAVILLARD, Mem. Trav. Inst. Bot. Univ. Montpellier 4 (1916) 38; LEBOUR, Dinoflagellates Northern Seas (1925) 23, fig. 2; MATZENAUER, Bot. Archiv 35 (1933) 461, figs. 42*a*–42*c*.

Small species with epitheca more or less pointed. Epitheca and hypotheca with decidedly convex sides. Girdle almost circular in cross section, slightly right-handed. Longitudinal furrow with one right and two left antapical spines. Striæ quite prominent. Theca finely reticulate. First apical plate 5-sided, second apical intercalary 6-sided as stated by Matzenauer.(70)

Cell about 43 μ in diameter and 53 μ high.

Genus PODOLAMPAS Stein (1883)

Cell pear-shaped, drawn out apically into an apical horn with a prominent apical pore. Girdle absent. Two strong antapical spines with transverse wings present. Plate formula: apicals 2, anterior intercalary 1, precingulars 6, postcingulars 3, antapicals 4 (′′′ 1*a* 6′′ 3′′′ 4′′′′).

PODOLAMPAS BIPES Stein (1883). Plate 2, figs. 5a and 5b.

Podolampas bipes STEIN, Org. Infusionsthiere (1883) pl. 8, figs. 6–9; SCHÜTT, Natürliche Pflanzenfamilien 1 (1896) 23, fig. 33; MURRAY and WHITTING, Trans. Linn. Soc. 5 (1899) 328; KOFOID, Arch. f. Protist. 16 (1909) 55–58; OKAMURA, Rep. Imp. Bur. Fish 1 (1912) pl. 2, fig. 37; LEBOUR, Dinoflagellates Northern Seas (1925) text-fig. 52*b*; LINDEMANN, Natürliche Pflanzenfamilien 2 (1928) 100, 101, fig. 87; PAULSEN, Microplancton d'Alboran (1930) 74; MATZENAUER, Bot. Archiv 35 (1933) 482.

Cell broadly pear-shaped, with a short apical horn. Antapical spines about equal, wings not fused. Intercalary striæ very wide.

Cell about 92 μ long, 65 μ in greatest diameter.

Occasionally met with in Manila Bay.

Genus CERATIUM Schrank (1793)

Cell dorsoventrally flattened. Transverse furrow usually equatorial, girdle left-handed. Longitudinal furrow usually very wide, occupying a large portion of the ventral surface of the body. Epitheca with one apical horn terminating at an apical pore. Hypotheca with two abapical hollow horns which are open or closed at the end. Test thick, reticulate or striped, with numerous tiny pores. Boundaries of cell plates indistinct. Plate formula 4′ 5″ 5‴ 2⁗.

Subgenus BICERATIUM Gran

With one apical horn and two (rarely three) abapical horns normally closed at tips and directly backward. Right hind horn smaller, rarely shorter than half the left. Epitheca, including horn, much longer than hypotheca.

CERATIUM FURCA (Ehrenberg). Plate 8, figs. 17a and 17b.

Peridinium furca EHRENBERG, Infusionsthierchen als vollkommene Organismen **18** (1838) 256, pl. 22, fig. 21.

Ceratium furca CLAPARÈDE and LACHMANN, Mem. Inst. Nat. Geneve **6** (1859) 399, pl. 19, fig. 5; STEIN, Org. Infusionsthiere (1883) pl. 15; figs. 7–14, pl. 25; CLEVE, Kongl. Sv. Vet.-Akad. Handl. **32** (1899) 36; (1) **34** (1900) 19; (2) **34** (1900) 20; Öfv. Kongl. Sv. Vet.-Akad. Förhandl. (9) **57** (1900) 1030; Kongl. Sv. Vet.-Akad. Handl. (5) **35** (1901) 13; (7) **35** (1902) 24; SCHRÖDER, Mitt. Zool. Stat. Neapel **14** (1901) 17; OSTENFELD and SCHMIDT, Vidensk. Medd. **52** (1901) 163; OKAMURA and NISHIKAWA, Annot. Zool. **5** (1904) 126, pl. 6, fig. 15; JOLLOS, Arch. f. Protist. **19** (1910) 193, pl. 9, fig. 54; OKAMURA, Rep. Imp. Bur. Fish **1** (1912) 7; MEUNIER, Mem. Mus. Roy. d'Hist. Nat. (1919) 85, pl. 20, figs. 30–32; LEBOUR, Dinoflagellates Northern Seas (1925) 145, pl. 30, fig. 3; PAULSEN, Microplancton d'Alboran (1930) 76, fig. 46; BÖHM, Bull. B. P. Bishop Mus. **87** (1931) 8–13, figs. 4–8; WANG and NIE, Cont. Biol. Lab. Sci. Soc. **8** (1932) 297, figs. 10, 11; NIELSEN, Dana Exp. Rep. **4** (1934) 9, fig. 849; CAMPBELL, Journ. Ent. Zool. **26** (1934) 21, fig. 15.

Epitheca longer than hypotheca, evenly narrowing into an open apical horn of medium length. Hypotheca shorter than epitheca, with two more or less parallel, pointed, closed, antapical horns. Right antapical horn about half as long as left, both more or less toothed at sides. With deep yellow chromatophores.

Total length, 150 to 160 μ; greatest breadth, 33 to 37 μ.

Common in Manila Bay.

CERATIUM CANDELABRUM (Ehrenberg). Plate 8, fig. 18a.

Peridinium candelabrum EHRENBERG, Monatsber. der Berliner Akad. d. Wiss. (1859).

Ceratium candelabrum STEIN, Org. Infusionsthiere (1883) pl. 16, figs. 15, 16; OSTENFELD and SCHMIDT, Vidensk. Medd. 52 (1901) 163; CLEVE, Ark. f. Zool. 1 (1903) 340; OKAMURA, Rep. Imp. Bur. Fish 1 (1912) 7; LEBOUR, Dinoflagellates Northern Seas (1925) 143, pl. 30, fig. 2, text figs. 45*b*, 45*c*; BÖHM, Arch. f. Protist. (1931) 351, 367, text figs. 1, 2, 24; Bull. B. P. Bishop Mus. 81 (1931) 8, fig. 3; PAVILLARD, Prince Monaco Res. Camp. Sci. 82 (1931) 68, pl. 2, figs. 16*a*–16*d*; NIELSEN, Dana Exp. Rep. 4 (1934) 8, figs. 6, 7.

Epitheca longer than hypotheca; abruptly narrowing (90°) to form a stout, long, open, apical horn. Hypotheca with two more or less parallel or slightly divergent horns close to their tips. Right antapical horn shorter but very much more than half of left.

Total length, about 265 μ; greatest width, about 76 μ; apical horn, 180 μ; right antapical horn, 48 μ; left antapical horn, about 65 μ.

Found in Puerto Galera Bay, Mindoro, during April.

CERATIUM PENTAGONUM Gourret. Plate 8, figs. 19a and 19b.

Ceratium pentagonum GOURRET, Ann. Mus. d'Hist. Nat. Zool. 5 (1881) 45, tab. 4, fig. 58; OKAMURA, Rep. Imp. Bur. Fish 1 (1912) 8, pl. 3, fig. 50; BÖHM, Arch. f. Protist. (1931) 352; Bull. B. P. Bishop Mus. 87 (1931) 12, fig. 9*b*; PAVILLARD, Prince Monaco Res. Camp. Sci. 82 (1931) 71; NIELSEN, Dana Exp. Rep. 4 (1934) 11, fig. 12.

Ceratium lineatum var. *robusta* CLEVE, Öfv. Kongl. Sv. Vet.-Akad. Forhandl. 57 (1900) 925, fig. 6.

Ceratium lineatum var. *longiseta* OSTENFELD and SCHMIDT, Vidensk. Medd. 52 (1901) 163, fig. 12; CLEVE, Ark. f. Zool. 1 (1903) 341; OKAMURA, Annot. Zool. Japon. 6 (1907) 127, pl. 3, fig. 7*a*.

Ceratium lineatum OSTENFELD and SCHMIDT, Vidensk. Medd. 52 (1901) 163.

Epitheca only slightly greater than hypotheca. Epitheca converging to about 80° and giving rise to a slender, weak-looking, apical horn. Hypotheca short, provided with two parallel, weak-looking, pointed, close, antapical horns. Right antapical greater than one half of left.

Total length about 265 μ; greatest diameter about 55 μ.

Found in Puerto Galera Bay, Mindoro.

CERATIUM DENS Ostenfeld and Schmidt. Plate 9, fig. 20a.

Ceratium dens OSTENFELD and SCHMIDT, Vidensk. Medd. 52 (1901) 165, text fig. 16; CLEVE, Ark. f. Zool. 1 (1903) 340; KARSTEN, Wiss. Ergeb. Deuts. Tief.-Exp. 2 (1907) 414, pl. 48, figs. 8*a*, 8*b*; BÖHM, Bull B. P. Bishop Mus. 87 (1931) 15, fig. 11; NIELSEN, Dana Exp. Rep. 4 (1934) 15, fig. 27.

Epitheca less than hypotheca. Epitheca converging to about 85° to produce a strong apical horn open at the tip. Hypotheca diverging, with two antapical horns both closed at the tip. Left antapical short, about 36 μ long, directed more or less laterally. Right antapical more than twice as long, about 80 μ, directed anteriorly, making an angle of about 75° with body wall.

Total length about 190 μ; body about 60 μ long, 60 μ in diameter.

Found in Puerto Galera Bay, Mindoro.

Subgenus AMPHICERATIUM Vanhöffen

Cell long and narrow, only slightly, if at all, dorsoventrally flattened. Right posterior horn rudimentary or absent. Horns normally closed at tips.

CERATIUM FUSUS (Ehrenberg). Plate 9, figs. 21a and 21b.

Peridinium fusus EHRENBERG, Infusionsthierchen als vollkommene Organismen 18 (1838) 256, pl. 22, fig. 20.

Ceratium fusus CLAPARÉDE and LACHMANN, Mem. Inst. Nat. 6 (1859) 400, pl. 19, fig. 7; STEIN, Org. Infusionsthiere (1883) 15, figs. 1–6; CLEVE, Kongl. Sv. Vet.-Akad. Handl. (3) 32 (1899) 36; (8) 32 (1900) 19; (2) 34 (1900) 20; Öfv. Kongl. Sv. Vet.-Akad. Förhandl. (9) 57 (1900) 1030; (5) 35 (1901) 14; (7) 35 (1902) 24; AURIVILLUS, Kongl. Sv. Vet.-Akad. Handl. (6) 32 (1899) 31; SCHRÖDER, Mitt. Zool. Stat. Neapel 14 (1901) 17; OSTENFELD and SCHMIDT, Vidensk. Medd. 52 (1901) 164; JOLLOS, Arch. f. Protist. 19 (1910) 193, pl. 9, fig. 53; MEUNIER, Mem. Mus. Roy. d'Hist. Nat. 8 (1919) 89, pl. 21, figs. 1, 2; LEBOUR, Dinoflagellates Northern Seas (1925) 146, pl. 31, fig. 1; PAULSEN, Microplancton d'Alboran (4) (1930) 77; BÖHM, Arch. f. Protist. (1931) 355; Bull. B. P. Bishop Mus. 87 (1931) 14, fig. 10, *c–f;* NIELSEN, Dana Exp. Rep. 4 (1934) 14, figs. 25, 26; CAMPBELL, Journ. Ent. Zool. 26 (1934) 21, fig. 16.

Epitheca long, regularly narrowing into a long, evenly wide apical horn, often with a tiny knot at tip. Apical horn straight or weakly bent dorsally. Hypotheca with a long left antapical horn not quite as long as the apical horn, and a tiny, very short, rudimentary right horn. Both closed at tips.

Total length, about 278 μ; greatest breadth, about 19 μ.

Common in surface plankton, Manila Bay.

Subgenus EUCERATIUM Gran

Cell broad and flattened, usually anchor-shaped; with two anteriorly directed posterior horns.

Horn normally closed at tip.

CERATIUM TRIPOS (O. F. Müller). Plate 9, figs. 22a and 22b.

Cercaria tripos O. F. MÜLLER, Zool. danicae prodromus (1777); (1871) 206.

Ceratium tripos NITZSCH, Neue Schriften d. Naturf. Ges. zu Halle 3 (1817) 4; CLAPARÉDE and LACHMANN, Mem. Inst. Nat. Geneve 6 (1859) 396, pl. 19, figs. 1–4; STEIN, Org. Infusionsthiere (1883) pl. 16, figs. 1–11; CLEVE, Kongl. Sv. Vet.-Akad. Handl. (3) 32 (1899) 36; (8) 32 (1900) 19; (1) 34 (1900) 21; (5) 35 (1901) 14; (7) 35 (1902) 25; SCHRÖDER, Mitt. Zool. Stat. Neapel 14 (1901) 15, pl. 1, fig. 17; OKAMURA and NISHIKAWA, Annot, Zool. Japon. 5 (1904) 121, pl. 6, fig. 1; KARSTEN, Wiss. Ergeb. d. Deuts. Tief.-Exp. 2 (1907) 404; PAVILLARD, Bull. Soc. Bot. 54 (1907) 153; JOLLOS, Arch. f. Protist. 19 (1910) 193, pl. 9, fig. 52; LEBOUR, Journ. Mar. Biol. Ass. 11 (1917) 187, fig. 1; Dinoflagellates Northern Seas (1925) 125, pls. 32*a*–32*c*, 33; text figs. 46*b*–46*d*; MEUNIER, Mem. Mus. Roy. d'Hist. Nat. pt. 3 8 (1919) 83, pl. 20, figs. 27–29; BIGELOW, Bull. U. S. Bur. Fish 40 (1924) 407, figs. 113, 114; LINDEMANN, Natürliche Pflanzenfamilien 2 (1928) 27, figs. 8*a*–8*e*; PAULSEN, Microplancton d'Alboran (1930) 79, fig. 47; BÖHM, Arch. f. Protist. (1931) 15, fig. 12; WANG and NIE, Cont. Biol. Lab. Sci. Soc. 8 (1932) 302, figs. 16, 17; NIELSEN, Dana Exp. Rep. 4 (1934) 17, figs. 32, 33.

Fairly large species with cell anchor-shaped, broad, more or less flattened. Epitheca shorter than wide, with an anterior horn of more or less uniform diameter. Hypotheca with an oblique, but slightly convex posterior border. Right side of hypotheca about 6 or 7 times as great as left side. Antapical horns both pointed and closed at tip, right antapical horn making a more acute angle with the cell body than left. Theca provided with prominent, anastomosing ridges and numerous tiny pores. With greenish-yellow chromatophores.

Cell about 67 μ long, 67 μ wide; total length about 210 μ.

Common in Manila Bay.

CERATIUM BREVE Ostenfeld and Schmidt. Plate 10, fig. 23a.

Ceratium tripos var. *brevis* OSTENFELD and SCHMIDT, Vidensk. Medd. 52 (1901) 164, fig. 13.

Ceratium breve var. *parallelum* OKAMURA, Rep. Imp. Bur. Fish 1 (1912) 9, fig. 86.

Ceratium breve DANGEARD, Ann. L'Inst. Oceanog. (1927) 376; BÖHM, Bull. B. P. Bishop Mus. 87 (1931) 18, fig. 18; WANG and NIE, Cont. Biol. Lab. Sci. Soc. 8 (1932) 306, fig. 19; NIELSEN, Dana Exp. Rep. 4 (1934) 18, figs. 35, 36.

Fairly large specimen with epitheca longer but much narrower than hypotheca. Left side of hypotheca several times as great as right side. Antapical horns pointed, close, very prominent, directed more or less anteriorly, their bases making an obtuse angle (90° to 105°) with the sides of the hypotheca. Anterior border of these horns for the greatest part of their length prominently ribbed. Horns normally open at tips.

Total length with apical horn, 132 μ; greatest width, 62 μ; right abapical horn about 100 μ; left abapical horn, about 190 μ.

Occasionally met with in Puerto Galera Bay, Mindoro.

CERATIUM MACROCEROS (Ehrenberg). Plate 10, fig. 24a.

Peridinium macroceros EHRENBERG, Verh. Ber. Akad. d. Wiss. (1840) 201.

Ceratium tripos var. *macroceros* CLAPARÉDE and LACHMANN, Mem. Inst. Nat. Genéve **6** (1859) 397, pl. 19, fig. 1; CLEVE, Kongl. Sv. Vet.-Akad. Handl. (3) **32** (1899) 21; (8) **32** (1900) 21.

Ceratium macroceros STEIN, Org. Infusionsthiere (1882) pl. 14, figs. 1–11; CLEVE, Kongl. Sv. Vet.-Akad. Handl. (8) **32** (1900) 19; (7) **35** (1902) 24; OSTENFELD and SCHMIDT, Vidensk. Medd. **52** (1901) 167; OKAMURA and NISHIKAWA, Annot. Zool. Japon. **5** (1904) 122, fig. 2; OKAMURA, Annot. Zool. Japon. **6** (1907) pl. 4, figs. 19, 20; LEBOUR, Dinoflagellates Northern Seas (1925) 155, pl. 35; PAULSEN, Microplancton d'Alboran (1930) 87, fig. 54; BÖHM, Arch. f. Protist. (1931) 364; Bull. B. P. Bishop Mus. **87** (1931) 38, fig. 35*a;* NIELSEN, Dana Exp. Rept. **4** (1934) 25, fig. 59.

Medium-sized, long-horned species. Epitheca shorter than hypotheca, with a long horn very gradually tapering to an open end. Hypotheca with an almost straight, oblique hind margin making an oblique angle with the two antapical horns open at their tips. Antapical horns first diverging obliquely and posteriorly, then taking a turn anteriorly and running more or less parallel with the apical horn. Antapical horns provided with spines at curved portions and open at ends. Theca traversed by numerous irregularly longitudinal ridges and with numerous pores. With yellow chromatophores.

Length of cell body, about 59 μ; width, 55 μ.

Common in Manila Bay.

CERATIUM TRICHOCEROS (Ehrenberg). Plate 10, fig. 25a.

Peridinium trichoceros EHRENBERG, Verh. Berliner Akad. Wiss. (1840).

Ceratium trichoceros KOFOID, Bull. Mus. Comp. Zool. (6) **1** (1907); NIELSEN, Dana Exp. Rept. **4** (1934) 27, fig. 68; BÖHM, Arch. f. Protist. (1931) 365; WANG and NIE, Cont. Biol. Lab. Sci. Soc. **8** (1932) 303, fig. 15.

Theca thin, smooth, without ridges or pores; girdle incomplete, only on right oral side; only a tiny remnant of girdle visible on left oral side. Epitheca shorter than hypotheca, with a long apical horn of almost uniform diameter. Hypotheca with two long, slender, antapical horns making a very obtuse angle with cell body, both open at ends, with yellowish chromatophores.

Cell body about 37 μ long and 44 to 48 μ wide.

This species is easily differentiated from *C. macroceros* by being much smaller, by the more obtuse angle of the antapical horns with the body, and by the absence of ridges on the theca and spines at the curved portions of the antapical horns.

Very common in Manila Bay.

CERATIUM CONTRARIUM Gourret. Plate 11, fig. 26a.

Ceratium tripos var. *contrarium* GOURRET, Ann. Mus. d'Hist. Nat. (8) 1 (1883) pl. 3, fig. 51.

Ceratium tripos var. *macroceros* fo. *contraria* SCHRÖDER, Mitt. Zool. Stat. Neapel 14 (1901) 16.

Ceratium contrarium PAVILLARD, Trav. Inst. Bot. Univ. Montpellier (1905) 53, pl. 2, fig. 1; Bull. Soc. Bot. 54 (1907) 229; BÖHM, Arch. f. Protist. (1931) 365; Bull. B. P. Bishop Mus. 87 (1931) 40; NIELSEN, Dana Exp. Rept. 4 (1934) 27, fig. 67.

Delicate looking form with epitheca shorter than hypotheca. Epitheca converging to about 90° to form a very long, prominent, open, apical horn about 260 μ long. Left side of hypotheca only slightly longer than right. Antapical horns curved and long, directed anteriorly. Left posterior horn making an angle of 125° with the body, right posterior horn making an angle of about 135° with the body. Only left ventral part of girdle distinctly visible.

Length of body, excluding apical horn, 44 μ; greatest diameter, 40 μ; antapical horns, about 120 μ long.

Often met with in Puerto Galera Bay, Mindoro, during April.

CERATIUM MOLLE Kofoid. Plate 11, fig. 27a.

Ceratium molle KOFOID, Bull. Mus. Comp. Zool. (6) 1 (1907); OKAMURA, Rept. Imp. Bur. Fish 1 (1912) 16, pl. 2, figs. 22–24, pl. 3, fig. 40; NIELSEN, Dana Exp. Rept. 4 (1934) 28, fig. 71.

Epitheca as long as hypotheca, narrowing to an angle of 75° to form a narrow, slender, gradually tapering, anterior horn which is open. Hypotheca with two more or less curved open horns, right horn making an angle of 130° with its wall, left horn making an angle of 150° with its wall; both horns directed anterolaterally. Posterior border of antapical horns with prominent spinelets. Left side of hypotheca about twice right, giving its posterior border an oblique angle with axis of body.

Total length including apical horn, 144 μ; depth of body, 40 μ; right antapical horn 72 μ long, left, 48.

Common in Puerto Galera Bay, Mindoro, in April.

Family DINOPHYSIDÆ Kofoid and Michener

Body compressed laterally, divided by a seam into two lateral halves. Transverse furrow situated far apically, making epitheca obsolete and much smaller than hypotheca. Epitheca more or less enclosed by upper list which forms a cup. Transverse or cingular lists prominent, directed apically, supported by fine radiating ribs. Longitudinal or sulcal lists wide, supported by few ribs. Apical pore absent. Test usually poroid or with pores.

Genus PHALACROMA Stein (1883)

Small forms with bodies only slightly flattened, wedge-shaped, and egg-shaped in lateral view. Epitheca poorly developed, appearing as a flat lid above transverse girdle. Transverse lists with fine ribs not highly developed as in other genera. Left longitudinal list usually well developed with three spines. Chromatophores absent. Test strongly poroid.

PHALACROMA ROTUNDATUM Claparéde and Lachmann. Plate 12, fig. 28.

Phalacroma rotundatum CLAPARÉDE and LACHMANN, Mem. Inst. Nat. Genéve 5 (1858) pl. 20, fig. 13; 6 (1859) 409, pl. 20, fig. 16; STEIN, Org. Infusionsthiere (1883) pl. 19, figs. 9–11; pl. 20, figs. 1, 2; LEBOUR, Dinoflagellates Northern Seas (1925) 78, pl. 11, figs. 3*a*–3*e*; PAULSEN, Microplancton d'Alboran (1930) 32, fig. 17; BÖHM, Bull. B. P. Bishop Mus. 137 (1936) 15, fig. 5*a*.

Dinophysis rotundata MEUNIER, Duc D'Orleans Campagne Arctique 1 (1910) 59, pl. 3, figs. 43–46; Mem. Mus. Roy. d'Hist. Nat. pt. 4 8 (1919) 79, pl. 20, figs. 14–20; FAURÉ-FREMIET and PUIGAUDEAU, Bull. Soc. Zool. 48 (1923) 261, fig. 2; ABE, Sci. Rep. Tohoku Imp. Univ. 2 (1927) 385, fig. 2; KOFOID and SKOGSBERG, Mem. Mus. Comp. Zool. 51 (1928) 67; SCHILLER, Arch. f. Protist. 61 (1928) 66, 67; TAI and SKOGSBERG, Arch. f. Protist. 82 (1934) 426, fig. 2.

Cell oval, compressed, widest at middle. Epitheca small, hardly extending beyond rim of upper list. Hypotheca smooth, without protuberances. Left sulcal list relatively narrow, broadening slightly abapically. Theca finely poroid. Cell content pinkish, with yellowish fat globules.

Length 46 μ, width 40 μ.

At times found in Manila Bay.

PHALACROMA CUNEUS Schütt. Plate 12, fig. 29.

Phalacroma cuneus SCHÜTT, Ergeb. Plankton Exped. 4 (1895) 148, pl. 3, fig. 14; Natürliche Pflanzenfamilien 1 (1896) 27, fig. 38*b*; CLEVE, Kongl. Sv. Vet.-Akad. Handl. (5) 35 (1901) 16; CLEVE, Göteborgs Vetensk. Handl. IV 4 (1902) 35; Ark. f. Zool. 1 (1903) 347; SCHRÖDER, Mitt. Zool. Stat. Neapel 14 (1901) 19; OSTENFELD and SCHMIDT, Vidensk. Medd. 52 (1901) 175; KOFOID, Univ. Cal. Pub. Zool. (13) 3 (1907) 195; KARSTEN, Wiss. Ergeb. Deuts. Tief.-Exp. 2 (1907) 325, 353, 355; PAVILLARD, Bull. Soc. Bot. 56 (1909) 283; 70 (1923) 878; Prince Monaco Res. Campagnes Scientifiques 82 (1931) 41; OKAMURA, Rep. Imp. Bur. Fish 1 (1912) 18, pl. 5, fig. 76; DANGEARD, Ann. L'Inst. Oceanog. (1927) 380; KOFOID and SKOGSBERG, Mem. Mus. Comp. Zool. 51 (1928) 124–139, fig. 58*b*; SCHILLER, Arch. f. Protist. 61 (1928) 71; LINDEMANN, Nat. Pflanzenfamilien 2 (1928) 74.

Cell more or less wedge-shaped; epitheca low, broadly rounded; hypotheca with narrowly rounded posterior portion; greatest diameter at region of posterior cingular list, which is subhorizontal and as wide as the transverse furrow. Left sulcal list wide and prominent, right narrow and inconspicuous. Wall provided with a reticulum of small polygons, each with a tiny pore at the center. There are from 25 to 35 polygons bordering the posterior margin of the girdle, on each valve.

Length about 82 μ; greatest depth about 84 μ.

Occasionally met with in Puerto Galera Bay, Mindoro.

PHALACROMA MITRA Schütt. Plate 12, fig. 30.

Phalacroma mitra SCHÜTT, Nat. Pflanzenfamilien 1 (1896) 27, fig. 38; OKAMURA, Annot. Zool. Japon. 6 (1907) 134, pl. 5, fig. 43; Rep. Imp. Bur. Fish. 1 (1912) pl. 5, figs. 78–80; ABE, Sci. Rep. Tohoku Imp. Univ. 2 (1927) 385, fig. 3*a*; SCHILLER, Arch. f. Protist. 61 (1928) 72; KOFOID and SKOGSBERG, Mem. Mus. Comp. Zool. 51 (1928) 75; PAULSEN, Microplancton d'Alboran (1930) 23.

Phalacroma rapa LINDEMANN, Nat. Pflanzenfamilien 2 (1928) 74, fig. 58; MATZENAUER, Bot. Archiv 35 (1933) 443.

Body wedge-shaped, more or less oblong anteriorly and becoming compressed posteriorly. Lateral view more or less oval, widest at middle. Epitheca symmetrical, low, only slightly projecting above upper list. Lists of girdle prominent, supported by fine ribs. Left longitudinal list supported by three spines. Test coarsely areolated.

Length and greatest width about 56 μ.

Rarely met with in Manila Bay (seen only once in June, 1936).

PHALACROMA DORYPHORUM Stein. Plate 12, fig. 31.

Phalacroma doryphorum STEIN, Org. Infusionsthiere (1883) pl. 19, figs. 1–4; SCHRÖDER, Mitt. Zool. Stat. Neapel 14 (1901) 19; CLEVE, Ark. f. Zool. 1 (1903) 347; PAVILLARD, Bull. Soc. Bot. 56 (1909) 283; Resultats des Campagnes Scientifiques 82 (1931) 42; OKAMURA, Rep. Imp. Bur. Fish 1 (1912) 18, pl. 5, fig. 77; KOFOID and SKOGSBERG, Mem. Mus. Comp. Zool. 51 (1928) 175, fig. 23.

Dinophysis galea POUCHET, J. Annot. Physiol. (1883) 426, fig. *G*; DANGEARD, Ann. L'Inst. Oceanog. (1927) 380.

Cell more or less subovate in lateral outline. Epitheca moderately convex to rather flat, hardly extending beyond edge of anterior cingular list. Hypotheca symmeterical, more or less oval with strongly convex posterior margin. Transverse furrow flat or slightly convex. Cingular lists structureless, unequal, both directed apically; left sulcal list with three well-defined ribs and with cingular posterior margin; cell with a triangular sail. Thecal wall finely areolate, with widely scattered pores.

Length about 68 μ; greatest depth about 64 μ.

Occasionally met with in Puerto Galera Bay, Mindoro.

Genus DINOPHYSIS Ehrenberg (1839)

Body much flattened, egg-shaped, elongate, or forked in lateral view. Epitheca much reduced, usually completely enclosed by upper cingular list which is funnel-shaped. Upper cingular list more developed than lower, both directed upward, supported by fine ribs. Hypotheca making up almost all of body. Posterior tip provided with one or two knobs or spines.

Left sulcal list as in *Phalacroma*.

DINOPHYSIS MILES fo. INDICA Cleve. Plate 12, fig. 32.

Dinophysis miles fo. *indica* CLEVE, Öfv. Kongl. Sv. Vet.-Akad. Förhandl. (9) 57 (1900) 1030–1031; KARSTEN, Wiss. Ergeb. Deuts. Tief.-Exp. 2 (1907) 419, pl. 47; MATZENAUER, Bot. Arch. 35 (1933) 446, 503, fig. 10; BÖHM, Bull. B. P. Bishop Mus. 137 (1936) 26.

Dinophysis aggregata WEBER and VAN BOSSE, Ann. Jard. Bot. Buit. 2 (1901) 140, pl. 17, fig. 344.

Cell more or less fork-shaped posteriorly. Epitheca obsolete, upper list more or less cup-shaped, supported by ribs. Longitudinal list ribbon-shaped, supported by three prominent ribs. Dorsal process of hypotheca shorter than ventral, only very slightly curved ventrally at posterior portion and with a tiny knob at tip. Ventral process almost straight, with two tiny knobs at tip.

Length about 148 μ, greatest width about 44 μ.

Common in Manila Bay (June).

DINOPHYSIS CAUDATA Kent, 1882. Plate 12, figs. 33a and 33b.

Dinophysis caudata KENT, Manual Infusoria (1881); PAVILLARD, Bull Soc. Bot. 56 (1909) 881; LEBOUR, Dinoflagellates Northern Seas (1925) 82, text fig. 21*c;* SCHILLER, Arch. f. Protist. 61 (1928) 78; KOFOID and SKOGSBERG, Mem. Mus. Comp. Zool. 51 (1928) 314, figs. 44, 46; PAULSEN, Microplancton d'Alboran (1930) 34, fig. 19: WANG and NIE, Cont. Biol. Lab. Sci. Soc. (9) 8 (1932) 309, fig. 21; MATZENAUER, Bot. Archiv 35 (1933) 445; CAMPBELL, Journ. Ent. Zool. 26 (1934) 18, fig. 3; TAI and SKOGSBERG, Arch. f. Protist. 82 (1934) 453, text figs. 9, 10*D*, 10*E*.

Dinophysis humunculus STEIN, Org. Infusionsthiere (1883) 24, pl. 21, figs. 1, 2, 5, 7.

Cell much flattened, epitheca rudimentary, hidden by deep, funnellike, upper, transverse list. Hypotheca long, with an elongate, fingerlike, antapical lobe provided with two spinelets at tip. Upper girdle list prominent, funnel-shaped, supported by strong radial ribs. A small dorsal finlet present. Theca very prominently areolated. Cell with yellow chromatophores. It appears that this species is represented in Manila by both the pedunculate and the abbreviate varieties.

Length, 80 μ to 100 μ; width, 45 μ to 49 μ (excluding longitudinal list).

Common in Manila Bay.

DINOPHYSIS HASTATA Stein. Plate 12, fig. 34.

Dinophysis hastata STEIN, Org. Infusionsthiere (1883) pl. 19, fig. 12; MURRAY and WHITTING, Trans. Linn. Soc. II 5 (1899) 331, pls. 1–3, 6; OSTENFELD and SCHMIDT, Vidensk. Medd. 52 (1901) 169; CLEVE. Göteborgs Vet. Handl. IV 4 (1902) 29; Arch. f. Zool. 1 (1903) 343; KARSTEN, Ergeb. Deuts. Tief.-Exped. 2 (1907) 234; PAVILLARD, Bull. Soc. Bot. 56 (1909) 283, 284; 70 (1923) 879, 880, fig. 2*a;* OKAMURA, Rep. Imp. Bur. Fish 1 (1912) 19, 33, figs. 73–75; KOFOID and SKOGSBERG, Mem. Mus. Comp. Zool. 51 (1928) 261–272, fig. 32.

Phalacroma hastatum PAVILLARD, Bull. Soc. Bot. 56 (1909) 283, fig. 4; 70 (1923) 879, 880; LEBOUR, Dinoflagellates Northern Seas (1925) 83, fig. 21*e*.

Dinophysis hastata var. *parvula* LINDEMANN, Bot. Arch. 5 (1923) 219, fig. 6.

Cell inside more or less oblong. Epitheca insignificant, hardly protruding beyond base of anterior cingular list. Transverse groove convex. Anterior cingular list prominently ribbed and seemingly larger than posterior. Posterior cingular list structureless, at base of which is a transverse row of prominent pores. Hypotheca more or less ovoid. Left sulcal list prominent, wider and pointed posteriorly, with three large ribs, posterior rib longest and rugged. Cell with triangular sail with two large median and several small marginal ribs. Theca areolate or with pores.

Length, about 72 μ; width, 60 μ.

Sometimes met with in Puerto Galera Bay, Mindoro.

Family TINTINNIDINÆ Kofoid Campbell

Lorica usually tubular or saccular; with or without suboral spiral structure, but rarely with collar or suboral differentiation; aboral end sometimes enlarged, never with fins, either open or closed; wall with primary alveoli only, soft, with agglomerating materials, without highly developed, well-separated lamellæ in lorica.

Genus TINTINNIDIUM Kent (1882)

Tintinnididæ with generally elongate lorica with aboral end closed or with a minute opening; collar sometimes present; wall viscous with agglomerating foreign bodies.

TINTINNIDIUM PRIMITIVUM Busch. Plate 13, figs. 35a to 35c.

Tintinnidium primitivum BUSCH, Verh. Deuts. Zool. Ges. 28 (1923) 71; Arch. f. Protist. 54 (1925) 183–190, figs. *a–d;* CAMPBELL, Journ. Ent. Zool. 26 (1926) 124; KOFOID and CAMPBELL, Univ. Cal. Pub. Zool. 34 (1929) 15, fig. 3.

Lorica tubular, straight, of nearly uniform diameter, without collar. Oral end about 4.8 to entire length. Oral opening occupying entire oral width. Aboral end with a slightly smaller diameter and with only a tiny opening situated at one side of flattened aboral surface. Wall not of uniform thickness, with few agglomerating foreign bodies.

Total length, about 160 μ; oral diameter, about 33.3 μ; basal diameter, 29.6 μ.

TINTINNIDIUM CYLINDRICA sp. nov. Plate 13, fig. 36.

Lorica tubelike, with a wall of medium thickness and a distinct hyaline, structureless collar. Shoulder of bowl at right angles to collar. Height of collar about 16 times in total length. Cavity of uniform diameter, equal to diameter of collar which is about 19 μ. Aboral end rounded, usually with an irregular break (resulting perhaps from detachment). Wall coarsely granular with few coarse agglomerations.

Total length, 126 μ; greatest diameter, 33 μ; thickest portion of wall, 8 μ.

Type locality.—Bacoor Bay, Philippines.

This species differs from *T. ampullarium* in being slenderer, in having a thinner wall, and in having the shoulder of the bowl at right angles to the collar instead of sloping.

TINTINNIDIUM AMPULLARIUM sp. nov. Plate 13, figs. 37a and 37b.

Lorica flask-shaped, with a thick, finely granular wall and a distinct, hyaline, structureless collar. Shoulder next to collar sloping. Height of collar 10 times in total length. Cavity of uniform diameter, equal to oral diameter. Aboral end somewhat flattened, always with irregular opening (perhaps a break resulting from detachment).

Oral diameter, 17 μ; total length, about 100 μ; greatest diameter, 45 μ, which is about twice diameter of aboral region; thickest portion of wall about 14 μ.

Type locality.—Manila Bay, Philippines.

Genus LEPROTINTINNUS Jörgensen (1899)

Tintinnididæ with tubelike, elongate lorica open at both ends; collar absent; surface sticky with agglomerating foreign bodies; wall soft and coarsely alveolar.

LEPROTINTINNUS NORDQUISTI (Brandt). Plate 13, figs. 38a to 38c.

Tintinnopsis nordquisti BRANDT, Ergeb. Plankton Exp. 3 (1906) 18, pl. 24, figs. 1–4; 3 (1907) 166, 167, 444, 473; OKAMURA, Annot. Zool. Japon. 6 (1907) 138, pl. 6, fig. 61.

Leprotintinnus nordquisti KOFOID and CAMPBELL, Univ. Cal. Pub. Zool. 34 (1929) 17, fig. 13; WANG and NIE, Cont. Biol. Lab. Sci. Soc. 8 (1932) 341, fig. 49.

Lorica long, tubular; basal portion well expanded, about 2.6 wider than rest of tube; wall with fine agglomerating particles.

Most of Philippine specimens examined have total length, 118 μ; oral diameter, 40 μ; diameter of basal portion of tube, 29 μ; diameter of expanded base, about 78 μ. Some variations occur, however. The individual shown in Plate 13, fig. 38*b*, is very long and slightly narrower, while the individual shown in Plate 13, fig. 38*c*, is much shorter, slightly thicker, and with a narrower expanded base.

Very common in Manila Bay, Philippines.

LEPROTINTINNUS TUBULOSUS sp. nov. Plate 13, fig. 39.

Lorica long, in form of a simple tube, basal portion not at all expanded; oral diameter about 3.9 in total length; wall thin.

with fine agglomerating particles. Lorica about 140 μ long and 37 μ in diameter. Specimens showing transverse budding are often met with.

Type locality.—Manila Bay, Philippines.

Family CODONELLIDÆ Kent

Bowl globose, conical or cylindrical; oral end without hyaline structure or collar. Aboral end generally closed, rounded or pointed, with or without horn; wall with fine primary alveoli and coarse secondary structures, which are irregular in arrangement and size and not differentiated into inner and outer lamina.

Genus TINTINNOPSIS Stein (1867)

Codonellidæ with lorica usually bowl-shaped, never with a narrow oral opening; aboral end usually closed, but very rarely with an irregular (broken ?) aperture; wall thin, with a fine primary structure and freely agglomerated matter and detritus.

TINTINNOPSIS BACOORENSIS sp. nov. Plate 14, fig. 40.

Lorica campanulate, with an expanded bulbous fundus and a spreading oral rim. Between fundus and flaring collar a cylindrical middle portion, the neck. Oral rim rugged, about 1 in total length; diameter of neck about 1.75 in total length; bulbous portion about 1.38 in total length. Wall with thick agglomerations of various sizes.

Total length, 63.8 μ; oral rim diameter, 63.8 μ, neck, 29.6 μ; fundus, 41.9 μ.

This species differs from *T. mortensenii* in having a bulbous fundus distinctly set off from the central cylindrical portion which has a smaller diameter. In the figure of Kofoid and Campbell as well as in that of Okamura such a differentiated neck is not visible.

Type locality.—Manila Bay, Philippines.

TINTINNOPSIS BÜTSCHLII Daday. Plate 14, fig. 41.

Tintinnopsis bütschlii DADAY, Mitt. Zool. Stat. Neapel 7 (1887) 556, pl. 20, figs. 4, 5; KOFOID and CAMPBELL, Univ. Cal. Pub. Zool. 34 (1929) 29, fig. 85; HADA, Sci. Rep. Tohoku Imp. Univ. (4) 7 (1932) 557, 558, text fig. 5.

Codonella bütschlii AURIVILLUS, Kongl. Sv. Vet.-Akad. Handl. (3) 30 (1898) 111.

Tintinnopsis campanula var. *bütschlii* BRANDT in part, Ergeb. Plankton-Exp. 3 (1907) 151–152, 456; JÖRGENSEN, Rep. Danish Ocean. Exp. Biol. 2 (1924) 67, 69, fig. 76*a*; Tierwelt Nord. Ostsee pt. 2 8 (1927) 6, 7, fig. 2; ENTZ, Arch. f. Protist. 15 (1909) 106, pl. 20, fig. 46, 47, 49; PAULSEN, Microplancton d'Alboran 4 (1930) 96.

Lorica bell-shaped, composed of an everted, expanded oral region and a convex rounded bowl; oral rim irregular, diameter about 1.05 in length; bowl narrowest about upper third, transdiameter about 2.1 in total length. Oral diameter, above 67 μ; smallest transdiameter, about 34; total length, about 71.

Rarely met with in Bacoor Bay (a part of Manila Bay), Philippines.

TINTINNOPSIS GRACILIS Kofoid and Campbell. Plate 14, fig. 42.

Tintinnopsis karajacensis var. *a* BRANDT, Ergeb. Plankton-Exp. 3 (1906) 16, pl. 19, figs. 1, 2, 21; (1907) 163, 488; HADA, Sci. Rep. Tohoku Imp. Univ. (4) 7 (1932) 558, text fig. 6.

Tintinnopsis gracilis KOFOID and CAMPBELL, Univ. Cal. Pub. Zool. 34 (1929) 36, fig. 37; WANG and NIE, Cont. Biol. Lab. Sci. Soc. China (9) 8 (1932) 343, fig. 50.

Lorica tubular, oral diameter 3.4 in total length; oral rim regular; aboral half slightly swollen with a slightly greater diameter than oral half. Aboral region conical but without a definite point. Wall thick, with heavier coarse agglomerations on the aboral half.

Length, about 112 μ; oral diameter, 33 μ.

Unlike the figure of Kofoid and Campbell, these specimens show a distinct constriction between the oral and aboral halves. In some specimens the aboral end is seemingly open.

Quite common in Manila Bay.

TINTINNOPSIS LORICATA (Brandt). Plate 14, fig. 43.

Tintinnopsis dadayi var. *b loricata* BRANDT, Ergeb. Plankton-Exp. 3 (1906) 16, 17, pl. 19, fig. 4, pl. 20, fig. 11; (1907) 130, 144–146, 470.

Tintinnopsis loricata KOFOID and CAMPBELL, Univ. Cal. Pub. Zool. 34 (1929) 39, fig. 60; WANG and NIE, Cont. Biol. Lab. Sci. Soc. China (1932) 345, fig. 53.

Lorica an elongate bell; oral rim ragged, with diameter 1.7 in total length; suboral region in the form of a flaring collar, 5.1 in total length; test or lorica cylindrical, diameter 2.16 in total length; aboral region convex-conical, ending bluntly; agglomeration coarse, with distinct primary alveoli.

Length 152 μ.

Rarely met with in Manila Bay.

TINTINNOPSIS MANILENSIS sp. nov. Plate 14, fig. 44.

Lorica tall, campanulate, with an irregular oral opening about 1.2 in total length, and a convex, rounded, expanded fundus. Bowl narrowest at its middle, which is visibly in the form of a neck; oral margin of lorica in the form of a flaring collar, diverging to about 45°; neck diameter 3, neck length also 3 in total length; bulbous portion with a diameter 2.2 in total length; wall with thick agglomerations of various sizes and shapes.

Oral diameter, about 67 μ; smallest transdiameter of neck, 26 μ; diameter of fundus, 37 μ; total length, 81.5 μ.

This species is closely allied to *T. bütschlii.* It differs from the latter, however, in having a distinct narrowed portion of the bowl, here called the neck, which is visibly set off from the bulbous terminal fundus. It is almost twice as long as *T. bacoorensis.*

Type locality.—Manila Bay.

TINTINNOPSIS MAJOR Meunier. Plate 15, fig. 48.

Tintinnopsis major MEUNIER, Duc D'Orleans Campagne Arctique 1 (1910) 138, pl. 12, fig. 1; KOFOID and CAMPBELL, Univ. Cal. Pub. Zool. 34 (1929) 39, fig. 18.

Lorica small, more or less cup-shaped; oral diameter about the same as length; bowl with straight sides at oral half; aboral half more or less rounded (50°, then 110°); wall with coarse, angular agglomerations of varied sizes.

Length, about 52 μ.

Common in Manila Bay.

T. major was first reported from much colder waters off Tromsö, Norway.

TINTINNOPSIS MORTENSENII Schmidt. Plate 15, fig. 49.

Tintinnopsis mortensenii SCHMIDT, Vidensk. Medd. 52 (1901) 186, fig. 3.

Tintinnopsis mortenseni BRANDT, Ergeb. Plankton-Exp. 3 (1906) 17, 18, pl. 21, figs. 13, 13*a;* (1907) 152, 444, 472; OKAMURA, Annot. Zool. Japon. 6 (1907) 138, pl. 6, fig. 65.

Lorica campanulate, with a rounded fundus, not distinctly set off from the more or less straight side, and a wide, everted oral rim. Diameter of bowl about 1.6 in entire length of lorica which in turn is 1.4 in oral rim diameter.

Total length, 63 μ; diameter of bowl, 36 μ; diameter of oral rim, 83 μ.

Met with in Bacoor Bay during January.

This species differs from *T. bacoorensis* in having a wider, more flaring oral rim and in not having a distinct separation between the fundus and the cylindrical portion of the lorica.

TINTINNOPSIS RADIX (Imhof). Plate 14, fig. 45.

Codonella radix IMHOF, Zool. Anz. 9 (1886) 103; KOFOID and CAMPBELL, Univ. Cal. Pub. Zool. 34 (1929) 45, fig. 93; PAULSEN, Microplancton d'Alboran (1930) 96.

Tintinnopsis davidoffii DADAY, Mitt. Zool. Stat. Neapel 7 (1887) 552, pl. 19, fig. 23.

Tintinnopsis curvicauda DADAY, Mitt. Zool. Stat. Neapel 7 (1887) 554, 555, pl. 19, fig. 33.

Tintinnopsis radix BRANDT, Ergeb. Plankton-Exp. 3 (1907) 20, 465, 477; HADA, Sci. Rep. Tohoku Imp. Univ. (4) 7 (1932) 560, 561, text fig. 10.

Tintinnopsis fracta OKAMURA, Annot. Zool. Japon. 6 (1907) 137, pl. 6, fig. 57; BRANDT, Ergeb. Plankton-Exp. 3 (1906) pl. 23, figs. 1, 3–5, 9–13, pl. 31, fig. 8; (1907) 174.

Lorica an elongate cone, gradually tapering from a wide oral end to an irregularly pointed aboral tip. Oral rim irregular, about 5.6 entire length. Agglomerations fine.

Total length about 247 μ.

Very common in Manila Bay.

TINTINNOPSIS TOCANTINENSIS Kofoid and Campbell. Plate 14, fig. 46.

Tintinnopsis aferta var. *a* BRANDT, Ergeb. Plankton-Exp. 3 (1906) 19, pl. 25, figs. 2, 7; (1907) 129, 177.

Tintinnopsis tocantinensis KOFOID and CAMPBELL, Univ. Cal. Pub. Zool. 34 (1929) 48, fig. 46; HADA, Sci. Rep. Tohoku Imp. Univ. (4) 7 (1932) 559, fig. 8; WANG and NIE, Cont. Biol. Lab. Sci. Soc. China (9) 8 (1932) 343, fig. 51.

Lorica elongate, anterior cylindrical portion about 2 in total length, transdiameter about 5 in total length; aboral fourth of lorica bulbous, diameter about 3.6 in total length; dilated portion tapering abruptly into a stout aboral horn, 5 in total length.

Oral diameter, 18.5 μ; total length, 93 to 110 μ; diameter of bulbous portion, about 34 μ.

Very common in Manila Bay.

TINTINNOPSIS TURGIDA Kofoid and Campbell. Plate 14, fig. 47.

Tintinnopsis karajacensis var. *d* BRANDT, Ergeb. Plankton-Exp. 3 (1906) 17, 19, pl. 19, figs. 9, 20, pl. 26, fig. 9; (1907) 163, 469; HADA, Sci. Rep. Tohoku Imp. Univ. (4) 7 (1932) 558, text fig. 6.

Tintinnopsis turgida KOFOID and CAMPBELL, Univ. Cal. Pub. Zool. 34 (1929) 49, fig. 65.

Lorica cylindrical orally, expanding aborally to a bulbous portion 1.3 times diameter of long neck. Neck about 1.7, bulbous portion about 2.55 in total length. Oral region slightly everted to about diameter of bulbous portion. In some specimens this oral eversion is not present. Wall with irregular particles of various shapes and sizes.

Total length, 85 μ.

Very common in Manila Bay.

Family CODONELLOPSIDÆ Kofoid and Campbell

Lorica more or less top-shaped, oral rim entire; hyaline collar with annular or spiral structure and with bowl which is short, ovate, with closed rounded or pointed, aboral horn, and with coarse secondary structure.

Genus CODONELLOPSIS Jörgensen (1924)

Codonellopsidæ with lorica divided into an annular collar and a bowl; collar hyaline, distinctly set off from bowl, and with spiral structure or with one or two sometimes obscure bands; bowl oval to spheroidal, wall with primary, secondary, and tertiary structure; agglomerating material often on wall.

CODONELLOPSIS OSTENFELDI (Schmidt). Plate 15, fig. 50.

Codonella ostenfeldi SCHMIDT, Vidensk. Medd. 52 (1901) 187, fig. 4; BRANDT, Ergeb. Plankton-Exp. 3 (1906) 15, 17; pl. 14, figs. 1, 2; pl. 15, fig. 2; pl. 20, fig. 10; (1907) 122–124; OKAMURA, Annot. Zool. Japon. 6 (1907) 137, pl. 6, figs. 53*a*, 53*b*; KOFOID and CAMPBELL, Univ. Cal. Pub. Zool. 34 (1929) 84, fig. 160.

Codonella fenestrata CLEVE, Kongl. Sv. Vet.-Akad. Handl. (5) 35 (1901) 53, pl. 7, fig. 15.

Codonella morchella var. *ostenfeldi* SCHMIDT, Vidensk. Medd. 52 (1901) 187; CLEVE, Ark. f. Zool. 1 (1903) 350; OKAMURA Annot. Zool. Japon. 6 (1907) 137, pl. 6, fig. 54.

Tintinnopsis ostenfeldi BRANDT, Ergeb. Plankton-Exp. 3 (1907) 123, 125.

Codonellopsis ostenfeldi WANG and NIE, Cont. Biol. Lab. Sci. Soc. China (9) 8 (1932) 348, fig. 57.

Lorica with bowl and collar; collar nearly cylindrical, with little or no oral eversion, its diameter 1.7 in its length; mostly with 7 rows of prominent, closely set apertures, bowl spherical, slightly longer than wide; shoulder moderately emergent, aboral end rounded; agglomerated particles coarse.

Length, about 100 to 120 μ.

Rather common in Manila Bay.

Family COXLIELLIDÆ Kofoid and Campbell

Lorica open or closed at aboral end, if closed often irregular; collar present or absent; with coiled lamina forming lorica fully or partially; wall without agglomerated particles.

Genus COXLIELLA Brandt (1907)

Lorica usually tall, bowl- or vaselike; oral rim never denticulate, without differentiated collar; wall double, usually with two laminæ, with coarse, secondary structure; lorica formed by a single spiral band with superimposed turns of varying heights to a greater or less extent.

COXLIELLA LONGA (Brandt). Plate 15, fig. 51.

Cyttarocylis (?) *ampla* (?) var. *c longa* BRANDT, Ergeb. Plankton-Exp. 3 (1906) 20, pl. 28, fig. 3; (1907) 272, 453, 470.

Cyttarocylis (?) *laciniosa* var. *longa* BRANDT, Ergeb. Plankton-Exp. 3 (1907) 31, 262, 272, 453, 469, 470.

Coxliella laciniosa var. *longa* LAACKMANN, Deuts. Südp. Exp. 11 (1909) 456.

Coxliella longa KOFOID and CAMPBELL, Univ. Cal. Pub. Zool. 34 (1929) 101, fig. 196.

Lorica bullet-shaped, oral diameter about 2 in total length; oral rim irregularly and finely denticulate; bowl cylindrical for 0.6 of total length; wall with 13 turns.

Length about 205 μ; oral diameter, 102 μ.

Occasionally met with in Manila Bay (August 3, 1936). Differs from a species described by Kofoid and Campbell in not having a "short, stout, curved point" at aboral end.

Family CYTTAROCYLIDÆ Kofoid and Campbell

Lorica usually large, bell-shaped, often stalked. Oral rim variable, with or without a collar; aboral end closed, without spiral structure. Wall with primary and very regular secondary and sometimes tertiary structure, with prominent prismatic structure between the two lamellæ of the lorica.

This family is usually divided into 2 subfamilies: Cyttarocylineæ in which a flaring collar is usually present and a distinct aboral horn is absent; and Favellineæ in which a flaring collar is absent, but an aboral horn often present.

Genus FAVELLA Jörgensen (1924)

Favellineæ with lorica usually campanulate or subconical; oral rim entire, or with small skirt, or with denticles, no collar distinct from bowl, but sometimes one or more rings; aboral horn usually present, thick-walled; wall with two lamellæ, usually with coarse, intermediate prismatic secondary alveoli and a very fine, primary structure, never with regular polygonal structure.

FAVELLA SIMPLEX sp. nov. Plate 15, fig. 52.

Lorica campanulate, widest at oral region, its total length about 2.17 oral diameter, oral rim smooth; oral region with almost straight sides and bowl almost cylindrical to about 0.46 of its length; aboral region with slightly convex sides and contracting to about 55°; aboral horn about 0.32 oral diameter, with a slight constriction at middle, tip pointed. Wall double, thin and structureless. Oral diameter, 70 μ; total length, 152 μ; aboral horn, 25 μ.

Type locality.—Manila Bay.

FAVELLA PHILIPPINENSIS sp. nov. Plate 15, fig. 53.

Lorica cylindrical, stout, its length about 1.7 oral diameters; oral rim slightly serrate or denticulate, with two narrow rings; orally bowl cylindrical for about 0.70 of its length, with a slight nuchal constriction; aboral region more or less conical, contracting to about 70°; aboral horn about 0.43 oral diameter in length, and a pointed cone (20°), tip pointed; wall very smooth and finely alveolar.

Oral diameter, 108 μ; length excluding horn, 215 μ; aboral horn, 47 μ.

Similar to *F. panamensis* Kofoid and Campbell in many respects, except in the fine serration of the oral rim. A number of specimens were seen in which the lorica is slightly wider (oral diameter about 1.5 in the length).

Type locality.—Manila Bay.

FAVELLA ELONGATA sp. nov. Plate 15, fig. 54.

Lorica cylindrical, long, its length about 2.6 oral diameters; oral rim irregularly serrate with two very narrow rings without a definite nuchal constriction; anteriorly bowl cylindrical for about 70 per cent of its length; aboral region more or less rounded, contracting gradually to about 80 per cent; aboral horn proportionally small for the size of the bowl, 0.38 oral diameter, with rounded tip. Wall alveolar, double, with striæ between.

Oral diameter, 115 μ; length of bowl, about 299 μ; aboral horn, 43 μ.

This species is much longer than *F. philippinensis,* and the aboral region is more rounded.

Type locality.—Manila Bay.

FAVELLA AZORICA (Cleve). Plate 15, fig. 55.

Undella azorica CLEVE, Öfv. Kongl. Sv. Vet.-Akad. Forhandl. **57** (1900) 974, fig. 10; BRANDT, Ergeb. Plankton-Exp. **3** (1907) 212, 377, 405, 409, 455.

Favella azorica JÖRGENSEN, Rep. Danish Oceanog. Exp. Biol. **2** (1924) 6–8, 24–27, 37, 72, 105, fig. 28; KOFOID and CAMPBELL, Univ. Cal. Pub. Zool. **34** (1929) 151, fig. 284; MARSHALL, Great Barrier Reef Exp. (15) **4** (1934) 642, text fig. 15.

Lorica campanulate, oral diameter about 1.4 in length; oral region with one annulus; bowl almost cylindrical for over one-half orally, then converging to about 75° to form a blunt, somewhat rounded, thick-looking abapical end; wall finely reticulate, with two distinct lamellæ.

Length, about 104 μ; oral diameter about 70 μ.

Specimens examined agree closely with Marshall's figure of a specimen obtained from the Great Barrier Reef, except for having only one annulus.

Occasionally met with in Puerto Galera Bay, Mindoro.

Family PTYCHOCYLIDÆ Kofoid and Campbell

Lorica stout, kettle- or acorn-shaped; with or without suboral ledge or thickened region; aboral portion sculptured externally; wall with two lamellæ, with a distinct reticulum except at the suboral region.

Genus EPIPLOCYLIS Jörgensen (1924)

Ptychocylidæ with acornlike lorica; with a reticulated zone on the posterior portion which sometimes extends toward the collar, but never to the oral rim; wall thick, with large, heavy, and developed reticulation.

EPIPLOCYLIS EXQUISITA (Brandt). Plate 16, fig. 56.

Ptychocylis exquisita var. *e* BRANDT, Ergeb. Plankton-Exp. 3 (1906) 29, pl. 61, figs. 1, 1*a*; (1907) 295–296, 482.

Ptychocylis exquisita var. *f* BRANDT, Ergeb. Plankton-Exp. 3 (1906) 29, pl. 61, fig. 4; (1907) 296, 482.

Epiplocylis exquisita KOFOID and CAMPBELL, Univ. Cal. Pub. Zool. 34 (1929) 179, fig. 342.

Lorica acornlike, wide in diameter in proportion to length; oral rim smooth, with a diameter about 1.3 in total length; aboral region with a large, prominent horn about 4 in total length; fundus about 90°; wall of oral region coarsely granular; reticulations coarse, mostly on aboral half, only few lines reaching oral rim.

Length about 92 μ; oral diameter about 77 μ.

Obtained from Puerto Galera Bay, Mindoro.

EPIPLOCYLIS RALUMENSIS (Brandt). Plate 16, fig. 57.

Ptychocylis reticulata var. *ralumensis* BRANDT, Ergeb. Plankton-Exp. 3 (1906) 28, 29, pl. 63, figs. 3, 8; (1907) 289.

Epiplocylis ralumensis KOFOID and CAMPBELL, Univ. Cal. Pub. Zool. 34 (1929) 184, fig. 320; MARSHALL, Great Barrier Reef Exp. (15) 4 (1934) 642.

Lorica moderately stout, oral diameter about 1.7 in total length; collar present, erect and entire; a suboral ledge present between oral rim and collar; bowl bulging; fundus about 102°; aboral horn about 30°, subconical, pointed, about 5.7 in total length; bowl uniformly and heavily reticulated throughout.

Total length, about 76 μ; oral diameter, 52 μ; aboral horn, 16 μ.

Obtained from Puerto Galera Bay, Mindoro.

EPIPLOCYLIS UNDELLA (Ostenfeld and Schmidt). Plate 16, fig. 58.

Cyttacocylis undella OSTENFELD and SCHMIDT, Vidensk. Medd. 52 (1901) 181, fig. 30.

Ptychocylis undella BRANDT, Ergeb. Plankton-Exp. 3 (1906) 29, pl. 59, figs. 1–5, pl. 60, figs. 1–6, pl. 61 (1907) 288; OKAMURA, Annot. Zool. Japon. 6 (1907) 138, pl. 6, fig. 51; Rep. Imp. Bur. Fish 1 (1912) 24, pl. 5, fig. 97.

Epiplocylis undella KOFOID and CAMPBELL, Univ. Cal. Pub. Zool. 34 (1929) 185, fig. 345; MARSHALL, Great Barrier Reef Exp. (15) 4 (1934) 645, fig. 18.

Lorica kettle-shaped, with a prominent aboral horn; oral rim smooth, with a diameter about 1.7 in total length; aboral horn about 4.5 in total length; reticulations coarse, confined on aboral half of bowl; oral half with very fine granulation, two laminæ of wall well separate.

Length, about 108 μ; oral diameter, about 64 μ; aboral horn, 24 μ.

Obtained from Puerto Galera Bay, Mindoro.

Family PETALOTRICHIDÆ Kofoid and Campbell

Lorica cup-shaped; oral rim smooth, wavy or denticulate; mouth usually wide, with one or two collars; wall hyaline or with primary prismatic structure.

Genus METACYLIS Jörgensen (1924)

Lorica short and wide, oval or elongate; mouth wide, with a low collar with few closely-set annuli; bowl wide, aboral end rounded, flattened, pointed or with a spinule; wall with or without distinct structure or hyaline.

METACYLIS HEMISPHÆRICA sp. nov. Plate 16, fig. 59.

A small species with stout basketlike lorica, oral diameter about 1.09 in total length; collar with height about 4.3 in total length, slightly contracting with four spiral laminæ; bowl rounded abapically; wall hyaline.

Length, about 45 μ; oral diameter, about 41 μ; greatest diameter of bowl, about 48 μ.

Differs from *A. corbula* Kofoid and Campbell in being shorter but wider and in having a much rounded bowl abapically.

Obtained from Puerto Galera Bay, Mindoro, Philippines.

METACYLIS KOFOIDI sp. nov. Plate 16, fig. 60.

Lorica stout, basketlike; oral diameter 1.2 in length; collar very low, about 6 in length, wall slightly contracting and with three spiral laminæ; bowl rounded, but with a slight knoblike protuberance abapically; wall hyaline.

Length, about 45 μ; oral diameter, about 37 μ; greatest diameter of bowl, about 45 μ.

Differs from *M. hemisphærica* in having a lower collar with only three laminæ, in being narrower, and in having a knob of the bowl abapically.

Type locality.—Puerto Galera Bay, Mindoro.

Named after Prof. Charles A. Kofoid, Protozoologist, University of California.

Genus PETALOTRICHA Kent (1882)

Lorica bowl-shaped or conical; oral shelf spreading; oral ridge low, collar conical, flaring; nuchal constriction slight or deep; bowl saclike or conical; one row of suboral fenestræ with horizontal axis; subnuchal fenestra circular or elliptical, with oblique or vertical axis.

PETALOTRICHA MAJOR Jörgensen. Plate 16, fig. 61.

> *Petalotricha ampulla* var. *major* JÖRGENSEN, Rep. Danish Oceanog. Exp. Biol. 2 (1924) 89, figs. 100*a*, 100*b*.
>
> *Petalotricha major* KOFOID and CAMPBELL, Univ. Cal. Pub. Zool. 34 (1929) 204, fig. 384.

Lorica pot-shaped, oral diameter 0.85 in length; oral shelf slightly cupped, rim wavy; collar (about 60°) with straight sides; bowl almost rounded, about as high as it is wide; wall with few scattered fenestræ above equator of bowl; a single line of small fenestræ below oral rim.

Length, about 92 μ; oral diameter, 108 μ.

Obtained from Puerto Galera Bay, Mindoro.

Family RHABDONELLIDÆ Kofoid and Campbell

Lorica chalice-shaped to conical; oral aperture smooth, without teeth; a gutter present about mouth between two wall laminæ; aboral end closed or with only a minute pore; longitudinal ribs present, simple, branched or anastomosing, reaching from pedicel to mouth; wall often with fenestræ between ribs.

Genus RHABDONELLA Kent (1907)

Lorica usually elongate, chalice-shaped, oral rim without teeth, but with a gutter between inner and outer laminæ; pedicel more or less protracted without apophyses; ribs prominent, may be branched; usually vertical or slightly twisted, with fenestræ between them.

RHABDONELLA AMOR (Cleve). Plate 17, fig. 62.

Cyttarocylis amor CLEVE, Öfv. Kongl. Sv. Vet.-Akad. Förhandl. 57 (1900) 970, 971, fig. 4; Kongl. Sv. Vet.-Akad. Handl. (5) 35 (1901) 10; OSTENFELD and SCHMIDT, Vidensk. Medd. 52 (1901) 178.

Ptychocylis (*Rhabdonella*) *amor* BRANDT, Ergeb. Plankton-Exp. 3 (1906) 27, pl. 54, figs. 4, 6, 12–15; (1907) 21, 327–331, 453.

Rhabdonella amor ENTZ, Arch. f. Protist. 15 (1909) pl. 12, fig. 2; KOFOID and CAMPBELL, Univ. Cal. Pub. Zool. 34 (1929) 212, fig. 398; ALZAMORA, Inst. Español Oceanog. XI (76) (1933) 9, pl. 2, fig. 21; MARSHALL, Great Barrier Reef Exp. (15) 4 (1934) 649, text fig. 26.

Lorica short-subconical, without perceptible pedicel; oral diameter about 2 in length; suboral shelf slightly flaring, oral rim thin, immergent; bowl convex, inverted-subconical, changing from about 16° orally to about 38° aborally; ribs far apart, running more or less in a left-handed spiral near aboral end, few are branched, with several rows of fenestræ between two of them.

Length, about 88 µ; oral diameter, 44 µ.

Common in Puerto Galera Bay, Mindoro.

RHABDONELLA SPIRALIS (Fol). Plate 17, fig. 63.

Tintinnus spiralis FOL, Arch. Sci. Phys. Nat. (3) 5 (1881) 21, pl. 1, fig. 4.

Cyttarocylis spiralis OSTENFELD and SCHMIDT, Vidensk. Medd. 52 (1901) 180, fig. 29; SCHMIDT, Vidensk. Medd. 52 (1901) 188.

Ptychocylis (*Rhabdonella*) *spiralis* BRANDT, Ergeb. Plankton-Exp. 3 (1906) pls. 52–54, figs. 2–7; (1907) 321, 323, 327; OKAMURA, Annot. Zool. Japon. 6 (1907) 140, pl. 6, fig. 52; ENTZ, Arch. f. Protist. 15 (1909) 109, pl. 20, fig. 2.

Rhabdonella spiralis KOFOID and CAMPBELL, Univ. Cal. Pub. Zool. 34 (1929) 219, fig. 414; HOFKER, Arch. f. Protist. 75 (1931) 378, figs. 67–74; MARSHALL, Great Barrier Reef Exp. (15) 4 (1934) 646, 647, text fig. 23.

Lorica tall, chalice-shaped, about 4.8 oral diameters in total length; oral rim only with a slight flare; bowl orally almost cylindrical, then tapering abruptly to about 28°; aboral end in the form of a long, narrow pedicel with almost straight sides, open at end; length of pedicel only slightly less than half of total length; about 16 ribs visible from one side, straight orally, but with slight left-handed twist aborally; usually one vertical row of fenestræ between two ribs.

Total length, about 327 μ; oral diameter, 68 μ.

Often met with at Puerto Galera Bay, Mindoro.

RHABDONELLA BRANDTI Kofoid and Campbell. Plate 17, fig. 64.

Ptychocylis (*Rhabdonella*) *amor* var. *cuspidata* BRANDT, Ergeb. Plankton-Exp. 3 (1906) 27, pl. 54, figs. 3, 10, 11; (1907) 315–320, 331, 332, 453.

Rhabdonella brandti KOFOID and CAMPBELL, Univ. Cal. Pub. Zool. 34 (1929) 213, fig. 400; MARSHALL, Great Barrier Reef Exp. (15) 4 (1934) 649, text fig. 24.

Lorica chalice-shaped, of medium length, with a distinct pedicel; oral diameter about 3 in length, oral rim without visible flare; oral third of bowl more or less cylindrical, then bowl converging to about posterior third from pedicel, pedicel stout, about one-fourth of total length and closed at tip; about eighteen ribs visible from one side, usually running vertically at oral region but with slight left-handed twist basally, closely set, with one vertical row of fenestræ between two of them.

Length, about 192 μ; oral diameter, about 64 μ.

Common in Puerto Galera Bay, Mindoro.

RHABDONELLA FENESTRATA sp. nov. Plate 17, fig. 65.

Lorica small, oral diameter about 16 in total length; oral rim with a pronounced gutter between inner and outer laminæ; bowl cylindrical toward oral half, then becoming subconical, first about 65°, then contracting to about 32° to form short, blunt pedicel about 2.5 in oral diameter; ribs about 3.5, very prominent, with a slight counter-clockwise spiral; one row of well-developed fenestræ between two ribs.

Total length, about 80 μ; oral diameter, about 48 μ.

Type locality.—Puerto Galera Bay, Mindoro.

Family TINTINNIDÆ Claparéde and Lachmann

Lorica rigid, variously formed; oral region usually flaring (except *Bursaopis*); aboral end open or closed; wall hyaline, usually without secondary structure; with two, four, or eight macronuclei and micronuclei, and sixteen to twenty-four membranelles.

Genus TINTINNUS Schrank (1803)

Lorica in form of a truncated cone or cylinder, open at both ends; wall hyaline, homogenous, never with spiral structure, rarely externally wrinkled.

TINTINNUS PERMINUTUS Kofoid and Campbell. Plate 17, fig. 66.

Tintinnus lusus-undae DADAY in part, Mitt. Zool. Stat. Neapel 7 (1887) 527, 530.

Tintinnus franknoi OKAMURA in part, Annot. Zool. Japon. 6 (1907) 140, pl. 6, fig. 67*a*.

Tintinnus perminutus KOFOID and CAMPBELL, Univ. Cal. Pub. Zool. 34 (1929) 337, fig. 649.

Lorica in form of a truncated cone, 3° 6' with only a very slight median bulge; oral diameter about 4.3 in length.

Length about 177 μ.

Rarely met with in surface plankton of Manila Bay.

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ILLUSTRATIONS

[In Plates 1 to 11, *a*, ventral view; *b*, dorsal view; *c*, apical view; *d*, abapical view; *e*, lateral view.]

PLATE 1

FIG. 1, *a*, *c*, and *d*. *Peridiniopsis asymmetrica;* × 720.
2, *a*, *c*, and *d*. *Diplopseltopsis minor;* × 808.

PLATE 2

FIG. 3, *c* and *d*. *Goniaulux polyedra;* × 565.
4, *a* and *d*. *Goniaulux digitale;* × 842.
5, *a* and *b*. *Podolampas bipes;* × 565.

PLATE 3

FIG. 6, *a* to *d*. *Peridinium conicoides;* × 585.
7, *a* to *e*. *Peridinium latissimum;* × 585.

PLATE 4

FIG. 8, *a* to *e*. *Peridinium leonis;* × 610.
9, *a* to *d*. *Peridinium subinerme;* × 610.

PLATE 5

FIG. 10, *a* to *d*. *Peridinium depressum;* × 326.
11, *a* to *d*. *Peridinium obtusum;* × 652.

PLATE 6

FIG. 12, *a*, *b*, *d*, and *e*. *Peridinium venustum;* × 493.
13, *a*, *c*, and *d*. *Peridinium africanoides;* × 493.

PLATE 7

FIG. 14, *a*, *b*, and *d*. *Peridinium divergens;* × 540.
15, *a* to *d*. *Peridinium curtipes;* × 540.

PLATE 8

FIG. 16, *a* to *d*. *Peridinium pellucidum;* × 630.
17, *a* and *b*, *Ceratium furca;* × 281.
18, *a*. *Ceratium candelabrum;* × 374.
19, *a* and *b*. *Ceratium pentagonum;* × 374.

PLATE 9

FIG. 20, *a*. *Ceratium dens;* × 436.
21, *a* and *b*. *Ceratium fusus;* × 436.
22, *a* and *b*. *Ceratium tripos;* × 326.

PLATE 10

FIG. 23, *a*. *Ceratium breve*; × 360.
24, *a*. *Ceratium macroceros*; × 360.
25, *a*. *Ceratium trichoceros*; × 270.

PLATE 11

FIG. 26, *a*. *Ceratium contrarium*; × 382.
27, *a*. *Ceratium molle*; × 382.

PLATE 12

FIG. 28. *Phalocroma rotundatum*; × 630.
29. *Phalocroma cuneus*; × 374.
30. *Phalocroma mitra*; × 593.
31. *Phalocroma doryphorum*; × 593.
32. *Dinophysis miles* fo. *indica*; × 374.
33. *Dinophysis caudata*; *a*, var. *abbreviata*; *b*, var. *pedunculata*; × 593.
34. *Dinophysis hastata*; × 593.

PLATE 13

FIG. 35, *a* to *c*. *Tintinnidium primitivum*; *a*, *b*, aboral view; *c*, oral view, × 505.
36. *Tintinnidium cylindrica*, × 505.
37, *a*, *b*. *Tintinnidium ampullarum*; *b*, oral view, × 505.
38, *a*, *b*. *Leprotintinnus nordquisti*, slender form; × 287.
38, *c*. *Leprotintinnus nordquisti*, stout form; × 573.
39. *Leprotintinnus tubulosus*; × 573.

PLATE 14

FIG. 40. *Tintinnopsis bacoorensis*; × 540.
41. *Tintinnopsis bütschlii*; × 540.
42. *Tintinnopsis gracilis*; × 606.
43. *Tintinnopsis loricata*; × 540.
44. *Tintinnopsis manilensis*; × 540.
45. *Tintinnopsis radix*; × 270.
46. *Tintinnopsis tocantinensis*; × 540.
47. *Tintinnopsis turgida*; × 540.

PLATE 15

FIG. 48. *Tintinnopsis major*; × 570.
49. *Tintinnopsis mortensenii*; × 360.
50. *Codonellopsis ostenfeldi*; × 540.
51. *Coxliella longa*; × 606.
52. *Favella simplex*; × 360.
53. *Favella philippinensis*; × 270.
54. *Favella elongata*; × 215.
55. *Favella azorica*; × 360.

PLATE 16

FIG. 56. *Epiplocylis exquisita;* × 659.
57. *Epiplocylis ralumensis;* × 659.
58. *Epiplocylis undella;* × 659.
59. *Metacylis hemisphærica;* × 624.
60. *Metacylis kofoidi;* × 624.
61. *Petalotricha major;* × 416.

PLATE 17

FIG. 62. *Rhabdonella amor;* × 760.
63. *Rhabdonella spiralis;* × 293.
64. *Rhabdonella brandti;* × 293.
65. *Rhabdonella fenestrata;* × 760.
66. *Tintinnus perminutus;* × 720.

TEXT FIGURES

FIG. 1. Number of intercalaries and their relation to the precingulars in the groups *Orthoperidinium, Metaperidinium,* and *Paraperidinium.*
2. Number of intercalaries in their relation to the precingulars in the subgenera of *Peridinium.*

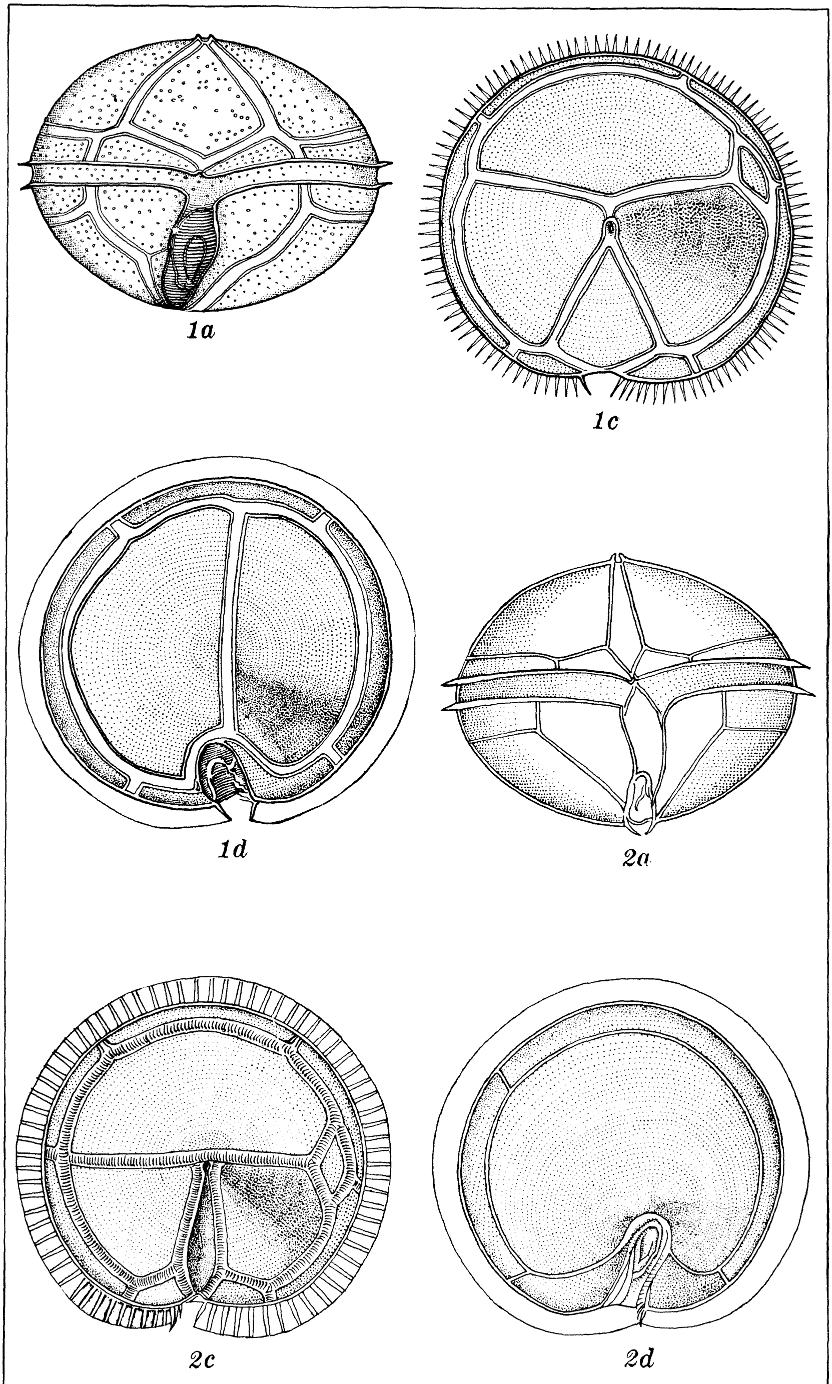


PLATE 1.

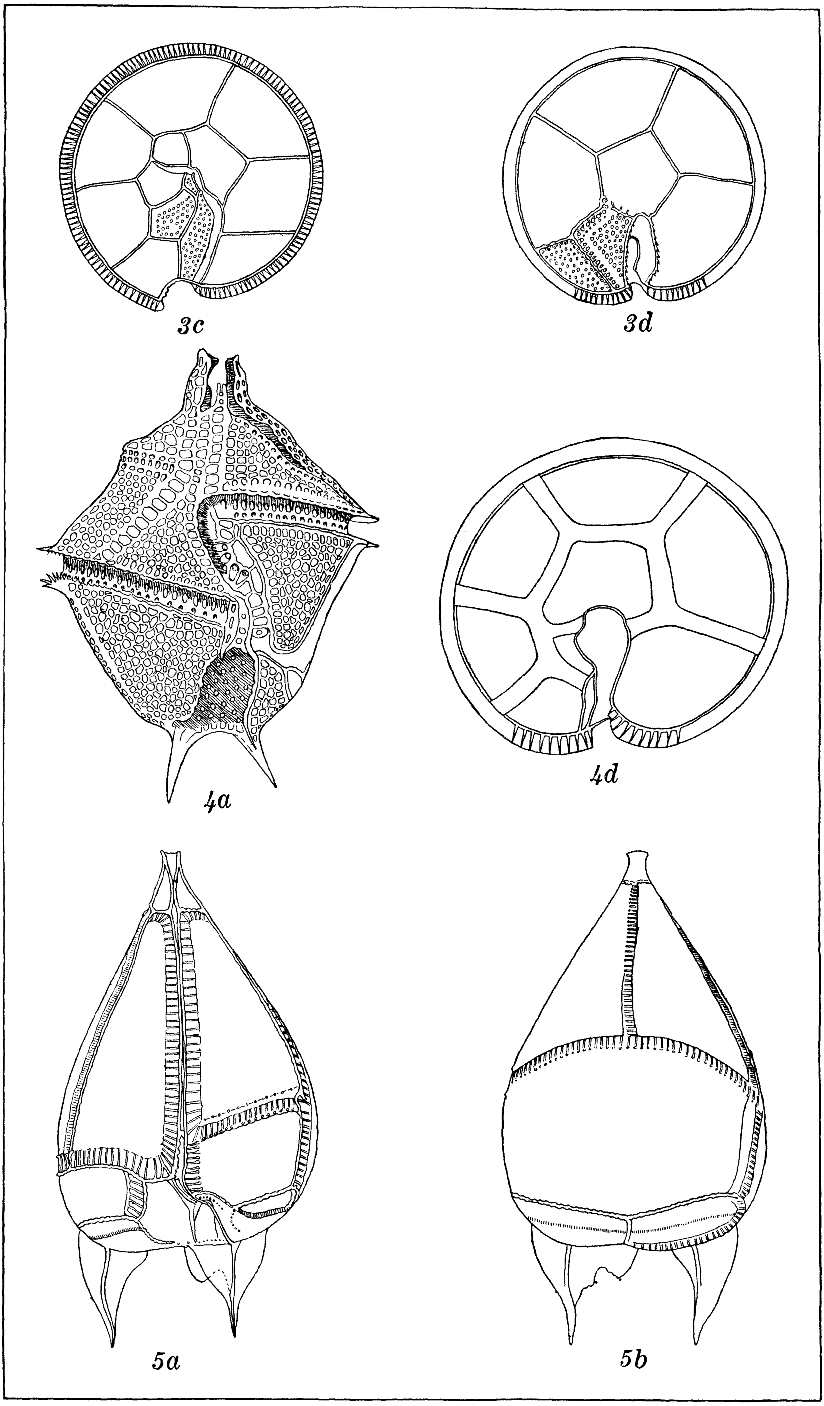
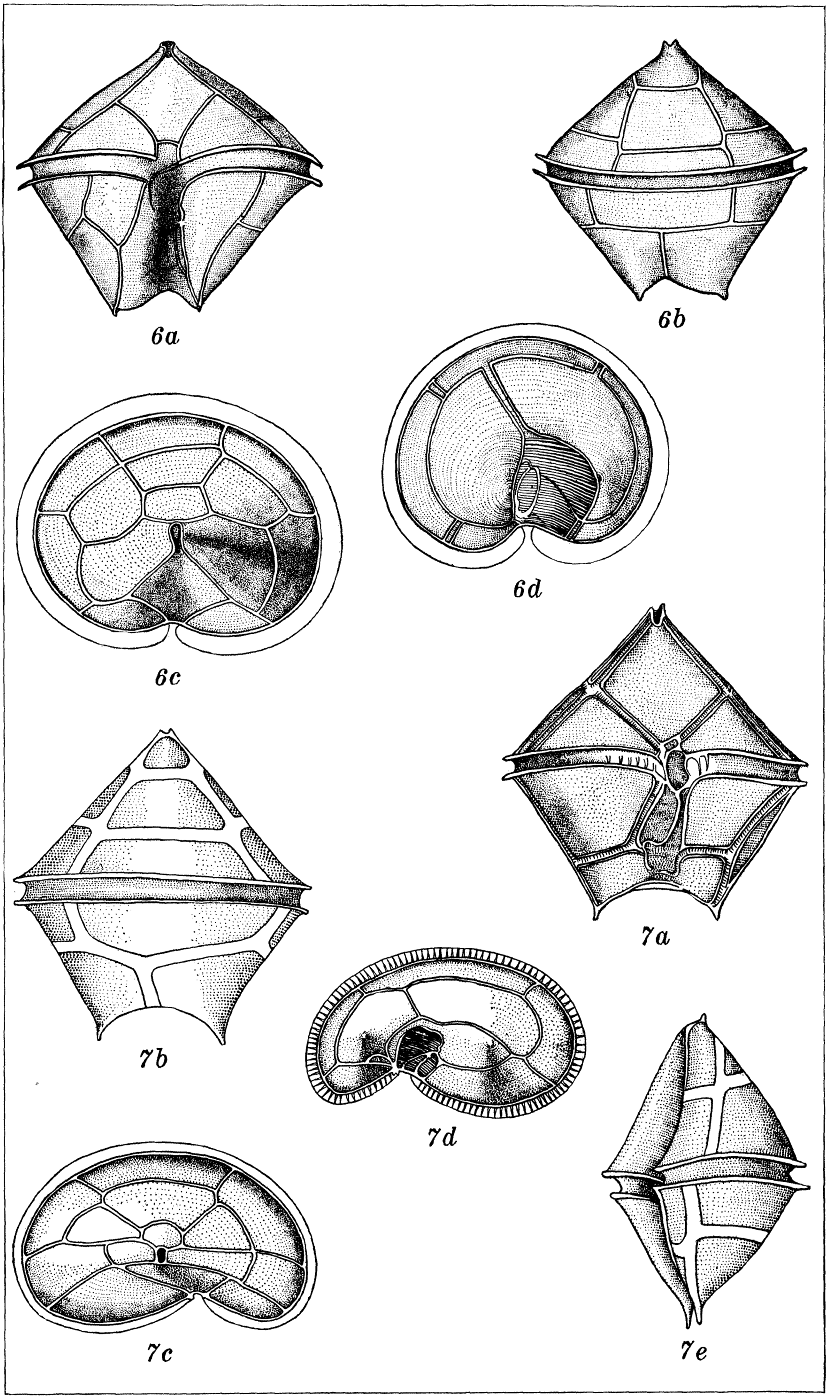


PLATE 2.



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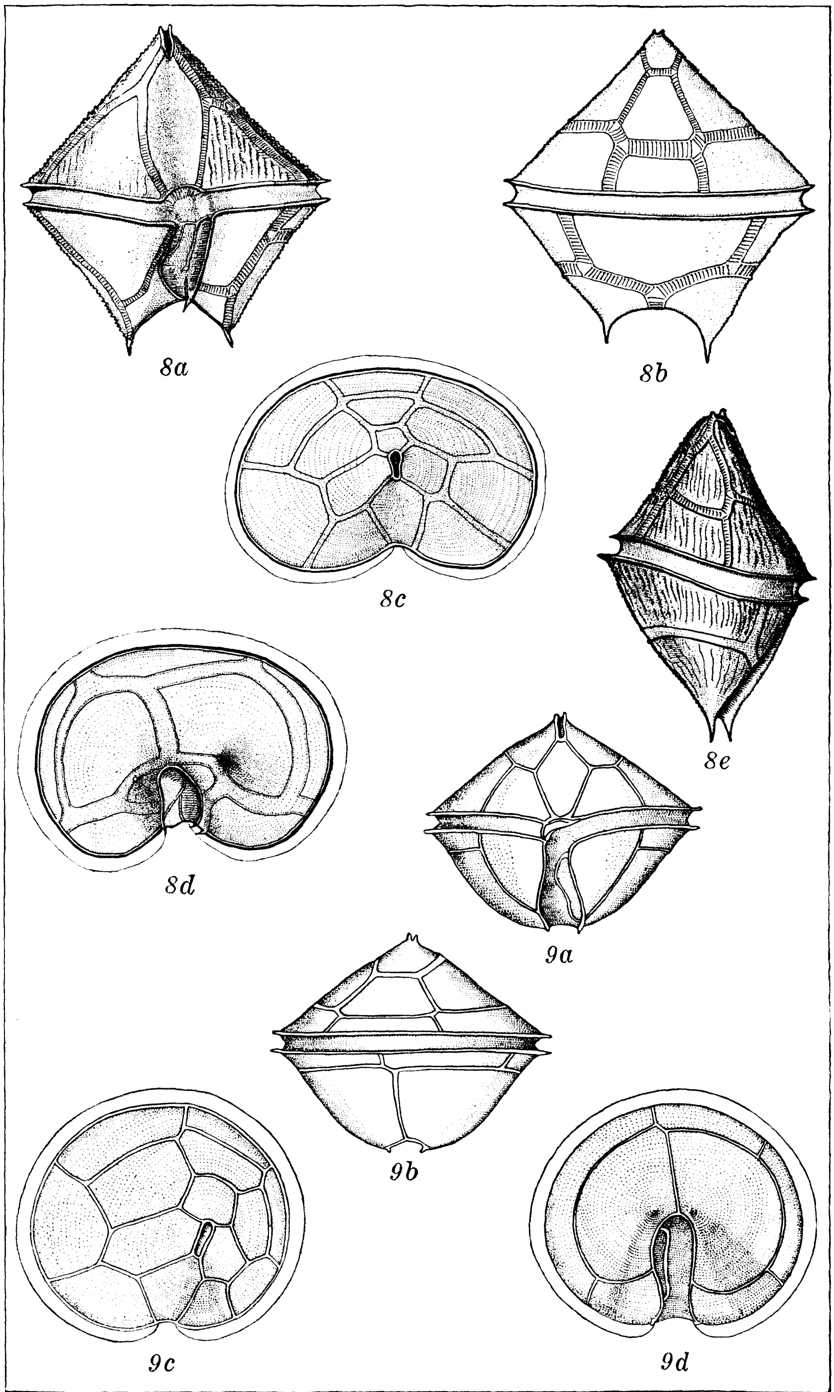

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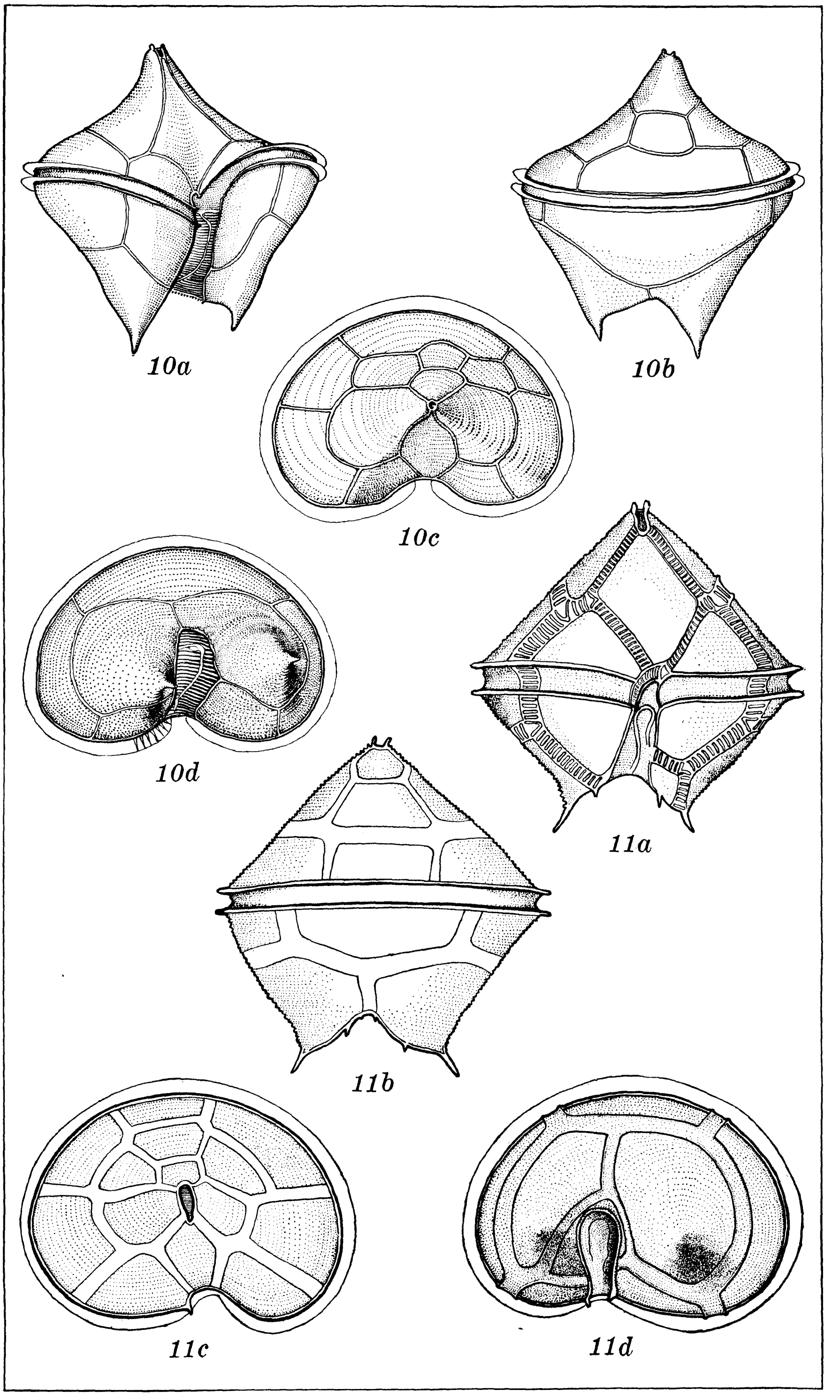

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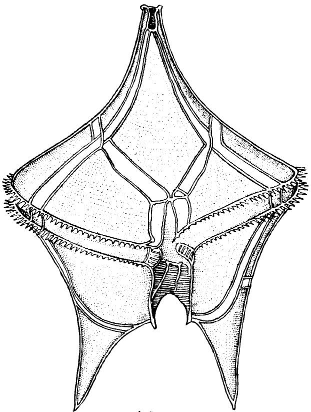

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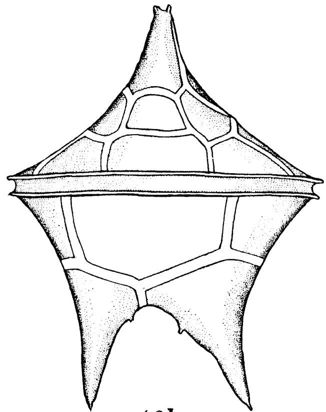

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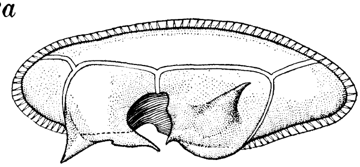

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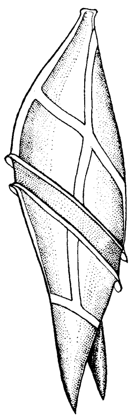

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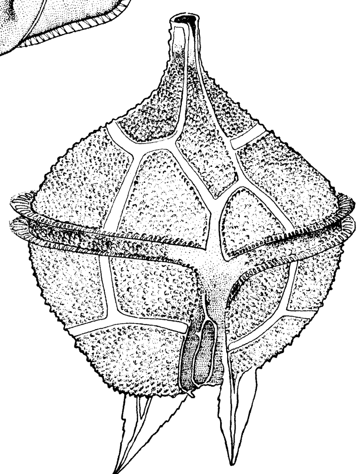

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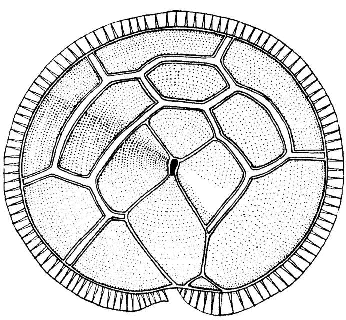

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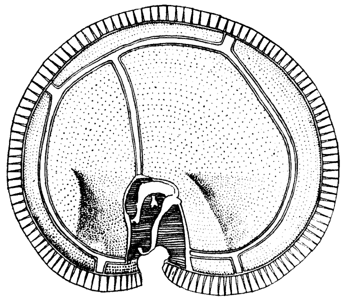
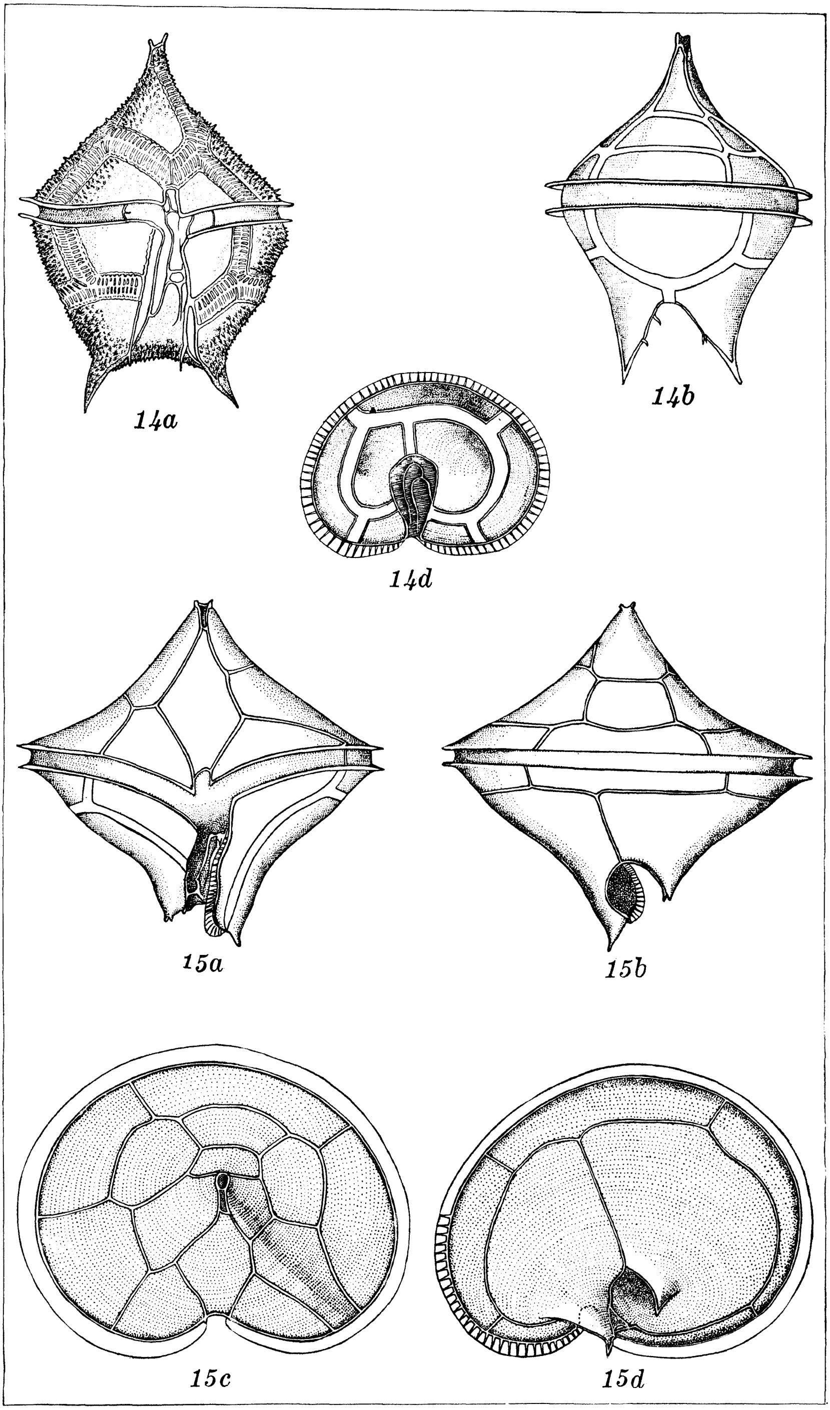


13d

PLATE 6.



