ANNALS

OF THE

CARNEGIE MUSEUM

VOLUME XII

1919

W. J. HOLLAND, *Editor*

PUBLISHED BY THE AUTHORITY OF THE
BOARD OF TRUSTEES OF THE CARNEGIE INSTITUTE
JANUARY AND DECEMBER, 1919

PRESS OF
THE NEW ERA PRINTING COMPANY
LANCASTER, PA.

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Publications of the Carnegie Museum Serial No. 100

ANNALS

OF THE

CARNEGIE MUSEUM

Vol. XII. Nos. 2–4

W. J. HOLLAND, *Editor*

Published by the Authority of the
Board of Trustees of the Carnegie Institute
October, 1919

PRESS OF
THE NEW ERA PRINTING COMPANY
LANCASTER, PA.

ANNALS

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CARNEGIE MUSEUM

VOLUME XII. NO. I.

Editorial Notes

Last June a proposal made by the Alabama Museum of Natural History to undertake a thorough exploration of the Tertiary deposits of Alabama and adjoining states in conjunction with the Carnegie Museum, was received and accepted. It is not necessary here to outline the details of the arrangement entered into by the two institutions. The field work was, however, to be in charge of Mr. Herbert H. Smith. Mr. Smith is a veteran collector, who enjoys an international reputation as probably one of the ablest and most painstaking field-naturalists of our day. The work has been begun and most gratifying results are already reported. A number of localities, which hitherto have not been carefully investigated, prove to be very rich in specimens and species, some of which no doubt are new to science. They represent horizons from which up to the present time but very scanty collections have been made. Certain of the beds in Alabama have been quite thoroughly worked in times past and the faunules contained in them are known; but other horizons have been more or less neglected. While not overlooking such well-known deposits as the Claiborne, the joint expedition of the Carnegie Museum and the Alabama Museum of Natural History will devote much time to the investigation of those deposits which have as yet been only partially studied. It is hoped that by thus coöperating the two institutions may add considerably to the knowledge gained of the faunas of this most interesting geological region.

Letters received in August from Mr. Samuel M. Klages report that in spite of various difficulties he has succeeded in obtaining large series of birds and other natural history specimens, principally insects, in the Mana Valley, French Guiana, which he reports to be highly interesting and to contain a very large and varied avifauna. He found the country immediately in proximity to Cayenne rather poor in species, partly because of the wholesale destruction of birds by "pot-hunters," but on reaching the distant interior, where the ravages of the hungry are less visible, he discovered a great wealth of interesting forms, and hopes to be able to make a representative collection. This will possess much scientific interest, if for no other reason, because of its topotypic value, it being well known to ornithologists that many species of South American birds originally described in the writings of French and Dutch naturalists were obtained in this region. In these days in which writers are much addicted to the erection of subspecies and the description of so-called local varieties, we have deemed it desirable that at least one of the great American museums should endeavor to acquire a collection of the birds of Guiana, as complete as possible by comparison with which the value of so-called subspecies may be in a measure tested.

Mr. H. J. Heinz has added to the collection deposited in the Heinz Room a number of interesting objects coming from the imperial palace at Pekin. According to the information which he has received concerning them, these things are pieces of elaborately carved or decorated furniture which affirmed were removed at the time of the establishment of the Republic in China, in order that certain rooms in the palace might be furnished in the latest European styles. Whether this was the exact motive for their removal from the imperial palace or not, they are certainly highly interesting as illustrating Chinese art.

The building and installation of a large and costly series of cases for the display of the specimens in the Heinz Room is nearing completion. The work has heavily taxed the time and thought of the Director of the Museum, who for the most part prepared the drawings and has attended to a multiplicity of structural details involved in the adaptation of the cases to the room and to the uses to which they are to be put.

Mr. Herbert DuPuy has within recent months added to the collection of old American silverware which he has kindly loaned to the Museum, thirteen pieces which possess great interest. He has also deposited a strip of Gobelin tapestry made toward the end of the seventeenth century.

The initial paper in this number of the ANNALS consists of a catalog of the collection of watches deposited by Mr. H. J. Heinz in the Carnegie Museum, containing one hundred specimens illustrating the evolution of this form of time-piece and showing a number of beautiful specimens of the jeweler's art displayed in the adornment of watch-cases. Probably the most interesting specimen from an historic standpoint, is the watch which belonged to Lord Nelson, the hero of Trafalgar, which is shown as the frontispiece of the catalog, a small edition of which is being separately issued. The catalog has been prepared jointly by Mr. Douglas Stewart, who wrote the introduction and prepared the list of the specimens, and by Dr. W. J. Holland who edited the paper and attended to the preparation of the plates which illustrate it, the photographs having been made by Mr. A. S. Coggeshall.

I. A CATALOG OF THE COLLECTION OF WATCHES BELONGING TO MR. H. J. HEINZ OF PITTSBURGH AND DEPOSITED BY HIM IN THE CARNEGIE MUSEUM.

By Douglas Stewart, W. J. Holland, and A. S. Coggeshall.

INTRODUCTION.

The necessity of some means of marking the passage of time must early have impressed the minds of even primitive peoples. It is impossible to clearly trace the evolution of chronometric instruments, but the passage of the sun across the heavens at comparatively regular intervals doubtless gave the first impulse to their invention. The earliest form was doubtless the sun-dial, not as we know it now, but simply a stake driven into the ground, which measured time by the shadow which it cast. It was called by the Greeks a gnomon (*γνώμων*), "the one who knows." The word *dial*, from the Latin *dies*, is more familiar, *gnomon* now being used to designate that part of the sun-dial which casts the shadow. As in the case of many other inventions, that of the sun-dial is attributed to the Phœnicians. The first direct reference to it in literature is in Isaiah XXX–VIII, 8, which, in the Revised Version, says: "Behold I will cause the shadow on the steps, which is gone down on the dial of Ahaz with the sun, to return backward ten steps; So the sun returned ten steps on the dial whereon it was gone down." As chronologists assign the reign of Ahaz, King of Judah, to the years 742–727 B. C., some idea of the antiquity of the dial is given by this passage. The earliest dial of which we have an accurate description is the hemicycle, or hemisphere, of the Chaldæan astronomer, Berosus. This learned man, a priest of Bel, translated the standard Babylonian work on astrology and astronomy into Greek. The translation, which was completed in the reign of Antiochus II, about the year 250 B. C., gives a full description of the dial.

Another very ancient method of determining the flight of time was by means of the clepsydra or water-clock. The name is derived from the Greek κλέπτειν, *to steal*, and ὕδωρ, *water*, and refers to the grad-

Watch which belonged to Lord Nelson (No. 76.).

ual "stealing away of water." Time was measured by the amount of water discharged from a vessel through a small aperture, the quantity discharged in a given unit of time being first determined. In the Athenian courts it was customary to limit the length of arguments by this device; Æschines (389–314 B. C.) tells us that the "first water" was allowed to the accuser, the "second" to the accused, and the "third" to the judges. Many modifications of this instrument were employed, and the familiar hour-glass, also known to the Asiatics long before the time of Christ, was practically the same instrument, in which sand was substituted for water.

All of these earlier methods for measuring time were woefully inaccurate, so that the invention of the clock was a great step in advance. The name of the inventor and the date of the invention of this valuable instrument are both lost in the mists of mediæval times. In the year 1120 A. D. in the rules of the Monastery of Citeaux, France, the sacristan is charged with the duty of "adjusting the clock, so that it may strike and awaken the monks for matins." In the latter part of the same rules it is ordered "to prolong their reading until the clock sounds."[1] The bell was an important part of these early timekeepers. The word "clock" itself is most probably derived from the Celtic word for a *bell*, and in the Celtic, Scandinavian, and German tongues still preserves its original meaning (German, *glocke;* Danish, *klokke;* Gælic, *clog;* Welsh, *cloch*).

Peter Henlein or Hele of Nuremberg, a noted clock-maker, seems to hold the undisputed honor of inventing the watch. He was born in 1480 and died in 1542. His ingenuity in substituting a spring to take the place of the ponderous weights of the clock made the watch, or portable clock, a possibility. This first spring was simply a straight band about a pillar. In the year 1658 Hooke applied a spiral spring to the balance-wheel of the watch in the same year that Huyghens first applied the pendulum to the clock. It does not seem necessary to attempt a history of the mechanical improvements which followed, as many technical works, fully illustrated, have been published. It was some time, however, before the mechanical improvements kept pace with the perfection which was lavished upon the ornamentation of the case.

The bell was retained as an essential feature of these early time-

[1] See Dom. Augustin Calmet, "Commentaire littéral sur la règle de Saint Benoît," Vol. 1, pp. 279–280.

pieces. The word watch, from the Anglo-Saxon *wacan*, to waken, gives an indication of this.

Though originating in Germany the watch-making craft soon obtained a foothold in France, and by 1600 A. D. the manufacture of time-pieces was a flourishing industry in that country, having its most important center in the town of Blois. The skill of the metal-workers of the seventeenth century found full scope in the ornamentation of watch-cases and many beautiful examples were produced, but they are now exceedingly rare in collections. From France some watchmakers emigrated to England, and many skilled workmen were presently engaged there in this calling.

The earliest watches were fitted with only one hand, which indicated the hour. The subdivisions of the hour were roughly calculated by the position of this hand between the points marking the hours. The figures were raised and many of the earlier watches were provided with a knob above each numeral so that the time could be ascertained in the dark by feeling. Watches with two hands did not appear until somewhat later, and it was not until the middle of the seventeenth century that dials painted in enamel became the fashion for the most costly watches. Shortly afterwards dials of gold and silver with figures in relief came into vogue.

The development of the characteristic circular shape of the watch of today was gradual. The earliest types were square metal boxes, with the figures placed on a circle of a different metal fastened to the face. No. 19 of this collection is a good example of this type. This form of watch had no protecting lid, but the resultant injury to the dial soon necessitated the invention of a cover or outer case. The first lids were of perforated metal, thus permitting the figures underneath to be seen. Watches at this time were expensive and could only be owned by the very wealthy. The extravagance of dress in the Elizabethan period had its effect upon watches. Gold and other precious metals, crystal, tortoise-shell, and enamel were lavishly used in the decoration of watch-cases and the most skillful artists were employed to make them. As the watch-glass had not yet come into general use, many of the watches had double or pair-cases. The outer case had no connection with the watch proper, but was a box in which the watch was carried. Many beautiful examples of these outer gold cases ornamented with a chased or repoussé design are exhibited in this collection. In this connection it is well to distinguish between these two methods of ornament. In repoussé work, the metal is punched from the back, producing a design in bold relief, while in chasing the design is cut or engraved from the front and is the more delicate method. As these Elizabethan watches were not carried in the pocket, but were suspended about the neck by a ribbon, fashioned into bracelets, or set in brooches, every opportunity was afforded for their display. Both transparent and opaque enamel were extensively employed and many artists, noted as workers in enamel, as well as lapidaries, were engaged in designing and fabricating watch-cases.

On account of the high price of watches, the portable, but inaccurate, sun-dial persisted in use, and Nos. 1 to 6 of this collection are rare examples of that instrument. In Shakespeare's "As You Like It" Jaques's speech, "And then he drew a dial from his poke," contains a reference to such a pocket-dial.

The Puritan hatred for display reveals its influence even in watch-cases. During the period of the Revolution and Protectorate extravagance and beauty of ornament gave way to plainness in decoration and watches were carried concealed in the pocket. The fob (Provincial German *fuppe*—a little pocket) now made its appearance, and Cromwell's watch, preserved in the British Museum, is one of the earliest to display this adjunct.

The mechanical skill of the Swiss shortly after this period began to reveal itself in the manufacture of watches, and in modern times Switzerland became the recognized center of the industry, many thousands of persons being employed in it. With the introduction of machinery for making the parts of watches the trade gradually became of great importance in the United States. The American working man of today is able to buy for a few dollars a much more accurate time-piece than could have been possessed by the wealthiest courtier of the Elizabethan Era. It must be confessed, however, that in these instruments artistic design has been very largely sacrificed to utility.

It is rather exceptional to find the name of the maker on early watches, but many of the cities had a distinctive trade-mark, as an "N" for Nuremberg, a pineapple for Augsburg, and a bear for Berne. By such marks, in many cases, it is at least possible to determine the place of manufacture.

In England the "Hall-mark" is a sure guide to the date. These marks are impressed upon watch-cases, jewelry, and plate, made from either gold or silver, after the quality of the metal has been ascertained by analysis at the Assay Halls of the Goldsmith's Company of London. The privilege of assaying and marking precious metals was conferred upon this honorable body by statute in 1300 A. D. and a charter was granted in A. D. 1327. The powers of the company have been confirmed by subsequent acts of Parliament. The standard mark of the London Hall is a lion passant for sterling silver and this was also the mark on twenty-two-carat gold until the year 1845. The present mark for gold is a crown and the figures, which indicate the purity of the metal, such as "18" for eighteen-carats. Prior to 1821 a crowned leopard's head was also used as hall-mark. The exact year of manufacture is indicated by a letter of the alphabet which is changed each year on the last day of May. The standard of purity in gold in the earlier watch-cases was much higher than at present, as it was not until 1798 that a lower standard than twenty-two carats was allowed. In that year the use of eighteen-carat gold was permitted. In 1854 three more standards were introduced, fifteen, twelve, and nine carats of gold being admitted to use.