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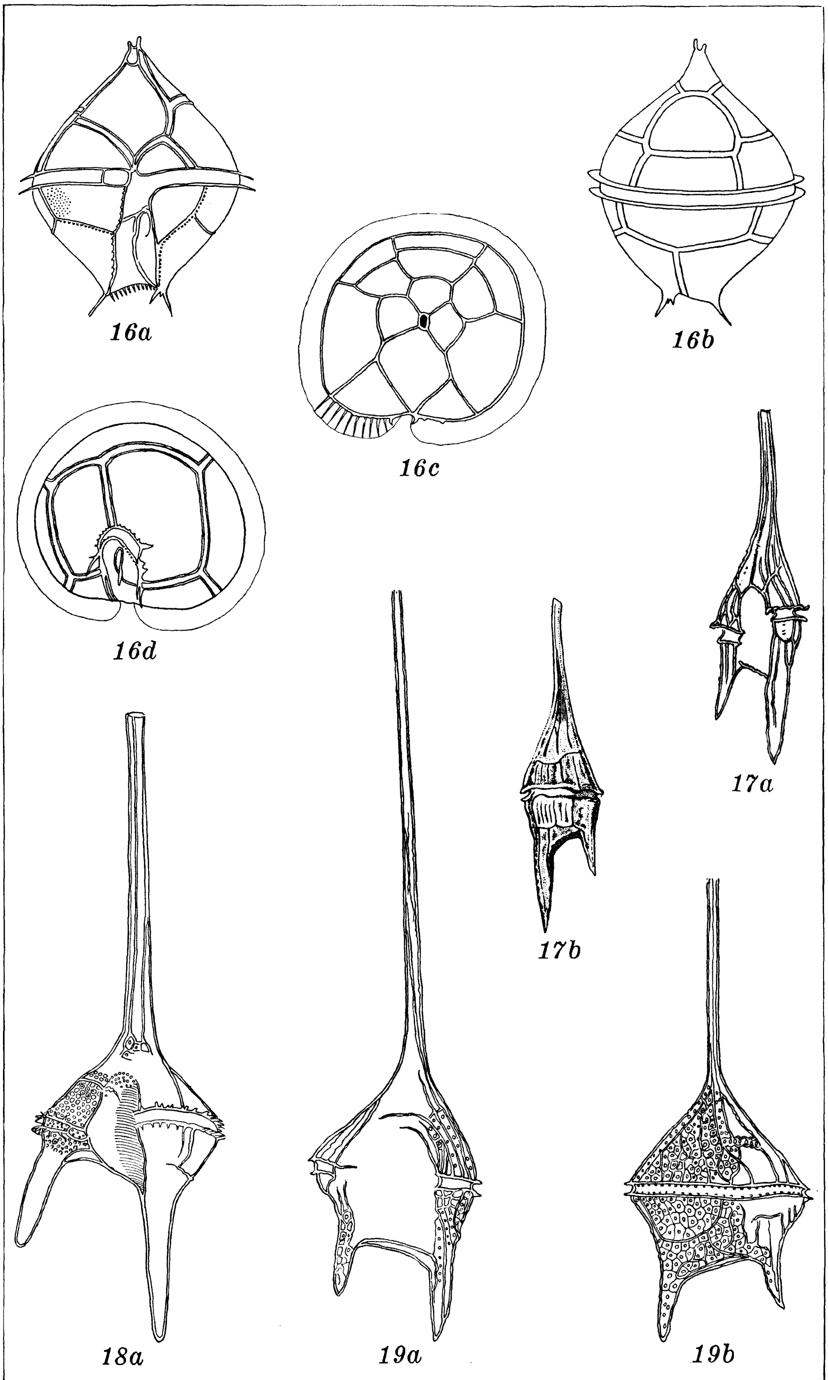

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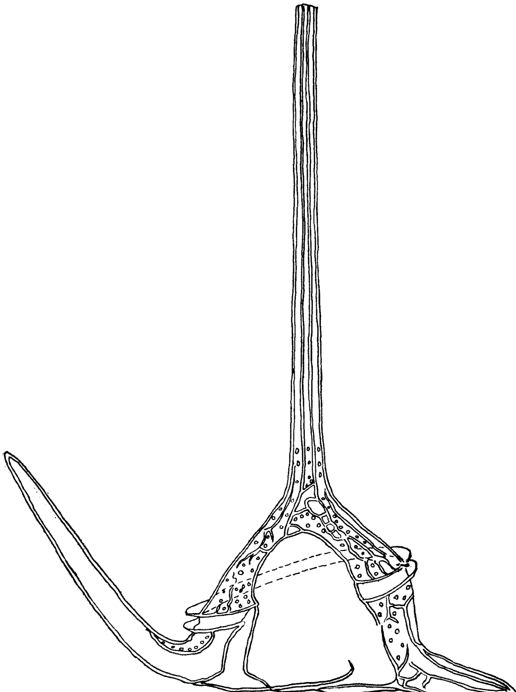

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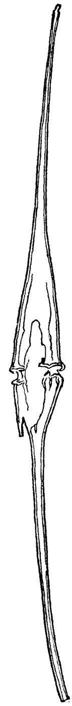

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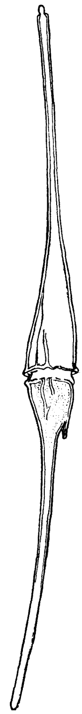

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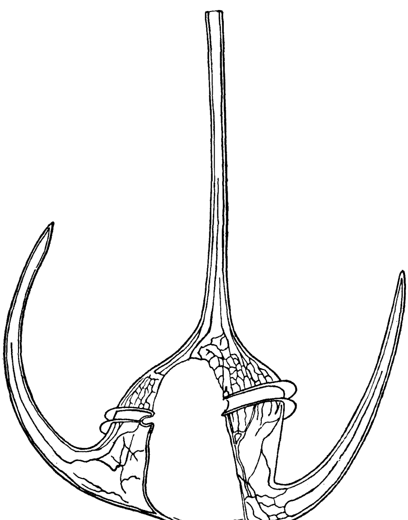

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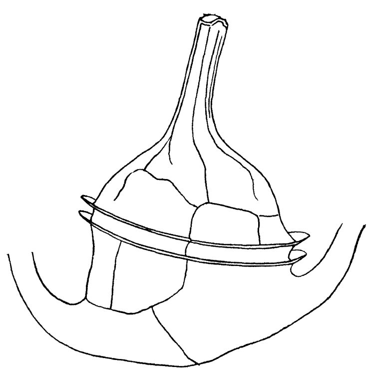

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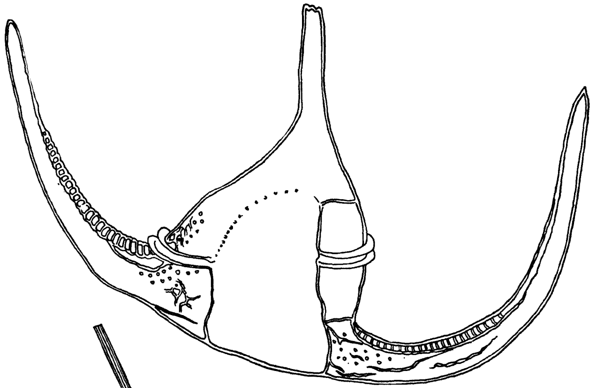

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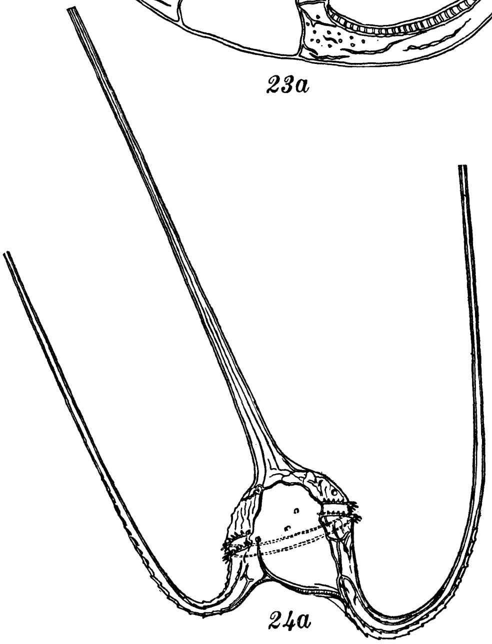

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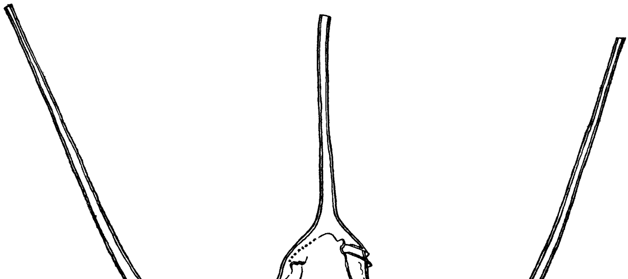

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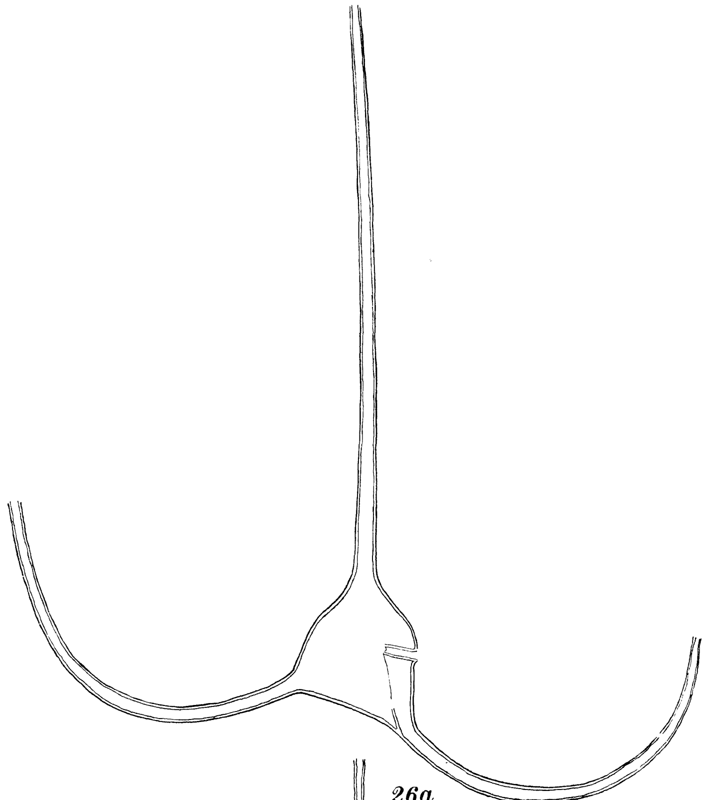

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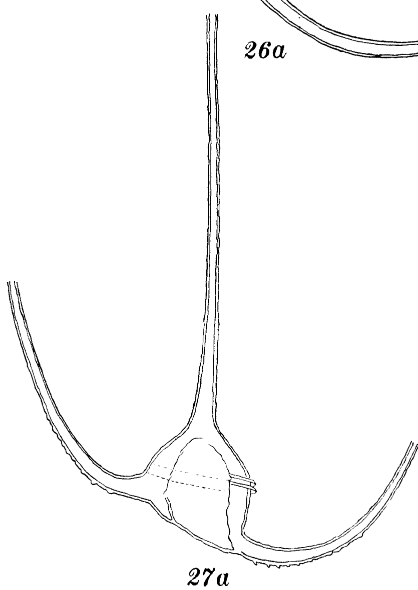

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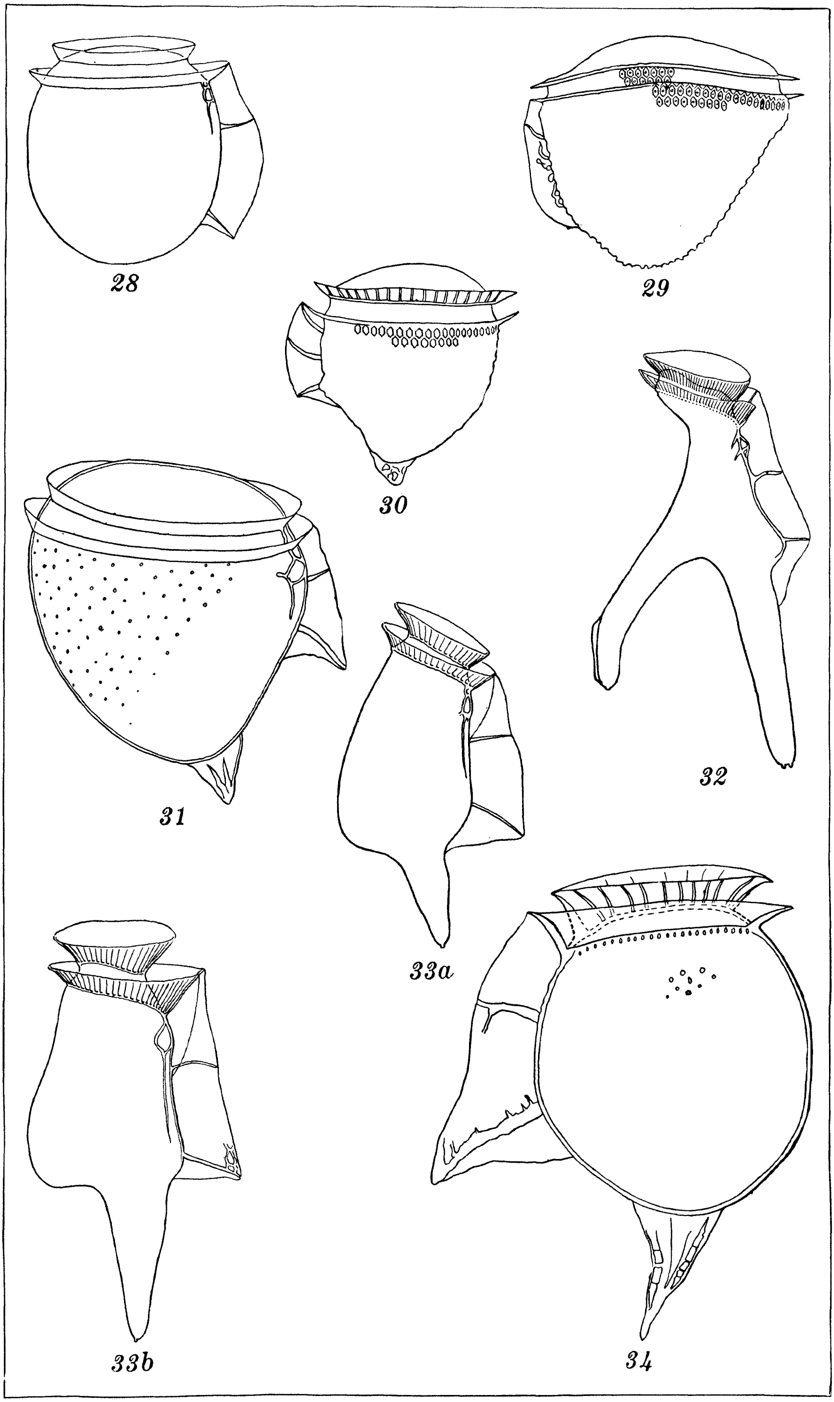

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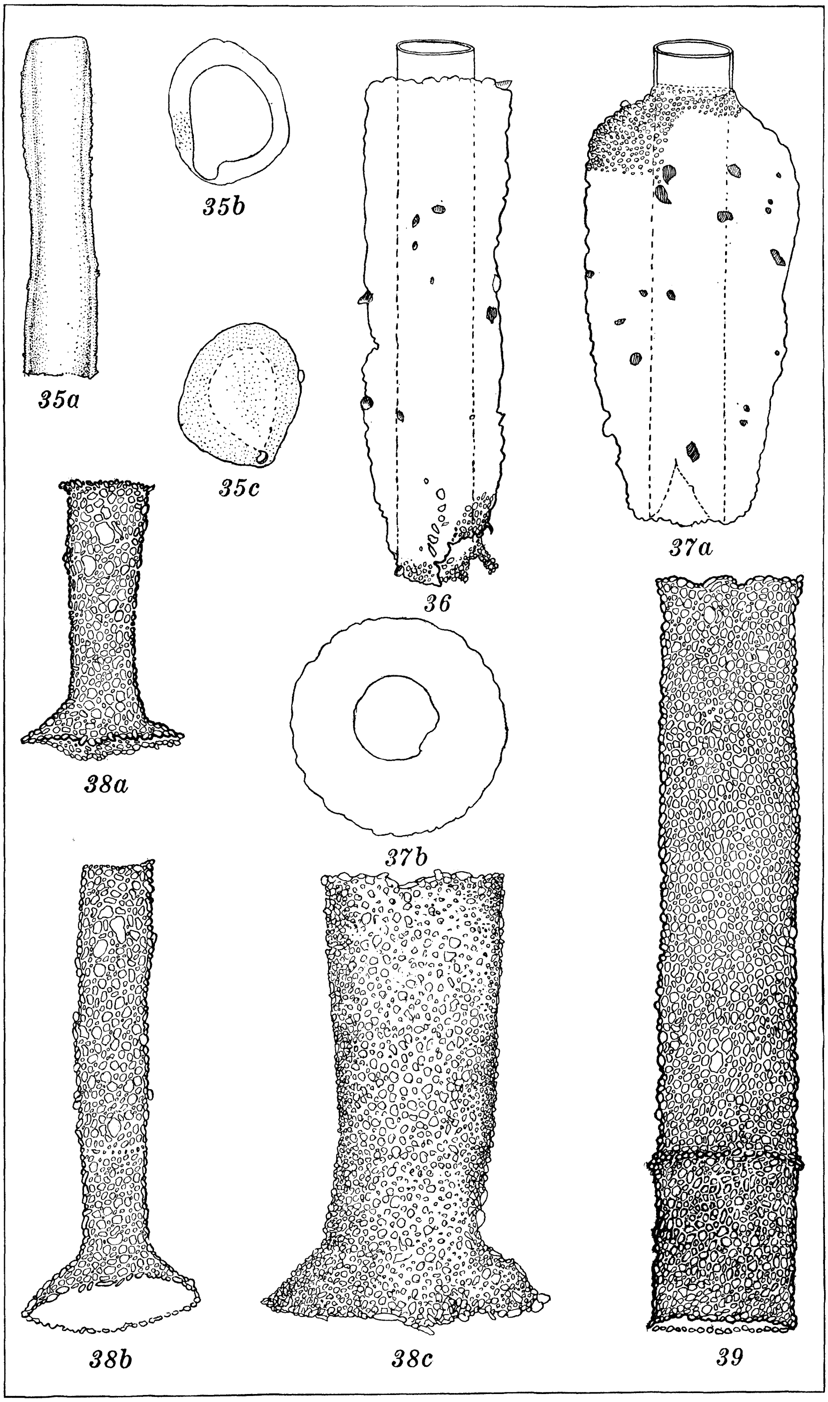

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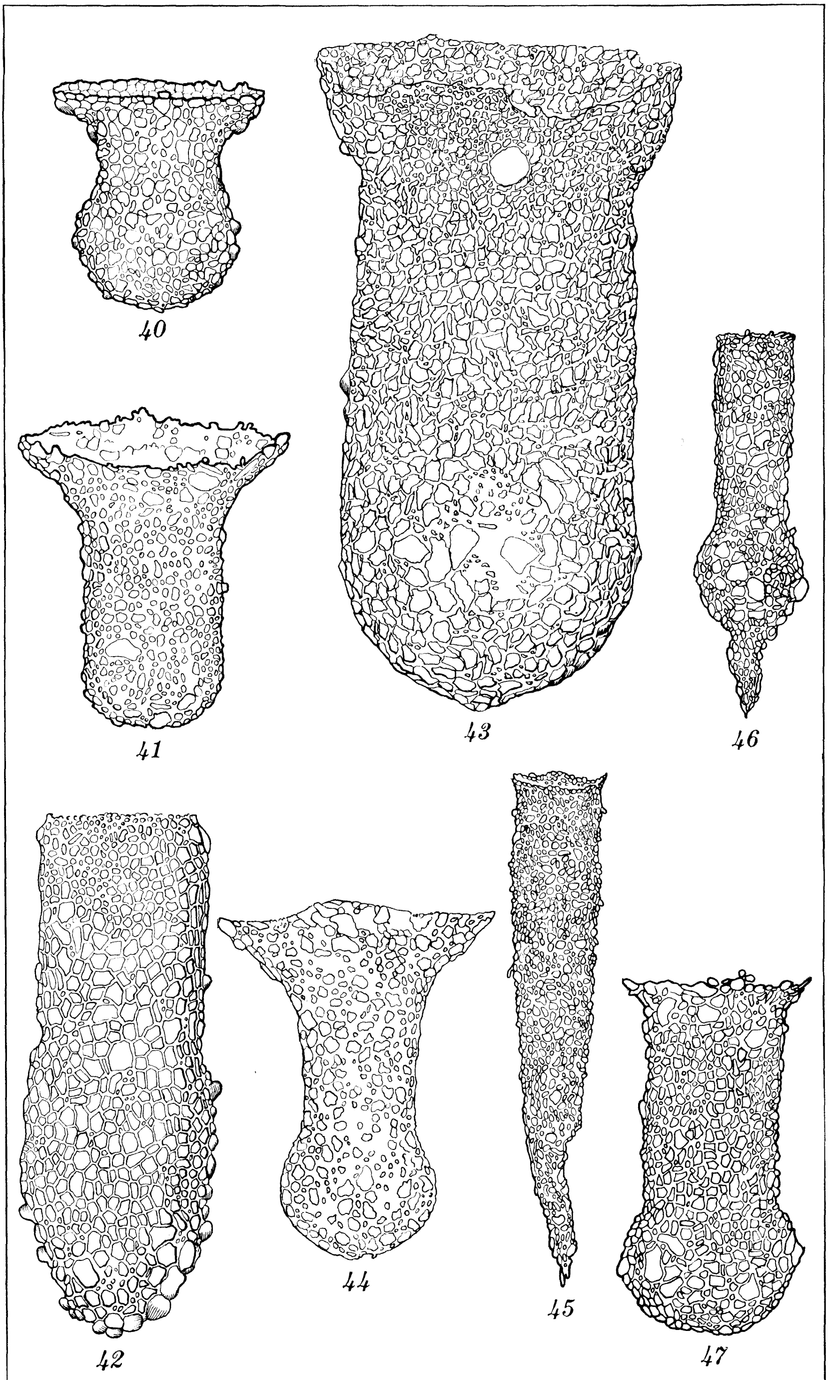

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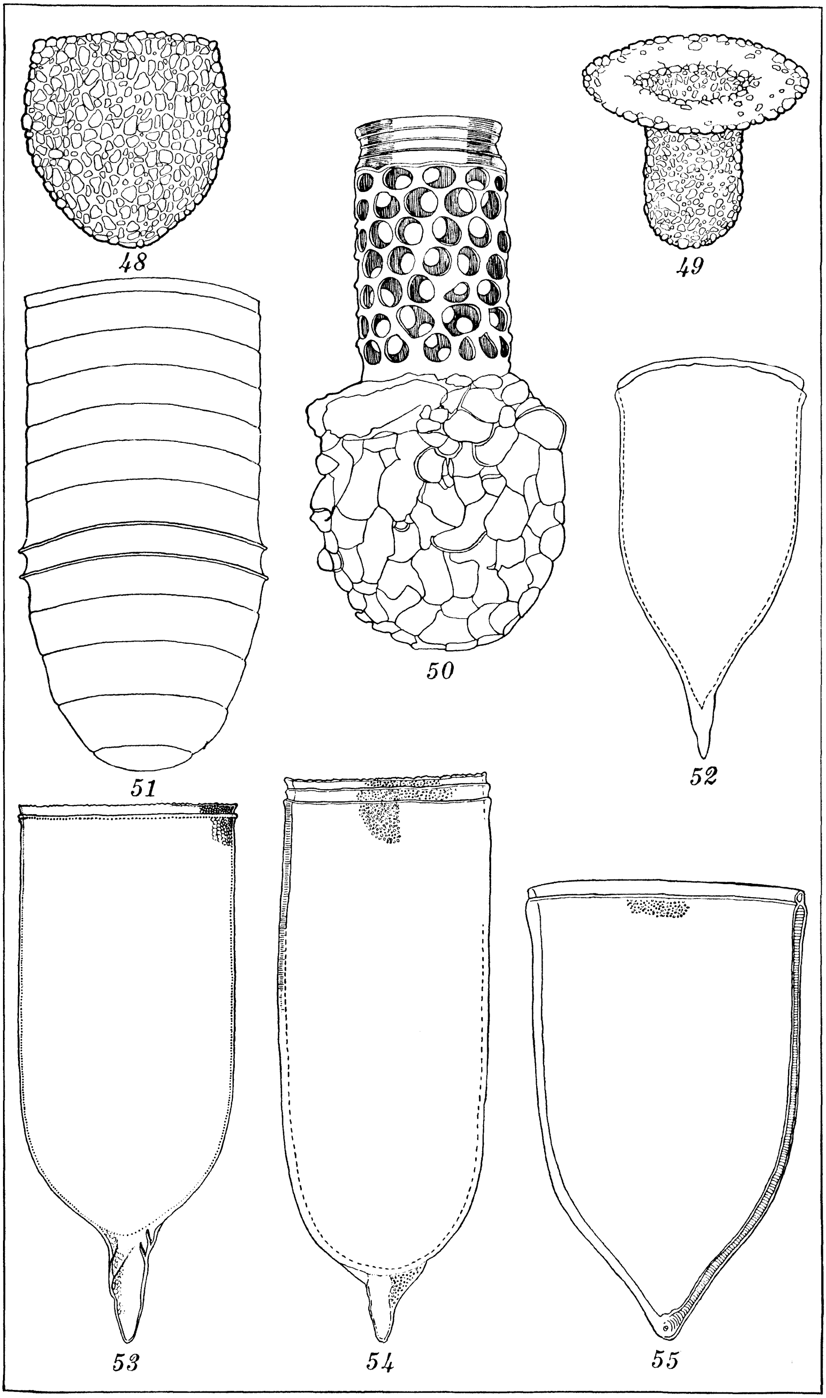

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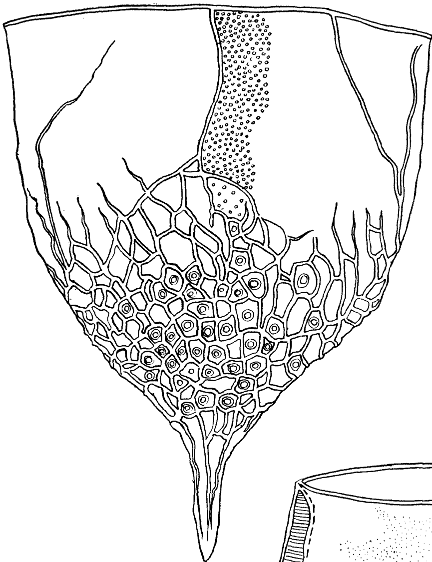
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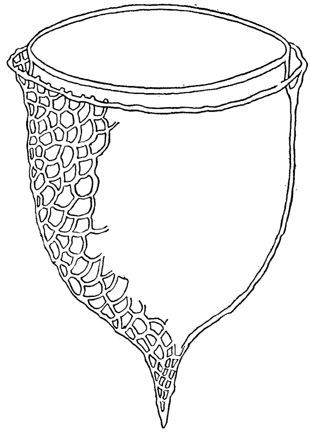
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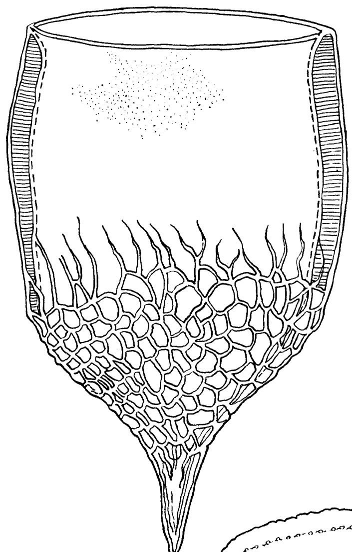
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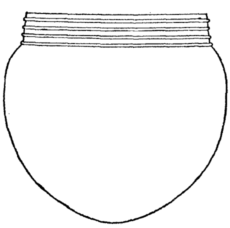
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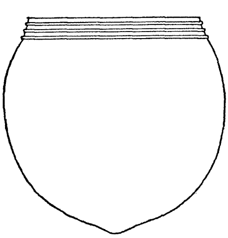
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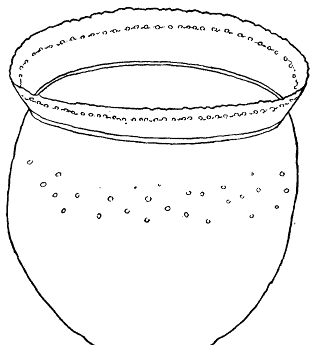
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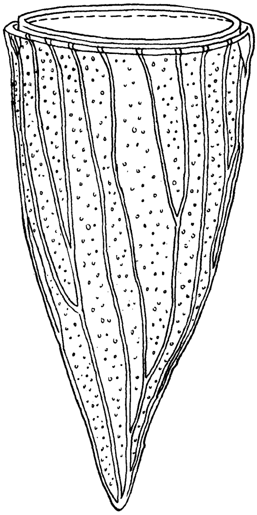
PLATE 16.



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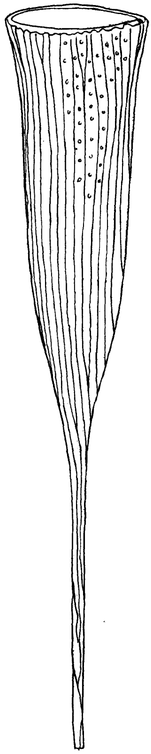

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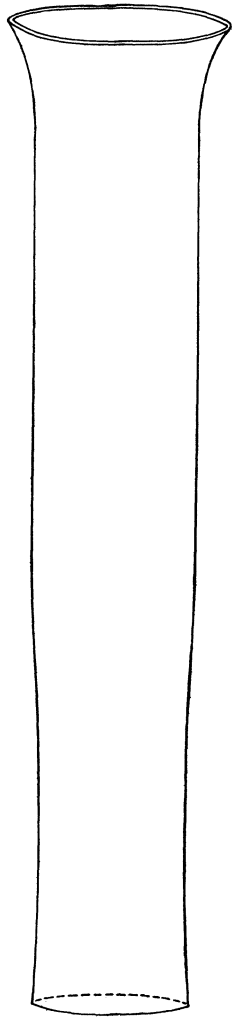

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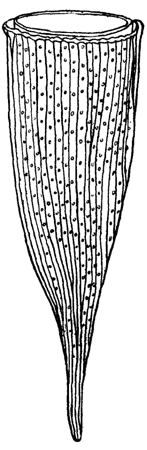

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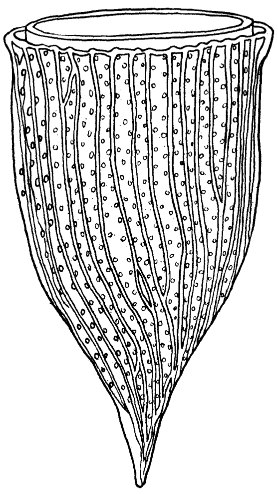

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PLATE 17.

MORE ODONATA FROM THE PHILIPPINES

By JAMES G. NEEDHAM and MAY K. GYGER
Of Cornell University, Ithaca

ONE PLATE

Since the completion of our monograph on the Odonata of the Philippines, published in the Philippine Journal of Science,[1] there has become available to us some new material, further illustrating the richness of the odonate fauna of these Islands. Some additional specimens came from Doctor Uichanco in Los Baños, but much more was found in the Museum of Comparative Zoology at Cambridge, Massachusetts, and was made available to us through the kindness of Dr. Nathan Banks. The latter material was collected by Mr. C. S. Clagg in 1927 in Mindanao. It includes a number of new species, as well as odds and ends that amplify our knowledge of species previously described.

New species described in the present paper are: *Diplacina lisa* from Luzon; and *Prionecnemis atripes, Prionocnemis tendipes, Drepanosticta aries, Drepanosticta taurus,* and *Teinobasis ranee* from Mindanao. The amplified descriptions of species heretofore known from one sex are: *Indæschna balugas* Needham and Gyger, female; *Pericnemis incallida* Needham and Gyger, female; and *Pericnemis lestoides* Brauer. There are also a number of new records that extend the knowledge of the range and altitude; the more important of these are: *Heteronaias heterodoxa* Selys, a fine series from Mount Apo in Mindanao, collected in September and November at an altitude of 6,000 feet; *Heliogomphus bakeri* Laidlaw, a single pair from Mindanao; *Idionyx philippa* Ris, one female, also from Mount Apo; *Lyriothemis cleis* Brauer, a single female from Calian, Davao Province, Mindanao.

We have deemed it advisable to continue to apply generic names as in the monograph, to which this paper is merely a supplement. Hence we have not followed changes in names re-

[1] I. Anisoptera. Philip. Journ. Sci. 63 (1937) 21; II. Zygoptera. Ibid. 70 (1939) 239.

cently proposed, save only in the case of *Euphæa*, which is merely a restoration of a long-used earlier name. Kirby proposed to substitute the name *Pseudophæa* because he found *Euphæa* preoccupied; and Cowley later found that *Euphæa* was not preoccupied and it is therefore restored.

INDÆSCHNA BALUGAS Needham and Gyger.

The male of this species was described in Part I of our Dragonflies of the Philippines.[2] We now have a single, very mature female from the same locality, Mount Banahao, Luzon, collected April 27, 1936, by Mr. V. J. Madrid.

Length, 82 mm; abdomen, 60; hind wing, 60.

The female is a little more uniformly blackish than the male, and a little less hairy, with more amber tinting in the membrane of the wings, and with much shorter and stouter abdomen. In our very mature specimen no trace remains of the pale stripes on the front of the thorax, and those on the sides are reduced to three indistinct spots: a round spot behind the humeral suture, and two more spots behind the third lateral suture; of the latter the upper is half the size of the lower. The abdomen shows the pale apical cross rings on abdominal segments 3 to 6, much as in the male. The wings are broader, especially the hind wings, and have a distinct brown spot covering their roots. The nodal crossveins are 28:18–19 and 17:22 in the fore- and hind wing, respectively, with the second and twelfth in the forewing and the second and eighth in the hind wing hypertrophied.

This species is very closely related to *Indæschna perampla* Martin, and may yet prove to be identical with it. There is agreement in size and in general coloration, but the labrum is not black but green, save for a very narrow brownish edging. Martin's figure[3] of the wings as those of *perampla* is doubtless incorrectly labelled; it does not correspond with his description. Perhaps through inadvertence it was labelled *Amphiæschna perampla* when *A. ampla* was intended; for it is on the same page with the description of *ampla*.

Our specimens show in both sexes the venational characteristics of *Indæschna:* two cell rows in the fork of the vein Rs in both wings and one row in the fork of Cu in the hind wing. The male generically agrees with Martin's figure of the male appendages of *perampla*, and the female with Fraser's figure[4] of the

[2] Philip. Journ. Sci. 63 (1937) 44, pl. 2, figs. 31, 32.

[3] Coll. Zool. de Selys Aeschninae. fascs. 19, 20 (1909) 114.

[4] Treubia 8 (1926) 476; likewise mislabelled by transposition of figures with those of *Amphiæschna ampla*.

genitalia of the female of *I. grubaueri* Forster, the type species.

DIPLACINA LISA sp. nov. Plate 1, fig. 21.

Male.—Length, 32 mm; abdomen, 22; hind wing, 26.

Teneral coloration blackish varied with yellow. Face and frons yellow except for an encircling narrow line of black in front of the ocelli, that widens at the side to include the wholly black antennæ, and then narrows again as it runs downward along the border of the eye to the mouth. Labium wholly yellow. Vertex and occiput blackish. Across the pale rear side of each eye there are three blackish horizontal bars.

Prothorax blackish above with its broad hinder lobe yellow. This lobe is erect but scarcely bilobed, and bears a marginal fringe of very long soft hairs, that are longer than the lobe is high. The synthorax is blackish in front, with a yellow band across the top from side to side, its inner half within and its outer half lying just below the crest. Lower down on each side of the front there is a broad, yellow band that is wide and angulated at its inner end next the carina and narrows laterally and runs down on the middle coxa. The sides of the synthorax are yellow with the usual black H mark of the genus (on the second and third lateral sutures) incomplete on the second suture, and wanting beneath the spiracle. The legs are blackish with only the outer side of the front femora yellow. Wings hyaline with a faint tinge of hyaline at the base. Veins brown, stigma tawny. Ante- and postnodal crossveins 13 : 8 and 10 : 8 in fore- and hind wing, respectively. Triangles free from crossveins except for one in the supertriangle of a forewing and one in the triangle of a hind wing.

Abdomen fuscous varied with yellow. The sides of segments 1, 2, and 3 are mainly yellow and there is a diffuse midlateral yellow area on segments 4 to 9 that diminishes in size to rearward. The apical dorsal margin of the first segment is sparsely fringed with long brown hairs. Appendages black. A single male specimen from Los Baños was collected January 27, 1936, and sent us by Doctor Uichanco.

This species is near to *Diplacina nana,* but differs in a number of characters. It entirely lacks the black longitudinal band that traverses the labium in that species. It lacks the lower end of the black stripe on the midlateral suture of the thorax below the spiracle. The yellow of the front of the synthorax seems to be laid on in quite a different pattern. The inner branch of the genital hamule is long and sharp.

D. lisa differs from both its nearest allies *nana* and *smaragdina* in having a crossvein in the triangle of one hind wing.

We add new figures (Plate 1, fig. 22 and 23) of the genital hamules of the male of *Diplacina bolivari* and *D. braueri*. The latter has not been figured, and Ris' figure [5] of *bolivari* does not show the thin and transparent platelike inner edge of the outer branch of the hamule.

The type is in the Cornell University collection.

DREPANOSTICTA ARIES sp. nov. Plate 1, figs. 3, 4, 8, and 9.

Male.—Abdomen, 35 mm; hind wing, 24.

Female.—Abdomen, 31 mm; hind wing, 24.

A slender blackish species, white about the mouth, with basal pale rings on the very slender abdominal segments.

Male.—Mouthparts pale, except for a narrow front border of black on the labrum and a shiny black triangular streak on the base of the mandibles externally. Anteclypeus white; the narrow postclypeus shiny black. Pedicel of antennæ pale; remainder of upper surface of head black. Occipital border slightly concave, ending in a slight rearward projecting angle on either side.

Prothorax pale, darker on front lobe, on all convex areas, and between bases of horns on hind lobe. These horns flat, outcurving like the horns of the conventional ram that appears among the signs of the zodiac. Synthorax greenish black on its front, with a very black edging on its middorsal carina. Sides brown, paler below the subalar carina, and about the base of the legs. Legs pale with a touch of brown above the knees, and with reddish spines. Wings hyaline with brown veins and stigma. Postnodals, forewing 16 or 17, hind wing, 15 or 16. Stigma rhomboidal, covering a single cell. Middle fork at subnodus: vein Rs arising half a costal cell beyond it.

Abdomen blackish, pale on basal segments, darkest on subterminal segments. Pale subbasal rings on segments 3 to 6 widened below, narrowed toward the middorsal line. The short segment 10 paler, with only its carinæ interruptedly brown. Appendages pale brown. Superiors not longer than inferiors: both swollen at base and forcipate at tips, angulated internally but without teeth (Plate 1, fig. 9).

Female.—Colored like the male, hind lobe of prothorax slightly produced in a trilobate margin. The short triangular-pyramidal caudal appendages yellow, hardly as long as segment 10.

[5] Coll. Zool. Libell. fasc. 9 (1909) 98.

Smaller than *D. taurus* and with shorter stigma and male superior appendages lacking inferior tooth.

Holotype, male, Mindanao, Mount Apo, Galog River, altitude 6,000 feet, September 4, C. S. Clagg. Allotype, female, same data. Both in the Museum of Comparative Zoology. Paratypes in the Museum of Comparative Zoology and the Cornell University Collection.

DREPANOSTICTA TAURUS sp. nov. Plate 1, figs. 1, 2, 5, 6, 7, and 10.

Male.—Abdomen, 47 mm; hind wing, 25.

Female.—Abdomen, 37 mm; hind wing, 26.

This is a blackish species with yellowish mouth parts, and a very slender abdomen.

Male.—Labrum reddish yellow, fringed with stiff bristles; anteclypeus yellow; postclypeus shiny black; antennæ black with segment 2 tawny. Top of head wholly black. The concave occipital border ending each side in a sharply projecting angle.

Prothorax blackish, paler toward front, its hind lobe bearing a pair of long, slender, cylindric, tapering horns that are almost as long as the dorsum is wide. Synthorax deep greenish black in front, brownish black on sides, black between leg bases, yellowish to rearward beneath. Legs pale, darker along dorsal carinæ of femora, and especially near knees. Leg spines all pale; claws reddish. Wings hyaline, membrane very faintly tinged. Postnodals 16 and 15 in fore- and hind wings, respectively. Stigma rhomboidal, one and one-half as long as wide, surmounting a little more than a cell. Middle fork at or very slightly beyond abdomen; vein Rs arising less than half a costal cell beyond it.

Abdomen very elongate, blackish throughout its length, with only segment 10 and the appendages a little paler, and with yellow subbasal rings on segments 3 to 6. Superior appendages a trifle longer than inferiors, both wide and angulate in the basal third and forcipate beyond; near midway superiors with a sharp internal tooth that inclines downward (Plate 1, fig. 5).

The female is similar to the male in coloration. The hind lobe of the prothorax ends laterally on each side in a small, rather sharply pointed and distinctly recurved tooth. The appendages of segment 10 are yellowish.

The species seems to be allied to *D. bicornuta* of de Selys from New Guinea, but the horns of the prothorax at least do not fit the description of that species. Similar to *D. aries* in general coloration, but very different by its straight bovine prothoracic horns.

Holotype, male, Mindanao, Davao Province. La Lun River, July 4, *C. S. Clagg*. Allotype, female, same locality and collector, May 3. Both in the Museum of Comparative Zoology.

PRIONOCNEMIS ATRIPES sp. nov. Plate 1, figs. 11, 13, and 14.

Male.—Abdomen, 44 mm; hind wing, 29.

Female.—Abdomen, 42 mm; hind wing, 31.

This is a slender, black species with a white bar above the mouth and whitish membranes about the wing roots. Entire dorsum black. Face black except for the anteclypeus and basal third of the labrum which are white. Front third of labrum and top of postclypeus metallic black, tinged with greenish or bluish in reflected light.

Thorax black, with only the thin membrane about the wing roots whitish; sides hairless. Midventral prominence of prothorax black on a paler ground. Legs black. Wings hyaline, with black veins and stigma, membrane highly tridescent. Postnodal crossveins about nineteen. The lozenge-shaped stigma generally covering a single cell. Lines of crossveins in field behind stigma strongly concave to outer side. Arculus at or very close to second antenodal crossvein.

Abdomen including appendages black dorsally and externally, paler beneath. Appendages of male paler within, huge inferior tooth of superiors black. Length of abdominal segments 6 to 10 about as 10: 8: 4: 2: 1.5, superior appendages as long as segment 10, slightly divaricate, parallel-sided at base and with a long bevel to outer apex, bevelled portion in lateral view in almost direct line with outer side of large inferior tooth.

Surmounted by this tooth is a large rounded hump on base of inferior appendage. Lower outer point of that appendage extended laterally.

Female very similar to male but paler. Hind lobe of prothorax in female with a W-shaped median notch.

Type, male, Mindanao, Mount Apo, Mainit River, altitude 6,500 feet, October 27. Allotype, female, same locality, August 14. Both in the Museum of Comparative Zoology. Paratypes in the Museum of Comparative Zoology and in the Cornell University Entomological Collection.

In our key to the species of *Prionocnemis*[6] this species will run out with *atropurpurea*, except that in *atripes* the legs are wholly black.

[6] Philip. Journ. Sci. 70 (1939) 270.

PRIONOCNEMIS TENDIPES sp. nov. Plate 1, figs. 12, 15, and 16.

Male.—Abdomen, 48 mm; hind wing, 32.

Female.—Abdomen, 43 mm; hind wing, 32.

This is a large, brownish, red-legged species with rather broad wings and somewhat trapezoidal stigma. The general color of the body is brown, suffused with blackish on the front of the thorax and tending toward red on the middle abdominal segments. Face brown; anteclypeus paler, postclypeus and labrum becoming shiny black with age. Top of head brown, blackish around ocelli and on hind occipital margin.

Top of thorax brown with the carina and sutures narrowly black. Paler underneath. An isolated line of six to twelve long, thin bristles parallel to and close behind humeral suture. A shiny black prominence at upper end of first and third lateral sutures, another at lateral articulation of thorax and abdomen. Legs beyond brownish coxæ bright reddish, including spines and claws. Wings subhyaline, with 20 to 22 postnodal crossveins. Arculus at or very slightly beyond second antenodal crossvein. Stigma brown, trapezoidal, slightly longer at rear than along front side.

Abdomen brown, darkening toward ends, washed with blackish upon all joints of segments and with reddish along dorsum of long middle segments. Segments 6 to 10 of male in length as 10 : 7 : 4.5 : 2 : 1, superior appendages 2. Appendages of the male reddish with black tips: superiors elongate-triangular with apices slightly divergent; inferior tooth basal and rather small.

The female is paler, but similarly colored. Hind lobe of thorax widely notched.

Type, male, Mindanao, Mount Apo, Galog River, September 6 (*C. S. Clagg*). Allotype, female, same locality, September 4. Both in the Museum of Comparative Zoology. Paratypes in the Museum of Comparative Zoology and in the Cornell University Entomological Collection.

In our key to the species of *Priocnemis* [7] this species will run out with *rubripes,* from which it will be readily distinguished by its larger size as well as by differences shown in our figures.

PRIONOCNEMIS IGNEA Brauer. Plate 1, figs. 17 and 18.

A number of specimens collected by Mr. C. S. Clagg on Mount Apo, Mindanao, agree very well with Brauer's original descrip-

[7] Loc. cit.

tion draw from Luzon specimens, and with the single female from the Agricultural College reported on and figured by us in Part II of our monograph.[8] They are very similar in superficial appearance to *P. tendipes* but distinctly smaller. Both sexes are represented among them so we now add figures of the male appendages (Plate 1, figs. 17 and 18).

PERICNEMIS INCALLIDA Needham and Gyger.

The male has been described in The Philippine Journal of Science.[9] A female has since been found among the material sent by Doctor Uichanco bearing the data "7 III '36. J. T. Hernandez." It may be described as follows:

Abdomen, 50 mm; hind wing, 36.

Much paler than the male, being brownish olive where the male is black, and light green where the male is dark metallic green. The top of the head is dark green and the face is similar in pattern to the male except that the black on the labrum is restricted to a large median spot and a marginal streak at each side.

The thorax is nearly concolorous, merely paler below. The abdomen is brownish black above and yellowish beneath, with the yellow spreading upward to cover most of the dorsum of segment 9 and most of the sides of segment 8. The ovipositor is yellow with black edgings. Segment 10 and the very short appendages are black.

PERICNEMIS LESTOIDES Brauer. Plate 1, fig. 24.

The male of this species has been redescribed and figured by us in the Philippine Journal of Science,[10] with full bibliography. A female has since been received from Doctor Uichanco labelled "Mt. Maquiling, 8 VII, '37." It may be described as follows:

Abdomen, 45 mm; hind wing, 29.

Agrees with the male in having the head broadly black above but the coloration lighter everywhere else. The postclypeus is not wholly black but bears a transverse row of three yellow spots. The pale area at each side of the face extends up to and around the roots of the antennæ. The labrum is mainly yellow with the black restricted to its basal hinge line, and three short streaks project forward therefrom, one median and the others marginal.

Thorax olive-brown with faint coppery reflections in front. A black hair line tops the edge of the carina. Under parts pale.

[8] Ibid., p. 275. [9] Ibid., p. 291. [10] Ibid., p. 297.

Legs very pale with black spines and blackish joints to the segments and a black line on the foretibia externally.

Abdomen black above and pale beneath, becoming yellowish on the sides toward the end. From the base of the very long segment 7 onward the dorsum becomes obscurely reddish, including stylets and ovipositor.

TEINOBASIS RANEE sp. nov. Plate 1, figs. 10 and 20.

Male.—Abdomen, 52 mm; hind wing, 32.

Female.—Abdomen, 51 mm; hind wing, 33.

Closely allied to *T. glauca* Brauer, of which we describe first the female, to facilitate direct comparison with the male, hitherto unknown.

Female.—Face pale yellowish brown up to crossridge of frons, with a median impressed black spot on base of labrum and black edgings at labroclypeal suture. Anteclypeus pale. Postclypeus darker, with two black outer edges and a pair of submarginal, impressed, oval, obscure, blackish spots. Top of head wholly black. Antennæ pale brown with a black streak up inner side of both segments of pedicel. Margin of occiput and rear of eyes pale.

Prothorax brown with brown bands across its front and rear lobes, and a diffuse black area above each leg base, also an ill-defined middorsal stripe of black. Synthorax with a black middorsal stripe narrowed downward to the black collar, and widened at its upper end where it is forked and spread out beneath the antealar crest. Crest black with a yellow spot each side at front. Subalar carina pale with black touches where it joins the second and third lateral sutures. Sides otherwise pale brown, becoming yellowish below. Legs pale with blackish spines and blackish markings at all articulations and black along dorsal side of all femora. Hind tibiæ with five spines in each row.

Wings hyaline, with a brown stigma that is bordered by heavy veins, inside which is an encircling line of yellow. Postnodals 18 and 16 in fore- and hind wing, respectively. Wings stalked to the level of the arculus which is slightly beyond the second antenodal crossvein. Middle fork a little before the subnodus (in one male forewing at the subnodus and there fused with base of vein Rs); vein Rs variable at origin but usually slightly beyond subnodus. Vein M_2 arising usually at ninth postnodal in forewing and seventh in hind wing, not constant. Stigma trapezoidal, about as long as wide, slightly convex externally on all sides but mostly so on outer side.

Abdomen blackish on dorsum from end to end, paler on sides and beneath with paler color spreading upward at joinings of segments, but not meeting above to form rings: sides of segment 8 broadly yellowish. Caudal appendages conic, shorter than segment 10. Sheath of ovipositor and palp brown with yellowish tip.

Male.—Old and pruinose, blackish pulverulent over top of head and on all of face except genæ; also over entire dorsum of thorax and halfway down sides of synthorax. Black of dorsal surface of legs extending outward on tibiæ and tarsi to base of yellow claws. The slenderer abdomen colored as in female except at posterior end where segment 8 is wholly black above and on sides, as also is segment 9, while segment 10 is yellow at sides and has a middorsal yellow triangle in the black of the dorsum just before its apical notch. Appendages yellow, brown-tipped, blunt superiors with a terminal tuft of yellow hair.

The largest species of the genus, too large for comparison with any of the numerous described species except *T. glauca* Brauer, from which it seems to differ in lacking the bluish white of the face and the dorsal pattern of abdominal segment 8, and in having the ovipositor serrulate and not hairy along its lower margin.

Holotype, male, Mindanao, Davao Province, La Lun Mountains, May 3 (*C. S. Clagg*). Allotype, female, Mindanao, Mount Apo, Paraka River, November 10 (*C. S. Clagg*). Both in the Museum of Comparative Zoology.

ILLUSTRATION

PLATE 1

FIG. 1. *Drepanosticta taurus* sp. nov.; dorsal view of anal appendages of male.
2. *Drepanosticta taurus* sp. nov.; lateral view of anal appendages of male.
3. *Drepanosticta aries* sp. nov.; lateral view of anal appendages of male.
4. *Drepanosticta aries* sp. nov.; dorsal view of anal appendages of male.
5. *Drepanosticta taurus* sp. nov.; diagonal interior view of superior anal appendage of male.
6. *Drepanosticta taurus* sp. nov.; front view of prothorax of female.
7. *Drepanosticta taurus* sp. nov.; front view of prothorax of male.
8. *Drepanosticta aries* sp. nov.; front view of prothorax of male.
9. *Drepanosticta aries* sp. nov.; diagonal interior view of superior anal appendage of male.
10. *Drepanosticta taurus* sp. nov.; lateral view of tip of abdomen of female.
11. *Prionocnemis atripes* sp. nov.; front view of prothorax of female.
12. *Prionocnemis tendipes* sp. nov.; front view of prothorax of female.
13. *Prionocnemis atripes* sp. nov.; dorsal view of anal appendages of male.
14. *Prionocnemis atripes* sp. nov.; lateral view of anal appendages of male.
15. *Prionocnemis tendipes* sp. nov.; lateral view of anal appendages of male.
16. *Prionocnemis tendipes* sp. nov.; dorsal view of anal appendages of male.
17. *Prionocnemis ignea* Brauer; dorsal view of anal appendages of male.
18. *Prionocnemis ignea* Brauer; lateral view of anal appendages of male.
19. *Teinobasis ranee* sp. nov.; lateral view of anal appendages of male.
20. *Teinobasis ranee* sp. nov.; dorsal view of anal appendages of male.
21. *Diplacina lisa* sp. nov.; lateral view of hamules of male.
22. *Diplacina bolivari* Selys; lateral view of hamules of male.
23. *Diplacina braueri* Selys; lateral view of hamules of male.
24. *Pericnemis lestoides* Brauer; lateral view of tip of abdomen of female.

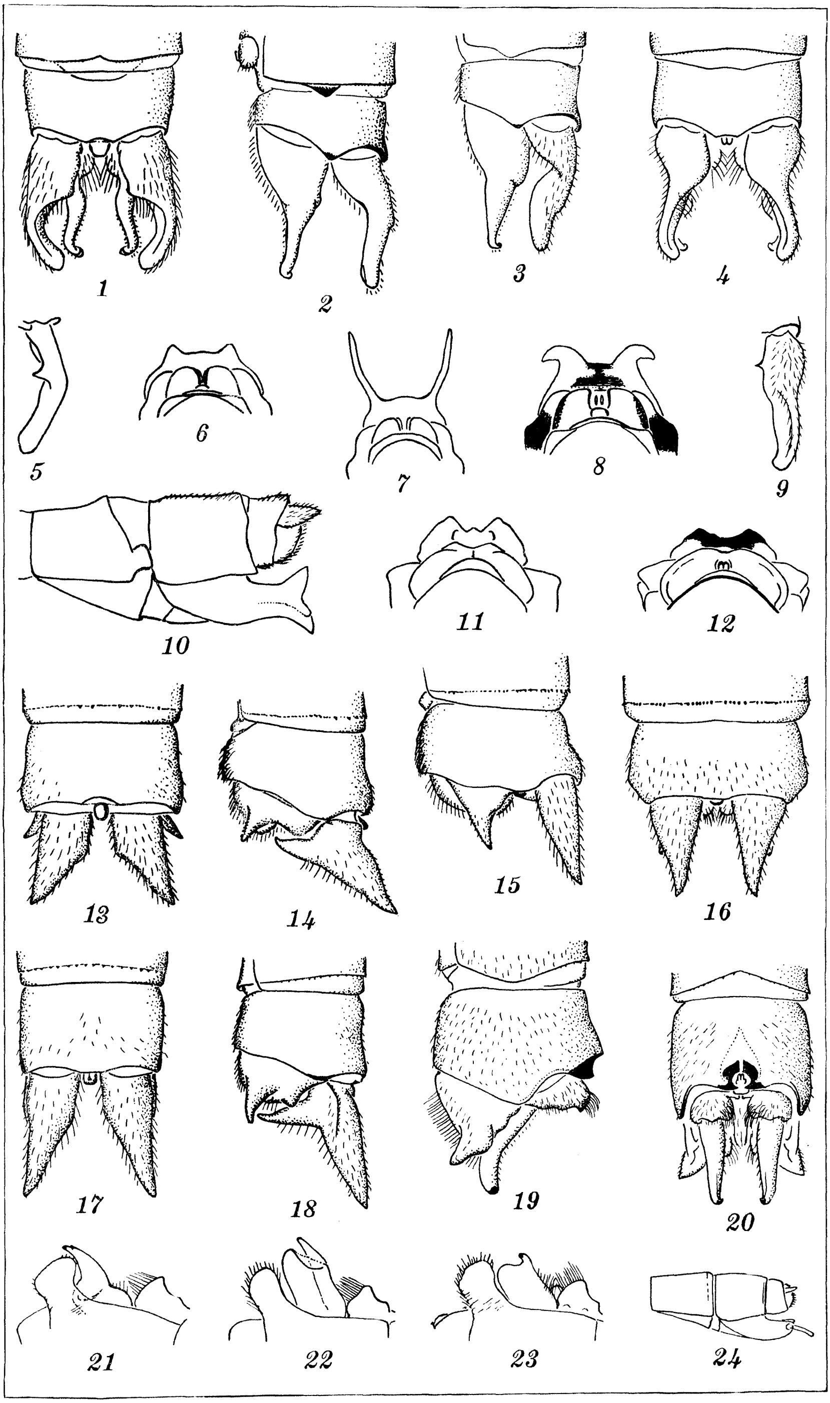

PLATE 1.

HOLTTUMIA, GENUS NOVUM

By Edwin Bingham Copeland
Of the University of California, Berkeley

ONE PLATE

Genus Dipteridi affine, fronde minuta orbiculare haud dichotoma carnosa distinctum; rhizomate repente setis rigidis nigris vestito; costa media in lamina deliquescente, venis flabellato-dichotomis, hic illus anastomosantibus venulis inclusis nullis; soris orbicularibus, nudis, intramarginalibus, ad furcas venularum, sporangiis (ut videtur) sessilibus.

Typus in Herb. Singapore, l. G. F. Hose, Mount Linga, Sarawak, 1889. R. E. Holttumio, Directori illustrissimo Horti Singaporensis, dedicatum.

HOLTTUMIA FLABELLIFOLIUM (Baker) Copeland comb nov. Plate 1.

Polypodium flabellifolium Baker, Syn. Fil. (1867) 322.

Polypodium holophyllum Baker, Journ. Bot. (1879) 43.

In his first description Baker remarked on this species as a remarkable plant, and Diels, in Natürliche Pflanzenfamilien, characterized it as completely isolated. That would be so, indeed, in *Polypodium,* but the affinity to *Dipteris* seems to me to be unmistakable. The fronds in hand are hardly over 1 cm in diameter, on filiform stipes about 3 cm long. In the herbarium the laminæ are rugose, evidently due to the collapse of the once fleshy mesophyll. The margin, instead of being thickened as Baker described it, is cartilaginous and firm, but thinner than the rest of the frond. As a protection against collapse, the epidermal cells have the lateral walls reinforced by projections into the lumen. These project from the back of the guard cell into the parent cell, protecting the stoma against lateral compression as in *Medeola* [1]; the stomata of this mechanical type in ferns were described by the present author in 1907.[2]

Besides the generic type there is in the Singapore Herbarium another collection, evidently also by Bishop Hose, dated 1887. Both are scanty and old, with few sporangia remaining. In view of the particular interest attached to any relative of *Dipteris,* material for a more complete study is much desired.

[1] Annals of Botany 16 (1902) 333.
[2] Philip. Journ. Sci. § C 2 (1907) 41.

ILLUSTRATION

PLATE 1. *Holttumia flabellifolium* (Baker) Copeland sp. nov.; Fig. *1*, habit; *2*, frond, × 4.

with some acid (7), as shown by the ester number (16.16). These acids had very different constants. The saponification number of acid (6) was almost double that of acid (7).

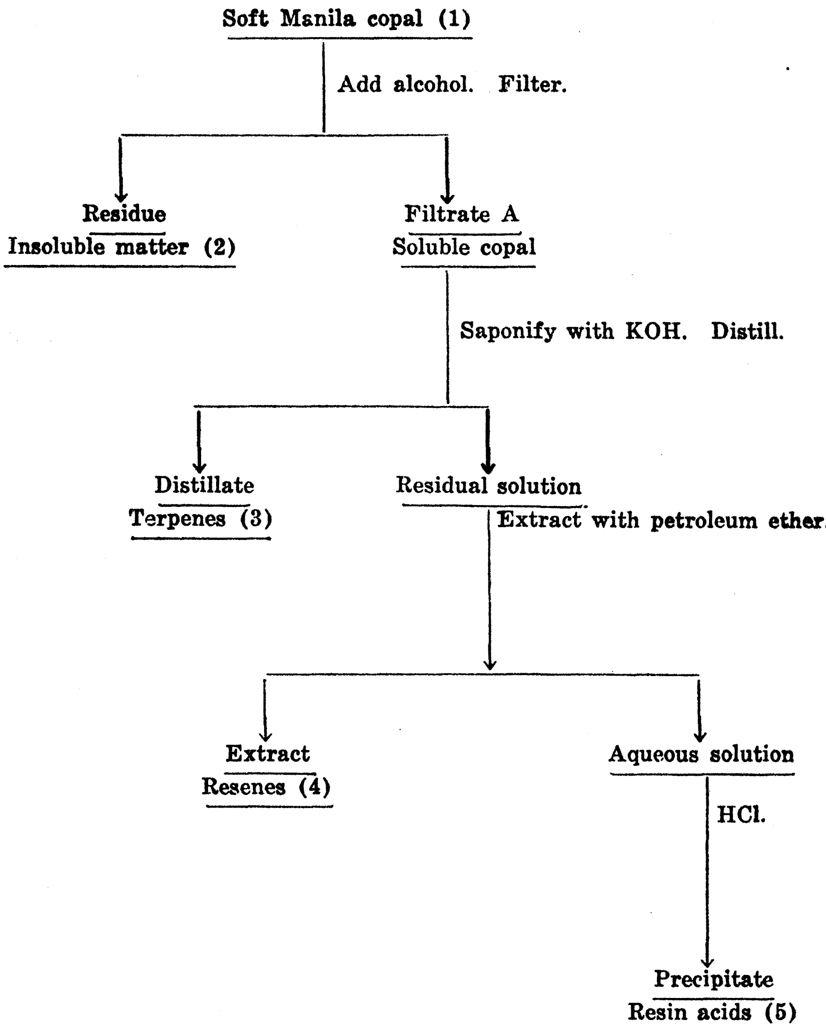

FIG. 1. Analysis of soft Manila copal.

By dissolving resin acid (6) in alcohol and neutralizing the solution, a second precipitation of the sticky residue may be obtained. When the filtrate from this residue is again boiled (reflux) with potassium hydroxide, the excess alcohol removed by distilling, and the solution diluted with water and then acidified

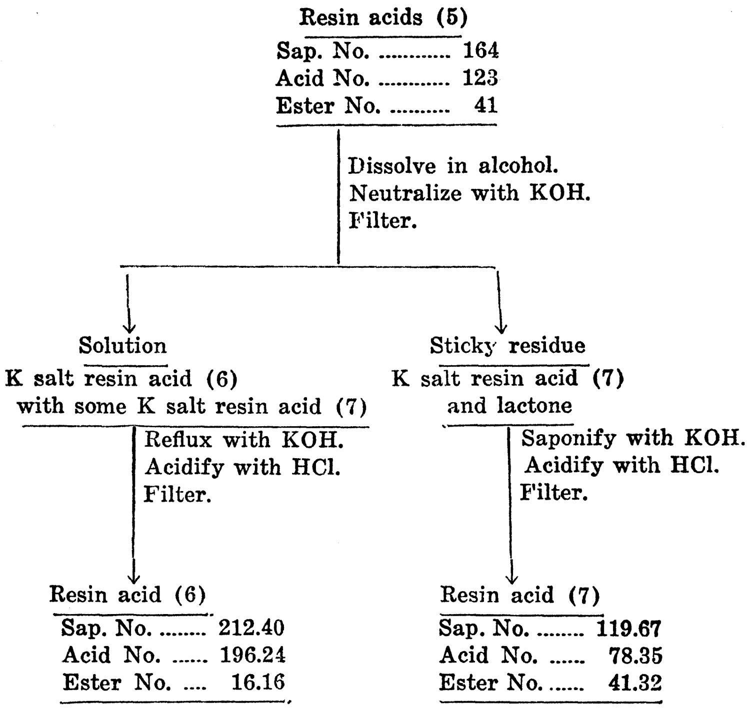

FIG. 2. Separation of the mixture, resin acids (5).

with hydrochloric acid, there is obtained a second precipitation of resin acid (6). By this procedure more of the resin acid (7) is removed from resin acid (6). The ester number of acid (6) is thus considerably reduced.

The sticky residue obtained by neutralizing an alcoholic solution of resin acids (5) consists of the potassium salt of resin acid (7) and a lactone (text fig. 2). When the sticky residue is treated with water the potassium salt dissolves, leaving the lactone. The lactone, when dried at 50° C., was found to be slightly soluble in methyl alcohol and acetone but practically insoluble in the other common organic solvents.

The moist lactone was saponified with alcoholic potassium hydroxide. The reaction product was distilled to remove excess alcohol. It was then treated with water and acidified with hydrochloric acid which precipitated resin acid (7). The constants of this acid are as follows:

Resin Acid (7) from lactone alone.

Sap. No.	120.68
Acid No.	84.22
Ester No.	36.46

These constants are very nearly the same as those of the resin acid (7) in text fig. 2. Similar results were obtained in a previous investigation.[3]

Resin acid (7) obtained from the lactone alone gave an ester number of 36.46. The acid (7) in text fig. 2 had an ester number of 41.32. In each case these ester numbers show that a lactone has been reformed to a considerable extent from resin acid (7) when the acid is liberated from its potassium salt.

Lewkowitsch[4] investigated the fatty acids in wool wax and found that they gave an ester number (15.79). According to him the ester number indicates the presence of a lactone in the fatty acids. The results of his researches on the lactone were similar to those obtained by us.

INSOLUBLE MATTER IN SOFT MANILA COPAL

Treatment of soft Manila copal with hot alcohol dissolves the alcohol-soluble part (text fig. 1). Insoluble matter (2), if present, usually consists of a grayish, gelatinous mass that contains some foreign matter, such as dirt, and perhaps pieces of leaves and twigs. When the mixture is allowed to stand overnight the alcohol-insoluble constituents settle out and are removed by filtering. When the insoluble matter is heated to a temperature of 50 to 60° C. for about a week, the gel that is contained in it slowly undergoes various changes, as indicated below:

Gelatinous insoluble matter

↓

Viscous, elastic material

↓

Amorphous solid

↓

Impure brittle resin

The insoluble matter is first converted into a viscous, elastic material that gradually changes to an amorphous solid which finally becomes an impure brittle resin. With some samples this transformation may be hastened by simply boiling the amorphous

[3] Tanchico, S. S., and A. P. West, Philip. Journ. Sci. 73 (1940) 259–283.
[4] Journ. Soc. Chem. Ind. 15 (1896) 15.

solid with water or steaming for about three hours, after which the brittle resin is drained off and dried at 50 to 60° C.

The gelatinous part of the insoluble matter is thus converted into a brittle copal resin, soluble in alcohol. It would appear that the gel is very closely related to the genuine copal and is probably a modified form.

With some samples the insoluble matter contained no gelatinous material and consisted entirely of foreign matter (dirt, twigs, leaves, and the like). Such copal was not aged long enough to accumulate gel and no particular precautions were taken to keep the exudation clean.

Richmond[5] examined some surface copal. He also found it to be incompletely soluble in absolute alcohol, leaving a grayish, gelatinous, neutral residue which dried to a brittle resin.

A composite sample of the insoluble matter (2) (text fig. 1), obtained from several lumps of copal, was analyzed as indicated in text fig. 3.

Analysis of the soluble copal separated from the impure brittle resin showed that it contained very small amounts of terpenes and resenes and was composed almost entirely of resin acids (10). These acids consisted of a mixture of free resin acids and a saponifiable substance (lactone) indicated by the ester number (31.55). These products were separated (text fig. 3) into resin acids (11) and (12), which had different constants.

The separation of resin acids (11) and (12) is generally not complete. Acid (11) usually has an ester number due to contamination from acid (12). These various acids were given these particular numbers because, in a previous investigation,[6] nine other products were isolated from the copal before these acids were obtained.

The formation of the insoluble gel in Manila copal may, perhaps, be explained in accordance with the outline in text fig. 4.

White, soft copal (text fig. 4) that is soluble in alcohol consists of terpenes, resenes, and resin acids (6) and (7). This kind of resin, obtained as a fresh or very recent exudation from the copal tree, contains no insoluble gelatinous material. As the copal ages it gradually becomes hard and darker in color. The hardening of the surface copal is accompanied by partial evaporation of volatile constituents (terpenes and moisture) and oxidation of the resin acid (7) which, as shown later, is the prin-

[5] Philip. Journ. Sci. § A 5 (1910) 183.
[6] Tanchico, S. S., and A. P. West, Philip. Journ. Sci. 73 (1940) 259–283.

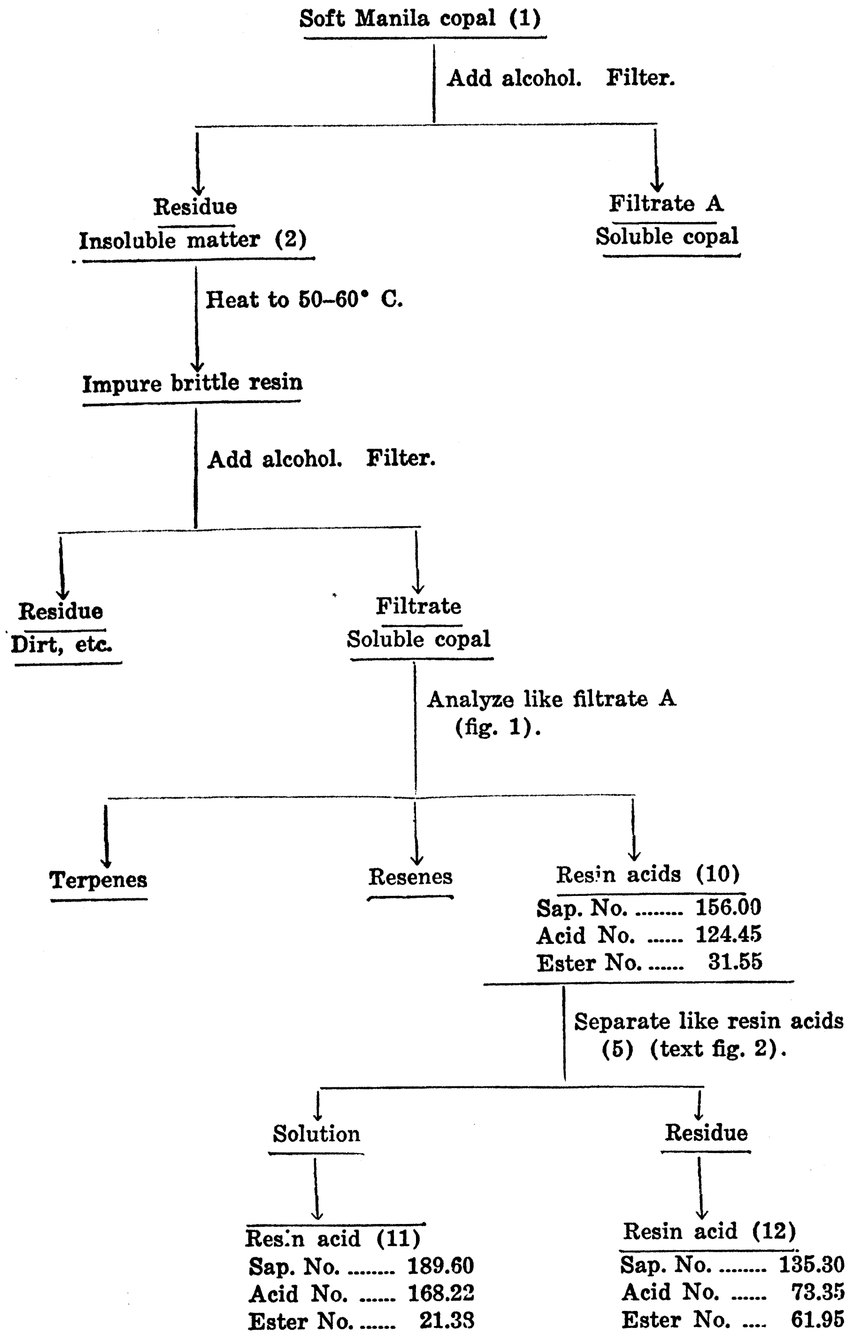

FIG. 3. Analysis of insoluble matter in soft Manila copal.

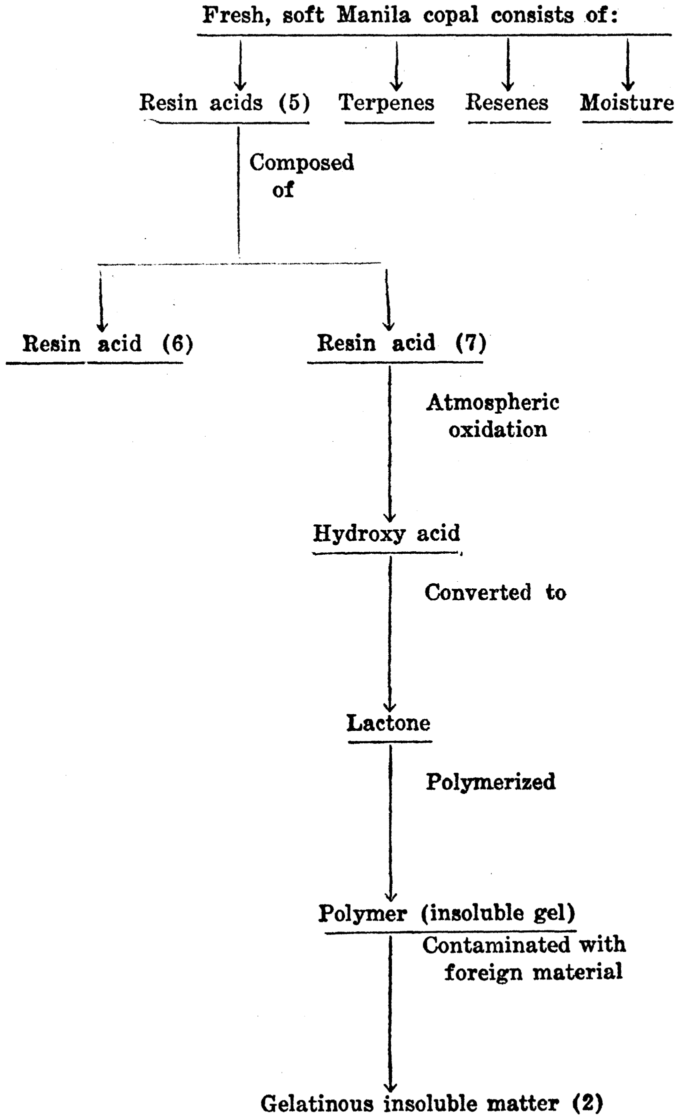

FIG. 4. Formation of gelatinous insoluble matter in fresh, soft Manila copal.

Note: As shown later (Table 4) resin acid (6) is not affected by atmospheric oxidation.

cipal constituent affected. The hydroxy acid, thus formed, is gradually converted to a lactone which tends to act as an antioxidant and hinder further oxidation of the copal.

48813——6

The presence of the lactone (text fig. 2) is indicated by the high ester number (41.32) of the resin acid (7).

Richmond[7] noted the tendency of copal resin acids to form lactones.

As the copal grows older and larger, more of the lactone is produced. It appears that the lactone is slowly converted to complex bodies of high molecular weight. These polymers constitute the insoluble gel that accumulates principally in the surface copal as it ages on the tree. The gel probably serves as a protective coating for the interior copal. It is likely to be contaminated with foreign material (dirt and the like), thus constituting the usual insoluble matter (2) that is separated in the analysis of copal (text fig. 1). When the insoluble matter is heated the gel in it depolymerizes and is converted into a brittle copal resin (text fig. 3), soluble in alcohol.

Ellis[8] discusses the conversion of lactones into polymers as follows:

> Lactone formation is of importance in the chemistry of resins, an example of a naturally occurring product of this type being shellac. Lactones, or inner esters, are obtained by the elimination of water between a hydroxyl group and a carboxyl group. ....
>
> Many lactones, particularly six-membered cyclic esters, are known to polymerize with ease, and depolymerize (reversible polymerization) on heating. ....
>
> It seems probable that the first step in the polymerization of cyclic esters (lactones) involves the intervention of a trace of the corresponding hydroxy acid. This reacts with the lactone to give the dimeric acid. The latter in turn yields a trimeric acid, and reaction continues until all the lactone is exhausted or the chains become too long for further reaction.

Concerning the formation and polymerization of lactones of the fatty acids Lewkowitsch[9] states:

> Neutralisation and saponification values of fatty acids should be identical. In case, however, the fatty acids contain such substances as lactones, or anhydrides of the fatty acids, which do not combine with aqueous alkali in the cold (and are only hydrolysed on boiling with alcoholic potash), then the saponification value of the fatty acids will be higher than the neutralisation number. ....
>
> Hydroxylated fatty acids especially are likely to suffer dehydration with the formation of inner anhydrides. Thus the fatty acids of castor oil readily form inner anhydrides (polymerisation products); indeed it has been shown that the fatty acids of castor oil become "polymerised" even at the

[7] Philip. Journ. Sci. § A 5 (1910) 191.

[8] The Chemistry of Synthetic Resins 2 (1935) 1000.

[9] Chemical Technology and Analysis of Oils, Fats and Waxes 1 (1921) 528 and 531.

ordinary temperature on prolonged keeping, forming polyricinoleic acids. .... In the case of such polymerised ricinoleic acids the difference is considerable between the saponification and the neutralisation values.

EXPERIMENTAL PROCEDURE

The Manila copal used in this investigation was collected by forest rangers and kindly presented to us by Director Florencio Tamesis of the Philippine Bureau of Forestry. It was the soft variety, like the samples used in previous experiments[10] carried out in this laboratory.

Since oxidation is apparently an important reaction in the ageing and weathering of Manila copal, experiments were carried out to determine the exact effects of oxidizing this resin.

High-grade copal, containing less than one per cent of insoluble matter, was powdered very finely and placed in a tube about 1 meter long and 2 centimeters in diameter. Some cotton was inserted into each end of the tube to keep the copal intact. The tube was connected to a Drechsel wash bottle, containing a small amount of water, and this in turn was joined to a vacuum pump. The rate at which the air was drawn through the copal was indicated by the passage of the air through the liquid in the wash bottle.

The air was passed continuously through the copal, at room temperature, for 30 days and nights. The copal was analyzed and the constants determined both before and after oxidation. The methods[11] for obtaining these data were the same as those reported in a previous communication. The alcohol used as solvent for the copal was aldehyde-free, absolute alcohol.[12] In the determination of the acetyl number we followed the procedure recommended by Gardner.[13] For accurate comparison all the results (Table 1) were calculated on a moisture-free basis.

As shown by the data (Table 1) oxidation of the copal gave a marked increase in the saponification, ester, and acetyl numbers. During the oxidation there was an increase in the amount of hydroxy acids in the copal as indicated by the rise in acetyl number. A rise in the ester number indicated that the amount of lactones also increased. The lactones are formed from the hydroxy acids. As the hydroxy acids increase there is likely to be an increase in the amount of lactones.

[10] Tanchico, S. S., and A. P. West, Philip. Journ. Sci. 73 (1940) 259–283.
[11] Ibid.
[12] Dunlap, F. L., Journ. Am. Chem. Soc. 28 (1906) 397.
[13] Institute of Paint and Varnish Research. Washington (1937) 848.

TABLE 1.—*Oxidation of soft Manila copal.*

Experiments.	Copal.		Difference.
	Before oxidation.	After oxidation.	
Constants:			
Saponification No.	158.61	200.52	+41.91
Acid No.	103.62	110.57	+ 7.31
Ester No.	55.35	89.95	+34.60
Acetyl No.	103.47	141.66	+38.19
Analysis:			
Insoluble matter	0.50	1.22	+ 0.72
Terpenes	12.29	10.76	— 1.53
Resenes	5.01	4.41	— 0.60
Resin acids	82.20	83.61	+ 1.41
Total	100.00	100.00	

NOTES.—The powdered copal (sample No. 25) was oxidized continuously for 30 days and nights by passing through it air not previously dried. Sample 25 was thus converted to sample 26.

Before oxidation the copal had a melting point of 120° C., and contained 2.13 per cent moisture as determined by difference. After oxidation the moisture content was 8.55 per cent.

For accurate comparison the results above were calculated on a moisture-free basis.

Analysis of the copal showed that during the oxidation a small amount of the terpenes was volatilized, but there was very little change in the resene content of the copal. However, the amount of resin acids increased slightly.

The insoluble gel (polymer) is probably formed by the polymerization of lactones. As the amount of lactones increases there should be some increase in the amount of gel (polymer). Our results showed that the copal was oxidized but not to any considerable extent. The insoluble gel increased only 0.72 per cent. Apparently the lactone tends to act as an antioxidant which inhibits the oxidation of the copal. It would seem that when the copal is oxidized for 30 days the gel stage is just about reached. Production of any considerable amount of polymer probably requires a much longer period of oxidation than that employed in our experiment. Copal samples that show a high percentage of insoluble gel are probably obtained from exudations that have been exposed on the copal tree for quite a long time.

Brooks [14] believed that the atmospheric oxidation of Manila copal is accompanied by the formation of organic peroxides. He also oxidized powdered copal by allowing it to remain ex-

[14] Philip. Journ. Sci. § A 5 (1910) 225.

posed to the air for four months. The saponification number was 157 before oxidation and 182 after oxidation, thus giving an increase of 25. Brooks states that this increase points to the rearrangement of peroxides to lactones, but he did not isolate such compounds. However, he did call attention to the possibility that the oxidized copal may contain hydroxy acids which form lactones.

The air used in our oxidation experiment (Table 1) was not dried; it was just the ordinary moist laboratory air. A similar oxidation experiment was carried out with dried air. The air was well dried by passing it through sulfuric acid, calcium chloride, and soda lime. The constants of the copal after oxidizing for 30 days and nights with both moist and dried air are given in Table 2.

TABLE 2.—*Oxidation of copal with moist and dried air.*

Constants.	Moist air.	Dried air.
Saponification No.	200.52	193.80
Acid No.	110.57	111.49
Ester No.	89.95	82.31

There was a little more oxidation with the moist air since it gave saponification and ester numbers somewhat greater than the dried air.

Further experiments were made to determine what effect, if any, the terpenes or resenes have on the oxidation of copal. The resin acids (5) were separated from the copal in accordance with the outline in text fig. 1. The acids, thus free of terpenes and resenes, were powdered and exposed to atmospheric oxidation in the same manner as the copal. The results are recorded in Table 3.

TABLE 3.—*Oxidation of resin acids (5) from Manila copal.*

Constants.	Before oxidation.	After oxidation.				
		1st to 11th day.	Increase in 11 days.	11th to 33rd day.	Inc ease in 22 days.	Total increase in 33 days.
Saponification No.	166.91	174.14	7.23	177.58	3.44	10.67
Acid No.	134.32	136.07	1.75	137.43	1.36	3.11
Ester No.	32.59	38.07	5.48	40.15	2.08	7.56
Acetyl No.	100.53					9.12

NOTE.—The resin acids (5), separated from Manila copal (sample 27), were oxidized for 33 days and nights. The procedure was the same as in the oxidation of the copal.

The acetyl number of the acids after final oxidation was 109.65.

The oxidation was carried out in two periods—one period of 11 days followed immediately by a second period of 22 days. Samples were taken after each period and the constants determined.

Comparison of the data given in Tables 1 and 3 shows that the resin acids (5) (text fig. 1), when separated from Manila copal and free of terpenes and resenes, are oxidized less readily than the copal itself. After oxidation the saponification and ester numbers for the acids were much less than for the copal. Evidently either the terpenes, the resenes, or both, have a tendency to promote oxidation of the copal.

During the first period (11 days) that the free resin acids were oxidized, the increase in the saponification and ester numbers was more than double the corresponding increase in the following period (22 days). Continuation of the oxidation gave a decrease in the rate of oxidation.

Resin acids (5), obtained from Manila copal, consist of two acids, (6) and (7). These individual acids were again separated in accordance with the outline in text fig. 2. In this case the separation was not very complete as the acid (6) had an ester number of 20.22, showing that it contained some acid (7). A portion of acid (6) was purified by neutralizing it and removing the sticky part. This refined product then had an ester number of only 2.66. Oxidation data on acid (6), before and after refining, and on acid (7) are given in Table 4. These samples were subjected to continuous atmospheric oxidation for eleven days and nights in the same manner as that employed for resin acids (5), Table 3.

TABLE 4.—*Oxidation of resin acids (6) and (7) from Manila copal.*

Resins acids.	Constants.	Before oxidation.	After oxidation.	Difference.
Acid (6) (small ester No.)	Saponification No.	211.83	211.72	—0.11
	Acid No.	209.17	209.48	+0.31
	Ester No.	2.66	2.24	—0.42
Acid (6) with some acid (7)	Saponification No.	211.81	215.07	+3.26
	Acid No.	191.59	192.45	+0.86
	Ester No.	20.22	22.62	+2.40
Acid (7) (large ester No.)	Saponification No.	133.86	139.71	+5.85
	Acid No.	93.14	92.58	—0.56
	Ester No.	40.72	47.13	+6.41

NOTE: These samples were subjected to continuous atmospheric oxidation for 11 days and nights.

Both before and after subjection to atmospheric oxidation, the acid (6), with small ester number, gave the same constants within experimental error. So this acid was not affected by oxidation.

When oxidized, the acid (6), with some (7), having a medium ester number of 20.22, gave a slight increase in saponification and ester numbers.

Oxidation of acid (7), (ester no. 40.72), gave a larger increase in saponification and ester numbers than the acid (6), with some (7). However, when acid (7) is oxidized alone it is not affected as much as when mixed (Table 3) in about equal proportions with acid (6). Probably acid (6) has a catalyzing effect.

These results show that acid (7) is the only acid in Manila copal that is affected by atmospheric oxidation. When this acid is oxidized it is partly converted into lactone as shown by the increase in ester number.

In addition to our laboratory oxidation experiments we also investigated the atmospheric weathering of Manila copal adhering to the copal tree.

When the copal resin emerges from the tree the outer surface of the copal soon hardens. As the exudation continues, the fresh copal forces the hardened surface copal outward and the deposit gradually enlarges. The surface portion of a large block of copal is therefore much older than the interior portion. Since the surface is in contact with the air it is likely to be oxidized and to contain more of the insoluble gelatinous material (polymer) than the interior part.

Nagel and Körnchen [15] studied the solubility of copals in relation to their age. They concluded from their work that copals decrease in solubility with age as a result of the formation of compounds of high molecular weight.

We procured a block of copal that had a dull, brown surface. The surface was quite weathered, thus having the appearance of copal that was rather old. When cut in half, the interior part was found to be light yellow, and it appeared to be a much more recent exudation than the outer portion.

Samples were taken from the exterior and interior of this block of copal and the constants determined. The insoluble matter was separated from these samples and heated until the gel, if present, was converted to brittle resin (text fig. 3). The brittle resin was then removed by alcohol and the amount determined. The latter represented the insoluble gel originally

[15] Wiss. Veroffentlisch. Siemens-Konzern 13, No. 3 (1934) 42.

contained in the copal. Data on these samples are recorded in Table 5.

TABLE 5.—*Weathering of Manila copal.*

Constants.	Copal.		Difference.
	Interior.	Exterior.	
Saponification No.	155.47	193.15	+37.69
Acid No.	97.37	103.30	+ 5.93
Ester No.	58.10	89.85	+31.75
Acetyl No.	115.50	151.16	+35.66
Insoluble gel converted to soluble brittle copal	None	3.08	+ 3.08

Weathering of copal resin adhering to the tree (Table 5) gave, in general, about the same kind of results as oxidation in the laboratory (Table 1). In both cases oxidation of the copal gave an increase in all the constants determined.

The insoluble gel produced during ageing of the copal on the tree was 3.08 per cent (Table 5) while in the laboratory oxidation experiment the copal acquired only 0.72 per cent increase in insoluble gel (Table 1). Copal on the tree is not only subjected to atmospheric oxidation but also to the effects of weathering, especially the action of sunlight, which darkens the copal and also probably tends to increase the gel formation. Brooks [16] found that sunlight accelerates the oxidation of copal by air.

SUMMARY

Manila copal is one of the important minor forest products of the Philippines. In general, it is composed mostly of resin acids (5) (text fig. 1), together with some terpenes, resenes, and insoluble matter.

Copal that contains much material insoluble in alcohol is considered low grade and is not purchased for export by local dealers. The insoluble matter usually consists of a grayish gel that is contaminated with foreign material (dirt and the like). When the insoluble matter is heated properly the gel in it is converted into a brittle resin soluble in alcohol.

Analysis (text fig. 3) of the soluble copal obtained from the impure brittle resin shows that it is composed almost entirely of resin acids (10) that are contaminated with very small amounts of terpenes and resenes.

[16] Philip. Journ. Sci. § A 5 (1910) 226.

Since oxidation is apparently an important reaction in the ageing of Manila copal, experiments were carried out to determine the exact effects of oxidizing this resin.

A rapid current of air was passed for thirty days and nights through powdered copal. The result was a marked increase in the ester number indicating the formation of lactones. Polymerization of the lactone gave only a small amount of insoluble gel. These results showed that Manila copal was oxidized but not to any considerable extent. Probably the lactone that is formed in the copal tends to act as an antioxidant.

The resin acids (5) (text fig. 1) were isolated and exposed to atmospheric oxidation in the same manner as the copal. They were oxidized even less than the copal, due probably, to lactone formation in the acids and also to the absence of terpenes and resenes. One or both of these tend to promote oxidation of the copal.

Resin acids (5) consist of two acids, (6) and (7), which have very different constants, especially saponification numbers (text fig. 2). When these acids were separated and each one subjected to atmospheric oxidation, acid (6) was not affected. Acid (7) was partly converted to lactone as shown by the increase in ester number.

Weathering of copal resin adhering to the tree (Table 5) gave, in general, about the same kind of results as oxidation in the laboratory (Table 1). In both cases oxidation of the copal gave an increase in all the constants determined. The insoluble gel produced in the copal during the period of weathering on the tree was 3.08 per cent.

As the copal ages, the resin acid (7) in the copal apparently oxidizes to a hydroxy acid. This gradually decomposes into a lactone that slowly polymerizes to an insoluble gel. The gel probably serves as a protective coating for the interior copal. It naturally absorbs copal constituents and foreign material, thus constituting the usual insoluble matter (2) that is separated in the analysis of copal (text fig. 1). When the insoluble matter is isolated and heated properly, the gel in it depolymerizes into a brittle resin.

ILLUSTRATIONS

TEXT FIGURES

STUDIES ON PHALAENOPSIS, I

THE IDENTITY OF PHALAENOPSIS AMABILIS (LINN.) BLUME AND OF PHALAENOPSIS APHRODITE REICHB. F.

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TWO PLATES

Those species of genus *Phalaenopsis* which occur, and are rather common in the Philippines, have intrigued me for many years. A prolonged study of these species, as they occur here, has lead to some fairly definite conclusions. The present restudy and revision of these botanically and commercially important species is the outgrowth of the observations made, and an attempt to make clear the systematic and nomenclatorial confusion with which some of them are surrounded.

Phalaenopsis amabilis seems to have had a hectic career. It is a well-known species, having had a scientific record as early as two centuries ago. It was figured and described by Rumpf in 1750, under the name *Angraecum album majus.*[1] It was discovered in Amboyna growing on trees. Osbeck [2] found it in the western extremity of Java. Specimens were sent by him to Linnæus, who described the plant under the name of *Epidendrum amabile.*[3] Roxburgh [4] later transferred the plant to *Cymbidium,* as *C. amabile,* and stated that it was a native of the Moluccas.

In 1825 Blume [5] based a new genus on the species and made the combination *Phalaenopsis amabilis.* The name *Phalaenopsis* is perhaps due to fancied resemblance of the flower to some tropical moths while on the wing.

More confusion was added when Cuming in his trip to the Philippines in 1838 discovered another moth orchid. Lindley [6]

[1] Herb. Amb. 6 (1750) 99, *t. 43.*
[2] Cited in Orch. Rev. 14 (1906) 234.
[3] Linnæus, Sp. Pl. (1753) 953.
[4] Fl. Ind. 3 (1832) 457.
[5] Bijdr. (1825) 294, *t. 44.*
[6] Lindley, Gen. & Sp. Orch. Pl. (1833) 213.

in 1833 included *P. amabilis* in his genera and species of orchidaceous plants. But in 1938 [7] he unfortunately confused the allied Philippine species with *P. amabilis.*

In 1848 *P. amabilis* appeared in cultivation. Lindley, instead of correcting his previous mistake, described it as a new species (*Phalaenopsis grandiflora*).[8]

In 1862 Reichenbach filius noted Lindley's error, and proposed the new name *Phalaenopsis aphrodite* [9] for the Philippine species collected by Cuming. Nomenclatural confusion continued for some time, and proved extremely difficult to rectify. The beautiful illustration in Curtis's Bot. Mag. 73 (1847) *t. 4297,* of the plant which flowered at Kew Gardens in the winter of 1846–1847, is doubtless a Cuming plant, not *P. amabilis* but *P. aphrodite,* as correctly interpreted by Reichenbach filius. Ames [10] in 1905 reported and described a moth orchid collected from Lamao River, Bataan Province, Philippines, and for it used the name *P. amabilis* Blume. The English description doubtless agrees well with a typical *P. aphrodite.* In 1908 Ames [11] reduced *P. aphrodite* to a variety of *P. amabilis,* and stated that "*P. aphrodite* and *P. amabilis* have always been more or less confused, the differences between them being very slight and often obscure." In Ames's herbarium he claims to have an almost complete series which shows the gradual passage of one set of characters regarded as specific into the other. He further states that the retuse character of the apex of the arms of the callus is about the only character which may be relied upon to separate the Javan from the Philippine plants. In Merrill's Enumeration of Philippine Flowering Plants [12] Ames retained *P. aphrodite* as a variety of *P. amabilis.*

There is no doubt in my mind after many years contact with thousands of living specimens of various species of *Phalaenopsis,* that *P. grandiflora* Lindl. is not distinct from the typical Javan *P. amabilis* Blume; the differences in the size of the flowers, the shape of the leaves, and the yellow cirrhi are inconsequential and of minor importance. Even the features of the callus, which is an important character separating *P. amabilis* and *P. aphrodite,*

[7] Bot. Reg. (1838) *t. 34.*
[8] Gard. Chron. (1848) 39, *fig. 1.*
[9] Hamb. Gartenz. 18 (1862) 35.
[10] Orch. 1 (1905) 101.
[11] Orch. 2 (1908) 226.
[12] Merrill, Enum. Philip. Fl. Plts. 2 (1925) 411.

are the same in *P. grandiflora* and *P. amabilis*. They are both thick, and the arms are not retuse.

Much of the confusion, even to this date, lies in the species *P. amabilis* and *P. aphrodite*. I have examined living specimens of *P. aphrodite*, collected from the Batanes Islands, from nearly all provinces of Luzon, Mindoro, and islands in the Visayas, and have compared them with those of *P. amabilis* (cultivated in Manila and seen in Java in 1938), and am convinced that the two species are distinct. The differences between the two species are so conspicuous that even gardeners and orchid peddlers in Manila can recognize them.

In the matter of distribution, *P. aphrodite* is found in South Cape and Formosa, Batanes, Luzon, Mindoro, islands of the Visayas, but not Palawan, and in Mindanao. *P. amabilis* has a peculiar distribution, being restricted in the Philippines to Palawan Island, and other small islands adjacent to it; Sulu, and the Tawitawi group; and reaches as far as Borneo, Celebes, Java, Boeroe, Amboina, and Sunda Island.

The outstanding feature of *P. amabilis* lies in the narrow middle lobe of the labellum; in *P. aphrodite* the middle lobe is very broad at the base. I agree with Professor Ames that the retuse character of the apex of the arms of the callus in *P. aphrodite* is a reliable character, which may separate the two species in question. In *P. amabilis*, this structure is not retuse. In *P. amabilis* the auricles of the middle lobe of the labellum are much reduced, measuring 1.5 mm to 3 mm. In *P. aphrodite* the auricles are rather prolonged, often measuring up to 7 mm in length but not less than 5 mm.

Phalaenopsis Sanderiana, which is suspected to be a natural hybrid between *P. Schilleriana* and *P. aphrodite* is only found in Davao, Lanao, and Zamboanga Provinces, Mindanao, and is treated here as a variety of *P. aphrodite*. The shape of the flowers is that of *P. aphrodite*, from which, however, it differs in color; in typical *P. aphrodite* the petals and sepals are flushed with delicate mauve or pale pink-purple; while in *P. aphrodite* var. *Sanderiana* they become deep rose-purple. The leaves differ in being silvery gray on the surfaces. The shape of the middle lobe of the labellum is similar to that of *P. aphrodite* with a broad base, differing slightly in details of the arms of the callus. It seems an intermediate between *P. amabilis* and *P. aphrodite*. In *P. amabilis* the side division (*a*) of the arms of the callus is much reduced and not prominent; in *P. aphrodite* this division is fairly promiment; however in *P. aphrodite* var. *Sanderiana* this division is very prominent and well developed. The retuse condition of the apex of the arm of the callus which is very prominent in *P. aphrodite* is very inconspicuous and undeveloped in var. *Sanderiana,* so as to appear almost truncate.

Genus PHALAENOPSIS Blume

Perianthii sepala quinque patentia, inaequalis; sepala interiora latiora, superne dilatato-rotundata. *Labellum* ecalcaratum, cum ungue gynostemii confluens, tuberculo emarginato ad basim auctum; limbus trilobus; lobis lateralibus rotundatis, arcuato-inflexis; lobo medio angustato, basi hastato, apice appendicibus 2 subulatis terminato. *Gynostemium* liberum. *Anthera* gynostemio interne versus apicem insidens, rostello prominenti incumbens, bilocularis. *Massae pollinis* duae, ovales, dorso depressae, cereaceae, pedicello communi ad basin peltato elastice insidentes.

Herba parasitica. Caules radicantes, simplices. Folia rigida, lato-lanceolata, apice oblique-retusa. Flores paniculati.—BLUME, Bijdr. (1825) 294.

PHALAENOPSIS AMABILIS (Linn.) Blume. Plate 1, fig. 1; Plate 2, figs. 1 and 4 to 6.

Phalaenopsis amabilis (Linn.) BLUME, Bijdr. (1825) 294, *fig. 44;* Rumphia 4 (1848) 52, *tt. 194, fig. 1 199A* (excl. citat. Lindl.); LINDL., Gen. and Sp. Orch. Pl. (1833) 213; BENNET, Pl. Jav. Rar. (1838) 28, *t. 8;* REICHB. f., Bot. Zeit. 10 (1852) 672; in Walp. Ann. 3 (1852) 561 (excl. pars Philip.); Xen. Orch. 2 (1862) 5; MIQ., Fl. Ind. Bat. 3 (1859) 690 (excl. citat. Bot. Mag. et pars Philip.), Sumatra (1862) 274; DUCHARTRE, Journ. Soc. Imp. et Centr. Hort. Par. 8 (1862) 730; LEM., Ill. Hort. 10 (1863) Misc. 13; LINDEN and RODIGAS, Lindenia 2 (1886) 65, quoad syn. in part; ROLFE, Gard. Chron. 26 (1886) 212, *fig. 48A;* l'Orchidoph. 13 (1893) 100; *ex* Gibbs in Journ. Linn. Soc. 42 (1914) 157; KERCHOVE, Rev. Hort. Belg. 16 (1890) 25, *t. 3;* VEITCH, Man. Orch. Pl. pt. 7 (1891) 22, *t.;* STEIN, Orchideenb. (1892) 504, fig. 153; WILL., Orch. Grow. Man. ed. 7 (1894) 660, *text cut* (excl. bibliog. in parte et quoad Philip.); RIDL., Journ. Linn. Soc. 31 (1896) 292; J. J. SM., Fl. Buitenz. 6 (Orch. Jav.) (1905) 549; Fig. - Atlas (1912) *fig. 416* (excl. bibliog. in parte et quoad Philip.); Orch. Amb. (1905) 92; Nova Guinea 8 (1909) Bot. 119 (excl. Philip.); 8^B (1912) Bot. 604; 9 (1913) Bot. 100; 12^4 (1916) Bot. 455; Philip. Journ. Sci. 12 (1917) Bot. 258, ex Merr. Interp. Rumph. Herb. Amb. (1917) 177; AMES, Orch. 1 (1905) 101 (excl. desc.); 2 (1908) 224; *ex* Merr. in Journ. Roy. Asiat. Soc. Straits Branch. Special No. (1921) 196; *ex* Merr. Enum. Philip. Fl. Pl. 1 (1925) 410; SCHLTR., Orchideen ed. 2 (1927) 535, *fig. 183.*

Edipendrum amabile LINN., Sp. Pl. ed. 1 (1753) 953; ed. 2 (1763) 1351; Sw., Nov. Act. Ups. 6 (1799) 67; in Schrad. Journ. Bot. 2 (1799) 210; WILLD., Sp. Pl. 4 (1805) 115; PERS., Syn. Pl. 2 (1807) 518; SPRENG., Syst. Veg. 3 (1826) 737.

Cymbidium amabile ROXB., Hort. Beng. (1814) 63, *nomen;* Fl. Ind. ed. 2 3 (1832) 457.

Phalaenopsis grandiflora LINDL., Gard. Chron. (1848) 39, *fig. 1*, REICHB. f. in Walp., Ann. 3 (1852) 561; MOORE, Ill. Orch. Pl. (1857) Phalaenop. 7; MIQ., Fl. Ind. Bat. 3 (1859) 690; HOOK., Bot. Mag. 86 (1860) *t. 5184;* GROENLAND, Rev. Hort. 32 (1860) 238, *figs. 53, 54;* GEDNEY, Floral World (1876) 323; PUYDT, Orch. (1880) 307, *t. 34;* BURB., The Garden 22 (1882) 118; HEMSL., Bot. Chal. Exped. 1 (1885) 199; WARNER and WILL., Orch. Alb. 6 (1887) *t. 277;* ROLFE, Gard. Chron. III 5 (1889) 88; in l'Orchidoph. 13 (1893) 100; GOWER, The Garden 35 (1889) 363; WILL., Orch. Grow. Man. ed. 7 (1894) 664.

Phalaenopsis aphrodite LEM., Ill. Hort. 10 (1863) Misc. 14, quoad citat. Rumph., non Reichb. f.

Phalaenopsis amabilis BLUME var. *grandiflora* BATEM, Second Cent. Orch. Pl. (1867) *t. 114.*

Phalaenopsis amabilis Blume var. *rimestadtiana* LINDEN, Lindenia 16 1902) 35, *t. 736;* edit. in Gard. Chron. III 32 (1902) 306, *t.;* PAUWELS, Rev. Hort. Belg. 29 (1903) 88, *figs. 22–24;* ROLFE, Orch. Rev. 14 (1906) 233, *fig. 27*, 23 (1915) 254.

Phalaenopsis Rimestadtiana "ARGUS," Orch. Rev. 13 (1905) 260, in textu, *nomen;* ROLFE, Orch. Rev. 25 (1917) 151, in textu, *nomen.*

Foliis radicalibus lato-lanceolatis, *petalis* lateralibus orbiculatis. *Habitat* in India. Osbeck. *Radices* crassae, funiformes, supra arborea scandentes. *Folia Crini* s. *Scillae officinalis* lata. lanceolata, carnosa, semipedalia. *Culmus* bipedalis, nudus, cinctus aliquot squamis acutis brevissimis. *Flores* nivei *Orchidis Susannae* aemuli, s. magnitudine *Narcissi:* constantes petalis 5, quorum 2 lateralia orbiculata, reliqua ovata. *Cucullus* alter triphyllus: lateralibus oblongis, intermedio hastato, bifido setis duabus subulatis.—*Epidendrum amabile* Linn. Sp. Pl. ed. 1 (1753) 953.

Leaves large, fleshy, greenish, elliptic-oblong, lanceolate or oblanceolate, apex obliquely retuse or broadly obtuse, 15 to 30 cm long, 5 to 6 cm wide. Inflorescence simple or branched, few or many-flowered, long, drooping or suberect, 20 to 50 cm long. Flowers white, odorless, large, 7.5 to 9.5 cm across. Pedicellate ovary greenish at the base, otherwise white, 4 to 5 cm long. Lateral sepals pure white, with faint yellowish green at the center on the back, obliquely lanceolate-oblong or elliptic-ovate, apex subacute or subobtuse, base contracted, 3.8 to 4.5 cm long, 1.6 to 2.1 cm wide. Dorsal sepal pure white, elliptic-oblong, apex subobtuse, 4 to 4.4 cm long, 2.3 to 2.5 cm wide. Petals pure white, broad, sub-rhomboidal, apex rounded, contracted at base, 3.8 to 4.5 cm long, 3.5 to 4.5 cm wide at the widest portion. Labellum three-lobed; lateral lobes incurved, subquadrate, apex rounded, white, lined and dotted at base with pomegranate purple, stained with empire yellow on the front lower edge, base contracted, 1.9 to 2.1 cm long, 1.1 to 1.4 cm wide at the widest portion; middle lobe narrowly linear, hastate, 1.8 to 2 cm long, white except the two auricles, cirrhi, and a line at center base which is empire yellow, 6 to 7 mm wide at base, 2 to 3 mm wide at apex; apex bearing at the extremity two long, very slender, incurved and twisted cirrhi, 1.5 to 3 cm long, auricles subulate, short, 1.5 to 3 mm long. Claw at base of column white, dotted and pencilled with pomegranate purple. Callus 2-lobed, apricot-yellow, dotted with pomegranate-purple, arms 3 to 4 mm thick, apex not retuse, apiculate. Column white, except pale-pink anther cap, subclavate, 10 to 11 mm long. Anther cap subquadrate. Pollinia two, subquadrate, 1.8 to 2 mm long.

PHILIPPINES, PALAWAN, without locality, *Bur. Sci. 10866 Celestino,* July 6, 1910; Brooks Point, *Elmer 12614,* March, 1911, *Bur. Sci. 81133, 81137a Taylor,* September, 1923; Taytay, *Merrill 9174,* April 30, 1913; without locality, *Bur. Sci. 21586 Escritor,* August 7, 1913. LUMBUGAN ISLAND, SULU, *Merrill 7188,* September 20, 1910. TAWITAWI, *Bur. Sci. 44256 Ramos and Edaño,* July 19, 1924. LUZON, Rizal Province, Pasay, cultivated in Quisumbing's garden, *Phil. Nat. Herb. 6942 Quisumbing,* October 20, 1940; originally collected by Mr. Edwards from around Brooks Point, Palawan. In addition to above the author has in cultivation many plants from Palawan, and also flowers of the species, preserved in liquid, from various gardens in Manila and from Java. The species is found outside of the Philippines in Java, Borneo, Celebes, Boeroe, Amboyna, and the Sunda Islands.

PHALAENOPSIS APHRODITE Reichb. f. Plate 1, Fig. 2; Plate 2, Figs. 2 and 7 to 9.

Phalaenopsis aphrodite REICHB. F., Hamb. Gartenz. 18 (1862) 35; Xen. Orch. 2 (1862) 6; DUCHARTRE, Journ. Soc. Imp. et Centr. Hort. Par. 8 (1862) 730; LEM., Ill. Hort. 10 (1863) Misc. 14 (excl. citat. Rumph.); ROLFE, Gard. Chron. 26 (1886) 212, *fig. 43 B;* Orch. Rev. 2 (1894) 209, *fig. 30;* 8 (1900) 135–136, *fig. 20;* 13 (1905) 232, *fig. 52; ex* Forbes and Hemsl. in Journ. Linn. Soc. 36 (1903) 34; PFITZ. in Engl. and Prantl, Nat. Pflanzenfam. 2 pt. 6 (1889) 211, *fig. 230;* VEITCH, Man. Orch. Pl. pt. 7 (1891) 24, *t.;* STEIN, Orchideenb. (1892) 505, *fig. 155;* COGN. in Dict. Icon. Orch. (1898) Phalaenop. *t. 1;* edit. in Sem. Hort. 4 (1900) 392, *fig. 132;* MATSUM., Ind. Pl. Jap. 2 (1905) 257; AMES, Orch. 1 (1905) 102 (desc.); Philip. Journ. Sci. § 2 (1907) 336; *ex* Merr. Enum. Philip. Fl. Pl. 1 (1925) 412; SCHLTR., Fedde. Repert. 4 (1919) 277; Orchideen ed. 2 (1927) 537.

Phalaenopsis amabilis HOOK., Bot. Mag. 73 (1847) *t. 4297* non Blume.

Leaves elliptic-oblong, ovate-oblong or obovate-oblong, apex obtuse to rounded, 10 to 25 cm long, 5 to 9 cm wide, greenish on both surfaces or greenish above and purplish-green beneath. Peduncles variable in length, greenish and usually tinged with madder-purple, erect, arching or drooping, few- to many-flowered, 30 to 90 cm long. Flowers odorless, 5.5 to 8.5 cm across. Pedicellate ovary white, greenish-yellow at base, slender, 2.5 to 3.2 cm long. Lateral sepals ovate or ovate-lanceolate, apex subacute, falcate, 2.6 to 3.8 cm long, 1.5 to 2.1 cm wide at widest portion, white, flushed with pale yellowish green and dotted at base with purple. Dorsal sepal white, oblong-elliptic, obtuse, 2.4 to 3.8 cm long, 1.4 to 2.0 cm wide. Petals white, broad, subrhomboidal, contracted at base, 2.7 to 3.8 cm long, 2.7 to 3.9 cm wide at the widest portion, broadly obtuse or rounded. Labellum 3-lobed; lateral lobes contracted at base, incurved, subquadrate, 1.5 to 2.1 cm long, 1.2 to 1.6 cm wide; apex truncate or somewhat rounded, white, within base yellow, spotted and pencilled with purple; middle lobe hastate with a broad base, 1.6 to 2.3 cm long, base above auricles 7 to 12 mm wide, apex 2 to 4 mm wide, white except with yellow or yellow and purple mixed at base above auricles, auricles prominent with a broad base, triangular or subulate, 6 to 10 mm long, 3 to 6.5 mm wide at base, apex terminating in two filiform, tendrillike divisions (cirrhi), these 12 to 20 mm long; crest or callus thin, 0.8 to 1 mm thick, 2-lobed, yellow spotted with red or purple, apex of arms or lobe prominently retuse. Column white, short, subterete, 7 to 8 mm long. Anther cap beaked, subquadrate. Pollinia two, subglobose.

In habit *P. aphrodite* resembles *P. amabilis.* The leaves are practically the same in shape and color except that in *P. aphrodite* there is a flush of purple beneath. The most important feature, however, and the one which separates *P. aphrodite* from *P. amabilis,* is the labellum and the callus. In *P. aphrodite* the middle lobe of the labellum is hastate with a broad base; the callus is thin, with very prominent terminal retuse lobe or arm. *P. aphrodite* is very variable in the Philippines,—variations in the shape and color of the leaves, size and color of the flower parts, the shape of the labellum particularly the middle lobe, and the length of the cirrhi are not uncommon. Three varieties have been published, but many more varieties and forms could be added. A separate account on the study of these various varieties and forms will be published separately.

The distribution of *Phalaenopsis aphrodite* is rather interesting. The only record we have outside of the Philippines is from South Cape and Formosa. In the Philippines the species reaches only as far as the Visayas, not to Palawan or Mindanao. We have records of the species from Batan and Camiguin, two islands north of Luzon, and it is found southward, in practically all provinces of Luzon. The species is common in both primary and secondary forests at low and medium altitudes. It flowers practically throughout the year.

PHILIPPINES, BATAN ISLAND, Mount Iraya, *Bur. Sci. 80798 Ramos,* April 30, 1930. CAMIGUIN ISLAND, Mount Malabsing, *Bur. Sci. 79589 Edaño,* March 13, 1930. LUZON, Ilocos Norte Province, Bangui, *Bur. Sci. 7647 Ramos,* March, 1909: Ifugao Subprovince, Payauan, *Bur. Sci. 20026 McGregor,* January 24, 1913: Nueva Vizcaya Province, vicinity of Dupax, *Bur. Sci. 11133 McGregor,* April, 1912: Nueva Ecija Province, without definite locality, *Bur. Sci. 12318 Foxworthy,* January 31, 1911: Zambales Province, Tangil, *For. Bur. 6914 Curran,* May 6, 1907: Bataan Province, Lamao, *For. Bur. 680 Borden,* May 7, 1904: Pampanga Province, Mount Arayat, *For. Bur. 19311 Curran,* March, 1910; Rizal Province, Montalban, *Loher, s. n.,* May, 1909; Mount Purro, *Bur. Sci. 12526 Ramos,* November 26, 1910; Mount Susong-dalaga, *Bur. Sci. 19242 Reillo,* December 6, 1912; without locality, *Bur. Sci. 3058 Ramos,* November 21, 1907: Laguna Province, Los Baños, *Quisumbing 1043,* December 29, 1917; Mount Maquiling, *Bur. Sci. 17134 Robinson,* December 9, 1912; Calauan, *Bur. Sci. 12390 McGregor,* December 8, 1910: Tayabas Province, Basiad, *Bur. Sci. 25573 Yates,* December 19, 1916; Casiguran, *Bur. Sci. 45533 Ramos and Edaño,* June 13, 1925; Laguimanoc, *Merrill 4017,* March 12, 1905; Mount Cadig (Guinayangan), *Bur. Sci. 20822, 20856, 20682, Escritor,* March 7, 1913; Camarines Sur Province, Ragay, *For. Bur. 11342 Curran,* May 10, 1908: Sorsogon Province, Mount Bulusan (Mount Irosin), *Elmer 15478,* September, 1916. MINDORO, Alag River, *Merrill 5845,* December 3, 1906; Lake Naujan, *For. Bur. 6789 Merritt,* April 5, 1907. BILIRAN, *Bur. Sci. 19915 McGregor,* May 30, 1914, *Bur. Sci. 18877 McGregor,* June 20, 1914. LEYTE, Cabalian, *Lopez 3407,* May 18, 1921. SAMAR, Paranas, *Bur. Sci. 17571 Ramos,* April 12, 1914. NEGROS, Occidental Negros Province, Sagay, *For. Bur. 5544 Everett,* October 18, 1906.

PHALAENOPSIS APHRODITE var. SANDERIANA (Reichb. f). Quis. comb. nov. Plate 1, fig. 3; Plate 2, figs. 3 and 10 to 12.

Phalaenopsis sanderiana REICHB. F., Flora 65 (1882) 466; Gard. Chron. 19 (1883) 607, 656; 20 (1883) 110; BURB., The Garden 24 (1883) 270, *t. 407;* edit. in l'Orchidoph. 3 (1883) 661; GODEFR.-LEBŒUF, l'Orchidoph. 5 (1885) 18, *t.;* LINDEN and RODIGAS, Lindenia 1 (1885) 51, *t. 23;* WILL., Orch. Grow. Man. ed. 6 (1885)

535; ed. 7 (1894) 670; ROLFE, Gard. Chron. II 26 (1886) 212; Orch. Rev. 8 (1900) 133; 15 (1907) 185, *fig. 22;* l'Orchidoph. 13 (1903) 101; WARNER and WILL., Orch. Alb. 5 (1886) *t. 209;* GOWER, The Garden 35 (1889) 363; ROEBELEN, Gard. Chron. III 7 (1890) 459, in textu; STEIN, Orchideenb. (1892) 511; KRÄNZL. in Sander Reichenbachia II 2 (1894) 41, *t. 68* (upper fig.); COGN. in Dict. Icon. Orch. (1903) Phalaenop. Hybr. *t. 2;* G. WILSON, Orch. World 6 (1916) 266.

Phalaenopsis amabilis Blume var. *aphrodite* (Reichb. f.) Ames subvar. *Sanderiana* (Reichb. f.) AMES, Orch. 2 (1908) 228; in Merr. Enum. Philip. Fl. Pl. 1 (1925) 412.

In habit similar to the species. Leaves oblong, oblong-obovate, or oblong-oblanceolate, apex obtuse or subrounded, dark green, marked on the upper surface with silvery gray, the lower surface sometimes with a flush of dull brownish-purple, 15 to 27 cm long, 6 to 9 cm wide. Inflorescence branched or unbranched, 30 to 80 cm long. Flowers faintly fragrant, 7 to 9 cm across. Lateral sepals obliquely ovate, apex acute, basal margin on broader side undulate-recurved, almost white, flushed with pale mauve particularly on narrower side, 3 to 3.6 cm long, 1.8 to 2.2 cm wide. Dorsal sepal oblong, subacute, or subobtuse, very delicate mauve or pale pink-purple, 3 to 3.6 cm long, 1.8 to 2.3 cm wide. Petals subrhomboidal or subrounded, broadly obtuse or subrounded, base cuneate, same color as dorsal sepal, 1.9 to 3.8 cm long, 1.9 to 3.8 cm wide at widest portion. Labellum 3-lobed; lateral lobes incurved, rounded or semi-ovate, apex rounded, base contracted as in the species, 1.8 to 2.1 cm long, 1.2 to 1.3 cm wide at widest portion, white, upper edge pencilled and spotted with eugenia red, lower edge cadmium yellow; middle lobe white, streaked with purple along the center, hastate with a broad base, similar in shape to species, 1.9 to 2 cm long, base above auricles 1.2 to 1.3 cm wide, apex below cirrhi 3 to 3.5 mm wide; cirrhi white, 1.2 to 1.5 cm long; auricles narrowly triangular, with a broad base, 7 to 9 mm long, cadmium yellow; callus 2-lobed, thin as in species, apex of arms truncate or obscurely retuse, white or yellowish, spotted with brown or purple brown, side division prominent. Column subterete, white with a short mauve-tinted beak, 8 to 9 mm long.

PHILIPPINES, MINDANAO, Davao Province, Davao, *Copeland, s. n.*, October, 1904; *Rev. Black, s. n.*, October 24, 1905; Todaya (Mount Apo), *Elmer 10883a*, May, 1909: Lanao Province, Camp Keithley (Lake Lanao), *Clemens, s. n.*, July, 1907: Zamboanga Province, Malangas, *Bur. Sci. 37109 Ramos and Edaño,* November 16, 1919. IGAT ISLAND, Dumanguilas Bay, Zamboanga Province, *For. Bur. 12361 Hutchinson*, May 7, 1908. MANILA, cultivated in gardens, plants originally from Davao Province, *Bur. Sci. 78917 Quisumbing*, March 30, 1930; *Mrs. K. B. Day 19154*, February, 1930; *Bur. Sci. 82210 Quisumbing*, January 15, 1931; *Bur. Sci. 84572, 84573 Quisumbing*, January 17, 1932; *Bur. Sci. 84704, 84705 Quisumbing*, July 2, 1932. In forests at low altitudes up to 100 meters. Endemic.

In growth and habit similar to the species; differing in the presence of silvery gray on the upper surface of the leaves, the color of the sepals and petals and the details of the callus. The sepals and petals, instead of being white as in the species, are flushed with a pleasing delicate mauve or pale pink-purple. In some forms these are almost white, while in others the color is more intensified, that is, they are of deep rose-purple. The callus is thin as in the species,—unlike in *P. amabilis* where it is conspicuously thick. The apex of the arm of the callus is not retuse as in the species, but truncate or very obscurely retuse; the side division of the arm is very prominent; in some cases the side division is so prominent that with the apex the arm appears retuse. The white form, except the details of the callus and the silvery gray of the surface of the leaf, almost resembles the species. Three varieties had been previously recognized and published but these have not been recognized here to merit varietal rank as they represent color variations and differences and not morphological differences.

ILLUSTRATIONS

Plate 1

Fig. 1. *Phalaenopsis amabilis* (Linn.) Blume; reduced.
2. *Phalaenopsis aphrodite* Reichb. f. var. *Sanderiana* (Reichb. f.) Quis.; reduced.
3. *Phalaenopsis aphrodite* Reichb. f. typical; reduced.

Plate 2

Fig. 1. *Phalaenopsis amabilis* (Linn.) Blume, labellum expanded; × 1.
2. *Phalaenopsis aphrodite* Reichb. f., labellum expanded; × 1.
3. *Phalaenopsis aphrodite* Reichb. f. var. *Sanderiana* (Reichb. f.) Quis., labellum expanded; × 1.

Figs. 4 to 6. *Phalaenopsis amabilis* (Linn.) Blume, three views of the callus showing apiculate arms and the very inconspicuous side division of the lobe or arm; × 4.
7 to 9. *Phalaenopsis aphrodite* Reichb. f., three views of the callus showing very conspicuous retuse apex of the arms and the prominent side division; × 4.
10 to 12. *Phalaenopsis aphrodite* Reichb. f. var. *Sanderiana* (Reichb. f.) Quis., three views of the callus showing the truncate or very obscure retuse apex of the arm (*a*), and very prominent side division (*b*); × 4.

To replace Plate 1 in the article cited:

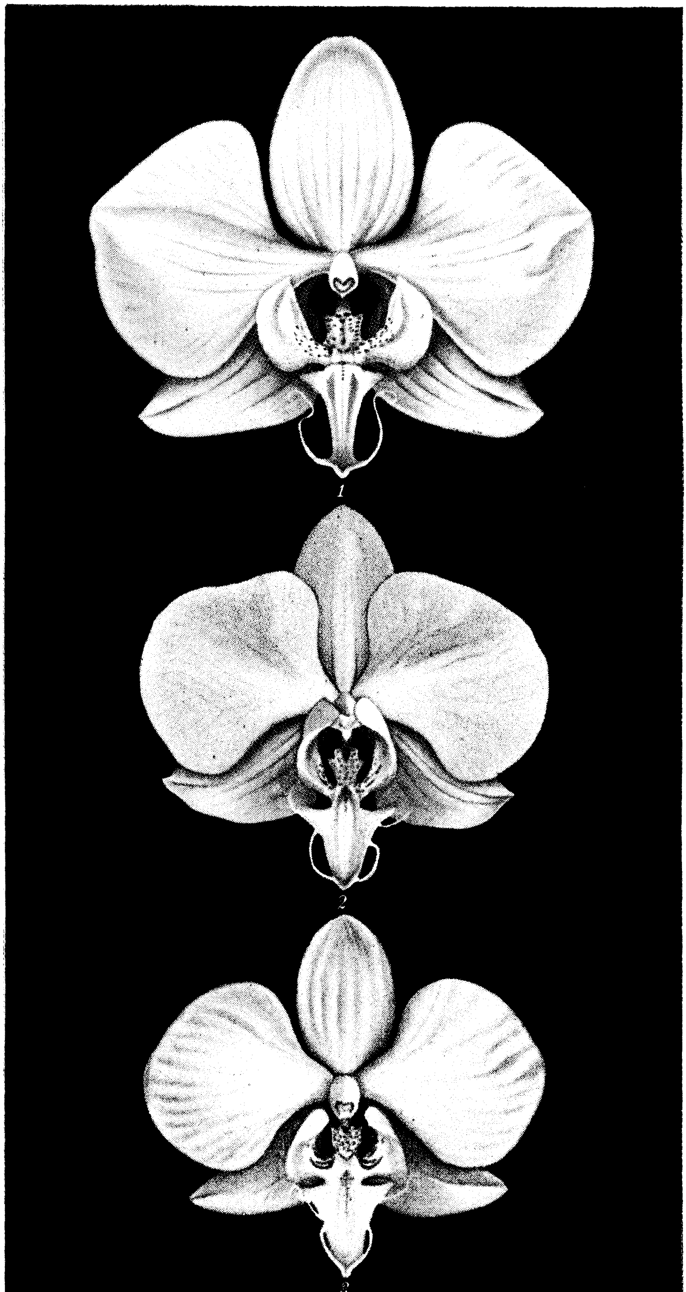

PLATE 1.

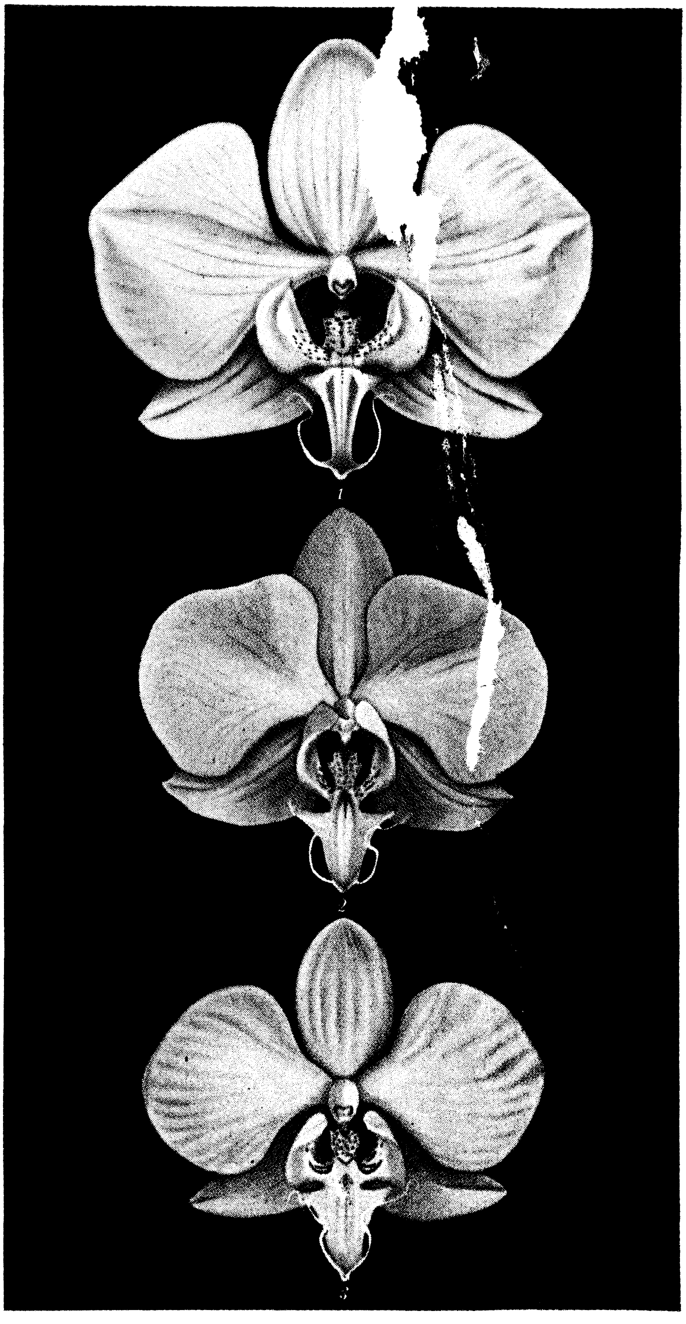

PLATE 1.

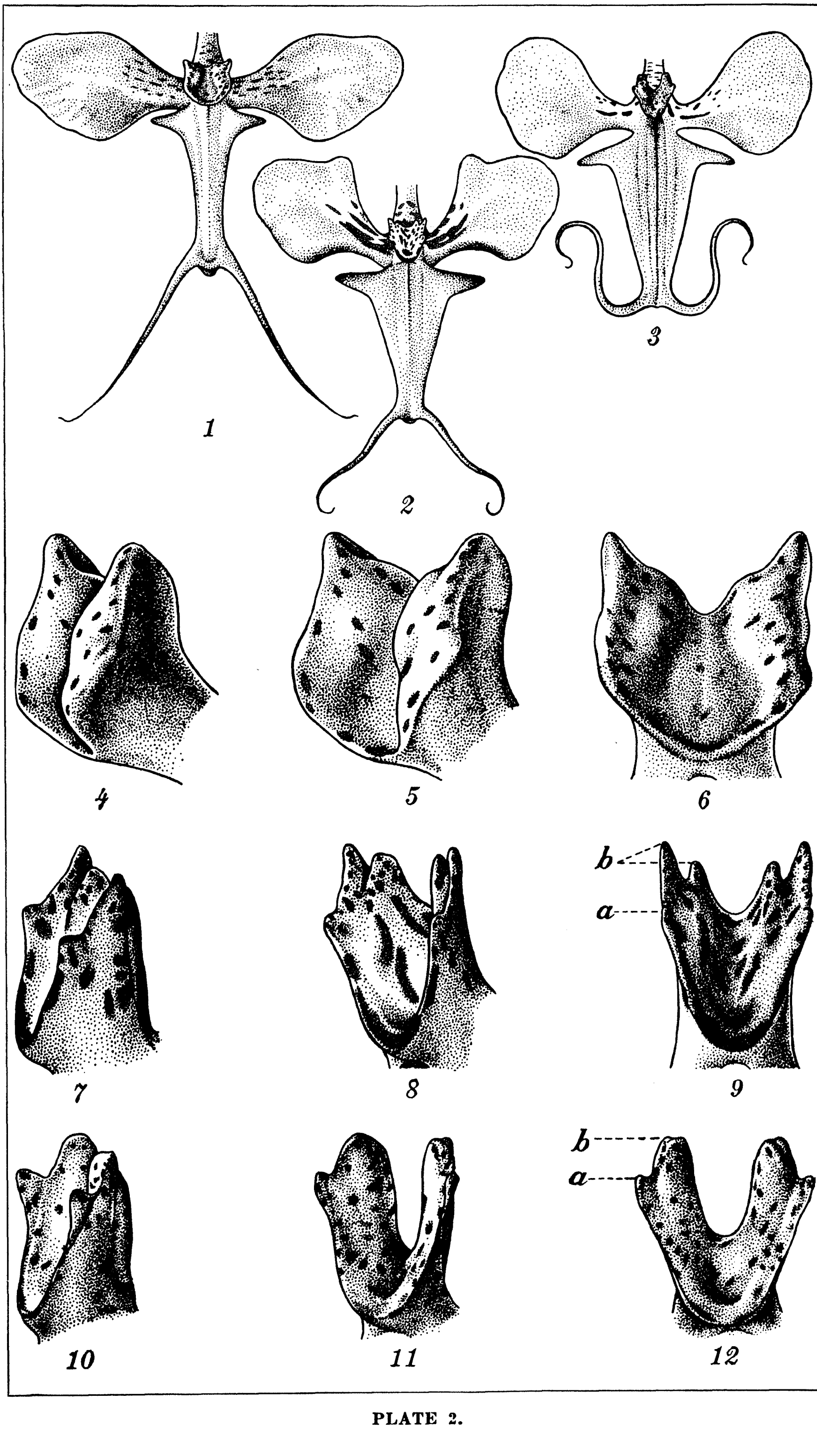

PLATE 2.

BOOKS

Books reviewed here have been selected from books received by the Philippine Journal of Science from time to time and acknowledged in this section.

REVIEWS

Researches in Cancer: Part One (1896–1921; 1922–1932). By Caleb Wyand Geting Rohrer. Baltimore, The Brentwood printing company, 1934. 144 pp., front., illus. Price, $3.50.

This book presents a novel theory dealing with the relation of premature birth to cancer. The author also makes use of his "fetal-cell suspension" in the treatment of human cancer and claims encouraging results. This part of the book ought not to be accepted without due deliberation, lest the reader may try it at the sacrifice of surgery, X-ray, and radium, which, up to this time, are the only methods regarded as effective in the treatment of cancer.

The biography of Professor Cohnheim and his relation to cancer research is both interesting and inspiring and make the book worth reading by those interested in the cancer problem.

—P. S. C.

End-results in the Treatment of Gastric Cancer; An Analytical Study and Statistical Survey of Sixty Years of Surgical Treatment. By Edward M. Livingston and George T. Pack. With a Foreword by Bowman C. Crowell. New York, London, Paul B. Hoeber, Inc., 1939. 179 pp., illus. Price, $3.

This book is interesting and profitable to the surgeon, radiologist, clinician, and general practitioner, because the presentation of the subject is practical, analytical, and graphic. It is practical in the sense that it portrays certain gastric cancers which may be cured if found early and operated, as evidenced by the analytical studies of abundant and rich material furnished by reputable institutions of the different countries of the world.

Due to the great incidence of malignancy of cancer of the stomach affecting the human race, this piece of work may be considered among the most significant, because it furnishes the cancerologist important information that will serve as a guide and an encouragement to those whose interest lies principally in the lessening of cancer mortality by surgical intervention.—P. S. S.

Quantitative Biological Spectroscopy. By Elmer S. Miller. Minneapolis, Minnesota, Burgess Publishing Company, 1939. 213 pp., illus. Price. $3.50.

This mimeographed pamphlet of 213 pages contains a concise but complete description of modern spectroscopic apparatus used in the determination of absorption bands of organic substances. Starting with a minutious discussion of the fundamental principles of spectrum analysis and the sources of error, the actual spectroscopic analyses taken up deal with vitamins, lipids, hæmoglobin, cytochrome, and plant pigments. An extensive bibliography is found at the end of each chapter. The author's complete grasp of the physics principles involved is admirable, considering that his special line of work is botany.—N. C.

I Knew 3000 Lunatics. By Victor R. Small. New York, Farrar & Rinehart, Inc., 1935. 273 pp. Price, $2.50.

As a treatise for bringing the science of psychiatry to the layman, devoid of technicalities and intricacies, this book well fulfills its mission. In simple and easily understood language the author proceeds to tell of his experiences as a staff member in an insane asylum where approximately 3000 inmates are housed. He gives a concise and vivid picture of the behavior and the manner of living of each of the more common types of the insane and the mentally deficient. He does this in such an interesting manner that the reader will not want to lay down the book until he finishes it.

This book serves as very good preliminary reading for students intending to take a course in psychiatry. The student will get a clear idea of what the subject is about, its scope and its practical applications. From the borderline cases of the psychoneuroses to the well-confirmed schizophrenics, he will get a vivid picture of what these concepts represent. Finally the author gives a first-class classification of mental diseases, devoid of technicalities, and a chapter on forensic psychiatry wherein he enumerates some of the glaring discrepancies in opinion between the experts and the law.—D. S.

Modern Sewage Disposal; Anniversary Book of the Federation of Sewage Works Associations. Edited by Langdon Pearse. New York, The Federation, 1938. 371 pp., illus. Price, $3.50.

This book treats of the history and methods of sewage disposal and treatment as practiced in the United States, England, South Africa, the Netherlands, and Germany. Under the editorship of Langdon Pearse and under the direction of Dr. F. W. Mohlman, it was written by chosen research workers, engineers, and other authorities who have distinguished themselves in their respective fields. It describes the latest methods of sewage treatment as well as methods of disposal of waste and sewage effluents for irrigation or as fertilizer in the form of digested sludge.

The vast amount of research conducted in sewage treatment plants now in operation and in 36 educational institutions in the United States is well and concisely covered by this volume. It is more thorough and comprehensive than an ordinary text on the subject. As stated in the foreword, "this Anniversary Volume is an effort to replace a convention of world-wide workers by a contributed set of papers along unusual topical lines."

The book is an excellent reference work for sanitary engineers, especially for those engaged in the designing and operation of sewage treatment plants.—G. de L.

Electric Welding: A Practical Text Covering the Fundamental Principles and Applications of the Various Types of Electric Arc Welding, Including the use of Power Tube Rectifiers. By Morgan H. Potter. Chicago, American Technical Society, 1938. 126 pp., illus. $1.25.

Electric Welding by Morgan H. Potter is a practical text covering the fundamental principles and applications of the various types of electric arc welding, including the use of power tube rectifiers. The importance of the welding industry in the United States has grown so rapidly that the large demand for competent welders and welding engineers can hardly be met at the rate they are trained.

The book is very practical and comprehensive, and as such it will serve best in providing the beginner and the inexperienced welder with the technical and practical information he needs to become an expert welder. The book also discusses and illustrates important improvements in the design and control of welding machines as well as improvements in the welding rod and welding technique. All the various methods of welding are dealth with, namely, Thermit, Electric resistance, Spot, Butt, Electric arc, Carbon arc, and Metallic arc.

The use of Power tube rectifiers may be considered one of the foremost achievements in the science of electric welding. With complete accurate control of the current, voltage, and time by Ignitron timers, as illustrated in this book, spot and seam welding can be accomplished very effectively.—F. D. M.

Cotton Progress in Brazil. By N. S. Pearse. Manchester, England, International Federation of Master Cotton Spinners and Manufacturer's Associations, 1937. 183 pp., illus.

This pamphlet, in ten chapters, deals with the progress made in the cotton growing industry in Brazil. How climatic and weather conditions and soil types affect the cotton industry in Brazil is well explained. The pamphlet also explains how the ginning laws, particularly the Sâo Paulo laws, aid in increasing the demand of spinners as a result of the uniformity of staples set up and produced under such laws. The low cost in production made possible by cooperation among the ginner, the shipper, and the spinner, contributes largely to the progress made in this industry.

In Chapter ten the conditions prevailing and the most suitable methods used in the different states make possible the production of an improved and high grade cotton at very low cost. Apparently, with all these favorable conditions obtaining in Brazil, its cotton industry is a real asset. The author did not incorporate in the pamphlet possible further improvements in the industry as a whole, such as the general adoption by the country of the Cotton laws of Sâo Paulo and research work on the maximum density and other characteristics of Brazilian cotton, including the most advantageous and profitable baling.
—T. G.

From Forest to Woodworker. By L. H. Noble and R. B. Everill. New York, The Bruce Publishing Co., 1938. 252 pp., illus. Price, $1.75.

As an introduction to the science of forestry and to the art of woodworking, this profusely illustrated book is a valuable addition to the library of all natural science and woodworking instructors as well as students. In clear, concise language, it imparts to the reader practical information on the measuring and grading of lumber, the application of paints, varnishes, and lacquers, as well as the use and proper care of woodworking tools. A whole chapter is devoted to the importance of conservation in the utilization of existing forest wealth.—T. N. R.

Modern Agricultural Mathematics. By Maurice Nadler. New York, Orange Judd Publishing Company, 1940. 315 pp., illus. Price, $2.

This book, in two parts, gives a detailed and comprehensive discourse on the application of mathematical principles to a variety of farming activities.

Part I of the book seeks to develop, by logical steps, various rules and formulas used in measurement of length, direction, area, and volume, and also specific relationships between the different units of measure. Mathematical principles presented are followed by a series of farm problems and sample solutions. Certain applications have been given special detailed presentation, as for example, crops and orchards, and the measurement of lumber and timber. In Part II a detailed consideration of dairying, feeding of farm animals, soil fertility, fertilizers, farm mechanics, and finance and management, provides the necessary skill in calculation.

This book is profusely illustrated by graphs, diagrams, and photographs. Valuable tables necessary in scientific farming are given in the appendix. This text will be of invaluable service to those training for or now engaged in agricultural pursuits.—D. B. P.

The Drama of Weather. By Sir. Napier Shaw. 2d. ed. Cambridge, at the University Press, 1939. 307 pp., front., illus. Price, $3.50.

This is the second edition, partly revised, of one of Sir Napier Shaw's entertaining and instructive books on the weather. It is popular in style in the sense that it is not written for meteorologists as such, but it is certainly unlike the usual run of popular books on science. It is rather written for well-educated nonmeteorologists skillfully endeavoring to make them share the thrill there is in watching the play and interplay of the various elements that go to make up the elusive thing we call weather.

Sir Napier's style is felicitous, and even veteran meteorologists can find much food for thought in the side remarks and reflections which are plentifully strewn over the pages, the mature fruit of many years of musing by the dean of English weather men. The illustrations are, for the most part, excellent, and the author's dexterous use of graphs very commendable.—C. F. D.

RECEIVED

ADAM, T. R. The museum and popular culture. New York, American association for adult education, 1939. 177 pp. Price, $1.

BUTLER, J. A. V. Electrocapillarity; the chemistry and physics of electrodes and other charged surfaces. New York, Chemical publishing co., inc., 1940. 208 pp., illus. Price, $5.

CAMM, F. J. ED. A dictionary of metals and their alloys, their composition and characteristics. With special sections on plating, polishing, hardening and tempering, metal spraying, rustproofing, chemical colouring and useful tables. New York, Chemical publishing co., inc., 1940. 245 pp. Price, $3.

The detection and identification of war gases. Notes for the use of gas identification officers. 1st Am. ed. New York, Chemical publishing co., inc., 1940. 53 pp. Price, $1.50.

DIEHL, HARVEY. The applications of the dioximes to analytical chemistry. Columbus, Ohio, The G. Frederick Smith chemical co., 1940. 62 pp., illus.

Drilling and production practice, 1938. Sponsored by the Central committee on drilling and production practice, Division of production, American Petroleum institute. New York, American petroleum institute, 1939. 458 pp., illus. Price, $3.

GAER, JOSEPH. Fair and warmer. The problem of weather forecasting and the work of the United States weather bureau. New York, Harcourt, Brace and company, 1939. 137 pp., illus. Price, $1.

HEISS, ELWOOD, D., and others. Modern methods and materials for teaching science. New York, The Macmillan company, 1940. 351 pp., illus. Price, $2.50.

JANSSEN, RAYMOND E. Leaves and stems from fossil forests. A handbook of the paleobotanical collections. (Popular science series vol. 1). Springfield, Illinois State museum, 1939. 190 pp., illus. Price, paper, $1.25.

KNANDEL, H. CLYDE. Profitable poultry keeping. New York, Orange Judd publishing co., inc., 1940. 462 pp., illus. Price, $3.

MANLY, HAROLD P., and L. O. GORDER. Drake's cyclopedia of radio and electronics. A practical reference book. 9th ed. Chicago, Frederick J. Drake & co., 1939. unpaged. illus. Price, $5.

MAY, PERCY, and G. MALCOLM DYSON. May's chemistry of synthetic drugs. 4th ed., rev. rewr. London—New York—Toronto, Longmans, Green and co., 1939. 370 pp., illus. Price, $6.

The meteorological glossary. In continuation of the weather map. Published by the authority of the meteorological committee. 3d. ed. New York, Chemical publishing co., 1940. 251 pp., illus. Price, $3.

National geographic society, Washington, D. C. The book of birds. The first work presenting in full color all the major species of the United States and Canada. Washington, D. C., The society, 1939. 2 v., illus. Price, $5.

PATTEE, ALIDA FRANCES. Practical dietetics with reference to diet in health and disease. 22d. ed. Mount Vernon, New York, The author, 1940. 880 pp., illus. Price, $3.

PETERSON, ANNA J., and NENA WILSON BADENOCH. Delectable dinners. New York, E. P. Dutton & co., inc., 1939. 460 pp. Price, $2.50.

PHILIPS, A. H. Gardening without soil. New York, Chemical publishing co., inc., 1940. 137 pp., front., illus. Price, $2.

Another issue. London, Arthur Pearson. n. d.

Popular science talks. Presented by members of the faculty of the Philadelphia college of pharmacy and science and published under the auspices of the American journal of pharmacy. Philadelphia, Philadelphia college of pharmacy and science. 241 pp., illus. Price, $1.

REED, C. I., and others. Vitamin D. Chemistry, physiology, pharmacology, pathology, experimental and clinical investigations. Chicago, The University of Chicago press, 1939. 389 pp., illus. Price, $4.50.

REMINGTON, J. STEWART, and F. L. JAMESON. Metallurgical analysis and assaying. London, The Technical press ltd., 1939. 101 pp. Price, 5s/-.

SANSUM, W. D., and others. A manual for diabetic patients. New York, The Macmillan company, 1939. 227 pp., front., illus. Price, $3.25.

VERRILL, A. Hyatt. Minerals, metals and gems. Boston, L. C. Page & company, 1939. 293 pp., front., illus. Price, $3.

WADDINGTON, C. H. An introduction to modern genetics. New York, The Macmillan company, 1939. 441 pp., illus. Price, $4.

WEISKOTTEN, HERMAN G., and others. Medical education in the United States 1934–1939. Prepared for the council on medical education and hospitals of the American medical association. Chicago, American medical association, 1940. 259 pp., illus. Price, $1.

THE PHILIPPINE JOURNAL OF SCIENCE

VOL. 74 MARCH, 1941 No. 3

MALACODERMATA VON DEN PHILIPPINEN AUS DER SAMMLUNG DES ZOOLOGISCHEN MUSEUMS IN AMSTERDAM

8. BEITRAG ZUR KENNTNIS DER INDO-MALAYISCHEN MALACODERMATA

Von W. WITTMER
Zürich, Schweitz

ZWEI TEXTFIGUREN

Die in der vorliegenden Arbeit behandelten Arten entstammen einer Bestimmungssendung von ungefähr 2800 Stück, aus der Sammlung des Zoologischen Museums, Amsterdam. Die Tiere wurden von Herrn Boettcher in den Jahren 1914–1918 auf den Philippinen gesammelt, sind dann durch Kauf in den Privatbesitz des Cleridenspezialisten Herrn J. B. Corporaal übergegangen, der sie später, zusammen mit seinen übrigen entomologischen Sammlungen, dem genannten Museum geschenkt hat.

Es handelt sich um die reichste Ausbeute die je aus dieser Gruppe der Malacodermata von den Philippinen gebracht wurde. Die Anzahl der bekannten Formen, den zentralen Inseln entstammend, also mit Ausschluss von Palawan, erhöht sich durch die nachfolgend beschriebenen um 28, und bringt die Gesamtzahl der Arten aus den Familien der Drilidæ, Cantharidæ, Malachiidæ, Dasytidæ und Prionoceridæ auf 118. In der nachfolgenden Artenaufzählung sind neben den aus dem Zoologischen Museum in Amsterdam stammenden Formen auch alle übrigen bisher von den Philippinen beschriebenen Arten aufgezählt. Die von Boettcher aufgesammelten sind erkenntlich an den genauen Fundorten und Daten, die hinter jedem Zitat aufgeführt sind, während bei den übrigen nur die Literaturangabe vermerkt ist. Die Holotypen und Cotypen aller Arten befinden sich in der Sammlung des Zoologischen Museums in Amsterdam; für die reichliche Ueberlassung von Dubletten für meine eigene Sammlung sage ich Herrn J. B. Corporaal meinen besten Dank.

Von der Aufzählung der Lampyridæ, die ebenfalls ziemlich reich vertreten sind, habe ich Abstand genommen, weil die bereits veröffentlichten Listen[1] ein hinreichendes Bild über die auf den Philippinen vorkommenden Formen, die meistens sehr weit, fast über alle Inseln, verbreitet sind, vermitteln. Die Sendung enthielt nur eine neue Art der Gattung *Colophotia* Motsch., deren Beschreibung nächstens anderweitig veröffentlicht wird.

Als bemerkenswertester Fund ist das Auffinden eines ersten Vertreters aus der Familie Dasytidæ und zwar aus der Gattung *Haplocnemus* Kies. zu erwähnen. Die Gattung findet ihre Hauptverbreitung im Mittelmeer; der östlichste und zugleich der südlichste Vertreter war aus Indien beschrieben.

DRILIDÆ

PLATERODRILUS CURTUS Pic.

Platerodrilus curtus PIC, L'Echange 47 (1931) 97, *hors-texte.*

MINDANAO, Surigao, Mai und November, 1915. PANAON, November, 1915.

Subgenus PLATERODRIPLESIUS novum

Von der Gattung *Platerodrilus* Pic *s. str.* einzig durch die Bildung der Fühler verschieden, die, anstatt etwas flachgedrückt und leicht gezahnt oder fadenförmig, vom dritten Gliede an nach innen lang und fadenförmig ausgezogen sind (ähnlich wie bei *Phengodes* oder *Phrixothrix,* mit dem Unterschiede, dass aus jeder Spitze des Gliedes nur eine, anstatt wie dort zwei Verlängerungen entspringen und die Fühler anstatt ziemlich lang, schräg abstehend, äusserst kurz, grob und dicht, anliegend behaart sind). Die Verlängerungen sind verhältnismässig robust und erreichen bei den mittleren Gliedern etwa die sechsfache Länge des Stammgliedes, beim 3. Gliede nur die vierfache Länge.

PLATERODRILUS (PLATERODRILOPLESIUS) BICOLOR sp. nov.

Schwarz, Mandibeln und Clypeus etwas aufgehellt, braun, Halsschild und Unterseite des Kopfes rotbraun.

[1] Olivier, Ann. Soc. Ent. France (1886) 132–133, 182–187; M. Pic, Philip. Journ. Sci. 25 (1924) 712, 713.

Kopf mit den leicht hervortretenden Augen so breit wie der Halsschild an den Vorderecken, fein, dicht punktiert und behaart. Fühler fast von Körperlänge, 2. Glied äusserst kurz, vom 1. Glied fast verdeckt; 3. Glied kaum halb so lang wie das 4.; letzteres etwas schmäler als das 3. 5. Glied und folgende Glieder bis zum 10. unter sich ungefähr von gleicher Länge, in der Dicke allmählich abnehmend. Spitze eines jeden Gliedes vom 3. an in einen langen, mehr oder weniger gekrümmten Fortsatz ausgezogen. Halsschild breiter als lang, mit nach vorne konvergierenden Seiten, Basalecken spitzwinklig, Vorderecken stumpf, Halsschild in der Mitte leicht gewölbt, Seiten flach abgesetzt, chagrinartig punktiert, dicht gelb behaart. Flügeldecken runzlig skulptiert mit Spuren von acht Längsrippen, von denen drei deutlicher ausgeprägt sind als die übrigen, gegen die Spitze erlöschen die Rippen ganz.

Länge, 8.5 Millimeter.

Fundort.—MINDORO, Calapan, 8. und 9. Februar, 1916.

BICLADODRILUS BAKERI Pic.

Bicladodrilus bakeri PIC, L'Echange 37 (1921) 15.

MINDANAO.

DODECATOMA TESTACEICEPS Pic.

Dodecatoma testaceiceps PIC, Philip. Journ. Sci. 25 (1924) 713.

OTOTRETADRILUS PHILIPPINUS sp. nov.

Männchen. Orangegelb, Fühler vom 2. Gliede an, Augen nebst deren Rand, Palpen, Spitze der Flügeldecken, Seitenrand des Abdomens, Spitze der Tibien und die Tarsen schwarzbraun bis schwarz. Ein Exemplar mit Fundort Bucas Grande, Socorro, 19. Oktober, 1916, hat einfarbig dunkle Fühler, stark angedunkelten Kopf, eine dunkle Mittellinie auf dem Halsschilde, schwarzes Schildchen, die Flügeldecken sind ebenfalls einfarbig dunkel bis auf die Schulterbeulen, die gelb gefärbt sind; ab. *maculata* nov.

Kopf deutlich punktiert, Fühler vom 3. Gliede an gesägt, mittlere Glieder breiter als lang. Halsschild mit den leicht gebogenen Seiten schmäler als die Flügeldecken an den Schultern. Basalecken fast rechtwinklig, Vorderecken stumpf, Scheibe mit deutlicher Mittellinie, Punktierung tief, zerstreut, Abstand der einzelnen Punkte grösser als deren Durchmesser. Flügeldecken verkürzt, nicht ganz zwei-drittel der Länge des Abdomens bedeckend, Enden spitz zulaufend, Punktierung der Spitzen grob und tief, unregelmässig, höchstens in der Mitte an der Naht und an den Seiten mit vier oder fünf aufeinanderfolgenden

Punkten besetzt, gegen die Basis wird die Punktierung weniger deutlich, runzlig verworren.

Länge, 7 bis 7.5 Millimeter.

Fundort.—LUZON, Nueva Vizcaya, Imugan, 4000 Fuss Höhe, 8. Juli, 1917: Laguna, Mount Banahao, 2000 Fuss Höhe, 16. April, 1914 (Holotype).

In der Färbung gleicht die Stammform *O. flavoscutellatus* ab. *innotaticollis* Wittm. von Java. Die Form und Punktierung der Flügeldecken gestatten jedoch eine leichte Unterscheidung der beiden nahe verwandten Arten. Bei der neuen Art laufen die Seiten der Decken gegen die Spitze in gerader Linie zu und die ganze Spitze ist mit einer grösseren Anzahl unregelmässiger, tiefer Punkte besetzt. Bei *O. flavoscutellatus* Wittm. laufen die Seiten gegen die Spitze in leichtem Bogen zusammen, die Decken verschmälern sich weniger schnell und die Spitzen sind runzlig skulptiert, der ganze Spitzenrand mit einer Reihe regelmässiger, tiefer Punkte versehen.

Subgenus PALPODRILONIUS novum

Unterscheidet sich von der Gattung *Drilonius* Kies. (*Curtodrilus* Pic) *s. str.* durch das stark verbreiterte und verlängerte letzte Glied der Kiefer- und Lippentaster. Dieses Glied ist etwas länger als der Abstand der Augen, ungefähr drei mal so lang wie breit, nach innen von der Basis bis zur Spitze gleichmässig erweitert, flachgedrückt, Oberseite seicht eingedrückt, Spitze gerundet, stumpf.

DRILONIUS (PALPODRILONIUS) INSULARIES sp. nov.

Einfarbig dunkelbraun bis schwarz, nur die Beine etwas heller braun gefärbt.

Kopf mit den Augen schmäler als der Halsschild, glatt. Fühler kaum so lang wie der halbe Körper, 1. Glied dick und kurz, so lang wie breit; 2. Glied kürzer und schmäler als das 1.; 3. Glied ungefähr so lang wie die folgenden, aber nicht so breit; 4. Glied etwas gezahnt, vom 5. Gliede an deutlich gezahnt. Halsschild doppelt so breit wie lang, in der Mitte am längsten, gegen die Seiten zu verschmälert, glatt, fein behaart. Flügeldecken langgestreckt, mit fünf Längsrippen (inklusiv Nahtrippe), dazwischen gitterartig in regelmässigen Reihen punktiert, gegen die Spitzen erlischt die Punktierung etwas.

Länge, 3.8 bis 4 Millimeter.

Fundort.—LUZON, Laguna, Los Baños, 12. Dezember, 1916.

Ein Exemplar von Nord Mindanao, Mumungan, 23. Februar, 1915, ist stark aufgehellt, vordere Hälfte des Kopfes gelb, Halsschild ebenfalls gelb bis auf eine dunkle Makel in der Mitte am Vorderrand und je einer kleineren an den Seitenrändern, Flügeldecken schwarz, basales Drittel gelb; ab. *basitincta* nov. Vielleicht eine selbständige Art, eine Frage die erst aufgeklärt werden kann aufgrund reicheren Materials.

CANTHARIDÆ

TYLOCERUS ATRICORNIS Guérin.

Tylocerus atricornis GUÉRIN, Voy. Favorite (1838) 37.

SAMAR, Catbalogan, April, 1915. BASILAN, Oktober, 1915. PANAON, November, 1915. MINDANAO, Surigao, November, 1915; Kolambugan, Januar, 1915; Port Banga, Januar, 1915. MINDORO, Calapan, Februar, 1916; San Teodoro (Suban), Januar, 1916. BOHOL, Juli, 1916. CATANDUANES, Virac, März, 1916. LEYTE, Burauen, Mai, 1915.

TYLOCERUS MINDANAONUS Pic.

Tylocerus mindanaonus PIC, Philip. Journ. Sci. 25 (1924) 718.

NORD-MINDANAO, Surigao, Mai, 1915.

TYLOCERUS SERICEUS Pic.

Tylocerus serieceus PIC, Philip. Journ. Sci. 25 (1924) 722.

LUZON, Imugan, Mai und Juni, 1916; Mount Polis, 2400 Fuss Höhe, Februar, 1917; Trinidad, 4000 Fuss Höhe, Mai, 1914; Lubuagan, 3500 Fuss Höhe, Februar, 1917; Benguet, Haight's Place, 8000 Fuss Höhe, März, 1917.

TYLOCERUS SERICEUS var. BASITINCTA var. nov.

Gekennzeichnet durch die Färbung des Halsschildes, der, anstatt wie bei der Stammform einfarbig dunkel zu sein, gelbliche Basalecken aufweist; manchmal ist der ganze Basalrand und die Seiten, oft bis nach der Mitte, gegen den Vorderrand schmal gelb gesäumt. Bei zwei Exemplaren sind auch die beiden ersten Fühlerglieder etwas aufgehellt.

Fundort.—LUZON, Nueva Viscaya, Imugan, 4000 Fuss Höhe, Mai und Juni, 1916; Kalinga, Lubuagan, 3500 Fuss Höhe, Februar, 1917.

TYLOCERUS VITTIGERUS Pic.

Tylocerus vittigerus PIC, Philip. Journ. Sci. 25 (1924) 721.

NORD-LUZON, Benguet, Haight's Place, 8000 Fuss Höhe, März, 1917.

TYLOCERUS INVITTATUS Pic.

Tylocerus invittatus PIC, Philip. Journ. Sci. 25 (1924) 720.

TYLOCERUS BAKERI Pic.

Tylocerus bakeri PIC, Philip. Journ. Sci. 25 (1924) 719.

LUZON, Mount Banahao, 2000 Fuss Höhe, April und Juni, 1914.

TYLOCERUS DISCOVITTATUS Pic.

Tylocerus discovittatus PIC, Philip. Journ. Sci. 25 (1924) 720.

NORD-MINDANAO, Dansalan, Februar, 1915.

TYLOCERUS GRISEUS sp. nov.

Männchen.—Schwarz, Halsschild rotorange, Vorderrand meist etwas angedunkelt, Flügeldecken greis behaart, vor der Spitze (ein Viertel ihrer Länge) dunkelbraun bis schwarz behaart.

Fühler die Spitzen der Flügeldecken fast erreichend, 1. Glied zur Spitze ziemlich stark verdickt, ungefähr so lang wie das 3.; 4. bis 10. Glied unter sich von fast gleicher Länge, vom 5. Glied an schwach verbreitert, leicht flachgedrückt; 11. Glied etwas länger als das 10., zur Spitze verschmälert. Halsschild breiter als lang, Seiten nach vorne schwach verengt, fast parallel, Ränder ringsum leicht erhaben, Scheibe matt, in der Mitte mit zwei undeutlichen Erhabenheiten deren Oberseite glatt ist und glänzt. Flügeldecken matt chagriniert, mit je ein bis zwei undeutlichen Längsrippen.

Weibchen.—Wie das Männchen gefärbt, Fühler etwas kürzer, Halsschild plumper, nach vorne stärker verengt, die greise Behaarung der vorderen drei Viertel der Decken mitunter dichter als beim Männchen.

Länge, 9.5 bis 10 Millimeter.

Fundort.—SÜD-LUZON, Mount Isarog, 4000 Fuss Höhe, April, 1915.

Von *T. bakeri* Pic, mit der die neue Art nahe verwandt ist, unterscheidet sie sich durch breitere Gestalt, die Färbung des Halsschildes, der einfarbig orangegelb oder dessen Vorder- und Basalrand nur schmal schwarz gesäumt ist, und den einfarbig schwarzbraunen Grund der Flügeldecken. Bei *T. bakeri* Pic ist die vordere Hälfte des Halsschildes meist in mehr oder weniger grossem Umfange mit einer schwarzen Makel und die Flügeldecken in ihrer Mitte mit je einem gelbweissen Längswisch versehen, der vor der dunkleren Spitzenfärbung beginnt, hier am breitesten ist, gegen die Basis sich verschmälert, manchmal sind auch die Seiten in der Mitte ganz schmal hell gesäumt.

TYLOCERUS CONVEXITHORAX Pic.

Tylocerus convexithorax PIC, Philip. Journ. Sci. 25 (1924) 719.

TYLOCERUS HICKERI Pic.

Tylocerus hickeri PIC, Ent. Anzeiger 15 (1935) 254.

MINDANAO.

TYLOCERUS LUTEOAPICALIS Pic.

Tylocerus luteoapicalis PIC, L'Echange 42 (1926) 26, *hors-texte.*

LUZON.

TYLOCERUS (DISCODON?) PICI sp. nov.

Männchen.—Schwarz, Mundteile, 10. und 11. Glied, oder nur das Endglied der Fühler, Halsschild bis auf eine Makel am Vorderrand, Koxen meist aller Beine und Basis der Vorderschenkel gelb oder gelborange gefärbt. Schildchen gelb. Flügeldecken mit heller Naht, beginnend an der Basis und gelben Seiten, beginnend an der Basis unter den Schulterbeulen, Spitzen der Decken, ungefähr ein Viertel der Länge einnehmend, schwarz; vor der dunkeln Spitze fliessen die helle Naht und Seitensaum zu einer hellen Querbinde zusammen.

Kopf mit den Augen breiter als der Halsschild, Augen gross, stark hervortretend, Stirne zwischen den Augen leicht eingedrückt, glatt. Fühler fast von Körperlänge, 2. Glied kaum halb so lang wie das 3.; 3. Glied nicht ganz so lang wie das 4.; 4. bis 10. Glied unter sich ungefähr von gleicher Länge; 11. Glied kaum länger als das 10. Halsschild breiter als lang, Seiten nach vorne schwach verengt, Scheibe glatt, glänzend. Flügeldecken chagrinartig skulptiert, matt, an der Basis weniger stark chagriniert, fast glatt. Behaarung einfach, hell auf dem hellen und dunkel auf dem schwarzbraunen Grunde.

Länge, 7 bis 7.5 Millimeter.

Fundort.—NORD-MINDANAO, Mumungan, Februar und März, 1915.

Die Färbung charakterisiert die Art gut; verwandtschaftlich kann sie neben *T. vittigerus* Pic gestellt werden.

TYLOCERUS (DISCODON ?) MINOR sp. nov.

Männchen.—Schwarzbraun, Mundteile, 1. bis 3. Fühlerglied in mehr oder weniger grossem Umfange, manchmal auch das letzte Glied, Halsschild bis auf eine dunkle Makel am Vorderrand, Schildchen und Koxen der Vorderbeine gelborange gefärbt. Flügeldecken in der hinteren Hälfte etwas heller erscheinend, Behaarung an der Basis, besonders aber an den Spitzen dunkler als an der heller erscheinenden Stelle in der Mitte, die Grenze zwischen der dunkleren und der helleren Behaarung verschwommen.

Kopf mit den Augen etwas breiter als der Halsschild, Augen stark hervortretend. Fühler langgestreckt, 1. Glied wenig verdickt; 2. Glied halb so lang wie das 3.; 3. bis 10. Glied unter sich gleich lang, Halsschild breiter als lang, Seiten parallel, alle Ecken verrundet, Scheibe glatt, fein behaart. Flügeldecken matt, runzlig gewirkt.

Weibchen.—Plumper, Fühler kürzer, Halsschild nach vorne deutlich verengt.

Länge, 4.5 bis 5.5 Millimeter.

Fundort.—NORD-MINDANAO, Mumungan, February, 1915.

Mit *T. discovittatus* Pic nahe verwandt. Die neue Art unterscheidet sich durch etwas kleinere Gestalt, die Färbung der Fühler, deren Basis und Spitze aufgehellt ist, die Form des Halsschildes mit seinen fast parallelen Seiten und die Flügeldecken, die keinen metallischen Schimmer und keine hellen Längsbinden aufweisen. *T. discovittatus* Pic hat einfarbig dunkle Fühler, der Halsschild ist sehr kurz und breit, nach vorne fast halbkreisförmig verengt, die Flügeldecken schimmern grün metallisch und sind mit je einem mehr oder weniger deutlichen hellen Längsstreifen versehen.

PODABRINUS QUADRIIMPRESSUS sp. nov.

Rotbraun, Fühler vom 2. Gliede an, Tarsen und Flügeldecken ausgenommen die Schultern, dunkelbraun, Augen schwarz.

Kopf breit, mit den Augen gut so breit wie die Flügeldecken. Schläfen gegen den Halsschildvorderrand verengt (wie bei *Malthinus*). Stirne mit einem breiten Quereindruck an der Basis, der vom Halsschildvorderrand fast verdeckt ist, ein Längseindruck beginnt zwischen den Fühlerwurzeln und erstreckt sich gegen den Clypeus, die ganze Kopfoberfläche runzlig gewirkt, matt. Fühler fast so lang wie der Körper, alle Glieder langgestreckt, 2. Glied knötchenförmig, kaum so lang wie breit. Halsschild etwas länger als breit, Vorderrand gerundet, in der Mitte ziemlich stark vorgezogen, Seiten leicht geschweift, zur Basis kaum verengt. Jederseits in der vorderen Hälfte des Halsschildes, gegen die Vorderecken mit einem ziemlich breiten Eindruck, zwei weitere Eindrücke in der Mitte, wovon der eine, grössere und seichtere vor dem Schildchen liegt, der andere, auf der vorderen Hälfte kurz nach der Mitte, ist etwas kleiner aber tiefer. Die beiden Eindrücke sind durch die Halsschildmittellinie miteinander verbunden. Basis and Höcker undeutlich, jedoch regelmässiger als der Kopf punktiert, Grund der Seiteneindrücke bis zu den Vorderecken runzlig gewirkt. Flügeldecken fast viermal so lang wie an den Schultern breit, runzlig gewirkt, mit deutlichen Querrunzeln, schräg abstehend behaart. Klauen einfach.

Länge, 6.5 bis 7 Millimeter.

NORD-MINDANAO, Mumungan, 25. Februar, 1915.

Neben *P. singularicollis* Pic zu stellen, mit der die neue Art nahe verwandt zu sein scheint.

DISCODON GRANULIPENNIS Boheman.

Discodon granulipennis BOHEMAN, Eugenies Reise (1858) 78.

LUZON, Mount Banahao, 2000 Fuss Höhe, April bis Juni, 1914. MINDORO, Calapan, 7, Februar, 1916.

Die Exemplare der nachfolgenden Fundorte unterscheiden sich von der Stammform durch die Färbung der Fühler, die einfarbig gelb sind, oder bei denen nur das 1. und 2., manchmal auch das 3. und 4. Glied schwarz ist; ab. *tincticornis* nov. Die Stammform hat einfarbig schwarze Fühler.

SAMAR, Catbalogan, April, 1915. SIARGAO, Dapa, September, 1916; Cabuntug, September, 1916. PANAON, November, 1915. NORD-MINDANAO, Surigao, Mai, 1915.

DISCODON VANIKORENSE Boisduval.

Discodon vanikorense BOISDUVAL, Voy. Astrolabe Ent. 2 (1835) 134.

NORD-MINDANAO, Dansalan, Februar, 1915; Mumungan, Februar und März, 1915; Surigao, Mai und August, 1915. BASILAN, Dezember, 1915.

DISCODON TANGKULANUM Pic.

Discodon tangkulanum PIC, Philip. Journ. Sci. 25 (1924) 715.

NORD-MINDANAO, Mumungan, Februar, 1915.

DISCODON ATROCYANEUM Pic.

Discodon atrocyaneum PIC, Philip. Journ. Sci. 25 (1924) 716.

LUZON, Mount Isarog, 4000 Fuss Höhe, April, 1916; Imugan, 4000 Fuss Höhe, Juni, 1917.

DISCODON ATROCYANEUM var. PALLIDICORNE Pic.

Discodon atrocyaneum var. *pallidicorne* PIC, Ent. Anzeiger 14 (1934) 54.

NORD-MINDANAO, Surigao, Mai, 1915.

DISCODON BAGUIONUM Pic.

Discodon baguionum PIC, Philip. Journ. Sci. 25 (1924) 714.

LUZON, Nueva Viscaya, Imugan, 4000 Fuss Höhe, Mai, 1916; Kalinga, Lubuagan, 3500 Fuss Höhe, Januar und Februar, 1917;

Balbalan, Januar, 1917; Benguet, Trinidad, 4000 Fuss Höhe, Mai, 1914; Mount Banahao, 2000 Fuss Höhe, April, 1914.

DISCODON SUBLINEATUM Pic.

Discodon sublineatum PIC, L'Echange 55 (1939) 170, *hors-texte.*

NORD-MINDANAO, Mumungan, Februar und März, 1915; Surigao, Mai, 1915.

Die Beschreibung Pic's bezieht sich auf das männliche Geschlecht. Die Weibchen unterscheiden sich durch grün oder blau gefärbte, metallisch schimmernde Flügeldecken, gelb ist nur ein schmaler Saum der sich von der Basis unter den Schultern bis kurz vor die Spitzen erstreckt. Halsschild einfarbig orangerot, oder mit einer mehr oder weniger grossen Makel auf der vorderen Hälfte. Fühler gelb, nur die beiden ersten Glieder und das letzte Glied in mehr oder weniger grosser Ausdehnung dunkel. Beine gelb, Knie, Tibien und Tarsen meist dunkel; ab. *bicoloricorne* nov. Auch das Männchen bildet in der Färbung eine von der Stammform abweichende Form, bei der die Flügeldecken wie bei den Weibchen gezeichnet, beziehungsweise gefärbt sind.

DISCODON PHILIPPINENSIS (Pic).

Cantharis philippinensis PIC, Mél. exotico-ent. 33 (1921) 29.

LUZON, Mount Banahao, Mai, 1915; Imugan, Mai, 1916; Mount Isarog, April, 1915; Lubuagan, Januar, 1917.

Die Beine dieser Art sind meist einfarbig dunkel, die Makel des Halsschildes schlecht begrenzt. Einzelne Exemplare weichen in der Färbung ab und bilden die ab. *flavotincta* nov. mit einfarbig gelben Flügeldecken, oder mit gelben Decken, bei denen die Naht äusserst schmal schwarz gefärbt ist. Die Form des Halsschildes und die der Fühler erinnert stark an die nahe verwandte Art *D. sublineatum* Pic.

DISCODON THOMASI Pic.

Discodon thomasi PIC, L'Echange 42 (1926) 27, *hors-texte.*

LUZON.

DISCODON SURIGAONUM Pic.

Discodon surigaonum PIC, Philip. Journ. Sci. 25 (1924) 716.

DISCODON CORPORAALI sp. nov.

Einfarbig schwarzbraun, nur die Mundteile und die Vorder- und Basalecken des Halsschildes (Männchen), oft der ganze Vorder- und Basalrand (Weibchen), gelblich gefärbt.

Kopf mit den ziemlich stark hervortretenden, grob fazettierten Augen kaum breiter als der Halsschild, fein punktiert mit einer seichten Längsdepression zwischen den Augen. Fühler länger als der halbe Körper, die Koxen der Hinterbeine um zwei bis drei Fühlergliederlängen überragend, schnurförmig, 1. Glied etwas verdickt, leicht gebogen, nur wenig länger als das 3.; 2. Glied nicht ganz halb so lang wie das 3.; 3. Glied eine Spur kürzer als das 4.; 5 bis 10. Glied unter sich ungefähr von gleicher Länge; 11. Glied nur wenig länger als das 10. Halsschild fast quadratisch, Seiten leicht ausgeschweift, jederseits kurz nach der Mitte in der vorderen Hälfte, in der Nähe des Randes mit einem punktförmigen Eindrucke. Basal- und Vorderecken abgerundet, leicht vorstehend, Basalecken etwas stärker vorstehend als die vorderen, Scheibe mit einer höckerförmigen Erhebung jederseits an der Basis neben der Mittellinie. Behaarung von Kopf und Halsschild kurz, gelblich. Flügeldecken ungefähr viertehalb mal so lang wie an der Basis breit, über die ganze Länge fein chagrinartig gerunzelt, ziemlich dicht und kurz gelb behaart, mit vereinzelten längeren abstehenden Haaren, die an der Spitze etwas zahlreicher als an der Basis vertreten sind. Eine Klaue an jeder Tarse gespalten (Männchen), alle Klauen einfach (Weibchen).

Länge, 6 bis 7 Millimeter.

Fundort.—LUZON, Nueva Viscaya, Imugan, 4000 Fuss Höhe, Juni, 1916.

In der Färbung ist diese Art *D. philippinensis* Pic sehr ähnlich. Sie unterscheidet sich von ihr durch etwas weniger grosse Augen, weniger breiten, fast quadratischen Halsschild, die Behaarung der Decken, die viel dichter mit gelblichen Haaren besetzt sind, und die dünneren, etwas längeren Fühler.

RHAGONYCHA BIPARTITA sp. nov.

Rotbraun, Fühler vom 2. Gliede an, Augen, die apikalen zwei Drittel der Decken und die Tarsen mehr oder weniger schwarz. Kopf mit den Augen etwas breiter als der Halsschild, Stirne leicht gewölbt, fast glatt, nur mit vereinzelten Haarpunkten. Fühler nur wenig länger als der halbe Körper, 3. Glied länger als das 2.; 3. bis 10. Glied unter sich gleich lang, jedes Glied zur Spitze leicht verdickt; 11. Glied eine Spur länger als das 10. Halsschild breiter als lang, glatt, mit zwei undeutlichen Höckern in der Mitte, Mittelinie nur angedeutet, Seiten des Halsschildes in der Mitte leicht ausgeschweift, nach vorne schwach verengt. Flügeldecken nur wenig breiter als der Halsschild, Viertehalb mal so lang wie breit, körnig skulptiert.

Länge, 4 Millimeter.

Fundort.—NORD-MINDANAO, Mumungan, Juli, 1915.

RHAGONYCHA (HARMONYCHA) BASICRASSICORNIS sp. nov.

Einfarbig schwarz, nur die Mundteile und der Clypeus bis zur Fühlerbasis braun; oder stark aufgehellt und nur die Augen, die Fühler vom 3. Gliede an, die Flügeldecken bis auf das basale Fünftel, alle Tarsen und die Hinterschienen mehr oder weniger dunkel; ab. *banosaca* nov.

Kopft breiter als lang, Stirne leicht gewölbt, glatt, zerstreut behaart. Fühler von kaum mehr als halber Körperlänge, 2. Glied knapp halb so lang die das 3., nur wenig schmäler als das 1.; 3. bis 5. Glied verdickt, 3. Glied etwas länger und stärker verdickt als das 4. und 5.; 3. und 4. Glied auf der Oberseite mit einer deutlichen Längseinkerbung, die manchmal von den Haaren fast vollständig verdeckt ist. Halsschild fast quadratisch, an den Basalecken etwas breiter als vorne, Seiten auf der vorderen Hälfte leicht ausgeschweift. Flügeldecken körnig skulptiert, ohne Spuren von Längsrippen. Alle Klauen gespalten.

Länge, 5 bis 6 Millimeter.

Fundort.—LUZON, Imugan, 7. Mai, 1916; Los Baños, 3. April, 1914.

MIMOPOLEMIUS LUZONICUM (Pic).

Discodon luzonicum PIC, Philip. Journ. Sci. 25 (1924) 717.

LUZON, Mount Banahao, Juni, 1914.

Die flachgedrückten, ziemlich stark gezahnten Fühler weisen für diesen und den nahe verwandten *Discodon mindanaonum* Pic auf die Gattung *Mimopolemius* Pic, in die ich sie stellen möchte. Vom gleichen Fundorte liegen mir drei Exemplare vor, die von *M. luzonicum* (Pic) sich durch einfarbig gelbe Flügeldecken unterscheiden; ab. *testacea* nov. Die Beine sind gelb mit schwarzen Knien, Tibien und Tarsen, oder gelb und nur die Knie und Tarsen schwarz.

MIMOPOLEMIUS (DISCODON) MINDANAONUM Pic.

Discodon mindanaonum PIC, Philip. Journ. Sci. 25 (1924) 715.

NORD-MINDANAO, Mumungan, Juni, 1915.

POLEMIOSILIS PICEOLATERALIS Pic.

Polemiosilis piceolateralis PIC, Philip. Journ. Sci. 25 (1924) 722.

LUZON, Mount Bulusan, 30. September, 1917; Los Baños, 3. April, 1914.

POLEMIOSILIS FORTICORNIS Pic.

Polemiosilis forticornis PIC, Philip. Journn. Sci. 25 (1924) 723.

NORD-MINDANAO, Siargao, Mai, August und November, 1916; Momungan, Februar, 1915.

POLEMIOSILIS BOETTCHERI Pic.

Polemiosilis boettcheri PIC, in litt.

SIARGAO, Dapa, September und November, 1916; Cabuntug, September, 1916. LEYTE, Santa Cruz, Oktober, 1915.

POLEMIOSILIS PROXIMUS Pic.

Polemiosilis proximus PIC, Philip. Journ. Sci. 25 (1924) 723.

MINDANAO, Mumungan, Februar und März, 1915; Port Banga, Januar, 1915. SIARGAO, Dapa, November, 1916.

POLEMIOSILIS LATIORITHORAX Pic.

Polemiosilis latiorithorax PIC, in litt.

MINDANAO, Surigao.

POLEMIOSILIS ATROAPICALIS Pic.

Polemiosilis atroapicalis PIC, L'Echange 40 (1924) 2, *hors-texte.*

POLEMIOSILIS SUBTRIANGULARIS Pic var.

Polemiosilis subtriangularis PIC var., L'Echange 41 (1924) 14.

SILIS CORDICOLLIS Pic.

Silis cordicollis PIC, Philip. Journ. Sci. 25 (1924) 726.

NORD-MINDANAO, Surigao, Mai, 1915; Mumungan, März, 1915.

SILIS PLICICOLLIS sp. nov.

Männchen.—Gelb, Fühler bis auf die Basis des 1. Gliedes, Augen, Tarsen, schwarzbraun; Schenkel und Unterseite ebenfalls leicht angedunkelt.

Kopf mit den stark hervortretenden Augen nicht breiter als der Halsschild, fast glatt, glänzend, fein behaart. Fühler die Spitzen der Flügeldecken fast erreichend, 1. Glied verhältnismässig kurz und dick, kürzer als das 3.; 2. Glied äusserst kurz, knötchenförmig, breiter als lang, 3. bis 10. Glied alle langgestreckt, jedes etwa vier bis fünf mal so lang wie an der Basis breit, rund, zur Spitze schwach verdickt, 3. Glied etwas länger als die nachfolgenden Glieder. Halsschild breiter als lang, Seiten geschweift, an der Basis etwas schmäler, mit scharfen Ecken, am Vorderrand etwas breiter, Ecken leicht abgeschrägt, an den Vorderecken etwas stärker behaart als auf der Scheibe, die etwas vorstehenden Seiten weisen jederseits einen schwach gebogenen, gegen den Basalrand sich leicht verbreiternden, kanalförmigen

Eindruck auf, Aussenrand in seiner vorderen Hälfte deutlich nach innen geschlagen, Innenrand im basalen Teil eingekerbt und gegen die Halsschildscheibe geöffnet. Halsschildscheibe mit deutlichem Längseindruck an der Basis, gegen den Vorderrand erlischt der Eindruck allmählich, Punktierung deutlich, aber weniger tief als auf den Flügeldecken. Flügeldecken langgestreckt, Spitzen leicht auf die Unterseite gebogen, stark, fast körnig punktiert, Nahtrand und Epipleuralrand leicht erhaben, fein gekerbt.

Länge, 7 bis 7.5 Millimeter.

Fundort.—LUZON, Nueva Viscaya, Imugan, 4000 Fuss Höhe, 30. Mai, 1916.

Von *S. minimus* Pic durch grössere Gestalt und dunklere Färbung der Fühler, Beine, und Unterseite verschieden, auch der Halsschild ist verschieden geformt, anstelle eines mit den Seiten fast parallel laufenden Kanals sind die Seiten bei *minimus* nur mit einem kerbartigen Einschnitt versehen.

SILIS PLICICOLLIS var. APICEFLAVA var. nov.

Ein männliches Exemplar von Luzon, Los Baños, 3. März, 1914, unterscheidet sich von der Stammform durch hellere Färbung, nur die Augen und die Fühler vom 3. bis zum 9. oder 10. Gliede sind schwarz. Die Gestalt etwas kleiner, die Fühler um weniges kürzer.

SILIS BAKERI Pic.

Silis bakeri PIC, Philip. Journ. Sci. 25 (1924) 726.

NORD-MINDANAO, Mumungan, Februar und Juli, 1915; Surigao, 2. November, 1915. LEYTE, Burauen, Mai, 1915.

SILIS BAKERI var. BREVEAPICALIS Pic.

Silis bakeri var. *breveapicalis* PIC, Philip. Journ. Sci. 25 (1924) 726.

LUZON, Mount Banahao, April, 1914; Los Baños, April und Dezember, 1914.

SILIS BUKIDNONA Pic.

Silis bukidnona PIC, Philip. Journ. Sci. 25 (1924) 727.

SILIS BUKIDNONA var. BANAHAONA Pic.

Silis bukidnona var. *banahaona* PIC, Philip. Journ. Sci. 25 (1924) 727.

LUZON, Mount Banahao, April, 1914.

SILIS DILATICOLLIS Pic.

Silis dilaticollis PIC, Philip. Journ. Sci. 25 (1924) 727.

LUZON, Mount Banahao, April, 1914; Los Baños, Dezember, 1916.

SILIS ANANCOIDES Pic.

Silis anancoides PIG, L'Echange 40 (1924) 2, *hors-texte.*

SAMAR.

SILIS LONGELATERALIS Pic.

Silis longelateralis PIC, Mél. exotico-ent. 43 (1925) 2.

LUZON.

SILIS OBCONICICOLLIS Pic.

Silis obconicicollis PIC, L'Echange 40 (1924) 2, *hors-texte.*

SAMAR.

SILIS PROLONGATA Pic.

Silis prolongata PIC, L'Echange 40 (1924) 3.

SAMAR.

SILIS SAMARENSIS Pic.

Silis samarensis PIC, L'Echange 40 (1924) 2.

SAMAR.

SILIS LONGESUTURALIS Pic.

Silis longesuturalis PIC, L'Echange 41 (1925) 15.

LUZON.

LÆMOGLYPTUS (DRILOSILIS) ROBUSTICORNIS Pic.

Læmoglyptus (*Drilosilis*) *robusticornis* PIC, Philip. Journ. Sci. 25 (1924) 728.

NORD-MINDANAO, Surigao, 18. Mai, 1915.

Das mir vorliegende Exemplar weicht von der Stammform durch einfarbigen, rötlichen Halsschild und vollständig schwarze Flügeldecken ab; ab. *unicolorata* nov. Die Stammform hat eine schwarze Makel am Vorderrande des Halsschildes und die Naht der Decken ist gelb gefärbt.

LÆMOGLYPTUS (DRILOSILIS) SUTURALIS Pic.

Læmoglyptus (*Drilosilis*) *suturalis* PIC, Philip. Journ. Sci. 25 (1924) 728.

NORD-MINDANAO, Surigao, Mai, August und September, 1915; Mumungan, 9. Juli, 1915. SÜD-MINDANAO, Port Banga, 12. Januar, 1915.

Alle fünf mir vorliegenden Exemplare sind Weibchen. Es ist auffällig das von dieser mit *robusticornis* zusammenlebenden Art, die sich von ihr nur durch die dunkeln Fühler unterscheidet, bisher nur Weibchen aufgefunden worden sind, dagegen von *robusticornis*, dessen Fühler gelb sind, nur Männchen. Es ist zu vermuten dass die beiden Formen ein und derselben Art angehören, und also *suturalis* Pic lediglich die weibliche Form von *robusticornis* Pic darstellt.

LÆMOGLYPTUS (DRILOSILIS) LITURATUS Pic.

Læmoglyptus (*Drilosilis*) *lituratus* PIC, L'Echange 39 (1924) 24.

LÆMOGLYPTUS sp. (prope SUTURALIS Pic).

Zwei Weibchen von Süd-Luzon, Mount Isarog, 10 April, 1916, und Mount Bulusan, Januar und Oktober, 1917, sind in der Körperform *L. suturalis* Pic ähnlich, jedoch Fühler, Beine und Flügeldecken einfarbig schwarz. Mit *rubrithorax* Pic wohl noch näher als mit *suturalis* verwandt. Von der Beschreibung dieser wahrscheinlich neuen Art sehe ich ab. Es empfiehlt sich die Arten dieser Gattung nur dann zu beschreiben, wenn auch die Männchen vorliegen, weil die Artmerkmale beim weiblichen Geschlecht zu wenig stark ausgeprägt sind.

LÆMOGLYPTUS sp. (prope LITURATUS Pic).

Ein Weibchen von der Insel Dinagat, 13. Dezember, 1915, ähnlich wie *lituratus* gefärbt, jedoch ist die dunkle Färbung der Flügeldecken auf das hintere Drittel beschränkt und die Naht bis zu dem ebenfalls dunkeln Schildchen schmal schwarz gesäumt. Vielleicht eine Variation von *lituratus*.

ICHTHYURUS DOHRNI Fairmaire.

Ichthyurus dohrni FAIRMAIRE, Stett. Ent. Zeit. (1867) 114.

LUZON, Nueva Viscaya, Imugan, 4000 Fuss Höhe, Mai, 1916, und Juni, 1917.

ICHCTHYURUS SCRIPTICOLLIS Fairmaire.

Ichthyurus scripticollis FAIRMAIRE, Stett. Ent. Zeit. (1867) 115.

MINDANAO, Port Banga, Januar, 1915; Dezember, 1915; Kolambugan, Januar, 1915; Mumungan, März, 1915. BASILAN, Dezember, 1914.

Bei den Exemplaren der Insel Basilan erreicht die Quermakel auf den Flügeldecken die Naht nicht ganz. Die Färbung würde also mit der von *I. bakeri* Pic übereinstimmen, der Bau des Analtergites zeight jedoch eindeutig die Zusammengehörigkeit mit *scripticollis*, dieselbe breite, eher kurze Gabel, die auf der Unterseite eine wellenlinienförmige, scharfe Kante aufweist, an der Basis zahnartig vorspringt, gegen die Spitze erlischt die Kante allmählich und wird hier durch eine andere Leiste ersetzt, die kurz vor der Spitze, etwas weiter nach innen gerückt, beginnt und in abnehmender Höhe bis zur Spitze reicht; var. *basilana* nov. Die Beine sind etwas heller als bei der Stammform gefärbt.

ICHTHYURUS BAKERI Pic.

Ichthyurus bakeri PIC, Philip. Journ. Sci. 25 (1924) 729.

LUZON, Nueva Viscaya, Imugan, Mai, 1916; Mount Banahao, 2000 Fuss Höhe, April und Mai, 1914. NORD-MINDANAO, Dansalan, Februar, 1915.

ICHTHYURUS SEMPERI Fairmaire.

Ichthyurus semperi FAIRMAIRE, Stett. Ent. Zeit. (1867) 113.

LUZON.

ICHTHYURUS BIMACULATUS Pic.

Ichthyurus bimaculatus PIC, Philip. Journ. Sci. 25 (1924) 729.

ICHTHYURUS PILICORNIS Pic.

Ichthyurus pilicornis PIC, Philip. Journ. Sci. 25 (1924) 730.

ICHTHYURUS BILINEATUS Pic.

Ichthyurus bilineatus PIC, Philip. Journ. Sci. 25 (1924) 730.

MICROICHTHYURUS BAGUIONUS Pic.

Microichthyurus baguionus PIC, Philip. Journ. Sci. 25 (1924) 730.

LUZON, Bontoc, Mount Polis, 2400 Fuss Höhe, Februar, 1917; Kalinga, Balbalasang, 4000 bis 5000 Fuss Höhe, März, 1918; Balbalan, 4000 Fuss Höhe, Januar, 1917; Lubuagan, 3500 Fuss Höhe, Februar, 1917.

Pic beschrieb diese Art als Variation zu *bicoloripennis* Pic. Grosse Serien die mir, besonders von *baguionus*, vorliegen, zeigen, dass es sich um zwei voneinander verschiedene Arten handelt, die im männlichen Geschlecht wie folgt auseinandergehalten werden können:

M. baguionus Pic. Männchen.	*M. bicoloripennis Pic. Männchen.*
Halsschild braun, oder gelb mit oder ohne dunklerem, verschwommenem Mittelfleck.	Halsschild stets dunkelbraun.
Flügeldecken gelb oder schmutzighellbraun, die Naht meist etwas dunkler, Spitzenflecken von gleicher Färbung wie der Rest der Decken oder nur wenig heller.	Flügeldecken braun bis dunkelbraun, Spitzenflecken hellgelb.
Analtergit äusserst schmal und lang, Spitze wenig tief eingeschnitten, kaum ein Fünftel der Länge ausmachend.	Analtergit kürzer und im Verhältinis zur Länge breiter, Einschnitt tiefer, bis zu ein Drittel der Länge reichend.
Fühler ziemlich dicht mit kurzen Haaren bedeckt.	Fühler neben den kurzen Haaren an den Basalgliedern mit einzelnen feinen, abstehenden, etwas längeren Haaren besetzt.

MICROICHTHYURUS BICOLORIPENNIS Pic.

Microichthyurus bicoloripennis PIC, Philip. Journn. Sci. 25 (1924) 730.

LUZON, Kalinga, Balbalan, Januar und Februar, 1917; Lubuagan, Januar, 1917; Amburayan, Naiba, Januar, 1917; Nueva Viscaya, Imugan, Mai und Juni, 1916. NORD-MINDANAO, Surigao, Mai, 1915.

MICROICHTHYURUS sp.

Eine vollständig schwarze Art, bei der nur die beiden ersten Fühlerglieder und die Seiten des Abdomens hell gefärbt sind, liegt in acht Exemplaren, alle Weibchen, von der Insel Basilan, Dezember, 1914, vor.

MICROICHTHYURUS CYANICOLLIS sp. nov.

Braunschwarz, die zwei bis drei ersten Fühlerglieder und die Seiten der ersten Bauchsegmente gelbeichweiss. Halsschild und manchmal auch der Kopf mehr oder weniger violett metallschimmernd.

Kopf mit den Augen etwas breiter als der Halsschild, glatt, Fühler ziemlich langgestreckt, 1. Glied das längste, doppelt so lang wie das 2.; 2. Glied um ungefähr ein Drittel kürzer als das 3.; 3. Glied eine Spur länger als das 4.; 5. Glied so lang wie das 2.; 6. Glied ungefähr ein Fünftel kürzer als das 5.; 7. bis 11. Glied unter sich ungefähr gleich lang, noch etwas kürzer als das 6.; alle Glieder fein und ziemlich dicht behaart, ausserdem mit einzelnen etwas längeren, abstehenden Haaren besetzt, 1. Glied mit ein oder zwei feinen, sehr langen, borstenförmigen Haaren versehen. Halsschild fast breiter als lang, zur Basis, beginnend bei den Vorderecken, schwach und in gerader Linie verengt. Basalrand und Seitenrand fast bis zu den Vorderecken sichtbar, Scheibe glatt mit angedeuteter Punktierung (Haarpunkte) und zwei bis vier mehr oder weniger deutlichen höckerartigen Erhabenheiten. Flügeldecken stark verkürzt, jede kaum länger als zusammen breit, Spitzen napfartig eingedrückt, Scheibe mit angedeuteten Längseindrücken, deren Grund erloschene Punktierung zeigt. Letztes Abdominaltergit des Männchens ungefähr ein Viertel länger als breit, Spitze nur schwach ausgerandet (nicht tief ausgeschnitten oder gespalten), auf der Unterseite sind etwas nach der Mitte, auf der Spitzenhälfte zwei kurze Bügel sichtbar, deren Spitzen gegeneinander gerichtet sind.