Mr. H. J. Heinz, who has generously deposited this collection in the Carnegie Museum, has used extreme care in the selection of the specimens of which it is composed. A number of years ago he became interested in the subject and began the formation of a collection. His collection is much more extensive than that displayed, but he insists that only the best specimens shall be exhibited. Quality is emphasized rather than quantity, though the collection is not by any means small. So far as possible the catalog is arranged in chronological order and the various steps in the development of the watch from the portable dial to watches of modern times may be traced. The collection has great educative value, not merely from the artistic standpoint, but from the mechanical standpoint as well, since it is possible by its help to study the evolution of watches as machines. For many reasons the collection is worthy to be regarded as one of the most important in the United States.

CATALOG

1. Ivory universal portable sun-dial and compass. Made by Lienhart Miller at Augsburg, Germany, in the year 1618. (92 × 54 × 14 mm.)[2]

(Plate II, fig. 1.)

2. Ivory universal portable sun-dial and compass. Made by Hanns Troeschel at Augsburg, Germany, in the year 1621. (100 × 72 × 16 mm.)

(Plate II, fig. 2.)

3. Ivory universal portable sun-dial, perpetual calendar, and compass. Made by Ch. Blond at Dieppe, France, about the year 1660. (69 × 58 × 13 mm.)

(Plate III, fig. 1.)

4. Bronze portable sun-dial. Made by Johan Schretteger at Augsburg, Germany, about the year 1660. (Diameter 57 mm.; thickness 13 mm.)

(Plate III, fig. 2.)

5. Bronze octagonal portable sun-dial. Made by Piochat in Paris, A. D. 1710. (77 × 64 × 9 mm.)

(Plate IV, fig. 1.)

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[2] As in many cases the figures given on the plates accompanying this Catalog are necessarily reduced, we have given the principal dimensions, diameter over all across the face, and greatest thickness including the crystals or covers as they now are. It is proper to observe that crystals when broken may be replaced by others of a different curvature, and that this measurement, for purposes of comparison, may therefore at times prove to be misleading.

6. Bronze octagonal portable sun-dial* and compass. Made by Butterfield, an Englishman, who settled in Paris in the year 1720. This dial is almost a duplicate of the preceding, even to the design of the gnomon, which is a bird. (77 × 65 × 11 mm.)

(Plate IV, fig. 2.)

7. Silver "Nuremberg Egg".[3] An elaborately engraved silver dial has a brass ring superimposed, on which the figures for the hours are engraved. The case is pierced and engraved, the engraving depicting a boar hunt. Made at Augsburg, Germany, during the early part of the seventeenth century. (Length 63, breadth 41, thickness 28 mm.)

(Plate V, fig. 2.)

8. Gilt brass "Nuremberg Egg", signed "H." Made in the seventeenth century. (Length 48, breadth 30, thickness 23 mm.)

(Plate V, fig. 3.)

9. Watch in gilt metal case with a perforated and engraved lid, which makes the dial visible without raising the lid. The dial is of engraved metal. The case is surrounded by a band of pierced and engraved silver. The watch has an alarm-bell. Made by Angelo Rota in Rome between the years 1590 and 1600. The catgut movement of this watch is of slightly later date. (Diameter 60, thickness 31 mm.)

(Plate V, fig. 1.)

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[3] The "Nuremberg Egg" is a name applied to watches of this flattened, oval form, which were first made at Nuremberg about 1600 A. D.

10. Watch in metal case with blue and white enameled dial, catgut movement, and alarm-bell. Made by P. Gregoire at Blois, France, about the year 1620. (Diameter 52, thickness 30 mm.) (Plate V, fig. 4.)

11. Silver watch in a pierced and engraved case. The dial is of silver and bears the name of Grantham, though the works were made by Fromanteel and Clark of London, about the year 1680. The case is of a later date. (Diameter 50, thickness 34 mm.) (Plate VI, fig. 1.)

12. Silver watch with a pierced and engraved case. Made by Daniel Quare, of London, about the year 1680.[4] (Diameter 46, thickness 31 mm.) (Plate VI, fig. 2.)

13. A silver watch with a double case. The outer and inner cases are pierced and engraved. The dial is of carved silver. Made by Paul Luttin in London, A. D. 1690. (Diameter 55, thickness 38 mm.) (Plate VI, fig. 3.)

14. Watch in a case enameled both inside and out in a Louis XIII design. Made by Thomas Tompion in London in the year 1690.[5] (Diameter 46, thickness 29 mm.) (Plate VI, fig. 4.)

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[4] Quare was a famous English watchmaker and the inventor of the repeating watch.

[5] Tompion (1638–1713) was known as the "Father of English watchmaking," and did more to bring this craft to the fore in England than any man of his time. He was the first maker to number watches successively and thus make positive identification possible. This watch is number 234. Tompion and his pupil, George Graham, are buried in Westminster Abbey.

15. Silver watch in an outer case of tortoise-shell piqué. Made by Henry Jones, of London. Jones died in the year 1693.[6] (Diameter 53, thickness 30 mm.)

(Plate VII, fig. 1.)

16. Silver watch with a pierced and engraved case, white enameled dial. Contains an alarm-bell. Made by Duquesne in the seventeenth century. (Diameter 60, thickness 31 mm.)

(Plate VII, fig. 2.)

17. Silver watch with a pierced and engraved case. An engraved metal dial with an ornamental brass border. Curious cover for winding holes, in the form of a mask. Made by Millegg in Vienna in the seventeenth century. (Diameter 53, thickness 37 mm.)

(Plate VII, fig. 3.)

18. Silver watch contained in an outer protecting case. Highly decorated movement. A semicircular piece is removed from the upper half of the dial and through it is seen one-half of a disc which rotates underneath once in twenty-four hours. On one-half of the disc is a golden sun, one of the rays of which points to the hour from 6 A. M. to 6 P. M., and on the other half a silver moon performs the same service from 6 P. M. to 6 A. M. The figures are all on the upper half of the dial. The minutes are indicated by a hand in the usual way. Made by Paul Brämer, of Amsterdam, about the year 1700. (Diameter 58, thickness 31 mm.)

(Plate VIII, fig. 3.)

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[6] Henry Jones was a noted English clock- and watch-maker and the first Englishman to construct a Torricellian tube, as the barometer was first called.

The word *piqué* designates a form of decoration made by driving silver pins through the outer surface of the case in a conventional design.

19. Square iron watch, ornamented with brass and cut iron. This is one of the earliest types of watches and was made by Johann Sigmund Schloer, at Regensburg, (?) Bavaria,[7] probably in the seventeenth century. (Diameter 38, thickness 19 mm.)

(Plate VIII, fig. 2.)

20. Chatelaine of chased gold on grey agate. Period of Louis XV (1710–1774). (120 × 60 × 4 mm.)

(Plate VIII, fig. 1.)

21. Gold and enamel watch. Miniature of a lady on the back, surrounded by a border of paste. Made by Esquivillon Frères and DeChoudens of Paris. Period of Louis XV (1710–1774). (Diameter 36, thickness 20 mm.)

(Plate IX, fig. 2.)

22. Silver watch in a pierced and engraved case, containing an alarm-bell. White enameled dial. Made by Tasinon at Tournay, France. Period of Louis XV (1710–1774). (Diameter 62, thickness 37 mm.)

(Plate IX, fig. 1.)

23. Silver repeating watch with a pierced and engraved case; enameled dial. Made by Jean Fardoit in Paris in the early eighteenth century. (Diameter 52, thickness 31 mm.)

(Plate IX, fig. 4.)

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[7] The inscription seems to be "Regenb," which we take to be an abbreviation for Regensburg. There is a small village named Regen in Bavaria, but it is more likely that Schloer was located in Ratisbon (Regensburg).

24. Brass watch with a white metal dial. The movement was made by Gaudron in Paris (1710–1730), though the case is of a later date. Made for the Turkish market. (Diameter 52, thickness 32 mm.)

(Plate IX, fig. 3.)

25. Silver double case watch. The outer case is in a repoussé design; signed by D. Cochin, a celebrated French silver worker (1660–1680). The movement was made at a later date (1718) by George Graham, of London.[8] (Diameter 55, thickness 31 mm.)

(Plate X, fig. 2.)

26. Watch with a crystal case held by a silver gilt rim; chased gold dial, upon which are superimposed white plaques with black enameled figures. Green enamel decoration on dial. Made for the Turkish market by Julien LeRoy of Paris, about the year 1700.[9] (Diameter 49, thickness 29 mm.)

(Plate VII, fig. 4.)

27. Gold watch with double case; white enameled dial ornamented with a gold and green enamel plaque. The outer case is of dark blue opaque enamel with a floral design in silver gilt appliqué. Made by Julien LeRoy in Paris for the Turkish market. Early eighteenth century. (Diameter 57, thickness 28 mm.)

(Plate X, fig. 1.)

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[8] George Graham, known as "Honest George Graham," was one of the most eminent watchmakers of his time (1673–1751). A pupil of Thomas Tompion (see No. 14), he was the only other watchmaker to be honored by burial in Westminster Abbey.

[9] Julien Le Roy was a scientific watchmaker born in 1686 and died in 1759. He devised a form of repeating mechanism, which was soon substituted for the bell in use before.

28. Gold watch set with a beautiful enamel of a lady watering flowers surrounded by a border of blue enamel and vari-colored gold. Made by Esquivillon Frères and De Choudens in Paris. Period of Louis XV (1710–1774). (Diameter 53, thickness 22 mm.)

(Plate X, fig. 3.)

29. Double case silver watch. The back of the outer case covered with tortoise-shell upon which is painted "Peter and the Cock." Made by Charles Meadows in London in the year 1719. (Diameter 65, thickness 31 mm.)

(Plate X, fig. 4.)

30. Silver watch with an engraved gold border and silver dial. Made in Paris by L'Epine, about the year 1720. L'Epine was the father of Jean Antoine L'Epine, Court watchmaker to Louis XV of France. (Diameter 54, thickness 11 mm.)

(Plate XIII, fig. 1.)

31. Silver watch with an outer case covered by leather with piqué decoration. Silver dial. Made by Hilgerus Vogel at Cologne in the year 1720. (Diameter 57, thickness 33 mm.)

(Plate XIII, fig. 4.)

32. Silver watch with a silver dial. Outer case of tortoise-shell piqué. Made by Francois Mercier, Paris, A. D. 1725. (Diameter 53, thickness 30 mm.)

(Plate XII, fig. 5.)

33. Silver watch, four inches in diameter, with an outer protecting case covered with black tooled leather, silver mounted, the inner case beautifully pierced, engraved, and ornamented with silver gilt. The watch contains a bell upon which the hours and quarters are repeated, when the cord, suspended from the bottom of the case, is pulled. It also contains an alarm and indicates the days of the month. Made by Frantz Roth at Augsburg, Germany, about the year 1730. (Diameter 89, thickness 51 mm.)

(Plate XI.)

34. Double case silver watch. Both the outer and inner cases elaborately pierced and engraved. Repeats the hours and quarters. Made by Andreas Colling at Augsburg, Germany, about the year 1730. (Diameter 53, thickness 29 mm.)

(Plate XIII, fig. 2.)

35. Gold repeating watch in a pierced and engraved case. Made by Charles Cabrier in London, in the year 1730. (Diameter 45, thickness 25 mm.)

(Plate XII, fig. 1.)

36. Enameled watch set with zircons; the back of beautiful enamel in two shades of blue with gold decorations; a fine pair of jewelled hands. The outer case is ornamented with bands of tortoise-shell with a glass protecting both front and back. Made by Phillip Terrot at Genoa, about the year 1730. (Diameter 58, thickness 25 mm.)

(Plate XII, fig. 4.)

37. Gold watch pierced and engraved. The outer case is ornamented with a repoussé design, depicting a warrior leaving for battle. It repeats the hours and quarters. Made by William Hawes, London, A. D. 1741. (Diameter 49, thickness 30 mm.)

(Plate XII, fig. 2.)

38. Gold quarter repeating watch in a pierced and engraved case. Made by Benjamin Gray and Justin Vulliamy, London, A. D. 1746.[10] (Diameter 40, thickness 23 mm.)

(Plate XII, fig. 3.)

39. Gold double-case watch, the outer case pierced and decorated with a repoussé design. Black enameled figures are super-imposed upon an engine-turned dial. Made by James Blackborow, London, A. D. 1734–1746. (Diameter 50, thickness 28 mm.)

(Plate XIII, fig. 3.)

40. Large silver watch designed for use in a sedan-chair. Case beautifully pierced and engraved. Black enameled figures on a silver dial; repeats and contains an alarm. Made by Antonius Heckel, Vienna, A. D. 1750. (Diameter 96, thickness 55 mm.)

(Plate XIV.)

41. Gold pair-case watch, decorated with a pierced, embossed, and engraved design. Repeating movement. Made by Beuster of London in the year 1750. (Diameter 48, thickness 29 mm.)

(Plate XV, fig. 4.)