Länge, 3.8 bis 5 Millimeter.

Fundort.—MINDANAO, Dansalan, 13. Februar, 1915. PANAON, 2. Dezember, 1915, ein Weibchen.

Eine *M. robustus* Pic nahestehende Art, die sich in der Hauptsache durch einfarbig schwarze Beine und den blauen, beziehungsweise violett schimmernden Halsschild, manchmal auch Kopf, unterscheidet.

MICROICHTHYURUS PILICORNIS sp. nov.

Männchen.—Dunkelbraun bis schwarz, 1. bis 4. Fühlerglied, Spitzen der Flügeldecken, Abdominalsegmente teilweise und Beine (die Schienen sind oft etwas angedunkelt) gelb. Ein Exemplar besitzt gelbraune Flügeldecken, ebenfalls der Halsschild ist etwas aufgehellt mit gelblichem Basal- und Vorderrand.

Kopf mit den Augen breiter als der Halsschild, so breit wie die Flügeldecken, fein und zerstreut punktiert, Stirne leicht gewölbt, Mittellinie nur angedeutet, Behaarung fein, kurz und greis, auf der vorderen Hälfte länger, aber weniger dicht als an der Basis. Fühler ungefähr von halber Körperlänge, 2. und 3. Glied verkürzt, unter sich gleich lang; 4. Glied fast ein Drittel länger als das 3.; 5. Glied nur wenig kürzer als das 4., deutlich länger als das 3.; 6. bis 10. Glied jedes eine Spur kürzer als das vorangehende Glied, 10. Glied so lang wie das 3.; 11. Glied schwach flachgedrückt, an der breitesten Stelle etwas breiter als das vorangehende. Alle Glieder ziemlich dicht, fein und kurz behaart, vom 3. bis 5. oder 6. Glied auf der Innenseite ausserdem noch mit längeren Haaren besetzt, deren Spitzen gegen die Fühlerbasis zu gekrümmt sind. Basalglied mit zwei und 2. Glied mit vier borstenförmigen, büschelförmig angeordneten Haaren besetzt, von denen die ersteren etwas kürzer, die letzteren länger, so lang wie das 2. Fühlerglied, sind. Halsschild fast länger als breit, Seiten gegen die Basis regelmässig und schwach verengt, Basis und ein Teil der Seiten, bis zu Mitte, deutlich gerandet, Punktierung äusserst fein. Flügeldecken verkürzt, ungefähr ein Drittel so lang wie die hautigen Flügel, klaffend, runzlig gewirkt, matt, nur die hellen, eingedrückten Spitzen sind amz Grunde fast glatt. Letztes Abdominaltergit langgestreckt, zweimal so lang wie breit, bis zu ein Drittel der Länge dreieckig eingeschnitten, auf der Unterseite, die bis zur Basis eingeschnitten ist, sind zwei lange, schmale Valven sichtbar.

Länge, 3.5 bis 4 Millimeter.

Fundort.—LUZON, Amburayan, Butac, 1000 Meter Höhe, 11. Januar, 1917.

Verwandt mit *M. bicoloripennis* Pic, von der sich die Art hauptsächlich durch die Bildung der Fühler unterscheidet, deren 2. und 3. Glied bei *pilicornis* sp. nov. von gleicher Länge ist, und die Art der Behaarung (1. Glied mit zwei borstenähnlichen Haaren in der Nähe der Spitze, 2. Glied mit vier längeren, büschelförmig angeordneten, borstigen Haaren, 3. bis 5. Glied auf der Innenseite mit einer Anzahl abstehenden, ziemlich feinen und langen Haaren besetzt, deren Spitzen gegen den Kopf zu gekrümmt sind), das 2. Fühlerglied von *bicoloripennis* Pic ist kürzer, nur halb so lang wie das 3., auch fehlen die Borsten auf dem 1. und 2. Gliede und die feinen längeren Haare auf der Innenseite des 3. bis 5. Gliedes.

MICROICHTHYURUS BRUNNEUS sp. nov.

Männchen.—Schwarzbraun, Beine und die zwei bis drei ersten Fühlerglieder gelblich, manchmal sind auch Kopf und Flügeldecken etwas aufgehellt (braun bis gelbbraun).

Kopf mit den Augen kaum breiter als der Halsschild, etwas schmäler als die Flügeldecken, Längsfurche kaum angedeutet, Punktierung ziemlich dicht und grob. Fühler nicht ganz halb so lang wie der Körper, 2. Glied fast um ein Drittel kürzer als das 3.; 3. und 4. Glied von gleicher Länge; 5. bis 10. Glied in der Länge leicht abnehmend; 11. Glied etwas länger als das 10., schwach flachgedrückt. Behaarung doppelt, kurz greis und am Innenrande lang abstehend, die langen, abstehenden Haare sind etwas mehr als doppelt so lang wie das Glied breit, die Spitzen leicht gebogen. Halsschild gut anderthalb mal so breit wie lang, Seiten gegen die Basis fast unmerklich verengt, Punktierung ziemlich dicht und verhältnismässig grob. Flügeldecken stark verkürzt, beinahe glatt, mit vereinzelten, flachen Punkten oder undeutlichen Runzeln versehen, Spitzenrand leicht erhaben. Letztes Abdominaltergit nicht ganz doppelt so lang wie das vorletzte, ziemlich schmal, Spitze schwach ausgerandet.

Länge, 3.5 bis 4.5 Millimeter.

Fundort.—LUZON, Mount Banahao, 2000 Fuss Höhe, 15 bis 18. April, 1914.

Von *M. atripennis* Pic, der laut Beschreibung ebenfalls einfarbige Flügeldecken besitzt, unterscheidet sich *M. brunneus* sp. nov. durch kleinere Gestalt und die einfarbig dunkle Färbung von Kopf (höchstens die vordere Hälfte zeigt manchmal geringere Aufhellung) und Halsschild, Teile die bei *atripennis* Pic gelb gezeichnet sind.

MICROICHTHYURUS MACULICOLLIS sp. nov.

Weibchen.—Schwarzbraun, Kopf gelb bis auf je eine dunkle Makel hinter den Augen in variabler Grösse, Halsschild mit einer gelben Makel auf der vorderen Hälfte, die sich bis zum Vorderrande erstreckt. Spitzenrand der Flügeldecken, Koxen und Trochanteren aufgehellt.

Kopf mit den Augen etwas breiter als der Halsschild, kaum wahrnehmbar punktiert, Mittellinie verschwommen. Fühler ungefähr von halber Körperlänge, 3. Glied nur wenig länger als das 2.; 3. bis 11. Glied in der Länge wenig verschieden, die letzten etwas kürzer als die ersten. Behaarung kurz, greis. Halsschild breiter als lang, Seiten parallel, Basal- und Seitenrand sind bei der Art besonders deutlich, Scheibe fast glatt, Punktierung kaum wahrnehmbar. Flügeldecken die Koxen der Hinterbeine nicht erreichend, runzlig skulptiert, dazwischen wenig deutlich punktiert. Letztes Abdominaltergit breit und flach ausgerandet.

Länge, 5.5 Millimeter.

Fundort.—SAMAR, Catbalogan, April, 1915.

Durch die Färbung von Kopf und Halsschild und die einfarbig schwarzen Fühler gut gekennzeichnet. Verwandt mit *M. atripennis* Pic.

MICROICHTHYURUS MEDIOINCRASSATUS sp. nov.

Männchen.—Gelb, nur die Augen und die Fühler von 3. oder 5. Gliede an dunkel.

Kopf mit den Augen etwas breiter als der Halsschild, Stirne glatt, leicht gewölbt, in der Mitte über den Fühlerwurzeln mit einem seichten Längseindrucke versehen. Fühler verhältnismässig kurz, die Spitzen der vorkürzten Flügeldecken kaum überragend, ziemlich lang, teils abstehend, behaart. 3. Glied eine Spur länger als das 2.; 4. Glied fast so lang wie das 2. und 3. zusammengenommen; 5. bis 11. Glied flachgedrückt; 5. und 6. Glied unter sich gleich lang, jedes etwas kürzer als das 4.; 6. Glied wenig breiter als das 5.; 7. bis 9. Glied von gleicher Breite, etwas breiter als das 6., 7. Glied ungefähr so lang wie das 4., 8. Glied wieder etwas kürzer, so lang wie das 6.; 9. Glied etwas länger als das 8., nicht ganz so lang wie das 7., 10. Glied stark verkürzt, fast so lang wie breit, etwas schmäler als das 9.; 11. Glied schmäler als das 10. und so lang wie das 9. Halsschild breiter als lang, Seiten zur Basis schwach verengt. Flügeldecken stark verkürzt, ungefähr um ein Drittel länger als der Halsschild, runzlig, erloschen gewirkt. Letztes Abdominalsegment um die Hälfte länger als breit, Spitze fast gerade abgestutzt, nur schwach ausgerandet.

Länge, 4.5 Millimeter.

Fundort.—Samar, Catbalogan, 14. April, 1915.

Die hellgelbe Färbung sowie die eigentümlich gebildeten Fühler unterscheiden die Art von allen übrigen Arten der Gattung.

MICROICHTHYURUS APICEINCRASSATUS sp. nov.

Männchen.—Färbung und Form des Körpers wie bei der vorangehend beschriebenen Art, von der sie sich nur unterscheidet durch die Bildung der Fühler, die etwas länger (sie überragen die Spitzen der Decken) und verschieden geformt sind. 3. Glied doppelt so lang wie das 2.; 4. bis 7. Glied jedes nur wenig länger als das 3., unter sich ungefähr von gleicher Länge; 8. Glied etwas kürzer und auch dicker als das 7.; 9. bis 11. Glied flachgedrückt, fast doppelt so breit wie das 7.; 9. Glied ungefähr so lang wie das 7.; 10. Glied wieder kürzer, ungefähr so lang wie das 8.; 11. Glied so lang wie das 8.

Die Fühler sind beim Weibchen kürzer, nicht verdickt, das 4. Glied ist am längsten, bis zum 10. nehmen die Glieder in der Länge langsam ab. Letztes Abdominaltergit dreieckig, weniger tief eingeschnitten.

MICROICHTHYURUS ATRIPENNIS Pic.

Microichthyurus atripennis PIC, Philip. Journ. Sci. 25 (1924) 730.

TRYPHERUS BAKERI Pic.

Trypherus bakeri PIC, Philip. Journ. Sci. 25 (1924) 731.

FALSOMALTHINUS PALLIDUS Pic.

Falsomalthinus pallidus PIC, Philip. Journ. Sci. 25 (1924) 731.

FALSOMALTHODES BISBINOTATUS Pic.

Falsomalthodes bisbinotatus PIC, L'Echange 42 (1926) 4.

Der Autor beschreibt die Art wie folgt: "Oblongus, niger antennis ad basin, capite, thorace, pedibus pro parte ad abdomine circa rufis, elytris nigris, ad humeros et apice luteo maculatis."

Fundort.—LUZON; Grösse wird keine angegeben. Zwei mir vorliegende Exemplare mit Fundort NORD-LUZON, Benguet, Haight's Place, 8000 Fuss Höhe, März, 1917, stimmen in der Färbung nicht mit der etwas knapp gehaltenen Originalbeschreibung überein, indem die Fühler (Basalglieder manchmal etwas heller als die Spitzenglieder) und Beine einfarbig gelb sind; var. *filicornis* var. nov. Es ist möglich dass es sich bei dieser Form um eine eigene Art handelt, weshalb ich nachstehend die hauptsächlichsten Merkmale wiedergebe:

Männchen.—Dunkelbraun, Fühler gelbbraun, Basis manchmal etwas heller gelb, Kopf (bis auf die schwarzen Augen), Halsschild mehr oder weniger, Schulterbeulen, Spitzen der Decken und Beine gelb (Schenkel, besonders die hinteren, manchmal angedunkelt).

Kopf mit den halbkugelförmig hervortretenden Augen breiter als der Halsschild. Fühler langgestreckt, die Spitzen der Decken fast erreichend, 2. Glied etwas länger als das 3., so lang wie das 4.; 5. bis 10. Glied unter sich ungefähr gleich lang, 11. Glied eine Spur länger als das 10., Spitze leicht verdickt. Behaarung fein. Halsschild breiter als lang, fast glatt, nach vorne deutlich verengt, Vorderecken spitz, stark erhaben, Vorder- und Basalrand ungerandet. Flügeldecken drittehalb mal so lang wie breit, die Koxen der Hinterbeine etwas überragend, an der Basis fast glatt, gegen die verdickten und glatten Spitzen in zunehmender Dichte und Tiefe punktiert.

Weibchen.—In der Färbung meist etwas heller, Augen kleiner, Fühler kürzer, vom 4. Glied an in zunehmendem Masse verkürzt. 10. Glied etwas kürzer als das 2.

Länge, 2.8 bis 3 Millimeter.

FALSOMALTHODES FLAVUS sp. nov.

Männchen.—Hellgelbbraun, die Unterseite braun, Kopf und Halsschild rotbraun, die Augen schwarz.

Kopf breiter als lang, mit den Augen so breit wie die Flügeldecken, glänzend, glatt, staubartig behaart, Durchmesser der Augen kleiner als ihr Abstand. Fühler gut so lang wie der halbe Körper, 1. Glied langgestreckt, so lang wie das 2. und 3. zusammengenommen: 2. Glied eine Spur länger als das 3.; 3. bis 10. Glied unter sich gleich lang, jedes knapp doppelt so lang wie breit; 11. Glied um ein Viertel länger als das 10. Halsschild breiter als lang, nach vorne kaum verengt, Vorderecken verdickt, leicht aufstehend, Scheibe glatt, Behaarung fein, greis. Flügeldecken ungefähr doppelt so lang wie an den Schultern breit, in der basalen Hälfte fast glatt, gegen den erhabenen Spitzenwulst mit einzelnen Punkten besetzt, der Spitzenwulst verhältnismässig breit.

Länge, 2 bis 2.5 Millimeter.

Fundort.—NORD-LUZON, Apayao, February, 1918.

Dank der hellen Färbung mit keiner der bisher beschriebenen Arten zu verwechseln, verwandtschaftlich gehört sie in die Nähe von *F. reductocarinatus* Wittmer.

INCERTAE SEDIS

CANTHARIS FLAVIFEMORALIS Blanchard.

Cantharis flavifemoralis BLANCHARD, Voy. Pol. Sud 4 (1853) 67, pl. 5, fig. 3.

MALACHIIDÆ

CARPHURUS RUBROANNULATUS Motschulsky.

Carphurus rubroannulatus MOTSCHULSKY, Et. ent. 8 (1859) 64.

BASILAN, Dezember, 1914. SAMAR, April, 1915. MINDANAO, Port Banga, Januar, 1915.

CARPHURUS DILUTUS Champion.

Carphurus dilutus CHAMPION, Ann. & Mag. Nat. Hist. (9) 12 (1923) 24.

MINDANAO, Dansalan, Februar, 1915; Iligan, Februar, 1915; Kolambugan, Januar, 1915; Mumungan, Februar, 1915; Port Banga, Januar, 1915. SAMAR, Catbalogan, April, 1915. MINDORO, Calapan, Februar, 1916. LEYTE, Santa Cruz, Oktober, 1915; Burauen, Mai, 1915. LUZON, Los Baños, Mai und April, 1914. BASILAN, Dezember, 1914.

CARPHURUS LUZONICUS Champion.

Carphurus luzonicus CHAMPION, Ann. & Mag. Nat. Hist. (9) 12 (1923) 42.

NORD-MINDANAO, Mumungan, Februar, 1915; Surigao, November, 1915; Port Banga, Januar, 1915. LUZON, Mount Banahao, April und Juni, 1914; Los Baños, April, 1914; Imugan, April, 1917.

CARPHURUS FILICORNIS Champion.

Carphurus filicornis CHAMPION, Ann. & Mag. Nat. Hist. (9) 12 (1923) 38.

MINDANAO, Surigao, Mai und August, 1915–1916; Port Banga, Januar, 1915.

CARPHURUS PHILIPPINUS Champion.

Carphurus philippinus CHAMPION, Ann. & Mag. Nat. Hist. (9) 12 (1923) 26.

LUZON, Los Baños, März und April, 1914; Imugan, August, 1917, Montalban, März, 1914; Mount Banahao, April und Juni, Trinidad, Mai, 1914; Butac, Februar, 1917; Naiba, Januar, 1917. BASILAN, Dezember, 1914. SAN MIGUEL, März, 1916. MINDANAO, Mumungan, Februar, 1915; Surigao, Mai, 1915, Port Banga, Januar, 1915, Dansalan, Februar, 1915, Kolambugan, Januar, 1915.

CARPHURUS DAPITANUS Champion.

Carphurus dapitanus CHAMPION, Ann. & Mag. Nat. Hist (9) 12 (1923) 31.

LUZON, Apayao, Februar, 1918; Benguet, Haight's Place, 8000 Fuss Höhe, März, 1917; Imugan, 26. Mai, 1916. MINDORO, Calapan, Februar, 1916.

CARPHURUS NIGRIVENTRIS sp. nov.

Männchen.—Schwarz, ausgenommen der Kopf, die Fühler bis zum 3. oder 5. Gliede und Halsschild rotorange, Flügeldecken mit schwachem bläulichem Schimmer.

Kopf mit den Augen breiter als der Halsschild, Stirne fast glatt, zerstreut punktiert, in der Nähe des Halsschildvorderrandes mit einzelnen Querrunzeln, zwischen den Augen ob der Fühlerbasis undeutlich eingedrückt. Fühler lang, die Mitte der Flügeldecken etwas überragend, vom 3. Glied an scharf gezahnt, die mittleren Glieder unter sich ungefähr von gleicher Länge. Halsschild länger als breit, die Seiten leicht zusammengedrückt sodass die Seitenränder bei der Ansicht von oben nicht sichtbar sind, vor der Basis nur schwach quereingedrückt, in der Basalhälfte verengt, glatt, ziemlich lang abstehend, dunkel behaart. Flügeldecken ungefähr drittehalb mal so lang wie an den Schultern breit, zur Spitze wenig verbreitert, verworren, wenig tief, fast runzlig punktiert, die vier letzten Abdominalsegmente unbedeckt, letztere mit lang abstehenden Haaren besetzt. 1. Tarsenglied der Vordertarsen mit dem üblichen kammartigen Anhängsel auf der Unterseite.

Länge, 3.7 bis 7 Millimeter.

Fundort.—MINDANAO, Port Banga, Januar, 1915. BASILAN, Dezember, 1914.

Die Fühler sind ähnlich gebildet wei bei *C. dapitanus* Champ. Die neue Art unterscheidet sich von ihr durch die Färbung von Kopf und Halsschild, Teile die bei *nigriventris* sp. nov. orangerot, bei *dapitanus* Champ. hingegen schwarz gefärbt sind.

CARPHURUS BRUNNESCENS sp. nov.

Einfarbig gelbraun, nur die Augen schwarz. Fühler manchmal von 8. Gliede an etwas angedunkelt.

Kopf mit den Augen breiter als der Halsschild, so breit wie die Flügeldecken an den Schultern. Stirne glatt, leicht gewölbt, zwischen den Augen mit zwei nebeneinanderliegenden Eindrücken. Fühler von halber Körperlänge, alle Glieder etwas länger als breit, 2. Glied so lang wie das 3., folgende Glieder etwas länger. Halsschild ungefähr so lang wie breit, zur Basis leicht verengt, Basis nur schwach quereingedrückt, fast glatt mit einzelnen Querrunzeln in der Basalhälfte. Flügeldecken gut zwei mal so lang wie breit, zur Spitze leicht verbreitert, fein, wenig dicht punktiert, matt. Behaarung des ganzen Köpers gelblich.

Länge, 2.3 bis 2.5 Millimeter.

Fundort.—NORD-MINDANAO, Mumungan, Februar, 1915. LUZON, Los Baños, April, 1914.

Von den übrigen hellen Arten durch die geringere Körpergrösse verschieden.

CARPHURUS BASIOBSCURUS sp. nov.

Kopf und Halsschild rötlichgelbbraun, Augen schwarz, Fühler gelbbraun, vom 5. Gliede an dunkel, Flügeldecken weisslich-gelb, bis auf das basale Drittel, das dunkelbraun gefärbt ist, Abdomen dunkelbraun, die vier Vorderbeine gelblich, Hinterbeine dunkel, nur die Knie aufgehellt.

Kopf glatt, glänzend, ziemlich flach, zwischen den Augen nur ganz schwach eingedrückt. Fühler von halber Köperlänge, 2. und 3. Glied unter sich gleich lang, nur wenig länger als breit, 2. Glied etwas dicker als das 3.; 4. Glied eine Spur länger als das 3., so lang wie das 5. und die folgenden bis zum 10. Glied. Halsschild fast breiter als lang, zur Basis gerundet verengt, fast vollständig glatt. Flügeldecken fast drittehalb mal so lang wie an den Schultern breit, fast glatt, nur mit vereinzelten Haarpunkten. Behaarung des ganzen Körpers wenig dicht, greis, nur die Fühler des Männchens sind dicht und kurz behaart.

Länge, 2.5 Millimeter.

Fundort.—SÜD-MINDANAO, Port Banga, Januar, 1915.

C. flavoapicalis Pic ist ganz ähnlich gefärbt, doch unterscheidet sich die neue Art durch kleinere Gestalt und das Fehlen der Querrunzeln an der Stirne und Halsschildbasis.

CARPHURUS BASILANUS Champion.

Carphurus basilanus CHAMPION, Ann. & Mag. Nat. Hist. (9) 12 (1923) 21.

CARPHURUS SUMATRENSIS Pic.

Carphurus sumatrensis PIC, L'Echange 22 (1906) 57.

Wird von Champion als auch auf den Philippinen vorkommend gemeldet.

CARPHUROIDES CORPORAALIANUS sp. nov.

Männchen.—Gelborange, die Augen, die Fühler vom 3. Gliede an, die Tibien und Tarsen dunkel, der Halsschild geht in der Färbung stärker ins rötliche über. Ein Exemplar hat braunen Kopf, dunkles Schildchen und dunkle Spitzen der Flügeldecken.

Kopf mit den Augen ungefähr so breit wie der Halsschild, ziemlich dicht und tief punktiert, an der Basis stärker punktiert als zwischen den Augen, hier mit einem V-förmigen Eindrucke versehen, über jedem Auge eine lange Borste. Fühler die Schulterbeulen nur um weniges überragend, vom 4. Gliede an stark gezahnt, 8. Glied etwa um die Hälfte breiter als lang, 4. Glied kaum breiter als lang; 3. Glied knötchenförmig, in Form und Grösse vom 2. wenig abweichend. Halsschild etwas breiter als lang, glatt, nur mit vereinzelten kaum sichtbaren Haarpunkten, Basalrand deutlich abgesetzt, Seitenrand an der Basis deutlich, gegen die Vorderecken erlöschend, jederseits vor den Basalecken eine lange, aufgerichtete Borste, Flügeldecken ungefähr zwei mal so lang wie breit, fast glatt, vier bis fünf Abdominaltergite unbedeckt.

Länge, 3.5 bis 3.8 Millimeter.

Fundort.—NORD-MINDANAO, Mumungan, Februar und März, 1915.

Die hellen Flügeldecken, deren Spitzen dunkel sind, kennzeichnen die Art und lassen sie leicht von den übrigen unterscheiden.

Die nachfolgend beschriebenen drei Arten, die ich vorläufig in die Gattung *Carphuroides* Champ. stelle, bilden ein Gruppe die vielleicht später von ihr abgetrennt werden muss. Der Halsschild ist ähnlich geformt wie bei *Carphuroides*, es fehlt ihm also der Quereindruck an der Basis, der für die Gattung *Carphurus* Er. charakteristisch ist; an Stelle der einzelnen Borste in der Nähe der Basalecken sind die Seiten mit einer grösseren Anzahl, drei bis acht, dicken Borsten besetzt. Auch der Kopf weist an Stelle der Superorbitalborste eine grössere Anzahl Borsten auf, die über die ganze Kopfoberfläche verteilt sind. Die Flügeldecken sind mit mehr oder weniger dicken, schräg abstehenden oder gerade aufgerichteten, borstenähnlichen Haaren, neben der dichteren und kürzeren Grundbehaarung, versehen. Die Spitze der Tibien weist dicke und lange Enddornen auf.

CARPHUROIDES? PALLIDIPES sp. nov.

Schwarz, Fühler und Beine bis auf die etwas angedunkelte Basis der Schenkel, gelb. Manchmal sind die letzten Fühlerglieder mehr oder weniger angedunkelt.

Kopf mit den Augen schmäler als der Halsschild, fast glatt, vereinzelt punktiert, vor jeder Fühlerwurzel mit einem Längseindruck gegen den Clypeus. Fühler von nicht halber Körperlänge, 2. bis 4. Glied ungefähr gleich lang, jedes so lang wie breit; 5. Glied eine Spur länger als das 4.; 6. Glied deutlich länger als das 5., so lang wie die folgenden bis zum 10. Glied. Halsschild fast glatt, mit vereinzelten Haarpunkten, alle Ecken verrundet, Basalecken stärker verrundet als die vorderen. Flügeldecken verhältnismässig lang, nur die zwei oder drei letzten Abdominalsegmente unbedeckt lassend, die ganze Oberfläche lederartig gerunzelt.

Länge, 2.2 bis 2.5 Millimeter.

Fundort.—SAMAR, Catbalogan, 15. April, 1915.

CARPHUROIDES? CORIACEIPENNIS sp. nov.

Schwarz, Halsschild und Flügeldecken mit schwachem grünlichem Metallschimmer, Fühler gelb, vom 4. oder 5. Glied an dunkel, Beine dunkel, höchstens die Vordertibien etwas aufgehellt.

In der Körperform der vorangehenden Art sehr ähnlich, grösser, Flügeldecken drei oder vier Abdominalsegmente unbedeckt lassend.

Länge, 3.5 bis 3.8 Millimeter.

Fundort.—SÜD-MINDANAO, Port Banga, Dezember, 1914.

CARPHUROIDES? VICINUS sp. nov.

Einfarbig schwarz, nur die drei oder vier ersten Fühlerglieder und die Vordertibien gelb.

Kopf mit den Augen nicht ganz so breit wie der Halsschild, zwischen den Augen mit drei undeutlichen Eindrücken, Stirne zerstreut punktiert. Fühler nicht ganz so lang wie der halbe Körper. Halsschild mit einzelnen Haarpunkten, dazwischen glatt. Flügeldecken zerstreut, wenig tief punktiert. Drei oder vier letzte Abdominalsegmente unbedeckt.

Länge, 2.5 Millimeter.

Fundort.—NORD-MINDANAO; Mumungan, Februar, 1915.

Die drei in die Gruppe *Carphuroides?* fallenden Arten lassen sich wie folgt unterscheiden:

1. Alle Tibien und Tarsen gelb.. *C.? pallidipes* sp. nov.
   Wenigstens die Tibien und Tarsen der Mittel- und Hinterbeine dunkel.. 2.
2. Flügeldecken lederartig gerunzelt, beziehungsweise gewirkt, grössere Art mit leicht grünlich schimmerndem Halsschild und Flügeldecken. *C.? coriaceipennis* sp. nov.
   Flügeldecken punktiert, kleinere Art, Halsschild und Flügeldecken schwarz ohne Metallglanz.. *C. ? vicinus* sp. nov.

MYRMECOPHASMA (LUZONOTROGLOPS) CARINATA Pic.

Myrmecophasma (*Luzonotroglops*) *carinata* PIC, Bull. Soc. Ent. France (1924) 230.

NORD-LUZON, Benguet, Haight's Place, 8000 Fuss Höhe, März, 1917; Kalinga, Balbalasang, 4000 bis 5000 Fuss Höhe, März, 1918.

Ein Exemplar von der Insel Mindanao, Surigao, 25. Mai, 1915, unterscheidet sich von den Stücken von Luzon durch eine weissliche Quermakel auf den Flügeldecken, die sich von Naht zu Naht erstreckt, und hellere Fühler; ab. *discovittata* nov.

LAIUS SUBMARINUS Champion.

Laius submarinus CHAMPION, Ann. & Mag. Nat. Hist. (9) **8** (1921) 195, 196, figs. 9, 9*a*.

MINDANAO, Port Banga, Dezember, 1914; Surigao, November, 1915.

LAIUS BAERI Fairmaire.

Laius baeri FAIRMAIRE, Ann. Soc. Ent. France **67** (1898) 389.

LUZON, Mount Alban, März und April, 1915; Laguna, Pagsanjan, März, 1914.

LAIUS RECTEFASCIATUS Champion.

Laius rectefasciatus CHAMPION, Ann. & Mag. Nat. Hist. (9) **8** (1921) 197.

NORD-MINDANAO, Dansalan, 5. Februar, 1915, 1 Weibchen.

LAIUS SUBDENTATUS Champion.

Laius subdentatus CHAMPION, Ann. & Mag. Nat. Hist. (9) **8** (1921) 201.

SÜD-MINDANAO, Port Banga, 1. bis 12. Januar, 1915.

LAIUS QUADRISTRIGATUS Champion.

Laius quadristrigatus CHAMPION, Ann. & Mag. Nat. (9) **8** (1921) 203.

LUZON, Bontoc, Mount Polis, 2400 Fuss Höhe, Februar, 1917, 1 Weibchen.

LAIUS CONFLUENS sp. nov. Textfig. 1.

Männchen.—Kopf, Vorderbeine und die beiden ersten Fühlerglieder gelborange, Halsschild orangerot, Fühler vom 3. Gliede an braun, Flügeldecken teilweise, Hinterleib und die vier Hinterbeine schwarzbraun bis schwarz, jede Decke mit zwei weissen queren Makeln versehen, die wohl die Seitenränder, nicht aber die Naht erreichen, die obere Makel besteht aus einem queren, regelmässig breiten Bande, die untere aus zwei Flecken, die miteinander durch einen schmalen Kanal verbunden sind.

Kopf mit den Augen so breit wie der Halsschild, Augen ziemlich stark hervortretend, Scheibe fein chagrinartig skulptiert, mit angedeuteter Mittellinie, die am Scheitel und zwischen den Augen am deutlichsten ist und gegen den Clypeus langsam erlischt. Kopf ziemlich flach, nur gegen den Clypeus sind die

Seitenränder der Wangen, ob der Fühlerwurzeln und dem Vorderrand der Augen, leicht kantenartig erhaben. Der ganze Kopf mit den Wangen ist greis, ziemlich dicht behaart. Fühler die Schulterbeulen etwas überragend, 1. Glied in der Form einer länglichen Keule, zur Spitze stark verdickt; 2. Glied verhältnismässig flach, ungefähr doppelt so lang wie breit, auf der Oberseite tief ausgehöhlt, Vorder- und Hinterrand (auf der Aussenseite des Fühlers) des fast muschelartig geformten Gliedes leicht ausgezogen, besonders deutlich der Vorderrand, der in stumpfer Spitze ausgezogen und nur wenig über den Rand der Aushöhlung geschlagen ist; 3. bis 10. Glied schnurförmig, jedes länger als breit. Halsschild nur wenig breiter als lang, zur Basis stärker als nach vorne verengt, fein chagrinartig gewirkt, matt, Behaarung kurz, greis. Flügeldecken ungefähr drittehalb mal so lang wie an den Schultern breit, nach hinten nur wenig verbreitert, Oberfläche matt, Punktierung dicht, fein, fast körnig. Vorderschenkel kurz vor der Spitze schwach ausgehöhlt.

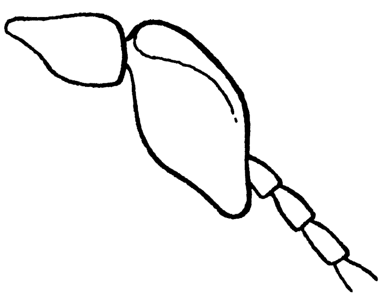

FIG. 1. *Laius confluens* sp. nov.; Fühler des Männchens.

Länge, 2.5 bis 2.7 Millimeter.

Fundort.—MINDORO, Calapan, 10. Februar, 1916.

Durch die rote Färbung von Kopf und Halsschild ist die Art mit *L. quadristrigatus* Champ. verwandt; sie unterscheidet sich durch has Fehlen des Seitenzahnes am Halsschilde beim Männchen, die Färbung der Flügeldecken, deren Spitzen mit zwei weissen ineinanderfliessenden Makeln versehen sind und die Bildung der ersten beiden Fühlerglieder, deren 1. Glied nicht in eine Spitze ausläuft und die Erweiterung des 2. Gliedes an der Basis auf der Innenseite nicht in zwei Spitzen ausgezogen ist.

LAIUS BOETTCHERI sp. nov. Textfig. 2.

Schwarz bis schwarzbraun, die Unterseite des Kopfes, die Wangen, die beiden ersten Fühlerglieder teilweise und die Vorderschenkel mehr oder weniger rötlichgelb gefärbt, Flügeldecken mit je drei gelblichweissen Makeln, die erste, grössere, quere Makel in der vorderen Hälfte berührt weder die Naht noch den Seitenrand, und zwei kleinere, fast kreisrunde Makeln, dicht nebeneinander, kurz vor der Spitze, deren äussere den Seitenrand berührt und deren innere von der Naht durch einen schmalen Saum getrennt ist.

Männchen.—Kopf eher länglich, mit den stark hervortretenden, halbkugelförmigen Augen so breit wie der Halsschild, Augen gegen die Stirne durch eine feine, leicht erhabene Leiste abgesetzt, bis zum Clypeus fein körnig punktiert, von der Stirne bis zur Hälfte der Kopflänge mit einer feinen Längskerbe, Wangen jederseits ziemlich tief eingedrückt, Grund glatt. Fühler die Schulterbeulen erreichend, 1. Glied fast länger wie an der Spitze breit; 2. Glied stark verdickt, auf der Oberseite ausgehöhlt, auf der Innenseite ist der Seitenrand in einen gegen den Kopf gerichteten Zahn oder Dorn ausgezogen, der Aussenrand der Erhebung its kurz vor der Spitze leicht ausgerandet; 3. Glied fast um die Hälfte kürzer als das 4; 5. Glied eine Spur länger als das 4., so lang wie die folgenden Glieder bis zum 9.; 10. Glied etwas länger als das 9. Halsschild ungefähr so lang wie breit, gegen die Basis, von der Mitte an leicht verengt, körnig, fein und dicht punktiert, greis, kurz behaart. Flügeldecken zur Spitze leicht verbreitert, matt, in der gleichen Art wie der Halsschild punktiert, kurz und greis behaart. 2. Tarsenglied ohne Auszeichnungen.

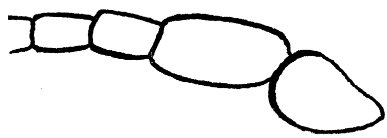

FIG. 2. *Laius boettcheri* sp. nov.; Fühler des Weibchens.

Weibchen.—In der Körperform dem Männchen sehr ähnlich, Wangen nicht eingedrückt, 2. Fühlerglied so dick wie das 1., aber länger, walzenförmig.

Länge, 2.5 bis 2.7 Millimeter.

Fundort.—NORD-MINDANAO, Dansalan, 6. und 13. Februar, 1915.

Die neue Art, die durch ihre je drei Makeln auf den Flügeldecken und den Kopf, dessen Unterseite rötlich gefärbt ist, leicht erkenntlich ist, gehört in die Verwandtschaft von *L. guttatus* Pasc. und *L. hexastigma* Champ.

LAIUS GUTTATUS Pascoe.

Laius guttatus PASCOE, Journ. ent. 2 (1866) 448.

Die Art wurde nach weiblichen Exemplaren von der Insel Batchian beschrieben. Von Luzon, Bontoc, Mount Polis, 2400 Fuss Höhe, Februar, 1917, liegen mir fünf Weibchen vor, die ich, bis das Männchen aufgefunden wird, vorläufig zu *L. guttatus* Pascoe stelle. Der Halsschild der Tiere von Luzon weist den für diese Art charakteristischen Seitenzahn auf, der allerdings bei einzelnen Exemplaren fast ganz verschwindet und nur noch angedeutet ist. Die Flügeldecken sind tiefschwarz und weisen einen schwachen bläulichen Schimmer auf, die weissen Punkte sind ziemlich klein, im Gegensatz zu den anderen Arten nur ganz vereinzelt mit Punkten versehen, die weissen Flächen erscheinen als glatte Flächen zwischen der übrigen verhältnismässig dicht punktierten, dunkeln Oberfläche, die Behaarung der Decken ist doppelt, fein kurz anliegend und lang schwarz abstehend. Es ist sehr leicht möglich dass es sich hier um eine von *guttatus* Pasc. spezifisch verschiedene Art handelt, die Beschreibung ist leider zu kurz gehalten um einen Vergleich zu ermöglichen. Flügel sind vorhanden. Champion stellt das Vorhandensein von Flügeln in Frage.[2]

LAIUS DENTATITHORAX Pic.

Laius dentatithorax PIC, Mél. exot.-ent. **25** (1917) 5.

LAIUS SEMIDEPRESSUS Pic.

Laius semidepressus PIC, Mél. exot.-ent. 25 (1917) 6.

LAIUS ALBOARCUATUS Champion.

Laius alboarcuatus CHAMPION, Ann. & Mag. Nat. Hist. (9) **8** (1921) 196.

LAIUS SEMPERI Champion.

Laius semperi CHAMPION, Ann. & Mag. Nat. Hist. (9) **8** (1921) 201.

LAIUS FALCIFER Champion.

Laius falcifer CHAMPION, Ann. & Mag. Nat. Hist. (9) **8** (1921) 204.

HAPALOCHRUS LUZONENSIS Pic.

Hapalochrus luzonensis PIC, Mél. exot. ent. **10** (1914) 15.

LUZON, Guadalupe, bei Manila, 29. Juni, 1915; Imugan, 30, Mai, 1916.

INCERTAE SEDIS

MALACHIUS RUFIVENTRIS Eschscholtz.

Malachius rufiventris ESCHSCHOLTZ, Entomogr. **1** (1822) 64.

Vielleicht identisch mit *Carphurus rubroannulatus* Motsch.

DASYTIDÆ

HAPLOCNEMUS PHILIPPINUS sp. nov.

Dunkelbraun bis schwarz, nur die beiden ersten Fühlerglieder und die Tarsen rötlich.

[2] Ann. & Mag. Nat. Hist. (9) 7 (1921) 340.

Kopf und Halsschild fein chagrinartig gerunzelt, matt, dazwischen zerstreut, wenig tief, ungefähr ein Drittel so tief und grob als die Flügeldecken punktiert. Fühler die Mitte der Decken nicht ganz erreichend, 2. Glied knötchenförmig, 3. bis 11. Glied unter sich ungefähr von gleicher Länge, 3. Glied fast parallel, zur Spitze nur schwach verbreitert, 4. Glied deutlich gezahnt, 5. Glied zur Spitze noch etwas stärker verbreitert als das 4. Halsschild ungefähr anderthalb mal so breit wie lang, Seiten nach vorne schwach gerundetverengt, Seitenrand an der Basis etwas breiter als an den Vorderecken, mit vereinzelten kaum sichtbaren Einkerbungen versehen. Flügeldecken nur wenig breiter als der Halsschild, ungefähr drittehalb mal so lang wie breit, stark glänzend, Punktierung ausserordentlich grob und tief, Wulste zwischen den Punkten kleiner als der Durchmesser eines Punktes, an den Schultern und an den Spitzen ist die Punktierung weniger dicht und tief und die glatten Zwischenräume sind grösser als der Durchmesser eines Punktes.

Länge, 3.5 bis 3.7 Millimeter.

Fundort.—LUZON, Nueva Vizcaya, Imugan, 4000 Fuss Hone, 3. Juni, 1916.

Durch den matten, chagrinartig gewirkten Kopf und Halsschild, die in starkem Kontrast zu den glänzenden, tief punktierten Flügeldecken stehen, gut erkenntlich.

PRIONOCERIDÆ

PRIONOCERUS CÆRULEIPENNIS Perty.

Prionocerus cæruleipennis PERTY, Obs. Col. Ind. Or. (1831) 33.

MINDANAO, Kolambugan, Januar, 1915; Dansalan, Februar, 1915; Mumungan, Juli, 1915; Iligan, Februar, 1915; Surigao, Port Banga, Dezember, 1914. MINDORO, San Teodoro, Januar, 1916. LUZON, Manila, April, 1915. MASBATE, Aroroy, August, 1917. BASILAN, Dezember, 1914.

PRIONOCERUS BICOLOR Redtenbacher.

Prionocerus bicolor REDTENBACHER, Reise Novara 2 (1868) 109.

NORD-MINDANAO, Dansalan, Februar, 1915.

IDGIA LUZONICA Pic.

Idgia luzonica PIC, Bull. Soc. Ent. France (1924) 230.

NORD-LUZON, Kalinga, Lubuagan, 3500 Fuss Höhe, Februar, 1917.

IDGIA BAKERI Pic.

Idgia bakeri PIC, L'Echange (1920) 8, *hors-texte.*

NORD-MINDANAO, Mumungan, März, 1915. LUZON, Mount Bulusan, Oktober, 1917. NORD-MINDORO, San Teodoro (Subaen), Januar, 1916.

Einzelne Exemplare weichen durch einfarbig gelbe Flügeldecken von der Stammform ab; ab. *testaceipennis* nov.

IDGIA ROUYERI var. MINDANAONA Pic.

Idgia rouyeri var. *mindanaona* PIC, in litt.

NORD-MINDANAO, Mumungan, Februar und März, 1915.

IDGIA LONGICOLLIS Pic.

Idgia longicollis PIC, L'Echange (1925) 17, *hors-texte.*

ILLUSTRATIONEN

TEXTFIGUREN

CONGENITAL EXTERNAL AND INTERNAL ANOMALIES IN A FOAL

By T. T. DAVID and J. A. SOLIS
Of the College of Veterinary Science, University of the Philippines Manila

THREE PLATES

Malformations of the extremities are not infrequently met with in animals, but two or more similar abnormalities in one individual are very rare. The monstrosity reported in this paper, besides having the congenital defects of the anterior limbs and other external abnormalities, also presented marked anomalies of the digestive and urogenital systems. The study of this specimen represents an extension of our limited knowledge of anatomical aberrations and the factors causing disturbances in the normal process of orderly development.

In the preparation of this manuscript, the works of Mall(8, 9) on the frequency of localized anomalies in human embryos and the origin of human monsters, Ziegler's(16) classification of abnormalities, and textbooks in anatomy and embryology have been consulted. Other investigations of monstrosities and abnormalities by various authors, like Watt,(14) Sumulong,(12) Carreon,(3) Kaura,(7) Crew and Panikkar,(4) and Fitzgerald(5) have also been referred to.

MATERIAL

The foal was received at noon, November 10, 1938. According to a letter received from Ibaan, Batangas Province, dated November 9, 1938, the animal was foaled November 8, 1938, after a gestation period of eleven months. The parturition was normal and the foal was born alive. It died on the third day, November 10, 1938, and was sent to the College. The dam was a grade animal and the sire was one of the breeding stallions of the Bureau of Animal Industry. The owner of the dam was Mr. Juan A. Mariño of Batangas Province.

The living attitude of the animal could not be determined, as it was already dead when received, but judging from the bed sores found on the left face and left side of the trunk, the front and left surfaces of the thigh, the animal must have lain on its left side most of the time after delivery.

If the animal had been alive and able to support its weight on the two hind legs, its standing attitude would have simulated very much that of a kangaroo.

SURFACE ANATOMY

The coat was bay, with a white sock on the left hind limb and an irregular white marking (star) on the frontal region.

Viewed from the sides and front, the animal seemed to lack both forelimbs. On closer observation, however, the distal extremities of the scapulæ on both sides could be noticed and could be felt subcutaneously as pointed projections. They were located more anteriorly than in normal individuals. On the left side, in addition to the small shoulder, a winglike segmented structure, representing the other parts of the left limb, could be observed posteriorly and below the scapula. Palpation showed that this winglike structure did not articulate with the distal end of the scapula. The upper part, which was loosely attached to the thorax, was somewhat oval, while the middle and lower portions were elongated and very slender, the former being the shorter and smaller of the two. At the distal end, and concealed by hair, was a horny nodule the size of a grain of corn.

The anterior part of the thorax was depressed on the right side, while the left side was correspondingly convex. The right side of the neck was also slightly concave, and the left side was convex.

Viewed from behind, the complete absence of both tail and anus was very noticeable. The vortex of the hair was present at the region where the anus normally appears. A depression between the tubera ischii could be palpated. Below the vortex of hair was an opening that would admit an ordinary probe. The orifice was situated on a rounded elevation about the size of a 10-centavo piece, which was pigmented and surrounded by a tuft of fine, short hairs. Two moderately developed teats were located normally.

The croup as a whole was almost horizontal throughout, its length exhibiting a slight depression at its middle. The buttocks were also wide, laterally and anteroposteriorly, roughly resembling the buttocks of a monkey.

The head, trunk, and pelvic limbs were normally developed.

The length of the body, measured from the poll to the point of the buttock, was 34 inches, and the height, measured with the animal made to assume a normal standing position, 27.25 inches. The weight of the foal was 42.98 pounds.

INTERNAL ANATOMY

The following account includes only the descriptions and discussions of the deformed parts, omitting entirely the anatomy of the structures that were apparently normal.

Skeleton.—The vertebral column after maceration by the rapid method of Green(6) and drying for 2 days, together with the ribs, weighed 750 grams. The length, taken from the atlas to the end of a fibrocartilagenous prolongation representing the coccygeal vertebræ (which were absent) was 25 inches. The vertebral formula was $C_7T_{18}L_6S_2Cy_0$. There are only 33 vertebral structures, in contrast to Sisson's(11) normal number in the horse, which is 54, taking 18 as the average number of coccygeal vertebræ.

The cervical vertebræ were normally developed with the exception of the slight bending of the 6th and 7th cervical vertebræ to the left of the longitudinal axis. The longitudinal axis of the thoracic region was crooked, and, from the 1st thoracic vertebra to the 6th, curved outward and backward towards the left side away from the median line. The 7th and 8th vertebræ were directed backward and inward towards the median plane, and finally the 9th to the 18th vertebræ were directed almost straight backward, showing a slight curve at about the 12th and 13th vertebræ towards the right side across the median plane.

The bodies of the thoracic vertebræ were normal, except those of the 6th and 7th which were greatly compressed on the right halves anteroposteriorly; this deformation may have been brought about by the curvature in this region. The transverse processes on the left side were normally developed, while those on the right side, where the bones were crowded and depressed, were undeveloped. The thoracic spines were also normal in number and in form. With regard to the obliquity of the spines, the following was observed: From the 1st spine to the 12th the direction was backward and to the right in such a way that the summits of the spines overhung their bodies, especially in the region of the 2d to the 10th spines. The shafts of the 3d, 4th, and 5th spines, and those of the 6th and 7th were completely fused.

The lumbar vertebræ were normal, save for a curved direction towards the left side at the region of the 2d and the 4th lumbar vertebræ.

The sacrum was very incomplete, consisting of only 2 vertebræ. The first vertebra articulated with the wings of the ilium. It was almost as large as the last lumbar, while the 2d was only about one half the size of the first.

There was no developed coccygeal vertebra. However, there was a sort of a fibrocartilagenous tissue connected to the last segment of the sacrum which undoubtedly represented the rudiments of the coccygeal vertebræ.

The vertebral curve was very abnormal. From the 1st to the 7th cervical it was almost horizontal, with a very slight concavity dorsally. From the 1st thoracic to the 4th and 5th, it was concave ventrally, and from there to about the 9th, slightly concave dorsally. From the 10th to the 4th or 5th lumbar it was concave ventrally, and the rest presented a complete change of course, that is, it was directed upward and backward or concave dorsally.

Ribs.—The ribs were normal in number, there being 18 pairs. They were in general smaller and slenderer than normal. The curvature of the ribs on the right side was apparently normal on the 1st and 2d, and on the 10th to the last. The 3d to the 9th were depressed. The 3d, 4th, 5th, and 6th were practically fused at their sternal extremities.

The ribs on the left side appeared normal and well sprung. They were larger and stronger than those on the right side.

On account of the deformity, which was largely confined to this region at about the level of the 5th to the 6th ribs, the thorax, viewed from the front, did not show a truncated conical form but instead presented a shape like the outline of a mango fruit.

Bones of the anterior limb.—The bones representing the right and left anterior limbs were a scapula on each limb; on the left side there were additional 4 segments of bones, arranged in a winglike manner. Therefore, of both anterior limbs there were only 6 bones present, 1 on the right side and 5 on the left side.

Scapulæ.—After drying the right scapula was 3.75 inches long and 3 inches wide, and weighed 17 grams. It was more developed, wider, and heavier than the left. The scapular spine was prominent, and presented a distinct tuber spinae. The tuber scapulae was larger than that of the left bone. The medial surface was shallow. At about the junction of the middle and lower thirds of this surface was found the nutrient foramen, about 0.5 inch from the posterior border. It presented no articular glenoid cavity, on account of the fact that the rest of the bones of the limb were not present, so that the articular angle was represented by a blunt-pointed termination.

The left scapula, on the other hand, was 3.76 inches long and 2.75 inches wide, and weighed 15 grams. It was slightly longer but a little narrower and not as heavy as the right scapula. The scapular spine was not as prominent, and the tuber spinae was indistinct. The medial surface was deeply concave, and presented the nutrient foramen at about the middle of this surface and at about the same distance as the right, to the posterior border. Also, there was no articular cavity, instead the part terminated in a somewhat pointed projection.

Winglike structure.—The term "winglike structure" is used here for convenience, inasmuch as the structure consisted of 4 bony segments, referred to above, simulating the appearance of a bird's wing. This structure was located on the left side, just below the left scapula. Together these 4 bony segments weighed 5 grams.

The uppermost segment was the largest, and had the form of a miniature scapula minus its elaborations. On the vertebral border it presented a cartilage. It did not articulate with the left scapula, but like the latter was also attached to the thorax by muscular and connective tissues. The 2d segment was in the form of a flattened disc about the size of the head of a thumb tack. The 3d segment was a round nodule the size of a large mongo seed. The 4th segment was the largest, and was in the form of a rod about 4 inches long, whose ends were somewhat enlarged and rounded. Its distal end was connected by about 0.5 inch cartilagenous tissue to a nodular tissue with hairs, most probably representing the hoof.

Muscles.—The salient characteristics of the muscles in the abnormal parts are briefly described as follows:

Muscles of the left shoulder girdle.—The cutaneous omobrachialis had a thick anterior part where the muscle fibers were almost vertical up to the distal end of the scapula. The posterior part was very thin, directed upward and backward, fading out to be blended with the fascia.

The trapezius thoracalis was very thick, and its attachment to the spine of the scapula was very thick and strong.

The rhomboideus cervicalis was also thick.

The latissimus dorsi was very well developed below the withers. It was thick distally and attached to the posterior angle of the scapula, besides being attached to the medial border of the upper part of the first bony segment described before. It was blended closely with the teres major and with the posterior deep pectoral.

All the pectoral muscles in general were well developed, particularly the anterior and posterior superficial. The scapular part of the anterior deep thinned out at the posterior third of the scapula, while the posterior deep formed a thick, rounded mass in front of the anterior end of the supposed humerus where it was attached. It was also attached to the distal third of the medial surface of the scapula, blending with a thin subscapularis.

The serratus cervicis was well developed but narrower from above downward.

The brachiocephalicus blended below with the loose connective tissue and fascia in front of the shoulder, but to a greater extent with the superficial pectoral, besides being attached to the lateral side of the distal point of the scapula.

Muscles of the left shoulder.—In general all the muscles of the shoulder that were observed were very small and underdeveloped.

The supraspinatus was wholly confined to the scapula where it was attached below to the pointed distal end of the scapula.

The infraspinatus was thick superiorly, but only extended as far as the lower third of the fossa.

The deltoideus was very thin. The teres minor could not be distinguished as well as the capsularis and coraco brachialis. The teres major was thick and blended very well with the latissimus dorsi. The subscapularis was very thin and poorly developed.

Muscles of the left arm.—With the exception of the long head of the triceps, which was very slender and loosely attached to the connective tissue, no muscles of the arm could be identified, but an irregular sheet of muscular tissue and connective tissue surrounded the first bony segment.

Muscles of the forearm and manus.—There were no muscles, but connective tissue and fascia covered the lower bony segments.

Muscles of the right shoulder girdle.—The cutaneous omobrachialis had a less developed vertical part, and the horizontal part was blended to the latissimus dorsi and skin. The brachiocephalicus was blended with the two superficial pectoral muscles and fascia surrounding the tip of the scapula. The serratus cervicis was very much elongated from front to back. The rhomboideus cervicalis was strong and attached to the anterior edge, and both surfaces of the big scapular cartilage. The pectoral muscles were less separable than those of the left side, and poorly developed. The latissimus dorsi was thin at its origin and blended with the teres major and cutaneous omobrachialis, and loosely attached to the posterior border of the scapula. The trapezius was very thin, and a very weak fascia connected it with the scapular spine.

Muscles of the right shoulder.—In general the muscles of the right shoulder were less developed than those of the left. Only the supraspinatus and infraspinatus were distinct.

Below this region there were no more muscles, just as there were no bony segments representing the rest of the right appendage.

BLOOD AND NERVE SUPPLIES OF THE DEFORMED PARTS

The left anterior appendage.—The brachial artery was observed to extend as far as the second bony segment. The external thoracic artery was large and extended backward to the abdominal muscles. The suprascapular and subscapular branches were very short, but the thoracodorsal branch of the latter was large. No other named collateral branches were observed, but many fine muscular branches were present.

The brachial plexus was fully developed, and all the eleven branches coming from it could be identified. The anterior thoracic or pectoral nerves were large, and had several well-defined branches to the pectoral muscles and the distal end of the brachiocephalicus. The median and ulnar nerves could be traced down the supposed region of the arm where the muscular tissue and connective tissue only formed a bundle around the bone.

The right anterior appendage.—The suprascapular branch of the branchial artery was large, but the subscapular was very much smaller and the rest of the branches were wanting. The brachial artery itself terminated in a fine blood vessel in the fibromuscular tissue surrounding the distal end of the scapula.

The brachial plexus appeared incomplete. The ventral branches of the last two cervical nerves largely formed the brachial plexus. The branches emanating from the plexus that were observed present were the long thoracic, external thoracic, pectoral, subscapular, and a large suprascapular.

Other abnormalities that were observed in the circulatory system were the presence of two large posterior mesenteric arteries. The internal iliac or hypogastric arteries were very much larger than the external iliac arteries. The middle and lateral coccygeal arteries were absent.

VISCERAL ORGANS

Digestive system.—The stomach, small intestines, and large intestines were normally developed and were in normal position and relation, save for the terminal part of the colon which was connected with the genital apparatus. There was no independent anus.

The liver and pancreas were normally developed and located, whereas the spleen was situated more forward, and the left lateral and central lobes of the liver overlapped about half of its parietal surface.

The terminal part of the small colon joined the posterior part of the urogenital tract.

Urogenital system.—Two kidneys were present, but were almost completely divided by transverse fissures into two anterior and two posterior lobes. The urinary bladder was elongated and thick-walled. The uterus and round ligaments were normal. The urinary bladder, by means of a short urethra, communicated with the distal tapering portion of the urogenital tract at about the same level where the colon joined the latter.

Two large ovaries, each the size of a santol seed, were present. The fallopian tubes as well as the horns of the uterus were observed to be somewhat thin-walled. The tapering thin-walled portion of the urogenital tract, which on dissection was found to be the phallic portion of the urogenital sinus, was continued by an elongated tube extending to the external genital orifice. This portion resembled the penis, as it coarsed around and ventrally to the ischial arch. On dissection this extrapelvic genital tract appeared enclosed by a pigmented integument, probably the prepuce, and opened on a minute orifice imbedded in an elongated enlargement about 1 cm long, simulating more or less the glans penis.

The uterus and vagina had not completely differentiated. The body of the uterovaginal canal was divided into dorsal and ventral cavities, communicating only by a small opening near a circular fold representing the hymen. The left horn of the uterovaginal canal lead into what may be called the dorsal half, and the right horn opened into the ventral cavity, the other half of the uterovaginal canal. Into the posterior cavity, separated in front from the uterovaginal canal by the hymen, opened the urethra on the right side and the colon on the left side. This thin-walled cylindrical sac, which was the undifferentiated phallic portion of the urogenital sinus, abruptly thickened near the ischial arch and continued by the penislike structure already described in the preceding paragraph.

COMMENTS

According to its history, the animal was a full-term foal. The measurements obtained showed that it was not underdeveloped or stunted. Its weight, however, lacks about 20 pounds of the normal birth weight of foals as found by Villegas.(13) The discrepancy may be explained by the almost complete absence of anterior appendages and tail in the animal.

The presence of 2 ovaries, fallopian tubes, and uterovaginal canal caused this foal to be classified as female. However, the external genital organ was a long, narrow, firm structure curving around ventrally to the ischial arch, with the external urethral orifice at the center of an elongated prominence. This structure resembled more the penis and its prepuce, the glans penis being represented by an elongated prominence about 1 cm long. The presence of this penislike external genital made the foal a false hermaphrodite (pseudohermaphrodismus femininus externus). Embryologically this condition may be explained by the rapid development of the indifferent anlage, the genital tubercle. It should be remembered, according to Arey,(1) that organs not only developed from definite primordia or anlagen, but also at a definite time. And if differentiation does not take place at that moment, there will be no perfect development, and the organs in turn may be depressed by other organs which have acquired the power to develop dominantly.

The other abnormalities, such as the intercommunication of the digestive tract and urogenital sinus, may be explained by the persistence of the cloaca due to the incomplete development of the urorectal fold which ultimately separates the rectum dorsally and the urogenital sinus ventrally. However, the vesicourethral portion of the urogenital sinus differentiated into urinary bladder and part of the urethra, whereas the phallic portion remained undifferentiated, persisting as the cloaca where the colon and urethra opened. As a consequent anomaly, the anal membrane failed to rupture, producing an imperforate anus. The division of the uterovaginal canal into two compartments might have been due to the failure of the distal wall between the two Müllerian ducts to degenerate. These two ducts normally fuse caudally and the intervening wall between them disappears to constitute the anlage for the uterus and vagina. Bailey and Miller(2) termed this potential wall condition throughout the uterine and vaginal portions 'uterus didelphys.'

The lobulation in the kidneys might have been brought about by the persistence of the transverse fissures, which normally are present in the developing embryo, showing the primary centers of development of the kidneys. This is a transient fœtal condition development from which has been arrested.

The agencies that have caused the rapid growth of some parts on the one hand, and the arrested development of certain organs on the other, cannot be definitely determined. Causes of monstrosities have always been the capital problems of anatomy. Many investigators have been working on the phenomenon, using all means of experimentation, but never has a definite abnormality been produced by a definite experiment.

On the basis of modern theories of the causes of monsters and on many studies of several workers with regard to the origin of monsters, we may safely assume that the present case is not hereditary, as the sire's other offspring are normal. Both previous foals of the dam have also been normal. The foal immediately preceding the present one, however, had abnormal anterior limbs, but we are inclined to believe that the abnormality is not hereditary, as the offspring foaled by the same dam last December, which immediately followed the case under discussion, is normal. Some authorities claim that only very few extremity abnormalities, such as polydactylism, are hereditary. Nor can this abnormality be germinal, due to pathological ova or sperm, for, as other workers observed, if this were the case the changes in the embryo generally would be so pronounced that the embryo could not live through the duration of pregnancy but would be aborted in most cases. Otherwise the resulting offspring is a total monster, with complete and not localized disfiguration of most parts. We therefore assume that the present monster came from normal germs and normal fertilization. The normally fertilized egg, however, may not have been well surrounded by the mucous membrane of the uterus on its implantation, due, possibly, to poor health in the uterus during the preceding pregnancy and failure to return to normal before the succeeding pregnancy. The immediate effect of this faulty implantation is impaired nutrition, which according to some investigators, causes the fœtal membranes to greatly suffer, particularly the chorion. The amniotic fluid becomes deficient, the chorion rough and rugged, pressing on the developing embryo and thus arresting development of certain parts. At the same time the chorion could not have grown *pari passu* with the growing long axis of the embryo, thus arresting the growth of the tail and producing the various abnormal curves of the vertebral column. The head was not affected, because, according to Williams,(15) the head grows first and faster than the caudal region. All these external abnormalities tend to show that a mechanical pressure occurred. Again, this faulty implantation altered the environment of the developing embryo, causing nutritional disturbance. Thus development in some of the organs was arrested or accelerated, resulting in the many aberrations of both the digestive and the urogenital systems.

As to the time when these agencies affected the normal developmental process, it is very likely that they occurred at about 4 to 7 weeks of development, as manifested by the presence of the limb buds which normally appear during the first 3 or 4 weeks of development. Prentiss et al.(10) mentioned that the cloaca usually appears after about one month, and should be completely separated into rectum and urogenital sinus in 36 to 40 days.

SUMMARY AND CONCLUSIONS

1. A multiple monstrosity of a full-term foal is reported.
2. The animal was not underdeveloped.
3. The following aberrations were observed: (*a*) Perobrachius. The left anterior limb was represented, besides the shoulder, by a winglike structure that on dissection revealed the presence of 4 bony segments. The shoulder had only a very small scapula. The right anterior limb was only the shoulder represented by a very small scapula. The muscles in the region of the arm on both sides were vaguely identified. (*b*) Atresia ani. (*c*) Agenesia of the tail. (*d*) The vertebral formula was only $C_7T_{18}L_6S_2Cy_0$. (*e*) Scoliosis and lordosis. The vertebral column viewed dorsally showed an undulating curve, and viewed laterally presented a marked concavity at the middle of the thoracic and lumbar vertebræ. (*f*) The right brachial plexus appeared incomplete, and only 5 out of the 11 branches were present. (*g*) Collateral branches of both brachial arteries were incomplete. There were present two large posterior mesenteric arteries, and the lateral and middle coccygeal arteries were wanting. (*h*) Persistence of the cloaca. Urethra and colon communicated freely with the phallic portion of the urogenital sinus. (*j*) Uterus didelphys. (*k*) Pseudohermaphrodismus femininus

externus. The internal genital organs were characteristically female, whereas the external genitals very much resembled the penis.

4. The most probable cause of this multiple monstrosity was faulty implantation with a subsequent disturbance in nutrition. This factor might have affected the normal process of development about the first or second month of development.

5. Because of the extremity deformities, which were the most conspicuous, the monster was classified as a perobrachius. It was a pseudohermaphrodismus femininus externus.

ACKNOWLEDGMENT

Thanks are due to Dr. Manuel D. Sumulong for correcting the manuscript, and to Dr. Sotero Macalalad for furnishing us data relative to the dam. To Mr. Juan A. Mariño, who donated the specimen to the College, we also extend our thanks.

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ILLUSTRATIONS

Plate 1

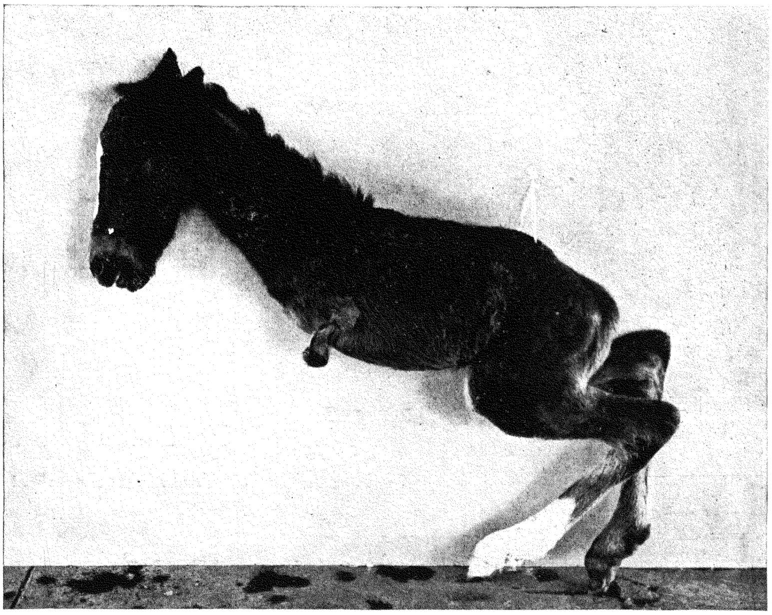
Fig. 1. The foal, viewed from the left.
2. The foal, viewed from the right.

Plate 2

Fig. 1. Bones of the left anterior limb.
2. Vertebral column and ribs.
3. The only bone (scapula) of the right anterior limb.

Plate 3

The urogenital system. Fig. *1*, penislike structure; *2*, phallic portion of urogenital sinus; *3*, hymen; *4*, distal end of colon; *5*, rectum; *6*, dorsal cavity of uterovaginal canal; *7*, urinary bladder; *8* and *9*, ovaries; *10*, horn of uterus; *11*, broad ligament; *12*, ureter; *13*, right kidney; *14*, left adrenal; *15*, umbilical ligament; *16*, round ligament.



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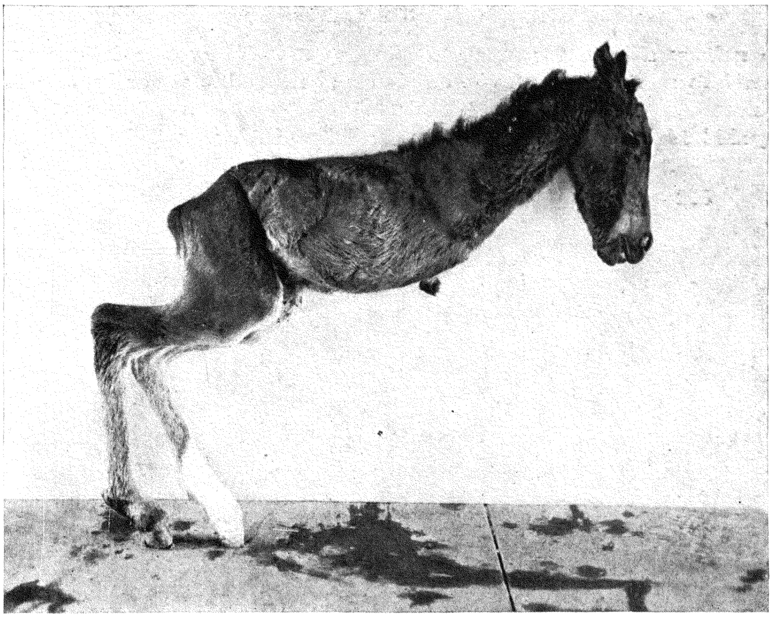

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PLATE 1.

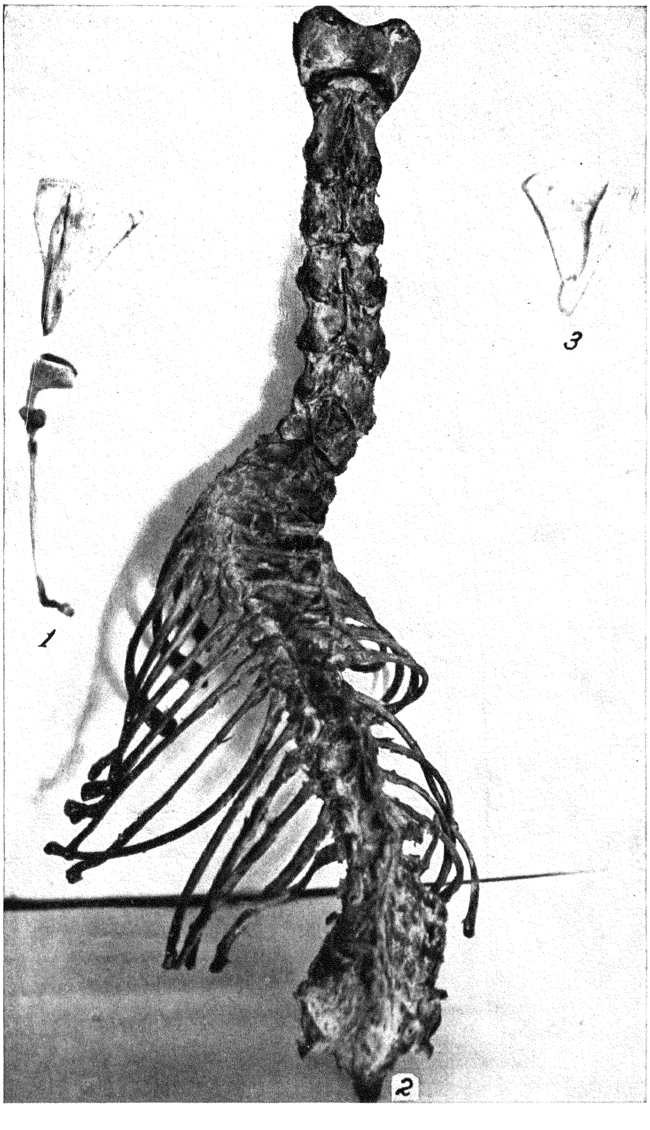

PLATE 2.

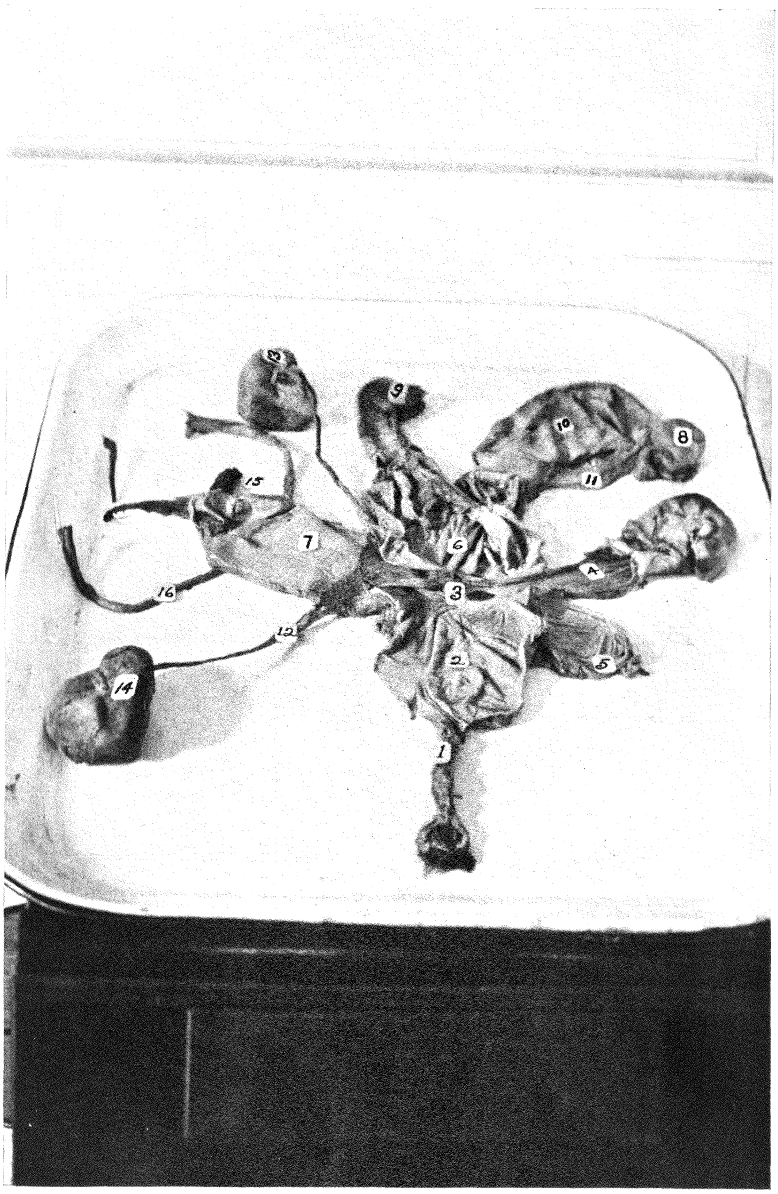

PLATE 3.

CHEMICAL STUDIES ON COCONUT PRODUCTS, III

A NEW PROCESS FOR THE EXTRACTION OF COCONUT OIL

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ONE TEXT FIGURE

That the expeller process for extracting coconut oil is, from the point of view of the coconut industry, not an economical process in spite of its high degree of mechanization and efficiency, has been well appreciated for some time. In general the expeller process uses as its raw material copra which has passed through various stages of decomposition by the action of molds, bugs, and other organisms, and which has to be well dried before an efficient extraction can be made.

The use of copra as raw material has various effects:[1] (*a*) some oil, sugars and other carbohydrates, and proteins are lost during the period between the making of copra and the milling; (*b*) the oil produced contains a considerable amount of free fatty acids and is rancid, and therefore requires a refining process involving neutralization, decolorization, and deodorization, before it can be sold as edible oil; (*c*) the copra meal and cake are dirty and rancid and can be used only for animal feed and fertilizer, unless they are first purified by an expensive process; (*d*) no other by-products are obtainable that can be transformed into easily marketable products.

Since the first World War, when coconut oil was given a sudden boost, various investigators have realized these disadvantages to the coconut industry. Most investigations centered on the problem of improving the quality of copra. Some investigators, however, take a different view. Brill,[2] to mention only on worker, points out that a desirable way of obtaining coconut oil is by getting it directly from the fresh coconut meat, since drying difficulties are thus eliminated and the residual cake becomes available for food, and that the only drawback to this

[1] Lava, V. G. The Philip. Soc. Sci. Rev. (1) 11 (1939) 1–25; Philip. Nat. Res. Council Bull. No. 23 (1939) 95–100.

[2] Brill, H. C. Chem. and Met. Eng. 24 (1921) 567, 568.

method is the great difficulty of breaking the emulsion in the separation of the oil.

If the degree of extraction of the oil emulsion from the fresh coconut meat can be made high, and if the separation of the oil from the emulsion can be made almost complete, oil extraction directly from fresh meat offers many advantages. In the first place, the oil produced will be water white, will have no rancid odor and taste, and will have no appreciable free fatty acid. In most cases such an oil may be used directly as food, as is actually being done in many parts of the Philippines and in other Far Eastern countries; even if refining should be necessary, it can be accomplished by a simplified and short deodorization process. In the second place, the sugars and proteins, portions of which are extracted with the oil emulsion, can be used to good advantage, especially in view of the fact that the coconut meat has a peculiar pleasant flavor which is also partially extracted with the oil emulsion; a product known as "Coco-honey," which has now a good foreign market, is essentially composed of coconut sugars, protein, and oil to which sucrose has been added. In the third place, the coconut cake produced has still some food value, and may be used as a flour substitute; or, if the coconut meat is first pared before being subjected to extraction, as a low-grade desiccated coconut. In the fourth place, the loss of oil due to the action of copra bugs and to molding and to bacterial decomposition is prevented; in some cases this loss amounts to more than 10 per cent of the total oil from the fresh meat. In the fifth place, the coconut-shell by-products can be used not only to satisfy the power requirements of the plant, but also for other purposes (metallurgical charcoal, graphite, and the like).

Various methods have been proposed to extract the oil directly from the fresh coconut meat, among them those of Alexander,[3] Beckman,[4] and Lava.[5]

EXPERIMENTAL DATA

The present article gives data on various factors affecting the extraction of emulsion or gatâ from fresh coconut meat by cage hydraulic pressure, and also preliminary data on the efficiency of coconut oil recovery by the Lava process, together with

[3] Alexander, Wallace. U. S. 1,366,338 and U. S. 1,366,339 (1921).
[4] Beckman, J. W. British 326,195 (1928).
[5] Lava, V. G. U. S. 2,101,371 (1937).

data on the performance of the machinery used. Briefly this process consists in extracting the oil emulsion from the comminuted fresh meat by pressing, breaking this emulsion by regulating its pH or by further dehydration of the protein in the emulsion, and finally separating the oil by mechanical means.

In the experiments on the effect of various factors on the extraction of gatâ, fresh coconut meat, grated to about the size of sawdust, was used, and pressing was done in a 1-kilo capacity cage hydraulic press. (A. L. G. Dehne, German manufacture, with an area of about 122.5 square centimeters). The coconuts were bought in the Manila markets.

Table 1 shows the effect of pressure on the efficiency of extraction of oil from grated coconut meat.

Table 2 shows the effect of the amount of water used in the first pressing on the efficiency of extraction of oil from grated coconut meat.

Table 3 shows the effect of the amount of water used in the second and third pressings on the efficiency of extraction of oil from grated coconut meat.

Table 4 shows the effect of the temperature of water used on the efficiency of extraction in the first pressing of oil from grated coconut meat.

Table 5 shows the effect of the time of contact of the grated coconut meat with water on the efficiency of extraction in the first pressing.

Table 6 shows the effect of the pH of the water used on the efficiency of extraction in the first pressing of grated coconut meat.

Table 7 shows the effect of further grinding on the efficiency of oil extraction in the first pressing of grated coconut meat.

Tables 8 and 9 give data on the efficiency of oil recovery by the Lava process, involving the use of crude rollers for the extraction of the oil emulsion and small capacity Westphalia centrifuges for separating the oil. These data were obtained in a pilot plant in Calumpang, Laguna Province, beginning in August and ending November, 1937.

Table 8 gives data on the efficiency of oil extraction, on the quality of the nuts used, and on the quantity of some of the byproducts obtained with the use of the process described.

TABLE 1.—*Effect of pressure on efficiency of extraction of oil from grated coconut meat.*

[Temperature of extraction, 28°C. Water added in first pressing, 50 per cent of fresh weight; in second pressing, 100 per cent of weight of cake from first pressing; in third pressing, 100 of weight of cake from second pressing.]

Experiment No.	Date.	Weight of fresh sample used.	Pressure.	After first pressing.					After second pressing.				
				Cake (based on fresh sample).	Water in cake (wet basis).	Oil in cake (dry basis).	Oil in cake (based on fresh sample).	Nonoil solids in cake (based on fresh sample).	Cake (based on fresh sample).	Water in cake (wet basis).	Oil in cake (dry basis).	Oil in cake (based on fresh sample).	Nonoil solids in cake (based on fresh sample).
	1939	*Kg.*	*Atmospheres.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
1	August 4	1,083	100	34.4	41.7	46.1	9.5	11.1	32.2	40.3	50.9	9.8	9.4
2	do	0.920	200	34.8	41.7	50.0	10.1	10.1	31.0	40.0	48.2	9.0	9.6
3	do	0.936	300	33.2	39.9	49.6	9.9	10.1	28.4	38.4	47.0	8.3	9.2
4	do	0.963	400	3.08	39.2	50.0	9.4	9.3	26.0	37.2	52.1	8.5	7.8
A	do	Fresh sample: Water (wet basis), 53.2 per cent Oil (dry basis), 64.6 per cent Oil (wet basis), 30.3 per cent Nonoil solids (wet basis), 16.5 per cent Nitrogen (dry oil-free basis), 3.67 per cent Protein (dry oil-free basis), 21.2 per cent Protein (dry but not oil-free basis), 7.5 per cent Protein (wet basis), 3.5 per cent											
A[1]	do	Combined sapals after third pressing: Nitrogen (dry oil-free basis), average, 1.4 per cent Protein (dry oil-free basis), average, 8.1 per cent Protein (dry but not oil-free basis), average 1.23 per cent Protein, based on fresh sample, average, 0.74 per cent											
5	August 7	0.950	500	29.0	38.8	55.3	9.8	7.9	23.7	37.4	47.6	7.1	7.7
6	do	0.858	600	26.8	36.9	58.7	9.9	7.0	20.9	34.9	46.9	6.4	7.2
B	do	Fresh sample: Water (wet basis), 51.8 per cent Oil (dry basis), 64.1 per cent Oil (wet basis), 30.8 per cent Nonoil solids (wet basis), 17.4 per cent											

Experiment No.	Date.	After third pressing.					Efficiency of oil extraction.			Extraction of nonoil solids.		
		Cake (based on fresh sample).	Water in cake (wet basis).	Oil in cake (dry basis).	Oil in cake (based on fresh sample).	Nonoil solids in cake (based on fresh sample).	First pressing.	Second pressing.	Third pressing.	First pressing.	Second pressing.	Third pressing.
	1939	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
1	August 4	30.0	40.7	49.9	8.9	8.9	69	68	71	33	43	46
2	do	29.2	39.8	45.3	7.9	9.6	67	71	74	39	42	42
3	do	27.2	39.9	40.3	6.6	9.7	68	73	78	39	44	41
4	do	24.4	40.5	42.6	6.2	8.3	69	72	80	44	53	50
5	August 7	21.5	38.0	42.8	5.7	7.6	68	77	82	54	56	56
6	do	19.3	37.9	42.4	5.1	6.9	68	79	83	60	59	58

TABLE 2.—*Effect of amount of water used in first pressing on efficiency of extraction of oil from grated coconut meat.*

[Temperature of extraction, 24°C; pressure, 300 atmospheres.]

Experiment No.	Date.	Weight of fresh sample used.	Water used (based on fresh sample).	Cake after pressing (based on fresh sample).	Weight of gatâ extracted per kilogram of sample.	Weight of oil from gatâ by boiling and pressing.	Weight of pressed protein cake.	Water in protein cake (wet basis).	Oil in protein cake (dry basis).	Nonoil solids extracted (based on fresh sample).	Oil extracted (based on fresh sample).	Efficiency of oil extraction.	Extraction of nonoil solids.
	1939	Kg.	Per cent.	Per cent.	Kg.	Kg.	Kg.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
1	August 21	0.912	0	42.5	0.525	.125	0.077	18.0	21.4	5.9	15.3	50	37
2	do	0.951	50	36.2	0.600	0.169	0.085	13.0	9.7	7.9	18.6	61	44
3	do	1.008	100	36.0	0.630	0.186	0.088	13.2	8.7	6.9	19.3	64	43
4	do	0.947	200	35.0	0.614	0.176	0.098	15.1	10.8	7.8	19.5	64	49
A	do	Fresh sample: Water (wet basis), 55.8 per cent; Oil (dry basis), 65.8 per cent; Oil (wet basis), 30.4 per cent; Nonoil solids (wet basis), 15.8 per cent											

TABLE 3.—*Effect of amount of water used in second and third pressings on efficiency of extraction of oil from grated coconut meat.*

Experiment No.	Date.	Weight of fresh sample used.	First pressing.						Second pressing.					
			Water used (based on fresh sample).	Cake (based on fresh sample).	Water in cake (wet basis).	Oil in cake (dry basis).	Oil in cake (based on first sample).	Nonoil solids in cake (based on fresh sample).	Water used (based on cake fresh first pressing).	Cake (based on fresh sample).	Water in cake (wet basis).	Oil in cake (dry basis).	Oil in cake (based on fresh sample).	Nonoil solids in cake (based on fresh sample).
	1939	*Kg.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
1	August 17	1.031	50	34.9	41.4	57.5	11.7	8.8	100	30.3	41.5	----------	----------	----------
2	do	0.969	50	37.1	42.9	58.7	12.4	8.8	200	31.0	41.5	48.2	8.8	9.3
3	do	0.861	50	38.9	45.1	60.0	12.8	8.6	300	30.9	41.6	50.5	9.2	8.9
4	do	0.976	50	38.6	44.7	57.1	12.3	9.2	400	31.3	44.0	48.8	8.6	8.9
A	Do	Fresh sample: Water (wet basis), 51.3 per cent Oil (dry basis), 65.6 per cent Oil (wet basis), 31.8 per cent Nonoil solids (wet basis), 16.9 per cent												

Experiment No.	Date.	Third pressing.						Efficiency of oil extraction.			Extraction of nonoil solids.		
		Water used (based on cake in second pressing).	Cake (based on fresh sample).	Water in cake (wet basis).	Oil in cake (dry basis).	Oil in cake (based on fresh sample).	Nonoil solids in cake (based on fresh sample).	First pressing.	Second pressing.	Third pressing.	First pressing.	Second pressing.	Third pressing.
	1939	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
1	August 17	100	28.7	41.0	47.8	8.1	8.8	63	----	75	48	----	48
2	do	200	29.1	43.5	46.8	7.5	8.9	61	72	77	48	45	47
3	do	300	28.2	44.1	42.7	6.7	9.1	60	71	79	49	47	46
4	do	400	28.6	46.2	45.6	7.1	8.5	61	73	78	46	47	50

TABLE 4.—*Effect of temperature on the efficiency of oil extraction in first pressing of grated coconut meat.*

[Temperature of extraction, 28°C.; pressure, 300 atmospheres.]

[Water used in extraction, 50 per cent of weight of fresh meat; mixing time, 5 minutes; pressing time, 10 minutes.]

Experiment No.	Date.	Weight of fresh sample used.	Pressure.	Temperature of water used.	Temperature of mixture before pressing.	Cake after pressing (based on fresh sample).	Calculations from boiling and pressing.									Calculations from solvent extraction.		
							Weight of gatâ extracted per kilogram of fresh sample.	Weight of oil from gatâ by boiling and pressing.	Weight of pressed protein cake.	Water in protein cake (wet basis).	Oil in protein cake (dry basis).	Nonoil solids extracted (based on fresh sample).	Oil extracted (based on fresh sample.	Efficiency of oil extraction.	Degree of extraction of nonoil solids.	Water in sapal cake (wet basis).	Oil in sapal cake (dry basis).	Efficiecy of oil extraction.
	1939	*Kg.*	*Atmospheres.*	°*C.*	*C.*	*Per cent.*	*Kg.*	*Kg.*	*Kg.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
1	August 24	0.935	300	28	28	39.5	0.518	0.159	0.075	18.4	8.1	6.0	17.5	56	40	39.0	56.2	57
2	do	0.954	300	34	31	38.8	0.600	0.168	0.074	12.7	11.4	6.0	18.4	59	40	46.2	56.3	63
3	do	0.981	300	56	38	37.7	0.606	0.173	0.072	12.7	7.2	5.9	18.2	58	39	42.3	57.6	60
4	do	0.937	300	77	46	37.3	0.605	0.170	0.074	10.5	6.1	6.6	18.6	60	43	39.8	43.8	68

A	do	Fresh sample: Water (wet basis), 52.6 per cent Oil (dry basis), 66 per cent Oil (wet basis), 31.2 per cent Nonoil solids (wet basis), 15.2 per cent																
5	August 28	0.936	440	34	32	33.4	0.617	0.178	0.085	21.0	11.8	6.1	19.4	58	40	37.3	56.0	58
6	do	0.971	440	56	38	31.0	0.627	0.191	0.091	15.5	13.1	6.9	20.7	62	45	37.6	51.9	64
7	do	0.970	440	77	42	33.8	0.590	0.081	0.081	18.4	6.3	6.4	20.0	60	42	41.7	61.0	58
8	do	0.960	440	28	28	34.6	0.617	0.200	0.080	18.4	6.9	6.4	21.3	64	42	-------	-------	-------
B	do	Fresh sample: Water (wet basis), 51 per cent Oil (dry basis), 68.2 per cent Oil (wet basis), 33.4 per cent Nonoil solids (wet basis), 15.2 per cent																

TABLE 5.—*Effect of the time of contact of grated coconut meat with water on efficiency of oil extraction.*

[Temperature of extraction, 28°C.; Pressure, 450 atmospheres; mixing time, 5 minutes.]

Experiment No.	Date.	Weight of fresh sample used.	First pressing.																
			Calculation from solvent extraction.									Calculation from boiling and pressing.							
			Amount of water used (based on fresh sample).	Time of contract between meat and water.	Cake (based on fresh sample).	Water in cake (wet basis).	Oil in cake (dry basis).	Nonoil solids extracted (based on fresh sample).	Oil extracted (based on fresh sample).	Efficiency of oil extraction.	Extraction of nonoil solids.	Weight of gatâ extracted per kilogram of fresh sample.	Weight of oil obtained from gata by boiling and pressing.	Weight of pressed protein cake.	Water in protein cake (wet basis).	Oil in protein cake (dry basis).	Nonoil solids extracted (based on fresh sample).	Oil extracted (based on fresh sample).	Efficiency of oil extraction.
	1939	*Kg.*	*Per cent.*	*Min.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent,*	*Per cent.*	*Per cent.*	*Kg.*	*Kg.*	*Kg.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
1	August 31	0.987	100	3	34.0	40.3	52.8	7.2	21.7	67	43	0.662	0.191	0.091	14.7	15.2	6.7	20.5	63
2	do	0.943	100	38	33.7	39.3	49.3	6.5	22.3	69	39	0.648	0.194	0.074	19.0	7.6	5.9	21.2	66
3	do	0.921	100	72	33.7	39.3	49.7	6.6	22.2	69	39	0.648	0.184	0.069	14.6	6.6	6.0	20.4	63
4	do	0.991	100	298	30.2	37.1	48.6	7.2	23.1	71	43	0.620	0.194	0.070	16.0	10.7	5.4	20.2	63

A	do	Fresh sample: Water (wet basis), 50.8 per cent; Oil (dry basis), 66 per cent; Oil (wet basis), 32.4 per cent; Nonoil solids (wet basis), 16.8 per cent																	
5	September 8	0.955	97.5	[a] 3	34.0	38.2	------	------	------	------	------	0.670	0.213	0.074	19.8	11.3	5.6	23.0	69
6	do	0.905	119	[a] 60	38.4	37.5	56.9	5.7	19.8	60	36	0.597	0.183	0.043	21.0	6.3	3.6	20.4	61
7	do	0.946	104	[a] 60	33.4	39.1	55.3	7.0	21.2	64	44	0.630	0.186	0.072	19.3	7.0	5.7	20.1	60
8	do	0.983	198	[a] 210	33.5	38.8	60.7	8.0	21.0	63	50	0.640	0.201	0.076	23.2	7.9	5.4	21.0	63
B	do	Fresh sample: Water (wet basis), 50.5 per cent; Oil (dry basis), 67.6 per cent; Oil (wet basis), 33.4 per cent; Nonoil solids (wet basis), 16.1 per cent																	

TABLE 5.—*Effect of the time of contact of grated coconut meat with water of efficiency of all extraction.*—Continued

Experiment No.	Date.	Second pressing. Calculations from solvent extraction. Amount of water used (based on cake).	Time of contact between cake and water.	Second pressed cake (based on fresh sample).	Water in second pressed cake (wet basis).	Oil in second pressed cake (dry basis.)	Nonoil solids extracted (based on fresh sample).	Oil extracted (based on fresh sample).	Efficiency of oil extraction.	Extraction of non oil solids.	Calculations from boiling and pressing. Weight of oil from cream by boiling and pressing.	Weight of pressed protein cake.	Water in protein cake (wet basis).	Oil in protein cake (dry basis).	Total nonoil solids extracted (based on fresh sample).	Total oil extracted (based on fresh sample).	Efficiency of oil extraction.
	1939	*Per cent.*	*Min.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
1	August 31	200	[b] 3	29.4	45.6	43.9	7.9	24.5	76	47	0.019	0.010			7.5	22.5	70
2	do	200	[c] 147	27.9	42.2	45.8	8.1	24.3	75	48	0.019	0.007	14.0	10.0	6.4	23.3	72
3	do	200	[d] 3	27.7	41.6	46.1	8.1	24.3	75	48	0.020	0.013			7.1	22.7	70
4	do	200	960	26.4	38.0	52.5	9.1	23.3	72	54	0.019	0.007			5.9	22.2	69

[a] Pressed 3 minutes after mixing.
[b] Pressed 60 minutes after mere addition of water.
[c] Pressed 60 minutes after addition of water and mixing.
[d] Pressed 210 minutes after addition of water and mixing.
[e] Cake was left overnight and mixed with water the next day.

TABLE 6.—*Effect of pH of extraction water on the efficiency of oil extraction from grated coconut meat.*

[Temperature of extraction, 28°C.; pressure, 450 atmospheres; time of mixing, 60 minutes.]

Experiment No.	Date.	Weight of fresh sample used.	Amount of water used.	Reagent added.		Calculations from solvent extraction.						
				Reagent.	Amount.	Cake (based on fresh sample).	Water in cake (wet basis).	Oil in cake (dry basis).	Nonoil solids in cake (based on fresh sample).	Oil in cake (based on fresh sample).	Efficiency of oil extraction.	Extraction of nonoil solids.
	1939	*Kg.*	*Kg.*		*Kg.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
1	September 14	0.979	0.952	HCl	2.5	37.8	38.6	60.5	9.2	14.0	53	47
2	do	1.005	0.989	None		35.0	42.9	58.5	8.3	11.7	61	53
3	do	1.004	0.993	Na_2CO_3	2.5	32.0	43.2	56.1	8.0	10.2	66	54
4	do	0.974	0.971	do	7.5	26.4	40.4	44.2	8.7	7.0	76	50
A	do	Fresh sample: Water (wet basis), 52.9 per cent Oil (dry basis), 63 per cent Oil (wet basis), 29.6 per cent Noncil solids (wet basis), 17.5 per cent										

5[a]	September 18	0.918	0.904	None		36.0	40.3	59.5	8.7	12.5	55	50
6[a]	do	0.960	0.942	do		35.0	34.4	58.3	9.6	13.3	53	45
7[a]	do	0.938	0.926	Na_2CO_3	0.5	35.2	40.1	59.3	8.5	12.5	56	51
8[a]	do	0.942	0.923	do	1.0	35.9	39.8	57.0	9.3	12.3	57	47
B		Fresh sample: Water (wet basis), 54.3 per cent; Oil (dry basis), 62.7 per cent; Oil (wet basis), 28.2 per cent; Nonoil solids (wet basis), 17.5 per cent										

Experiment No.	Date.	Calculations from boiling and pressing.								
		Weight of gatâ extracted per kilogram of fresh sample.	Gatâ.	Weight of oil from gatâ by boiling and pressing.	Weight of pressed protein cake.	Water in protein cake (wet basis).	Oil in protein cake (dry basis).	Nonoil solids extracted (based on fresh sample).	Oil extracted (based on fresh sample).	Efficiency of oil extraction.
	1939	*Kg.*	*pH.*	*Kg.*	*Kg.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
1	September 14	0.704	5.4	0.133	0.074	13.1	12.1	5.7	14.4	49
2	do	0.648	6.1	0.172	0.090	13.2	10.6	7.0	18.0	61
3	do	0.674	8.1	0.189	0.099	8.7	9.8	8.1	19.8	68
4	do	0.700	9.6	0.190	0.093	6.6	4.2	8.6	20.0	68
5[a]	September 18	0.632	6.3	0.160	0.089	10.8				
6[a]	do	0.643	6.3	0.178	0.099	13.2				
7[a]	do	0.636	6.5	0.178	0.094	12.3				
8[a]	do	0.630	6.7	0.158	0.088	13.3				

[a] Pressure used, 100 atmospheres.

TABLE 7.—*Effect of further grinding on the efficiency of oil extraction from grated coconut meat.*

[Temperature of extraction, 28°C.; pressure, 450 atmospheres.]