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[10] Benjamin Gray was watchmaker to King George II. Justin Vulliamy emigrated from Switzerland about 1730. He worked for Gray, married his daughter, and eventually became a partner in the business. Watches bearing the signature of these two men are invariably of exceptional quality.

42. Pendant watch with copper case and enameled dial. Raised inscription "M. Dieu." Made in Rome by J. Clovi in the year 1741, though the case is dated 1751. (Height 77, diameter 53 mm.)

(Plate XXIV, fig. 1.)

43. Silver watch with an outer case of opaque enamel. On the back of the case a man is depicted playing upon a pipe to a Watteau-like sheperdess, with Cupid in the background. Made by P. Charleson in London, A. D. 1758. (Diameter 54, thickness 28 mm.)

(Plate XXIII, fig. 3.)

44. Gold watch, repoussé case with an outer protecting case of glass and shagreen.[11] Made by Thomas White, of London, A. D. 1759. (Diameter 52, thickness 25 mm.)

(Plate XV, fig. 3.)

45. Gold double-case watch; the outer case ornamented with a repoussé design: "Maidens bringing offerings to Apollo." Made by Samuel Weldon, of London, in the year 1759. (Diameter 50, thickness 27 mm.)

(Plate XVI, fig. 1.)

[11] Shagreen was a popular covering for watch-cases during the eighteenth century. True shagreen is a remarkably tough kind of leather made chiefly in Astrachan from the skin of the ass or horse. The peculiar roughness is produced by treading into the dampened skin, hard, round seeds which are shaken out when the skin is dry. The skin is then stained green in a solution of copper filings and salammoniac, dried a second time, and rubbed down. The depressions left by the seeds produce the characteristic spotted appearance.

46. Watch of vari-colored gold. The back ornamented by a design in quatre couleur. Made by Gudin in Paris. Period of Louis XV, about the year 1760. (Diameter 40, thickness 17 mm.)

(Plate XVI, fig. 2.)

47. Pair-case watch, the outer case ornamented with a marine view in Battersea enamel.[12] The inner case is of gold with a cipher C. C. engraved on the back, surmounted by a unicorn head. Signed G. C. Made in London, about the year 1760. (Diameter 58, thickness 25 mm.)

(Plate XVI, fig. 3.)

48. Gilt metal watch with an engraved silver dial. The movement is by Daniel Torin of London, about the year 1760. The elaborate case is of French workmanship and was made for the Turkish market. At the back of the case a gold plaque depicting a boy playing with a bird is placed upon a painted background, while above the head a bird, controlled by the movement, flies back and forth. (Diameter 58, thickness 32 mm.)

(Plate XV, fig. 1.)

49. Silver verge [13] watch contained in an outer case of tortoise-shell piqué. Made in London by John Wilter (1760–1784) for the Dutch market. (Diameter 54, thickness 32 mm.)

(Plate XV, fig. 2.)

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[12] Battersea enamel dates from the year 1750, when Sir Theodore Janssen established a manufactory at York House, Battersea.

[13] The verge is the pin upon which are placed the plates which regulate the speed of the escape-wheel. This method was first used in the clock and later modified for use in the watch.

50. Watch of vari-colored gold. The mechanism is visible through a crystal plate at the back of the case; beautifully made hands set with jewels. Made by S. Triboulet, Geneva, A. D. 1760. (Diameter 45, thickness 23 mm.)

(Plate XVII, fig. 1.)

51. Gold pair-case watch; the outer case repoussé, classical design, with an ornamental border of green, blue, and white enamel. The dial is elaborately carved and discloses a calendar. Dutch manufacture, though signed "Smiht (*sic*) London." Made about 1760. (Diameter 50, thickness 25 mm.)

(Plate XVII, fig. 2.)

52. Pinchbeck[14] watch; pierced and engraved case. Made by John Cock, of London, about the year 1760. (Diameter 47, thickness 33 mm.)

(Plate XVII, fig. 3.)

53. Silver watch with a pierced and engraved dial. The back of the case is pierced and ornamented with five repoussé scenes from the legend of William Tell. Designed for use in a sedan-chair. Made by Philiph Votter, of Vienna, in the year 1763. (Diameter 95, thickness 55 mm.)

(Plate XVIII.)

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[14] Pinchbeck was a favorite material for the manufacture of watch-cases. It is composed of an alloy, three parts zinc to four of copper. It took its name from the inventor, Charles Pinchbeck (1670–1732). The secret of this composition was jealously guarded by the inventor and his descendants for many years.

54. Large silver-gilt double-case watch, both cases pierced and engraved. In the outer case a large enamel "Mother watching a sleeping child" is set. The watch is provided with hour-, minute-, second-, and split-second-hands. Two tunes may be played upon a concealed musical attachment. Made by Timothy Williamson of Fleet Street, London, in the year 1769. Looted from the Chinese Imperial Palace in Pekin during the "Boxer Rebellion." (Diameter 167, thickness 60 mm.)

(Plate XIX.)

55. Gold pair-case repeating watch. The inner case is pierced and engraved; the outer case with a pierced and repoussé design. Made by Hughes of London in the year 1770. (Diameter 48, thickness 25 mm.)

(Plate XVII, fig. 4.)

56. Gold watch of the Louis XVI period. The back is of gros bleu enamel with a superimposed floral design in platinum set with zircons, surrounded by a filigree gold border set with milk opals. French manufacture of about the year 1770. (Diameter 59, thickness 24 mm.)

(Plate XXII, fig. 1.)

57. Pair-case gold watch. The inner case is without ornament. The outer case is ornamented with a repoussé design. Made by Harry Potter in London, A. D. 1773. (Diameter 52, thickness 25 mm.)

(Plate XX, fig. 2.)

58. Gold watch with an outer protecting case of painted tortoise-shell. The back medallion depicts a maiden and Cupid. Made by N. Scott of Maidstone, England, about the year 1775. (Diameter 51, thickness 24 mm.)

(Plate XX, fig. 3.)

59. Gold watch with a beautifully enameled case depicting a lady and gentleman watching children at play in a park. Made by Paul Bannicker at Paris during the Louis XVI period. Upon the face of the watch a wreath of flowers terminating in clasped hands is painted, and the inscription "Mariés Le 3 Juillet, 1775." (Diameter 57, thickness 21 mm.)

(Plate XX, fig. 4.)

60. Pair-case gold watch. The outer case is ornamented with a repoussé design. Made by James Noakes, of London, A. D. 1776–1794. (Diameter 47, thickness 26 mm.)

(Plate XXII, fig. 2.)

61. A large watch in a pierced and engraved pinchbeck case; a border of imitation pearls and rubies at both sides of the case; musical attachment. Made by George Margetts in London, A. D. 1779. (Diameter 90, thickness 42 mm.)

(Plate XXI.)

62. Watch with a case of opaque enamel, the back decorated with a picture of a woman with a pot of flowers. Set with diamonds. Each side of the case is surrounded with a border of diamonds. Made in Switzerland by J. Fazy et fils, A. D. 1780–1785. (Diameter 49, thickness 19 mm.)

(Plate XVI, fig. 4.)

63. Gold watch with the dial surrounded by a border of milk-opals set in dark blue enamel. The back is also surrounded by opals and is of beautiful translucent mauve enamel on a chased surface. A wreath of small diamonds, set in platinum, is cemented on the center of the back. Made by Joseph Martineau & Son, St. Martin's Court, London, in the year 1784. (Diameter 49, thickness 22 mm.)

(Plate XXII, fig. 4.)

64. Gold watch with the back of the case ornamented with an enamel picture of a woman and child with pet bird; surrounded with a border of blue and white enamel. Made at Paris by Pierre Gregson, Watchmaker to Louis XVI of France, A. D. 1780–1790. (Diameter 51, thickness 17 mm.)

(Plate XXII, fig. 3.)

65. Gold watch, surrounded front and back with a border of paste. In the back a single carbuncle is set, surrounding which is a white enamel circle with the inscription in black: "L'amitié fait le charme de la vie." Border is of rose diamonds and green enamel. Period of Louis XVI, A. D. 1774–1792. (Diameter 35, thickness 18 mm.)

(Plate XV, fig. 5.)

66. Watch in a vari-colored gold case set with turquoise and garnets; gold dial with black enameled figures. Made by Pierre LeRoy, Paris, about the year 1780. (Diameter 38, thickness 14 mm.)

(Plate XX, fig. 1.)

67. Silver watch upon the dial of which are two mechanical figures, which seem to strike the hours and quarters, though this is done by a concealed bell. Made at Geneva, Switzerland, by George Achard et fils, about the year 1780. (Diameter 54, thickness 25 mm.)

(Plate XXVII, fig. 1.)

68. Gilt metal watch, the back enameled on copper and studded with jargons.[15] Made by Leonard Bordier at Geneva, Switzerland, about the year 1785. (Diameter 56, thickness 23 mm.)

(Plate XXIII, fig. 4.)

69. A pinchbeck watch with double case; the inner case pierced and engraved. The outer case is also pierced, engraved, and set with an enamel portrait of a lady. A pinchbeck chain with a topaz seal attached accompanies the watch. Made by Frazer of London in the year 1785. (Diameter 63, thickness 34 mm.)

(Plate XXXI, fig. 1.)

70. Silver verge watch with an outer case decorated with a painting of a man bearing a gun, and accompanied by two dogs; the outer case protected by a covering of transparent horn. Made by Philip Phillips, of London, in the year 1776. (Diameter 60, thickness 26 mm.)

(Plate XXIII, fig. 1.)

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[15] *Jargon* or *jargoon*, is the name given in Ceylon to the colorless or yellowish zircons, which are also sometimes called "Matura diamonds," because found in the province of Matura. Zircon is a mineral slightly harder than quartz and is a silicate of zirconium, though the name is also sometimes given to silicates of tin.

71. Watch contained in a bronze case ornamented with a conventional design of bronze pins piqué. Blue and white enamel dial. Made by Tayot, of Paris, in the eighteenth century. (Diameter 59, thickness 42 mm.)

(Plate XXIII, fig. 2.)

72. Gold pair-case watch. The movement is by George Graham of London (1695–1751), though the case is of much later date, being Hall-marked, "London 1789." It is probable that the works have been taken from an earlier piece. The inner case is pierced and engraved, while the outer case contains a well-executed enamel of a lady with parrot. (Diameter 51, thickness 29 mm.)

(Plate XXIV, fig. 3.)

73. Gold watch with back of translucent blue enamel surrounded by a circle of pearls both front and back. Attached to the watch is an elaborate fob of gold, enamel, and pearls. Made in London by Jeffrys and Jones, A. D. 1769–1794. (Diameter 46, thickness 15 mm.)

(Plate XXV.)

74. Gold watch, the dial surrounded by a border of blue and white opaque enamel. The back is of royal blue translucent enamel, upon which is cemented a monogram in fine diamonds. Made by Rundle and Bridge of London. watchmakers to King George III of England, about the year 1790. (Diameter 49, thickness 19 mm.)

(Plate XXIV, fig. 2.)

75. Large gold watch, three and one-half inches in diameter. Open face showing split-second-hand. Made by Bouvier Frères at Geneva in the year 1790. (Diameter 80, thickness 27 mm.)

(Plate XXVI, fig. 3.)

76. Gold repeating watch contained in an outer case of brown and white opaque enamel attached to a chatelaine of the same material. The movement was made by Peter Mackdonald in London in the years 1790–1794. This watch was formerly the property of Admiral, Lord Nelson, the Hero of Trafalgar. On the back of the watch an N is engraved, surmounted by a coronet, and also the letter B. The N is for Nelson and the B for Bronté. The Neapolitan title of Duke of Bronté was granted to Nelson in 1799. This watch was made some years before being presented to Nelson, the date of manufacture antedating the conferment of the title "Duke of Bronté." (Diameter 50, thickness 22 mm.)

(Plate I. Frontispiece.)

77. Pinchbeck watch contained in an outer case of shagreen. Made by John Morier in London. Morier was admitted to the Clockmakers' Company in the year 1799.[16] (Diameter 46, thickness 22 mm.)

(Plate XXVI, fig. 1.)

78. Open-face pinchbeck watch; surrounded on each side by a border of paste. The back is ornamented with an enamel. French or Swiss manufacture of the late eighteenth century. (Diameter 51, thickness 22 mm.)

(Plate XXVII, fig. 3.)

[16] The shagreen cover on this watch is the best example of that material in the collection.

79. Watch of vari-colored gold, set with garnets and demantoids.[17] French or Swiss manufacture of the early nineteenth century. (Diameter 35, thickness 16 mm.)

(Plate XXVII, fig. 2.)

80. Watch in case of vari-colored gold set with garnets and turquoise. Made by Luigi Duchêne et fils in Switzerland in the late eighteenth or early nineteenth century. (Diameter 40, thickness 15 mm.)

(Plate XXVII, fig. 4.)

81. Gold open-face watch with a silver dial. The back is elaborately enameled in black, blue, gray, and yellow. Swiss manufacture of the early nineteenth century. (Diameter 41, thickness 12 mm.)

(Plate XXIX, fig. 2.)

82. Gold watch surrounded on the front by a border of pearls. The back also has a border of pearls around the outer edge upon a base of blue enamel; a picture framed in pearls is cleverly executed in gold, seed-pearls, and enamel. Made by Patry and Chaudoir at Geneva, Switzerland, about the year 1800. (Diameter 52, thickness 22 mm.)

(Plate XXVI, fig. 2.)

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[17] Demantoids are green garnets, the word "garnet" being in jewelers' parlance restricted to the *red* variety.

83. Silver watch with various dials showing the hours and minutes, the day of the month, a compass and a curious painting of Adam and Eve, about which a serpent revolves to mark the seconds. French manufacture of the early nineteenth century.[18] (Diameter 60, thickness 19 mm.)

(Plate XXIX, fig. 3.)

84. Chatelaine of gold and enamel with a circular enamel picture of two children and a bird upon its nest. French manufacture of the period of the First Empire. (62 × 40 × 3 mm.)

(Plate XXVIII, fig. 3.)

85. Gold watch with a silver dial upon which a miniature gold clock with a pendulum is shown. Made by Perrin Frères at Paris. Period of First Empire. (Diameter 56, thickness 17 mm.)

(Plate XXVIII, fig. 1.)

86. Gold mechanical repeating watch. The dial is cut out in the center disclosing two seated figures of gold, which seem to strike the quarters, while a movable figure at the top advances to strike the hours. In reality the striking is accomplished by a concealed mechanism. French or Swiss manufacture of the early nineteenth century. (Diameter 47, thickness 20 mm.)

(Plate XXX, fig. 1.)

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[18] A similar watch, number 291, is in the collection of Mrs. George A. Hearn at the Metropolitan Museum, New York City.

87. Gold mechanical musical watch. The face is painted with a woodland scene with a village in the distance. Beautifully made figures of vari-colored gold perform when the mechanism is set in motion. A maiden and youth dance to the music, a woman grinds an organ, while a seated boy industriously beats upon a kettledrum. French or Swiss manufacture of the early nineteenth century. (Diameter 57, thickness 20 mm.)

(Plate XXX, fig. 3.)

88. Gold open-face watch and white dial with black figures. The back has a scene painted to represent a kitchen. Figures of vari-colored gold and silver are set in motion by the mechanism concealed in the watch. A woman turns a spinning-wheel, a little girl stirs some food in a bowl, while the spit, upon which a fowl is roasting, is turned by a dog in a treadmill. French or Swiss manufacture. Early nineteenth century. (Diameter 56, thickness 27 mm.)

(Plate XXIX, fig. 1.)

89. Gold open-face watch with a border of small zircons. The back is set with an enamel of a lady listening to a youth playing upon a pipe. Made by Racine at Paris about the year 1800. (Diameter 51, thickness 19 mm.)

(Plate XXVIII, fig. 2.)

90. Silver watch with plain open face, made by Abraham Louis Broguet (1746–1823) at Paris. In the back is set a repoussé design by D. Cochin, depicting Esther at the Court of Ahasuerus.[19] (Diameter 54, thickness 20 mm.)

(Plate XXX, fig. 2.)

91. Gilt metal watch. Surrounded front and back by a border of paste. In the back an enamel of a young girl with flowers is set. Made by Abraham Louis Breguet, Paris, A. D. 1746–1823. (Diameter 49, thickness 23 mm.)

(Plate XXXIII, fig. 3.)

92. Silver open-face watch surrounded by two gold bands. Made by Abraham Louis Breguet, Paris, A. D. 1746–1823.[20] (Diameter 62, thickness 14 mm.)

(Plate XXXI, fig. 2.)

93. Gold watch with silver dial; enameled on the back. Made by Abraham Vacheron Girod in the early part of the nineteenth century. (Diameter 43, thickness 16 mm.)

(Plate XXIX, fig. 4.)

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[19] Abraham Louis Breguet was the most famous watchmaker of his time, a man of rare attainments and inventive genius. The silver back of this watch has been taken from a much earlier piece, as Cochin was a famous silversmith who worked between the years 1660 and 1680.

[20] Many of the watches made by this workman were contained in exceedingly plain cases as he was always willing to conform to the wishes of his customers in regard to cases.

94. Silver watch in a case without ornament; white enamel dial with twenty-four figures. The hours from seven A. M. to six P. M. are indicated by red Arabic numerals, while those from seven P. M. to six A. M. are indicated by black Roman numerals. Made by Louis Antoine Breguet, a son of the famous Breguet, in Paris in the year 1830. (Diameter 60, thickness 23 mm.)

(Plate XXXII, fig. 3.)

95. Gold engine-turned watch. Surrounded by a border of white enamel. Made by Louis Antoine Breguet, in Paris about the year 1830. (Diameter 55, thickness 13 mm.)

(Plate XXXII, fig. 1.)

96. Oval watch with a case enameled inside and out. The outer picture represents Venus disarming Cupid. Viennese work of the nineteenth century. (Long axis 48, shorter axis 40, thickness 24 mm.)

(Plate XXX, fig. 4.)

97. Watch set in a case carved from a single carbuncle, in the shape of a cockle shell. The dial is elaborately decorated in gold and enamel set with diamonds, covered by rock crystal. Made by Froment-Meurice. French, nineteenth century. (Height 46, width 53, thickness 24 mm.)

(Plate XXXIII, fig. 4.)

98. Blue translucent enamel box containing a miniature watch, ornamented with pearls. From a lid of vari-colored gold a small feathered bird emerges and moves its head and wings, while a bird-song is produced by a mechanism concealed within the box. The box also contains a musical attachment. French or Swiss manufacture of the nineteenth century. (95 × 60 × 26 mm.)

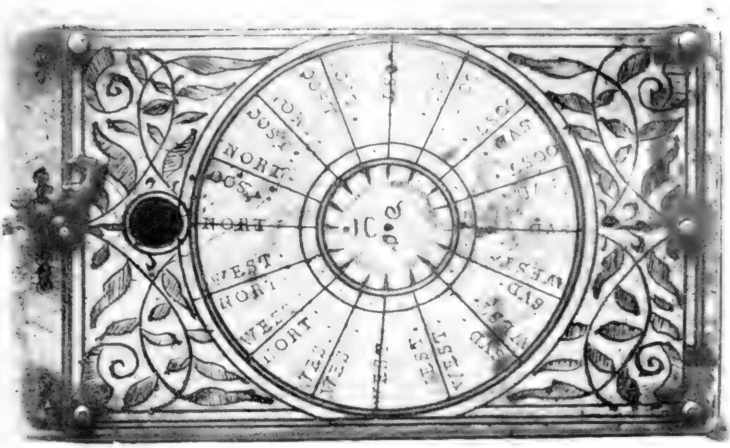
(Plate XXXI, fig. 3.)

99. Watch with a silver dial and gold case ornamented with Niello enamel in black and white. Made by F. Pernetti in Switzerland, in the nineteenth century. (Diameter 46, thickness 14 mm.)

(Plate XXXII, fig. 2.)

100. Watch completely studded with pearls, with the exception of the dial, which is of vari-colored gold. The figures are set with seed-pearls, and the key is studded with pearls with a small garnet in the center. Made by Bautte and Moynier at Geneva, Switzerland, between the years 1820 and 1825. (Diameter 45, thickness 12 mm.)

(Plate XXXIII, figs. 1, 2.)



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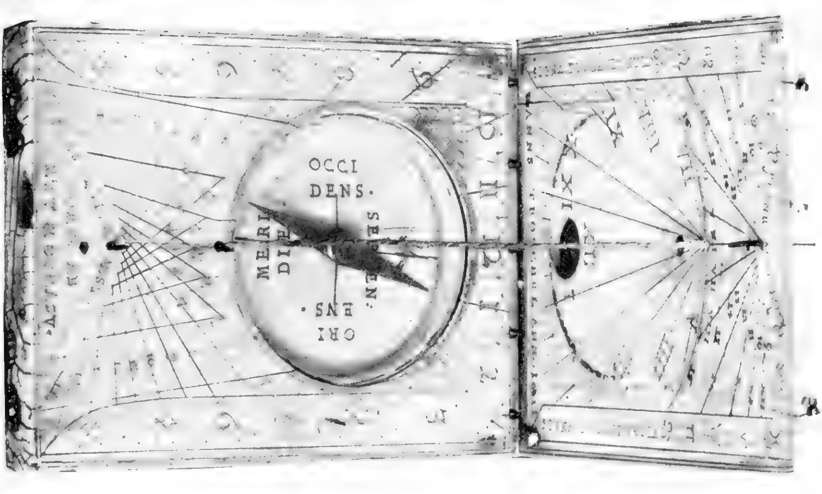
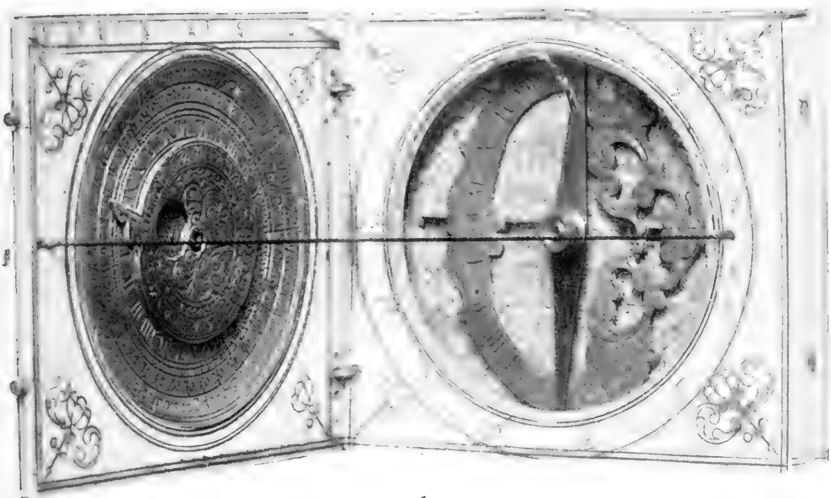


2

1. Portable sun-dial, A. D. 1618. (No. 1.) 2. Sun-dial and compass, 1621. (No. 2.)



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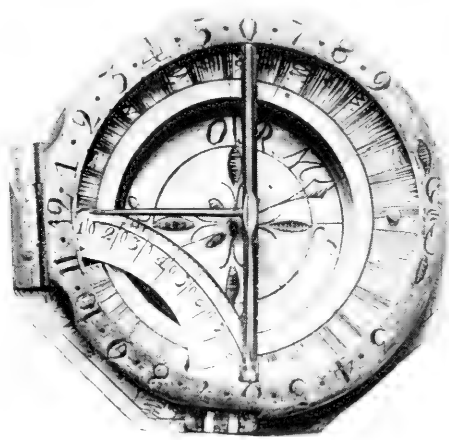
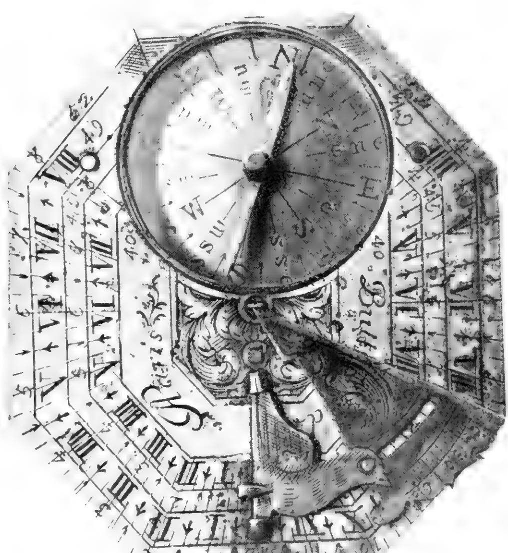


2

1. Sun-dial, calendar, and compass, A. D. 1660. (No. 3.)
2. Bronze portable sun-dial, A. D. 1660. (No. 4.)

1



2

1. Bronze sun-dial, A. D. 1710. (No. 5.) 2. Bronze sun-dial, A. D. 1720. (No. 6.)

1. Italian watch, A. D. 1590–1600. (No. 9.) 2. "Nuremberg Egg." (No. 7.) 3. "Nuremberg Egg." (No. 8.) 4. Watch made at Blois, France, *circa* 1620. (No. 10.)