Experiment No.	Date.	Weight of fresh sample used.	Treatment (grinding+, no grinding —).	Calculations from solvent extraction.								Calculations from boiling and pressing.							
				Amount of water used.	Cake (based on fresh sample).	Water in cake (wet basis).	Oil in cake (dry basis).	Nonoil solids in cake (based on fresh sample).	Oil in cake (based on fresh sample).	Efficiency of oil extraction.	Extraction of nonoil solids.	Weight of gatâ extracted per kilogram of fresh sample.	Weight of oil from gatâ by boiling and pressing.	Weight of pressed protein cake.	Water in protein cake (wet basis).	Oil in protein cake (dry basis).	Nonoil solids extracted (based on fresh sample).	Oil extracted (based on fresh sample).	Efficiency of oil extraction.
	1939	*Kg.*		*Kg.*	*Per cent.*	*Per cent.*	*Per cent.*	*Pre cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Kg.*	*Kg.*	*Kg.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
1	October 5	1.742	—	1.713	33.8	33.7	61.0	8.5	13.2	60	49	0.603	0.314	0.145	14.1	8.7	6.5	18.8	57
2	do	1.600	+	1.566	28.3	35.9	57.2	7.8	10.3	69	53	0.648	0.343	0.142	16.8	(8.7)	6.7	22.1	67
A	do	Fresh sample: Water (wet basis), 50.5 per cent; Oil (dry basis), 66.7 per cent; Oil (wet basis), 32.9 per cent; Nonoil solids (wet basis), 16.6 per cent																	

3	October 10	1.748	—	1.728	36.3	37.2	59.5	9.2	13.5	59	45	0.578	0.305	0.146	11.9	10.8	6.6	18.2	55
4	do	1.517	+	1.500	29.3	35.9	57.3	8.0	10.7	68	52	0.678	0.318	0.122	12.7	6.3	6.5	21.4	65
B	do	Fresh sample: Water (wet basis), 50.5 per cent Oil (dry basis), 66.7 per cent Oil (wet basis), 32.9 per cent Nonoil solids (wet basis), 16.6 per cent																	
5	October 17	2.232	—	2.207	37.0	37.8	60.7	9.1	13.9	58	46	0.600	0.380	0.203	11.1	15.0	6.8	18.3	56
6	do	2.202	+	2.177	31.1	34.5	56.8	8.8	11.5	65	48	0.680	0.457	0.204	13.6	6.2	7.5	21.2	65
C	do	Fresh sample: Water (wet basis), 50.1 per cent Oil (dry basis), 66.3 per cent Oil (wet basis), 33 per cent Nonoil solids (wet basis), 16.9 per cent																	

TABLE 8.—*Efficiency of coconut oil extraction by the Lava process, using crude rollers and nonsolid-ejecting centrifuges.*

Experiment No.	Date.	Nuts. Source.	Nuts. Weight per 100.	Nuts. Weight of meat per 1,000.	Nuts. Actual yield of oil per 1,000.	Actual oil yield (based on weight of fresh meat).	Weight of total oil obtainable from 1,000 nuts.	Weight of wet, coarse protein solids per 1,000 nuts	Weight of wet, fine protein solids per 1,000 nuts	Weight of wet sapal per 1,000 nuts.	Water in sapal (wet basis).	Weight of oil in sapal from 1,000 nuts.	Unextracted oil in sapal (based on total obtainable).	Weight of dry, oil-free sapal per 1,000 nuts.	Dry, oil-free sapal (based on fresh meat).	Efficiency of oil recovery.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
	1939		*Kg.*	*Kg.*	*Kg.*	*Per cent.*	*Kg.*	*Kg.*	*Kg.*	*Kg.*	*Per cent.*	*Kg.*	*Per cent.*	*Kg.*	*Per cent.*	*Kg.*
14	August 4	Aguirre, Calumpang	80	380	98.0	25.5	103.1			158	67.3	(5.1)	(5.0)	46.9	12.3	95
15	August 5	Lilio	87	410	99.0	24.5	102.8				68.7	(3.8)	(3.7)			96
16	August 6	Aguirre	75	385	102.0	26.5										
17	August 9	Lapad		406	115.0	28.4										
18	August 10	do	86	387	103.0	26.7	119.1			123		(16.1)	(13.5)			86
19	August 11	do	82	391	84.0	24.2	112.7			124		(18.7)	(16.5)			83
20	August 12	do	82	381	103.0	27.4	115.6					(12.6)	(10.8)			89
21	August 17	Cabubuhayan,	76	346	84.5	24.6		5.4	3.7	103						
22	August 18	Cabubuhayan, Aguirre	81	361	90.0	25.0				109						
23	August 19	do	78	351	88.0	25.0	101.0	4.7	3.5	109	54.3	13.0	13.0	37	10.6	87
24	August 20	Aguirre, Bautista	83	374	95.0	25.5	112.0	5.5	2.7	107	44.8	17.0	15.2	42	11.2	85
25	August 23	Bautista	83	378	106.2	28.4	123.0	5.6	3.2	118						87
26	August 24	do	81	370	96.5	26.4		9.8	4.0	129						
27	August 25	do	83	379	99.0	26.0		5.8	3.8	124						
28	August 26	do	83	368	96.0	26.0	123.0	5.4	3.8	138	55.2	27.0	21.9	35	9.5	78
29	August 27	do	82	371	96.2	25.8	123.4	5.4	3.4	147	55.7	27.2	21.9	38	10.2	78
30	August 30	do	80	371	94.5	25.4		5.2	4.0	135						
31	August 31	Loma	79	363	86.2	23.8		4.2	2.8	145						
32	September 1	do	81	361	90.0	24.9		4.4	3.4	152						

TABLE 8.—*Efficiency of coconut oil extraction by the Lava process, using crude rollers and nonsolid-ejecting centrifuges*—Cont.

Experiment No.	Date.	Nuts. Source.	Nuts. Weight per 100.	Nuts. Weight of meat per 1,000.	Nuts. Actual yield of oil per 1,000.	Actual oil yield (based on weight of fresh meat).	Weight of total oil obtainable from 1,000 nuts.	Weight of wet, coarse protein solids per 1,000 nuts.	Weight of wet, fine protein solids per 1,000 nuts.	Weight of wet sapal per 1,000 nuts.	Water in sapal (wet basis).	Weight of oil in sapal from 1,000 nuts.	Unextracted oil in sapal (based on total obtainable).	Weight of dry, oil-free sapal per 1,000 nuts.	Dry, oil-free sapal (based on fresh meat).	Efficiency of oil recovery.
1	2	3	4		6	7	8	9	10	11	12	13	14	14	16	17
33	September 2	Loma	76	332	82.0	25.0	105.0	4.5	3.0	122	58.6	20.0	20.0	30	9.1	78
34	September 3	do	76	342	84.0	24.5	108.7	4.8	3.1	125	52.4	24.7	22.6	35	10.2	77
35	September 6	Dita, Bautista	83	340	96.0	28.1		4.6	3.4	125						
36	September 7	Bautista	83	350	96.0	27.6	115.9	3.8	2.0	119	52.0	19.9	17.1	37	10.5	83
37	September 8	Bautista (ripe)	83	340	96.0	28.1	120.0	4.6	3.8	120	46.5	24.0	20.0	40	11.7	80
38	September 9	Mercado (picked green)	81	345	86.0	25.0		4.4	3.8	116						
39	September 10	do	79	340	85.5	25.2	106.8	4.4	2.8	115	57.2	21.3	20.0	28	8.5	80
40	September 15	do	76	326	87.0	26.5	101.3	4.5	1.5	107	53.0	15.4	15.2	35	10.7	85
41	September 16	do	76	326	87.0	26.8	105.3	3.8	2.0	99	49.3	18.3	17.4	32	9.8	83
42	September 17	Mercado, Fernandez	75	325	90.5	27.9	105.6	3.6	2.25	99	55.6	15.1	14.2	29	8.9	86
43	September 20	Fernandez, Noma	83	365	94.0	25.6	111.1	4.9	1.8	104	45.0	17.1	15.3	40	10.9	85
44	September 21	do	81	356	93.0	26.2	107.2	4.8	2.2	103	50.5	14.2	13.2	36	10.1	87
45	September 22	do	81	351	94.0	26.6	110.7	4.6	2.0	103	47.9	16.7	15.0	37	11.7	85
46	September 23	Villanueva (Sibulan)	81	356	93.5	26.1	112.1	5.3	2.8	104	43.5	18.6	16.6	40	11.2	83
47	September 24	do	82	370	96.0	26.0	109.8	5.2	3.2	99	47.5	13.8	12.5	38	10.3	88
48	September 25	do	80	361	93.0	26.1	105.0	5.3	2.3	97		(12.0)	(11.4)			89
49	September 26	do	79	360	95.2	26.4	111.0	4.4	2.8	96	44.0	15.8	14.2	38	10.5	86
50	September 29	Roberto Orlandes	88	370	103.8	28.0	120.4	5.0	2.8	99		16.6	(13.8)			86
51	September 30	S. Fernandez (old nuts)	88	381	98.4	25.8	111.3	4.6	3.0	102	43.0	12.9	11.6	45	11.8	88
52	October 1	do	80	355	95.0	26.8	108.4	4.4	2.8	91	43.0	13.4	12.4	38	10.7	88

53	October 2	P. Toscara	82	366	97.0	26.1	109.0	4.6	3.6	105	47.0	12.0	11.0	44	12.0	89
54	October 5	Aniquinta	80	362	98.8	27.1	112.6	4.6	3.2	102	46.4	13.8	12.2	41	11.3	88
55	October 6	do	82	356	97.4	27.4	112.5	6.8	2.8	100	45.2	15.1	13.3	40	11.2	87
56	October 7	do	83	366	97.5	26.6		5.0	2.8	100						
57	October 8	Mercado	77	333	92.4	27.9	105.8	4.8	3.0	98		(13.4)	(12.6)			87
58	October 11	do	76	329	88.4	26.8	101.8	3.2	2.8	97	47.0	13.6	13.3	38	11.5	87
59	October 12	Suelam	72	311	88.0	28.3	97.5	5.2	2.6	90	53.1	9.5	9.7	33	10.6	90
60	October 13	Chiquito	84	349	93.0	26.7	101.8	4.6	3.4	99	55.5	8.8	8.6	35	10.0	91
61	October 14	do	83	358	90.0	25.2	101.0	5.2	3.2	97	44.8	11.0	10.9	42	11.7	89
62	October 15	do	80	348	92.0	26.5	104.4	4.4	3.4	90	47.2	12.1	11.6	35	10.0	88
63	October 18	do	78	344	87.2	25.2	103.0	4.8	2.6	93		(15.8)	(15.3)			85
64	October 19	do	74	339	87.2	25.2	102.2	4.6	3.4	98		(15.0)	(14.7)			85
65	October 20	do	75	330	89.0	27.0	100.1	5.2	2.8	98		(11.1)	(11.1)			89
66	October 21	do	77	340	92.6	27.3	103.4	5.6	4.2	113		(10.8)	(10.4)			90
67	October 22	do	75	334	93.0	27.8	102.4	8.2	3.8	106		(9.4)	(9.2)			91
68	October 25	Chiquito (ripe)	80	344	94.8	27.6	107.8	7.8	3.2	107		(13.0)	(12.0)			88
69	October 26	do	80	339	90.8	26.7	102.6	6.0	2.8	106		(11.8)	(11.5)			88
70	October 27	do	79	335	91.0	27.2	104.2	7.2	3.2	104		(13.2)	(12.7)			87
71	October 28	do	79	341	93.0	27.1	106.4	7.4	3.4	110		(13.4)	(12.6)			87
72	October 29	do	79	346	89.0	25.8	98.2	6.4	3.8	87	44.7	9.2	9.4	39	11.2	91
73	November 1	Chiquito, Anong	81	349	99.2	28.3	106.4	8.4	3.2	89		(7.2)	6.8			93
74	November 2	do	81	353	92.5	26.1	106.9	6.8	4.5	101	45.6	14.4	13.4	41	11.6	87
75	November 3	do	81	369	90.5	24.5		5.4	10.1	103						
76	November 4	do	82	359	96.0	26.8		6.2	3.4	87	47.8	12.9		33		
77	November 5	do	81	347	94.0	27.1		7.0	3.6	84						
78	November 8	do	79	343	90.0	26.1		7.0	5.2	89						
		Average	80	355	93.6	26.7	108.1	5.5	3.2	106	50.2	14.6	13.4	37	10.7	86

Average total obtainable oil based on fresh meat, 30.5 per cent.

TABLE 9.—*Some data on the use of crude rollers and Westphalia centrifuge for the Lava process.*

Experiment No.	Date.	Actual number of nuts used.	Temperature of water used.	Pressure on rollers (empirical).	Volume of first extract, per 1,000 nuts.	Period of first extraction per 1,000 nuts.	Period of centrifuge of first extract, per 1,000 nuts.	Volume of centrifuged first extract, per 1,000 nuts.	Volume of 2d and 3d extracts, per 1,000 nuts.	Period of 2d and 3d extraction, per 1,000 nuts.	Period of centrifuge of 2d and 3d extracts, per 1,000 nuts.	Total volume of cream per 1,000 nuts.	Total volume cream is made up to before treatment, per 1,000 nuts.	Period of centrifuge of treated cream, per 1,000 nuts.	Efficiency of oil recovery.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	1937		°C.		*Liters.*	*Min.*	*Min.*	*Min.*	*Liters.*	*Min.*	*Min.*	*Liters.*	*Liters.*	*Min.*	*Per cent.*
1	July 14	150	40–60	----	800	100	----	----	1850	234	----	----	----	----	----
2	July 15	150	40–60	----	930	100	----	----	1070	200	----	----	----	600	----
3	July 16	150	60–95	----	600	----	----	----	930	----	----	----	----	----	----
4	July 20	150	56–95	----	530	----	----	----	1000	----	400	----	----	----	----
5	July 21	150	63	----	600	100	----	----	670	234	400	----	----	700	----
6	July 22	150	60	----	530	100	----	----	670	300	400	----	----	800	----
7	July 23	150	40	----	530	100	----	----	730	200	600	----	----	----	----
8	July 27	150	80	----	670	67	----	----	670	267	233	----	----	700	----
9	July 28	150	80	----	530	80	----	----	530	287	267	----	----	600	----
10	July 29	150	80	69/71/73	470	80	----	----	730	267	367	----	----	800	----
11	July 30	150	80	71/73/73	730	87	----	----	730	267	267	----	----	700	----
12	August 2	150	80	71/75/77	470	113	----	----	830	300	680	----	----	1200	----
13	August 3	150	80	71/77/79	670	140	----	----	1000	307	680	----	----	1200	----
14	August 4	150	70	71/79/81	730	107	----	----	800	367	800	----	----	920	95
15	August 5	150	80	71/77/79	770	183	----	----	800	467	1000	----	----	1400	96
16	August 6	150	80	71/77/79	570	200	----	----	500	307	400	----	----	2400	----
17	August 9	200	80	71/77/79	600	170	----	----	----	360	400	----	----	1080	----
18	August 10	300	80	71/77/79	500	117	----	----	----	254	234	----	----	2030	86
19	August 11	300	80	71/77/79	450	110	117	100	----	270	140	150	333	1780	83
20	August 12	300	80	71/77/79	430	94	87	117	----	267	190	200	400	600	89
21	August 17	300	80	71/77/79	370	127	100	100	----	294	140	150	333	600	----
22	August 18	300	80	71/77/79	400	87	100	100	----	234	234	183	333	650	----

23	August 19	400	80	71/77/81	425	93	125	88	--------	260	300	163	300	525	87
24	August 20	400	100	71/77/79	425	118	150	100	--------	268	226	162	300	465	85
25	August 23	500	80	71/77/79	--------	100	--------	110	--------	230	--------	180	280	540	87
26	August 24	500	80	71/77/79	--------	108	80	90	--------	198	180	160	280	600	--------
27	August 25	500	80–60	71/77/79	--------	92	92	100	--------	166	308	160	280	600	--------
28	August 26	500	80–60	71/77/79	--------	64	80	90	--------	126	126	170	280	480	78
29	August 27	500	80–60	73/79/81	--------	80	58	100	--------	136	120	180	280	420	78
30	August 30	600	60	73/79/81	--------	99	80	97	--------	293	182	200	234	400	--------
31	August 31	600	60	73/79/81	--------	70	59	92	--------	130	94	153	234	300	--------
32	September 1	700	60	73/79/81	--------	63	57	93	--------	156	143	173	209	430	--------
33	September 2	700	60	73/79/81	--------	67	64	83	--------	188	140	173	200	340	78
34	September 3	700	60	73/81/83	--------	71	57	89	--------	185	91	157	200	360	77
35	September 6	800	60	73/83/83	--------	69	52	94	--------	266	121	162	187	300	--------
36	September 7	800	80	75/81/83	--------	100	54	100	--------	177	113	162	200	300	83
37	September 8	800	80	75/83/85	--------	80	65	100	--------	202	137	187	200	280	80
38	September 9	800	80	{75/81/83 {71/81/83	--------	32	62	91	--------	100	137	200	212	280	(b)
39	September 10	800	80	75/81/83	--------	85	59	87	--------	--------	--------	200	212	--------	b 80
40	September 15	800	80	{71/77/79 {75/83/85	--------	32	49	79	--------	128	123	167	187	280	b 85
41	September 16	800	80	75/83/85	--------	32	50	75	--------	121	141	160	187	270	b 83
42	September 17	800	80	75/83/85	--------	34	56	87	--------	130	119	175	187	280	b 86
43	September 20	800	80	75/83/85	--------	31	56	87	--------	128	137	173	187	310	b 85
44	September 21	800	80–90	75/83/85	--------	32	35	75	--------	135	113	163	187	250	b 87
45	September 22	800	80–90	75/83/85	--------	30	44	77	--------	131	89	168	187	290	b 85
46	September 23	800	80–90	{71/77/79 {75/83/85	--------	29	56	77	89	264	136	163	182	275	b 83
47	September 24	500	80–90	75/83/85	--------	72	44	76	84	314	140	180	200	216	a 88
48	September 25	600	80–90	{71/79/81 {75/83/85	--------	40	70	100	100	444	140	200	240	400	b 89
49	September 26	500	80–90	73/83/85	--------	174	120	124	80	304	180	204	240	280	d 86
50	September 29	500	80–90	77/83/85	--------	128	140	140	60	206	102	200	240	290	d 86
51	September 30	500	80–90	75/83/85	--------	144	136	140	60	296	104	200	240	280	d 88
52	October 1	500	80–90	75/83/85	--------	122	130	124	56	270	148	180	220	300	d 88
53	October 2	500	80–90	73/83/85	--------	184	140	140	80	330	114	200	240	360	d 89
54	October 5	500	80–90	75/83/85	--------	50	110	150	--------	278	134	220	240	360	d 88
55	October 6	500	80–90	75/83/85	--------	76	134	96	66	340	178	160	200	360	d 87
56	October 7	500	80–90	75/83/85	--------	158	160	144	76	350	177	220	260	260	(d)
57	October 8	500	80–90	75/83/85	--------	128	144	120	60	282	120	180	220	260	d 87

TABLE 9.—*Some data on the use of crude rollers and Westphalia centrifuge for the Lava process*—Continued.

Experiment No.	Date.	Actual number of nuts used.	Temperature of water used.	Pressure on rollers (empirical).	Volume of first extract, per 1,000 nuts.	Period of first extraction per 1,000 nuts.	Period of centrifuged of first extract, per 1,000 nuts.	Volume of centrifuge first extract, per 1,000 nuts.	Volume of 2d and 3d extract, per 1,000 nuts.	Period of 2d and 3d extraction, per 1,000 nuts.	Period of centrifuge of 2d and 3d extracts, per 1,000 nuts.	Total volume of cream per 1,000 nuts.	Total volume cream is made up to before treatment, per 1,000 nuts.	Period of centrifuge of treated cream, per 1,000 nuts.	Efficiency of oil recovery.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
58	October 11	500	80–90	75/83/85	------	134	104	120	60	230	130	180	220	300	[d] 87
59	October 12	500	60	75/83/85	------	144	122	120	46	226	114	166	200	240	[d] 90
60	October 13	500	60	75/83/85	------	154	140	122	58	298	86	180	220	240	[d] 91
61	October 14	500	60	75/83/85	------	150	90	126	54	256	114	180	220	260	[d] 89
62	October 15	500	80–90	75/83/85	------	136	136	120	70	236	150	190	220	240	[d] 88
63	October 18	500	80–90	75/83/85	------	104	112	124	52	208	108	180	220	240	[d] 85
64	October 19	500	80–90	75/83/85	------	144	140	120	80	330	180	180	220	240	[d] 85
65	October 20	500	80–90	75/83/85	------	144	138	120	60	348	111	180	220	240	[d] 89
66	October 21	500	80–90	75/83/84	------	78	80	90	100	392	104	190	220	280	[c] 90
67	October 22	500	80	75/83/85	------	86	70	84	86	556	136	170	200	180	[c] 91
68	October 25	500	80	75/83/85	------	74	80	90	110	326	140	200	210	240	[c] 88
69	October 26	500	80	75/83/85	------	62	74	80	90	402	100	190	200	240	[c] 88
70	October 27	500	80	75/83/85	------	60	54	78	102	366	120	180	220	280	[c] 87
71	October 28	500	80	75/83/85	------	60	48	78	112	332	88	190	200	260	[c] 87
72	October 29	500	80	75/79/81	------	72	48	76	88	354	92	160	200	240	[c] 91
73	November 1	500	80	75/83/85	------	80	50	80	94	416	120	174	200	240	[c] 93
74	November 2	800	80	{71/79/81 75/83/85}	------	32	40	72	94	187	80	166	198	250	[b] 87
75	November 3	800	80	75/83/85	------	30	38	72	------	------	------	------	225	------	([b])
76	November 4	500	80	75/83/85	------	72	38	80	110	326	134	190	230	240	([a])
77	November 5	500	80	75/83/85	------	63	44	80	110	292	84	190	230	240	([a])
78	November 8	500	80	75/83/85	------	112	32	72	94	388	110	190	230	240	([a])

[a] 1 pair of rollers used. [b] 2 pairs of rollers used. [c] 3 extractions, 1 pair of rollers. [d] 4 extractions, 1 pair of rollers.

Table 9 gives data on the performance of the crude rollers used for pressing the emulsion from either the coarsely ground or shredded meat, and on the performance of three small Westphalia centrifugal separators (Type OA 800, with a capacity each of 350 liters per hour) in the separation of the oil, solids, and water.

DISCUSSION OF RESULTS

Tables 1 to 7 show that cage hydraulic pressure alone, even when the coconut meat is grated and even further ground, cannot be expected to effect a very high extraction of oil. While errors in manipulation are to be noted in these tables, as shown by lack of checks in some cases, these errors are small compared with actual extractions.

From Table 1 it may be concluded that while pressure has no appreciable effect on the extraction of oil in the first pressing, it has some effect on the extraction in the successive pressings. Meat pressed at 100 atmospheres per square inch in the first pressing yields about the same amount of oil as meat pressed at 600 atmospheres, while meat pressed at 100 atmospheres in the third pressing yields a smaller amount of oil than meat pressed at 600 atmospheres. Table 1 also shows that pressure has some effect on the extraction of nonoil solids (sugars and proteins), and that the lower the pressure used, the greater the difference between nonoil solids extracted in the first and third pressings. While at 100 atmospheres 69 per cent of the total obtainable oil and around 33 per cent of the total nonoil solids are extracted in the first pressing, and 71 per cent of the total oil and around 46 per cent of the total solids in the third pressing, at the higher pressure of 600 atmospheres, 68 per cent of the total oil and around 60 per cent of the total solids are extracted in the first pressing, and 83 per cent of the total oil and around 60 per cent of the total solids in the third pressing.

The percentages of water, oil, and nonoil solids in Table 1 are significant; in fact, results of analyses shown in Tables 1 to 7 show that the average water content of fresh meat is 51.8 per cent, the average oil content is 31.6 per cent, and the average content of nonoil solids is 16.6 per cent. Table 1 also shows that the protein content ($N \times 5.8$) of the fresh meat is around 3.5 per cent, and that while only around 0.74 per cent is left in the cake after the third pressing, this quantity is equivalent to 8.1 per cent in the dry, oil-free cake. This percentage of protein in the pressed coconut cake is still higher than those found in many cereals.

In Table 2 is shown the effect of the amount of water mixed with the meat before first pressing on the efficiency of extraction. Here, however, instead of determining the amounts of extracted oil and solids by the usual method of determining the percentages of water, oil and solids in both the fresh sample and the cake, the extracted oil emulsion was boiled to almost complete dehydration of the proteins, and the remaining mixture was pressed to produce the protein cake; the extracted oil was calculated from the actual amount of the oil separated out and the oil (determined also by solvent extraction) in the pressed protein cake, and the total extracted solids were calculated from the pressed protein cake after drying and solvent extraction.

Table 2 also shows that the efficiencies of oil extraction and of the extraction of nonoil solids do not vary much from those recorded in Table 1, and that the addition of from 50 to 200 per cent of water (based on the fresh meat) does not change the efficiency of extraction. Exception must be made in the case where no water is added at all; in this case the oil extraction seems to be definitely less than when water is added; and even the weight of the emulsion obtained per kilogram of fresh meat is less.

Table 3, giving the effect of the amount of water mixed with the cakes in the second and third pressings, shows that an increase in water for mixing has no appreciable effect on the efficiencies of oil and nonoil solids extraction.

Table 4 shows that changes in the temperature of the mixture of water and fresh meat before pressing (between 28° C. and 46° C.) have hardly any effect on the efficiencies of extraction of oil and nonoil solids. Only when the temperature goes below the solidification point of coconut oil (around 21° C.) can the effect of temperature be expected to be appreciable.

Even the time of contact between the water and the fresh meat before pressing does not seem to have any appreciable effect on the efficiencies of extraction of oil and nonoil solids as is shown Table 5.

The effect of the pH of the water used with the fresh meat on the efficiency of extraction is shown in Table 6, which indicates that while a low pH of water decreases the efficiency of oil extraction, a high pH increases the efficiency of extraction of the oil; in the case of the nonoil solids, no appreciable effect is noted with change of pH of the water. In any case, the effect of a change in the pH of the emulsion to 9.6 does not seem to increase the efficiency of oil extraction to more than 76 per cent; furthermore, it is doubtful whether the addition of an alkali to the fresh meat will not change the quality of the oil and its by-products.

Again, Table 7 shows that grinding after grating increases the efficiencies of oil extraction and of the extraction of nonoil solids by about 10 per cent.

From Tables 1 to 7 it must be concluded that while the factors of cage hydraulic pressure, temperature, further grinding, the amount of water mixed with the grated fresh coconut meat, and the pH of the water, play some rôle in the extraction of oil and nonoil solids from the meat, under no circumstances within the limits of the above experiments was the efficiency of oil extraction increased to over 70 per cent in the first pressing and to over 83 per cent in the third pressing by any of these factors.

The use of rollers for extraction, however, has better possibilities. Table 8 shows the results of extraction with mild steel rollers, 28 inches long and 10 inches in diameter. These rollers are placed one on top of the other, have rough surfaces, and have a speed of 8 to 16 R. P. M. The comminuted meat is fed to the rollers on one side by means of a moving plate actuated by a cam. Water is allowed to trickle on the meat before it passes between the rollers. After the first pressing the cake collected on the other side of the rollers is again placed on the moving plate for second and third pressings; in both cases water is allowed to trickle on the cake before pressing. The amount of total oil obtainable from each lot of fresh meat, and of the oil left in the cake, were determined by the usual method of getting samples, drying them, and extracting the oil with a solvent. The actual yield of oil in each lot was found by weighing the dry oil separated by the centrifuge, after treatment of the emulsion according to the process described. In those cases where the total obtainable oil and the actual oil yield are the only data taken in the experiment, the oil in the cake was calculated from the difference in the two oil determinations. Such values are given in parenthesis in columns 13 and 14 of Table 8. In almost all cases the difference between the amount of oil in the sapal determined by solvent extraction and that calculated from the oil in the original fresh meat and the oil yield, was not more than 1 kilogram per 1,000 nuts.

Table 8 shows that with the use of rollers and with three pressings, the lowest efficiency of oil recovery obtained is 77 per cent and the highest is 96 per cent, the average efficiency of all the runs being 86 per cent. In more concrete terms, 1,000 nuts weighing 800 kilograms (husked),[6] and containing 355 kilograms of fresh unpared meat and 108.1 kilograms of total obtainable oil, yield with our crude unmechanized rollers and with small-capacity Westphalia centrifuges, 93.6 kilograms of white, non-rancid, acid-free oil. Furthermore, from the same 1,000 nuts, 106 kilograms of wet coconut cake, of which 53.2 kilograms (that is, 50.2 per cent of the cake) are water, 14.6 kilograms are oil, and 37 kilograms are dry, oil-free solids (mostly carbohydrates and protein), and 8.7 kilograms of wet protein cake with some oil, are obtained as by-products. The aqueous solution separated from the different extractions, which contain plenty of soluble sugars, are not considered in this series of experiments, although it has been well established by us that good alcohol and vinegar can be prepared from this solution, and that this aqueous extract may well be used with the protein cake in the preparation of "Cocohoney."

Or again, expressed in another way, of the total obtainable oil, which is 30.5 per cent of the fresh meat, the actual yield of oil by the new process, involving the use of crude rollers and small-scale centrifuges, is 86 per cent, which is equivalent to 26.7 per cent of the fresh unpared meat; and the dry, oil-free solids obtained as residue is 10.7 per cent of the fresh unpared meat. The latter figure corresponds, within 1 to 2 per cent, to the values for dry, oil-free coconut cake given in Tables 1 to 7.

The performances of the rollers and the Westphalia centrifuges are described in Table 9. After the emulsion is extracted by use of the rollers, it is pumped into a tank from which it goes by gravity to a low-power centrifuge for the separation of the fine cellulosic materials and of some easily precipitated proteins. The cream obtained is then treated to precipitate the proteins, and after a few hours passed through a higher power separator for the separation of the oil.

Table 9 shows that the shortest time necessary with the rollers used in the first extraction of the emulsion from 1,000 nuts, is 50 minutes when one pair of rollers is used, and 29 minutes when two pairs of rollers are used. The time varies, depending on how well the feeding of the comminuted meat can be made, which is indicated by the fact that in the case of a good feed the cake, after passing through the rollers, comes out comparatively dry in the form of a uniform mat.

[6] This figure is rather low, and is due, probably, to the fact that many unripe coconuts, discarded by the desiccating factories, were used in the pilot plant.

With regard to the combined period of extraction in the second and third pressings, while the minimum period is 126 minutes for one pair of rollers and 100 minutes for two pairs of rollers, much longer periods are necessary in most of the experiments. Furthermore, no uniform mats of cake are found, and the cake is rather moist in some places. A close inspection of the rollers shows that they do not meet at all points, thus allowing the passage of the emulsion along with the outgoing cake. This contamination of the dry cake by the emulsion pressed out during the period of pressure in the roller surfaces accounts to some extent for the still high oil content of the coconut cake and for the total low average efficiency of oil recovery of around 86 per cent. It would appear from our observations that a few improvements could be made in the extraction of emulsion from coconut meat by means of rollers; such as (*a*) uniform rough surface of the rollers which should meet at all points; (*b*) a smaller number of revolutions of the rollers in conjunction with a larger diameter of the rollers; and (*c*) a better system of feeding of the comminuted meat to the rollers.

After passing through a low-power centrifuge, the minimum volume of cream obtained per 1000 nuts after the first extraction is 72 liters and the maximum is 150 liters, while the minimum combined volume of cream obtained after the third extraction is 133 liters and the maximum is 220 liters.

The poor performance of the Westphalia centrifuge used may easily be understood, considering that it is a nonsolid-ejecting small-capacity centrifuge with a maximum bowl speed of 5,800 R.P.M. There is now on the market a solid-ejecting centrifuge of high capacity with a speed of 6,400 R.P.M. However, even with the small-capacity Westphalia centrifuges used, the minimum period for centrifuging the first extracted emulsion from 1000 nuts is 35 minutes, and the maximum period is 160 minutes. The minimum period for centrifuging the combined extractions from the second and third pressings is 80 minutes and the maximum period is 1000 minutes, which was obtained at the beginning of our series of experiments, while the minimum period for centrifuging the total treated cream for oil separation is 180 minutes and the maximum period is 2400 minutes, which was also obtained at the beginning of our series of experiments.

COMMERCIAL POSSIBILITIES OF EXTRACTING OIL FROM FRESH COCONUT MEAT BY THE NEW PROCESS

The only way the commercial possibilities of extracting oil directly from fresh coconut meat may be evaluated is by comparing the cost of processing by any of the processes involving this concept (that is, the Lava process), with that by the copra-expeller process on low-grade copra.

Table 10 shows the cost of processing of coconut oil by the Lava process, not taking into consideration the commercial possibilities of the by-products. Table 10 shows the cost of factory and equipment for a production capacity of about 10 tons of oil a day involving 30,000,000 nuts a year, as well as the total cost per year of processing the coconuts to coconut oil; Table 11 shows the amount of oil obtainable per year, as affected by the efficiency of oil recovery (from 50 to 100 per cent) and taking into consideration the quality, specifically, the ripeness of the nuts and the regions from which they come; and Table 12 shows the cost of processing one kilo of coconut oil, as affected by the factors indicated in Table 11. The cost of processing shown in Table 12 is graphically shown in text fig. 1.

Table 12 and text fig. 1 show that the cost of processing of coconut oil per kilo is 0.0464 peso at 70 per cent efficiency of oil recovery, 0.0383 peso at 85 per cent efficiency, and 0.0342 peso at 95 per cent efficiency, when coconuts yield 108 kilograms of total obtainable oil per 1,000 nuts of 800 kilograms (husked); when coconuts yield 124 kilograms of total obtainable oil per 1,000 nuts of 800 kilograms, the cost of processing of coconut oil per kilo is 0.0406 peso at 70 per cent efficiency of oil recovery, 0.0333 peso at 85 per cent efficiency, and 0.0298 peso at 95 per cent efficiency. As coconuts differ in their oil contents, depending upon soil, climate, season, maturity, and other factors, for the purpose of the calculations, the average total obtainable oil in the overripe and semiripe nuts as they are actually picked for copra production may be assumed to be around 116 kilograms per 1,000 nuts of 800 kilograms (husked); with this average the cost of processing of coconut oil per kilogram is 0.0434 peso at 70 per cent efficiency of oil extraction, 0.0356 peso at 85 per cent efficiency, and 0.032 peso at 95 per cent efficiency.

Table 13 shows the cost of processing of coconut oil by the copra-expeller process, not taking into consideration the copra cake and meal by-products. This table shows that if we add up the cost of copraing of 0.50 peso per 1,000 nuts (the average in the Laguna towns is 0.80 peso), the cost of crude oil extraction of 0.015 peso per kilogram (about the average for a small expeller mill), and the cost of oil refining of 0.018 peso per kilogram (reported as the cost of partial refining in the Philippines), the total cost of processing of refined oil is 0.0402 peso

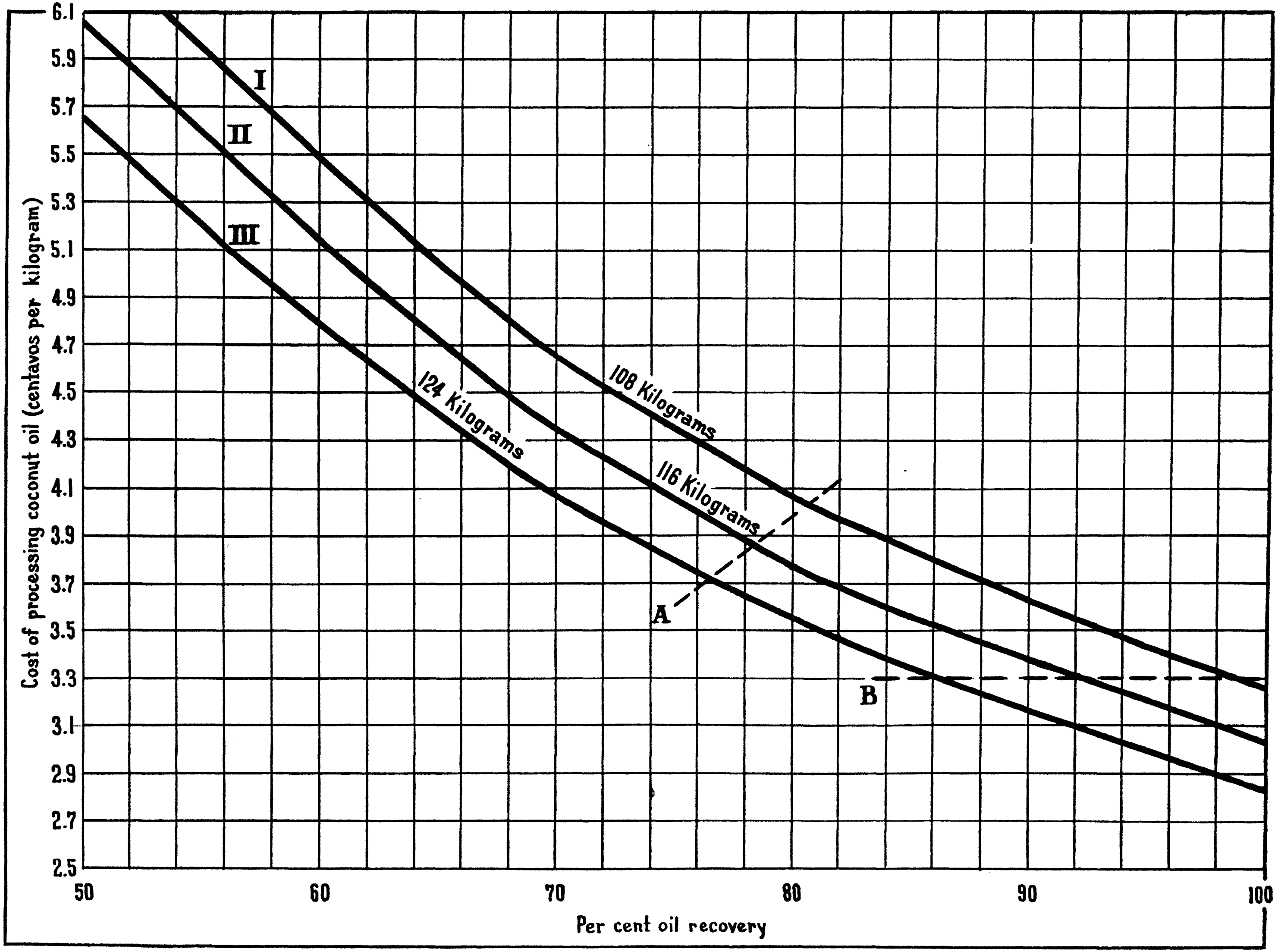

FIG. 1. Comparison of cost of processing coconut oil by the Lava process with that of the expeller process, not taking into consideration by-products. I, Lava process for nuts giving 108 kilograms total obtainable oil per 1,000; II, Lava process for nuts giving 116 kilograms total obtainable oil per 1,000; III, Lava process for nuts giving 124 kilograms total obtainable oil per 1,000; A, expeller process including manufacture of copra; B, expeller process not including manufacture of copra.

TABLE 10.—*Cost of processing coconut oil by the Lava process, disregarding by-products (plant capacity: 30,000,000 nuts per year of 300 days).*[a]

	Pesos
A. Cost of factory and equipment:	
Three grinders or shredders at 500 pesos each	1,500
Four pair of rollers, 36 inches long, 10 inches diameter, at 800 pesos each	3,200
Four pairs of rollers, 36 inches long, 15 inches diameter, at 1,800 pesos each	7,200
Four pairs of rollers, 36 inches long, 20 inches diameter, at 3,200 pesos each	12,800
Three rotojectors at 8,500 pesos each	25,500
Three driers, at 1,500 pesos each	4,500
One deodorizer, at 7,500 pesos each (complete)	7,500
One boiler, 80 H. P., with 100 to 125 pounds steam (complete)	4,500
One gass producer engineer, 250 H. P., with motor	45,000
Fifteen electric motors for rollers and centrifuges	5,600
Tanks	5,000
Wiring and switches	2,500
Conveyors	5,000
Piping	1,500
Land, building, and installation	25,000
Concrete foundation	3,000
Miscellaneous	10,700
Total	170,000
B. Total cost of processing per year:	
Shelling, at 1 peso per 1000 nuts	30,000
Labor, 30 men at 1 peso per day	9,000
Reserve for depreciation, 5 per cent of cost of factory and equipment	8,500
Repairs, at 5 per cent of cost of factory and equipment	8,500
Fuel and lubrication	2,000
1 plant manager, 6,000 pesos per year	6,000
1 chief chemist, 3,600 pesos per year	3,600
3 technicians, 1,200 pesos per year	3,600
1 chief engineer, 3,600 pesos per year	3,600
3 mechanics, 1,000 pesos per year	3,000
1 bookkeeper, 1,000 pesos per year	1,000
2 clerks, 480 pesos per year	960
3 extra laborers, 360 pesos per year	1,080
2 janitors, 300 pesos per year	600
Sales tax, 1.5 per cent gross earnings	10,000
Licenses, etc.	8,000
Transportation, chemicals, etc.	6,000
Total costs	105,440

[a] Cost based on 1938 prices.

per kilogram when the coconuts yield 108 kilograms of total obtainable oil per 1,000 nuts, 0.0386 peso per kilogram when the coconuts yield 116 kilograms of total obtainable oil per 1,000 nuts, and 0.0373 peso when the coconuts yield 124 kilograms of total obtainable oil per 1,000 nuts.

Since the millers do not pay for the cost of copraing, to them the cost of processing of refined (deodorized) coconut oil is only 0.033 peso.

TABLE 11.—*Total obtainable oil per year by the Lava process.*

[Per cent capacity, 30,000,000 nuts per year.]

Efficiency of oil recovery.	1,000 nuts yielding 108 kilograms oil (30.5 per cent).	1,000 nuts yielding 116 kilograms oil (32.6 per cent).	1,000 nuts yielding 124 kilograms oil (35 per cent).
Per cent.	*Tons.*	*Tons.*	*Tons.*
100	3,240	3,480	3,720
95	3,080	3,300	3,540
90	2,920	3,140	3,350
85	2,750	2,960	3,160
80	2,590	2,780	2,980
70	2,270	2,430	2,600
50	1,620	1,740	1,860

TABLE 12.—*Cost of processing of 1 kilogram of coconut oil by the Lava process.*

[Per cent capacity, 30,000,000 nuts per year.]

Efficiency of oil recovery.	1,000 nuts yielding 108 kilograms oil.	1,000 nuts yielding 116 kilograms oil.	1,000 nuts yielding 124 kilograms oil.
Per cent.	*Peso.*	*Peso.*	*Peso.*
100	0.0325	0.0303	0.0283
95	0.0342	0.0320	0.0298
90	0.0361	0.0336	0.0315
85	0.0383	0.0356	0.0333
80	0.0407	0.0376	0.0354
70	0.0464	0.0434	0.0406
50	0.0651	0.0606	0.0566

A comparison of the costs of processing oil by the new process and by the copra-expeller process is now possible. In text fig. 1 the points of intersection between the three curves (for nuts yielding 108 kilograms, 116 kilograms, and 124 kilograms, respectively, of total obtainable oil per 1,000 nuts) and line A shows at what efficiencies of oil recovery by the new process, from nuts of varying yields of total obtainable oil, this process may be considered commercially feasible. An efficiency, therefore, of oil recovery by the new process of 76 per cent for nuts giving 124 kilograms of total obtainable oil per 1,000 nuts, of 78 per cent for nuts giving 116 kilograms of oil per 1,000 nuts, and of 81 per cent for nuts giving 108 kilograms of oil per 1,000 nuts, would be sufficient to compete with the expeller process, even when the advantages obtainable from the by-products are not taken into consideration.

Even assuming that the actual cost of copraing is zero (resulting from the possibility of coconut landlords imposing this condition on their tenants and sharecroppers), the average cost of processing of refined oil is 0.033 peso. This corresponds to 92 per cent necessary efficiency of oil recovery by the new process for nuts giving an average total obtainable oil of 116 kilograms per 1,000 nuts (intersection of line B and the three curves, text fig. 1), before commercialization is possible. This is certainly within the realm of possibility, although great care is already indicated as highly necessary in the selection of the nuts, so that only nuts matured for optimum oil content are taken.

Therefore, even when the advantages of the by-products of the new process over those of the copra-expeller process are not taken into consideration, the former process can compete commercially with the latter process, if the extraction of the emulsion from the fresh meat can be sufficiently mechanized and raised in efficiency. But this is not all; as was pointed out in the introduction to this article, direct extraction from the fresh coconut meat allows the utilization of the coconut cake, the coconut protein, and the aqueous solution from the oil emulsion for food.

It has already been pointed out from the data in Tables 1 to 7 (the data in Tables 8 and 9 are not complete and cannot be used for this calculation) that the average water content of the fresh coconut meat is 51.8 per cent, the average oil content is 31.6 per cent, and the average nonoil solids content is 16.6 per cent. If we assume the protein contents of the fresh meat and of the *sapal* (coconut cake) found in Table 1, namely 3.5 per cent and 0.74 per cent, respectively, as the average protein contents in these two products, the amount of protein extracted after the third pressing would be around 2.8 per cent (based on the fresh coconut meat). If we further take as the average efficiency of extraction of nonoil solids after the third pressing, the value of 48 per cent, equivalent to 8 per cent (based on the fresh coconut meat) of protein and carbohydrates, the amount of sugars and other carbohydrates extracted would then be 5.2 per cent (based on the fresh coconut meat). This relationship is shown in Table 14.

TABLE 13.—*Cost of processing refined coconut oil from 30,000,000 nuts by the expeller process, disregarding by-products.*

[Assumed loss from molding, 5 per cent; plant capacity, 30,000,000 nuts per year]

Obtainable oil. Per 1000 nuts.		Obtainable oil. Total.	Available crude oil with 97 per cent efficiency of expeller.	Cost of extracting crude oil at 0.015 peso average per kilogram.	Cost of copraing at 0.50 peso per 1,000 nuts.	Cost of refining crude oil from 30,000,000 nuts at 0.018 peso per kilogram of oil.	Total cost of processing refined oil.	Total refined oil at 2 per cent loss of fatty acids, etc.	Cost of processing 1 kilogram refined coconut oil.	Cost of processing[a] 1 kilogram of refined oil at 0.018 peso for manufacture of crude oil and 0.018 peso for refining (average).	Loss of oil due to molding at 0.15 peso per kilogram.
Kg.	*Per cent.*	*Tons.*	*Tons.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Tons.*	*Pesos.*	*Pesos.*	*Pesos.*
108	30.5	3,080	2,980	48,600.00	15,000.00	53,640.00	117,240.00	2,920	0,0402		25,500.00
116	32.6	3,300	3,200	48,600.00	15,000.00	57,600.00	121,200.00	3,140	0,0386	0,033	25,500.00
124	35.0	3,540	3,440	48,600.00	15,000.00	61,920.00	125,520.00	3,370	0,0373		25,500.00

[a] Excluding copraing and losses in refining.

TABLE 14.—*Approximate composition of the by-products in the Lava process.*

[All percentages based on fresh coconut meat.]

Component.	Fresh meat.	Sapal.	Extracted substances.
Water	51.8		
Oil	31.6		
Nonoil solids	16.6	8.6	8.0
Protein	(3.5)	(0.74)	[a](2.8)
Sugar and other carbohydrates			[b](5.2)

[a] From centrifuge. [b] In aqueous solution.

The protein extracted is partly in the form of solids, which are obtained after the emulsion is centrifuged with the low-power centrifuge to obtain the cream, and after the treated cream is again centrifuged to obtain the oil, but most of this extracted protein is dissolved in the skimmed milk obtained during the first centrifuging. The sugars are found mostly in this aqueous extract.

Since we are at present working in a more detailed manner on the composition of coconut meat and on the distribution of its constituents among the different products and by-products, a discussion of the exact quantities of the by-products obtained would be premature and unnecessary. For the purposes of this article, however, it should therefore be sufficient to point out that from 1,000 nuts weighing 800 kilograms (husked) and containing 355 kilograms fresh meat, we can expect around 30 to 37 kilograms of dry, oil-free coconut cake, 2.4 to 10 kilograms of dry, oil-free protein cake, and around 18.5 kilograms of proteins, sugars, and other carbohydrates. Assuming a 92 per cent efficiency of oil recovery from nuts yielding 116 kilograms per 1,000, the amount of oil unextracted would be 9.3 kilograms, which for approximate purposes may be divided between the coconut cake and protein cake to yield approximately 37 to 44 kilograms of dry, oily coconut cake, and 4.7 to 12.3 kilograms of dry, oily protein cake.

Table 15 shows an approximate comparison of a possible income from by-products with the new process (excluding coconut shells not used for power), and the income from copra cake and meal by-products in the expeller process. The coconut cake is assumed to be transformed into flour and sold at 0.02 peso per kilo; the protein is assumed to be sold direct at 0.10 peso per kilo, instead of being converted into milk substitute or "Coco-honey." The sugars from the first maceration water are assumed to be converted into vinegar with around 2.5 per cent acetic acid, which is sold at 0.03 peso per liter, a very, low estimate, considering the price of nipa vinegar.

While the comparison in Table 15 cannot be expected to be rigorous, it shows that an extra income of from 0.04 to 0.048 peso per kilogram of oil produced, may be obtained by the direct extraction of oil by the new process, over the expeller process. For a plant capacity of about 10 tons of oil a day, this extra income amounts to from 607 to 697 pesos a day (over that from oil alone).

TABLE 15.—*Comparison of approximate additional income from by-products of the Lava process and the expeller process.*

Item.	Lava process.	Expeller process.
By-products per 1,000 nuts [a] pesos	[a] 6.07–6.97	[b] 1.95
Total income from by-products per year from 30,000,000 nuts pesos	182,000.00–209,000.00	58,500.00
Total income from by-products per day (300 days a year) pesos	607.00–697.00	----------
Average total production of oil per year [c] tons	3,200	----------
Additional income per kilogram of oil, resulting from by-products pesos	0.057–0.065	0.017

[a] Coconut cake, 37 to 44 kilograms, at 0.02 peso per kilogram, 0.74 to 0.88 peso.
Protein cake, 4.7 to 2.3 kilograms, at 0.10 peso per kilogram, 0.47 to 1.23 pesos.
Sugars with proteins, 18.5 kilograms (162 liters of 2.5 per cent acetic acid at 0.03 peso per liter), 4.86 pesos.

[b] Copra meal, 65 kilograms at 0.03 peso per kilogram.

[c] 92 per cent efficiency of recovery.

Since the coconut cake may be made to yield an income higher than that indicated in Table 15, since the protein cake together with the aqueous solution of coconut sugars can be converted into a more valuable product, and since the excess coconut shells not used for power requirements can be converted into metallurgical carbon or absorbent carbon, the prospect of this new process of oil extraction can be even brighter than indicated in this article.

SUMMARY AND RECOMMENDATIONS

1. From the standpoint of the coconut industry the expeller process for coconut oil extraction, which uses copra that has passed through various stages of decomposition for its raw material, is not economical, in spite of its high degree of mech-

anization and efficiency. One way of increasing the income of the industry is by improving the quality of copra.[7]

2. If the degree of extraction of oil emulsion from fresh coconut meat could be made high, and if the separation of the oil from the emulsion could be made efficient, oil extraction directly from fresh meat should be the more economical method, since a greater quantity of a superior quality oil is produced; the by-products could be used for food and thus be made to yield a greater income, and the shell by-product could be used not only for the power requirements of the plant but also for many other purposes.

3. Preliminary experiments on a laboratory scale and on a pilot-plant scale show that, in conjunction with the Lava process for coconut-oil extraction directly from fresh meat, the roller method of obtaining the oil emulsion from the coconut meat is better than the cage hydraulic press method, that an average of 86 per cent oil recovery can be made with the crude rollers used, but that improvements in the system of feeding fresh meat and in roller design are necessary before the process can be considered commercially practicable.

4. Calculations of the costs of processing of oil by this new process and by the expeller process, disregarding by-products, show that an oil recovery efficiency of from 76 to 81 per cent, or, at the most, of 92 per cent, with the new process, would be sufficient to compete with the expeller process.

5. A comparison of a possible income from by-products from the new process and the income from copra meal and cake from the expeller process shows that an extra income over that from the use of the latter process of from 0.04 to 0.048 peso per kilo of oil produced, may be obtained with the use of the former process.

6. Further improvements in the design of the roller press and in the feeding system for the comminuted meat, together with more intensive experiments on the utilization of the by-products of coconut oil obtained directly from fresh meat, are recommended.

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[7] One possible method is by taking the fresh meat from the shells, comminuting and drying it, as is done in the coconut desiccating plants, and finally passing the dried comminuted meat through expellers. In this way the cake can be sold at a much higher price than that of copra cake.

ILLUSTRATION

TEXT FIGURE

FIG. 1. Comparison of the cost of processing coconut oil by the Lava process with that of the expeller process, not taking into consideration by-products. I, Lava process for nuts giving 108 kilograms total obtainable oil per 1,000; II, Lava process for nuts giving 116 kilograms total obtainable oil per 1,000; III, Lava process for nuts giving 104 kilograms total obtainable oil per 1,000; A, expeller process including manufacture of copra; B, expeller process not including manufacture of copra.

PARAGONIMUS WESTERMANII

CASE REPORT WITH MICROPHOTOGRAPH OF OPERCULUM OF THE OVUM SPRUNG OPEN [1]

By C. M. HASSELMANN [2]

Practising Physician and Surgeon, Manila

TWO PLATES

The eggs of the following species of the more common parasitic helminths are operculated: *Paragonimus westermani, Clonorchis sinensis, Opisthorchis felineus, Metagonimus yokogawai,* and other heterophyids; and *Echinostoma ilocanum, Fasciola hepatica, Fasciolopsis buski,* and *Diphyllobotrium latum.* As I have never found in the available literature a photomicrograph of the operculum sprung open, I regard it as extremely good fortune that I am able to present here a photomicrograph obtained by me of this phenomenon.

The problem of paragonimiasis in the Philippines was first dealt with by Musgrave in 1907,[3] by Garrison [4] in 1908, and by Garrison and Leynes [5] in 1909. Recently interest in trematode infestation has increased in the Philippine Archipelago, due the opening up of new farm settlements, increased activity in the mining industry, and the resulting migration of populations and the discovery of new foci of infestation, especially in the northeastern coastal region of Mindanao.

The parasite in question was found in a male patient, 22 years old, a resident of Naga, Camarines Sur Province, Luzon. This man complained of cough and slight hæmoptysis in 1938, and again in 1940. Fever, general malaise, and other gross disease

[1] Demonstrated at the Scientific Meeting of the Manila Medical Society, held September 10, 1940.

[2] Staff member, St. Luke's Hospital; Assistant Professor, Afable College of Medicine and Surgery; former Special Consultant, U. S. Public Health Service, Washington, D. C.

[3] Musgrace, W. E. Paragonimiasis in the Philippine Islands. Philip. Journ. Sci. § B 2 (1907) 15–65.

[4] Garrison, P. E. Philip. Journ. Sci. § B 3 (1908) 203, 204.

[5] Garrison, P. E. and R. Leynes. Ibid. § B 4 (1909) 177–183.

symptoms were absent. His weight remained stationary at 54 kilograms, his sublingual temperature in the afternoon was 37.2° C., with pulse 76 of normal quality and rhythm. The urine was acid and negative for albumen, sugar urobilinogen, cellular elements, and casts. The number of red and white blood cells and the amount of hæmoglobin were all normal. Differential count revealed only a slight eosinophilia; nonsegmented polymorphonuclears, 3 per cent; segmented polymorphonuclears, 49 per cent; large lymphocytes, 2 per cent; small lymphocytes, 38 per cent; monocytes, 1 per cent; basophiles, 1 per cent, and eosinophiles, 6 per cent. Physical examination disclosed no gross pathological findings, except very moderate dullness on percussion over both entire lungs, together with decreased breathing sounds but without rales.

No acid-fast bacilli could be found in the blood-tinged, mucoid sputum, but the abundance of pus cells was suspicious. Examination of the fresh, native sputum preparation revealed the presence of the typical *Paragonimus* eggs.

In addition, an X-ray picture was made, and interpreted by Dr. R. C. Yuzon as follows:

> Presence of numerous, small, round, and scattered opaquities in a network of fibrosis in both hemithoraces, especially on the right side. A line of interlobitis in the right hemithorax. Pleura negative. Radiological impression: The character of the above mentioned opaquities not typical of tuberculous lesions of the lung; more indicative of numerous, small sacs of pus in scattered foci as encountered in staphylococcal pyemia.

Therapeutically, Emetine 0.05 was given intravenously several times, after which the slightly blood-stained sputum greatly diminished in quantity, and its color became whitish-yellowish. After that "Antimosan" was given intramuscularly. The patient soon felt well, and stayed away. It is, of course, impossible to evaluate the effect of the medication, since too few injections were given and no follow-up was possible, except to state that hæmoptysis promptly stopped after the second intravenous Emetine injection.

ILLUSTRATIONS

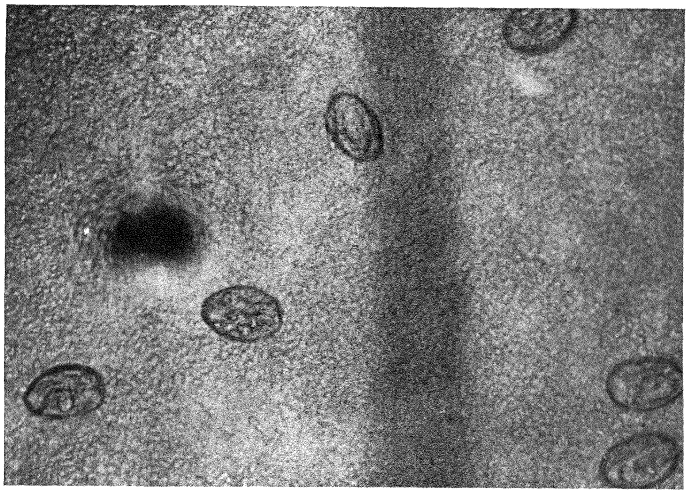
PLATE 1

FIG. 1. Photomicrograph of ova *Paragonimus westermanii* in sputum; low power.

2. Photomicrograph of ovum of *Paragonimus westermanii* with operculum clearly visible; high power.

PLATE 2

Photomicrograph of operculum of an ovum of *Paragonimus westermanii* sprung open.



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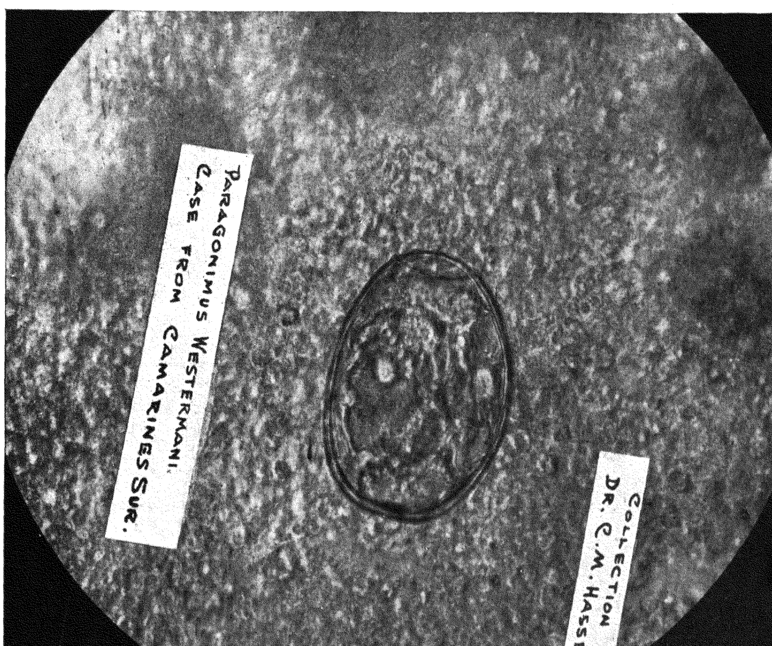
PARAGONIMUS WESTERMANI.
CASE FROM CAMARINES SUR.
COLLECTION OF
DR. C.M. HASSELMANN

2

PLATE 1.

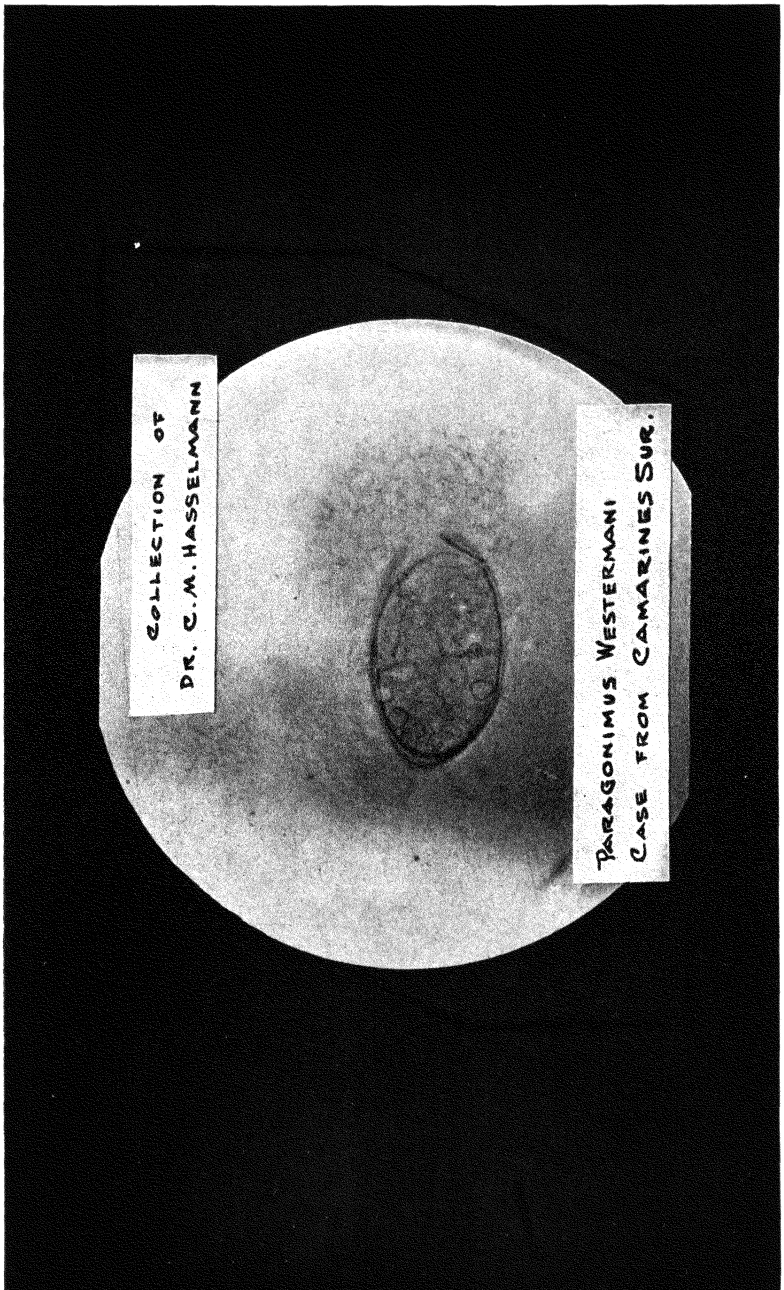
COLLECTION OF
DR. C. M. HASSELMANN
PARAGONIMUS WESTERMANI
CASE FROM CAMARINES SUR.

PLATE 2.

BOOKS

Books reviewed here have been selected from books received by the Philippine Journal of Science from time to time and acknowledged in this section.

REVIEWS

Fair and Warmer: The Problem of Weather Forecasting and the Work of the United States Weather Bureau. By Joseph Gaer. National Problem Series. New York, Harcourt, Brace and Company. 1939. 137 pp. Price, $1.

According to the author, "A description of weather and weather knowledge, the problems in weather forecasting, and an explanation of the work of the United States Weather Bureau—how it gathers its facts, when and where observations are made, and, most important of all, whom it serves—are the main concern of this book." Rather an ambitious program for such a small book! The book is written in journalistic style with emphasis on the bizarre. The description of the process of weather is not developed in any logical sequence nor does it give an intelligible picture of what goes on in the atmosphere. A disproportionate amount of space is devoted to a description of ancient ideas regarding weather signs and rain making. There are a number of loose statements, some historically false and others scientifically inaccurate. The book has one redeeming quality: it gives a comprehensive picture of the material benefits which the United States Weather Bureau confers on the taxpayers. The loss of property alone, leaving out the question of loss of life, which is prevented by the storm forecasts of the United States Weather Bureau, repays that country many times for what it has invested in meteorological services.—L. W. W.

Leaves and Stems from Fossil Forests. A Handbook of the Palæobotanical Collections in the Illinois State Museum. By Raymond E. Janssen. Popular Science Series, Vol. I. Springfield, Illinois, Illinois State Museum, 1939. 190 pp., illus. Price, $1.25.

This handbook of the palæobotanical collections in the Illinois State Museum is neatly printed and profusely illustrated. The treatment is decidedly simple, and easy for students to grasp because almost every species is clearly described and illustrated.

The author gives a short account of the formation of fossil remains and the exploration of valuable specimens, besides giving in outline form the group, family, and genus to which each species belongs. A brief history of palæobotany, a short bibliography, and an index to the species are also included.

As a whole, this handbook is undoubtedly useful to those interested in palæobotany. The careful reader will perhaps notice the misplacement of the Cordaitales between the Lycopodiales and the Equisetales.—E. T. K.

The Book of Birds. The First Work Presenting in Full Color All the Major Species of the United States and Canada. Edited by Gilbert Grosvenor and Alexander Wetmore. Washington, D. C., National Geographic Society, 1939. 2 vols., illus. Price, $5.

This set of two volumes in thirty-seven chapters depicts in literature and in illustrations most of the North American species of birds. All the articles included in this set have appeared over a period of years in the National Geographic Magazine. The haunts and habits of the birds are masterly described in a familiar style by famous American ornithologists, among them Dr. Alexander Wetmore, Dr. T. Gilbert Pearson, Dr. Robert Cushman Murphy, Dr. Arthur A. Allen, and Dr. Francis H. Herrick, supplemented by portraits largely in colors by the no less known Canadian artist-naturalist, Major Allan Brooks. The set will be a valuable addition to any nature library. It is by far the best literature for amateur bird students, and an important reference for professional ornithologists and artists as well.—C. G. M.

Strange Fish and Their Stories. By A. Hyatt Verrill. Boston, L. C. Page and Company, 1939. 220 pp., front., illus. Price, $2.50.

Written in a popular style for the consumption of the layman this book is readable and understandable. It contains interesting and entertaining descriptions of queer denizens of the seas, lakes, and streams throughout the world, together with vivid narrations of their unique and singular habits and behavior. In short, this work is rich in what we may term mysteries, oddities, and realities of the fishery world.

The first chapter deals with the relationship existing between man and fish, with emphasis laid on the part played by the ancient fishermen in important discoveries and explorations of unknown lands and uncharted seas. In the succeeding chapters the author describes the many and varied unique inhabitants of the watery world, some of which are worth mentioning.

It will perhaps be a surprise to many that there are some fishes that act as fishermen of their own kind; fishes that build nests like birds; fishes that climb trees, staying out of their natural habitat for some time without danger of death; fishes that fly; fishes that fight; fishes that shoot, not with steel guns or bullets, of course, but with water pistols; and fishes that possess terrible teeth capable of slashing and eating all animals, including man, that happen within their reach.

It will further interest the reader to learn that although some fishes are fierce warriors, others belong to the sentimental and emotional type known as kissing fishes. One perhaps wonders whether these continuously swimming fishes do not become tired. It is a fact that fishes sleep, and some, like parrot fishes, even don their "pajamas" in the act of changing their coloration before sleeping.

The work is abundant in fish oddities which will be enjoyed by all those who read it.—A. F. U.

Die Malaria-Uebertraeger. Eine Zusammenstellung der wichtigsten Anopheles-Arten mit Angaben ueber Verbreitung, Brutgewohnheiten, Lebensweise und praktische Bedeutung. By Fritz Weyer. Leipzig, Georg Tieme, 1939. 141 pp., illus. Price, Rm. 9.80.

The purpose of this excellently written and well-illustrated booklet is to familiarize the student and practitioner with the ecology, distribution, and practical importance of *Anopheles* in general and its species and subspecies in particular in the respective malarious countries. The author deliberately avoids the highly controversial subject of morphology and systematic nomenclature, leaving these still very much discussed topics outside of his present paper, except for an enumeration in index form of the various species and their known synonyms. In all sections the relation of mosquito to man in the transmission of malaria is the governing trend. Discussion of the many problems is unbiased, and quite up-to-date; for example, the old hypothesis that about 12 gametocytes are necessary per cc of blood for infecting the mosquito is branded as false, most likely 5 being sufficient, at least for *A. elutus*. The same modern attitude is adopted relative to the unproven hypothesis of pronounced androphylia of *Anopheles* with a low number of maxillar teeth.

In the first chapter the author discusses the complicated and protean problem of distribution and abundance of mosquitoes, their breeding habits, their susceptibility and infectiveness, respectively, to the plasmodium and to man, the mosquito's life and custom relative to its preference to house, stable, and other hiding places, the importance of androphilia and zoophilia, and the life span and fertility of anopheles. In the second chapter an enumeration of the different malarious countries in the world is given with the respective *Anopheles* species encountered, and the third and concluding chapter discusses in detail these respective species relative to their habitat and importance.

Here the author falls somewhat short, but the subject is so immense that hardly any living scientist will remain free from reproof in attempting this discussion, since mastery of the complex aspect of Anophelinæ relative to geography and importance as a malaria vector is utterly impossible. Thus, to mention only two, although minor points: *Anopheles lindesayi* is not infrequently found in the mountains of the Philippines where the reviewer caught them in the late afternoon even at an altitude of about 2,000 meters near Mount Data in northern Luzon; *A. elutus* Edwards (also often referred to as *A. sacharovi* with apparently better priority claims) has been ignored by the author in its most important and dominating influence relative to its increasing dominance as one goes down the Adriatic coast in Dalmatia (Jugoslavia) from North to South, and the author has fallen into error in claiming this *A. elutus* to be a carrier today in the important province of Yunnan, in southwestern China.

It is hoped that the student and practitioner who is able to read German will often turn to this very ably written account where he is sure to find expert advice and help on many of his interrogations.—C. M. H.

Essentials of Medical Electricity. By Elkin P. Cumberbatch. London, Henry Kimpton. 1939. 528 pp., illus. Price, 12s/–.

This book covers the important field of physical therapy as practiced in medicine. It also incorporates a practical and theoretical consideration of the use of short-wave current and the ductothermic method. The discussion of many topics relative to fundamental principles and the practical applications of different physical energies in the treatment and diagnosis of diseases makes this work very useful to all. The book will no doubt prove a useful companion of the medical practitioner, and no physician interested in medical electricity can afford to remain without it.—P. S. C.

Victory Over Cancer Without Radium or Surgery. A Book Dealing With Cancer Causation, Cancer Prevention, and Cancer Cures for Laymen and Doctors. By Cyril Scott. London, Methuen and Co., Ltd. 272 pp. Price, 8s/6d.

In this book the author expresses himself at the outset as skeptical of the reception cancerologists and researchers will give to the facts stated; although, in citing malignant cases cured by nonsurgical and radiological methods, he does not support his claims with scientific data in the form of biopsy reports, pictures before, during, and after treatment, and follow-up control.

In the chapter, "Dangerous methods of prevention and treatment," the author reveals his opposition to, and prejudice against, the use of surgery and radiotherapy which the scientific world has accepted as the only treatment, up to the present, capable of curing certain types of cancer in a given percentage of cases. It is true that a real researcher must never refuse to see what he does not want to see, yet in the treatment of cancer one has to be rather conservative because in trying other methods, time, which is important in the success of surgery and radium therapy, may be lost with serious results.

The book, as written and presented by the author, is for the cancer specialist to read rather than for the layman, who is not in a position to discriminate between truth and halftruth in medicine.—P. S. C.

A Manual for Diabetic Patients. By W. D. Sansum, A. E. Koehler and R. Bowden. New York. The Macmillan Company, 1939. 227 pp., front., illus. Price, $3.25.

The authors of this book have outlined the meaning of diabetes mellitus, its cause, symptoms, and treatment. Their object is to instruct the diabetic patient the recognition of his disease, the proper care of his body, careful selection of his diet, avoidance of the onset of diabetic coma, the correct use of insulin, and the proper behavior in case of insulin reaction. By these instructions they do not intend to drive away the physician from a diabetic patient; rather, the intention is to help the patient to appreciate and to avail himself of the physician's instructions.—M. B.

Population, Race and Eugenics. By Morris Siegel. Hamilton, Ontario, The Author, 1939. 206 pp. Price, $3.

This book is the result of intensive studies of the different agencies that influence the mental and social qualities of the individual, the family, and the race. It offers some clinical and statistical data concerning social and occupational status in relation to rate of production and marriage among peoples. It includes a survey of the factors responsible for greater fertility in rural districts than in cities. It also treats of the cultural and intellectual correlation between parents and children and of facts about the differences between mental capacities in different individuals, and takes up the different etiologic factors as well as constructive recommendations to make the future generations mentally and physically strong.

The foundation and principles of all race theories by several authors are clearly discussed by the author. Among the important subjects taken up are the factors responsible for the differentiation of man into races; the physical, mental and social status of persons belonging to each race; and the racial theories in relation to racial achievements.

The last part of this book treats of the nature, prevalence, causes, and mode of transmission of the different forms of mental disorders. The author presents a brief survey of the existence of these maladies in different localities and introduces restrictive measures against them. The book is of immense value to the student of eugenics as well as to the person actively engaged in social work.—P. J. A.

A Policy for British Agriculture by the Rt. Honble. Lord Addison of Stallingborough, Minister of Agriculture 1930–1931. London, Victor Gollancz, Ltd. 1939. 304 pp. Price, 7s/6d.

This book, modestly dedicated by the author "To the memory of those on the farm I knew so well as a boy, and who inspired my love for the land," consists of twenty interesting chapters replete with valuable information for students and practictioners not only in agricultural science but also in economics and business. It is a story that vividly portrays the rise and fall of agriculture in Great Britain.

It opens with a discussion of agriculture as an industry, pointing out that "Mother Earth" is the basis of all. The author then skillfully weaves the relationship of high and low wages, advocating good farm wages and a higher standard of living for producers, and extolling the importance of agriculture in rural life and in national existence in time of war and in time of peace.

Chapter II is a kaleidoscopic view of the landlord, farmer, and laborer. How each of these bears an important rôle in the community, and how all three form the partnership that promotes the economic system, are described in clear, apt language.

Here the author describes the peculiar condition of farmers in relation to each other, saying that isolation and individualism are its outstanding characteristics. The preservation of the landscape and the opportunities for farmers and their reactions to marketing problems are emphasized. The farm laborer, with his well-known industry and endurance, and the rôle he plays in the economic life of the farming communities, is meticulously discussed.

Chapter V deals with land. The value and importance of land, its fertility, drainage, water supply, and improvements that make for the comfort of its occupants are all discussed, followed by a discussion in Chapter VI of farm produce and how it is sold, touching on the relation of good crops and producers' poverty and on local and national food surpluses, of both vegetable and fruit crops and animal and fish products.

In an introductory review the author discussed in the next chapter the needs of the good land system premised on the principle that the productive powers of land should be raised to its maximum according to a proper knowledge of what the land is best suited for, so that the whole agricultural population should be able to find contentment and prosperity while at the same time landscapes are preserved for enjoyment and fresh air.

Chapter VIII deals with land policy as affecting land acquisition, land values, taxation, and reforms of land laws with special reference to food supply and control. The succeeding chapters deal with finance, management, and development, embodying the financial duties of the National Commission—such as credit and related topics. Next, soil surveys, the promotion of farming enterprise, and the restoration of neglected lands are discussed. Chapter X explains the essentials of price management with reference to tariffs, quotas, and quantitative regulations, subsidies, and distribution.

There are chapters dealing with the formation of producers boards to remedy marketing difficulties due to individualistic tendencies of farmers; the control of imports as relating to the security of an abundant food supply for the people; the abolition of uncertainties of prices for home producers, and to effect economies in storage and distribution under an import board. The National Commission and Home Producers Boards function to secure fair prices for local producers and stabilization of fair price levels; then the problems of importation, distribution and wages are discussed at length under another chapter.

The author goes on to discuss a program of development dealing with outstanding food needs, under both peace and war-time conditions. Emphasis is laid on production and consumption. The author concludes by emphasizing the need for a ministry of agriculture and food supplies and its relation to a National Agricultural Commission, and the need for the restoration of a progressive countryside to counteract the abandonment of farms. Discussion of land reclamation and afforestation have also been indulged in.

The reviewer believes that this book should serve as an encouragement for general progressive agricultural ideas in relation to the general economic development of any country.

—F. D. M.

Poultry Sanitation and Disease Control. The Complete Guide to Sanitation and Treatment of Disease. By B. F. Kaupp and R. C. Surface. Chicago, Kaupp and Surface, 1939. 420 pp., illus. Price, $3.50.

As the title indicates, this book is not a discussion of the poultry industry in general but merely a discussion of one particular phase—the sanitation and disease control of poultry. It is prepared not so much as a textbook as to give a dispassionate discussion of the fundamental factors underlying the control of such diseases as are threatening this industry.

This book is intended not only for poultry students and technical men, but for everybody interested in poultry raising. For this reason the authors have brought together scientific data and presented them in an orderly, clear-cut, and practical way. The vivid explanations and examples given are well supplemented by lavish illustrations. A glossary of scientific terms is included.

The poultry industry is one of the most important industries of every nation. The study of the sanitation and the control of the diseases of poultry, which has cost the United States around $100,000,000 annually, deserves the careful attention given to it in this book.—V. S. R.

—F. D. M.

Drilling and Production Practice, 1938. Sponsored by the Central Committee on Drilling and Production Practice, Division of Production, American Petroleum Institute. New York, American Petroleum Institute, 1939. 458 pp., illus. Price, $3.

This volume contains papers on drilling and production practice delivered at national or district meetings of the Division of Production during 1938. It is divided into four sections, covering Drilling practice, Production practice, Materials, and Miscellaneous topics. In addition, there is a bibliography of all papers presented at district meetings in 1938.

The group of papers included in the section of "Drilling practice" describes problems of close spacing in Kansas, use of drilling muds, and well-depth measurements. There are several worthwhile papers on drilling practice on the Gulf Coast, the Permian Basin, the Oriskany sand fields of Kanawha County, West Virginia, and Dominguez field, California. The application of electrical logging methods to West Texas problems is also given.

There are several papers on production practice that cover a wide range of oil field problems,—pressure maintenance, bottom-hole pressures, relationship of production to pressure, and gas-oil ratio. Another group of papers under the same heading covers many oil-well pumping problems, giving costs and efficiencies of various systems in different fields. Three papers of this group discuss problems from producing sands. They are: Well shooting, experiments on fluid capacity of oil-well screens, and the theoretical consideration of the perforation pattern in a screen pipe.

The section on the Materials is rather brief. Three papers deal with the physical properties of casing steel, welding properties of casings, and specifications for oil-well cement.

The Miscellaneous papers include a discussion of the production problems in consideration of the lighter crudes. There is one paper on subsurface oil sampling.

A bibliography of district meeting papers for 1938 concludes the volume.—G. W. C.

Metallurgical Analysis and Assaying. By J. Stewart Remington and F. L. Jameson. London, The Technical Press, Ltd., 1939. 101 pp. Price, 5s/–.

This book is a compilation of selected standard methods of analysis of elements commonly determined in most ore laboratories and assay offices. Grouped according to the accepted qualitative scheme of analysis, the elements are taken up in six chapters. The seventh chapter is devoted to special procedures, while the eighth contains useful chemical and mathematical data. In general the methods are presented with the least amount of detail and theoretical discussion. Hence this book is of practical value only to those who have had sufficient experience in analytical work.—B. R. S.

Minerals, Metals and Gems. By A. Hyatt Verrill. Boston, L. C. Page and Co., 1939. 293 pp., front., illus. Price, $3.

This book is a miniature encyclopedia of minerals and gems, interestingly and accurately written for the general public. The pages are filled with strange stories and anecdotes about minerals from different lands and from all ages. The author has succeeded in giving a general course in mineralogy and ore deposits in a manner that the average reader can appreciate and absorb easily. The first part of the book is devoted to the more common minerals—how and where they are mined. "Ordinary" and precious stones are then taken up. The last chapters give a very instructive and entertaining treatment of crystallography and economic mineralogy. There is a glossary of minerals and mineral terms at the end of the book.—J. B. B.

Delectable Dinners: Menus with Recipes. By Anna J. Peterson and Nena Wilson Bodenoch. New York, E. P. Dutton, Inc., 1939. 460 pp. Price, $2.50.

This book is prepared to help the general homemaker and average cook solve the daily problems of planning, buying, preparing, and serving dinners in a short time and in a very practical manner. Unlike other cook books, which generally deal with individual recipes only, this book plans recipes into menus appropriate for a good dinner, dinner being the principal meal in the average American household. The basis of all food combinations in this book is the main protein dish, as meat, poultry, fish, or their substitutes. The menus are planned for four courses which can be simplified according to individual choice.

This book is divided into ten chapters with various kinds of meat. There are 30 menus with beef, 12 with veal, 12 with lamb, 6 with mutton, 7 with pork, 8 with ham, 14 with meat sundries, 15 with meat substitutes, 15 with poultry, and 29 with fish. Each chapter begins with a chart of menus planned around different cuts of the same kind of meat, so that at a glance one can tell the food and flavor combination for a certain meal. Each menu is then treated separately with all the necessary recipes for the whole meal. Each chapter includes top-stove and oven dinners; last minute or preparation-in-advance dinners; hot weather dinners; dinners for special occasions; dinners for guests; dinners for the family.

In addition to these menus and recipes, this cook book includes time tables for every menu, for baking, and for boiling vegetables, general directions for success in cooking, general rules for successful marketing, instructions for carving, a cook's dictionary, chapters on serving, table setting, healthful eating and nutrition, a list of useful staple substitutes, appropriate menus for special occasions, an alphabetical index, and a classified group index.

The arrangement of this book is practical and helpful for the modern homemaker. But where the individual recipes or even the menus themselves are concerned, the materials called for in the recipes are too costly for the average Filipino homemaker.—P. A. E.

THE PHILIPPINE JOURNAL OF SCIENCE

VOL. 74 APRIL, 1941 NO. 4

STUDIES ON THE GEOGRAPHICAL DISTRIBUTION INCIDENCE, AND CONTROL OF SCHISTOSOMIASIS JAPONICA IN THE PHILIPPINES.[1]

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and

ANTONIO M. PASCO[2]
Formerly of the Institute of Hygiene
University of the Philippines, Manila

FIVE TEXT FIGURES

Schistosomiasis japonica is a fatal parasitic disease affecting man and other mammalian animals and caused by the blood fluke, *Schistosoma japonicum* (Katsurada). It is also called Asiatic or Oriental intestinal schistosomiasis because of its limited distribution in certain endemic areas in countries of the Far East. According to Faust and Meleney(7) it is probably an ancient disease, but its true nature remained unknown until the early part of the present century when Katsurada(12) discovered the causative agent in Japan and described it under the name *Schistosomum japonicum.* The following year Catto(5) and Logan(13) associated the same trematode with an ailment prevalent in some parts of China, and Stiles(23) recorded its

[1] Aided by a grant from the National Research Council of the Philippines. The writers wish to express their thanks to Director A. S. Argüelles of the Bureau of Science and to President B. M. Gonzalez, and Dean A. G. Sison, of the University of the Philippines, for their active support of these studies.

[2] Resigned July, 1939.

occurrence in the Philippines on the basis of material sent him by Woolley from Manila. In 1906 Woolley published his observations, which deal principally with the pathology of the infection. In 1915 Yokogawa found the parasite in Formosa and more recently Mueller and Tesch(16) and Brug and Tesch(4) reported it from Celebes.

Soon after the publication of Woolley's report, additional cases of schistosomiasis were encountered by other investigators working in Bilibid Prison and hospitals in Manila. A compilation of the earlier data by Mendoza-Guazon(14) showed that a large number of the cases came from Leyte, Samar, and Mindanao, indicating that these three islands are important sources of the infection. Thus far, however, only the former island has been definitely shown to be an endemic focus, as a result of the discovery by Tubangui(25) of a snail, *Blanfordia quadrasi* (Moellendorff)[3] in Palo, Leyte, which serves as the intermediary host of the helminth etiological agent.

The possible occurrence of schistosomiasis japonica in the other parts of the Philippines was pointed out recently by Africa and Garcia.(1) These investigators reported 4 cases, 2 of whom were suspected to have contracted the infection in the island of Mindoro and the other two either in Albay or Sorsogon Province. Confirmation of the existence of schistosomiasis in these places should lead to the supposition that the disease has either been spreading, or else it is more widely distributed than was formerly believed.

The studies reported in this paper were undertaken in order to determine more accurately the geographical distribution and incidence of the infection in the Philippines and to inquire into the advisability of instituting control measures. Although our observations are as yet far from complete, due to the lim-

[3] Specialists differ in their opinions on the systematic status of this snail. Rensch(21) first described it as *Oncomelania hydrobiopsis* sp. nov., but later(22) recognized its similarity with Moellendorff's *Prososthenia quadrasi*. Bequaert(3) identified it as *Blanfordia quadrasi* (= *Prososthenia quadrasi* Moellendorff). According to Bartsch(2) *hydrobiopsis* and *quadrasi* represent two distinct species of snails, and he has proposed the new genus *Schistosomophora* for them. Recently I forwarded to Doctor Bequaert for identification several batches of the same type of snail collected in Mindanao, Leyte, Samar, and Mindoro. In his reply Doctor Bequaert says: "Mr. Clench and I have very carefully compared all of these and we feel that they represent one and the same species, *Blanfordia quadrasi* v. Moellendorff."

ited time and funds at our disposal, we have decided to record them with the hope that they may at least serve to stimulate further investigation on this parasitism which, as will be discussed later, is a menace to the health of thousands of people living in the different endemic areas.

METHODS

The occurrence of the infection in a locality was ascertained by examining the fæces of some of the people, especially those showing suspicious symptoms of the disease, for the presence of the ova of *Schistosoma japonicum;* and/or by searching for the snail intermediate host of the parasite. In some places the fæces of domesticated animals were also examined. Some of the fæcal samples were examined within four or five hours after collection; the others were preserved in 10 per cent solution of commercial formalin and kept until our return to Manila. The latter were strained through a wire screen and then sedimented. In every case at least four slides were examined before a specimen was declared negative.

The search for *Blanfordia quadrasi* was made in all likely locations, such as in rice fields and on the banks of fresh-water streams, lakes, and irrigation canals or ditches. When found, samples of the snail were examined for the presence of the cercaria of *Schistosoma japonicum* and, if positive, infection experiments on laboratory rats were carried out for the purpose of recovering adult worms and their ova.

In some places other kinds of fresh-water mollusks, such as *Lymnæa philippinensis* and *Anisus* (*Gyraulus*) *convexiusculus,* were also examined, in view of the observation of Porter,(19) who found what was apparently the cercaria of *Schistosoma japonicum* in *Lymnæa natalensis* in Africa.

FINDINGS

INFECTED AREAS

Thus far our field studies have shown schistosomiasis japonica to be endemic in the islands of Leyte, Samar, Mindoro, and Mindanao (text fig. 1). Our findings thus confirm the earlier observations of Garrison(8) and Mendoza-Guazon,(14) and partly those of Africa and Garcia.(1) The infection, however, is not uniformly distributed in any one of these four islands, but is localized in certain isolated areas which are often very far apart.

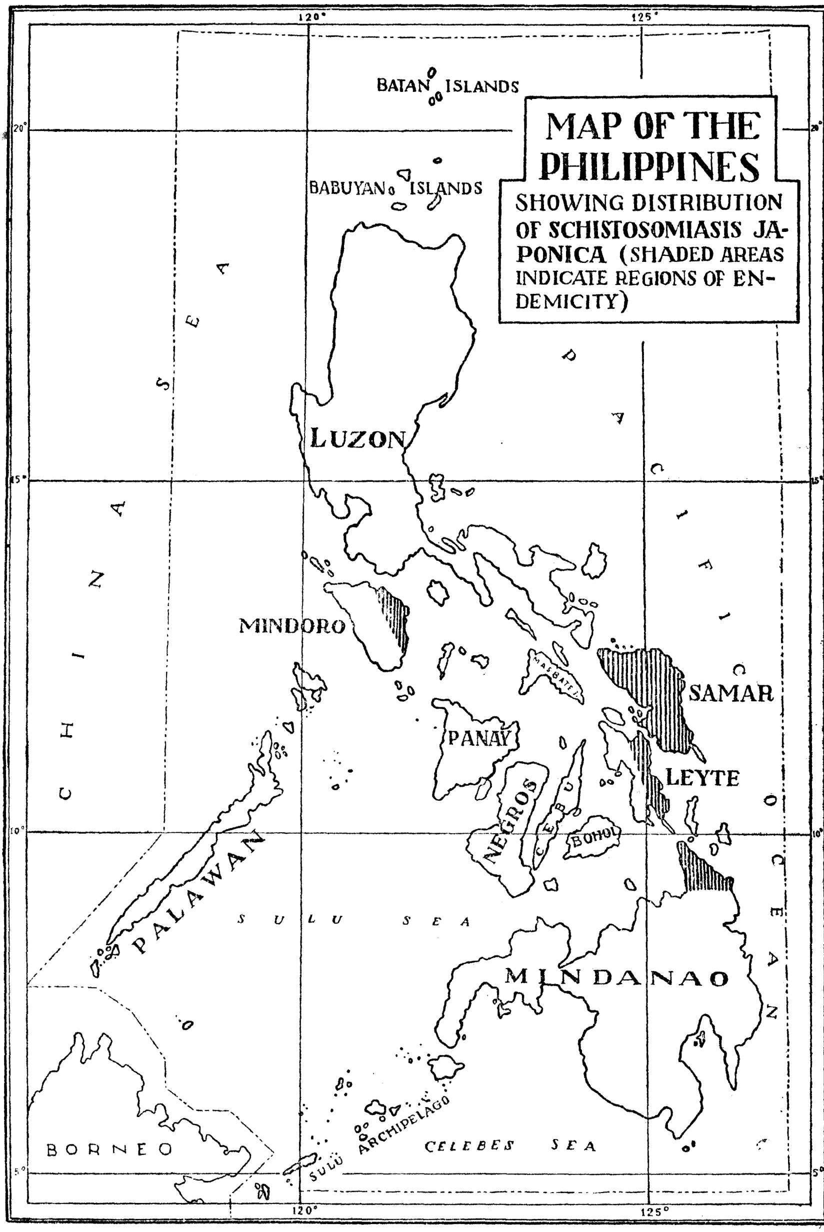

FIG. 1. General distribution of schistosomiasis japonica in the Philippines.

Leyte.—Leyte is one of the group of Visayan islands of the Philippine Archipelago located immediately southeast of Luzon Island. It lies between 9° 55′ and 11° 33′ north latitude and 124° 17′ and 125° 18′ east longitude. It has an area of about 7,250 square kilometers. The principal range of mountains runs from the northwestern part of the island to the southwestern extremity and divides the island into two parts, each of which has a distinct climate. In the eastern part there is practically no dry season, the greatest amount of rain falling in November or December. The average mean monthly temperature (average for 16 years) ranges from 25.6° C. in January to 27.6° C. in August. In the western part the annual rainfall is more evenly distributed, there being neither a dry season nor a very pronounced maximum rainy period. The average mean monthly temperature is from 24.9° C. in January and February to 27.5° C. in August.[4] The main industry of the island is agriculture and the principal products are abacá (Manila hemp), corn, copra, and rice.

The prevalence of schistosomiasis in Leyte is evidenced by the fact that nearly one-half of the total number of cases of the disease that have been recorded in the literature came from this island. The infection appears to be confined to the eastern half of the island, no cases having been reported from any of the towns in the western part (text fig. 2). Of the 4 cases reported by Hizon,(9) 2 were from Palo and 1 each from Tanauan and Burauen. Ramos(20) described 1 case from Dagami, and Ira-Concepcion(11) 1 case from Dulag. The cases reported by Africa and Garcia(1) were distributed as follows: 5 from Dagami, 4 from Palo, 11 from Tolosa, 2 from Tanauan, and 2 from Burauen.

As already mentioned, it was in Palo that the snail intermediate host of the parasite in the Philippines was first found by Tubangui.(25) In the present study we decided to look for the disease and the mollusk in Dagami and Dulag.[5] The former is an interior town while the latter is coastal; but both are

[4] The data on climate were obtained from The climate of the Philippines, published by the Department of Agriculture and Commerce, Manila (1939) 31 pp.

[5] We also made a brief survey in Baybay, a town on the western coast of Leyte, with the cooperation of Dr. Jose Mercado, President of the Sanitary Division of that municipality. No cases of the disease and no *Blanfordia* snails were found.

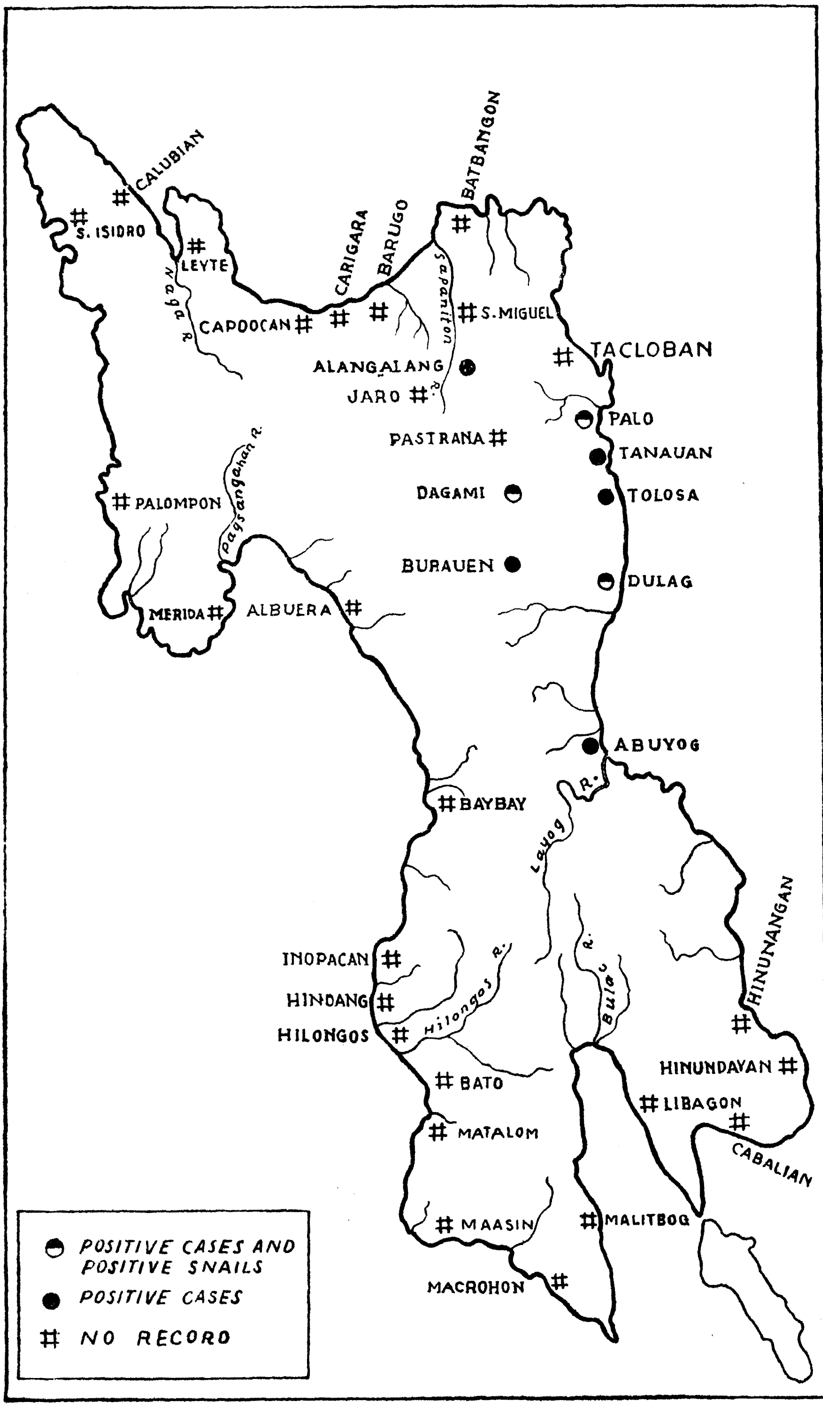

FIG. 2. Endemic centers of schistosomiasis japonica in Leyte.

rice-producing. No difficulty was experienced in finding cases in these two municipalities. After describing the disease to some of the people we were informed that an ailment locally known as "bagó" and characterized by enlargement of the abdomen, anæmia, and cachexia, is of common occurrence. The microscopic examination of the excreta of "bagó" cases showed the presence of schistosome eggs.

The search for the molluscan intermediate host did not prove difficult after cases had been found of the disease. The snail was easily located on the banks of streams and canals that were frequented by some of the infected individuals. In the población of Dagami were two boys who most probably contracted the disease by often going to a ditch not very far from the town church in order to catch mudfish. The ditch receives its water partly from the frequent rains and partly from seepage from the neighboring rice paddies, and discharges it into a fast-flowing stream. Large numbers of *Blanfordia quadrasi* were collected from the banks of this ditch on different occasions, of which from 2 to 5 per cent harbored the cercaria of *Schistosoma japonicum*. On the dikes of the neighboring rice fields, which at the time of our visit were flooded preparatory to plowing and planting, infected snails were also found.