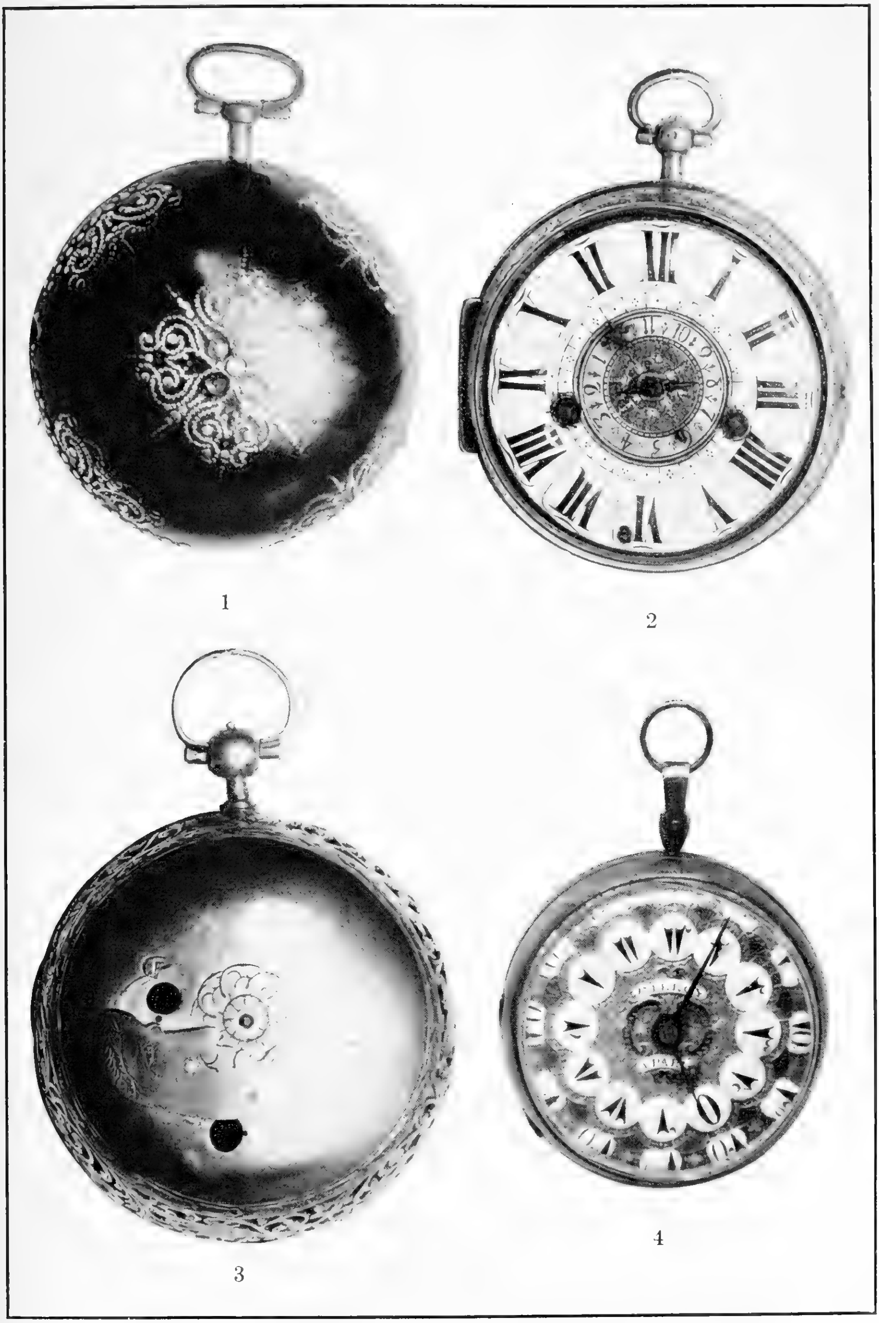
1

2

3

4

1. English watch, *circa* 1680. (No. 11.) 2. Watch by Quare, London, 1680. (No. 12.)
3. Watch by Luttin, London, 1690. (No. 13.) 4. Watch by Tompion, 1690. (No. 14.)



1. Watch in case of tortoise-shell piqué, 1693. (No. 15.)
2. Watch by Duquesne, seventeenth century. (No. 16.)
3. Watch by Millegg, Vienna, seventeenth century. (No. 17.)
4. Watch by LeRoy, Paris, *circa* 1700. (No. 26.)

1. Chatelaine, gold on agate, period of Louis XV. (No. 20.)
2. Early type of watch by J. S. Schloer, Regensburg. (No. 19.)
3. Watch by Brämer, Amsterdam, *circa* 1700. (No. 18.)

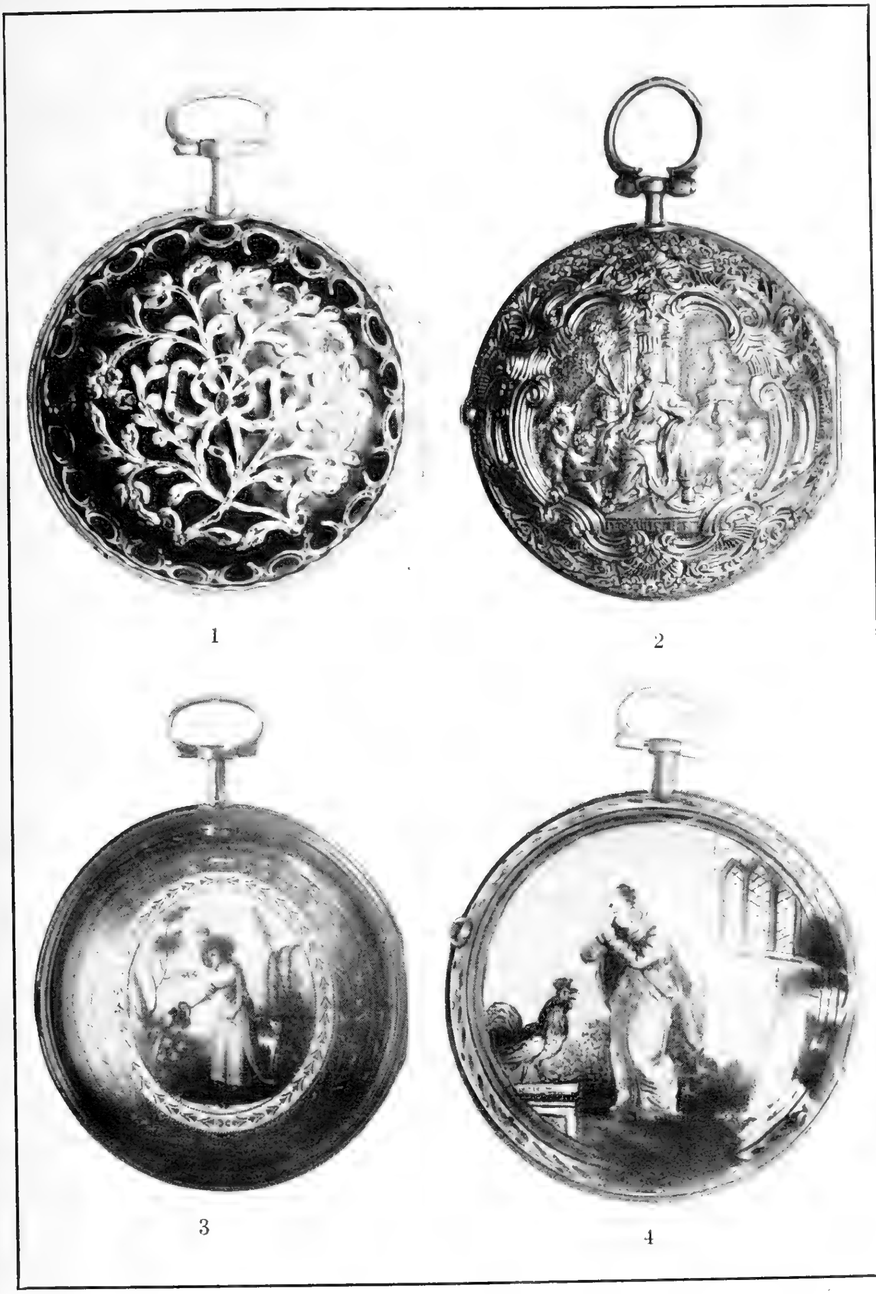
1

2

3

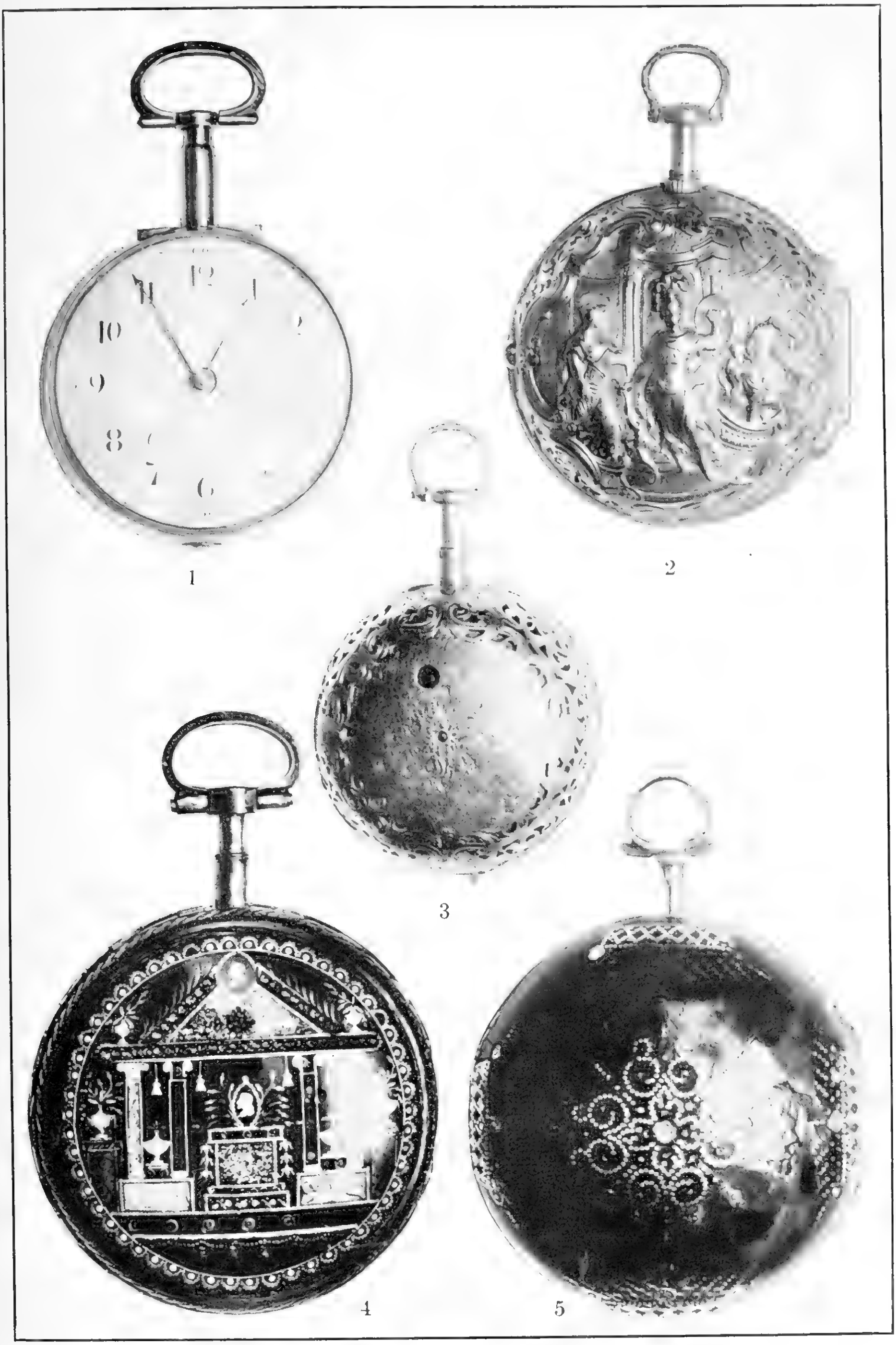
4

1. Watch by Tasinon, Tournay, France, period of Louis XV. (No. 22.)
2. Gold and enamel watch, by Esquivillon Frères, eighteenth century. (No. 21.)
3. Brass watch for Turkish market, Paris, eighteenth century. (No. 24.)
4. Silver repeating watch, by Fardoit, Paris, early eighteenth century. (No. 23.)