In several other places in Dagami and in one barrio in Dulag, where there were cases of "bagó," the source of the infection was similarly traced to the presence of infected *Blanfordia quadrasi* in rice fields and irrigation canals. In Barrio Union, Dulag, we also found the snail in an old bed of a branch of the Dulag River that flows through the locality. During heavy rains, when the river is swollen, this bed becomes flooded; at other times it is kept moist by the seepage of water from the near-by rice fields.

Samar.—Samar Island is located immediately northeast of Leyte, being separated from the latter by the very narrow San Juanico Strait. It lies between 11° 01′ and 12° 42′ north latitude and 124° 15′ and 125° 50′ east longitude. It has an area of about 13,250 square kilometers. The surface is very rugged, but there is not a single mountain range that is sufficiently high to serve as a barrier to rain-laden winds. For this reason the climate is nearly uniform for the entire island and is similar to that of eastern Leyte. Due to the ruggedness of the soil only a small portion of the land is under cultivation. Rice is grown in the river valleys and coastal plains.

A review of the cases recorded in the literature shows that the areas of infection in Samar are more widely scattered than those in Leyte (text fig. 3). The case described by Phalen and Nichols(18) came from Calbayog, which is on the west coast, while that described by Nieva(17) was from Borongan, an eastern town. The cases reported by Africa and Garcia(1) were from towns along the western and northern coasts, namely: Catbalogan, Santa Margarita, Calbayog, Palapag, Catarman, and Laoang. Among the unpublished records of the Philippine General Hospital one of us (A. M. P.) encountered the names of patients whose stools were positive for schistosome eggs and who gave the towns of Calbiga, Gandara, Basey, and Bobon as their birthplaces.

We went to Samar in March, 1939, and stayed for two weeks in the Municipality of Calbiga. The town proper is located on a hill and on the banks of the river of the same name. Although the environment did not impress us as favorable for the successful propagation of schistosomiasis, we decided to examine as many of the people as were willing to submit fæcal samples. As a result we came across one case, a boy about 15 years old, who presented the clinical symptons of the disease and whose fæces showed the presence of schistosome ova. The boy informed us that he formerly resided in Barrio Canticum which is about 5 kilometers northeast of the población. We went to this barrio and found it to be hilly and sparsely populated. Between the hills, however, and the Calbiga River are rice fields under cultivation. A house-to-house survey of the people living near the provincial road enabled us to contact several clinical suspects, in whose fæces the characteristic eggs of *Schistosoma japonicum* were later found.

The only bodies of fresh water in the locality were a small mountain creek, from which the rice fields were irrigated, and a long canal that carried the water from the rice fields to a branch of the Calbiga River. These were searched carefully for the presence of *Blanfordia quadrasi.* The snail was not found in the rice fields nor on the banks of the creek; but on the banks of the canal, especially where it passed in front of a group of houses, it was present in large numbers. Of the several hundred snails collected, about 3 per cent were infected with the cercaria of *Schistosoma japonicum.*

Mindoro.—Mindoro Island lies directly south of the southwestern end of Luzon, between 12° 13′ and 13° 32′ north la-

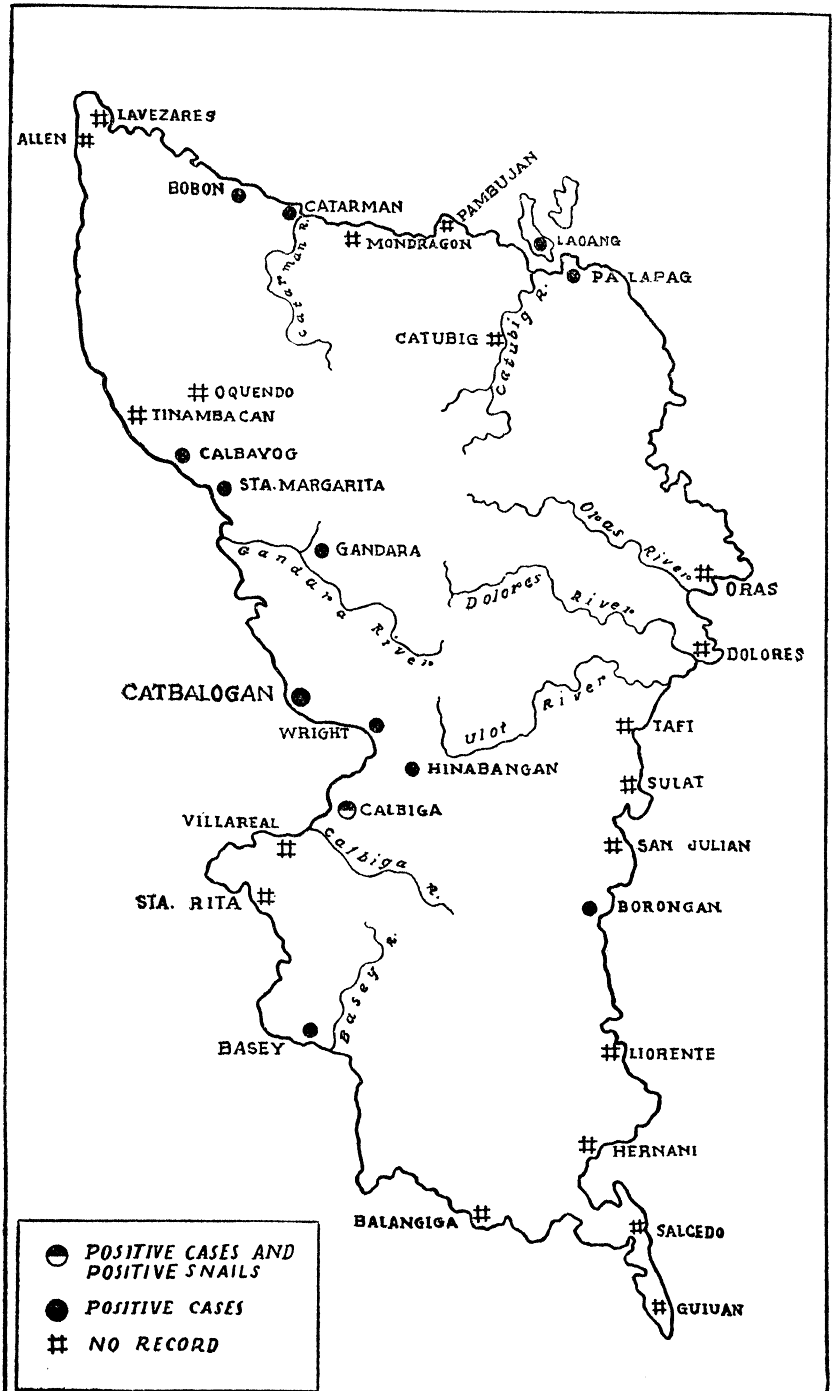

FIG. 3. Endemic centers of schistosomiasis japonica in Samar.

titude and 12° 18′ and 12° 34′ east longitude. It has an area of about 9,820 square kilometers. It is divided by a range of mountains into a western and an eastern part, each of which possesses a distinct climate. In the western part there are two pronounced seasons during the year, one dry and the other wet. In the eastern part the climate is similar to that of western Leyte. The island is traversed by numerous rivers, and in the northeastern part is Lake Naujan, a large fresh-water lake. The mountains are covered with valuable timber and the plains are fertile. Due, however, to the prevalence of malaria and other diseases, only a small portion of the land is under cultivation.

There are no available records by which it can be ascertained as to whether schistosomiasis has long been in existence in Mindoro or has been introduced only recently. The first intimation of the possible occurrence of the disease on the island was made only as late as 1935 by Africa and Garcia, who reported two cases, one of whom was suspected to have contracted the infection in Naujan and the other either in Pola or Bulalacao. The following year Torres (24) diagnosed one case from Naujan and treated it successfully with tartar emetic. In 1938 a male patient whose fæces were positive for schistosome eggs was registered in the Philippine General Hospital. When we went to Mindoro in May, 1939, we were able to locate the address of this person in Sitio Malayas, Naujan, but we were informed that he had died two months before our arrival. However, he had a younger brother whom we found confined in bed with symptoms of very advanced schistosomiasis and who died about a month after we saw him. Several other persons from the same neighborhood who were similarly affected were shown to us, and all of them were positive for schistosomiasis. The people believed, however, that the illness was due to malaria, this part of Mindoro being one of the worst malarious regions known in the Philippines, where the Philippine Bureau of Health maintains a malaria control unit. In conversation with Mr. C. M. Urbino, the entomologist in charge of the unit, we were told that a number of his malaria cases failed to show any physical improvement even after the prolonged use of quinine, and that the splenic index of the population was very high compared with the malaria-parasite index. Very likely the cases involved were mixed infections of malaria and schistosomiasis. Since quinine has no lethal action on the blood fluke, a person with both malaria and schistosomiasis may be cured of the former but not of the latter disease by the administration of the drug. As to the splenomegaly, in both diseases, there is known to be a splenic enlargement, but in schistosomiasis it is accompanied by an enlargement of the liver.

All of the infected persons whom we encountered resided in Malayas and in the other sitios and barrios of the town of Naujan, located near the northern and western shores of the lake (text fig. 4). It was learned that while some of them were originally from Nueva Ecija, La Union, and other provinces in northern Luzon, the rest were natives of Mindoro who had never been outside of the island. There is therefore hardly any doubt that the disease was contracted locally, and it only remained for us to trace the source of the infection by finding the snail intermediate host of the parasite.

We searched for the mollusk in the part of Sitio Malayas between the Borbocolon and Malayas Rivers, where many of the infected individuals had their houses and their rice fields. The fields are irrigated from branches of the Borbocolon River, the excess water returning to the same river through a tortuous main canal. For one week we examined very carefully the banks of the streams and canals and some of the rice fields, but no snail having any resemblance to *Blanfordia quadrasi* was found. We collected and crushed other kinds of snails, but none showed the presence of the cercaria of *Schistosoma japonicum.* On the eighth day, after an unsucessful all-morning search and as we were about to return to our quarters, we asked our assistant, Mr. Pablo Rimando, to remain and to search further along the banks of the main canal. He had not gone one-hundred yards from where he left us when he reached a short secondary canal which was partially hidden by some banana trees and other vegetation. Nearby was an old house formerly occupied by a man whom we later found to be suffering from schistosomiasis. From the banks of this canal numerous specimens of *Blanfordia quadrasi* were collected, about 3 per cent of which harbored the cercaria of the blood fluke.

The examination of the excreta of some animals that were seen roaming at large in the neighborhood of the hiding place of the snail yielded interesting results. The animals examined were 6 dogs, 6 pigs, and 21 carabaos. Of the dogs, 2 (33.3 per cent) and of the pigs 3 (50 per cent) were positive for

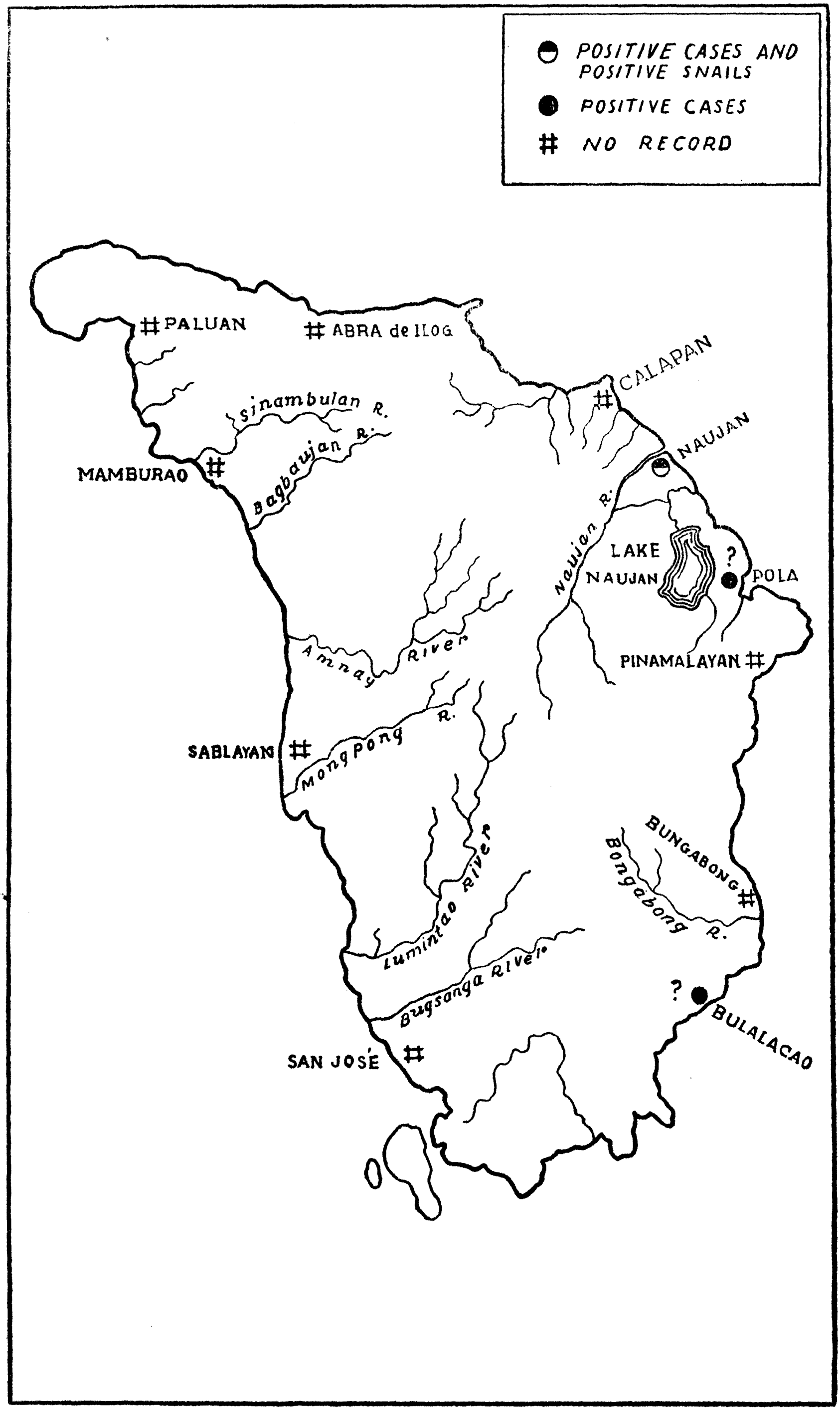

FIG. 4. Endemic centers of schistosomiasis japonica in Mindoro.

schistosome ova, but all of the carabaos were negative. As to whether or not the carabao is immune against the parasitism cannot be decided by the limited number of examinations made. In China the same type of animal has been found by Faust and Kellogg (6) and Wu(28) to be susceptible.

Mindanao.—Mindanao is the second largest island of the Philippine group, its area being about 95,520 square kilometers. It lies between 5° 33′ and 9° 48′ north latitude and 121° 53′ and 126° 36′ east longitude. It is divided into nine political subdivisions or provinces, namely: Surigao, Agusan, Davao, Bukidnon, Lanao, Cotabato, Oriental Misamis, Occidental Misamis, and Zamboanga. The climate varies in the different parts of the island, that in the eastern section being similar to the climate in Samar and eastern Leyte. Although mountainous, the island has several large fertile plains and valleys and level uplands. The principal agricultural products are hemp, corn, rice, and copra.

In 1908 Garrison found the eggs of *Schistosoma japonicum* in the fæces of four inmates of Bilibid Prison from Mindanao, but he did not state what part of the island the prisoners had come from. The information supplied by Hizon(9) and Africa and Garcia(1) is more definite, the former reporting 1 case and the latter 2 cases, all from Surigao Province. We have regarded the occurrence of schistosomiasis in this part of Mindanao as very probable after the demonstration by Tubangui(25) of the intermediate host status of *Blanfordia quadrasi,* since the type specimens of this snail, which were described by Moellendorff in 1895, were collected in Surigao, and since our observation has been that wherever the mollusk is found the disease is also present.

In April, 1938, we visited northeastern Mindanao by way of Surigao. We followed the main road from the capital of the province to the towns of Placer and Mainit, stopping at intervals of 2 to 3 kilometers to search for the snail. We found the mollusk, however, only when we reached the Surigao-Agusan road in Barrio Tubod, municipality of Mainit. At a place in Sitio Tuñgao, not far from the entrance to the camp of the Surigao Consolidated Mines, Incorporated, which is inhabited by a few families of rice farmers, *Blanfordia quadrasi* was present in large numbers on the banks of mountain creeks and irrigation canals and on the dikes of rice paddies. Of the several hundred specimens collected, about 4 per cent harbored the larval stages of the Asiatic blood fluke. The examination of fæcal samples submitted by 33 of the adult inhabitants of the place showed a very high infection rate (45.5 per cent).

From the town of Mainit our two assistants, Pablo Rimando and Manuel Celestino, crossed Lake Mainit to Agusan to look for the same kind of snail. They spent four days in Jabonga and Cabadbaran. In the former town they collected *Blanfordia quadrasi* from the banks of a canal that passes in front of the Jabonga Elementary School and from a creek near the Mayugda Falls. In Cabadbaran they found the mollusk along a canal near the provincial road going to Butuan, about 12 kilometers from the poblacion.

Search for the snail was also made in the towns of Balingasag and Gingoog, Oriental Misamis Province, but with negative results. We included this part of Mindanao in our survey in view of the information given by Houghton(10) that the greater part of northern Mindanao is endemic territory. It appears from our data, however, that the disease occurs only in the northeastern part of the island, around the shores of Lake Mainit (text fig. 5).

OTHER PLACES VISITED

The question is often asked as to whether or not schistosomiasis is endemic in Luzon, because the disease has been met with in persons who gave Manila or one of the neighboring provinces as their places of residence, thereby creating the impression that they contracted the infection somewhere in Luzon. In order to be able to answer the question, surveys were made in and around Manila and in several places in Rizal, Bulacan, Nueva Ecija, and Sorsogon Provinces. In all of these places fæcal examinations were made on school children and adults, but not a single case of schistosomiasis was encountered. The search for the presence of *Blanfordia quadrasi* and any other mollusk that might be capable of playing the rôle of intermediate host to *Schistosoma japonicum* also yielded negative results. In Manila Africa and Garcia(1) have also searched unsuccessfully for a snail host, and we concur with their opinion that:

> The endemicity of schistosomiasis in Manila is only apparent as disclosed by our analysis of the registered cases in this city. . . As Manila draws a considerable portion of her population from the provinces, it is very doubtful whether these cases really contracted their infestations in the city or its immediate environs. In the majority of these cases no

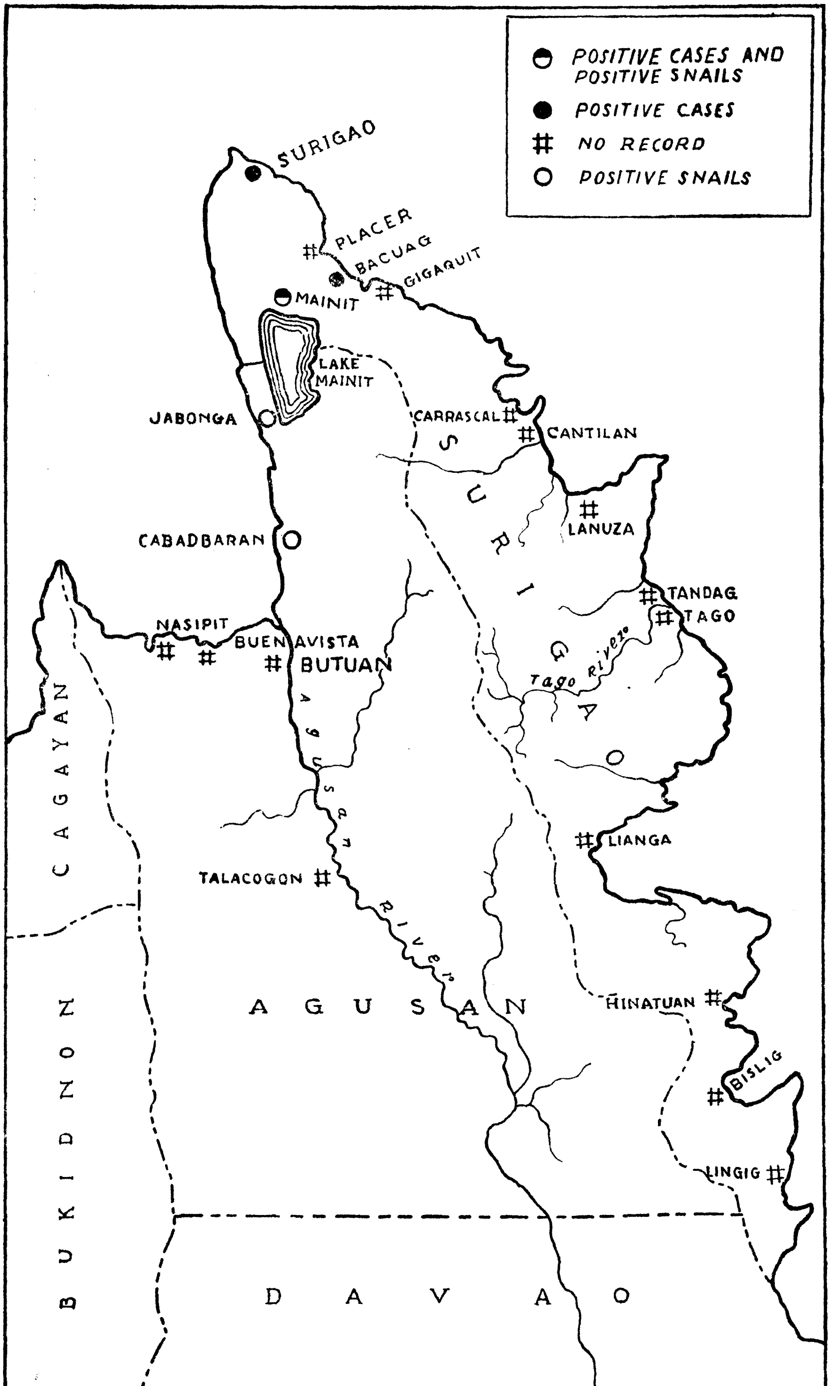

FIG. 5. Endemic centers of schistosomiasis japonica in Mindoro (northeastern part).

mention of their nativity was made in their case histories; they were merely recorded as laborers residing in the districts (of Manila) mentioned at the time of death. Manila is in all probability a non-endemic center. Our failure to collect snails similar or allied to the confirmed intermediate host in Leyte supports our contention.

If it were possible to trace the complete histories of the various cases reported from Luzon, the persons concerned would probably be found to have at one time or another been to some of the well-known endemic areas. For example, it has been found, according to Doctor Africa, that the case reported by Africa and Garcia(1) as coming from Bigaa, Bulacan Province, was a male student who spent one summer vacation in Samar. Willets's(26) case from La Union and that of Dr. W. de Leon from the same province, as reported by Africa and Garcia, were very likely natives of that province who had emigrated to Mindoro. During our visit to that island we met a number of rice farmers who came from La Union Province, many of whom were affected with schistosomiasis. If these persons should go to a hospital or to a private physician for treatment, in the course of the usual clinical history writing they would naturally mention their native towns as their places of birth.

Quite recently, through the courtesy of Dr. W. Vitug, we were shown two female patients in the Philippine General Hospital, both of whom were positive for schistosomiasis. One of them was a native of Bulan, the other of Gubat, Sorsogon. We questioned these patients repeatedly regarding the different places they had visited and the information they always gave us is that outside of their home province they had only been in Manila and in Baguio, Mountain Province. When we went to Sorsogon, however, we learned from their immediate relatives that one of them had stayed in Samar for at least one year and the other in Masbate and Leyte.

FACTORS PROBABLY INFLUENCING THE DISTRIBUTION OF THE SNAIL AND THE DISEASE

Mention has been made of the fact that the endemicity of schistosomiasis japonica in a locality depends entirely upon the presence of a suitable snail intermediate host. The question then arises: What factors are responsible for the distribution of *Blanfordia quadrasi* in the Philippines? We do not think we have found a complete answer to this question, but we have gathered data that may have something to do with it.

To begin with, it has already been stated that *Blanfordia quadrasi* is amphibious in its habits, being most frequently found, when it is not submerged in the water, on the constantly moist banks of small, slowly-flowing streams and irrigation canals or ditches. There are two factors in the endemic territories which help to keep the environment constantly moist. One of these is the climate which is characterized by the absence of a dry season and the more or less uniform distribution of the annual rainfall. The other factor is the location of the favorite sites of the mollusk in regions that are low and subject to frequent overflows, such as along the beds of rivers and the shores of lakes. The infected places around Lake Naujan in Mindoro and Lake Mainit in Mindanao are typical examples.

If, however, the conditions influencing the distribution of *Blanfordia quadrasi* were solely due to climate and topography, the snail as well as the disease could be expected to occur in other islands or provinces, such as Albay, Sorsogon, Camarines Norte, Camarines Sur, and in the other parts of Luzon and Mindanao where there are also frequent rains throughout the year and no dry season. Up to the present, however, no authentic cases of schistosomiasis have been reported from these places, and attempts to find the snail have thus far failed, indicating that there may be other factors involved in the distribution of the mollusk. The existence of these other factors appeared the more probable in view of the observation that even in the same endemic area there are places which are apparently avoided by the mollusk.

Suspecting that the chemical composition of the soil might have some influence, we collected three sets of soil samples from different places. One set composed of samples 1 to 5 were taken from the banks of streams and canals in infected areas where *Blanfordia quadrasi* was found; a second set, samples 6 to 8, was collected from similar locations in endemic territories where the snail was not encountered; and a third set, samples 9 to 10, was obtained from banks of irrigation canals in noninfected regions. These were analyzed for us in the soil laboratory of the Department of Agriculture and Commerce through the kindness of Dr. M. M. Alicante, chief of the Division of Soil Survey. The results of the analyses are shown in Table 1. In general the soil samples taken from places where the snail was found have slightly lower pH values, higher nitrogen and organic carbon contents, and lower calcium percentages than those obtained from places where the mollusk was absent.

TABLE 1.—*Chemical composition of soil samples collected from endemic and nonendemic areas.*

Sample.	Origin of sample.	Chemical composition.							Remarks.
		pH value.	Organic C.	N	P_2O_5	K_2O	CaO	MgO	
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	
1	Calbiga, Samar	5.86	6.31	0.50	0.12	0.06	1.63	1.96	*Blanfordia quadrasi* found.
2	Dagami, Leyte	5.76	2.12	0.20	0.21	0.08	2.45	1.10	Do.
3	Mainit, Surigao	5.65	3.39	0.34	0.26	0.27	1.27	1.02	Do.
4	do	5.84	2.22	0.22	0.25	0.24	1.46	1.18	Do.
5	Naujan, Mindoro	5.98	4.93	0.49	0.18	0.19	2.49	------	Do.
6	Calbiga, Samar	6.26	1.82	0.16	0.08	0.08	3.00	1.41	*Blanfordia quadrasi* not found.
7	Mainit, Surigao	5.98	1.93	0.20	0.18	0.48	2.88	1.50	Do.
8	Naujan, Mindoro	6.18	1.24	0.13	0.06	0.23	2.44	------	Do.
9	Baybay, Leyte	5.91	1.97	0.17	0.16	0.11	3.13	1.37	Do.
10	Gubat, Sorsogon	5.25	2.11	0.22	0.11	0.39	3.85	------	Do.

These differences in themselves may have but little significance, but in conjunction with climatic and other factors they may play an important rôle in creating a favorable environment for the mollusk. The high nitrogen and organic carbon contents denote the presence of a large amount of organic matter, on which the snail probably subsists. The low calcium content may be due to the fact that this element is utilized by the snail in building its shell.

INCIDENCE OF THE INFECTION

The results of the fæcal examinations in the different endemic places visited are summarized in Table 2. Of the 844 persons examined, 192, 22.7 per cent, were positive for *Schistosoma japonicum.* In some localities the infection percentages are rather high due most probably to the small number of people examined, the majority of whom were obviously suffering from the disease and presented themselves voluntarily with the hope of receiving treatment. If these selected cases are discarded, the general incidence is about 20 per cent. This figure is believed to be a very fair estimate of the prevalence of schistosomiasis among the rural population in the endemic territories. The term "rural" is here used to denote those persons, especially rice farmers, who live and work under conditions that expose them to the disease. In many thickly populated rice districts in Leyte the incidence of the infection is higher. In Mindoro

TABLE 2.—*Incidence of Schistosoma japonicum among persons examined in different endemic localities in the Philippines.*

Locality.	Number of persons examined.	Persons positive.	
		Number.	Per cent.
Leyte:			
Dagami—			
Poblacion	76	13	17.1
Guinerona	62	18	29.0
Bolirao	58	13	22.4
Buntay and other sitios	16	10	62.5
Abuyog	2	2	100.0
Burauen	4	4	100.0
Samar:			
Calbiga, Canticum	81	15	18.5
Hinabañgan	1	1	100.0
Wright	1	1	100.0
Mindoro:			
Naujan, Malayas	510	100	19.6
Mindanao:			
Surigao—			
Mainit, Tuñgao	33	15	45.5
Total	844	192	22.7

and Samar it tends to be lower, due probably to the sparse population of the infected areas.

The results of the examinations in Naujan, Mindoro, may be used to illustrate the age and sex distribution of the parasitism. Our data for the other places cannot be utilized for that purpose due to the small number of people examined. As shown in Table 3, of the 510 persons examined in Mindoro, 291 were males and 219 females. The infection percentage in the males was 23.7 per cent, in the females only 14.1 per cent. The infection percentage was lowest in children of both sexes who were not over 10 years old. It was highest in males between 11 and 30 years of age and in females between 11 and 20 years of age. In the older age groups the incidence was slightly lower and more or less uniform throughout, but it was always higher in the males than in the females. These differences may be explained if one recalls the manner by means of which infection with *Schistosoma japonicum* is brought about, namely, by the penetration through the skin or mucous membrane of infective cercariæ which are present in infected water. Male persons are generally more exposed to the disease because their occupations, such as rice farming, catching fish, digging canals, and the like, bring them in more frequent contact with bodies of water where the infection may be acquired.

TABLE 3.—*Infestation with Schistosoma japonicum in persons examined in Sitio Malayas, Naujan, Mindoro, arranged in age and sex groups.*

	Males by age groups.						Total.
	1–10	11–20	21–30	31–40	41–50	51+	
Number of persons examined	42	62	68	45	41	33	291
Number positive	4	19	21	11	8	6	69
Per cent positive	9.5	30.6	30.9	24.4	19.5	18.5	23.7
	Females by age groups.						**Total.**
	1–10	11–20	21–30	31–40	41–50	51+	
Number of persons examined	32	54	56	35	22	20	219
Number positive	1	13	7	6	2	2	31
Per cent positive	3.1	24.1	12.5	17.1	9.1	10	14.1

Males between the ages of 11 and 30 and females between the ages of 11 and 20 years are usually more actively engaged in these occupations than at any other time of their existence, and for that reason they are more likely to contract the infection. The lowering of the incidence in the older age groups is very likely brought about by the death of some of those individuals who contracted the disease during early life.

PROBABLE NUMBER OF PEOPLE WITH SCHISTOSOMIASIS

Before an accurate estimate of the number of people in the Philippines who are infected with *Schistosoma japonicum* can be made, it will be necessary to carry out specific epidemiological surveys in many more places than we have been able to visit. At present only a rough calculation is possible, based on the incidence data we have gathered and on our present knowledge of the distribution of the disease. According to the 1939 Census of the Philippines the total of the combined populations of the known infected localities in Leyte, Samar, Mindoro, and Mindanao is about 1,000,000 people. Of these, from one-eighth to one-sixth, or from 125,000 to 166,000, live under rural conditions and are therefore predisposed to the infection. If the incidence is 20 per cent, there are from 25,000 to 33,000 persons in the known endemic regions who harbor the Asiatic blood fluke.

The significance of the above figures from the health standpoint is too obvious for discussion. It should be emphasized, however, that a large number of the unfortunate victims are persons who should be most actively engaged in rice farming and other gainful occupations. Instead, due to physical disability and increasing weakness and other effects of the infection, they are compelled to remain idle and to be dependent economically upon their families for the rest of their lives. The parasitism is thus a medical and a sociological problem which should be attended to as early as possible.

PROPHYLACTIC CONSIDERATIONS

The infection may be prevented by the institution of measures calculated to bring about the destruction of the causative agent during one or another stage of its life cycle and to prevent its entrance into the human body. These measures may be employed singly or in combination, the choice depending upon the local conditions, the habits of the people, and the facilities available. The following are the principal stages in the development of the Asiatic blood fluke and the methods that may be used to destroy them:

1. *The adult parasite in man.*—Specific drugs, like potassium or sodium antimony tartrate and fuadin, have been found effective in killing the parasite and curing the disease during the earlier stages of the infection. Very advanced cases, where the function of the liver has been much impaired due to extensive cirrhosis, are practically incurable. Tartar emetic or its sodium homologue is injected intravenously in the form of a freshly prepared aqueous solution, while fuadin is administered intramuscularly. These drugs have been used extensively in Egypt for the control of schistosomiasis hæmatobia and schistosomiasis mansoni.

2. *The eggs with their contained miracidia in the fæces of infected persons and other mammalian hosts.*—The proper disposal of human excrement through the avoidance of promiscuous defæcation and the use of sanitary privies will prevent schistosome eggs from reaching a body of fresh water, hatching there, and infecting the snail intermediate host. In places like China, where the use of human fæces as fertilizer seems to be an absolute necessity, the excreta should be stored in appropriate containers for a certain length of time before it is spread in the fields, in order to kill the miracidia in the eggs through a natural process of fermentation. Domesticated animals and other mammals which are susceptible to the blood fluke must be eliminated or their movements restricted so that they will not scatter the eggs with their fæces.

3. *The larval stages of the parasite (sporocyst and young cercaria) within the molluscan intermediate host.*—The destruction of the larval stages of the parasite within the intermediate host can be brought about and their development prevented by the elimination of the snail carriers. In Japan attempts to exterminate the molluscan intermediate host of *Schistosoma japonicum* by the use of chemicals and heat have been in progress during the last twenty years, and, according to Miyajima, (15) satisfactory results are being obtained. The chemical employed is unslaked lime (CaO) because of its low cost. It is lethal in 0.1 per cent concentration not only to the snails but also to the infective cercaria. Heat is applied in the form of boiling water, which is either simply sprayed over the snails, or, in order to conserve the heat better, pumped from a boiler through a hose and expelled beneath a piece of heavy canvas spread over the ground where the mollusks are located.

4. *The liberated cercaria.*—The mature cercaria which escapes into the water from the snail intermediate host is the infective stage in the life cycle of the blood fluke. Its entrance into the human body may be prevented by killing it with a chemical like quicklime or by people not immersing themselves in infected water. Those whose occupations compel them to work in the water, should use appropriate coverings. In Japan the rice farmers are advised to cover the skin of the extremities with a double layer of cotton cloth with a mesh of not over 100 microns or to apply a coating of heavy oil or grease. High rubber boots are the best protection for the feet, but they are cumbersome and many farmers cannot afford to buy them.

CONTROL MEASURES RECOMMENDED

The control of schistosomiasis japonica in the Philippines should not be difficult to undertake, due to the localization of the disease in a few islands that are easily accessible. Since, however, due to financial considerations and the possible lack of adequate personnel, it may not be feasible to carry out immediately extensive campaigns in the different endemic areas, it may be better and more economical in the long run to begin in a number of small selected communities, in order that the experience thus gained may be utilized to advantage in the other infected places. The following control measures are recommended:

Educational propaganda.—In order to secure the intelligent cooperation of the people, it is of paramount importance that they should first be enlightened on the nature and mode of propagation of the disease. For this purpose, popular articles and illustrations on schistosomiasis should be prepared and explained to the people by trained lecturers through the medium of the schools, clinic centers, the radio, and other available agencies. Special emphasis should be placed on the following:

Avoidance of indiscriminate defæcation in the fields, especially near streams and canals.—The present campaign of the Philippine Bureau of Health, which requires every house to have a sanitary toilet, if intensified in the endemic territories and if the people can be convinced to use their toilets, will accomplish this object.

Avoidance of contact with infected water.—With few exceptions, the most important sources of the infection are streams and irrigation canals or ditches which people visit in order to catch fish or to wash after working in muddy fields, or which they cross in going from one place to another. These should be marked dangerous by means of conspicuous signs and people should be advised not to immerse themselves in the water. If they are on the way, bridges should be built so that in crossing them the people will not wet their feet. Those who work in rice fields believed to be infected should use hand and foot coverings.

Elimination of reservoir hosts.—In the Philippines the only animal used in rice cultivation is the water buffalo or carabao (*Bubalus bubalus* Linn.). This animal, however, does not appear to be an important reservoir host of the blood fluke. Dogs and pigs, on the other hand, have been found to be infected with the parasite and must be confined and not allowed to roam at large.

Establishment of treatment centers.—The treatment of the disease with specific drugs like tartar emetic or fuadin should be undertaken in the different endemic areas. This treatment will serve three useful purposes: (*a*) it will lessen the rate of mortality and economic loss from the disease; (*b*) it will reduce the number of people passing schistosome eggs and thus diminish the chances of propagating the infection; and (*c*) it will be a means of gaining the confidence of the people and obtaining their coöperation in the carrying out of the other preventive measures.

Extermination of the snail intermediate host.—A sound knowledge of the bionomics of *Blanfordia quadrasi* is an important prerequisite in attempts to practice control measures. Our observations have shown that the adult snail is truly amphibious in character, being found either in the water or on the constantly moist banks of irrigation canals and other small bodies of fresh water. In the water it may be killed by the use of such well-known poisons as copper sulphate or unslaked lime. On the ground it may be killed by means of heat. A good source of heat besides boiling water is the blaze of a portable torch or burner. In carrying out this control measure, the harborages of the mollusk must be accurately determined. These should be given heat treatment at intervals of a few days until the total disappearance of the snail.

SUMMARY AND CONCLUSIONS

1. The present studies were undertaken to determine more accurately the geographical distribution and incidence of schistosomiasis japonica in the Philippines and to inquire into the advisability of instituting prophylactic measures.

2. Surveys were made in those islands and provinces from which cases of the disease have been recorded in the literature. The existence of the infection in a locality was ascertained by examining the fæces of some of the people and sometimes of domestic animals for the presence of the ova of *Schistosoma japonicum* and/or by searching for the snail intermediate host of the parasite.

3. One or more areas of infection were found in Leyte, Samar, Mindanao, and Mindoro; none were found in Manila and in Bulacan, Nueva Ecija, Rizal, and Sorsogon Provinces. The cases of schistosomiasis appearing in the literature as having come from the latter places must have contracted the infection in one of the above-mentioned islands.

4. In Leyte the infection seems to be confined to the eastern half of the island, while in Samar it appears to be more widely distributed; in Mindoro and Mindanao it was found near the northeastern coasts, around Lakes Naujan and Mainit, respectively.

5. The determining factor in the distribution of schistosomiasis is the snail intermediate host; in other words, the disease is endemic only in places where the mollusk is found.

6. The snail is either in the water or on the constantly moist banks of small, slow-flowing fresh-water streams and irrigation canals where there is an abundance of decaying organic matter for the sustenance of the mollusk. Among the factors that help to maintain a favorable environment for the snail are probably climate and topography as well as the chemical composition of the soil.

7. The incidence of schistosomiasis in the different infected localities visited varied from 17.1 to 45.5 per cent, the average being about 20 per cent; it was higher in Leyte than in Samar or Mindoro.

8. The disease is a menace of medical and economic importance in the Philippines due to the large number of people affected, many of whom either succumb or are disabled physically.

9. The following control measures are recommended:

(*a*) *Educational propaganda.*—The object is to enlighten the people on the danger of promiscuous defæcation, the rôle of domesticated animals and other reservoir hosts in the propagation of the disease, and the methods of protecting the body from cercarial invasion.

(*b*) *Specific treatment of the disease.*—This treament will serve to lessen the rate of mortality from the infection, diminish the chances of propagating the malady by reducing the number of people passing schistosome eggs, and gain the confidence and active coöperation of the people.

(*c*) *Extermination of the snail intermediate host.*—This may be accomplished by the use of chemicals and heat.

10. Further studies should be made (*a*) on the disease in order to increase our knowledge of its geographical distribution and to determine whether it is spreading; and (*b*) on the snail intermediate host with special reference to its life history and bionomics.

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ILLUSTRATIONS

TEXT FIGURES

A COLLECTION OF LONGICORN BEETLES FROM THAI

COLEOPTERA: CERAMBYCIDÆ [1]

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ONE PLATE

The following descriptions and records of longicorn beetles from Thai (Siam) are based on part of a collection sent to the writer for study by Mr. W. S. Fisher of the United States Bureau of Entomology and Plant Quarantine at Washington, D. C. This collection consisted of miscellaneous small lots collected by various people, but mostly taken by Dr. Hugh M. Smith in northern Siam and at Bangkok, and by Dr. W. L. Abbott at Trong in lower Siam. Four new species are described in this contribution, all of them having been collected by Dr. Hugh M. Smith, and two others were described in an earlier article.[2] The types of the new species, and the other listed specimens, are in the collection of the United States National Museum in Washington, D. C., except for a few duplicates in the writer's collection. The writer is deeply indebted to Mr. W. S. Fisher and Dr. E. A. Chapin of the United States National Museum for the privilege of studying and reporting upon this material.

At the end of the enumeration of the species in the present collection is appended a list of the species of Cerambycidæ so far recorded from Siam. These number but slightly over one hundred species, which is strikingly few, considering the thousands of species that have been described from India, Burma, Indo-China, South China, and the Malay Peninsula and Archipelago. Many of these, of course, are to be expected in Thai, as there is no small number of well-known species which have been recorded from one or more parts of the Malay region as well as from Burma, Tenasserim, or some other area north of Thai.

[1] Contribution from the Lingnan Natural History Survey and Museum, Lingnan University.

[2] New longicorn beetles from the Philippines, Borneo and Siam. Philip. Journ. Sci. 58 (1935) 267–280.

PRIONINÆ

PHILINI

Genus PHILUS Saunders, 1853

1. PHILUS COSTATUS Gahan.

Philus costatus Gahan, Ann. & Mag. Nat. Hist. (6) 11 (1893) 254.

Several examples were collected at Bangkok by Dr. Hugh M. Smith. Specimens in the United States National Museum and in my collection.

DISTENIINÆ

DISTENIINI

Genus DISTENIA Serville, 1825

2. DISTENIA FULVIPENNIS Gressitt.

Distenia fulvipennis Gressitt, Philip. Journ. Sci. 58 (1935) 267.

Known only from the type specimen in the United States National Museum, collected at Chiengmai April 7, 1928, by Dr. and Mrs. J. W. McKean.

LEPTURINÆ

LEPTURINI

Genus OCALEMIA Pascoe, 1858

3. OCALEMIA AUREOVIRIDIS Gressitt sp. nov.

Elongate, posteriorly attenuate; metallic green with bronzy iridescence; antennæ black beyond scape; legs cyaneous, tarsi black; dorsal surface, including antennæ and legs, clothed with short, stiff, inclined, black bristles; scutellum and ventral surfaces of body silvery pubescent.

Head long; eyes subglobular, prominent; neck suddenly constricted behind eyes; occiput densely and finely punctured; frons with a triangular impunctate area; clypeus large, heavily punctured; genæ large, sparsely punctured. Antennæ reaching to last fifth of elytra, thickened distally; scape as long as fourth segment and three-fourths as long as third; fifth segment subequal to third, sixth to tenth segments gradually shorter; bristles longest on inner side of third to fifth segments. Prothorax barely longer than broad, broadest basally, slightly swollen at middle, strongly constricted behind anterior margin which is two-thirds as broad as base; basal margin slightly raised, concave on each side of middle; disc rather finely and densely punctured, a small oval impunctate area near base. Scutellum scutiform. Elytra narrow, twice as long as head and prothorax combined, constricted antemedially, slightly narrowed and interno-obliquely truncated apically; surface densely and deeply punctured. Ventral surfaces densely and finely punctured, more sparsely so on apical portions of abdominal segments. Legs long; hind tibiæ arched, shorter than their tarsi, which are laterally compressed and have the first segment as long as the remaining segments united.

Length, 14 to 15 millimeters; elytra, 9 to 9.5; breadth, 2.4.

Holotype, female (United States National Museum), Khun Tan Mountains, northern Siam, May 1933, Dr. Hugh M. Smith; female paratopotype in my collection.

This species is closely related to *O. prasina* Heller, of Luzon, differing in lacking red on its femora and antennæ, in having the head and prothorax more densely punctured, and in other respects. Differs from *O. viridescens* Pic, of Laos, from the brief description, in having the head and ventral surface green, and the legs blue instead of black.

CERAMBYCINÆ

HESPEROPHANINI

Genus STROMATIUM Serville, 1834

4. STROMATIUM LONGICORNE (Newman).

Arhopalus longicornis NEWMAN, Entomologist 1 (1842) 246, Philippines.

Stromatium longicorne WHITE, Cat. Col. Brit. Mus. 8 (1853) 300.

Specimens were collected at Bangkok by Dr. Hugh M. Smith and are now in the United States National Museum.

Genus GNATHOLEA Thomson, 1861

5. GNATHOLEA EBURIFERA Thomson.

Gnatholea eburifera THOMSON, Essai Class. Ceramb. (1861) 375, Cambodia; GAHAN, Fauna Brit. India Col. 1 (1906) 111.

One specimen was collected at "Secchol, Siam" by Dr. Hugh M. Smith.

CERAMBYCINI

Genus ÆOLESTHES Gahan, 1890

6. ÆOLESTHES INDUTA (Newman).

Hammaticherus indutus NEWMAN, Entomologist 1 (1842) 245, Philippines.

Æolesthes induta GAHAN, Ann. & Mag. Nat. Hist. (6) 6 (1890) 253; Fauna Brit. India Col. 1 (1906) 128.

One specimen was taken at Bangkok by Dr. Hugh M. Smith.

CALLIDIOPSINI

Genus CERESIUM Newman, 1842

7. CERESIUM GENICULATUM White.

Ceresium geniculatum WHITE, Cat. Col. Brit. Mus. 8 (1855) 245, East Indies; GAHAN, Fauna Brit. India Col. 1 (1906) 158.

Some specimens were taken at Bangkok by Dr. Hugh M. Smith.

CALLICHROMINI

Genus PACHYTERIA Serville, 1833

8. PACHYTERIA VIRESCENS Pascoe subsp.?

Pachyteria virescens PASCOE, Proc. Zool. Soc. London (1866) 519, pl. 43, fig. 2, Penang.

One specimen was taken at Khow Sai, Trong, lower Siam, by W. L. Abbott, and is now in the United States National Museum.

Genus POLYZONUS Castelnau, 1840

9. POLYZONUS PRASINUS (White).

Promeces prasinus WHITE, Cat. Col. Brit. Mus. 7 (1853) 170, India.
Polyzonus prasinus GAHAN, Fauna Brit. India Col. 1 (1906) 219.

Some specimens were collected at Bangkok by Dr. Hugh M. Smith and are in the United States National Museum. This is apparently the first record for this country.

PYRESTINI

Genus PACHYLOCERUS Hope, 1834

10. PACHYLOCERUS SULCATUS Brongniart.

Pachylocerus sulcatus Brongniart, Nouv. Archiv Mus. Paris (3) 3 (1891) 240, pl. 10, fig. 4.

One specimen was collected at Bangkok by Dr. Hugh M. Smith and is in the United States National Museum.

CLYTINI

Genus CHLOROPHORUS Chevrolat, 1863

11. CHLOROPHORUS RUBRICOLLIS (Castelnau & Gory).

Clytus rubricollis CASTELNAU and GORY, Monogr. Genre *Clytus* (1841) 88, pl. 16, fig. 102.

Coloclytus rubricollis GAHAN, Fauna Brit. India Col. 1 (1906) 265.

A specimen was collected at "Sarakam, E. Siam" by Dr. Hugh M. Smith, and is in the United States National Museum. New to Thai.

12. CHLOROPHORUS SMITHI Gressitt sp. nov. Plate 1, fig. 1.

Largely black, clothed with sulphur-yellow pubescence above and paler-yellow pubescence below; marked above with black as follows: prothorax with three large round spots in a transverse row, centered slightly before middle, elytra with a subcircular mark at base touching humeral angle and external margin, a subtransverse band at middle, sinuous anteriorly, extending forward a short distance along suture, broadest at external margin, and a wider band between preceding band and apex, narrowly divided at suture; ventral surfaces densely clothed with yellow pubescence except on anterior portion of mesosternum, mesepimeron, central portion of metasternum, and basal margins and centers of abdominal sternites; antennæ ochraceous brown, scape and apices of following segments duller; legs dark reddish brown; swollen portions of femora, apices of tibiæ, and tarsal segments nearly black.

Head deeper than wide, plane in front, depressed at vertex, largely granulate-punctate; frons much higher than wide, narrowed above, feebly carinate medially; vertex feebly concave, as broad as distance between inferior eye lobes, the latter wider than deep. Antennæ reaching to end of first third of elytra; scape one and one-fourth as long as third segment, third to tenth segments gradually shorter. Prothorax a little longer than broad, swollen before middle. Scutellum short, rounded. Elytra twice as long as head and prothorax together, narrowed posteriorly, subobliquely rounded-truncate apically. Posterior femora extending considerably beyond elytral apices; first hind tarsal segment twice as long as following two segments combined.

Length, 11 millimeters; breadth, 3.2.

Holotype, female, No. 53473, United States National Museum, Khun Tan Mountains, altitude 3000 feet, northern Siam, May 1933, Hugh M. Smith.

Differs from *Chlorophorus annularis* (Fabr.) in being much stouter, more narrowed posteriorly, with the antennæ shorter and thicker and the head more plane in front. This species seems to approach *Xylotrechus* rather closely in several of its characteristics. It differs from *X. subdepressus* (Chevr.) in having the frons more constricted near the eyes, almost entirely pubescent, and indistinctly carinated, the prothorax with three round, black spots, and the elytra with a pair of ringlike spots and two fasciæ.

This species is named in honor of Dr. Hugh M. Smith, formerly of Bangkok, where he was in charge of the Bureau of Fisheries of the Government of Siam.

Genus RHAPHUMA Pascoe, 1858

13. RHAPHUMA SULPHUREA Gressitt sp. nov. Plate 1, fig. 2.

Body black, densely clothed beneath with pale sulphur-yellow pubescence, and above with sulphur-green pubescence, marked with black as follows: prothorax with a pair of discal ( )-shaped marks, each connected with a short transverse bar at anterior end and a short, longitudinal stripe at each side, elytra with external margin, a narrow humeral stripe extending to end of basal third, a slightly sinuous discal stripe from near base to middle, followed by a shorter, suboblique stripe, and lastly a transverse band at beginning of apical quarter, not quite touching suture and external margins; antennæ ochraceous, thinly clothed with whitish hairs, apical segments slightly dull internally; legs ochraceous, swollen portions of femora blackish brown clothed with sulphur-green hairs. Inner sides of basal antennal segments, prothorax, bases of elytra, and ventral surfaces with very fine, suberect hairs.

Head about as broad as deep; frons squarish, a small nude area in middle; vertex grooved and slightly concave between antennal supports; occiput granulate behind; eyes deeply emarginate, lower lobes egg-shaped. Antennæ as long as body; scape arched, feebly thickened apically, three-fourths as long as third segment; fourth segment a little shorter than fifth, the latter not quite as long as third. Prothorax subcylindrical, weakly rounded laterally, a little longer than broad, granulose on surface. Scutellum short, rounded. Elytra parallel; apices narrowed and obliquely truncate; surfaces finely rippled-punctate. Legs slender; posterior femora exceeding elytral apices by one-fourth their length; first hind tarsal segment as long as following segments united; tarsal claws fully one-half as long as segments bearing them.

Length, 11 millimeters; breadth, 3.

Holotype, male, No. 53472, United States National Museum, Khun Tan Mountains, altitude 4,000 feet, northern Siam, May 1933, Hugh M. Smith.

Differs from *Rhaphuma quadricolor* Cast. and Gory in being less slender, with the vertex broader, the eyes smaller, the prothorax shorter, and the body less densely clothed with pubescence, besides being differently marked.

Genus DEMONAX Thomson, 1861

14. DEMONAX ELONGATULUS (Castelnau and Gory).

Clytus elongatulus CASTELNAU and GORY, Monogr. Genre *Clytus* (1841) 97, pl. 18, fig. 116.

Demonax elongatulus CHEVROLAT, Mem. Soc. Sci. Liege 18 (1869) 271; reprint, p. 19.

Two specimens were collected at Sarakam, eastern Siam, March 21, 1929, by Dr. Hugh M. Smith. One specimen is in the United States National Museum and one in my collection.

LAMIINÆ

MONOCHAMINI

Genus ARCTOLAMIA Gestro, 1888

15. ARCTOLAMIA FASCIATA Gestro.

Arctolamia fasciata GESTRO, Ann. Mus. Civ. Genova (2) 4 (1888) 222, fig., Tenasserim.

Three specimens were collected: one at Kanburi and two at Dai Nangka, northern Siam, November 8, 1930, by Dr. Hugh M. Smith. Two are in the United States National Museum and one is in my collection. New to Thai.

Genus PARALEPRODERA Breuning, 1935

16. PARALEPRODERA INSIDIOSA (Gahan).

Leprodera insidiosa GAHAN, Ann. & Mag. Nat. Hist. (6) 2 (1888) 391.

Specimens were collected at Trong, lower Siam, by W. L. Abbott.

Genus EPEPEOTES Pascoe, 1866

17. EPEPEOTES LATERALIS (Guerin).

Monochamus lateralis GUERIN, Dict. Class. d'Hist. Nat. 17 (1831) pl. 68, fig. 6.

Epepeotes meridianus PASCOE, Trans. Ent. Soc. London (3) 3 (1866) 302.

Two specimens: one from Khow Sai Dow, the other from Trong. New to Thai.

Genus PELARGODERUS Serville, 1835

18. PELARGODERUS sp.

Three examples of a form closely resembling *P. bipunctatus* (Dalm.) were taken at Trong by W. L. Abbott.

Genus PERIHAMMUS Aurivillius, 1924

19. PERIHAMMUS LUTEOFASCIATUS Gressitt sp. nov. Plate 1, fig. 3.

Female.—Black; elytra crossed by two slightly undulating transverse bands of pale-yellow pubescence, each a little more than a millimeter wide, the first placed after basal fifth, the second before apical quarter; third to tenth antennal segments each with basal quarter or basal third clothed with tawny-gray hairs; black portions of body largely clothed with a thin layer of silvery-gray pubescence.

Head deeper than wide, minutely punctulate except for a few sparse, shallow punctures on antennal tubercles; frons slightly swollen, higher than wide, a little broader above than below; antennal tubercles fairly prominent, diverging at an angle of about 100°, occiput even, feebly grooved; eyes deeply emarginate, inferior lobes deeper than wide, reaching three-fourths distance to bases of mandibles. Antennæ one and one-half as long as body; scape very slightly and gradually thickened apically, nearly as long as third segment, subequal to fourth; fourth to tenth segments gradually diminishing in length. Prothorax broader than long, armed at middle of each side with a broad-based and moderately acute tubercle; disc feebly swollen on each side of midline before center and behind middle, punctured in a sparse and irregular manner. Scutellum short, rounded-triangular. Elytra subparallel, subrounded apically, distinctly punctured in irregular rows basally, the punctures disappearing before apices. First hind tarsal segment shorter than following two segments united.

Length, 13.3 millimeters, breadth, 4.7.

Holotype, female, No. 53471, United States National Museum, Khun Tan Mountains, altitude 4,000 feet, northern Siam, May 1933, Dr. Hugh M. Smith, collector.

Differs from *Perihammus bifasciatus* Aurivillius in being slightly broader, in being black with two distinct, subtransverse, yellowish bands, and in having the antennæ thicker, the prothorax more strongly tuberculate laterally, and the elytra more heavily punctured basally and rounded apically.

MESOSINI

Genus CACIA Newman, 1842

20. CACIA sp.

A specimen probably representing a new species was taken in the Khun Tan Mountains, northern Siam, by Dr. Hugh M. Smith.

Genus COPTOPS Serville, 1835

21. COPTOPS LICHENEA Pascoe.

Coptops lichenea PASCOE, Trans. Ent. Soc. London (3) **3** (1865) 118, Malacca.

A specimen was collected at Trong, lower Siam, by W. L. Abbott. New to Thai.

ANCYLONOTINI

Genus PALIMNA Pascoe, 1862

22. **PALIMNA ANNULATA TESSELLATA (Pascoe).**

Golsinda tessellata PASCOE, Trans. Ent. Soc. London (2) 4 (1857) 49, Borneo.

Palimna tessellata PASCOE, Trans. Ent. Soc. London (3) 3 (1865) 135, pl. 6, fig. 2.

Palimna annulata var. *tessellata* AURIVILLIUS, Col. Cat. 73 (1922) 152.

Specimens were collected at Trong, lower Siam, by W. L. Abbott. New to Thai.

23. **PALIMNA MIMICA Fairmaire.**

Palimna mimica FAIRMAIRE, Ann. Soc. Ent. France 67 (1898) 399, Butang.

A specimen was collected at Bangkok by Dr. Hugh M. Smith and is in the United States National Museum. New to Thai.

DORCASCHEMATINI

Genus OLENOCAMPTUS Chevrolat, 1835

24. **OLENOCAMPTUS SIAMENSIS Breuning.**

Olenocamptus siamensis BREUNING, Festschr. E. Strand 1 (1936) 319, Siam.

One specimen probably referable to this species was taken at Bangkok by Dr. Hugh M. Smith and is in the United States National Museum.

NIPHONINI

Genus PTEROLOPHIA Newman, 1842

25. **PTEROLOPHIA spp.**

Unique specimens of two species were taken at Trong by W. L. Abbott.

Genus DAXATA Pascoe, 1864

26. **DAXATA USTULATA Pascoe. Plate 1, fig. 4.**

Daxata ustulata PASCOE, Proc. Zool. Soc. London (1866) 230, p. 27, fig. 4, Penang.

One specimen was collected at Trong, lower Siam, by W. L. Abbott, and is in the United States National Museum. New to Thai.

Genus PARAPHEMONE Gressitt, 1935

27. **PARAPHEMONE MULTIMACULATA Gressitt.**

Paraphemone multimaculata GRESSITT, Philippine Journ. Sci. 58 (1935) 279, Siam.

Known only from the type specimen in the United States National Museum, collected at Trong, lower Siam, by W. L. Abbot.

Genus STHENIAS Castelnau, 1840

28. STHENIAS FRANCISCANUS Thomson.

Sthenias franciscanus THOMSON, Syst. Ceramb. (1865) 550.

One specimen probably referable to this species was taken at Trong, lower Siam, by W. L. Abbott. New to Thai.

HIPPOPSINI

Genus POTHYNE Thomson, 1864

29. POTHYNE VARIEGATA Thomson.

Pothyne variegata THOMSON, Syst. Ceramb. (1864) 97; LACONDAIRE, Gen. Col. 9 (1872) 694; GAHAN, Ann. Mus. Civ. Genova 34 (1894) 78.

One specimen was collected at Bangkok by Dr. Hugh M. Smith, and is in the United States National Museum.

LIST OF CERAMBYCIDÆ OF THAI

PRIONINÆ

PRIONINI

Dorysthenes rostratus (Fabricius), Ent. Syst. 1, 2 (1792) 243.
Baladeva walkeri Waterhouse, Trans. Ent. Soc. London 2 (1840) 226, pl. 21, fig. 1.
Paraphrus granulosus (Thomson), Essai Classif. Ceramb. (1861) 329.

MACROTOMINI

Remphan hopei Waterhouse, Trans. Ent. Soc. London 1 (1836) 67, pl. 8, fig. 1.

MEGOPIDINI

Megopis (Ægolipton) marginalis (Fabricius), Syst. Ent. 2 (1775) 169.

PHILINI

Philus costatus Gahan, Ann. & Mag. Nat. Hist. (6) 9 (1893) 254.

DISTENIINÆ

DISTENIINI

Distenia fulvipennis Gressitt, Philippine Journ. Sci. 58 (1935) 267.

LEPTURINÆ

LEPTURINI

Ocalemia aureoviridis Gressitt sp. nov.

CERAMBYCINÆ

HESPEROPHANINI

Stromatium longicorne (Newman), Entomologist 1 (1842) 246.
Gnatholea eburifera Thomson, Essai Classif. Ceramb. (1861) 375.
Zoodes compressus (Fabricius), Mantissa Ins. 1 (1787) 153.

ŒMINI

Tetraommatus insignis Gahan, Ann. Mus. Civ. Genova **34** (1894) 8, pl. 1, fig. 1.
Xystrocera globosa (Olivier), Entomologie (4) 67 (1795) 27, pl. 12, fig. 81.

CERAMBYCINI

Æolesthes holosericea (Fabricius), Mantissa Ins. 1 (1787) 135.
Æolesthes induta (Newman), Entomologist 1 (1842) 245.
Neocerambyx paris (Wiedemann), Germ. Mag. Ent. 4 (1821) 167.
Plocœderus obesus Gahan, Ann. & Mag. Nat. Hist. (6) 5 (1890) 51.
Nadezhdiella cantori (Hope), Trans. Ent. Soc. London 4 (1845) 11.
[= *Cerambyx lucasi* Brongniart, Nouv. Arch. Mus. Paris (3) 3 (1892) 238, pl. 10, fig. 1.]
Diorthrus cinereus (Fabricius), Ent. Syst. 2 (1792) 264.
Dialeges undulatus Gahan, Ann. & Mag. Nat. Hist. (6) 7 (1891) 23.
Rhytidodera integra Kolbe, Archiv Naturg. 3 1 (1886) 237.
Rhytidodera siamica Nonfried, Berliner Ent. Zeit. **36** (1892) 378.
Xoanodera pascoei Brongniart, Nouv. Arch. Mus. Paris (3) 3 (1892) 239.
Zegriades fulvipennis Nonfried, Berliner Ent. Zeit. **40** (1895) 309.
Zegriades siamensis Nonfried, Berliner Ent. Zeit. **40** (1895) 308.

CALLIDIOPSINI

Ceresium geniculatum White, Cat. Col. Brit. Mus. 8 (1855) 245.
Ceresium leucosticticum White, Cat. Col. Brit. Mus. 8 (1855) 245, pl. 6, fig. 1.
Gelonœtha hirta (Fairmaire), Rev. et Mag. de Zool. (1850) 60.

PHORACANTHINI

Nyphasia pascoei Lacordaire, Gen. Col. 8 (1869) 309.

COMPSOCERINI

Rosalia lameerei Brongniart, Bull. Soc. Ent. France (1890) cxxi.
Acrocyrtidus fasciatus Jordan, Nov. Zool. 1 (1894) 500, pl. 13, fig. 10.

CALLICHROMINI

Pachyteria bouvieri Ritsema, Bull. Mus. Paris 2 (1896) 330.
Pachyteria fasciata (Fabricius), Syst. Ent. (1775) 168.
Pachyteria virescens Pascoe, Proc. Zool. Soc. London (1866) 519, pl. 43, fig. 2.
Chelidonium binotatum Brongniart, Nouv. Arch. Mus. Paris (3) **3** (1892) 245, pl. 10, fig. 9.
Polyzonus bizonatus White, Cat. Col. Brit. Mus. 7 (1853) 171.
Polyzonus prasinus (White), Cat. Col. Brit. Mus. 7 (1853) 170.
Anubis bipustulatus Thomson, Syst. Ceramb. (1865) 569.
Anubis bipustulatus ab.
quadripustulatus Plavilstshikov, Ent. Blätter 23 (1927) 108.
tripustulatus Plavilstshikov, Ent. Blätter 23 (1927) 108.
Anubis fimbriatus Bates, Cist. Ent. 2 (1879) 412.
Anubis inermis (White), Cat. Col. Brit. Mus. 7 (1853) 171.

PYRESTINI

Pachylocerus sulcatus Brongniart, Nouv. Archiv Mus. Paris (3) **3** (1891) 240, pl. 10, fig. 4.

CLYTINI

Xylotrechus buqueti (Castelnan and Gory), Hist. Nat. Icon. Ins. Col. (Monogr. Gen. *Clytus*) (1841) 86, pl. 16, fig. 99.
Xylotrechus quadripes Chevrolat, Mem. Soc. R. Sci. Liege **18** (1863) 315.
Perissus laetus Lameere, Ann. Soc. Ent. France **62** (1893) 283.
Perissus mutabilis Gahan, Ann. Mus. Civ. Genova **34** (1894) 23.
Clytosaurus siamensis Jordan, Nov. Zool. **1** (1894) 497, pl. 13, fig. 9.
Chlorophorus annularis (Fabricius), Mantissa Ins. **1** (1787) 156.
Chlorophorus rubricollis (Castelnau and Gory), Monogr. Gen. *Clytus* (1841) 88, pl. 16, fig. 102.
Chlorophorus smithi Gressitt sp. nov.
Rhaphuma sulphurea Gressitt sp. nov.
Demonax elongatulus (Castelnau and Gory), Monogr. Gen. *Clytus* (1841) 97, pl. 18, fig. 116.

CLEOMENINI

Nida flavovittata Pascoe, Ann. & Mag. Nat. Hist. (3) **19** (1867) 312.

STENASPINI

Pavieia superba Brongniart, Bull. Soc. Ent. France (1890) 185.
Purpuricenus malaccensis Lacordaire, Gen. Col. **9** (1869) 176, note 2.
[= *P. fasciatus* Brongn., Nov. Arch. Mus. Paris (3) **3** (1892) 241, pl. 10, fig. 5.]

LAMIINÆ

MONOCHAMINI

Arctolamia fasciata Gestro, Ann. Mus. Civ. Genova (2) **6** (1888) 129.
Epicedia triangularis Thomson, Syst. Ceramb. (1865) 554.
Paraleprodera cordifera (Thomson), Syst. Ceramb. (1865) 554.
Paraleprodera insidiosa Gahan, Ann. & Mag. Nat. Hist. (6) **2** (1888) 391.
Paraleprodera lecta Gahan, Ann. & Mag. Nat. Hist. (6) **2** (1888) 389.
Macrochenus guerinii White, Ann. & Mag. Nat. Hist. (3) **2** (1858) 274.
Epepeotes luscus (Fabricius), Mantissa Ins. **1** (1787) 139.
Epepeotes lateralis (Guerin), Dict. Class. d'Hist. Nat. **17** (1831) pl. 68, fig. 6.
Monochamus bimaculatus Gahan, Ann. & Mag. Nat. Hist. (6) **2** (1888) 260.
Pelargoderus sp.
Gerania bosci (Fabricius), Syst. Eleuth. **2** (1801) 323.
Melanauster zonator Thomson, Revue Zool. (3) **7** (1878) 50.
Pseudocyriocrates strandi Breuning, Fol. zool.-hydrobiol. **8** (1935) 64.
Aristobia voeti Thomson, Revue Zool. (3) **6** (1878) 51.
[= *A. angustifrons* Gahan, Ann. & Mag. Nat. Hist. (6) **1** (1888) 276.]
Cremnosterna carissima (Pascoe), Trans. Ent. Soc. London (2) **4** (1857) 104.
Perihammus luteofasciatus Gressitt sp. nov.
Blepephæus marshalli Breuning, Fol. zool.-hydrobiol. **8** (1935) 69.
Blepephæus pardalinus Breuning, Fol. zool.-hydrobiol. **8** (1935) 68.
Blepephæus succinctor (Chevrolat), Revue Zool. (2) **4** (1852) 417.

Cratotragus cinabarrinus Lacordaire, Gen. Col. 9 (1869) 332, note 2.
Cereopsius siamensis Breuning, Festschr. E. Strand 1 (1936) 299.
Haplothrix blairi Breuning, Fol. zool.-hydrobiol. 8 (1935) 67.
Haplothrix simplex Gahan, Ann. & Mag. Nat. Hist. (6) 1 (1888) 278.

AGNIINI

Pharsalia pulchra Gahan, Ann. & Mag. Nat. Hist. (6) 1 (1888) 280.
Cycos subgeminatus (Thomson), Archives Ent. 1 (1857) 294.

BATOCERINI

Batocera hector helena Thomson, Syst. Ceramb. (1865) 552.
Batocera munitor ferruginea Thomson, Archives Ent. 1 (1858) 456.
Batocera rubus punctatella Kriesche, Archiv Naturg. 80 A 11 (1915) 135, fig. 15.

GNOMINI

Imantocera olivieri Thomson, Syst. Ceramb. (1865) 555.

MESOSINI

Golsinda basicornis Gahan, Ann. Mus. Civ. Genova 34 (1894) 48.
Cacia sp.
Coptops annulipes Gahan, Ann. Mus. Civ. Genova 34 (1894) 54.
Coptops lichenea Pascoe, Trans. Ent. London (3) 3 (1865) 118.
Coptops pascoei Gahan, Ann. Mus. Civ. Genova 34 (1895) 55.
Mutatocoptops similis Breuning, Folia zool.-hydrobiol. 8 (1935) 263.
Pseudochœromorpha siamensis Breuning, Festsch. E. Strand 1 (1936) 310.
Saimia siamensis Breuning, Festchr. E. Strand 4 (1938) 200.
Therippia (*Paratherippia*) *mediofasciata* Breuning, Folia zool.-hydrobiol. 8 (1935) 274.

ANCYLONOTINI

Palimna annulata tessellata Pascoe, Trans. Ent. Soc. London (2) 4 (1857) 49.
Palimna mimica Fairmaire, Ann. Soc. Ent. France 67 (1898) 399.

DORCASCHEMATINI

Olenocamptus bilobus (Fabricius), Syst. Eleuth. 2 (1801) 324.
Olenocamptus diversemaculatus Breuning, Festschr. E. Strand 4 (1938) 225.
Olenocamptus siamensis Breuning, Festschr. E. Strand 1 (1936) 319.

ECYROSCHEMINI

Apatelarthron heteroclitum Thomson, Syst. Ceramb. (1864) 89.

NIPHONINI

Niphona scopulifera (Thomson), Syst. Ceramb. (1864) 54.
Camptocnema lateralis (White), Ann. & Mag. Nat. Hist. (3) 2 (1858) 267.
Pterolophia canescens Breuning, Festschr. E. Strand 5 (1939) 193.
Pterolophia siamensis Breuning, Festschr. E. Strand 4 (1938) 278.
Pterolophia transversefasciata Breuning, Festschr. E. Strand 4 (1938) 252.
Pterolophia virgulata Breuning, Festschr. E. Strand 5 (1939) 193.
Daxata ustulata Pascoe, Proc. Zool. Soc. London (1866) 230, pl. 27. fig. 4.
Paraphemone multimaculata Gressitt, Philip. Journ. Sci. 58 (1935) 279.

Sthenias franciscanus Thomson, Syst. Ceramb. (1865) 550.
Dystasia siamensis Breuning, Festschr. E. Strand 4 (1938) 383.
Egesina siamensis Breuning, Festschr. E. Strand 4 (1938) 386.

NEDININI

Nedine longipes Thomson, Syst. Ceramb. (1864) 27.

HIPPOPSINI

Pothyne variegata Thomson, Syst. Ceramb. (1864) 97.
Pothyne griseolineata Breuning, Fol. Zool.-hydrobiol. 10 (1940) 188.
Pothyne ochracea Breuning, Fol. Zool.-hydrobiol. 40 (1940) 188.

SAPERDINI

Serixia sedata Pascoe, Journ. Ent. 1 (1862) 354.

GLENEINI

Glenea (*Stiroglenea*) *cancellata* Thomson, Syst. Ceramb. (1865) 565.
Glenea diana Thomson, Syst. Ceramb. (1865) 561.
Glenea siamensis Gahan, Ann. & Mag. Nat. Hist. (6) 19 (1897) 479.
Heteroglenea nigromaculata (Thomson), Syst. Ceramb. (1865) 566.
Stibara rufina Pascoe, Trans. Ent. Soc. London (2) 4 (1858) 259.

PHYTOECIINI

Nupserha variabilis Gahan, Ann. Mus. Civ. Genova 34 (1894) 92.

TETRAOPINI

Cleonaria bicolor Thomson, Syst. Ceramb. (1864) 119.
Anastathes biplagiata Gahan, Trans. Ent. Soc. London (1901) 61, pl. 4, fig. 9.
Astathes dimidiata (Gory) in Guerin, Icon. Regne Anim. Ins. (1832) pl. 45, fig. 3; (1844) 244.
Astathes nitens (Fabricius), Syst. Eleuth. 2 (1801) 279.
[= *A. fabricii* Thomson, Syst. Ceramb. (1865) 558].

CORRECTIONS TO "THE LONGICORN BEETLES OF HAINAN ISLAND" COLEOPTERA: CERAMBYCIDÆ

By J. LINSLEY GRESSITT

[Published in the Philippine Journal of Science, vol. 72, nos 1–2, May–June, 1940]

Page.	Line.	As printed.	Correct form.
2	9	Van Dyke	van Dyke
9	34	*Microstola*	*Microestola*
20	7	MEZOPIDINI	MEGOPIDINI
81	15 (insert following):		

A single male (Lingnan Nat. Hist. Mus.) was taken at Tai-ping-ts'uen, near Loi Mother Mountain, April 25, 1935, by F. K. To.

New to Hainan.

Page.	Line.	As printed.	Correct form.
104	7 (from bottom)	Faan-na	Faan-a
118	5	Nos. 53456 and 53459	No. 53459
152	5 (from bottom)	Nos. 53457 and 53475	No. 53457
158	19	PRESATES	PHESATES
170	19	Trans. Soc. Lond.	Trans. Ent. Soc. Lond.
183	2 (from bottom)		
190	8	*Oligospis*	*Oligopsis*
	10–11 Delete last phrase of paragraph: one paratype ....Museum.	author, No. 53450	author, 1 No. 53450
211	18	scape	scape
228	7	P	p′
	8	t	t′
	7 (from bottom) — Reverse order of Chinese characters.		
229	8 (from bottom)	Leng-moon †	Leng-moon *
230	8 and 12 (from bottom)—Chinese characters shuffled.		
230	2 (from bottom), and p. 231, lines 1 and 4—Characters shuffled.		
233	23 (from bottom)	pls. 1–33.	pls. 1–3.
	14 (from bottom)	pt. 1 9 (1869)	9, pt. 1 (1869)
	12 (from bottom)	pt. 2 1 (1872)	9, pt. 2 (1872)

ILLUSTRATION

PLATE 1

FIG. 1. *Chlorophorus smithi* Gressitt sp. nov.; holotype, × 4.5.
2. *Rhaphuma sulphurea* Gressitt sp. nov.; holotype, × 4.9.
3. *Perihammus luteofasciatus* Gressitt sp. nov.; holotype, × 4.5.
4. *Daxata ustulata* Pascoe; Trong, Lower Siam, × 2.7.

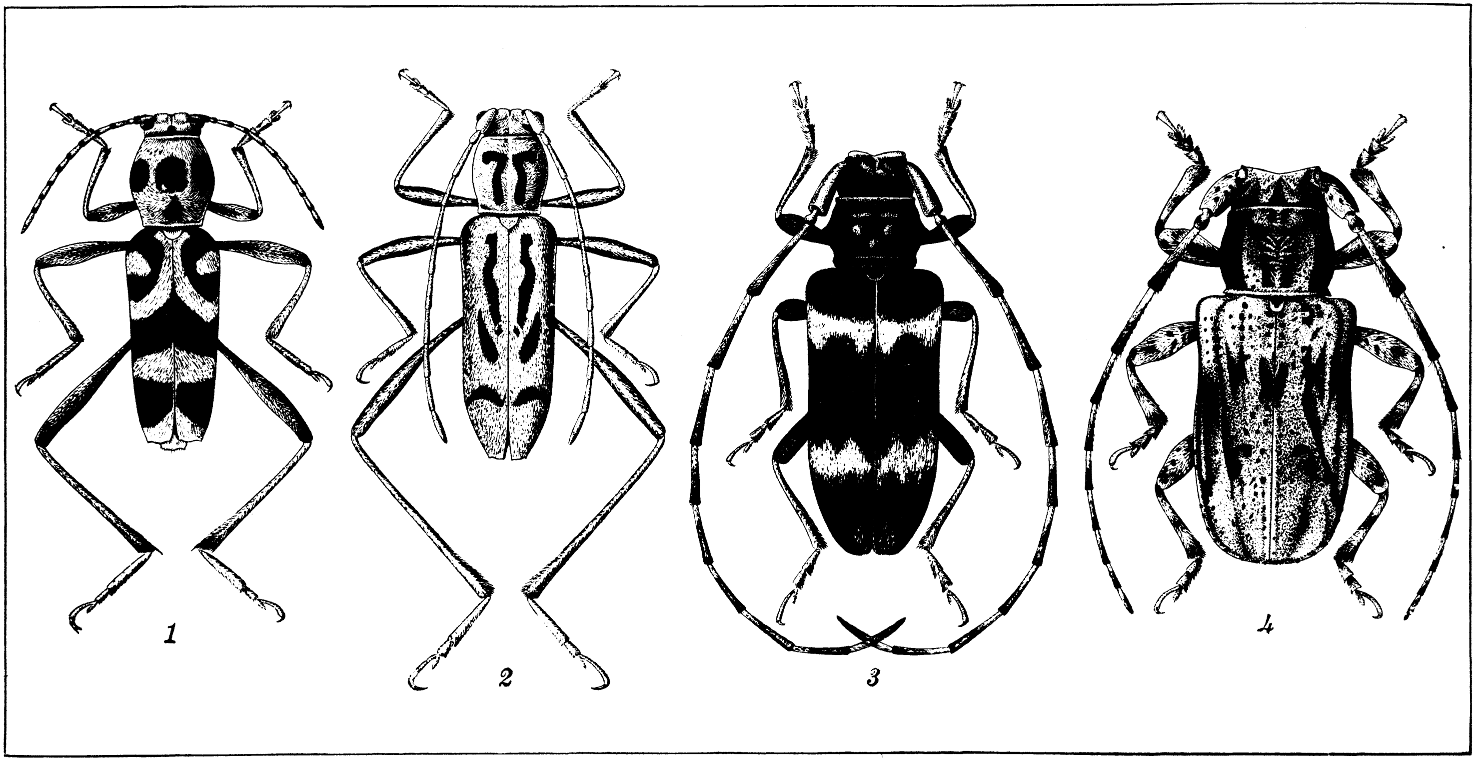

PLATE 1.

IFUGAO SOMATOLOGY

By J. J. ROGINSKY
Of the Institute of Anthropology, Moscow

and

R. F. BARTON
Fellow of the John Simon Guggenheim Memorial Foundation

While on an anthropological field trip in 1937,[1] R. F. Barton gathered somatological data on 124 Ifugaos, 109 men and 15 women. The women were all born in the vicinity of Balitang, the men, 56 in Balitang, 21 in Kiangan, 14 in Hapao, 9 in Benauwe, and 9 in Amduntug. In working up the data the measurements of 2 Kiangan men were not included because one was of half Ilokano blood and the other of one quarter Spanish blood (stature, 181 cm).

The distribution of the subjects by age groups was as follows:[2]

TABLE 1.—*Distribution of the 122 Ifugaos included in this study by age groups.*

Age in years.	Males.	Females.
18–20	8	3
21–25	23	4
26–30	18	
31–35	10	
36–40	13	6
41–45	10	1
46–50	11	
51–55	20	
56–60	1	
66–70	2	
No notation of age	9	1
	107	15

[1] Assisted by grants-in-aid from the Social Science Research Council, New York, and the National Research Council, Washington.

[2] Subjects' ages had to be estimated except in the case of a number of the younger Ifugaos.

Seventeen hair samples were obtained from 11 males, 3 females, and 3 without notation of sex.

The measurements were made with the instruments of Rudolph Martin. Eye color was determined by Martin's scale (old); skin color by Luschan's shade scale, and hair color by E. Fischer's scale (old). All data, including nonmensurable, were recorded on the Harvard University card of anthropometry.

If the nasion could not be palpated, it was assumed to be well above the lowest point of the nasion depression, for observations on living subjects and on Ifugao and other Indonesian skulls showed that, as a rule, the frontal bone strongly overhangs the nasal bones, which typically turn abruptly forward to meet it. The nasal width recorded was the greatest width of the alæ when the features were in repose.

The span recorded was the utmost reach that the subject could make.

The statistical computations were made by A. G. Yasnunskaya of the laboratory of the Institute of Anthropology, Moscow State University, and by E. G. Zhirov of the Anthropological Department of the Institute of Ethnography of the All-Union Academy of Science, USSR. Investigation of the hair specimens was carried out by Prof. J. J. Roginsky, one of the authors, and by P. I. Zenkovich, scientific worker of the Institute of Anthropology.

THE PRINCIPAL NONMENSURABLE CHARACTERS

Form and color of the hair.—The Ifugaos use hair in sorcery; consequently a good deal of opposition was encountered in the taking of hair specimens. Of the 17 specimens obtained, 12, or about 75 per cent, were characterized as either "extremely coarse" or "quite coarse"; 3 as "coarse"; and 2 as "half coarse." Of the "half coarse" specimens, 1 was that of a 20-year-old woman; the age and sex of the other donor was not recorded. Of the 3 "coarse" specimens, 2 were from boys 13 and 15 years old and 1 was from a 40-year-old man. All specimens were straight and, excluding those from women, children, and instances in which sex was not recorded, the overwhelming majority of the specimens might be characterized as exceedingly coarse. Waviness of the hair occurs, but unfortunately this character was not recorded. The color was always black—No. 27 by the E. Fischer scale.

Ifugaos pluck out their beard with bamboo or metallic tweezers—a painful process. The beard appears gradually with advancing maturity and is in nearly all cases sparse, never thick.

The tertiary hair covering is always weakly developed.

Skin color was determined at the midpoint of the inner surface of the upper arm; if the point was not clean, it was scrubbed and allowed to dry before the observation was taken. The data are:

TABLE 2.—*Skin color in the 122 Ifugaos included in this study.*

Birthplace.	Number.	Light brown.			Red brown.			Medium brown.		
		15	17	18	13	14	16	22	23	24
Balitang	56	2	21	20			1	7	3	2
Do	15		7	3	1	1	3			
All other regions	51	6	31	8			3		3	
	122	8	59	31	1	1	7	7	6	2

Thus 80.3 per cent are light brown, 7.4 per cent reddish brown, and 12.3 per cent medium brown. The most frequent skin color is No. 17 (48.4 per cent). Casual observation gives the impression that the Balitang people are a little darker than Ifugaos of other regions, and that the women there are darker than the men. While not conclusive, the recorded data appear to support this observation.

Eye color.—115 notations of eye color show: black (No. 1, Martin's scale) 4.2 per cent; dark brown (No. 2) 45.8 per cent; (No. 3) 43.8 per cent; light brown (No. 4) 6.2 per cent. Mixed eyes occurred in three cases.

External folds were absent in 55.8 per cent of the cases, weakly developed in 31.6 per cent, and moderate in 12.6 per cent. The medial fold was absent in 79.1 per cent of the cases, and weakly developed in 20.9 per cent. According to Barton's notations, the inner, or "Mongolian," fold was absent in 80.6 per cent of the cases, weakly developed in 16.1 per cent, and moderate in 4.3 per cent. However, Barton's understanding of the anatomy of this fold erred in that he considered it to be such a fold as must necessarily arise beneath the inner extremity of the lower lid. Determination by Roginsky from photographs of 62 of the subjects showed, however, not greatly different results, namely, 15 cases of presence of the fold, or

24.2 per cent. The error in Barton's understanding of the epicanthus appears not to have greatly affected his observations, for the discrepancy with the determination made from photographs may well be due to the disproportionately large number of female subjects photographed (10), the fold being present in 4 of these. It is generally observed that the epicanthus is more frequent among men than among women.

In correspondence with the weak development of the epicanthus is the generally straight and horizontal direction of the eye slit (in 73.9 per cent of the cases). A slight slant was found in 26.6 per cent of the cases and a moderate slant in 8.2 per cent. The eye slit is never round as with Negritos.

The nose.—The following data give a general characterization of the nose. The depression of the nasion was extremely great in 12.7 per cent of the cases, very great in 61.2 per cent, moderate in 16.7 per cent, and small in 9.4 per cent. There was no instance of absence of depression. The root height was quite small in 18.4 per cent of the cases, small in 36.9 per cent, medium in 38.8 per cent, and fairly high in 5.9 per cent. The root width was very small in 1 per cent of the cases, small in 20.4 per cent, medium in 36.9 per cent, great in 32 per cent, and very great in 9.7 per cent. The height of the bridge was small in 57.3 per cent of the cases, medium in 39.8 per cent, and high in 2.9 per cent.

The profile of the bridge was concave in 41.5 per cent of the cases, straight in 57.3 per cent, and convex in 1 per cent.

Alveolar prognathism was absent in 95 per cent of the cases, weakly developed in 3 per cent, moderate in 3 per cent, and strong in 1 per cent.

Chin prominence was weak in 56.4 per cent, moderate in 41.5 per cent, and strong in 2.1 per cent of the cases. The chin was of medial type in 90.7 per cent and bilateral in 9.3 per cent of the cases.

The forehead projected forward in 1 per cent of the cases, was without slope in 23.2 per cent, slanted weakly in 65.7 per cent, and slanted moderately in 10.1 per cent.

The teeth were fully erupted in 78.6 per cent, incompletely erupted in 21.4 per cent of the cases.

Occlusion was normal in 90 per cent of 110 observations, taking as the criterion the orthodontists's "key to occlusion," namely, the interdigitation of the mesiobuccal cusp of the upper first molar in the buccal groove of the lower first molar.

Of the 11 abnormal occlusions (1 case being of somewhat uncertain diagnosis owing to loss of some of the key teeth) 10 were cases of distal occlusion of the mandible, and 1 a case of mesial occlusion. Four of the 10, plus the case of uncertain diagnosis, were found in Hapao, where only 14 subjects were measured. This high percentage, no doubt, is partly a freak of chance, but it is not entirely so, for, to the eye of one trained to observe such things, there is apparent an unmistakably high percentage of distal occlusion in the region. It seems that even the Ifugaos recognize this abnormality of occlusion as a trait of Hapao, for an informant, in relating how he would distinguish the home regions of Ifugao strangers, enumerated among other things projecting teeth as characteristic of the Hapao people. Not all cases, of course, of projecting teeth are distal occlusions, but many are.

No loss of teeth was observed in 67.3 per cent of the cases; loss of 1 to 4 teeth in 14.3 per cent, of 5 to 8 teeth in 9.2 per cent, of 9 to 16 teeth in 5.1 per cent, of 17 or more teeth in 4.1 per cent, there being, in the last category, 2 edentulous cases.

Sixty observations with respect to crowding showed crowding absent in 61.7 per cent of the cases, slight in 28.2 per cent, and considerable in 10.1 per cent.

There was visible caries in 17.7 per cent of the cases.

Wear of the teeth was absent in only 6.6 per cent of the cases. It is always due to betel chewing, especially to the chewing of young areca nuts husk and all, for the husk contains a high percentage of fine, sharp abrasive.

Shovel incisors are characteristic, as is seen from the following data, based on 117 observations:

TABLE 3.—*Incidence of Mongolian fossa.*

Mongolian fossa.	Per cent
Definitely absent	23.5
Probably present, but not pronounced	20.1
Moderately marked	26.1
Very marked	30.3

Thus the Mongolian fossa occurs about three times as frequently as the Mongoloid fold, and the frequencies are those that would result if a population in which each character was universal were crossed with one of equal numbers in which neither character was present, provided the tooth fossa were a simple dominant and the epicanthus a simple recessive. It is greatly to be doubted that the case is anything of the kind. Indeed, Hauschild, on the basis of very limited but seemingly irreproachable evidence, concludes (2, p. 71) that the Mongoloid fold is a simple dominant. Redenwalt, with much more extensive but less clear-cut evidence, draws no conclusion on the point. (19, p. 245)

All subjects except for a very few who had been pupils in the Protestant Academy in Kiangan were betel chewers. Betel chewing always entails more or less heavy deposits of calculus and the calculus causes more or less severe gingivitis.

Pyorrhœa was not diagnosed by means of an explorer for the reason that no facilities were available for sterilization. On the basis of looseness of the teeth, appearance of the gums, and characteristic odor it appeared to be present in 35.9 of the cases. The probability is that it is much more frequent than this percentage would indicate.

MENSURABLE CHARACTERS

The data covering mensurable characters are shown in Tables 4 and 5. Individuals in age group 18 to 20 years averaged a little over a centimeter taller than those of age group 25 to 30, so they were included in the totals.

No important difference in type between regions is reflected in the mensurable data except that those cases from Balitang, Benauwe, and Kiangan have somewhat wider noses than those from Amduntug and Hapao.

GENERAL CHARACTERS OF THE IFUGAO TYPE

The Ifugaos may be characterized as a low-statured, dolichocephalic, orthognathous, platyrrhine group, having black or dark-brown eyes, light-brown skin, very coarse and straight black hair, and weakly developed tertiary hairy covering; the nasion depression is deep, the root of the nose broad or medium in width, the bridge low or medium in height and concave or straight in profile. The epicanthus is present in about 24 per cent of the cases. The chin is weak or moderately prominent, the forehead straight or slightly slanting, and the face short and of medium width. These characterizations hold for females as well as for males.

TABLE 4.—*Summary of measurements.—all males.*

Measurement.	Number.	Minimum.	Maximum.	M ± m.	s
		cm.	*cm.*	*cm.*	*cm.*
Stature	107	140.7	172.2	157.89±0.52	±5.39
Span	58	142.9	176.5	162.88±0.87	±6.65
Biacromial	56	32.3	38.2	36.17±0.19	±1.43
Bi-iliac	57	23.8	29.0	26.72±0.17	±1.26
Sitting height	106	75.0	92.8	84.72±0.30	±3.08
Head length	107	178.0	204.0	191.56±48	±4.95
Head breadth	107	134.0	154.0	144.21±0.44	±4.60
Minimum frontal	99	90.0	113.0	101.26±0.41	±4.04
Bizygomatic	106	126.0	144.0	136.35±0.39	±4.01
Bigonial	104	96.0	125.0	109.31±0.59	±6.02
Total face height	107	104.0	136.0	117.32±0.61	±6.33
Nose height	107	41.0	57.0	49.38±0.35	±3.59
Nose breadth	107	35.0	50.0	41.64±0.26	±2.74
Cephalic index	107	65.7	81.8	75.34±0.28	±2.89
Facial index	106	75.4	103.0	86.03±0.41	±4.69
Nasal index	107	66.7	102.2	85.05±0.76	±7.88

TABLE 5.—*Measurements, Balitang, males.*

Measurement.	Number.	Minimum.	Maximum.	M ± m.	s
		cm.	*cm.*	*cm.*	*cm.*
Stature	56	140.7	172.2	157.48±0.76	±5.70
Sitting height	56	75.0	90.4	84.11±0.43	±3.21
Head length	56	178.0	2040.	191.41±0.70	±5.26
Head breadth	56	134.0	152.0	143.75±0.59	±4.44
Minimum frontal	48	90.0	113.0	101.62±0.66	±4.54
Bizygomatic	55	128.0	144.0	136.29±0.50	±3.74
Bigonial	56	96.0	125.0	108.91±0.86	±6.44
Total face height	56	104.0	134.0	116.71±0.82	±6.17
Nose height	56	41.0	56.0	49.25±0.48	±3.57
Nose breadth	56	370.0	50.0	42.62±0.31	±2.34
Facial index	55	75.4	96.2	85.77±0.64	±4.78
Nasal index	56	69.8	102.2	87.36±0.98	±7.32

TABLE 6.—*Measurements, Balitang, females.*

Measurement.	Number.	Minimum.	Maximum.	Mean.
		cm.	*cm.*	*cm.*
Stature	15	137.0	157.6	146.1
Sitting height	15	73.3	82.8	79.1
Head length	15	176.0	198.0	183.5
Head breadth	15	133.0	151.0	141.1
Minimum frontal	12	90.0	103.0	97.9
Bizygomatic	15	120.0	139.0	128.5
Bigonial	15	96.0	106.0	100.9
Total face height	14	95.0	125.0	109.6
Nose height	15	37.0	52.0	44.4
Nose breadth	15	34.0	43.0	38.3
Cephalic index	15	72.1	79.5	76.9
Facial index	14	68.4	98.4	85.3
Nasal index	15	68.0	102.7	86.8

TABLE 7.—*Measurements, regions of Ifugao besides Balitang, males.*

Measurement.	Region.	Number.	Minimum.	Maximum.	Mean.
			cm.	*cm.*	*cm.*
Stature	Kiangan	19	149.5	171.0	152.2
	Hapao	14	153.6	167.5	159.0
	Benauwe	9	148.8	164.0	156.7
	Amduntug	9	152.3	163.1	157.3
Sitting height	Kiangan	19	81.3	92.8	86.9
	Hapao	14	82.0	88.8	84.8
	Benauwe	9	82.3	87.6	85.3
	Amduntug	8	77.8	86.1	83.6
Head length	Kiangan	19	182.0	200.0	190.8
	Hapao	14	183.0	202.0	191.9
	Benauwe	9	185.0	202.0	192.6
	Amduntug	9	190.0	196.0	192.6
Head breadth	Kiangan	19	134.0	154.0	146.7
	Hapao	14	135.0	152.0	144.6
	Benauwe	9	139.0	146.0	143.2
	Amduntug	9	134.0	146.0	142.2
Minimum frontal	Kiangan	19	92.0	107.0	101.0
	Hapao	14	94.0	110.0	99.6
	Benauwe	9	99.0	104.0	102.1
	Amduntug	9	98.0	106.0	101.7
Bizygomatic	Kiangan	19	126.0	143.0	137.2
	Hapao	14	131.0	143.0	136.5
	Benauwe	9	131.0	140.0	136.0
	Amduntug	9	126.0	141.0	135.0
Bigonial	Kiangan	19	103.0	117.0	111.1
	Hapao	13	101.0	117.0	108.8
	Benauwe	8	102.0	122.0	110.5
	Amduntug	8	102.0	117.0	107.5
Total face height	Kiangan	19	105.0	135.0	116.9
	Hapao	14	111.0	124.0	119.6
	Benauwe	9	114.0	129.0	119.1
	Amduntug	9	108.0	124.0	115.7
Nose height	Kiangan	19	44.0	56.0	49.7
	Hapao	14	42.0	57.0	49.3
	Benauwe	9	44.0	53.0	48.8
	Amduntug	9	35.0	43.0	39.7
Nose breadth	Kiangan	19	37.0	47.0	41.2
	Hapao	14	37.0	45.0	39.4
	Benauwe	9	38.0	47.0	41.9
	Amduntug	9	35.0	43.0	39.7
Cephalic index	Kiangan	19	72.5	81.8	76.9
	Hapao	14	71.3	80.4	75.4
	Benauwe	9	70.3	78.9	74.4
	Amduntug	9	69.1	76.4	73.9
Facial index	Kiangan	19	78.2	94.4	85.1
	Hapao	14	79.0	103.0	87.6
	Benauwe	9	82.0	98.5	87.6
	Amduntug	9	80.0	93.7	85.8
Nasal index	Kiangan	19	72.7	97.8	83.2
	Hapao	14	66.7	95.7	80.5
	Benauwe	9	74.5	100.0	86.4
	Amduntug	9	72.6	91.1	79.1

So far as bodily proportions are concerned, the Ifugaos may be classed as relatively short-legged:

$$\frac{\text{Stature—Sitting height .100}}{\text{Stature}} = 46.22 \text{ for males and } 45.85 \text{ for}$$

females.

Comparison with other Ifugao data.—The only other data that have been published are those of Barrows: (1)

10 Benauwe Men	
Stature	155.2
Cephalic index	76.9
Nasal index	101.9

So far as concerns stature and cephalic index, these figures are quite near to those given here, but there is a wide discrepancy in the nasal index, which may be attributable to a difference in the technique of measuring this character, or possibly to another factor. From the text accompanying Barrows's measurements it seems likely that he measured "professional" cargadores, and it is not unlikely that he measured them after they had carried burdens for him weighing 50 pounds or so over 30 to 40 kilometers of steep road. Under such conditions, or if the subjects habitually worked as carriers, the nostrils would be considerably distended.