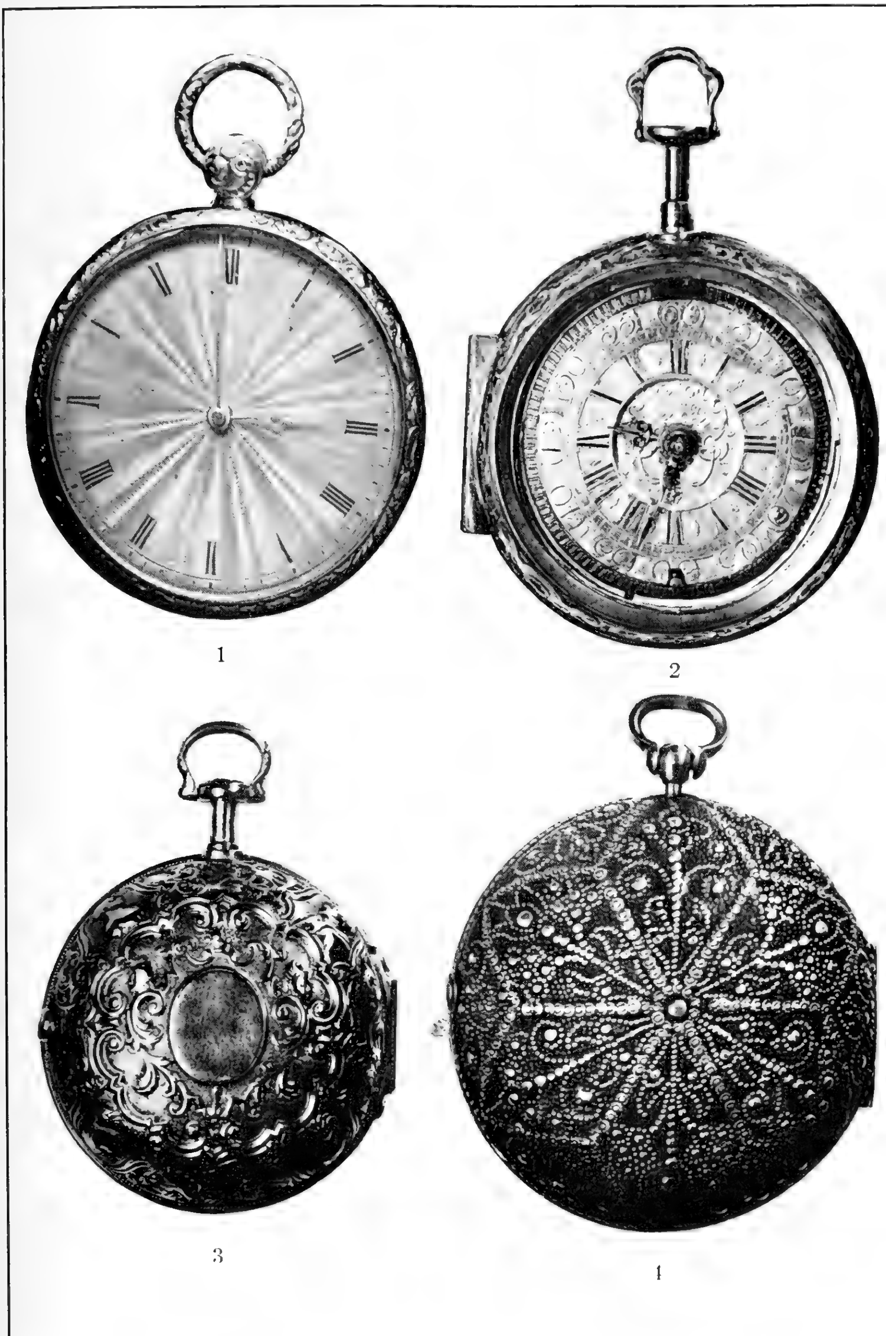


1. Gold watch by Le Roy, Paris, early eighteenth century. (No. 27.)
2. Silver watch, case by D. Cochin, Paris, 1660–1680. (No. 25.)
3. Enamelled gold watch, Paris, period of Louis XV. (No. 28.)
4. Silver watch by Meadows, London, A. D. 1719. (No. 29.)

Watch by Frantz Roth, Augsburg, *circa* A. D. 1730. (No. 33.)



1. Gold repeating watch by Cabrier, London, 1730. (No. 35.)
2. Gold watch by William Hawes, London, 1741. (No. 37.)
3. Gold watch by Gray and Vulliamy, London, 1746. (No. 38.)
4. Watch by P. Terrot, Genoa, 1730. Enamelled, set with zircons. (No. 36.)
5. Watch by F. Mercier, Paris, 1725. Outer case tortoise-shell piqué. (No. 32.)



1. Watch by L'Epine, Paris, 1720, gold border, silver dial. (No. 30.)
2. Watch by Andreas Colling, Augsburg, *circa* 1730. (No. 34)
3. Watch by James Blackborow, London, 1734–1746. (No. 39.)
4. Silver watch with outer leather cover, by Vogel, Cologne, 1720. (No. 31.)

Large watch for use in sedan-chair, by Heckel, Vienna, A. D. 1750. (No. 40.)

1. Gilt watch and key, London, *circa* 1760. (No. 48.)
2. Silver verge watch by John Wilter, London, A. D. 1760–1784. (No. 49.)
3. Gold watch by Thomas White, London, A. D. 1759. (No. 44.)
4. Gold repeating watch by Beuster, London, A. D. 1750. (No. 41.)
5. Gold watch with carbuncle in back, period of Louis XVI. (No. 65.)

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1. Gold watch by Samuel Weldon, London, A. D. 1759. (No. 45.)
2. Watch of vari-colored gold by Gudin, Paris, *circa* 1760. (No. 46.)
3. Watch with outer case of Battersea Enamel, London, *circa* 1760. (No. 47.)
4. Enamelled watch set with diamonds, Swiss, Fazy et fils, 1780–85. (No. 62.)

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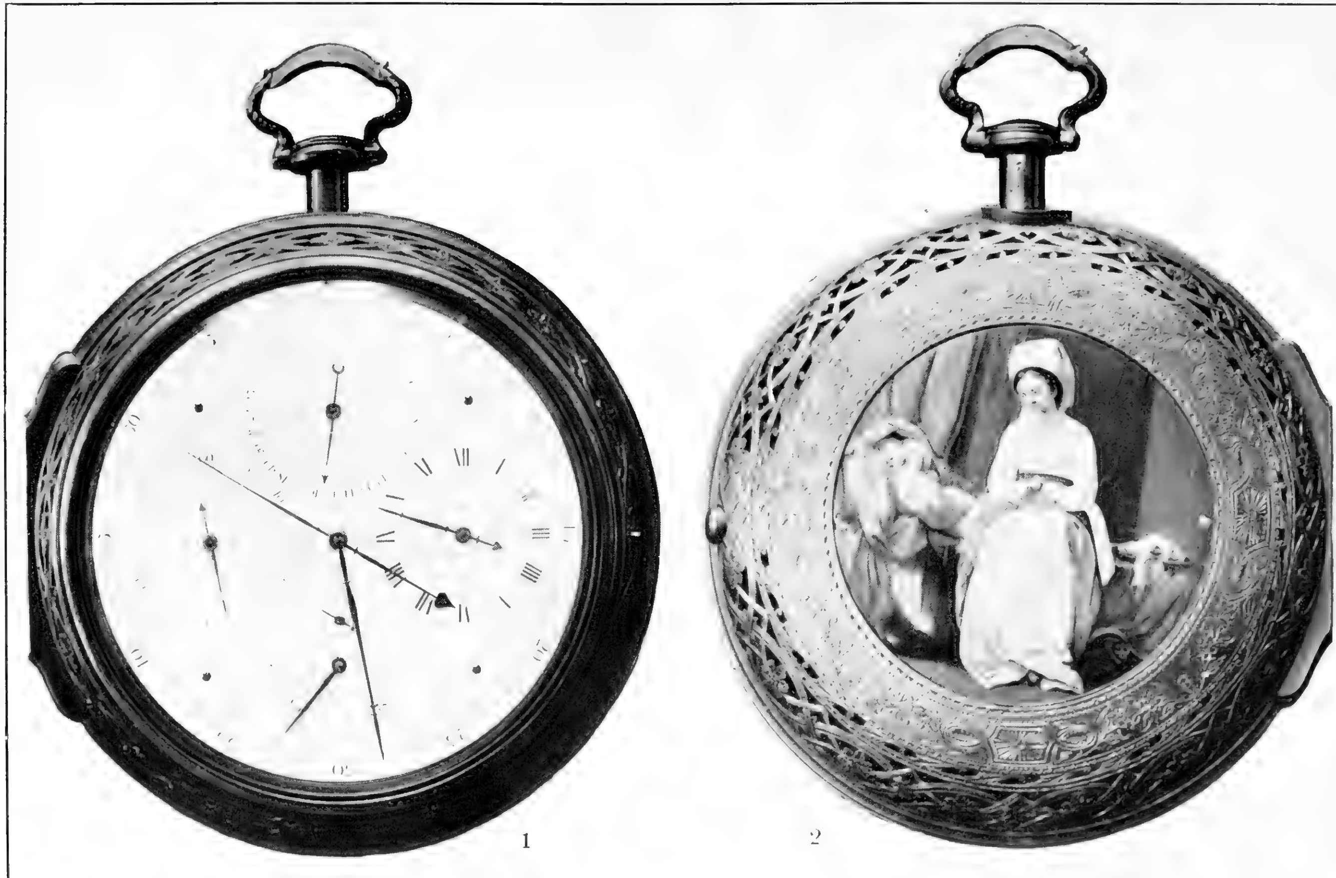
1. Watch by Triboulet, Geneva, A. D. 1760. (No. 50.)
2. Gold pair-case watch, Dutch, *circa* 1760. (No. 51.)
3. Pinchbeck watch by John Cock, London, *circa* 1760. (No. 52.)
4. Gold repeating watch by Hughes, London, A. D. 1770. (No. 55.)

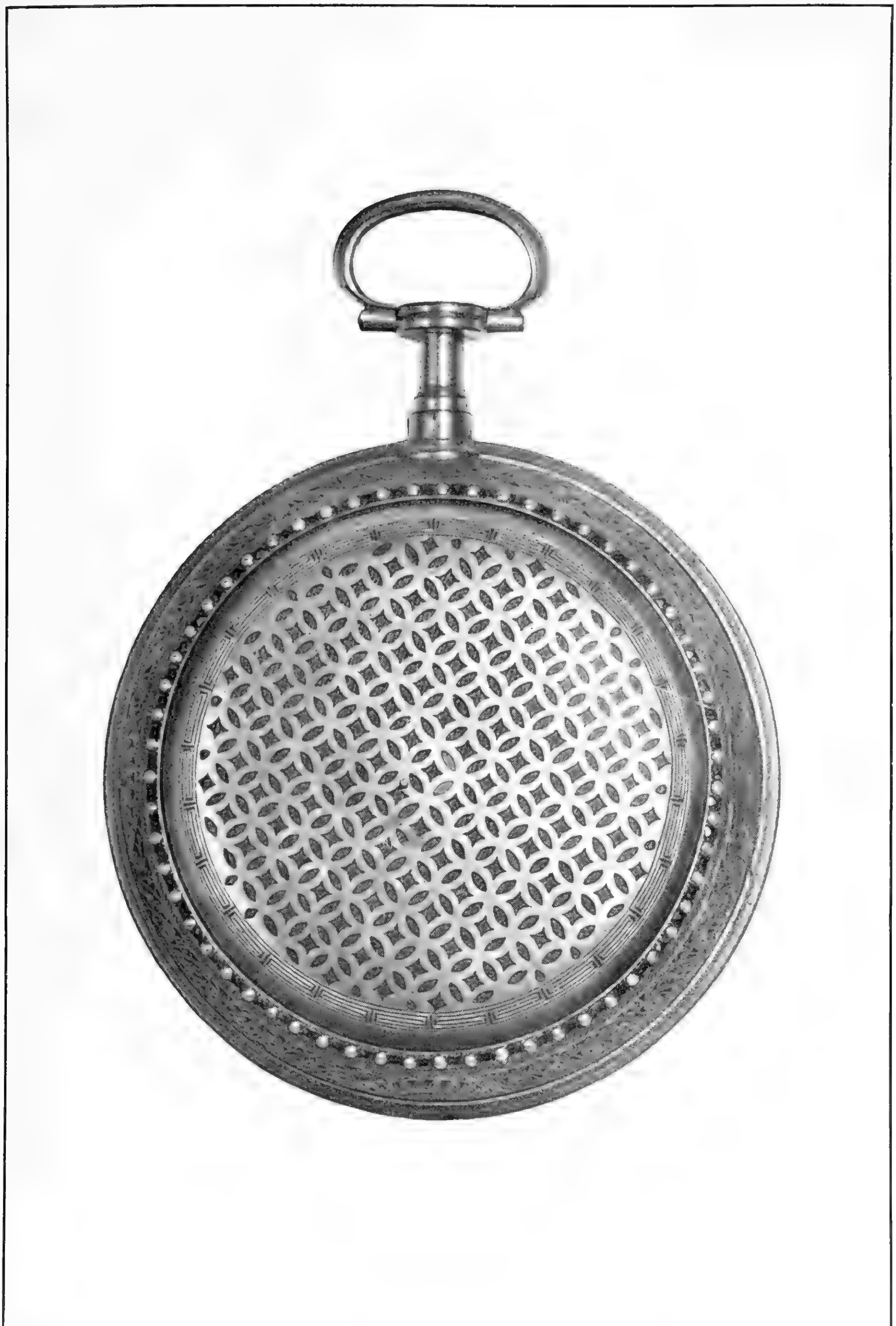
Silver watch for use in sedan-chair by Philiph Votter, Vienna, 1763. (No. 53.)



1 2

1. Face of large watch with musical attachment by Williamson, London, A. D. 1769. 2. Back of Do. (Looted from Imperial Palace at Pekin during "Boxer Rebellion.") (No. 54.)

1. Vari-colored gold watch, set with turquiose, P. LeRoy, Paris, 1780. (No. 66.)
2. Pair-case gold watch by Harry Potter, London, A. D. 1773. (No. 57.)
3. Gold watch with outer case of tortoise-shell, N. Scott, Maidstone. (No. 58.)
4. Enamelled gold watch by P. Bannicker, Paris, 1775. (No. 59.)



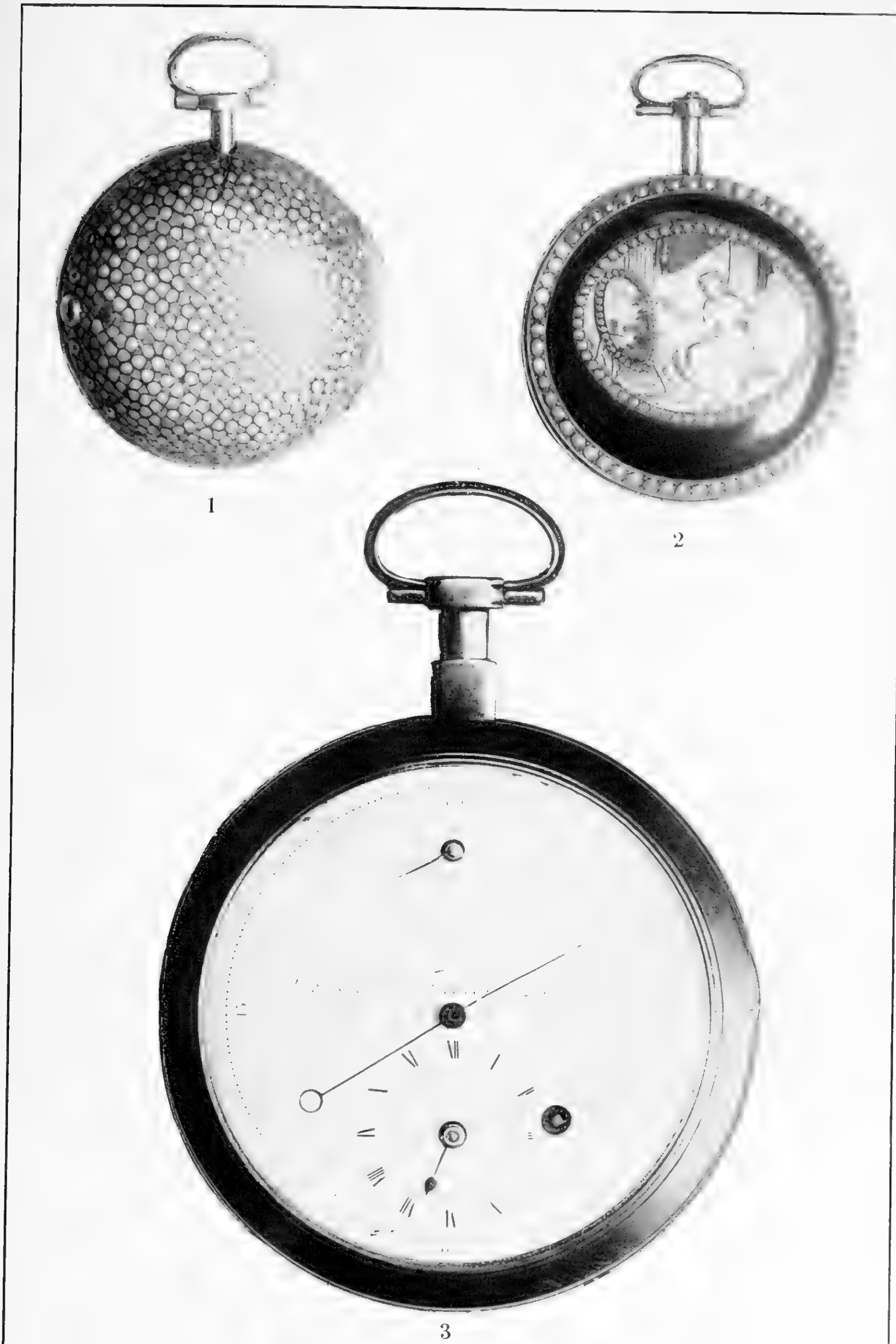
Large watch in pierced pinchback case, G. Margetts, London, A. D. 1779. (No. 61.)

1. Gold watch of Louis XVI period, French, *circa* 1770. (No. 56.)
2. Gold pair-case watch, by Jas. Noakes, London, 1776–1794. (No. 60.)
3. Gold watch by Jos. Martineau & Son, London, 1784. (No. 63.)
4. Gold watch by Pierre Gregson, Paris, 1780–1790. (No. 64.)

1. Silver verge watch by Philip Phillips, London, 1776. (No. 70.)
2. Watch in bronze case piqué by Tayot, Paris, eighteenth century. (No. 71.)
3. Silver watch with outer enamel case, Charleson, London, 1758. (No. 43.)
4. Gilt metal watch by L. Bordier, Geneva, *circa* 1785. (No. 68.)

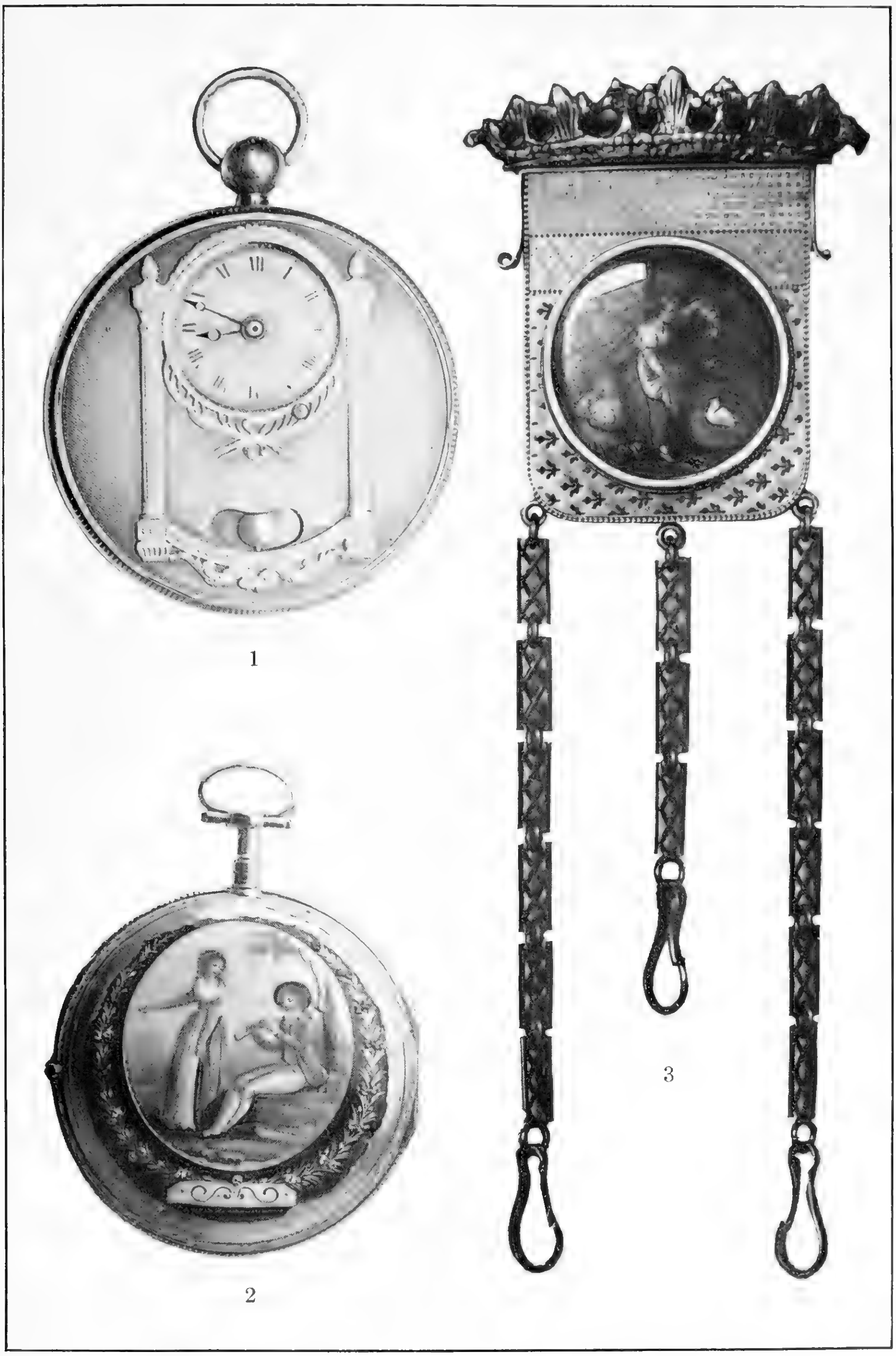
1. Pendant watch by J. Clovi, Rome, A. D. 1741. (No. 42.)
2. Gold watch by Rundle & Bridge, London, A. D. 1790. (No. 74.)
3. Gold pair-case watch, outer case enamelled. (No. 72.)

Watch and fob by Jeffrys & Jones, London, 1769–94. (No. 73.)



1. Watch in outer case of shagreen, J. Morier, London. (No. 77.)
2. Gold watch bordered with pearls by Patry & Chaudoir, Geneva, 1800. (No. 82.)
3. Large gold watch by Bouvier Frères, Geneva, A. D. 1790. (No. 75.)

1. Watch by George Achard et fils, Geneva, A. D. 1780. (No. 67.)
2. Gold watch, Swiss or French, early nineteenth century. (No. 79.)
3. Pinchbeck watch, French or Swiss, late eighteenth century. (No. 78.)
4. Watch by Luigi Duchêne et fils, Switzerland, late eighteenth century. (No. 80.)



1. Gold watch by Perrin Frères, period of First Empire. (No. 85.)
2. Watch by Racine, Paris, *circa* A. D. 1800. (No. 89.)
3. Chatelaine, gold and enamel, French, period of First Empire. (No. 84.)

1. Watch, French or Swiss, early nineteenth century. (No. 88.)
2. Swiss watch, early nineteenth century. (No. 81.)
3. French watch, early nineteenth century. (No. 83.)
4. Watch by A. V. Girod, early nineteenth century. (No. 93.)

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1. Watch, French or Swiss, early nineteenth century. (No. 86.)
2. Watch by A. L. Breguet, 1746–1823. (No. 90.)
3. Gold musical watch, French or Swiss, early nineteenth century. (No. 87.)
4. Viennese watch, early nineteenth century. (No. 96.)

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1. Watch by Frazer, London, 1785. (No. 69.)
2. Watch by A. L. Breguet, Paris, 1746–1823. (No. 92.)
3. Musical box and watch, Swiss or French, early nineteenth century. (No. 98.)

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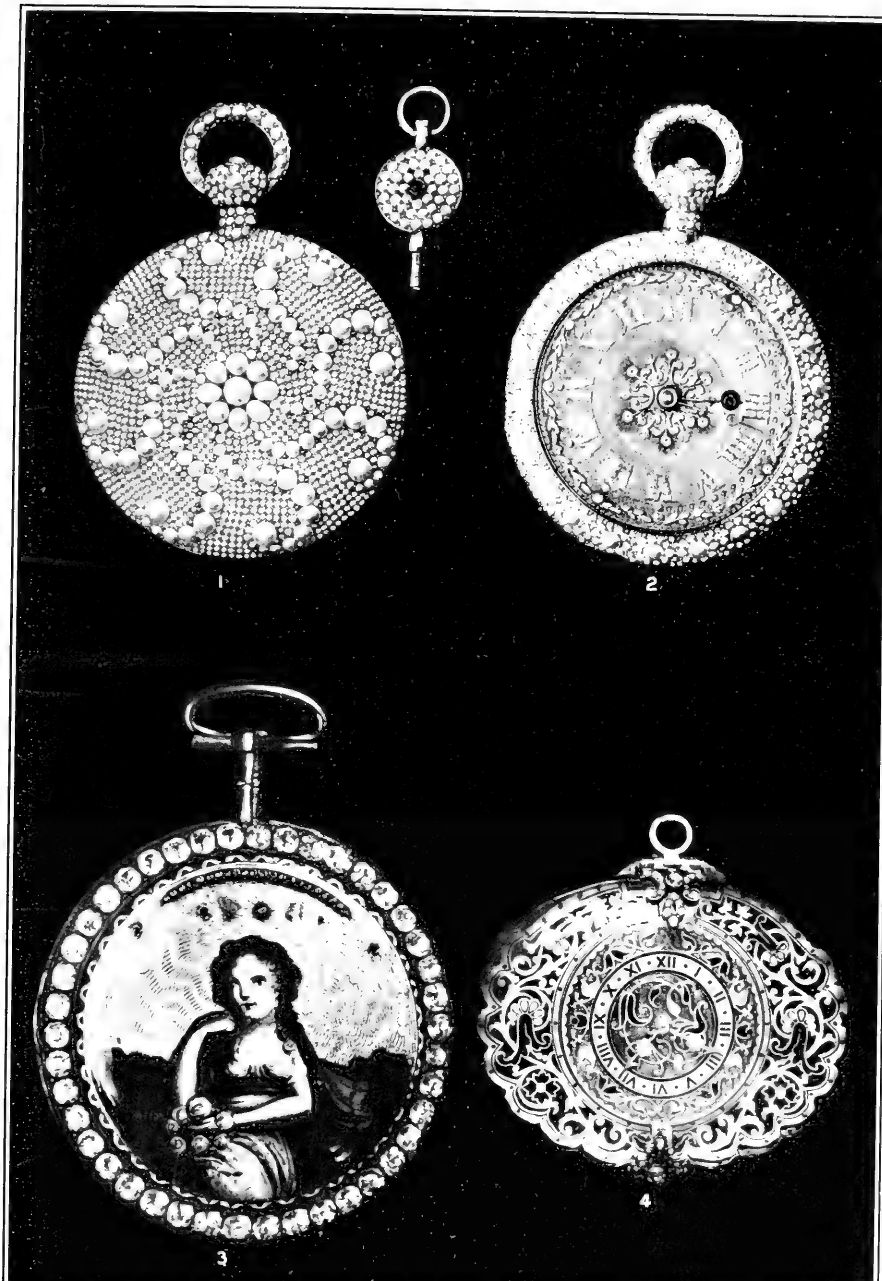
1. Watch by L. A. Breguet, Paris, *circa* 1830. (No. 95.)
2. Watch by Pernetti, Swiss, nineteenth century. (No. 99.)
3. Watch by L. A. Breguet, Paris, 1830. (No. 94.)