Soon after the American occupation Barrows advanced the hypothesis that there are only two fundamental races in the Philippines, namely, a short-headed, mesorrhine Malayan race, represented by such great lowland nationalities as the Tagalogs, Visayans, Ilokanos, Bicols, Pangasinanes, and others, and an aboriginal Negrito population. This Negrito population, aside from its specific negroid traits, is definitely short-headed. Barrows contended that the long-headed wide-nosed tribes, such as the Ifugao, the Bontok, the Nabaloi, Kankanai, Manobo, and several others of the so-called "pagan" tribes are a remote, "stable" cross between the Malayans and the Negritos. Sullivan attacked this theory on several grounds any one of which would seem to have been sufficient to controvert it. For example, he said that it is hard to see how a cross between two short-headed groups could give a long-headed one.

There can be no doubt that only a few generations ago Negritos roamed the territory now exclusively occupied by the Ifugaos, and there is even a tradition which might be interpreted as implying cases of intermarriage. (16, p. 456) Nevertheless, one never sees an Ifugao who manifests specifically

Negritoid traits, unless platyrrhiny can be admitted as such a trait. Thomson and Buxton have presented a strong case for the view that nasal index, while to some degree inherited and racial, is at the same time greatly dependent on climatic and environmental conditions. Moreover, a calculation made in the laboratory of the Institute of Anthropology, Moscow, of the correlation between cephalic and nasal indices for 78 Philippine groups (excluding Negritos), showed a negative correlation of 0.604 ± 0.072—that is to say, a statistically significant value, the more significant because it was calculated not for individuals but for average arithmetical quantities. Barrows's theory is thus obviously untenable and has found no acceptance.[3]

The authorities are in practical agreement that there are three great racial stocks native in southeastern Asia: Negrito, Pre-Dravidian or Veddoid, and a third, the so-called "Brown" race, Malayan, or Maritime Mongols. The latter is divided into two subraces, one of which has been called "Indonesian," "Old Malay," "proto-Malay," or "Nesiot," and the other "New Malay or "deutero-Malay."

The somatological characters of these types may be summed up as follows:

Negrito.—Negroid affinities; hair kinky and woolly; skin, dark brown, approaching black; eye slit round, open; head brachycephalic; nose platyrrhine, index above 93 (Sullivan); stature shortest of all races, average in the Philippines (according to Sullivan) about 150 cm.

Pre-Dravidian or Veddoid.—Australoid affinities; hair curly; skin various shades of brown; eye slit open and roundish, but less so than the Negroid eye; cephalic index capricious

[3] H. H. Bartlett [Fifth Pacific Science Congress. (2, p. 2851)] prefers to account for certain curly-headed Bataks (brachycephalic, however) on the basis of a Negrito admixture rather than of Veddoid: "In the light of present knowledge" he says (p. 2857) "we are, therefore, not justified in adopting the hypothesis that curly hair came into the population with a mesocephalic "Vedda"-like type, but neither is this hypothesis excluded. We can only say that it is simpler to assume that Negrito admixture is sufficient to account for the segregation of individuals with curly hair, perhaps not only in Sumatra but even in the Malay Peninsula." He also says, in effect, that like does not always give like in the matter of head form—that dolichocephalic children may be born of brachy- and mesocephalic parents. This, however, is quite different from an origin of a dolichocephalic race or breed from the crossing of two brachy- or mesocephalic races.

but predominatingly dolicho- or meso-. Nasal index high, overlapping that of the Negritos; stature short—about 155 cm.

Indonesians.—Mixed affinities but predominatingly Mongoloid; hair usually straight, but sometimes wavy; skin light or medium brown; eye slit narrow, straight or oblique, Mongoloid fold fairly frequent but less so than among the deutero-Malays; dolicho- or mesocephalic; mesorrhine or platyrrhine; stature less than that of the deutero-Malays—average in the Philippines (according to Sullivan (22) about 156 cm.

Deutero- or "New" Malays.—Affinities more Mongoloid than the Indonesian; hair usually straight, but sometimes wavy;[4] skin light or medium brown; eye slit, narrow, with obliqueness and Mongoloid fold more often present than with the Indonesians; definitely brachycephalic; mesorrhine; stature in the Philippines (according to Sullivan), about 160 cm.

The differences between the Indonesian type and the deutero-Malay lie mainly in the respects of frequency of the Mongoloid fold, in cephalic and nasal indices, and in stature.

The pre-Dravidians are generally recognized as the aborigines (along with the Negritos, perhaps) of southeastern Asia and of Australia, and possibly of the whole stretch of islands between. The modern Asiatic representatives are far from being a consistent physical type, and vary considerably, especially in respect to head length. But the fossil remains that are referred to this stock, such as the Wadjak skulls in Java, the Talgai and Cohuna skulls in Australia, an Australoid skull found in the Madras presidency, a skull found by Mansuy and Colani in Tonkin, all dating back probably to the close of the quaternary period and described as proto-Australoid, were definitely dolichocephalic. Support is thus lent to Dixon's view that the greater brachycephaly of the modern Veddoids is derived from mixture with other peoples of the region.

It is to the Indonesian race that the Ifugaos quite evidently belong, and they are one of the purest representatives of it.

Other representatives are the Bontoks, Kenkanai, and Nabaloi, neighboring tribes, and the Manobo and Bogobo in Min-

[4] Sullivan appears to consider that the hair of deutero-Malays is less frequently wavy than that of the Indonesians. Comparative data not being available, such an assumption is extremely hazardous.

danao, the Muruts, Dusuns, Land Dayaks, and Kenyas of Borneo, and the Tenggorese of Java. Such tribes as the Batak and Menangkabau of Sumatra, the Kayan of Borneo, and the Ilongot and Tagakaolo of the Philippines, having cephalic indices of about 81.5, may be regarded as crosses between Indonesians and deutero-Malays.

Outside the East Indian Archipelago the following are some of the peoples who may be referred to this race:

TABLE 8.—*Indonesian peoples outside the East Indian Archipelago.*

People.	Stature.	Cephalic index.	Nasal index.
Angami Nagas, Assam [a]	....	76	79
Sema Nagas [a]	....	79	80
Rengam Nagas [a]	....	79	82
Kenya Nagas [a]	....	77	89
Miao, of Tonkin [b]	155	80	....
Moi, See Chuan	157	77	....
Chingpo (Kachin)	160.0	75.6	80.8
Yap Islanders	163.7	77.7	85.7
Southern Carolinas [c]	171.0	78.5	75.4

[a] Hutton (8, p. 437) states that the hair of the Nagas is usually straight but sometimes wavy. Average stature is said to be about 160 cm.

[b] Denniker (8, p. 288).

[c] Rickstedt, p. 651. This author declares the Micronesians to be strongly "palæomongoloid-Wedda," increasingly so the further west one goes, and connects them with the Indonesians of Luzon.

Most authorities derive the Indonesian race from a proto-Mongolic stock, to which has been added a pre-Dravidic strain in greater or lesser measure. Buxton, Haddon, Elliot Smith, and others, consider that there is a strong Mediterranean element in this race; indeed, Elliot Smith appears to consider the Mediterranean element to have been first on the ground, even in Indonesia. A number of authorities hold that an Alpine element also entered into the formation of the proto-Mongolian stock. The proto-Mongolian stock, leaving its Asiatic home before the development in great measure of the traits that we regard as specific to the Mongols, migrated southward into Indo-China and northward into Siberia, and thence to America. The southern stream of proto-Mongols met Mediterraneans and probably proto-Australoids in southern Yunnan perhaps, and in northern Indo-China, which regions may be regarded as the cradle of the Indonesian race. The investigations of Chi Li lead him to the conclusion that the Shans, the ancestors of the modern Siamese beginning about 700 B.C., were pressed southward into Yunnan by the We-group and thence into the valley of the Mekong River. (7, p. 258) This great population movement right through the cradle of the Indonesian race must have driven some members of this race before it down the Malay Peninsula and out into the East Indian Archipelago, and pressed others to either side into the mountain regions they still occupy (Naga tribes, Miao, Lolo, Chingpo, and others).

On the basis of ethnographic data it is safe to conclude that the Ifugao tribe was formed from several streams of migrants into the present habitat. Beyer has noted that the rice fields are older on the west side of the habitat, whence it may be concluded that the stream of migrants that entered from the West were the carriers of irrigated terrace rice cultivation. Perhaps they were pushed over the mountain range by streams of succeeding immigrants, the ancestors of the present Nabaloi, Kankanai, and Bontoks. An exceedingly high proportion, perhaps three-fourths of the cultural traits of all these northern Luzon tribes, is paralleled in one or another of the Naga tribes. For example, the two Ao Nagas with freshly trimmed hair shown in Hutton's book, "The Angamai Nagas," might easily be taken for Ifugaos, since the features are nearly the same and the haircut is exactly the same as the Ifugao haircut. This coiffure is not found except in northern Indo-China and among the Ifugaos. We conclude therefore that it did not diffuse from one people to another, but that it was carried by one stream of Ifugao migration directly from Indo-China to the Philippines. There it must have been adopted by other streams of migrants pouring into the present habitat after having made the long trek southward through the Malay Peninsula, Borneo, Celebes, and north through the southern islands of the Philippine Archipelago. Hose and McDougall call attention to the numerous cultural traits shared in common by the tribes of Northern Indo-China with the Kayans, Kenyas, and other tribes of Borneo. Northern Indo-China may be regarded as the cultural cradle of the Indonesian race as well as its somatological cradle.

Insofar as it may be due to racial rather than environmental factors, the wide nose of some Indonesian groups may be regarded as evidence of a Veddoid admixture. Probably the typical "Veddoid notch"—the form of the nasion depression in which the forehead juts out over the nose giving the countenance the expression of a perpetual frown is the best guide to Veddoid admixture.

The 24 per cent occurrence of the epicanthus, the narrow eye slit, scanty beard and body hair, as well as the coarse, predominatingly straight character of the hair, link the Ifugao unmistakably with the Mongolian race.

But the Ifugao and the Indonesian type are sharply marked off from the more representative Mongoloid races of central Asia, Siberia, and northeastern Asia by the coincidence of a high skull, very coarse hair, low face, and small frequency of epicanthus. In the Asiatic regions named, coarse hair and weak hairy covering on the face and body are accompanied by a very high face, a low vault of the skull, and a very high development of the epicanthus. The hair, too, of some of these Asiatic groups is not so stiff and straight as that of the Ifugaos. Thus stiff hair was observed in only 33 per cent of the cases among the Kalmyks, while the epicanthus was present in 49 per cent of the cases (Cheboksarov). Taking into consideration the historically established fact of European admixture, to this group of Kalmyks must be attributed a formerly stiffer form of hair, as likewise a greater frequency of the epicanthus. The Tungus of the northern pre-Baikal strip have hair that, while predominatingly straight, can rarely be called stiff; in 7 per cent of the cases soft hair is encountered. The epicanthus is present in 65 per cent of the cases (Roginsky). Measurements on skulls of the height of the face, expressed in percentages of the height of the skull,

$$\frac{\text{Nasion—prosthien } .100}{\text{Nasion—bregma}}$$

gave an average for Kalmyks of 57.7 and for Tungus of 58.9 (J. J. Roginsky).

These high ratios, characteristic of peoples of typically Mongoloid race and apparently differentiating them from all other races of the earth, are not found among the Indonesian types. Taking into consideration the fact that the value of the craniofacial index is dependent mainly on the height of the face, it can be concluded that this index is considerably lower for the Ifugaos than the indices that are characteristic for the Mongol peoples of the continent. This supposition is indirectly confirmed by craniological data on the Tagalogs, calculated from the materials published by G. von Bonin,(3) among whom the index is 51. Among the Javanese it is 52.3 and among the Burmans it is 52.5.

Such a coincidence of stiff hair and scant development of tertiary hairy covering, with such additional traits, so rarely found among the typical Mongoloids, as a low face, high skull, and slight development of the epicanthus, has been found in only one other part of the world, namely in America. Absence of epicanthus in adults or a weak development of it is characteristic for the Indians in general. A low vertical craniofacial index is characteristic only for certain groups of Indians, especially for the Indians of northern California (52.1), those near San Francisco (52.1) for the Algonquins of Kentucky (50.5) for the East-Central Algonquins, and, apparently for a number of South American tribes.

These facts do not mean that the American Indians ought to be considered as forming a single race with the Indonesians. There are rather great differences between the types, for example in bigonial width (greater among the Indians), form of the nose, slant of the forehead, development of the brow-ridges, and other characters. However, these differences do not throw into the shade the quite important traits common to both races that may be explained on the ground that some time in the past, and from somewhere in eastern Asia, two streams of human beings migrated, one to the north and northeast into America and the other to the south to Indonesia and Oceania. The divergences in type that are now seen may have resulted from such causes as (*a*) prolonged local differentiation; (*b*) mixture of the Indonesian race with southeastern Asiatic Veddoids, a mixture that appears to be greatest in the southern regions and islands of this part of the world; (*c*) local differences in the groups where the two streams of migrants originated; mixture of the Indonesians with deutero-Malays in whom the Mongoloid traits are more highly developed, especially the Mongoloid fold, brachycephaly, the bridge of the nose, and the bones of the face.

The data here presented contribute to no new hypothesis; they add just a mite of evidence to confirm the views already advanced by Kroeber, Eicksted, Hrdlicka, Buxton, E. Smith, and other authorities that there is a two-fold division of the

Malaysian race, that the subrace variously denominated but here called "Indonesian" derives from an ancient, as yet unspecialized, proto-Mongoloid or palæo-Mongoloid race and so has a kindred origin with the American Indians.

SUMMARY

Measurements made by Barton on 107 Ifugao men and 15 women show this tribe to be typical for the branch of the Maritime Malays usually called the Indonesians, or proto-Malays. The average of all males for stature was 157.2 cm; for cephalic index, 75.34; for nasal index, 85.05. Epicanthus was present in about 24 per cent. Shovel teeth were definitely absent in 23.5 per cent, definitely present in 56.4 per cent, and probably present, but not pronounced in 20.1 per cent.

The dolichocephaly of the Ifugao, their usually straight eyes, and the low incidence of epicanthus, lend credit to the hypotheses of Buxton, Haddon, and Elliot Smith that there is a strong Mediterranean element in the Indonesians. However, these traits might also have been derived from an infusion of pre-Dravidian blood.

Going farther afield, we find that Ifugao affinities are definitely not with the more representative races of Central Asia, Siberia, and northeastern Asia. They are delimited by the Ifugaos' relatively high skull vault, stiffer hair, lower incidence of epicanthus, and shorter face.

On the other hand, these same characters connect the Ifugaos with the American Indians. Indeed, only in America, so far as has been reported, are similar craniofacial indices to be found.

The question raised in this paper of a high incidence of distal occlusions of the mandible in the Hapao area deserves further investigation.

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STUDIES ON PHILIPPINE KINGFISHERS, II

GENERA ALCEDO, HALCYON, AND RAMPHALCYON, WITH ADDITIONAL NOTES ON THE GENUS CEYX

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ONE PLATE

The present paper is the continuation of a previous study[1] and completes the series dealing with Philippine kingfishers. Before presenting the results of the present study, however, I would like to make a few corrections and additions to the first part of this series, which deals with the Philippine forms of the Genus *Ceyx*.

The distribution of *Ceyx cyanopectus nigrirostris*[2] includes Cebu, Negros, and Panay. Specimens from Panay were examined.

A collection of birds from Tawitawi that was received after the publication of the paper on *Ceyx*[3] included interesting specimens of three-toed kingfishers which for convenience should be recorded here. A single female *Ceyx rufidorsus rufidorsus* was taken June 24, 1940. Comparison of this specimen with those from Palawan and Busuanga shows no difference. A male and a female *Ceyx lepidus margarethæ* were also obtained. They are similar to the single female specimen from Basilan reported in the preceding paper.

The most interesting three-toed kingfishers obtained in Tawitawi are a pair of an apparently new form, which I propose to call:

CEYX GOODFELLOWI VIRGICAPITUS subsp. nov. Plate 1.

Type.—Adult male, Philip. Nat. Hist. Mus. 15281, Batobato, Tawitawi, Philippines, June 13, 1940, *Manuel Celestino* and *G. L. Alcasid.*

Characters.—From *Ceyx lepidus margarethæ* of Basilan, Negros, Tawitawi, and elsewhere, the present subspecies differs

[1] Philip. Journ. Sci. 69 (1939) 377–387, pl.
[2] Ibid., p. 380.
[3] *See* footnote 1.

in having most of its upper surface cobalt blue tinged with ultramarine blue instead of blue violet. Its probable closest ally is *Ceyx goodfellowi,* known only from a single specimen obtained in Mindanao and now in the British Museum. *C. goodfellowi virgicapitus* differs from typical *Ceyx goodfellowi,* according to the description of the latter (22) in having the blue of its crown appearing more or less spotted with a deeper shade of cobalt blue. This appearance is due to short median streaks at the distal portion of each feather.

Range.—This form has been found so far only in the forests of Tawitawi.

Description of type.—Upper surface, sides of head, neck, and wings cobalt blue, tinged with ultramarine blue on crown, nape, back, and wing coverts; exposed portion of some feathers of head, neck, and lesser coverts medially streaked with deeper cobalt blue, causing a more or less spotted appearance; lores, cheeks, and most of under parts rufous or orange rufous; chin and throat white with a slight yellow wash; outer web of first alula and of outer first primary rufous, tail black with bluish wash. Iris dark brown; bill, feet, and nails bright vermillion.

Measurements, wing, 64 millimeters; tail, 22; culmen from nostril, 31; tarsus, 10.

The paratype, an adult female, Philip. Nat. Hist. Mus. 15282, has a lighter tinge of ultramarine blue, as a result of which the streaks on the feathers of the head become more manifest.

Measurements, wing, 68 millimeters; tail, 24; culmen, 31; tarsus, 10.

The present study on four-toed Philippine kingfishers follows the general lines of the first part of this series. In addition to materials in the Natural History Museum (formerly the Bureau of Science collection) kingfishers in the private collection of Mr. Graciano Castañeda were examined. The birds treated here differ from those belonging to the Genus *Ceyx* principally in their possession of four toes.

Key to the genera of four-toed Philippine kingfishers.

a.[1] Bill longer than tail .... *Alcedo.*
a.[2] Bill shorter than tail.
  b.[1] Bill and culmen rounded........ *Halcyon.*
  b.[2] Bill compressed, culmen flattened .... *Ramphalcyon.*

Genus ALCEDO Linnæus, 1758

Small kingfishers; sexes slightly dissimilar; bill compressed, longer than tail; culmen rounded, slightly curved with a light groove on either side; feet weak. Two species occur in the Philippines.

Key to the Philippine species of Alcedo.

a.[1] Underparts light orange-rufous; wing coverts spotted with greenish cobalt .... *A. atthis.*
a.[2] Underparts deep chestnut-rufous; wing coverts spotted with purplish blue .... *A. meninting.*

ALCEDO ATTHIS BENGALENSIS Gmelin.

Alcedo bengalensis GMELIN, Syst. Nat. pt. 1 1 (1788) 405; in LE MARTIN, Pecheur de l'Îsle de Luzon; SONNERAT, Voy. Nov. Guin. (1776) 67, pl. 32.
Alcedo ispida SHARPE, Cat. Bds. Brit. Mus. 17 (1892) 150.
Alcedo ispida bengalensis HARTERT, Vög. Pal. Faun. 2 (1912) 883.
Alcedo atthis bengalensis LAUBMANN, Verh. Ornith. Ges. Bayern (4) 12 (1916) 241.
Alcedo atthis japonica KURODA, Bds. Is. Java 2 (1936) 407.

Balabac, Bantayan, Basilan, Batan, Bohol, Cagayancillo, Cagayan Sulu, Calamianes, Calayan, Catanduanes, Cebu, Cuyo, Guimaras, Leyte, Lubang, Luzon, Masbate, Mindanao, Mindoro, Negros, Palawan, Polillo, Romblon, Samar, Sibuyan, Siquijor, Sulu, Tablas, Tawitawi, Verde.

Specimens from Alabat, Bohol, Cagayancillo, Cagayan Sulu, Calayan, Cebu, Cuyo, Lubang, Luzon, Mindanao, Mindoro, Negros, Palawan, Polillo, and Siquijor were examined.

Upper surface generally dark greenish blue, cobalt in middle; head barred with cobalt and bluish black; in males a band of ferruginous extends from lores backward to white ear patch; below the ferruginous loral band a wider greenish-blue band spotted with cobalt and extending from base of lower mandible to below ear patch; under parts rufous except chin and throat, which are whitish buff. Females have duller color.

Measurements of Alcedo atthis bengalensis, based on 38 males and 35 females.

	Range. mm.	Mode. mm.
Wing	69–75	72
Tail	29–35	31
Culmen from nostril	30–34	32
Tarsus	7– 9	8
Middle toe with claw	16–17	17

The range of measurements of the wing (69 to 75 millimeters) corroborates the findings of Streseman.(36) This range was made the basis of Kuroda's(13) allocation of the Philippine form to *Alcedo atthis japonica* Bonaparte. The present study, however, records an average wing measurement, based on 38 males and 35 females, of 71.8 millimeters, while the average measurement made by Stresemann was 71 millimeters. Kuroda(13, p. 406) gives the wing measurement of *Alcedo atthis bengalensis* from Shanghai as 71 millimeters. Males from the Philippines do not differ sufficiently from a male *Alcedo atthis bengalensis* from Amoy, China, to warrant their separation. No birds from Formosa or Japan have been examined.

ALCEDO MENINTING MENINTING Horsfield.

Alcedo meninting HORSFIELD, Trans. Linn. Soc. 13 (1821) 172.
Alcedo asiatica GUILLEMARD, Proc. Zool. Soc. London (1885) 255.
Alcedo meninting meninting HACHISUKA, Bds. Philip. Is. pt. 3 (1934) 126.

Balabac, Bungao, Calamianes, Palawan, Sulu, Tawitawi.

Specimens from Palawan and Tawitawi were examined.

Smaller than *A. a. bengalensis.* Upper surface generally velvety black; head black, barred with purplish blue; midback, rump, and upper tail coverts cobalt blue; wing coverts black, spotted with purplish blue; outer secondaries margined with purplish blue. Underparts rufous, buffish white on chin and throat. Bill of male dark brown; bill of female dark brown on upper jaw, red on lower.

Measurements of Alcedo meninting meninting, based on 3 males and 3 females.

	Range. mm.	Mode. mm.
Wing	65–66	65
Tail	26–27	27
Culmen from nostril	34–36	35
Tarsus		7
Middle toe with claw	16–17	16

Genus HALCYON Swainson, 1821

Medium-sized kingfishers; bill strong, broad at base; culmen straight and rounded, without groove on either side; wing rounded; tail graduated, longer than culmen.

Six species are known to occur in the Philippines.

Key to the Philippine species of the genus Halcyon.

a.[1] Back spotted .... *H. lindsayi.*
a.[2] Back unspotted.
  b.[2] Crown and back of uniform color.
    c.[1] Head and neck partitioned by a collar of distinct color.

d.[1] Head and back blue, collar white .... *H. chloris.*
d.[2] Head and back deep blue, collar rufous .... *H. winchelli.*
c.[2] Head and neck not partitioned by a collar of distinct color. *H. coromanda.*
b.[2] Crown and back not of uniform color.
c.[1] Crown chestnut, back blue .... *H. smyrnensis.*
c.[2] Crown black, back blue .... *H. pileata.*

Species 1. HALCYON LINDSAYI

HALCYON LINDSAYI LINDSAYI (Vigors).

Dacelo lindsayi VIGORS, Proc. Zool. Soc. London (1831) 97.
Dacelo lessoni VIGORS, ibid.
Halcyon lindsayi GRAY, Gen. Birds 1 (1846) 79, pl. 27.
Actenoides lindsayi WALDEN, Trans. Zool. Soc. London **9** (1875) 156.
Halcyon lindsayi lindsayi HACHISUKA, Birds Philip. Is. pt. 3 (1934) 144, pl. 16.

Luzon.

Specimens from Luzon have been examined.

Sexes dissimilar. Upper parts generally green, forehead with a few buff feathers, lores and nape black; scapulars, mantle, and wing coverts with whitish buff spots. Underparts largely with green trimmings. In the male the crown is largely bordered by a blue band, followed by a black band, then a cinnamon band. Upper cheeks, chin, and throat cinnamon, this color enclosing a bright-blue patch on lower cheeks upon meeting the cinnamon band of the neck behind. In the female the blue color on cheeks in the male replaced by green, the cinnamon of chin and throat by whitish buff.

Measurements of Halcyon lindsayi lindsayi, based on 13 males and 10 females.

	Range. mm.	Mode. mm.
Wing	104–112	108
Tail	80–89	86
Culmen from nostril	30–37	35
Tarsus	17–19	18
Middle toe with claw.	27–28	27

HALCYON LINDSAYI MOSELEYI (Steere).

Actenoides Moseleyi STEERE, List Birds and Mamm. Steere Exped. (1890) 11.
Halcyon moseleyi SHARPE, Cat. Birds Brit. Mus. 17 (1892) 288.
Halcyon lindsayi moseleyi HACHISUKA, Birds Philip. Is. pt. 3 (1934) 145.

Negros.

A female specimen was examined.

Similar to the female of *H. lindsayi lindsayi* but edge of breast feathers black instead of green.

Measurements of a female *H. lindsayi moseleyi:* wing 107 millimeters; tail 80; culmen from nostril 38; tarsus 16; middle toe and claw 27.

HALCYON LINDSAYI HOMBRONI Bonaparte.

Actenoides hombroni BONAPARTE, Consp. Gen. Avium 1 (1850) 157.
Halcyon hombroni SHARPE, Mon. Alcedinidae (1870) pl. 84.

Mindanao.

Specimens from this island have been examined.

Sexes dissimilar. In male the crown, nape, and cheeks deep blue, approaching Hay's Blue in Ridgway's Color Standards and Color Nomenclature. Exposed midback, scapulars, and wing coverts generally green spotted with buff, the spots gradually reduced in number and in size from before backwards; lower back, rump, and upper tail coverts cobalt; tail blue with black shafts. Chin, throat, and midabdomen buffy white, rest of underparts buff, some feathers with fine black trimmings. In the female the crown is green and the cheek band is tawny with a greenish-brown wash.

Measurement of the Halcyon lindsayi hombroni based on 4 males and on 3 females.

	Range. mm.	Mode. mm.
Wing	120–122	122
Tail	88–95	89
Culmen from nostril	32–37	34
Tarsus	16–17	17
Middle toe with claw	26–29	28

This form shows specific affinity with *Halcyon lindsayi.* The main difference lies in the blue color of the head (in males only), the cobalt blue of the lower back, rump, and upper tail coverts, and the blue tail of *H. l. hombroni.* All these parts are more or less greenish in *H. l. lindsayi* and in *H. l. moseleyi.* The general pattern of the scapulars and wing coverts of *H. lindsayi lindsayi, H. lindsayi moseleyi,* and *H. lindsayi hombroni* is dark brown with greenish sheen spotted with buff. The chin and throat of the male *H. lindsayi lindsayi, H. lindsayi moseleyi,* and of *H. lindsayi hombroni* are of varying shades of buff or cinnamon. The buff breast, flanks, and abdomen of *H. l. hombroni* is merely an intensification of what is already slightly manifest in the abdomen of the other two races, while the nearly obsolete black trimmings on the feathers of the underparts is a reduction of those prominent in the other races. This color character gradient, however, is more discernible in the females of the three races. These characters, in addition to the facts presented by their distribution, will lead to their conspecific affiliation.

Species 2. HALCYON CHLORIS

HALCYON CHLORIS COLLARIS (Scopoli).

Halcyon chloris collaris (Scopoli) LE MARTIN, Pecheur a collier blane des Philippines; Sonn. Voy. Nouv. Guinee (1776) 67, pl. 38.
Alcedo collaris SCOPOLI, Del. Flor. et Faun. Insubr. 2 (1786) 90.
Halcyon chloris WALDEN and LAYARD, Ibis (1872) 96.
Sauropatis chloris TWEEDDALE, Proc. Zool. Soc. London (1877) 690.
Sauropatis chloris collaris OBERHOLSER, Proc. U. S. Nat. Mus. 55 (1920) 361.

Bantayan, Banton, Basilan, Batan, Bohol, Bungao, Cagayancillo, Cagayan Sulu, Calamianes, Caluya, Camiguin Norte, Camiguin Sur, Catanduanes, Cebu, Cuyo, Dinagat, Fuga, Guimaras, Lapac, Leyte, Lubang, Luzon, Maestre de Campo, Marinduque, Masbate, Mindanao, Mindoro, Negros, Palawan, Panay, Polillo, Romblon, Sibay, Samar, Semirara, Sibutu, Sibuyan, Siquijor, Sulu, Tablas, Tawitawi, Ticao, Verde, Y'Ami.

Specimens from Alabat, Apo, Bantayan, Bohol, Bungao, Cabancauan, Camiguin, Cuyo, Fuga, Gigante Norte, Jinamoc, Jolo, Leyte, Lubang, Luzon, Mindanao, Mindoro, Negros, Palawan, Panay, Pearl Bank, Polillo, Samar, Semirara, Siasi, Sibuyan, Siquijor, Tablas, and Tubbataha Reef were examined.

Sexes slightly dissimilar. In males upper parts generally greenish blue; wings, back, rump, and tail blue; behind nape a distinct white collar. Underparts white. Females are slightly duller on the upper parts.

Measurments of Halcyon chloris collaris, based on 62 males and 60 females.

	Extremes. mm.	Mode. mm.
Wing	105–112	109
Tail	63– 69	66
Culmen from nostril	38– 42	40
Tarsus	14– 16	14
Middle toe with claw	24– 26	25

The uniformity of specimens in the wide range from which they were collected indicates that only one race exists in the Philippines.

Species 3. HALCYON WINCHELLI

HALCYON WINCHELLI Sharpe.

Halcyon winchelli SHARPE, Trans. Linn. Soc. London II (1876) 318, pl. 47.
Halcyon alfredi OUSTALET, Le Naturaliste (1890) 62.
Halcyon winchelli winchelli HACHISUKA, Bds. Philip. Is. pt. 3 (1934) 41.

Basilan, Bohol, Bungao, Cebu, Mindanao, Papahag, Romblon, Samar, Sibuyan, Siquijor, Sulu, Tablas, Tawitawi.

Specimens from Basilan, Bohol, Mindanao, Sibuyan, Tablas, and Tawitawi were examined.

Sexes dissimilar. Upper surface generally deep blue, a lighter blue line above eye extending backward, meeting its fellow on nape and forming a U; lores and a narrow collar rufous, back, rump, and upper tail coverts silvery blue. Underparts white in male, whitish buff in female.

Measurements of Halcyon winchelli, based on 10 males and 12 females.

	Extremes. mm.	Mode. mm.
Wing	100–107	104
Tail	67– 74	68
Culmen from nostril	40– 48	42
Tarsus	13– 15	14
Middle toe with claw	21– 26	25

Hachisuka splits *Halcyon winchelli* into two races, naming the Negros form *Halcyon winchelli nigrorum*. In the present study no specimen from Negros was examined. In spite of similarities of the specimens from the islands named, the bird from Negros, in the center of its distributional area, is regarded by Hachisuka as distinct. In any case Hachisuka's opinion should be respected as it was on actual observation. Peters (24, p. 98) has a remark on this matter.

Species 4. HALCYON COROMANDA

HALCYON COROMANDA OCHROTHORECTIS (Oberholser).

Calialcyon coromanda WALDEN, Trans. Zool. Soc. London pt. 2 9 (1877) 155.

Halcyon coromandus SHARPE, Cat. Bds. Brit. Mus. 17 (1892) 217.

Entomothera coromanda ochrothorectis OBERHOLSER, Proc. U. S. Nat. Mus. 48 (1915) 652.

Halcyon coromanda bangsi HACHISUKA, Bds. Philip. Is. pt. 3 2 (1934) 138.

Halcyon coromanda ochrothorectis HACHISUKA, Bds. Philip. Is. pt. 3 2 (1934) 139.

Batan, Calayan, Camiguin Norte, Guimaras, Luzon, Masbate, Mindanao, Mindoro, Palawan, Sibuyan.

Specimens from Calayan, Luzon, and Mindoro were examined.

Sexes very slightly dissimilar. Upper parts generally dark rufous washed with violet. Lower back, rump, and upper tail coverts bluish silvery white. Underparts buff. Violet wash on upper parts of male more pronounced than in corresponding parts of female.

Measurements of Halcyon coromanda ochrothorectis, based on 5 males and 3 females.

	Extremes. mm.	Mode. mm.
Wing	120–126	122
Tail	66– 70	67
Culmen from nostril	43– 48	47
Tarsus	15– 17	16
Middle toe with claw	27– 29	28

When Oberholser (20, p. 652) described *Entomothera* (= *Halcyon*) *coromanda ochrothorectis* from Masbate, he had occasion also to indicate the measurements of specimens from Calayan, Luzon, Mindoro, and Mindanao. In addition, he hinted that the race was reported from Tawitawi, presumably on the basis of a report by Bourns and Worcester.(3) Notwithstanding this citation, Oberholser (20, p. 649) mentions Tawitawi as a locality for *Entomothera coromanda minor,* when he says "a single immature specimen from Tataän, on Tawitawi Island, in the southwestern part of the Philippine Archipelago, is apparently typical of *Entomothera coromanda minor.*" No reference was made to the collector, but it is very likely that this specimen was the one reported by Bourns and Worcester(3) as *Halcyon coromandus* from Tawitawi and later suggested by Oberholser to be *E. c. ochrothorectis.* On the other hand, Hachisuka(9) named two races of *Halcyon coromanda* as inhabiting the Philippines; namely; *H. c. bangsi* in Batan, Calayan, Camiguin Norte, Luzon, and Mindoro, and *H. c. ochrothorectis* in the southern islands.

The only specimen examined from Tawitawi in the present study proves to be

HALCYON COROMANDA MINOR (Temminck and Schlegel).

Halcyon coromanda ochrothorectis HACHISUKA, Birds Philip. Is. pt. 3 (1934) 139.

Measurements of female *H. c. minor* from Magsakaw, Tawitawi Island, collected by Manuel Celestino and Godofredo Alcasid, July 5, 1940; wing 106 millimeters; tail 61; culmen from nostril 49; tarsus 15; middle toe and claw 22.

This bird differs from *H. c. ochrothorectis* not only in its much reduced size but also in having the upper and underparts much darker.

Species 5. HALCYON SMYRNENSIS

HALCYON SMYRNENSIS GULARIS (Kuhl).

Alcedo gularis KUHL in Buff. and D' Aubent, Fig. Av. Col. Nom. Syst. (1820) 4.

Halcyon gularis SHARPE, Mon. Alced. (1870) 165, pl. 60.

Halcyon smyrnensis var. *albogularis* BLYTH, Journ. Asiat. Soc. Bengal 11 (1843) 99.
Entomobia gularis WALDEN, Trans. Zool. Soc. London 9 (1875) 154.
Halcyon smyrnensis gularis LAUBMANN and GÖTZ, Verh. Orn. Ges. Bayern 17 (1926) 44.

Basilan, Bohol, Caluya, Cebu, Guimaras, Leyte, Libago, Lubang, Luzon, Maestre de Campo, Marinduque, Masbate, Mindanao, Mindoro, Negros, Panaon, Panay, Polillo, Samar, Sibay, Siquijor, Tablas, Ticao, Verde.

Specimens from Alabat, Bohol, Catanduanes, Cebu, Leyte, Luzon, Mindanao, Mindoro, Negros, Panay, Samar, and Siquijor were examined.

Sexes similar. Head, neck, lores, and cheeks deep chestnut; scapulars and outer web of basal part of a number of primaries bright blue; portion of inner web white, otherwise black like distal part; secondary coverts black; tail blue; back and rump cobalt blue; chin and throat white; otherwise lower surface chestnut, slightly lighter than head. In fresh specimens bill, legs, and feet red.

Measurements of Halcyon smyrnensis gularis, based on 44 males and 42 females.

	Range. mm.	Mode. mm.
Wing	121–129	126
Tail	79– 83	80
Culmen from nostril	50– 54	52
Tarsus	12– 14	13
Middle toe with claw	26– 29	28

No difference was noted between the measurements of the male and those of the female.

Species 6. HALCYON PILEATA

HALCYON PILEATA (Schlegel).

Dacelo pileata SCHLEGEL, Vog. Ned. Ind. Alced. 2 (1864) 22, 54.
Halcyon pileata SHARPE, Ibis (1888) 197.
Entomobia pileata WALDEN, Trans. Zool. Soc. London 9 (1875) 154.

Balabac, Basilan, Palawan, Tawitawi.

A specimen bearing no locality was examined.

Genus RAMPHALCYON Reichenbach, 1851

Large kingfishers; sexes dissimilar; bill compressed, heavy, shorter than tail; culmen flattened, straight, and grooved on either side.

Sharpe(29) recorded three species (*Pelargopsis leucocephala* = *P. javana*, *P. gigantea*, and *P. gouldi*) from the Philippines.

Oberholser,(19) basing his conclusions on a large series of specimens, lumped the Philippine forms into one species with two subspecies; namely, *Ramphalcyon capensis gigantea* and *R. c. gouldi.* Mearns later in the same year(18) added *R. c. smithi* with "southeastern Luzon, Masbate and others of the middle islands of the Philippines, where the ranges of *R. c. gigantea* and *R. c. gouldi* approach each other" as its geographical range. In addition, Mearns claims *R. c. smithi* to be the largest Philippine form. The present study brought out a few facts concerning *R. c. smithi* Mearns. A female bird from Masbate has a wing measurement of 164 millimeters. Its color, however, is typical of *R. c. gigantea.* The wing measurement of this bird shows that it is indeed much larger than many specimens of *R. c. gigantea* as reported by previous writers. In the latter part of the present paper, however, specimens of *R. c. gigantea* will be shown to have wing measurements about as great as or greater than that of the wing of the bird from Masbate. A female bird from Sibuyan possesses a color intermediate between that of *R. c. gigantea* and *R. c. gouldi,* and has a wing measurement of 164 millimeters. These characters would fit in nicely with *R. c. smithi.* However, another female bird from the same locality possesses a color typical of *R. c. gigantea.* Sibuyan Island is about 30 miles (about 48 kilometers) from Masbate across the channel.(38) Obviously, this is one of the islands assumed by Mearns to be a locality for *R. c. smithi.* The lone bird examined from Ticao, on the other hand, is, from all indications, a typical *R. c. gigantea;* yet Ticao is less than 2 kilometers from the nearest point in Masbate and lies between Masbate and the southernmost tip of Luzon, assumed, beyond doubt, by Mearns as another locality for his *R. c. smithi.* Hence Oberholser(19) may be right when he states that "individual variation is not unusually great" and that specimens of the Philippine stork-billed kingfisher heretofore identified as *R. c. smithi* are obviously variants of *R. c. gigantea.* The birds examined from Polillo are also identical with typical *R. c. gigantea.*

Key to the Philippine subspecies of Ramphalcyon capensis.

a.[1] Head, neck, and underparts deep orchraceous .... *R. c. gouldi.*
a.[2] Head, neck, and underparts cream or pale buff .... *R. c. gigantea.*

RAMPHALCYON CAPENSIS GOULDI (Sharpe).

Pelargopsis gouldi SHARPE, Proc. Zool. Soc. London (1870) 63.
Pelargopsis leucocephala SHARPE, Ibis (1884) 318.
Ramphalcyon capensis gouldi OBERHOLSER, Proc. U. S. Nat. Mus. 35 (1909) 667.

Balabac, Calamianes, Lubang, Luzon, Mindoro, and Palawan. Specimens from Lubang, Mindoro, and Palawan were examined.

Measurements of R. c. gouldi, based on 11 males and 7 females.

	Range. mm.	Mode. mm.
Wing, males	139–171	142
Wing, females	149–175	150
Tail	88– 94	92
Culmen from nostril	69– 76	70
Tarsus	14– 16	15
Middle toe with claw	31– 25	32

The females examined have slightly longer wings than the males, corroborating the measurements taken by Oberholser.(19) In this study, however, no difference was noted between the measurements of the tail of the male and those of the female, although the tails of two males were 88 millimeters each, while others, including males and females, had tails 90 to 94 millimeters long. Oberholser(19) found a decided difference between the length of the tail of the male and that of the female of this kingfisher, being an average of 83 millimeters in the male and 93.5 millimeters in the female.

According to the literature, this stork-billed kingfisher was recorded in Luzon but once, when Sharpe(28) described a bird collected by Hugh Cuming. The locality, however, as in the case of much other material collected by Cuming, appears open to question, as may be gleaned from the following considerations. In the original description Sharpe gave "Philippines, Island of Luzon" as the habitat of this bird. The date of collection was not given. In a later paper Sharpe(31) identified the stork-billed kingfisher from southern Palawan, collected by Lempriere as *Pelargopsis leucocephala.* The stork-billed kingfisher from Palawan is now acknowledged to be typical *P. gouldi.* In the Catalogue of Birds, Sharpe(33) mentioned his type specimen of *P. gouldi,* specifying Manila as its locality. In addition, the bird collected by the "Challenger" Expedition from Iloilo (Panay Island) which was, according to our present knowledge, rightly labelled, but with doubt, by the Marquis of Tweeddale(37) as *Pelargopsis gigantea,* and the bird obtained by Lempriere from southern Palawan, were identified by Sharpe(31) as *P. gouldi.* It thus appears that Sharpe, in citing the locality in the original description of *P. gouldi* and in identifying the bird from Palawan, was not certain about the true identity of his *P. gouldi.*

McGregor(16) included Luzon and Palawan as localities for *P. gouldi,* but eliminated Panay and placed it as a locality for *P. gigantea.* Obviously the inclusion of Luzon was based on Sharpe's previous description which McGregor had not been able to confirm. The island of Mindoro, on the basis of specimens collected by the Steere Expedition, was also included as a locality for *P. gouldi.* Oberholser,(19) on the basis of a specimen of *P. gigantea* obtained by Dr. E. H. Porter from Sorsogon and apparently confirming the latest statement of Sharpe, limited the distribution of *P. gouldi* to the southern Philippines (Manila), besides Balabac, Calamianes, Lubang, Mindoro, and Palawan. McGregor(17) recorded *P. gigantea* from Polillo, although he was expecting to find *P. gouldi* there on the basis of previous reports of Sharpe. Hachisuka(9) insisted McGregor obtained *P. gouldi* and not *P. gigantea.*

Hachisuka,(8) referring to Hugh Cuming's collection in the Philippines of which the type of *P. gouldi* was a part, says:

> He (Cuming) resided for a long time in the Philippines, between 1836 and 1839, but as his large collection of birds was broken up without being catalogued (having been brought to Europe at a time when geographical distribution attracted less attention than now), we possess no published record of the exact localities where his specimens were obtained.

The interesting account of Rolfe(25) about the fate of Cuming's botanical collection and the statement that the latter visited Mindoro during his sojourn in the Philippines, in addition to later findings that *R. c. gigantea* inhabits Luzon, leads me to believe that Cuming obtained the type of *P. gouldi* from Mindoro, where the bird is relatively common. There is good reason to believe, on the basis of the foregoing circumstances, that in describing *P. gouldi* Sharpe was influenced by H. Cuming's letter,(4) dated at Manila, to the Zoological Society of London, advising the latter of a collection of birds and quadrupeds which he was forwarding from the southern part of Luzon. If it could be definitely proven that the type of *P. gouldi* was collected in Mindoro, the confusion of writers subsequent to Sharpe(29) wouuld be cleared up and henceforth due acknowledgment made of the fact that only *P. gigantea* occurs in Luzon, and that Mindoro is the type locality of *P. capensis gouldi.*

RAMPHALCYON CAPENSIS GIGANTEA (Walden).

Pelargopsis gigantea WALDEN, Ann. & Mag. Nat. Hist. IV 13 (1874) 123.

Ramphalcyon capensis gigantea OBERHOLSER, Proc. U. S. Nat. Mus. 35 (1909) 668.

Basilan, Bohol, Bungao, Cebu, Dinagat, Guimaras, Lapac, Leyte, Luzon, Masbate, Mindanao, Malanipa, Negros, Panay, Polillo, Salok, Samal, Samar, Sibutu, Sibuyan, Sulu, Tawitawi, Ticao.

Specimens from Basilan, Biliran, Bohol, Cebu, Leyte, Luzon, Masbate, Mindanao, Polillo, Samar, Sibuyan, Suluan, Tawitawi, and Ticao were examined.

Measurements of R. c. gigantea, based on 15 males and 13 females.

	Range. mm.	Mode. mm.
Wing, males	152–155	153
Wing, females	157–170	164
Tail, males	89–93	90
Tail, females	94–103	94
Culmen from nostril	66–75	67
Tarsus	14–16	14
Middle toe with claw	34–40	35

The measurements show that the wing and tail of the female are, on the average, longer than the corresponding parts of the male.

The lone specimen from Luzon studied was collected from Dupax, Nueva Vizcaya Province, in the northern part of Central Luzon. The race appears to be very rare in this Island. Another bird was seen on the wing along the river in Aloneros, Tayabas Province, in southern Luzon.

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ILLUSTRATION

[Drawing by Francisco Rafael.]

PLATE 1. *Ceyx goodfellowi virgicapitus* subsp. nov.

PLATE 1. CEYX GOODFELLOWI VIRGICAPITUS SUBSP. NOV.

SOME PHILIPPINE CERAMIC MATERIALS

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The value of ceramic products imported into the Philippines in 1938 amounted to nearly four million pesos.[1] Lately there has been some advance in the development of local ceramic industries. However, further research on ceramic raw materials is necessary for the proper encouragement of these industries. The present paper gives an account of recent investigations along this line.

BRICK AND TILE CLAYS

Brick and tile clays are found in many places in the Philippines. At present bricks are manufactured on a small scale in Ilocos Sur, Negros Oriental, and Cebu Provinces, and to a large extent in Rizal Province. Hollow bricks and tiles are manufactured at Tinajeros, near Manila, by the Ceramic Industries of the Philippines.

The chemical composition and the physical tests of one of these brick clays are given in Tables 1 and 2, respectively.

TABLE 1.—*Analysis of Philippine brick clay.*[a]

Constituent.	Per cent.
Loss on ignition	13.84
Silica (SiO_2)	51.00
Alumina (Al_2O_3)	20.60
Ferric oxide (Fe_2O_3)	6.36
Lime (CaO)	2.91
Magnesia (MgO)	2.31
Alkalies (Na_2O+K_2O)	3.06

[a] Obtained from San Pedro Macati near Manila.

TABLE 2.—*Physical tests on Philippine brick clay.*

Test.	Results.
Water of plasticity, per cent	45.96
Linear shrinkage, per cent	10.87
Slaking time, minutes	62
Tensile strength, pounds per square inch	176
Drying qualities	Good
Fusing point[a]	1,200 °C.

[a] Approximate.

[1] One peso equals 50 cents United States currency.

POTTERY CLAY

The making of cooking pots, water containers, flower vases, flower pots, and other similar products is carried out in many provinces, notably Albay, Batangas, Rizal, Bulacan, Pampanga, Pangasinan, La Union, Ilocos Norte, Ilocos Sur, Cebu, Oriental Negros, Leyte, Iloilo, and Capiz. Rice-paddy clays are used with the addition of the fine river sand.

SAND AND OTHER SILICEOUS MATERIALS

Silica is an important constituent of glass and bottles. Deposits of sand and other siliceous materials have been located in Baguio and in Pampanga, La Union, Tarlac, and Mindoro Provinces. The San Miguel Bottle Factory uses the Lubang sand of Mindoro. Because of the presence in some deposits of impurities, usually iron oxides and mica, treatment of the raw materials is necessary for the manufacture of certain products.

Bagasse ash, which is a good source of silica, is found in abundance in the Philippine sugar centrals. Bottles of good quality were made from this material with the addition of other ingredients.

Table 3 shows the average composition of Philippine bagasse ash.

TABLE 3.—*Composition of Philippine bagasse ash.*

Constituent.	Per cent.
Loss on ignition	0–1
Silica (SiO_2)	75–85
Alumina (Al_2O_3)	4–8
Iron oxide (Fe_2O_3)	Seldom 2
Lime (CaO)	2–3
Magnesia (MgO)	1.5–3
Manganese dioxide (MnO_2)	Less than 1
Potash (K_2O)	4–7
Soda (Na_2O)	2–4

KAOLIN

From Laguna, Batangas, Albay, Benguet, Abra, Ilocos Norte, Camarines Norte, Iloilo, and Cebu Provinces white burning clays have been reported. These clays are good sources of kaolin not only for ceramics but also for nonceramic industries. The mining of kaolin is not known in the Philippines.

Table 4 gives the chemical composition of one of these clays.

TABLE 4.—*Analysis of Philippine white clay.*

Constituent.	Per cent.
Loss on ignition	11.59
Silica (SiO_2)	55.99
Alumina (Al_2O_3)	28.77
Iron oxide (Fe_2O_3)	0.89
Lime (CaO)	0.18
Magnesia (MgO)	0.03
Soda (Na_2O)	0.08
Potash (K_2O)	0.09

SUMMARY

The sources of some Philippine ceramic materials together with their analyses are given.

Physical tests of a typical brick clay are included.

The Philippines imported nearly four million pesos worth of ceramic materials and products in 1938. For this reason and because of the existence of suitable raw materials, ceramic industries have a good future in the Islands.

The continuance of studies of possible sources of ceramic materials is recommended.

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TERATOLOGY OF PHILIPPINE ORCHIDS, III

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TWO PLATES

The present contribution is essentially similar to its predecessors.[1] It consists of descriptions of teratological cases in 6 species and 1 variety. All the illustrations were prepared by Mr. R. Aguilar of the Natural History Museum. All specimens reported in this paper are preserved in liquid and deposited with the Philippine National Herbarium.

ARUNDINA BAMBUSIFOLIA Lindl. Plate 2.

This is the first case of teratology observed in this species by the author, despite hundreds of plants under cultivation in his garden with normal flowers. (*a*) Flower with all parts normal except for the absence of one lateral sepal. (*b*) The dorsal sepal and the two petals are normal; conspicuous by the absence of one lateral sepal and the lip. (*c*) All the sepals and petals are present and normal in size and form; conspicuous by the absence of lip.

PHALAENOPSIS AMABILIS (Linn.) Blume. Plate 1, figs. 1 and 2.

Last year the author received several hundred living specimens of this species, collected from Brooks Point, Palawan. In the Philippines this species is limited in distribution, having been reported from Palawan, the Sulu Archipelago, and Tawitawi. In one of the plants received, which flowered last year, an interesting case of teratology occurred. The specimen was the first flower that opened, located at the base of the flower stalk. The case is similar to one in *Phalaenopsis equestris*,[2] reported by the author in 1932. The dorsal sepal, petals, and column are normally developed. The two normal lateral sepals are absent, but in their place a coalesced structure is present, which resembles fused lateral sepals. In shape the coalesced structure resembles the dorsal sepal, except in size, being slightly larger. The labellum is absent.

[1] Philip. Journ. Sci. 49 (1932) 137–141, *3 pls;* 57 (1935) 459–463, *1 pl.*
[2] Philip. Journ. Sci. 49 (1932) 138, *pl. 3, figs. 7–9.*

PHALAENOPSIS APHRODITE Reichb. f. Plate 1, figs. 4 and 5.

Cases of fine pelories were previously reported by Costerus and Smith [3] in *Phalaenopsis amabilis* where the labellum and the petals are alike without any incision or appendage, and the column wanting. Master [4] also reported teratological cases in *Phalaenopsis Schilleriana* and *P. amabilis*, but neither of them cited the teratological phenomenon herein described. Quisumbing [5] reported cases in *P. equestris, P. Sanderiana, P. Schilleriana, P. Stuartiana, P. amabilis*, and *P. aphrodite*, but not the kind herein reported.

All the flower parts, like the petals, sepals, column, lip, and callus, are normal in size, form, and color, except for the presence of a small structure at the middle at the base of the middle lobe of the lip. The specimen was collected March 10, 1936, among the plants in flower of Mrs. K. B. Day, Parañaque, Rizal Province.

PHALAENOPSIS STUARTIANA Reichb. f. Plate 1, fig. 3.

The sepals, labellum, and column are all normal in size, but sepals are more decorated with reddish-brown dots. The petals are peculiar and abnormal; they are 3-lobed, with slightly wrinkled margins, and on the surface of each near the base is a small, thin, needlelike structure. The specimen was sent in by Dr. Alexander Gordon of La Carlota, Oriental Negros Province.

VANDOPSIS LISSOCHILOIDES (Gaudich.) Pfitz. Plate 1, fig. 8.

Usually in this species the flower at the very base of the inflorescence is abnormal. The present case is characterized by difference in shape of flower parts and the absence of some parts. The dorsal sepal and petals are elliptic and broader than in the typical flower. The column is practically normal. There is complete absence of the labellum. The typical lateral sepals are absent and replaced by a coalesced, somewhat rounded structure. The author is indebted to Dr. Alexander Gordon of La Carlota, Occidental Negros Province, for the specimens, which were received July 13, 1940.

ARACHNIS LOWII J. J. Sm. Plate 1, figs. 6 and 7.

This is one of the most interesting species of orchids introduced into the Philippines, because of its long, pendant inflor-

[3] Ann. Jard. Bot. Buitenzorg 28 (1914) 133, *t. 26, fig. 14*.

[4] Vegetable Teratology (1869) 262.

[5] Philip. Journ. Sci. 49 (1932) 137–141, *3 pls;* 57 (1935) 459–463, *1 pl.*

escences and the peculiar shape and color of the flowers. The plant in question has flowered twice since its acquisition by Mr. Costenoble of del Carmen, Pampanga Province, who gave the author flowers at both times, although this is the first time this teratological case has occurred. All the flowers at the base of the long pendant inflorescence are abnormal (Plate 2, fig. 6). While all the flower parts are present, they are entirely distinct from the typical flowers (Plate 2, fig. 7) in size, shape of flower parts, and even in color. The petals and sepals are cadmium yellow spotted with dull mahogany red.

RENANTHERA STORIEI Reichb. f. Plate 1, fig. 9.

In many orchids teratological flowers are generally found at the base of the inflorescence. In this case, however, all the flowers of the inflorescence are teratological. All the flower parts are normal in size and color, except the lateral sepals which are joined, the union sometimes extending almost from end to end. Specimens collected from a plant belonging to Mr. M. Sulit of the School of Forestry, Los Baños, Laguna Province, October, 1932.

ILLUSTRATIONS

PLATE 1

FIGS. 1 and 2. *Phalaenopsis amabilis* (Linn.) Blume.
FIG. 3. *Phalaenopsis Stuartiana* Reichb. f.
FIGS. 4 and 5. *Phalaenopsis aphrodite* Reichb. f.
6 and 7. *Arachnis Lowi* J. J. Sm.
FIG. 8. *Vandopsis lissochiloides* (Gaudich.) Pfitz.
FIG. 9. *Renanthera storiei* Reichb. f.

PLATE 2

Arundinaria bambusifolia Lindl.

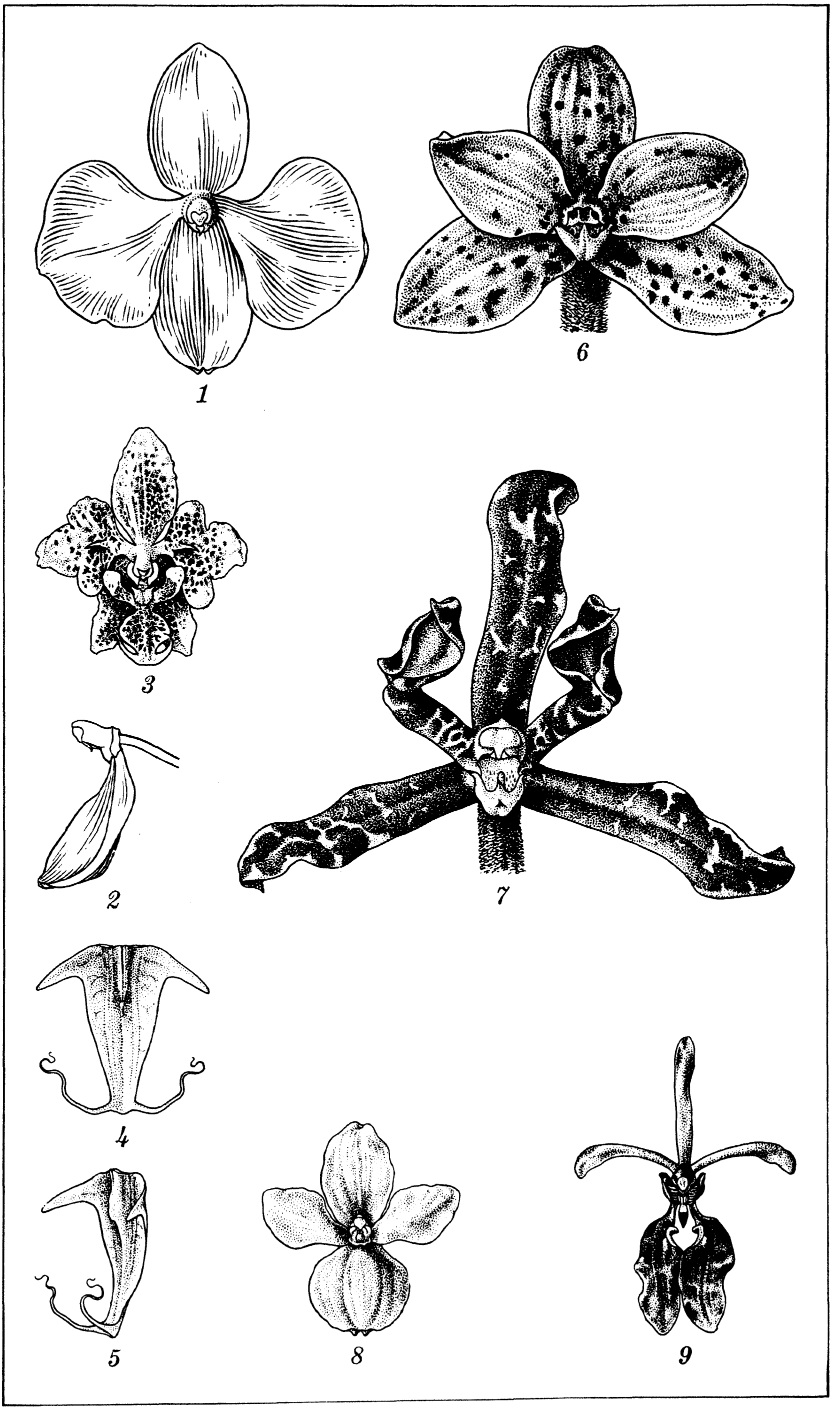


PLATE 1.

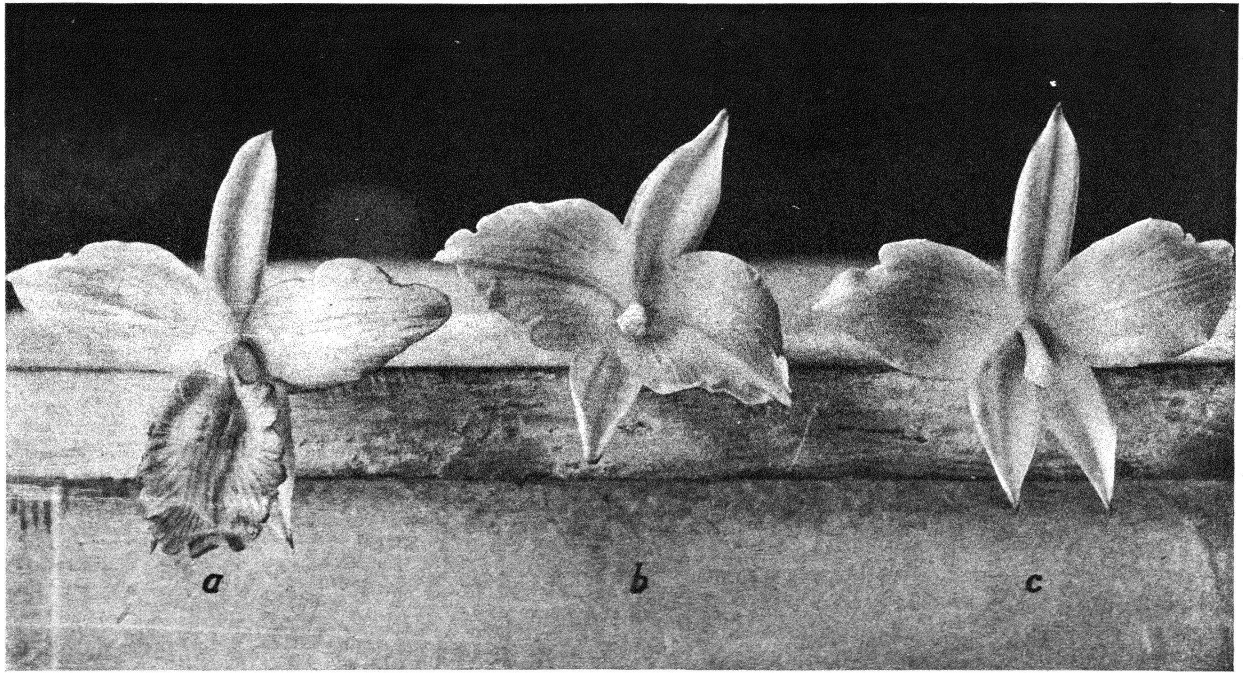


PLATE 2.

BOG AND WATER PLANTS OF MANCHURIA, I

THE GENUS POTAMOGETON

By V. I. KUZMIN and B. W. SKVORTZOW
Of Harbin, Manchoukuo

FOURTEEN PLATES

Although considerable work has been done during the past forty years on the plants of Manchuria, our knowledge with regard to them still remains incomplete. In the present series we intent to publish descriptions and diagrams on the water plants of Manchuria, together with various relevant observations on these plants. The present paper constitutes the first part of this series, and contains the description of species of *Potamogeton* Linn., collected by B. W. Skvortzow in the period 1920–1939, and by V. I. Kuzmin in 1938–1939. Most of the species of *Potamogeton* collected by B. W. Skvortzow were identified by Prof. V. L. Komarov of Leningrad, USSR, in 1930, and several by Dr. M. Kitagawa of Hsinking, Manchoukuo, in 1938.

Our present contribution contains the description of 14 species of *Potamogeton,* and the following features are pointed out in connection with the *Potamogeton* flora of northern Manchuria; (*a*) 50 per cent of all species here recorded are of cosmopolitan nature; they are: *Potamogeton pectinatus* Linn., *P. crispus* Linn., *P. pusillus* Linn., *P. natans* Linn., *P. heterophyllus* Schreb., *P. lucens* Linn., and *P. prælongus* Wulf. (*b*) The remaining species are Oriental plants, as *Potamogeton Maackianus* A. Benn. and *P. oxyphyllus* Miquel, reported from Manchuria, China, and Ussuri, USSR; and *P. Vaseyi* Robbins, *P. Tepperi* A. Benn., and *P. malainus* Miquel, known from Manchuria, Japan, China, Korea, the Philippines, and India. Only 2 species, *Potamogeton manschuriensis* A. Benn. and *P. perfoliatus* Linn. var. *mandschuriensis* A. Benn., are endemic to Manchuria. (*c*) *Potamogeton pectinatus* Linn. var. *gracilis* var. nov. and *P. malainus* Miquel var. *terrestris* var. nov. are proposed as new. (*d*) *Potamogeton crispus* Linn. × *P. Maackianus* A. Benn., a new hybrid, is proposed.

All *Potamogeton* species here described are illustrated by the authors. The diagrams have been made with E. Leitz Nos. 0, 1, 3, and 6 drawing oculars, and Nos. 1, 2, and 4 objectives.

Subgenus CALEOGETON (Reichb.) Raunk

Section CONVOLUTI Hagstr.

1. POTAMOGETON PECTINATUS LINNÆUS. Plate 13.

Potamogeton pectinatus LINNÆUS in Komarov, Flora USSR 1 (1934) 239, *pl. 12, figs. 4a–c.*

Rhizoma longa, ramosa, alba, repens, 2 mm diametro. Hibernacula tuberosa, ovaliformis, acuminata, 0.7 ad 5 cm longa, squamis vestitos edens. Caulis 50 ad 110 cm longus, tenuis, filiformis, rigidas, parte basalis simplex, rarissime ramosus, parte terminalis zigzagiformis ramosus et dense foliosus. Internodis inferiora 5 ad 11 cm, suprema 0.5 ad 2 cm longa. Folia tota demerso vaginalis filiformis 2 ad 7 cm longa, 0.3 ad 0.5 mm lata, atrovirens squarrosa. Folia novella apice acuminata vel modice apiculata, folia adulta apice abrupte subrostrata vel capitata. Vagina foliae distincta, 1 ad 3 cm longa, viridia, lata cum ligula acuminata membranacea ca. 0.2 ad 0.5 mm longa. Venis tota 3, centralis distinctis, margine tenuis indistinctis, venis lateralis sub angulo 90° divergentes. Pediculis racemi longis, filiformis, tenuis 5 ad 7 cm longis. Racemi pauciflori elongati, 2 ad 3.5 cm longi. Flores 1.5 ad 2 mm diametro, petalum accessorius androeci 1 mm latum, rotundatum. Racemus fructiferus elongata cum 5 ad 15 fructis laxis. Fructus robustis, 5 ad 7 mm longis, 2 ad 2.5 mm lata rotundato-ovalis depressis, ventralis rotundatis valde undulatis, dorsalis inflato sensum undulatis et costatis, in fronte elliptico-ovalis, a tergo subrotundatis cum stigma fere centralis. Stigma stipiformis adunca adversa.

MANCHURIA, Pinchiang Province, in lake near Cheng, August 20, 1924, *B. W. Skvortzow:* Kirin Province, in lake near Taolaichao, Sungari valley, August 10, 1927, *B. W. Skvortzow;* in lake Harbin, July 19, 1938, *V. I. Kuzmin;* in stagnant lake of Ashiho valley, August 14, 1939, *V. I. Kuzmin;* in lake of Sungari valley, August 21 and October 17, 1939, *B. W. Skvortzow.*

Distribution.—Europe, America, Siberia, Kamchatka, China, Japan, Korea, Manchuria.

2. POTAMOGETON PECTINATUS Linn. var. GRACILIS Kuzmin and Skvortzow var. nov. Plate 12, figs. 7 to 10.

Caulis parte basalis simplex pauciramosus, ramis lateralibus instructi-erecti vel adscendentes parte terminalis dense ramosi et foliati. Basalis 0.8 mm, terminalis, 0.1 ad 0.15 ad 0.17 mm diametro. Internodiis basalis, 5 ad 7 (ad 11) cm longis, terminalis, 2, 3, 6 (ad 8) mm longis. Foliis capilliformis aut hispidiformis, 2, 4, 5 (ad 6) cm longis, 0.16 ad 0.18 ad 0.25 mm latis, atrovirens, novella et adulta tota sensim acuminatis, ad apex cum venis indistinctis, in parte axilaris cum una venis centralis et venis lateralis sub angulo 90° divergentis. Vagina foliae 3 ad 6 ad 8 (ad 12) mm longa viridia. Ligula 0.5 ad 0.8 mm longa, acuminata. Flores et fructus ignota. Differt a typum foliis et caulis angustioribus.

MANCHURIA, Pinchiang Province, in stagnant lake near Harbin, Sungari valley, July 10, 1925, *B. W. Skvortzow.*

Potamogeton pectinatus Linn. is one of the commonest species in large lakes along Sungari River near Harbin. This plant constitutes thick growths especially in August and September. The new variety here described was classified by Prof. V. Komarov as *Potamogeton filiformis* Pers.

Subgenus EUPOTAMOGETON Raunk

Section ADNATI Hagstr.

3. POTAMOGETON MAACKIANUS A. Bennett. Plate 1, figs. 1 to 13.

Potamogeton maackianus A. BENNETT in Komarov, Flora USSR 1 (1934) 240, *pl. 12, figs. 5a–b.*

Rhizoma abbreviata, nodosa, fulvo-pubescens, filiforma, cum radicis gracilis brunnescens. Caulis gracilis, 0.3 ad 0.7 mm diametro, 20 ad 100 cm longis rigidis, diffusis vel dense ramosis ad parte terminalis. Internodis suprema 1 ad 3 (ad 4) cm, inferiora 3 ad 12 cm longa. Folia tota demerso viridia, 2 ad 4 (ad 7) cm longa, 2 ad 3 mm lata, lineari cum marginis parallelis sessilis, basin sensum attenuata late angustata vaginata. Vaginula viridia brevia 3 ad 4 cm longa. Folia novella ligula acuminata, 0.5 ad 1 cm longa, adulta cum ligula divisa corymbosa. Apex foliae rostrata rotundata aut emarginata. Margine minute denticulata, basi remota, ad apex conferta et manifesta. Venis tota 5, primaris ad parte mediana connata, ad apex monovenis. Venis secundaris parallelis, margine venis saepe undulatis et ad media foliae rare preruptis. Pediculis racemi elongatis, filiformis, 2 ad 3 (ad 4) cm longis. Racemi cylindricus, pauciflori 1.3 ad 2 cm longis, cum 3 ad 4 (ad 8) fructus laxus. Flores ignota. Fructus 2 ad 3 mm diametro, fere rotundato-depressus, dorsalis 3-undulato-emarginatus triquetrocostatus ventralis rotundatus, lateribus compressus, superne ovatus, in fronte viza rotundatus, a tergo rostratus. Stigma stipiformis elongata ad media parte fructus dispositis. Embryo involutus.

Differt a typus foliis vaginalis et ligularis.

MANCHURIA, Pinchiang, in fresh-water lake near Cheng, July 12, 1924, *B. W. Skvortzow;* in lake near Harbin, July 19, 1938, *V. I. Kuzmin;* in lake near Huangchan, Ashiho valley, September 9, 1939, *B. W. Skvortzow;* in Lake Chingpeho, October 10, 1931, *A. S. Lukachkin.*

Distribution.—Manchuria, Japan, China, Ussuri, Kamchatka. Fairly common near Harbin in small *Zizania* lakes and bogs. The plant collected near Cheng was identified by Prof. V. Komarov. The hybrid, *P. crispus* × *P. Maackanus,* was observed near Acho, eastern Harbin.

Section BATRASHOSERIS Irmisch

4. POTAMAGETON CRISPUS Linnæus. Plate 2, figs. 1, 4, and 5; Plate 3, figs. 1 to 11.

Potamogeton crispus LINNÆUS in Komarov, Flora USSR 1 (1934) 240, 241, *pl. 12, figs. 6a, b.*

Rhizoma tenuis ramosa, 1 mm diametro. Caulis complanatus, alatus, 1 ad 2.2 mm diametro, 80 ad 100 cm longus, parte terminalis dense ramosus. Internodis suprema 3 ad 4 (ad 5) cm, inferiora 2 ad 2.5 (ad 3.5) cm longa, ad caulis secundaris 1 ad 1.5 cm longa. Folia omnia equaliter lineari-lanceolata vel lanceolata, 1.7 ad 3 (ad 4.5) cm longa, 0.3 ad 0.5 (ad 0.8) mm lata, coriacea membranacea olivacea-viridia, crispae denticulata, apice rotundato vel abrupto-acuminata, basi attenuata vel rotundata. Venis primaris crassis, secundaris 2 ad 4 filiformis, lateralis sub angulo 80° ad 90° divergentes. Stipulae 1 ad 2 mm longae, latae, fuscae. Pediculis racemi 3 ad 3.5 (ad 4) cm longa, tenua non incrassata. Racemi pauciflori, 7 ad 12 mm longis. Fructis robustis, confertis adhaerens parte basalis 2.5 ad 3 mm longis, ovalis, depressis, dorsalis rotundato-undulatis ud costatis. Stigma curvata elongata falcata.

MANCHURIA, Lungchiang Province, along banks of streams near Tsitsihar, June 18, 1924, *B. W. Skvortzow.*

Distribution.—Europe, Siberia, Turkestan, Africa, America, Australia, Japan, Manchuria.

5. POTAMOGETON CRISPUS var. SERRULATUS Reichenbach. Plate 2, figs. 2 and 7.

Potamogeton crispus var. *serrulatus* REICHENBACH in Hegi, Illust. Flora v. Mittel-Europa 1 (1906) 132.

Potamogeton crispus LINNÆUS (*P. serrulatus* Schrd.) in Komarov, Flora USSR 1 (1934) 240.

Folia lineari-lanceolata, 4 ad 6 (ad 7) cm longa, 3 ad 7 mm lata, plana, denticulata non crispa, apice attenuato-rotundata, basi rotundata leviter attenuata. Flores non vidi.

MANCHURIA, Pinchiang Province, on banks of streams near Acho, Mudangchiang valley, July 20, 1924, *B. W. Skvortzow*.

POTAMOGETON CRISPUS Linnæus × POTAMAGETON MAACKINUS A. Bennett. Plate 1, figs, 14 and 15; Plate 2, figs. 3, 6, 8, and 9.

Rhizoma brevis, polyrrhiza. Caulis 50 cm longa, parte terminalis cum ramulis abbreviatis. Folia tota demerse viridia, 2 ad 4 ad 5 (ad 7) cm longa, 2.5 ad 4 cm lata, sessilia, linearia, apice breviter acuminata, rotundata aut rostrata, margine distincte denticulata. Venis tota 5. Nervi lateralis sub angulo 80° ad 90° divergentes. Foliis vagina et ligula evolutis. Flores et fructus non vidi.

MANCHURIA, Pinchiang Province, in mountain streams near Acho, Mutangchiang valley, July 20, 1924, *B. W. Skvortzow*.

This plant was identified by V. Komarov as *Potamogeton graminea* × *P. Maackianus,* but it seems to be *P. crispus* × *P. Maackianus*.

Section COMPRESSI Koch

6. POTAMOGETON MANSCHURIENSIS A. Bennett. Plate 4, figs. 6 to 14.

Potamogeton manschuriensis A. BENNETT in Komarov, Flora USSR 1 (1936) 243.

Rhizoma ignota. Caulis 40 ad 60 cm longa, complanatus tenuis 0.8 ad 1 mm diametro, ad parte basalis simplex, ad parte terminalis ramosus. Internodis 1 ad 6 (ad 10) cm longa, ad parte terminalis abbreviata. Folia attenuato-linearia, 2 ad 6 ad 9 (ad 11) cm longa, 0.5 ad 1 ad 2 (ad 3) mm lata, sessilis, viridia, integerrima basin non attenuata. Folia novella filiformia-acuminata cum 1 venis primaris ud 6 venis lateralis tenuis. Folia adulta sensum acuminata vel apiculata vel cuneata cum 1 venis primariis ud 12 ad 16 venis lateralis. Stipulae 1 ad 2 cm longae, acuminatae, dilute argillacea deciduus. Pediculis racemi 1.5 ad 3.5 cm longa, tenua 1 mm diametro non incrassatus. Racemi cum 6 ad 12 flores 5 ad 7 mm longa, fructifera 0.8 ad 1 cm longa et 0.5 mm lata. Flores 1.2 ad 1.3 mm diametro. Petalum accessorius androeci reniformis viridia cum venis indistinctis fere 1 mm lata. Fructus 2.5 ad 3 mm longa, obovato-rotundata, depressa, ventralis inferiora nodosa, dorsalis rotundata undulata et costata. Embryo involuto. Stigma incurvata ut capitata. Differt a typum fructus parte ventralis nodosa.

MANCHURIA, Pinchiang Province, in stagnant lakes near Harbin, Metaitzu, Sungari valley, July 10, 1925, *B. W. Skvortzow.*

Distribution.—Ussuri (USSR), Zea-Burea, Manchuria.

Only one lake was found rich in this distinct species associated with *Potamogeton pusillus, P. Vaseyi,* and *Euryale ferox.*

7. **POTAMOGETON OXYPHYLLUS** Miquel. Plate 12, figs. 1 to 6.

Potamogeton oxyphyllus MIQUEL in Komarov, Flora USSR 1 (1934) 243, 244, *pl. 12. fig. 9.*

Caulis valde complanatus ramosus, 0.3 mm diametro. Internodis 2 ad 6 ad 9 (ad 12) cm longa ad parte terminalis abbreviatis. Nodis valde apertus fuscentes. Folia 2 ad 4.5 (ad 6) cm longa et 0.4 ad 0.5 mm lata, linearis sessilis, ad basin valde tenuata, ad apicem sensim acuminata asymmetricis integerrimis. Venis primariis robusta cum venis lateralis parallelis connata, venis lateralis 6 ad 8, venis marginalis indistinctis. Stipulae 0.5 ad 1 cm longae, elongatae membranacea viridiae, adulta fuscentes decideus. Flores et fructus ignota.

MANCHURIA, Pinchiang, in stagnant lakes near Cheng, September 10, 1925, *B. W. Skvortzow.*

Distribution.—Eastern Siberia, Ussuri; Japan; Korea, Manchuria.

8. **POTAMOGETON PUSILLUS** Linnæus. Plate 4, figs. 1 to 5, and 15 to 22.

Potamogeton pusillus LINNÆUS in Komarov, Flora USSR 1 (1934) 247, *pl. 12, fig. 15.*

Rhizoma tenuis saepe abortinus. Caulis 5 ad 20 ad 40 ad 60 cm longa, filiformis, 0.4 ad 0.5 mm diametro tubulosus ad parte terminalis dense ramosus cum internodis 1 ad 4 ad 5 (ad 6) cm longa. Folia linearis, 1 ad 4 (ad 6) cm longa, 1 ad 1.2 mm lata ad apicem sensim acuminata vel apiculata vel cuneata. Venis 3, primaris robustis et distinctis, lateralis filiformis. Folia novella venis indistinctis. Stipulae 0.5 ad 1 cm longae, membranaceae, argillaceae. Pediculis racemi filiformis, tenua 1 ad 3 cm longa. Racemus floriferus 3 ad 5 mm longa cum 5 ad 15 flores. Flores 1.5 ad 2 mm diametro. Fructus 2 mm diametro, rotundato-ovalis depressa, dorsalis rotundato leniter undulato-costata, ventralis angularis. Stigma curta ut lata, in fronte lageniformis, a tergo ovato triquetra.

MANCHURIA, Pinchiang Province, near Harbin, Metaitzu, Sungari valley, on banks of streams, July 27, 1923, and September

3, 1938, *B. W. Skvortzow;* Acho, Mutangchiang valley, on banks of streams, July 20, 1924, *B. W. Skvortzow;* near Ertientziantze, on banks of stagnant streams, July 5, 1927, *B. W. Skvortzow;* Ashiho valley, August 16, 1938, *V. I. Kuzmin.*

Distribution.—Europe; America; Asia, Eastern Siberia, Ussuri, Manchuria, Sakhalin, Japan, China, Korea.

One of the commonest species of *Potamogeton* near Harbin, growing in bogs, *Typha* ponds, and rice fields. Identified by Prof. V. Komarov from specimens collected near Harbin.

Section HETEROPHYLLI Koch

9. POTAMOGETON VASEYI Robbins. Plate 5, figs. 1 to 7; Plate 6, figs. 1 to 21.

Potamogeton Vaseyi ROBBINS in Kitagawa, M. Lineamenta Florae Manshuricae (1939) 54.

Potamogeton miduhikimo MAKINO in Komarov, Flora USSR 1 (1934) 252.

Rhizoma et radicea filiformis saepe ad nodis percurrentes. Caulis 30 ad 50 cm longa, filiformis 0.5 mm diametro, parte basalis simplex, parte terminalis ramosus et dense foliosus. Internodis 1.3 ad 6 cm longa. Folia dubia natans ud demerse. Folia demerso angusto-linearis elongatis 2 ad 4.5 (ad 6) cm longa, 0.4 ad 1 mm lata, plana filiformis viridia, apice acuminata vel apiculata, basi attenuata. Stipulae longae viridia fusco-lucidus 0.4 ad 5 cm longae, venis tota 3. Folia natantes elliptica aut elongata aut lanceolata, marginibus parallelis, plerumque versus basin et apicem aequaliter attenuata vel truncata aut cuneata, 1.8 ad 2.1 ad 3 ad 4 cm longa, 1.7 ad 2.2 ad 4 ad 6 mm lata, compacta cum 3 ad 5 ad 7 venis, venis marginalis tenuis indistinctis. Petioli tenui, 0.5 ad 1 ad 2 cm longa. Stipulae foliis natantes ud bracteae inflorescentiae magnae, latae, membranaceae, apice subacutae ut rotundatae, 1 ad 1.4 cm longae, 2 mm lata cum 2 venis primariis. Pediculis racemi 1.3 ad 2 cm longa, incrassatis 1 mm diametro. Racemi 0.5 ad 0.7 ad 1 cm longa, 2 ad 2.5 mm lata, cum 3 ad 5 ad 15 floribus. Flores 1.5 mm diametro, petalum accesorius androeci reniformis. Fructus 1.8 ad 2 mm diametro rotundato-ovata depressa, concava cum stigma stipiformis recta aut adversa. Dorsalis late rotundata costatis, dorsalis gibbosa, in fronte lageniformis, a tergo elongato-ovalis.

MANCHURIA, Pinchiang Province, in lakes near Cheng, July 7, 1936, *B. W. Skvortzow;* in lakes near Harbin, August 10, 1928, *B. W. Skvortzow,* June 29, 1938, *V. I. Kuzmin;* in lakes of Sungari valley, September 5, 1939, *B. W. Skvortzow.*

Distribution.—Siberia, Ussuri, Manchuria; Japan; Korea.

An interesting species with polymorph leaves, quite common near Harbin in the early part of summer.

10. POTAMOGETON TEPPERI A. Bennett. Plate 7.

Potamogeton tepperi A. BENNETT in Kitagawa, M. Lineamenta Florae Manshuricae (1939) 53.

Potamogeton diginus WALL. in Komarov, Flora USSR 1 (1934) 253, 254.

Rhizoma ignota. Caulis apice ramosis, 20 ad 45 cm longa, 1 ad 1.5 mm lata. Internodis 3 ad 5 ad 6 (ad 8) cm longa. Folia dubia natans ut demersa. Folia demerso lanceolata falcata, apice asymmetricis acuminata olivacea equaliter attenuata, fere plana vel subundulata, 4 ad 6 ad 10 (ad 14) cm longa, 0.8 ad 1 ad 1.5 cm lata. Venis primaris robustis latis, secundaris 10 ad 16 tenuis. Petioli 1 ad 3 ad 5 ad 6 (7.5) cm longa. Folia natantes compactus coriaceus lucens, 2.5 ad 3 ad 5 ad 6 (ad 7) cm longa, 2 ad 3 cm lata, ovalis lanceolata vel elliptica, equaliter attenuata, apice abrupte acuminata, supra olivacea vel viridia, subtus rubra. Venis primaris distincta, secundaris 16. Petioli 8 ad 10 ad 12.9 ad 15 cm longa. Stipulae 4 ad 5 ad 6 cm longae, late-acuminatae, deciduae. Pediculis racemi incrassatus, 4 ad 6 (ad 7) cm longa. Racemi 2 ad 3 ad 4 cm longa, multiflori. Flores 1.5 to 2 cm diametro, digynus. Fructus 2.5 mm diametro, dorsalis rotundata costata, ventralis lata, in fronte quadrata, a tergo sexangulata. Stigma curta.

MANCHURIA, Pinchiang Province, on banks of streams near Acho, Mutangchiang valley, August 10, 1930, *B. W. Skvortzow.*

Distribution.—Reported from Siberia, Ussuri, Manchuria; Japan; China; India; Philippines.

11. POTAMOGETON NATANS Linnæus. Plate 12, fig. 11.

Potamogeton natans LINNÆUS in Komarov, Flora USSR 1 (1934) *pl. 12, fig. 21a, b.*

Caulis 40 ad 50 cm longa, 1.5 mm diametro, parte terminalis ramosus. Folia natans elliptica, ovala, subovala aut elongata, 6 ad 8 (ad 11) cm longa, 2.5 ad 3.5 cm lata, arillata, basi attenuata vel rotundata, apice abrupta acuminata utrinque viridia. Venis 20 ad 21 distinctis. Stipulae 6 ad 8 cm longae, viridiae. Flores non vidi.

MANCHURIA, Pinchiang Province, in lakes near Jablonaia, August 20, 1925, *B. W. Skvortzow.*

Distribution.—Europe; Asia, Manchuria; America; Africa.

12. **POTAMOGETON HETEROPHYLLUS** Schreb. Plate 14, fig. 9.

Potamogeton graminea Linn. var. *heterophyllus* FRIES in Komarov, Alisova-Klobukova, Key for the Plants of the Far Eastern Region of the USSR (1931) 132, *pl. 29, figs. 6–10.*

Potamogeton heterophyllus SCHREB. in Komarov, Flora USSR 1 (1934) 256, *pl. 12, fig. 22a–c.*

Rhizoma crassa ramosa 1 ad 1.5 mm diametro. Caulis 40 ad 80 cm longa, subtiliter ramosa crassa, 2 mm diametro. Internodis 2 ad 5 ad 8 (ad 10) cm longa. Folia 7 ad 15 (ad 17) cm longa, 0.5 ad 1 cm lata lanceolata equaliter attenuata, ad apicem saepe arcuato-acuminata, integerrima plana obscura-viridia. Venis primaris 1, lateralis 6. Stipulae 2 ad 4 cm longae elongatae viridiae. Flores non vidi.

MANCHURIA, Pinchiang Province, on banks of streams near Hsiaoling, July 20, 1938, *B. W. Skvortzow.*

Distribution.—Europe, Siberia, North America, Japan, Manchuria.

13. **POTAMOGETON LUCENS** Linnæus. Plate 8, figs. 1 to 9; Plate 9, figs. 1 to 16.

Potamogeton lucens LINNÆUS in Komarov, Flora USSR 1 (1934) 257, 258, *pl. 12, fig. 23a-c.*

Rhizoma elongata, crassa, 3 mm diametro, albida. Caulis 40 ad 90 cm longa, ad parte terminalis dense ramosi. Internodis suprema 1.3 ad 5 cm, inferiora 10 ad 26 cm longa. Folia tota demerso, (3) 4 ad 8 (ad 13) cm longa, 1.5 ad 2.3 cm lata viridis membranacea, suprema folio elongato-elliptica, abrupto-rotundata cum spinis terminalis 1 mm longa, inferiora lanceolata-elongata, acuminata cum spinis 1 ad 3 cm longa. Folia novella margine minute serrulata leniter undulata. Costa distincta lata ad basin impresse dilatata, secundaris utrinque 6 a costa sub angulo 15° ad 20° divergentes, venis marginalis tenuissima. Folia in petioles brevissimus, ca. 1 cm longa. Stipulae ut bracteae inflorescentiae 1.5 ad 5.5 cm longae, robustae lanceolatae, membranaceae-viridia plus minusve squarrosae, saepe tubulosae, cum 2 costae et venis secundaris multinervis, apicem rotundatae. Pediculis raceme crassis robustis, ca. 4 ad 5 cm longis. Racemi cylindricis multiflori, 2 ad 4 cm longa. Flores 2 ad 2.5 mm in diametro, petalum accessorius and roeci 1 ad 1.5 mm latus reniformis cum venis indistinctis. Fructus 2 ad 2.5 mm diametro fere rotundato-depressa, dorsalis rotundatis accrescens et apertus cum marginibus fere undulatis ut 3 costatis, ventralis fere plana, superne ovato, in fronte elongato-rotundato, a tergo acutangularis. Stigma stipiformis alaris. Embryo involuta.

MANCHURIA, Pinchiang Province, in fresh-water lakes, Ashiho valley near Huangshan, September 10, 1939, *V. I. Kuzmin.*

Distribution.—Europe, Kaukasus, Siberia, North America, Manchuria. Reported by Litvinov from environs of Tsitihar.

14. POTAMOGETON MALAINUS Miquel. Plate 10, figs. 1 to 3 and 5 to 9; Plate 11, figs. 1 to 22.

Potamogeton malainus MIQUEL in Komarov, Flora USSR 1 (1934) 258, 259, *pl. 12, fig. 24a, c.*

Rhizoma tenua repens. Caulis simplex solitarius rarissime ramosus, 100 ad 170 cm altus, cum ramulis abbreviatis, sub nodo interdem radicalis. Internodis suprema 4 ad 7 ad 10 cm, inferiora 15 ad 18 cm longis. Folia omnio demerso viridia olivacea, 5 ad 8 ad 19 cm longa, 1.8 ad 2 ad 3 cm lata, membranacea late linearia vel anguste-linearia, subovato-oblonga vel ovato-lanceolata, abrupta cum spinis 2 ad 3 mm longa ornata, basi rotundata vel late cuneata, margine minute subundulata-crispa, leviter denticulata. Venis primaris robustis, secundaris 3 ad 4 ad 5 distincte prominulis, margine venis tenuis indistinctis. Folia demerso longe petiolata, 2 ad 6 ad 11.5 cm longa superiora dilatada. Stipulae ut bracteae inflorescentie magnae ca. 4 ad 7 cm longae acuta lanceolata membranacea viridia olivacea cum 2 venis primariis. Pediculis racemi elongatis robustis crassis, 5 ad 6.5 cm longa. Racemi cylindricis multiflori 3 ad 4 cm longa. Flores 4 ad 5 mm diametro. Petalum accesorius androeci reniformis 1 mm latus cum venis tenuis indistinctis. Fructus ca. 2.5 ad 3 cm diametro adversus rotundo-obovata vel ovata, dorsalis undulata emarginata triquetro angulata, ventralis levissima arcuata ut angulata, lateribus compressa, superne rotundato-ovata vel subovata, in fronte acuminato-rotundata, a tergo undulata. Stigma stipiformis lateribus brevis. Embryo involuta. Differt a typum foliis latissimis ut fructus robustris.

MANCHURIA, Pinchiang Province, Sungari valley, near Meta-itzu, August 23, 1939, *B. W. Skvortzow,* September 20, 1939, *V. I. Kuzmin.*

Distribution.—Eastern Siberia, Ussuri; Korea; Japan; China; Manchuria; India; Borneo; Java; Philippines.

15. POTAMOGETON MALAINUS Miquel var. TERRESTRIS Kuzmin and Skvortzow var. nov. Plate 10, fig. 4; Plate 11, fig. 23.

Planta terrestris cum caulis simplex, rarissime ramosa, cum internodis confertus et folius minoris. Folia terrestris 3.5 ad 6 ad 7.5 cm longa, 1 ad 2 ad 2.5 cm lata, compacta viridia vel rubra, elliptica, elliptico-elongata abrupta, cum spina apicalis 1 mm longa. Margine integerrima subundulata fere plana. Venis primaris brunnea vel rubra, secundaris, 4 ad 5. Flores non vidi.

MANCHURIA, Pinchiang Province, in humid meadows of Sungari valley, July 7, 1938, *B. W. Skvortzow;* on banks of streams near Harbin, September 20, 1939, *B. W. Skvortzow.*

Section PELTOPSIS Rouy

16. POTAMOGETON PRAELONGUS Wulf. Plate 14, fig. 8.

Potamogeton praelongus WULF in Komarov, Flora USSR 1 (1934) 259, *pl. 12, figs. 25a, b.*

Rhizoma ramosa. Caulis 40 ad 60 cm longa, 1 mm diametro. Internodis 2 ad 6 ad 8 cm longa, parte terminalis abbreviata. Folia 8 ad 10 ad 15.9 ad 17 cm longa, 0.8 ad 1 ad 1.2 cm lata attenuato-lanceolata, sessilis margine subundulato-crispa non denticulata olivacea amplexicaule, apice abrupto acuminato. Venis primaris distinctis crassa, secundaris 8. Stipulae 1 ad 1.5 cm longae, indistinctis. Pediculis racemi 3 ad 5 ad 7 cm longa. Racemi cylindricis 8 ad 12 flore. Flores 1.5 mm diametro. Fructus non vidi.

MANCHURIA, Pinchiang Province, on banks of streams near Acho, Mutangchiang valley, July 20, 1924, *B. W. Skvortzow.*

Distribution.—Europe, North America, Siberia, Manchuria.

17. POTAMOGETON PERFOLIATUS Linn. var. MANDSCHURIENSIS A. Bennett. Plate 14, figs. 1 to 7.

Potamogeton perfoliatus Linn. var. *mandschuriensis* A. BENNETT in Komarov & Klobukova-Alisova, Key for the Plants of the Eastern Region of the USSR (1931) 131, *pl. 30, fig. 1.*

Potamogeton perfoliatus LINNÆUS in Komarov, Flora USSR 1 (1934) 260, *pl. 12, fig. 26a–c.*

Rhizoma ramosa. Caulis simplex vel ramosa 20 ad 45 ad 65 ad 100 cm longa cum internodis 0.5 ad 1 ad 2 ad 4 cm longa, apice abbreviata. Folia oblonga-ovala vel ovala, basi rotundata amplexicaulis, apice acuminata, margine undulata vel crispa 2 ad 2.5 ad 4.5 cm longa, 0.8 ad 1.5 ad 1.8 cm lata. Venis primaris 3, secundaris 5 ad 6 ad 8, lateralis sub angulo 80° divergentes. Stipulae 0.3 ad 0.5 cm longae. Pediculis racemi 1 ad 2 ad 3 cm longa, recta. Racemi 1 ad 2 cm longa, 8 ad 12 floriferi. Petalum accessorius androeci reniformis, 1.2 mm diametro. Fructus non vidi.

MANCHURIA, Lungchiang Province, on banks of streams near Tsitihar, June 18, 1924, *B. W. Skvortzow:* Pinchiang Province, in lakes of Chingpehu, November 10, 1931, *A. S. Lukachkin.*

Distribution.—Europe, Asia, North Africa, Central and North America, Australia.

We have no original description of var. *mandschuriensis* A. Benn. Judging from the type species the Manchurian plant differs by its elongate-crispate leaves.

ILLUSTRATIONS

PLATE 1

FIGS. 1 to 13. *Potamogeton Maackianus* A. Bennett. Fig. 1, upper part of plant with fruits; *2*, fruit, side view, enlarged; *figs. 3* and *4*, fruits, front view, enlarged; *fig. 5*, fruit, seen from above, enlarged; *6*, gross section of fruit with embryo inside, enlarged; *7*, vagina and ligula, enlarged; *figs. 8* and *9*, ligula, enlarged; *10* to *13*, end parts of leaves, enlarged.

14 and 15. *Potamogeton crispus* Linn. × *P. Maackianus* A. Bennett; end part of leaves, enlarged.

PLATE 2

FIG. 1. *Potamogeton crispus* Linnæus; upper part of plant with unripe fruits and with a winter bud.

2. *Potamogeton crispus* Linn. var. *serrulatus* Reichenbach; upper part of a branch.

3. *Potamogeton crispus* Linn. × *P. Maackianus* A. Bennett; upper part of stem.

FIGS. 4 and 5. *Potamogeton crispus* Linnæus; end part of leaves, enlarged.

FIG. 6. *Potamogeton crispus* Linn. × *P. Maackianus* A. Bennett; and part of leaf, enlarged.

7. *Potamogeton crispus* Linn. var. *serrulatus* Reichenbach; end part of leaves, enlarged.

FIGS. 8 and 9. *Potamogeton crispus* Linn. × *P. Maackianus* A. Bennett; end part of leaf, enlarged.

PLATE 3. POTAMOGETON CRISPUS LINNÆUS.

FIGS. 1 and 2, fruits, side view, enlarged; *3* and *4*, fruits, front view, enlarged; *fig. 5*, four fruits grown together, enlarged; *6*, cross section of fruit with embryo inside, enlarged; *7*, fruit, seen from above, enlarged; *figs. 8* and *9*, two types of stipules, enlarged; *10* and *11*, lower part of two leaves from a winter bud, enlarged.

PLATE 4

FIGS. 1 to 5. *Potamogeton pusillus* Linnæus. Fig. 1, upper part of a stem with flowers and fruits; *figs. 2* to *5*, end part of leaves, enlarged.

6 to 14. *Potamogeton mandschuriensis* A. Bennett. Fig. 6, upper part of stem with fruits; *figs. 7* to *10*, end part of leaves, enlarged; *fig. 11*, cross section of fruit with embryo inside, enlarged; *figs. 12* to *14*, fruit, side view, enlarged.

15 to 22. *Potamogeton pusillus* Linnæus. Figs. *15* to *17*, fruits, side view, enlarged; *8* and *19*, fruits, front view, enlarged; *20* to *22*, fruits, front view, enlarged.

PLATE 5. POTAMOGETON VASEYI ROBBINS.

FIG. 1. Upper part of plant with floating and submersed leaves, flowers, and fruits; *2*, flower, enlarged; *figs. 3* to *6*, different types of floating leaves, enlarged; *fig. 7*, stipule, enlarged.

PLATE 6. POTAMOGETON VASEYI ROBBINS.

FIGS. 1 and 2, parts of stem with stipules, enlarged; *3* and *4*, different types of floating leaves, enlarged; *5* to *7*, end part of submersed leaves, enlarged; *8* and *9*, petalous part of stamens, enlarged; *10* to *14*, fruits, side view, enlarged; *15* and *16*, ovaries, enlarged; *17* to *19*, fruits, seen from above, enlarged; *20* and *21*, fruits, front view, enlarged.

PLATE 7. POTAMOGETON TEPPERI A. BENNETT.

FIG. 1, upper part of plant with flowers and fruits; *2*, flower, enlarged; *figs. 3* and *4*, petalous part of stamens, enlarged; *fig. 5*, fruit, side view, enlarged; *6*, cross section of fruits with embryo inside, enlarged; *7*, fruit, seen from above, enlarged; *figs. 8* and *9*, fruit, front view, enlarged.

PLATE 8. POTAMOGETON LUCENS LINNÆUS.

FIG. 1, upper part of plant with flowers and fruits; *2*, flower, enlarged; *3*, end part of leaf, enlarged; *4*, submersed stem with distinct stipules; *5*, cross section of fruit with embryo inside, enlarged; *figs. 6* and *7*, stipules, enlarged; *8* and *9*, different types of leaves.

PLATE 9. POTAMOGETON LUCENS LINNÆUS.

FIGS. 1 to 4, petalous part of stamens, enlarged; *5* to *10*, fruits, side view, enlarged; *11* to *13*, fruits, front view, enlarged; *14* and *15*, fruits, front view, enlarged; *fig. 16*, end part of leaf, enlarged.

PLATE 10

FIGS. 1 to 3. *Potamogeton malainus* Miquel. Fig. 1, upper part of plant with flowers and fruits; *2*, ovary, enlarged; *3*, flowers, enlarged.

FIG. 4. *Potamogeton malainus* Miq. var. *terrestris* Kuzmin and Skvortzow var. nov.; small plant.

FIGS. 5 to 9. *Potamogeton malainus* Miquel. Fig. 5, stipule, enlarged; *figs. 6* to *8*, different types of leaves; *fig. 9*, end part of leaf, enlarged.

PLATE 11

FIGS. 1 to 22. *Potamogeton malainus* Miquel. Figs. *1* to *4*, petalous parts of stamens, enlarged; *5* to *12*, fruits, side view, enlarged; *13* to *16*, fruits, front view, enlarged; *17* to *20*, fruits, seen from above, enlarged; *21* and *22*, cross section of fruits with embryo inside, enlarged.

FIG. 23. *Potamogeton malainus* Miquel var. *terrestris* Kuzmin and Skvortzow var. nov.; end part of leaf.

PLATE 12

FIGS. 1 to 6. *Potamogeton oxyphyllus* Miquel. Fig. 1, upper part of plant; *2*, stipules, enlarged, *3*, middle part of leaf with veins, enlarged; *figs. 4* to *6*, end parts of leaves, enlarged.

7 to 10. *Potamogeton pectinatus* Linn. var. *gracilis* Kuzmin and Skvortzow var. nov. Fig 7, upper part of plant; *figs. 8* and *9*, end parts of leaves, enlarged; *fig. 10*, middle part of mature leaf, enlarged.

FIG. 11. *Potamogeton natans* Linnæus; upper part of stem.

PLATE 13. POTAMOGETON PECTINATUS LINNÆUS.

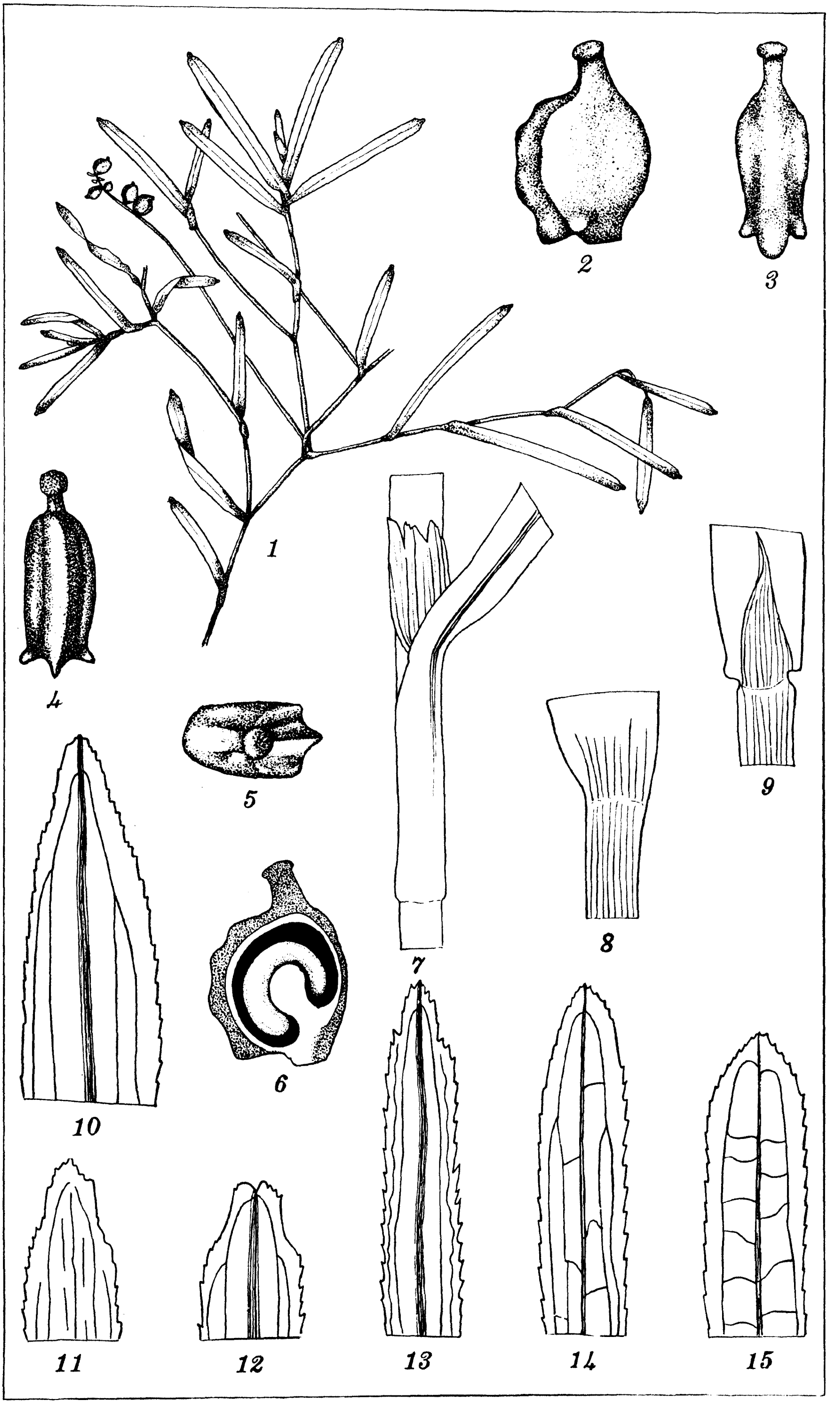
FIG. 1, upper part of plant with fruits; *2*, stipules and ligules, enlarged; *figs. 3* to *6*, fruits, side view, enlarged; *7* and *8*, fruits, front view, enlarged; *9* to *11*, fruits, seen from above, enlarged; *12* to *14*, petalous parts of stamens, enlarged; *15* to *17*, end parts of mature leaves, enlarged; *18* to *22*, end parts of young leaves, enlarged.

PLATE 14

FIGS. 1 to 7. *Potamogeton perfoliatus* Linn. var. *mandschuriensis* A. Bennett. Fig. 1, upper part of stem with flowers; *2*, part of inflorescence with flowers, enlarged; *figs. 3* to *5*, different types of leaves, enlarged; *6* and *7*, petalous parts of stamens, enlarged.

FIG. 8. *Potamogeton praelongus* Wulf; upper part of stem with flowers.

9. *Potamogeton heterophyllus* Schreb.; upper part of stem.



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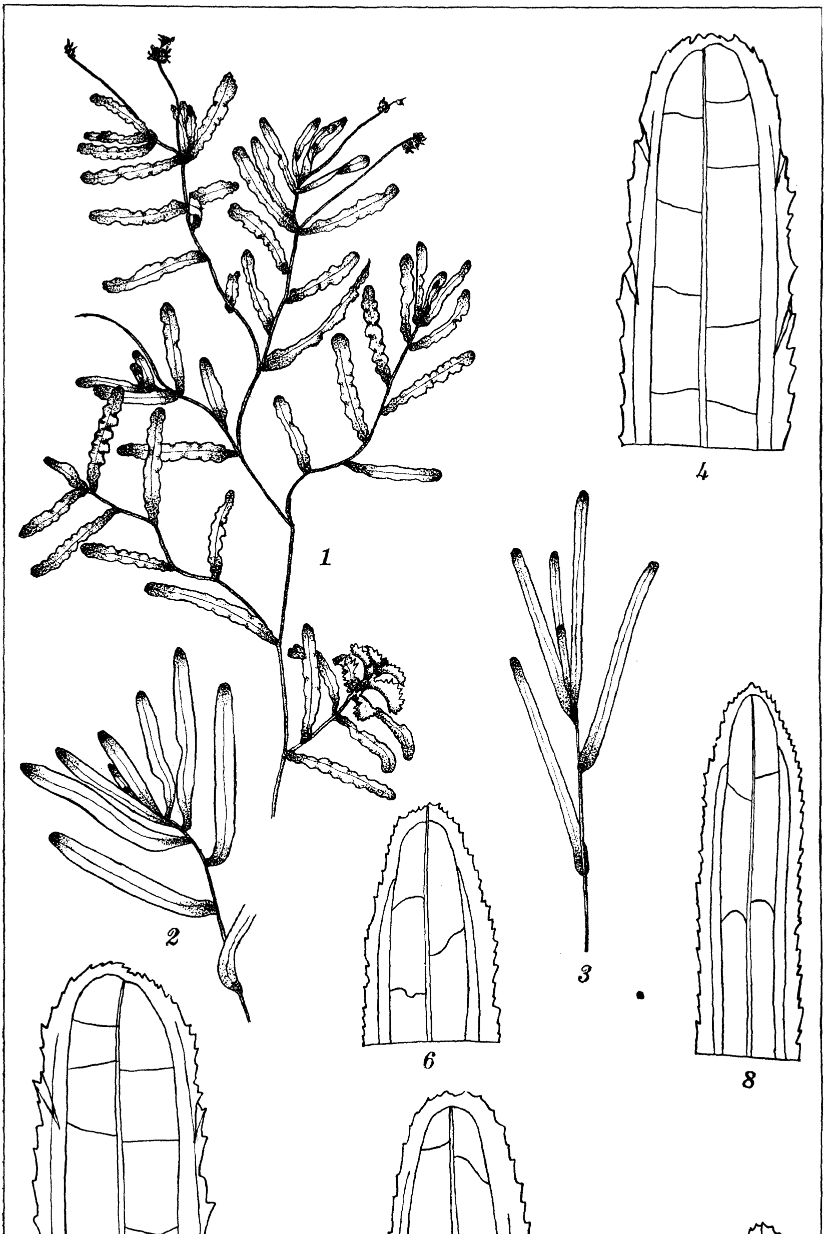

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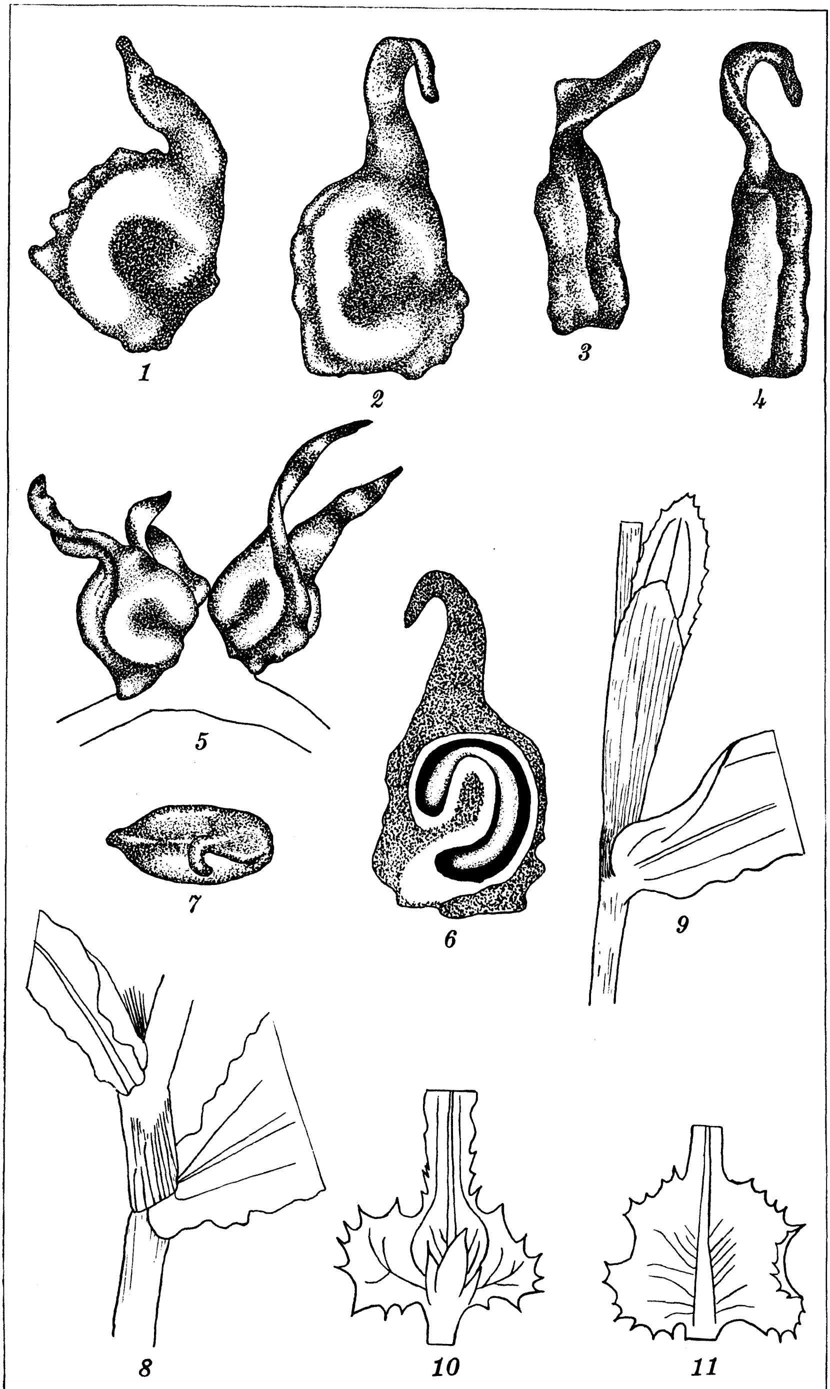

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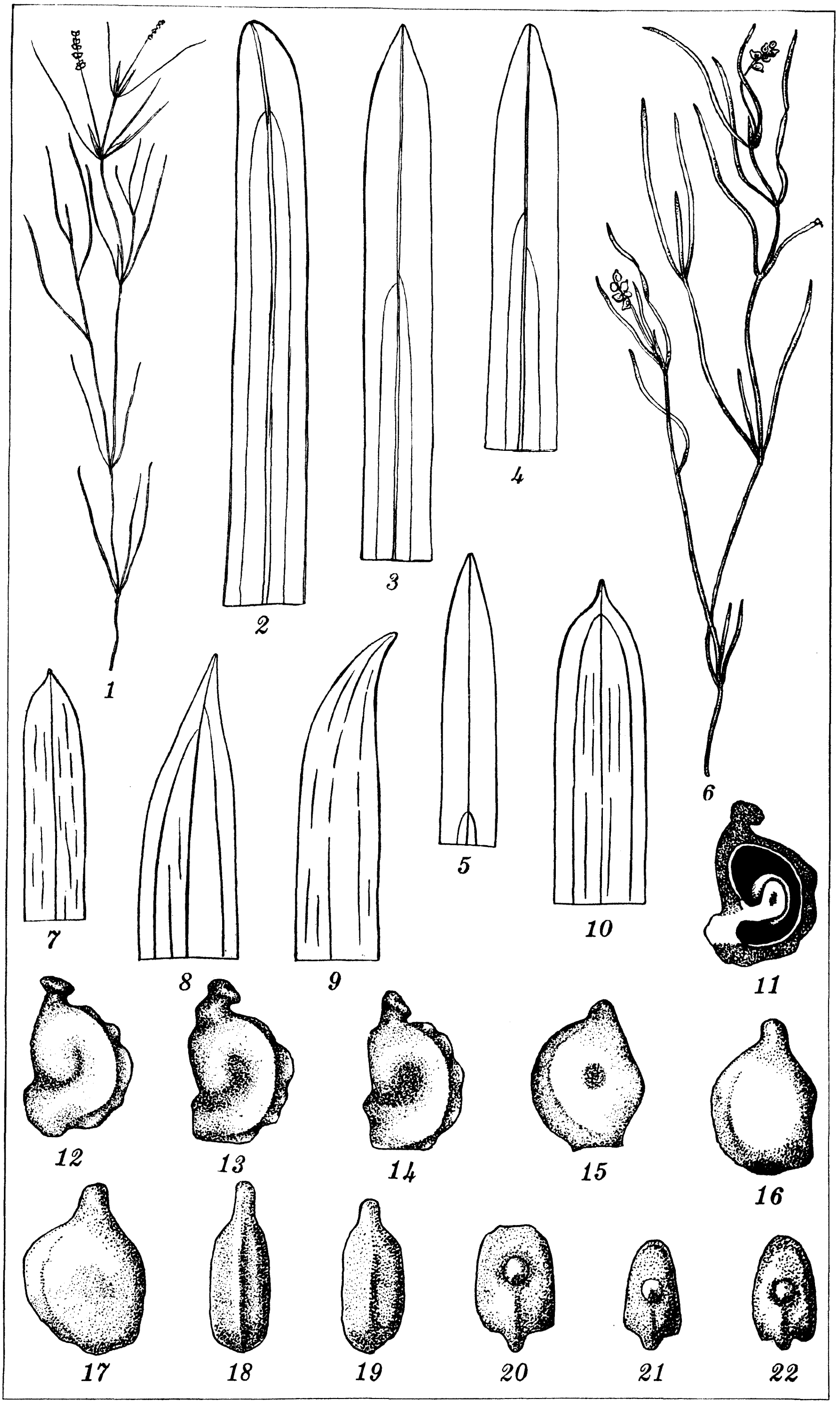

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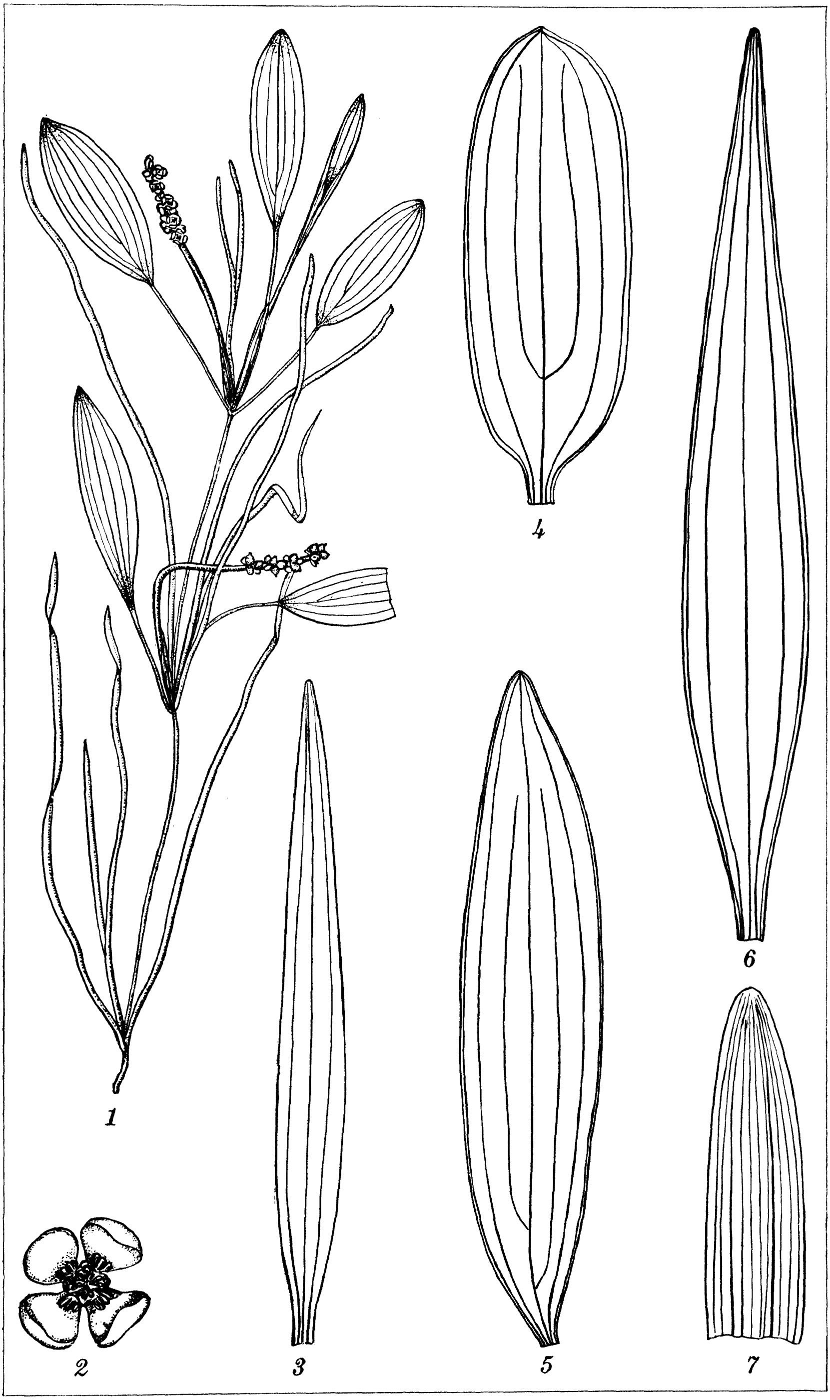

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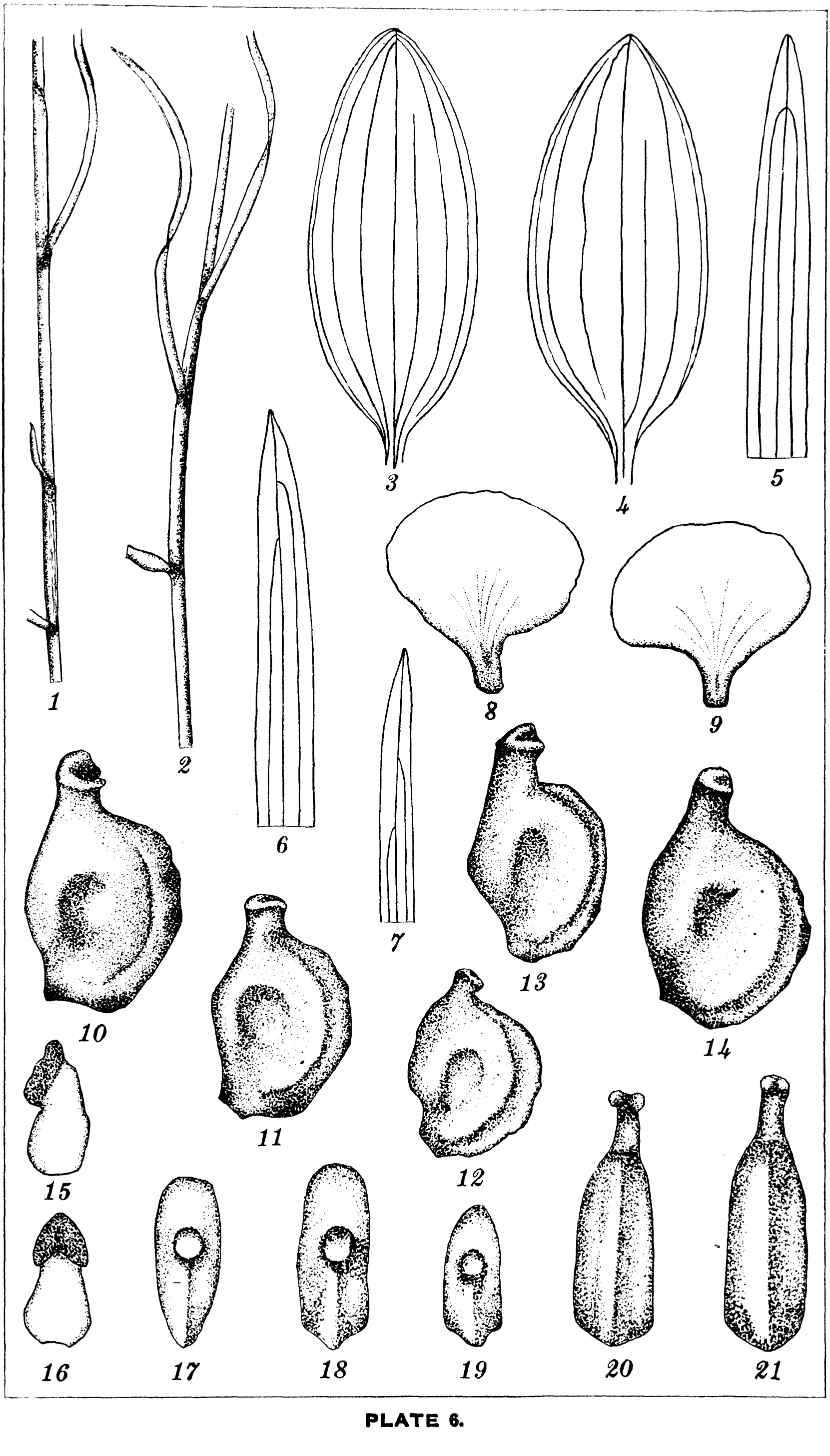

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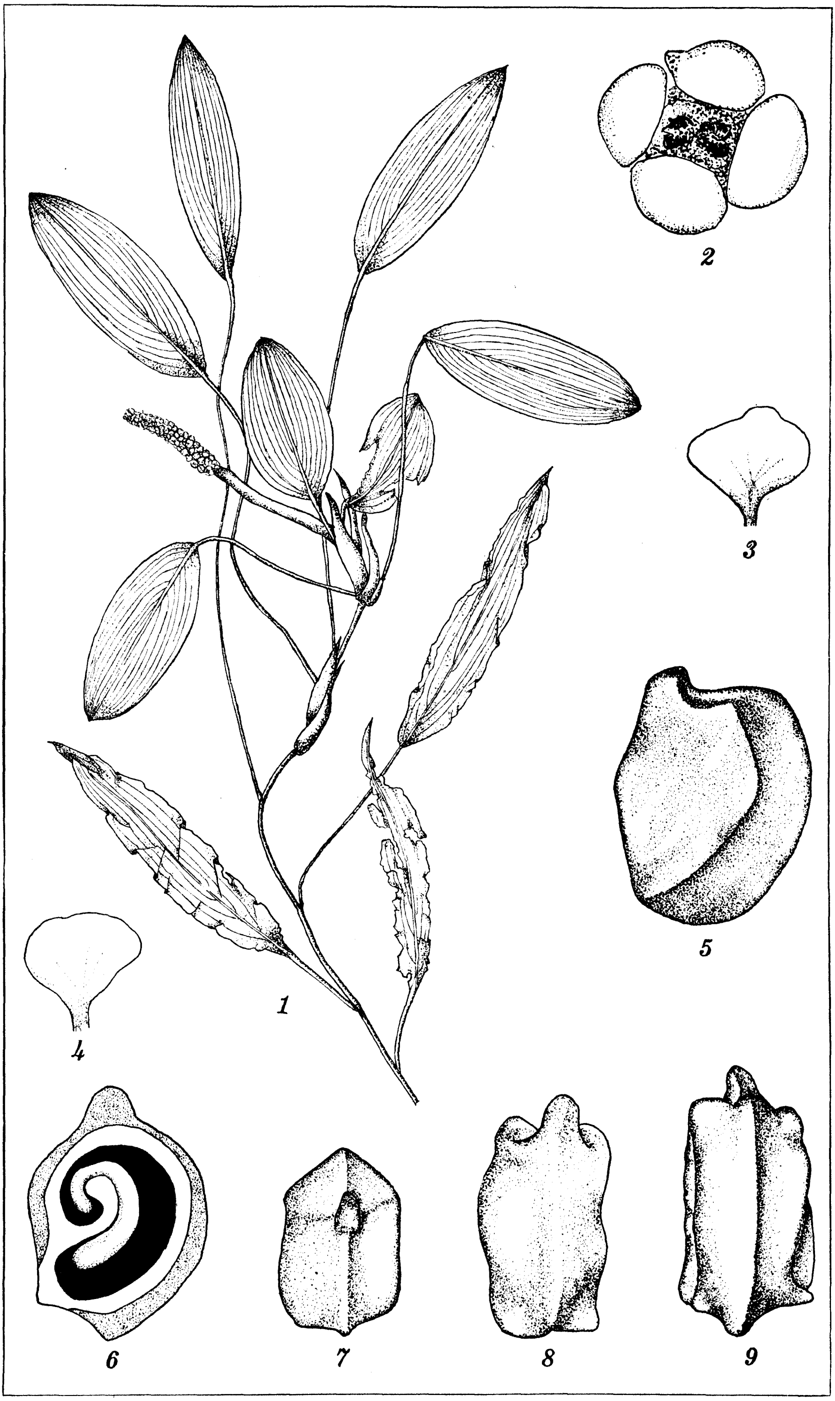

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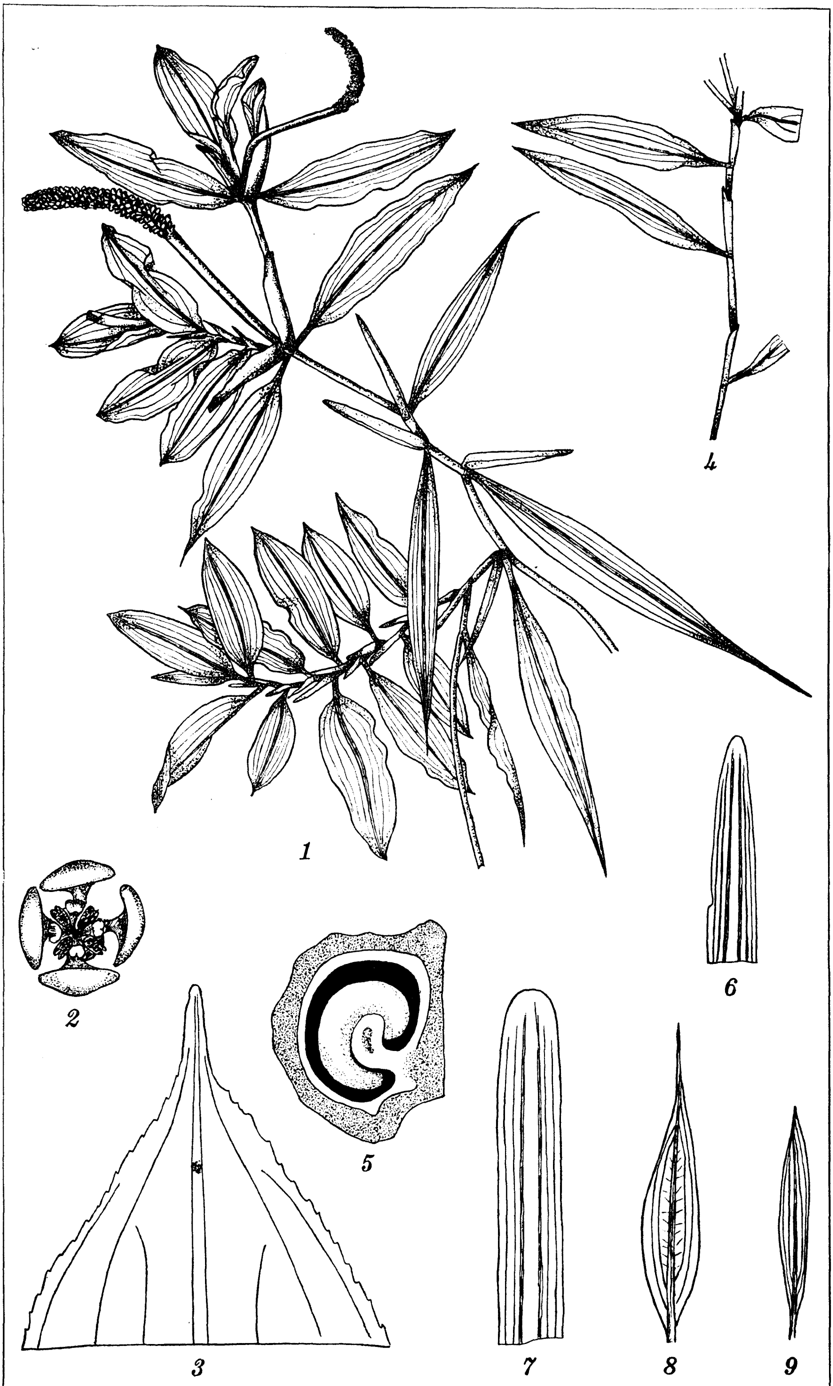

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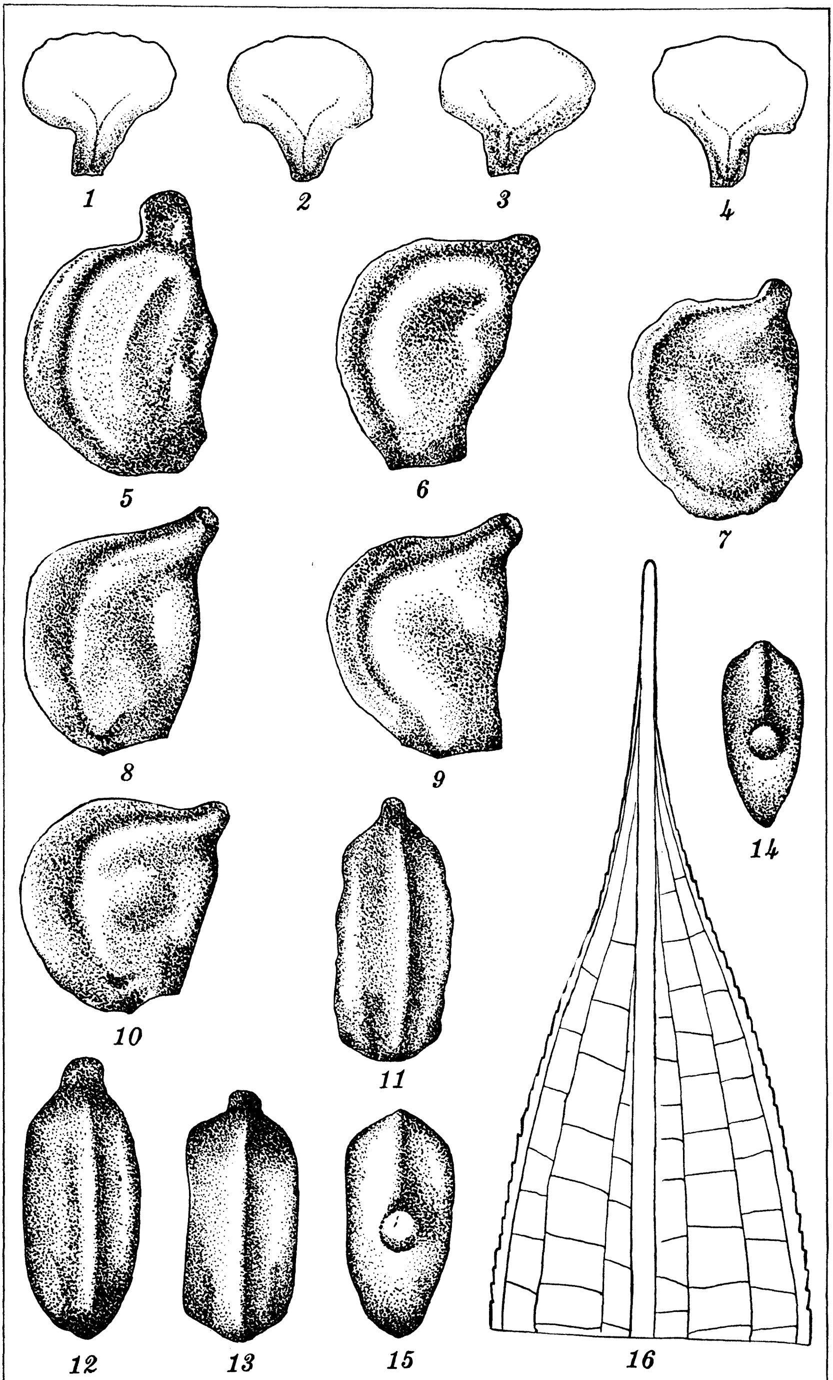

PLATE 9.

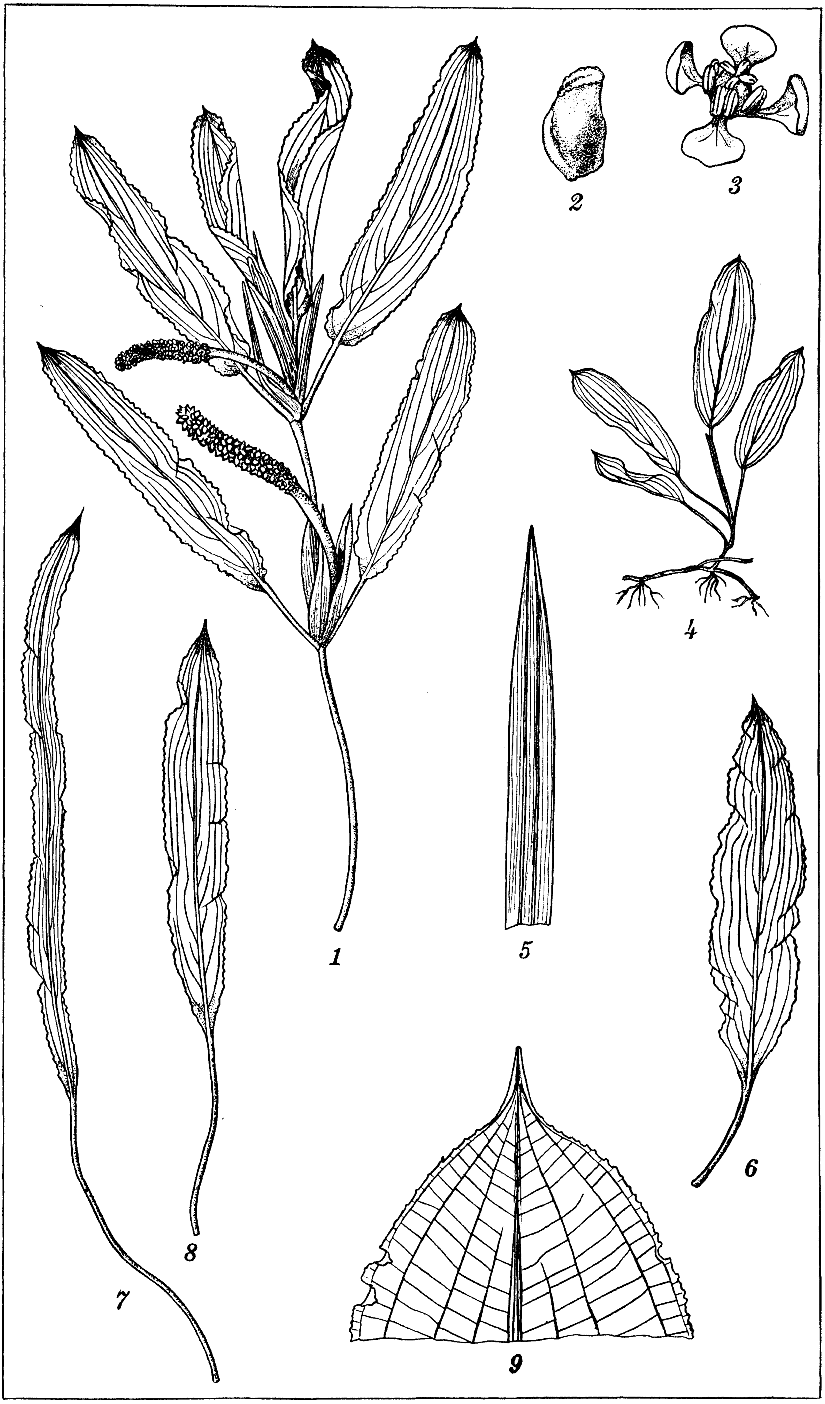

PLATE 10.

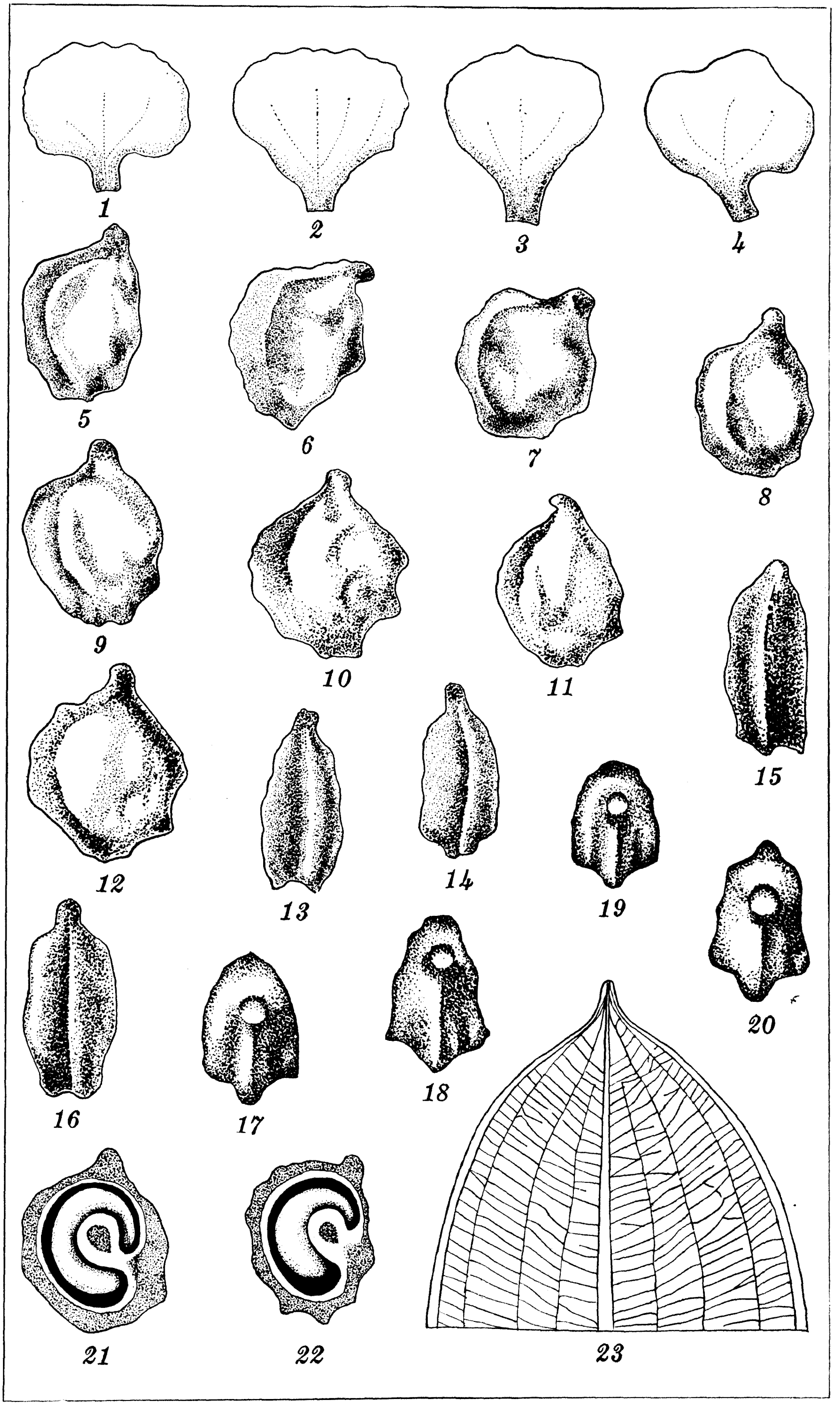

PLATE 11.

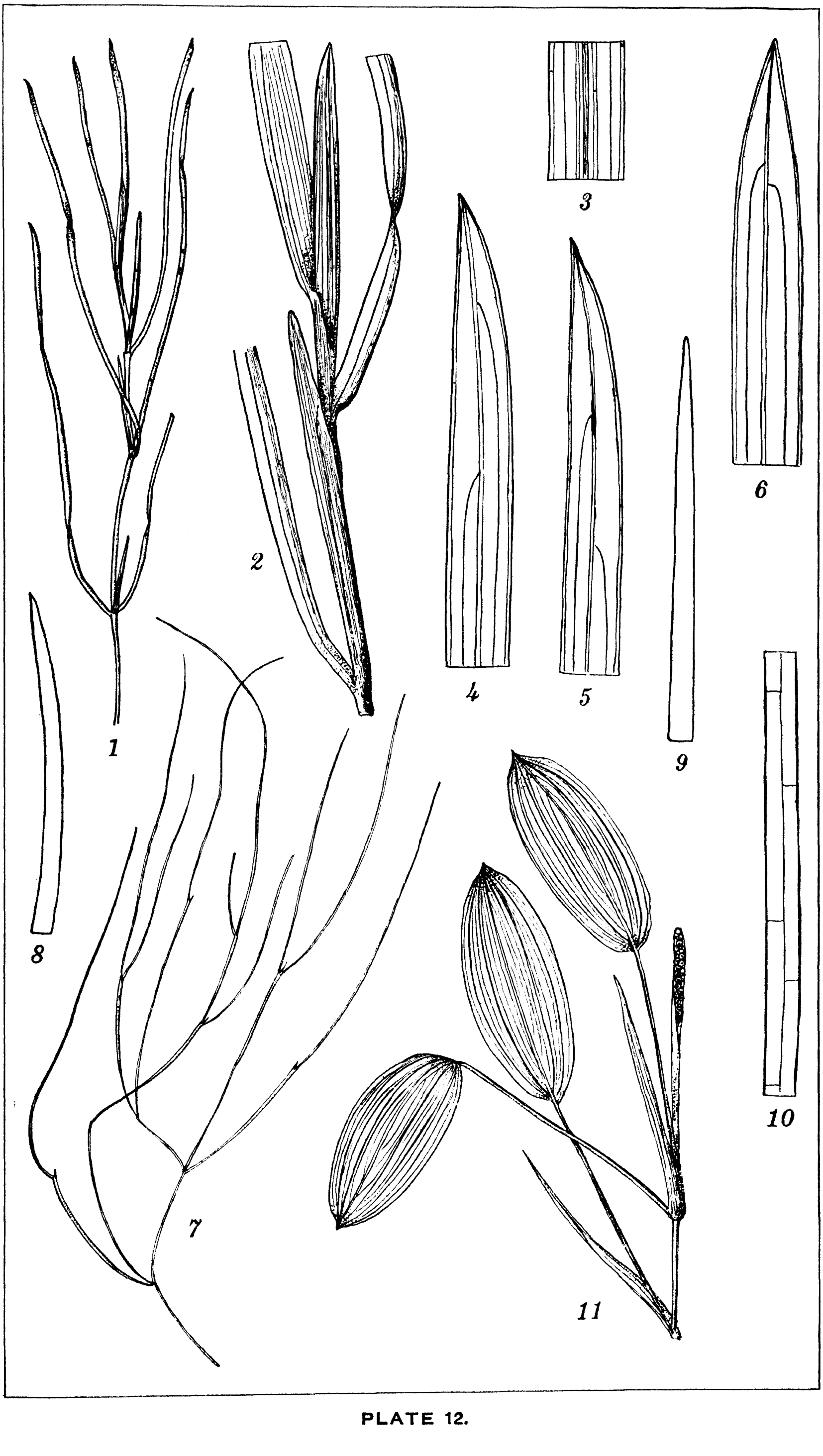

PLATE 12.

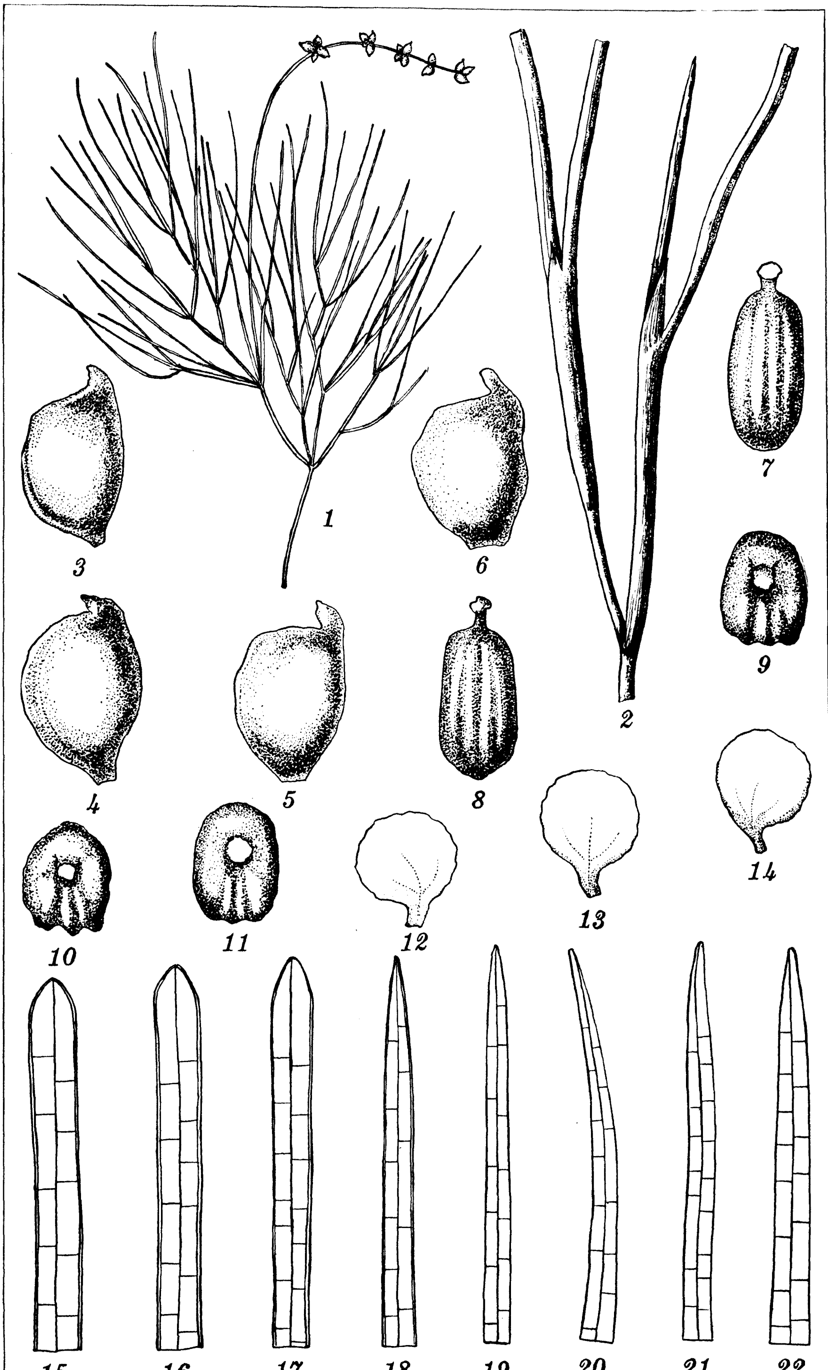

PLATE 13.

PLATE 14.

THE PHILIPPINE FAULT ZONE AND ITS RELATION TO PHILIPPINE STRUCTURE

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TWO PLATES

The Philippine Fault Zone[1] as conceived by the writer is obviously arcuate structure, extending from the northeastern coast of Alabat Island, across the narrow isthmus at the head of Ragay Gulf, through the center of Ragay Gulf to the western edge of Ticao Island, and the eastern coast of Masbate Island; thence to the sound between Biliran Island and northwestern Leyte, through Leyte to Cabalian Bay along the eastern side of Panaon Island, along the western escarpment of the Diwata Range in Surigao, to Pujada Bay and the eastern side of the peninsula (Davao Peninsula) which delimits the eastern coast of Davao Gulf. As traced it gives the impression of one continuous line, but it is probably a series of more or less connected faults properly termed a zone, and the line just sketched is probably where the greatest movements took place. There are, of course, branching faults at an angle to the main fault zone, the most obvious of which are in Leyte. One fault branches off from the main zone just west of the town of Leyte and follows a slightly curved line to the town of Ormoc, and may continue along western Leyte across the Mindanao deep into Gingoog Bay and along Pulangi River in Mindanao. Another fault, longer and more obvious, starts in the vicinity of barrio Oguis, about 23 kilometers north of the town of Sogod, and runs along the west side of Sogod Bay across the Mindanao Deep to the western side of Agusan Valley to Davao Gulf.

Davao Gulf is important because the block included between it and the main fault constitutes the graben now occupied by the Agusan Valley.[2]

[1] Willis, Bailey. Geological Observations in the Philippine Archipelago. National Research Council Bull. No. 13 (1937) 35–40.

[2] Smith, W. D., Geology and Mineral Resources of the Philippine Islands (1925) 283.

Speaking of the Philippine Fault Zone, Willis [3] states that the fault planes are vertical, that the horizontal displacement is large as compared with the vertical, and that the effect is that of rotation of the inner disc [4] within the outer rim, the former moving northwestward with reference to the latter. He fails to state his basis for this conclusion. It is presumed that his conjectures are based on the curvature and direction of the tectonic lines west of the fault zone, which could only result from stresses along the Philippine Fault Zone acting in a northerly or northwesterly direction.

However, the relative positions of several structures along the fault zone seem to provide evidence that the resultant relative movements have been in the opposite direction; that is, that the Eastern Philippine Rim [5] of Willis, or the outer rim, has moved to the north or northwest in relation to the inner disc. It is evident, however, that the inner disc has also moved to the northwest, but to a much lesser degree, apparently dragged by the outer rim along the Philippine Fault Zone.

EVIDENCES OF THE RELATIVE NORTHWARD DISPLACEMENT OF THE OUTER RIM ALONG THE PHILIPPINE FAULT ZONE

Conjectures of major geological structures based on long range observations are based mostly on the major topographic and bathymetric features of a very extensive area. We have an excellent plaster model relief map of the Philippines (Plate 1), showing topographic and bathymetric features, in which some very interesting structures along the Philippine Fault Zone can be observed.

At the head of Ragay Gulf, the Bicol Peninsula portion appears to have shifted about 25 kilometers to the northwest in relation to the Bondoc Peninsula portion, along the above-mentioned Philippine Fault Zone. Following this zone to the south gives rise to a very convincing piece of evidence. Ticao Island [6] appears to have been sliced from the eastern part of Masbate Island and shifted about 50 kilometers to the northwest. Both the western side of Ticao Island and the

[3] Willis, Bailey. Geological Observation in the Philippine Archipelago. National Research Council Bull. No. 13 (1937) 35.

[4] Loc. cit. The inner disc is the portion west of the fault zone and the outer rim is the portion east of the fault zone.

[5] Op. cit. p. 34.

[6] Smith, W. D. Geology and Mineral Resources of the Philippine Islands (1925) 282.

eastern side of Masbate Island have straight shore lines and escarpments, with rather deep water immediately below these cliffs. These straight shore lines fall in a remarkable alignment with the fault zone, and they are more or less coextensive.

In northern Leyte and central Leyte there is not much evidence of the horizontal displacement. Volcanic activity in Biliran Island and in Leyte proper has obscured this structure. However, in southern Leyte there is some evidence. At the head of Cabalian Bay a river flows in the direction of the fault after making a rectangular bend. The eastern side of Panaon Island is probably along the fault zone. A former eastern portion of this island may have been shifted to the north along the fault zone.

The eastern limit or wall of the Mindanao Deep is certainly in line with this structure and probably constitutes the continuation of the Philippine Fault Zone.

From Panaon Island and the eastern wall of the Mindanao Deep this structural line very decidedly continues apparently unbroken along the western shoreline of the Surigao Peninsula and along the fault scarp of the Diwata Mountains bordering the Agusan valley. Obviously the apparent movement of the outer rim is, again, to the north.

Block faulting of the Agusan depression [7] has made obvious the escarpment on the western flanks of the Diwata Mountains. It appears therefore that in the Agusan Valley, besides horizontal shifting, there have been great vertical movements along this fault.

As this structure is followed still further south to Pujada Bay we find more supporting evidence. The average and maximum relief of the region just west of the fault line is much lower than that of the region just east of the fault line. This region has apparently been affected by the block faulting which formed the Agusan depression. Portions of rivers are observed following the fault trace, and, incidentally, a case of river piracy is suspected. The eastern coast of Davao Peninsula is straight and precipitous and falls in line with the Philippine Fault Zone.

From the above it is evident that the portion of Mindanao east of the fault zone has shifted towards the north along the Philippine Fault Zone, attaining a horizontal displacement of about 75 kilometers.

[7] Op. cit. p. 283.

MECHANICS OF PHILIPPINE STRUCTURE

In considering the mechanics that apparently caused the initiation of the framework of our archipelago, and that eventually led to the present configuration, we shall discuss only those forces that are vital to our discussion and that have a direct connection. Of course there are the thrusts from the China Sea Deep and other basins and troughs within Philippine waters, which probably had to do with the original topographic and bathymetric configuration of basins and plateaus. These may have acted before, or at least simultaneously with, the forces that produced the arched lines of the mountain ranges of the archipelago.

Principal structural features.—The general topographic and bathymetric features of the Philippine Islands, as portrayed by the relief map, Plate 1*a*, shows, among other things, the following principal structural features:

A principal tectonic line of upwarp *A–A′* and a branch *A–A″* extends from the eastern coast of Luzon, through Bondoc Peninsula, Tayabas, through Masbate, Leyte, and Mindanao. This arcuate line is more or less a continuous mountain range or a zone of upwarp, convex to the east from Bondoc Peninsula, and roughly parallel to the edge of the Philippine platform. From the central part of Leyte this zone is apparently divided into two branches, one running through the Diwata Mountains of Surigao and the other along the western part of Agusan and Davao Provinces. This structure probably continues across Celebes Sea, to Celebes Island and Halmahera Island, Molucca Pass corresponding to the Agusan Graben.

Closely following the above-mentioned tectonic line is the Philippine Fault Zone *F–F′* with its branches *V–V′* and *Y–Y′*.

To the west of the line *A–A′* there are several arcuate tectonic lines of upwarp, emanating, as it were, from the main line A–A′. These are lines *c–c′*, *d–d′*, *e–e′*, and *n–n′* which run in a general southwesterly direction and are convex towards the east.

Line *B–B′* is certainly not a branch from *A–A′*. Moreover, it is the counterpart of the structure of *A–A′* on the opposite side of the platform.

East of the line *A–A′* we find only a few, short, and poorly developed lines of upwarp, but they have more or less a definite arrangement. Lines *g–g′* (Mambulao-Caramoan line) and *h–h′* (Batan Island Chain) are nearly but not quite parallel to both line A–A' and the edge of the Philippine platform. Line m–m' in Samar, k–k' through Dinagat Island, and l–l' through Siargao Island bear more or less the same direction with a slight convexity to the west. Ranges made up principally of volcanoes are naturally not considered in this discussion. These include the Bicol volcanic range and Negros.

Mechanics.—An attempt will now be made to trace the development of the above-described structural features and the forces responsible for them.

It is quite evident that the tectonic lines west of the zone A–A' (Plate 1*a*) must have been produced by stresses acting in a northwesterly direction along the zone of A–A' or the fault zone F–F', and that peripheral movement must have occurred in that direction. There is no doubt that thrusts from the China Sea Deep may have helped in the creation of these tectonic lines and in the degree of their curvature, especially as regards line B–B' (Zambales-Palawan arc), but these thrusts alone certainly could not have produced the peculiarities of our Philippine structure.

A consideration of the forces that probably acted on the archipelago is now in order.

There were thrusts from the China Sea Deep acting in an easterly direction. These thrusts were apparently not of the first magnitude since the area of the China Sea basin is comparatively small.

Then there were the thrusts from the Pacific Ocean acting in a general westerly direction. These were forces of the first magnitude, and since the center of the Pacific Ocean is to the southeast of the Philippines the forces may have had a direction some degrees north of west, about N 75° W.

And lastly, there were the forces from the northwest, the continental thrusts from Asia, which acted on a higher level than the oceanic thrusts, and affected northern Luzon more than the rest of the archipelago.

Taking into consideration the whole archipelago before the present configuration had been attained, it is believed that the initial structures produced were two long zones of upwarp or arching; one, B–B' (Plate 2), along the western edge of the Philippine platform and the other, A–A', along the eastern edge. These zones would naturally be the first to be affected by the forces from the China Sea Deep and the Pacific Ocean. They probably had a smaller degree of curvature than that shown in the illustration. Line B–B' extends into Borneo and line *A–A′* can be traced into the Celebes group by the alignment of islands across Celebes Sea.

Due to the heterogeneity of the earth's crust and to some irregularities around the rim of the Philippine platform, it is believed that some minor folds or upwarps related to the main structure may also have been initiated contemporaneously. Thus should be explained the Mindoro upwarp, and the irregular worn-down upwarp of Samar. The last named had more reason to be so on account of the rather large area of the platform to the east of the Main eastern structure *A–A′* (Plate 2).

To sum up, the Philippine Archipelago had then quite a simple structure. There were two main lines of upwarp, which were parallel in the northern third portion and which diverged to the south more or less along the edge of the platform. Between these two main lines of upwarp there was a depression or downwarp, which points to the origin of the Central Plain of Luzon and the Cagayan Valley, at that time one integral structural unit. Towards the south this central downwarp may have been accidented by the presence of the original basins and plateaus of irregular outline but without the present configuration of ranges.

These zones of upwarp were zones of weakness and relief of pressure which must have induced the liquefaction of igneous rocks under them, and consequently there must have been intrusions into the weakened zones.

The Eastern Philippine Rim [8] is a wedge that is wide to the north, bounded on the west by the Philippine Fault Zone, and on the east by the submarine fracture or fault of the Philippine Deep, *PD–P′D′*. It probably had a structure similar to the main Philippine structure on a much smaller scale. The Bicol Peninsula was a downwarp or trough between the main eastern structure *A–A′* (Plate 2) and an old upwarp axis *W–W′* which at present is not determinable.

Old plutonic rocks have been found in small areas of low elevation in the Bicol Peninsula. They are probably remnants of older mountains which have been eroded and then covered by volcanic products and sedimentation. Granite is found in the Paracale-Mambulao area, in a small area in Tagcauayan east of the head of Ragay Gulf, an area about 5 kilometers north

[8] Willis, Bailey. Geologic Observations in the Philippine Archipelago. National Research Council Bull. No. 13 (1937) 34.

of Tagcauayan, in Polillo, and in Catanduanes islands. Peridotite is also found in the Paracale-Mambulao area, in Caramoan Peninsula, in the Batan Island Chain, and in other isolated spots. These plutonic rocks must have been brought up to the surface by continued upwarping and erosion. While these rocks are now found along the Mambulao-Caramoan axis, it is nevertheless believed that the formation of this small tectonic axis is more plausibly explained by the buckling up of the wide northern end of the wedge due to the northward movement of the outer rim. The same holds for the upward of the Batan Island Chain and the low ridge along the northern coast of Samar. In Samar there was a depression or downwarp between the main fold *A–A′* and the Samar upward. This smaller structure of the Eastern Philippine Rim was probably continuous from Lamon Bay to eastern Leyte and ends there, at the edge of the platform.

We thus have the origin and structure of the Bicol Peninsula, whose downwarp, now mainly covered by volcanic products and Tertiary sediments, finds its continuation between Leyte and Samar.

Development of the present configuration.—With the initial structure of our archipelago as outlined above, and the forces acting on it as described earlier, we shall now endeavor to follow the development to its present general configuration.

The oceanic thrusts from the Pacific Ocean continued to act in a direction about N 75° W. Even if these forces were acting in a general westerly direction, the results would not have differed materially, since the tendency of the wedge, the outer rim, would be to move to the north if squeezed.

These forces must have had components tangential to the curved structure *A–A′* (Plate 1*a*). This structure, a curved zone of weakness, was, from the circumstances and its position, the most vulnerable to the forces acting. It is also evident that the most unstable portion of the Philippine platform was (and probably still is) the Eastern Philippine Rim. (Northern Luzon was also very unstable and will be taken up later.)

Consequently there was a very strong tendency for the Eastern Philippine Rim (the outer rim) to move to the north along the zone of weakness *A–A′* (Plate 1*a*), and along the submarine fracture *PD–P′D′* of the Philippine Deep. This tendency must have set up great stresses along the zone *A–A′* (Plate 1*a*) acting towards the northwest. Movement of the mass in that direction must have been accomplished, the outer rim dragging, as it were, the inner disc, and causing it to effect a rotatory or peripheral counterclockwise movement. Aided by the lateral forces, this peripheral movement acted as a trigger, and initiated the auxiliary or secondary tectonic lines *c–c′* along Tablas and Antique; *d–d′* along the western prong of Masbate; *e–e′* along Cebu and the Zamboanga-Jolo area; and *n–n′* along northwestern Leyte, Bohol, and Siquijor. Further movements increased the curvature of the lines, and have displaced some of them. Lines *c–c′* and *d–d′* were evidently displaced by an east-west fault, along northern Panay. Line *o–o′* through Romblon and Sibuyan appears to be a branch from line *c–c′*.

Minor lines, in the outer rim, like *k–k′* along Dinagat Island and *l–l′* along Siargao Island, may have been initiated also by the same northward movement coupled with the resistant stresses along the line *A–A″*.

The movement towards the north of the wedge or the outer rim must have produced new axes of upwarps more or less transverse to the direction of movement at the wider northern part of the wedge. As a result the Mambulao-Caramoan axis, the Batan Island Chain axis, and the low ridge of northern Samar were formed. To this northward movement of the wedge and to the consequent buckling up of the crust along the edge of the platform within the wedge, may also be attributed the formation of the Polillo Island group and Catanduanes Island and the bulge of the platform north of the Bicol Peninsula.

The Philippine Fault Zone.—The tendency of the outer rim to drag the inner disc to the north along the weakened zone *A–A′* culminated in sudden movements along a series of closely associated fractures, thus initiating the Philippine Fault Zone, immediately east and closely following the line *A–A′* (Plate 1*a*).

These sudden displacements along the fault zone must have relieved the compressive stresses momentarily, and normal faulting may have then taken place, specially along subsidiary faults. The inner disc may have even rotated back to some degree. Subsequently the compressive stresses must have built up again, and the outer rim must have tended to move northward once more, dragging the inner disc with it until the elastic limit had been reached, when sudden displacements must have again occurred along the planes of the fault zone, causing violent earthquakes. This process must have been repeated over and over again, and has probably persisted to the present time, as may be gathered from the recent tectonic earthquakes which affected Alabat Island and western Bicol Peninsula in 1937, and the many earthquakes recorded each year at Agusan Valley.

From southern Leyte the Philippine Fault Zone has an important secondary structure, which extends down through eastern Mindanao and probably into the Celebes Group. It is a huge structural unit, but it is termed secondary, with reference to its origin. Reference is made to the apparent branching of the upwarp zone *A–A′* (Plate 1*a*) along both sides of the Agusan Valley; and its accompanying branch fault *v–v′*. It is believed that these two upwarp branches originally constituted one wide zone of upwarp whose main axis may have occupied Agusan Valley. The stresses which tended to push the outer rim wedge to the north and which resulted in the fault zone *F–F′* may have also produced other lines of relief in this wide zone, among them faults *V–V′*, and *Y–Y′*. Periodic reactionary tensional stresses obtaining after sudden displacements along the Philippine Fault Zone have probably caused the Agusan Valley Block to sink, in relation to its sides, along its many fault planes, producing mainly a graben.

It is believed, moreover, that the structure of Agusan Valley is not as simple as an ordinary graben. It appears likely that there are several north-south faults on either side of Agusan Valley as well as within the valley. The movements along these faults have not always been of the same magnitude, and consequently there appear to be several horsts and grabens within the valley block as well as on either side. Nevertheless, the cumulative effect has been the relative sinking, as a whole, of the Agusan Valley Block.

This structure is reflected across the Celebes Sea, the western branch following a string of islands into the northern prong of Celebes Island, the eastern branch following another string of islands into Halmahera Island, and the space between these two strings corresponding to the Agusan Valley Graben.

In eastern Mindanao the cumulative total relative displacement of the outer rim wedge along the fault zone is about 75 kilometers, and was roughly measured by the length of Davao Peninsula and Surigao Peninsula along the fault zone. The probable total displacement of Ticao Island in relation to Masbate is about 50 kilometers. In Tayabas, across the narrow neck at the head of Ragay Gulf, the relative total displacement is about 25 kilometers. It is apparent that the total displacement is less and less towards the north, as may be expected when we consider that the fault zone probably ends just beyond Alabat Island, but may continue along the eastern coast of Tayabas.

From the foregoing it is clear that great northwest stresses have been acting and are still acting on the whole of southern Luzon, due to the push from the eastern Philippine Rim. These severe stresses must have found relief either by folding, thrust faulting, or by mass displacement along some major fracture. Some additional folding may have been produced in the Sierra Madre Range. Of thrust faulting we have at present no data. The Philippine Fault Zone may continue along Eastern Tayabas. But most of the relief must have been found in displacements along the central fault (*X–X′*) of Luzon. It is believed that northern Luzon [9] has moved to the southeast or that southern Luzon has moved to the northwest, along the central fault *X–X′*. From a consideration of the forces acting on Luzon it is more probable that both portions of Luzon have moved in opposite directions along the central fault.

Thus the island of Luzon has been and probably still is under the influence of a couple: forces from the southeast acting on southern Luzon and forces from the northwest acting on northern Luzon. The above contention is supported by the observations of Willis on the Abra thrust [10] along the western part of northern Luzon, and the apparent northwestward movement along the Philippine Fault Zone.[11] Relief from the stresses set up by this force couple is accomplished by sudden displacements along the Central Fault *X–X′* as evidenced by tectonic earthquakes whose origin has been traced to this fault.

Willis doubts the existence [12] of the Central Fault *X–X′*. However, the very definite trace of the fault nearing Dingalan Bay, and the absence of discernible alluvial fans along the fault trace prove that there is a fault and that it is still active; the sinking of the Central Plain block is keeping pace with

[9] Alvir, A. D. A theory on the major tectonic structure of the Island of Luzon, Philippine Islands. Third Pacific Science Congress Proceedings. Tokyo, Japan 1 (1926) 451.

[10] Willis, Bailey. Geologic Observations in the Philippine Archipelago. National Research Council Bull. No. 13 (1937) 17, 18.

[11] Op. cit. p. 35.

[12] Op. cit. pp. 20, 21.

the deposition of the alluvial fans. Moreover, observations across this fault trace in different places confirm its existence.

SEISMOLOGICAL CONSIDERATIONS

The most destructive earthquakes are of tectonic origin and are produced by sudden displacements along fractures. Of great interest to us, therefore, are the main fractures which are active today.

The most unstable portions of the Philippine Platform today are the Eastern Philippine Rim, northern Luzon, and to a lesser degree, southern Luzon; and the most active main fractures are the Philippine Fault Zone, F–F' with its branches, the Philippine Deep Fracture PD–$P'D'$, and the Central Fault of Luzon, X–X'. It is believed that the greatest part of crustal readjustments occur today along these three lines, and that displacements along other fractures are merely subsidiary.

ILLUSTRATIONS

PLATE 1. The Philippine Archipelago

PLATE 1*a*

The Philippine Archipelago, showing the present structural lines. Solid lines are tectonic lines of upwarp or folding. Broken lines are fault traces. *A–A′*, principal line of tectonic upwarp; *A–A″*, branch line of tectonic upwarp; *B–B′*, counterpart of *A–A′* on opposite side of platform; *F–F′*, fault zone; *PD–P′D′*, submarine fracture *c–c,′ d–d,′ c–c,′ n–n,′* tectonic lines of upwarp; *g–g,′* Mambulao-Caramoan line of upwarp; *h–h,′* Batan Island Chain line of upwarp; *k–k,′* Dinagat Island Line of upwarp; *l–l,′* Siargao Island line of upwarp; *m–m,′* Samar line of upwarp; *o–o,′* branch from line *c–c′; p–p,′ v–v,′* branch of Philippine Fault zone; *x–x,′* central fault; *y–y,′* Branch of Philippine Fault Zone.

PLATE 2

The Philippine Archipelago, showing the initial zones of upwarp. *A–A′*, principal line of tectonic upwarp; *B–B′*, counterpart of *A–A′* on opposite side of platform; *M–M′*, Samar line of upwarp; *P–P′*, *W–W′*, old upwarp axes.

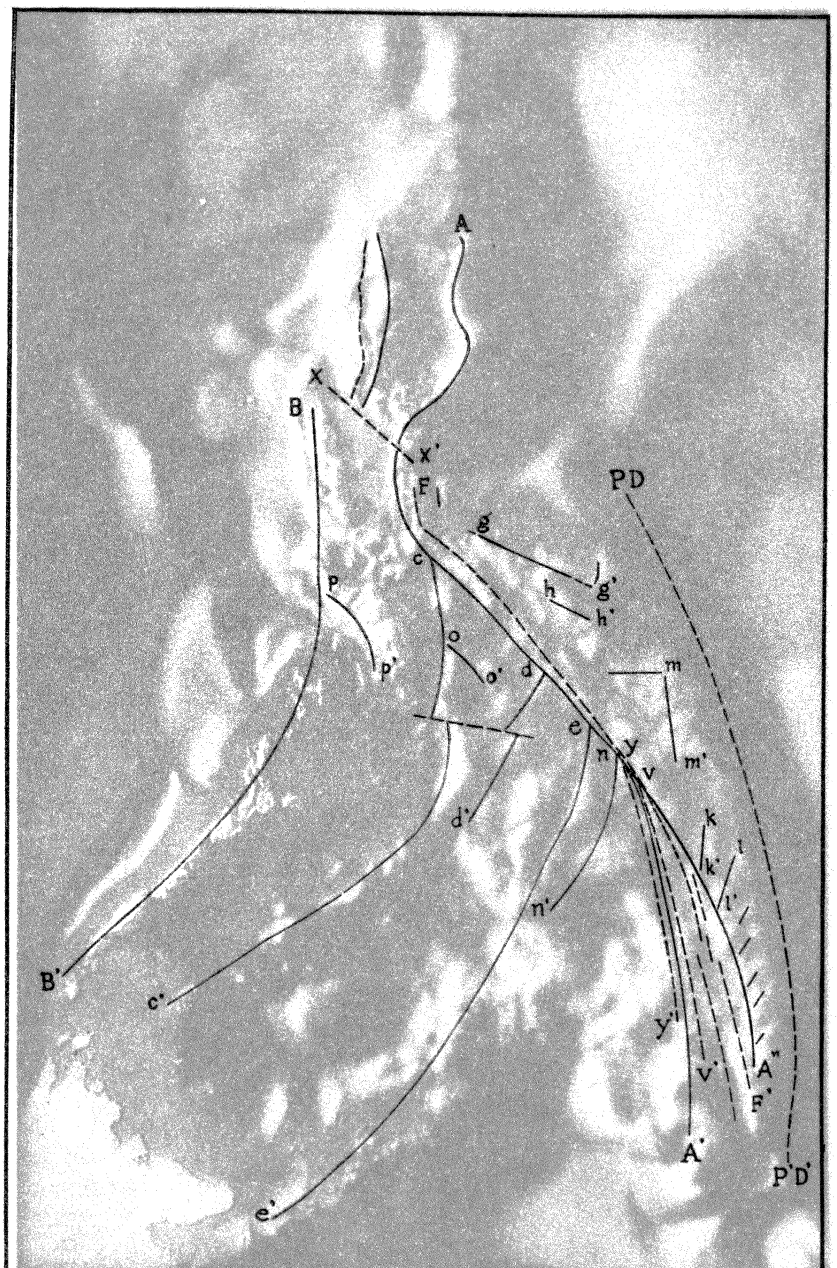

PLATE 1-a. The Philippine Archipelago—Showing the present structural lines. Solid lines are tectonic lines of upwarp or folding. Broken lines are fault traces.

PLATE 1.

PLATE 2.

THE PROBABILITY OF COMMERCIAL OIL POOLS IN THE CENTRAL PLAINS OF LUZON

By A. D. ALVIR

Geologist, Natural History Museum Division
Department of Agriculture and Commerce, Manila

Oil is a strategic product vitally needed by warring nations as well as by peaceful countries. It is the essence of modern warfare; it is the essence of industry. In times like the present the search for oil and the fight for oil is intense and vital.

Cognizant of the importance of oil, President Quezon instituted a geological reconnaissance throughout the Philippines for the purpose of ascertaining probable oil localities.

We produce no oil, yet we are surrounded by oil-producing countries. Oil seeps have been observed in many islands. The Vigo Formation, known to be the mother bed of oil, is widespread in our country. Studies and exploratory work have been made in Bondoc Peninsula, Leyte, Cebu, and Mindanao. Recent work by the National Development Company has covered practically all likely areas. Seismic prospecting is about to begin in Panay. At Daan-Bantayan, northern Cebu, the Far East Oil Company has drilled to a depth of about 6,000 feet. This is one of the likeliest of localities. In the early 1920's the Richmond Petroleum drilled several holes in Bondoc Peninsula. Recently the Far East Oil Company drilled a hole there. The results so far are not encouraging.

To this vigorous search of oil the present writer wishes to contribute his little "grain of sand."

Methods in the search for oil.—Before the application of practical oil geology wildcatting[1] was the regular procedure. The percentage of dry wells was very high. With the application of geology the percentage of successful wells began to rise. With the progress made in oil geology, especially along the lines of micropalæontology and sedimentary petrology, and the use made of structural contour maps, palæogeography, and other data, more complex and hidden structures have been determined and new fields discovered and made productive. And now geophysical methods are being used, mainly (*a*) with the aid of the

[1] Today "wildcatting" means drilling a still unproductive area if the geology has been studied and found favorable. "Wildcatting" used to mean drilling an unproductive area without benefit of geology.

torsion balance or determination of gravity anomalies, (*b*) with the aid of the seismograph, and (c) by electrical methods. These methods have lead to the discovery of hidden structures. Gone are the days of wildcatting and counted are the days of simple geological structures. In the Philippines, however, there is still room for the discovery of simple structures, such as anticlines, which are evident from the outcrops.

Nowadays the geologist, in examining an area, looks essentially for the following conditions:

1. An area of little orogenic movement, mainly plains or undulating plains, former basins of deposition, underlain by sedimentary rocks, especially shales, rich in organic materials.

2. Reservoir rocks, such as porous sands, sandstones, conglomerates, or cavernous limestones of sufficient thickness to hold commercial quantities of oil and gas.

3. Relatively impervious cap rocks, such as shales and compact limestone to act as seals above the reservoirs.

4. Traps for oil accumulation, such as anticlines, domes, unconformities, lenticular sands, and the like.

5. Hydraulic conditions, since water pressure helps in the accumulation of gas and oil.

The central plains of Luzon.—Probably no other area in the Philippine Islands fulfills the above conditions as fully as the central plains of Luzon.

The central plains of Luzon show no signs of past or present orogenic movements. The few scattered mountains within their limits are only volcanic necks, and these are few and far between. This region up to Pleistocene times has been an area of deposition, bordered on either side by uplands, probable islands during pre-Pleistocene times. We should therefore expect sediments of all Tertiary times represented here. This assumption is corroborated by the great thickness of sediments along Naguilian Road, a block raised in post Pliocene times. As a matter of fact, in a conversation with Mr. Beltz, chief geologist of Socony, the present writer was told that the geologists of this company have verified the presence of the Vigo Shales on both sides of the Central Plains. The Vigo Shales constitute the mother bed of oil in the Philippines.

Good Reservoir rocks are probably not lacking in this area because of its proximity to the mountains which were high islands when the area was a basin of deposition. We should expect therefore a good proportion of coarse sediments and lenticular beds.

Good cap rocks, shales, above the Vigo Horizon, have been noted on both sides of the Central Plains.

The structure of the Central Plains tends to be disregarded as a likely structure for oil accumulation, it being a geosyncline. It is a geosynclinal area of deposition that has recently become dry land as a result of an uplift of the land mass. But pressures acting from the east [2] must have slightly folded the strata in this geosyncline producing anticlines and synclines in the major geosynclinal structure. As a matter of fact, folds have been noted in Tarlac in the Pliocene tuffs. It is therefore believed that broad anticlines exist below the central plains, anticlines broad enough to trap oil in commercial quantities. Moreover, it is believed that lenticular sands must abound here due to the proximity of the deposition to the existing strand lines at different times.

The structure being a geosyncline, the upturned edges of the sediments should be and are found flanking the mountains on either side, dipping into the plains. Consequently it is easy to see that water will be taken in along these upturned edges and should help in the accumulation of oil in the traps below the plains. The oil may even be flushed into the traps. In other words the conditions are right for hydrostatic pressure and gushers may result when this region is drilled.

A few years ago the writer made a report on an oil seep at Guimba, Nueva Ecija Province. The oil could not be seen until about 4 meters of water had been bailed out of a well. Then one could see the oil spreading over the water surface at the rate of a couple of inches per second.

Studies [3] of gravity anomalies in the Central Plains have shown the Central Plains to be a probable petroliferous area.

CONCLUSION

From the above it is believed that the central plains of Luzon is one of the most favorable areas for commercial oil pools in the Philippines and it is hoped that the National Development Company will soon have seismic work done on it to determine the hidden structures. And these hidden structures should be drilled for oil.

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[2] This structure is explained in the preceding paper. This issue, pp. 411–423.

[3] Pelaez, Vinicio. Probable petroliferous areas in the Philippines, Nat. Appl. Sci. Bull. (2) 7 (1939) 169–184.

BOOKS

Books reviewed here have been selected from books received by the Philippine Journal of Science from time to time and acknowledged in this section.

REVIEWS

Standard Chemical and Technical Dictionary. By H. Bennett. New York, The Chemical Publishing Company, 1939. 638 pp. Price, $10.

This is a very handy chemical dictionary that presents useful information very briefly. It gives names and formulas of chemical compounds, together with identification data. For instance:

Lauric acid (dodecanoic acid). $CH_3(CH_2)_{10}COOH$; n. w. 200.19; col. need. f. al; m. p. 44; b. p. 220^{100}; l. w.; s. al.

A list of abbreviations is given in the preface. Also included are: directions for using the dictionary; prefix names of organic radicals; pronunciation of chemical words; and a condensed, though very interesting, account of the nomenclature of organic chemistry.

Definitions of expressions like "iodine number" are clear and concise. Many popular terms like "cosmic rays," producer gas," and the like, are included. However, we did not find "octane number."

The dictionary concludes with a rather complete list of both abbreviations and contractions, together with the Greek alphabet and symbols as well as mathematical and apothecary symbols.—A. P. W.

The Detection and Identification of War Gases. Notes for the Use of Gas Identification Officers. 1st American edition. New York, Chemical Publishing Company, Inc., 1940. 53 pp. Price, $1.50.

This little book of 53 pages gives complete information of the physical and chemical properties of war gases. The grouping of these gases on the basis of the effects they produce on the human body furnishes a very convenient way of identifying them and studying their dangerous properties. Two general methods of testing, the subjective and the objective methods, are described and discussed in a comprehensive and simple manner. In chapter IV the book gives complete instructions on the duties and responsibilities of gas identification officers, as well as the method of testing the more important gases, such as those used during the Great War. The book is a product of experience and therefore is very valuable to humanity in general and to those interested in chemical warfare service in particular. It closes with two appendices, giving a list of testing equipment and its use, and a blank form for reporting results of tests. Taking into consideration the prevailing chaotic condition of the world, the publication of this book may be considered very timely.—R. H. A.

Modern Cosmeticology; the Principles and Practice of Modern Cosmetics. By Ralph G. Harry. New York, Chemical Publishing Company, Inc., 1940. 288 pp., illus. Price, $5.|

This book, dealing with the manufacture of modern cosmetics, includes information on the dermatological principles underlying the use of cosmetics, and thus gives the reader an idea of the choice of raw materials for the product. It also gives the histology of the skin, the hair, and the nails. The problem of skin absorption, the efficacy of vitamin and hormone preparations, and the question of allergy and dermatitis are discussed. The book is not a mere collection of "cook book formulae," inasmuch as the author has only included those formulas that have been tested and proven to be satisfactory, and those which he has evolved through slight variation of constituents to obtain a variety of products to suit his own purpose. Comprehensive information with regards to the characteristics, properties, and the effects of creams, make-up preparations, lotions, and shaving and dental preparations is given.

This book is a valuable guide to manufacturers of cosmetics, chemists, and those interested in the small-scale production of such preparations.—M. R. A.

Varnish Making. By the Oil and Colour Chemists' Association. New York, Chemical Publishing Company, Inc., 1940. 231 pp., illus. Price, $6.

This book is a symposium on varnish making, prepared by the Oil and Colour Chemists' Association. It is a very interesting and a valuable publication for students, professional chemists, and manufacturers engaged in the making of varnish.

The various papers comprising this publication, which were written by different authors, deal with the important physical and chemical properties of natural and synthetic raw materials used in the manufacture of varnish. The discussions, especially on some of the most recent methods and procedures employed in the modern treatment and manufacture of varnish products, prove to be an important feature of this book. Other subjects and problems commonly met with in factory operations, such as: factory hazards, fume condensation, filtration and aging of varnishes, and methods of heating and accurate measurements of temperatures are also discussed in this book. The history of varnish manufacture, aside from its literary value, is very instructive.—T. D. J.

A Dictionary of Metals and Their Alloys; Their Composition and Characteristics. Edited by F. J. Camm. New York, Chemical Publishing Company, Inc., 1940. Price, $3.

This is a handy, concise metals handbook in dictionary form. It includes salient and useful facts regarding every known metal and nearly every type of commercial alloy, and contains authoritative information in easily understandable manner, as well as adequate cross references. In addition to the dictionary, the book also contains special sections on hardening, case-hardening and tempering, electro-rust-proofing, and tables. It is highly recommended to all metallurgical scientists and students as a valuable addition to their collections, and to all scientific libraries as a reference tool.—J. B. B.

The Book of Diamonds: Their Curious Lore, Properties, Tests and Synthetic Manufacture. By John Willard Hershey. New York, Chemical Publishing Company, Inc., 1940. 142 pp., pls. Price, $2.

This book is primarily a popular treatment of diamond lore. The author traces the history of the diamond from the earliest times to the present and gives an insight into the three great diamond districts of the world, India, Brazil, and South Africa. His chapters on properties and tests for diamonds and how to buy diamonds are very instructive. The average reader will be entertained by the author's account of the stories connected with famous diamonds and other gems. A chapter on synthetic diamonds as prepared at McPherson College is appended. The author has certainly fulfilled his promise of making this book a pleasant pastime.—J. B. B.

The Meteorological Glossary. 3d edition. 1st American edition. New York, Chemical Publishing Company, Inc., 1940. 251 pp., illus. Price, $3.

The third edition of the Meteorological Glossary is to be recommended because of its completeness. Terms of recent origin are explained briefly, and references which enable one to obtain further detailed information are given. Mathematical terms which occur in meteorology have excellent definitions together with short derivations. At the end of the book there is a list of equivalent words in various languages, a valuable help to a student of meteorology who has difficulty in finding meteorological terms in scientific dictionaries.

The following remarks concerning Philippine meteorology should be noted. Under the word "Baguio" the last sentence should be modified. It is not clearly understood just what is meant by the "class of cyclone which is especially associated with these islands, occurring from July to November." Under the word "cyclone" there is a table (page 59) giving the number of tropical cyclones that occurred in various parts of the world. The total number of frequencies of typhoons in "Cyclones of the Far East," by Jose Algue, S. J. (page 86) has been copied and copied correctly, but these frequencies referred to the Far East and not merely to the China Sea, as indicated on page 59 of the Glossary.—B. F. D.

Rubber Latex. By H. P. Stevens and W. H. Stevens. 1st American edition. New York, The Chemical Publishing Company, Inc., 1940. 224 pp., front., illus. Price, $2.

Rubber latex supersedes the pamphlet written by Stevens and Stevens on the same subject. The book gives general information to those having little or no specialized knowledge of latex. Pictures are included to show the methods of treating latex and of manufacturing rubber goods. There are also microphotographs of rubber latex particles.

About half of the book is devoted to British patents on latex. Although no United States or foreign patents are cited, their sources are given. The following chapters are discussed: The source and production of latex; conversion to rubber; the properties of latex; composition, stabilizing, and coagulation of latex; concentration of latex; the manipulation and compounding of latex and latex paste; stabilization of latex for industrial purposes; vulcanization of latex and latex products; manufacturing from latex by dipping and electrodeposition; applications and products of latex; the marketing of latex and patents. Although written for the general public, the book should also find a place in the libraries of those engaged in the rubber industry. A bibliography and index are included.—G. O. P.

Propagation of Plants. By M. G. Kains and L. M. McQuesten. New York, Orange Judd Publishing Company, Inc., 1938. 555 pp., illus., tables. Price, $3.50.

This richly illustrated book on the propagation of plants is a very handy guide to the professional as well as the amateur propagator, be he a nurseryman, experimenter, greenhouseman, researcher, or a teacher. The authors were able to condense all the important discoveries and improvements in the methods of the multiplication of plants achieved during the last few years. They were able to explain all the technical and scientific terms in a manner sufficiently simple to meet the needs of even a beginner in the science of plant propagation. The vividness of the presentation of the subject matter as well as the conciseness and nice choice of words in portraying to a layman the whys and hows in plant propagation will meet the demands of even the most scrutinizing of plant propagators.—J. B. J.

Gardening Without Soil. By A. H. Philips. New York, Chemical Publishing Company, 1940; London, C. Arthur Pearson, Ltd., 1939. 139 pp., illus. Price, $2.

This book introduces two methods of gardening without soil; namely, water culture and aggregate culture. Hydroponics as an analogous term to water culture is also known as chemiculture, aquaculture, tank farming, tray horticulture, and, more or less facetiously, as bath-tub farming. Aggregate culture is a term used to cover the growing of plants in mineral aggregates, which may range from sand to granite chips or gravel to cinders. The author gives unbiased judgment on the merits of the two systems. Finding that water culture is more practical than aggregate culture, the author dwells a great deal on the discussion of the former. His style is simple and well within the bounds of the layman's scientific understanding.

This manual gives a complete review of all the methods practicable in hydroponics, and provides a comprehensive guide to all principles involved in soilless culture. It treats the subject from all angles, giving the amateur soilless gardener an opportunity to know all the vital factors necessary in the accomplishment of his aim. The chapter dealing on "doctoring the plants" is especially interesting to the soilless culturist, as it helps him diagnose nutritional ills in growing plants and thus eliminating as much as possible "chlorosis."

This little book is useful as a manual for those who wish to try hydroponics as a hobby.—J. T. S.

Intermediate Biology. By W. F. Wheeler. New York, Chemical Publishing Company, Inc., 1940. 530 pp., illus. Price, $6.

The larger majority of books written on living organisms pertain exclusively to either botany or zoology, dividing biology into two independent sections. This arrangement is unfortunate, for it is apt to cause the student to overlook "the similarities between the groups of living organisms and the general principles which apply to all." This book aims to overcome that tendency. By a wise selection of material, the author leads the student step by step to a recognition of "the fundamental attributes, formal and functional, of living organisms, with the discovery of their essential uniformity, frequently masked by superficial diversity."

The book is up-to-date in the discussion of biological principles. It is divided into seven parts, of which the first two are introductory and deal with the anatomy of well-selected types of plants and animals. The other parts take up in a comparative manner their cellular structure, physiology, development, inheritance, evolution, and ecology. A noteworthy feature is the inclusion of "practical work" at the ends of many of the chapters. This arrangement helps to make the subject more instructive and more interesting.—M. T.

RECEIVED

American Society for Testing Materials methods of chemical analysis of metals. Analytical procedures for ferrous and non-ferrous metals spectrochemical analysis methods. September, 1939. Philadelphia, American society for testing materials, 1939. 250 pp., illus. Price, $2.

American institute of mining and metallurgical engineers. Petroleum division. Transactions, petroleum development and technology, 1940. v. 136. Papers and discussions presented before the division at meetings held at Galveston, Oct. 5–7, 1939; Los Angeles, Oct. 19–20, 1939; New York, Feb. 12–15, 1940. New York, The institute, 1940. 608 pp., illus. Price, $5.

American medical association. Periodic health examination; a manual for physicians. 2d rev. ed. Chicago, The association, 1940. 104 pp., illus. Price, $0.25.

American medical association. The pharmacopeia and the physician. A series of articles on the use in therapy of pharmacopeial substances which appeared in the journal of the American medical association. Chicago, The association, 1939. 353 pp. Price. $1.50.

BUSHNELL, LELAND D., and others. Poultry practice. Chicago, Veterinary magazine corporation, 1940. 160 pp., tables, illus. Price, $1.

Cancer, a handbook for physicians. Prepared by the Tumor committee of the Connecticut State medical society. Hartford, The Connecticut state department of health, 1939. 193 pp., illus.

COUCH, OSMA PALMER. Basket pioneering. With introduction by Daniel Carter Beard. Rev. ed. New York, Orange Judd publishing co., inc., 1940. 163 pp., front., illus. Price, $1.75.

CROWLEY, C. A., ed. Money-making formulas. Chicago, Popular mechanics press, 1930. 480 pp., illus. Price, $4.35.

EILMANN, HENRY J. Medicolegal and industrial toxicology. Philadelphia, The Blakiston co., 1940. 324 pp. Price, $3.

FAIRCHILD, HENRY PRATT. Economics for the millions. New York, Modern age books, 1940. 262 pp., illus. Price, $2.50.

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PATTERSON, STERLING. Be your own gardener; how to make maintain and find satisfaction in intimate flower gardens. New York and London, Harper & brothers, 1940. 370 pp., illus. Price, $2.50.

READ, THOMAS T. Careers in the mineral industries. A vocational booklet for use in secondary schools. New York, The American institute of mining and metallurgical engineers, 1939. 32 pp. Price, $0.25.

RICE, C. MABEL. Dictionary of geological terms. Princeton, New Jersey, The author, 1940. 461 pp. Price, $6.

SHOHL, ALFRED T. Mineral metabolism. New York, Reinhold publishing corporation, 1939. 384 pp., illus. Price, $5.

STEFFEN, M. R. The milking goat; a practical hand-book for the novice, as well as a book of reference for the seasoned goat dairyman. Vincennes, Indiana, W. L. TeWalt, 1940. 69 pp. Price, $1.

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WISHART, JOHN. Field trials: their lay-out and statistical analysis. Cambridge, England, School of agriculture, n. d. 36 pp., illus. Price paper, 2s/6d.

YATES, RAYMOND F. Science with simple things. New York—London, D. Appleton-Century co., 1940. 245 pp., front., illus. Price, $2.50.

YOUMANS, JOHN B. Essentials of the diagnostic examination. New York, The commonwealth fund, 1940. 417 pp., illus. Price, $3.

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[New names and new combinations are printed in **boldface.**]

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VOL. 74, NO. 4 APRIL, 1941

THE PHILIPPINE JOURNAL OF SCIENCE

MANILA
BUREAU OF PRINTING
1941

52057

THE PHILIPPINE JOURNAL OF SCIENCE

Published by the Bureau of Science, Department of Agriculture and Commerce

[Entered at the Post Office at Manila, Philippines, as second-class matter.]

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