1, 2. Watch studded with pearls by Bautte & Moynier, Geneva, 1820. (No. 100.)
3. Watch by A. L. Breguet, Paris, 1746–1823. (No. 91.)
4. Watch set in carbuncle, by Froment-Meurice, France, nineteenth century. (No. 97.)

ANNALS

OF THE

CARNEGIE MUSEUM

VOLUME XII. NOS. 2–4.

Editorial Notes.

The exigencies of the period, which began when the United States were forced into the world war by Germany, left their impress upon the entire life of the nation, and affected every individual and institution. The Carnegie Museum did not escape this influence. In view of all the circumstances and the painful economies which seemed to be necessitated, the Director of the Museum, who is also the Editor of its publications, felt constrained to suspend the issue of the Annals and Memoirs of the Museum, until such time as the institution might be relieved in a measure from the financial embarrassment into which it had been brought in the spring of 1918 by the reduction in its revenues, which took place at that time. During the year 1918 no parts of either of the above-named publications were placed in the hands of the printer. It is a matter of congratulation that in May, 1919, we were apprised of the fact that the funds available for the work of the Museum for the current fiscal year had been restored to the same amount as that which had been granted in a number of the preceding years, and accordingly steps have been taken to issue as speedily as possible a number of valuable and important papers on various subjects which should, and under other circumstances would, have been published in 1918. The Editor sincerely hopes that the temporary delay in the issue of these contributions to science may not have worked entire disappointment to the authors of the same, and that he may receive their pardon in view of the fact that the circumstances were not of his making or choosing.

FROM July, 1918, to the middle of April, 1919, Mr. Douglas Stewart, who has long been associated with the Director of the Carnegie Museum as an administrative assistant, and also has discharged the functions of the Curatorship of Mineralogy, and taken charge of the collections in several of the other sections, was absent from Pittsburgh. Mr. Stewart had volunteered his services to the American Red Cross in Washington, and there was occupied in the work of the Bureau of Prisoners Relief for most of his time. Letters testifying in unqualified terms to the value of his services in this connection, and to the gratitude of the Officers of the American Red Cross for the kindness of the Trustees of the Carnegie Institute in having allowed him to undertake the work have been received, and are cherished in the archives of the Museum.

MR. O. J. MURIE, who at the time the United States entered into the war, was assistant curator of the collections of mammals in our possession, was called to the colors, and entered the Aviation Service. It was not his privilege to be called into duty across seas, and he has recently been honorably discharged. He writes that it is his present intention not to devote himself to curatorial duties, as he prefers life in the open, and he has made arrangements to undertake the breeding of fur-bearing animals in the Northwest, in association with his brothers.

MR. JOHN LINK, who entered an Officers Training Camp in June, 1918, to better qualify himself for military service, was in the fall of the year discharged because of a minor physical defect, and immediately returned to his post at the Museum.

SINCE the last number of the ANNALS of the Museum was issued, the hand of death has removed from us a number of those whose services to the institution have made their connection with it memorable. On Christmas Eve, December 24, 1918, Monsignor A. A. Lambing passed away, full of years and honors. He was one of the original Trustees of the Institute, having been appointed by Mr. Carnegie, had served for a considerable time as a member of the Committee upon the Museum, and almost continuously as Honorary Curator of our Historical Collections. The sudden death from pneumonia on May 14, 1919, of Mr. Henry J. Heinz, has robbed us of another devoted friend, who did much to add to the collections of the Museum, and long served as Honorary Curator of Textiles, Timepieces, and Ivory Carvings. His loss is irreparable. Professor Charles Rochester Eastman and Herbert Huntington Smith are two others whose names are indelibly linked with the development of the Carnegie Museum, and they both were summoned from life under tragic circumstances. Brief biographies of these friends of the institution and former associates of the Director will be given elsewhere in this issue of the ANNALS.

IN spite of the financial embarrassment under which we labored during the fiscal year, which closed on March 31, 1919, there were some notable additions made to the collections in the Museum during that period.

One hundred and twenty-six mammals were added, seventy-nine representing the fauna of North America, the remainder being from South America. We have over four thousand five hundred mammals in the Museum.

The collection of birds was increased by the addition of six thousand and eighty-five specimens. Thirty-two specimens represent species from North America, the remainder are specimens from portions of South America, which have hitherto been little explored, or only imperfectly represented in the museums of the world. Our birds number about seventy thousand specimens.

Our collection of recent reptiles was notably augmented as the result of the journey undertaken by Dr. L. E. Griffin through New Mexico, Arizona, and southern California. There are not far from eight thousand specimens now in the collection, principally from North America, although South America is also represented, and we have some material from other continents.

The acquisition of a representative collection of the fresh-water fishes of the island of Formosa through the kindness of Mr. Matsumitsu Oshima of the Institute of Science which is maintained by the government of that island, is noteworthy. Our collection of fishes aggregates over fifteen thousand specimens.

Numerous mollusca, principally from the Mississippi Valley were acquired, and a great deal of important work was done during the year by Drs. Ortmann and Sterki in determining and classifying material already obtained in former years. The collection of mollusks now numbers about six thousand seven hundred species, represented by about thirty thousand sets of specimens.

About sixteen thousand insects were obtained mainly from South America and tropical Africa. The Director completed for the American Museum of Natural History an extensive paper upon the lepidoptera of the Congo brought back from that country by the Lang-Chapin Expedition. A number of new species and new varieties are described. There are over a million of insects in our collections, representing approximately one hundred thousand species.

The work in the Herbarium was largely restricted during the past year to the classification and arrangement of material acquired in former years, but some important accessions were made by purchase and exchange. A very important paper upon the Oligocene fossil plants collected some years ago by Mr. Earl Douglas near Missoula, Montana, has been prepared by Professor O. E. Jennings, and submitted for publication. Dr. Jennings informs me that there are about two hundred and fifty thousand specimens in the herbarium, representing approximately fifty-five thousand species.

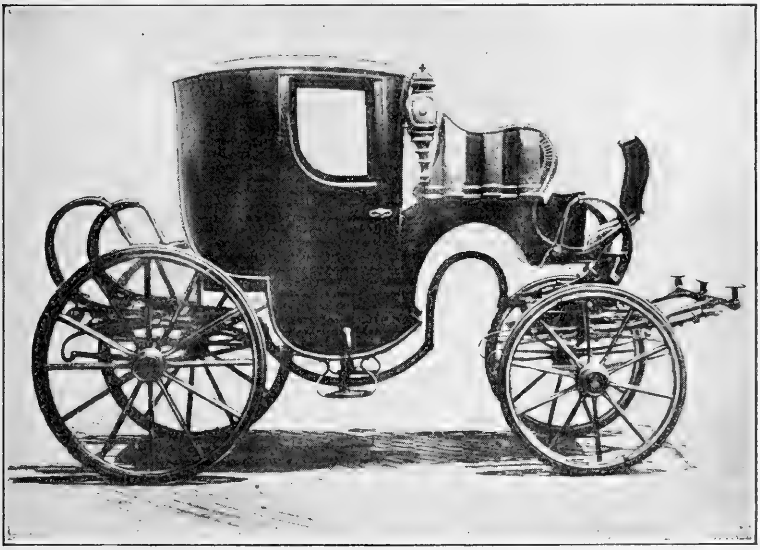
Nearly one thousand mineralogical specimens were received during the year, principally as gifts, including that of the Andriessen Collection, presented to the Museum by Mr. Richard Hartje, Jr., and the collection made by the late Mr. E. L. Dunbar of Pittsburgh, presented by his daughter, Miss Fannie K. Dunbar. Our collection of minerals is one of the largest in the state.

In the field of paleontology important work was done at the National Dinosaur Monument in Utah, where Mr. Earl Douglass has continued the work of excavation commenced some years ago. The force in the laboratory has succeeded in freeing from the matrix a great deal of interesting and valuable material, which we hope to soon describe and publish to the world. Some of it undoubtedly represents forms hitherto unknown to science. Our paleontological collections are very extensive, exceeded in size and importance by only one, or possibly two others in North America.

One of our undertakings was the thorough exploration of the Indian mound at Guyasuta, the ancestral home of the Darlington family near the city, the Museum having been invited by Mrs. S. A. Ammon and her sister, Miss Darlington, to do this work. It is a well-confirmed tradition that the late General O'Hara caused the interment in this mound of the remains of the celebrated Indian chief, Guyasuta, who accompanied George Washington on his memorable journey to the French commandant at Fort LeBoeuf. During the later years of the life of the old Seneca chief, General O'Hara built for him a log cabin near the spot and provided him with food and clothing. Evidence of an intrusive burial in the mound was discovered, and the remains have been carefully preserved, and when the proper time comes, it is hoped to obtain permission to reinter them in Highland Park at a point overlooking his old home, marking the spot by a suitable memorial not only to him but to the tribe to which he belonged, which has almost vanished.

We have received many important gifts and loans of ethnological material, among which may be mentioned the entire collection of the late Robert C. Hall, which, having become the property of Mr. Edward B. Lee, has by him been kindly placed in our custody.

Our collection of coins and medals was enriched by the gift to the Museum by Mrs. S. A. Ammon of the beautiful assemblage of medals formed by her father, the late William M. Darlington, Esq. A large number of the medals struck by the authority of the American Congress at various dates in the last century, thus became our property.



D'Orsay presented to the Carnegie Museum by Messrs. Healey & Co. of N. Y. City. The first vehicle lighted by electric storage batteries.

Notable additions to the ceramics in the Museum have been made, among which may be mentioned the gift of one hundred and forty-three specimens of early colonial and eighteenth century English pottery and glass-ware presented by Mrs. Jessie Porterfield Heasley.

A gift which is much appreciated is that made by Messrs. Healey & Company, the famous carriage-builders of New York City, who presented to us a D'Orsay, made under the personal supervision of General Healey, which is a masterpiece of the art of the blacksmith and carriage-builder, and which has historic interest because it is known to be the first vehicle manufactured in America which was illuminated by electric light from storage-batteries, and was one of the first, if not the very first, to be provided with rubber tires.

Numerous interesting additions were made to our carvings in wood and ivory, and art-work in the metals.

Important accessions of letters and documents were added to our rapidly growing accumulation of historical papers.

The foregoing paragraphs serve to throw some light on the activities of the Museum during the past year. Fuller and more detailed information is contained in the Annual Report of the Director, presented to the Trustees in April, 1919.

THE fraternity between men of science in foreign lands and ourselves has been illustrated in a pleasing manner on several occasions during the past years.

The following letter was received from Monsieur Edmond Perrier, the Director of the National Museum of Natural History in Paris, and Ex-President of the Académie des Sciences, shortly after the United States had begun hostilities against Germany.

"MUSÉUM NATIONAL D'HISTOIRE NATURELLE

"PARIS, le 22 Avril, 1917.

"LE MUSÉUM D'HISTOIRE NATURELLE DE PARIS AU MUSÉE CARNEGIE.

"DR. W. J. HOLLAND, Directeur,

"*Mon cher Collègue.*

"Au moment où on va dresser avec accompagnement de salves d'artillerie pour cette fin le drapeau américain et le drapeau tricolor accolés l'un à l'autre au sommet de la tour Eiffel, le Muséum National d'Histoire Naturelle, que vous avez comblé, tient à vous adresser avec émotion un salut confraternel, et je suis heureux d'être son interprête. Ensemble nos deux pays combattent pour assurer la paix au monde, pour détruire ce qui reste des institutions du moyen-âge organisées pour la conquête et le butin, et leur substituer des institutions pacifiques basées sur la bienveillante solidarité qui doit unir tous les hommes dignes de ce nom. Cette commune conception de la vie est le gage que les États Unis et la France ne se sépareront plus.

"Soyez, confrère, de vos collègues de l'Institut Carnegie, institut de paix, notre interprête très aimé.

"EDMOND PERRIER,
"*Directeur du Muséum d'Histoire Naturelle.*"

Another communication, which was inspired by the signing of the armistice in November, and which came to hand in January, is the following:

"MUSEO NACIONAL DE CIENCIAS NATURALES MADRID
(HIPÓDROMO).

"Nov. 15, 1918.

TO THE DIRECTOR OF THE CARNEGIE MUSEUM, PITTSBURGH.

Dear Sir: Please let us congratulate very warmly your Museum, as representative of American Science, for the end of the great war, a so glorious end for your country and for the cause of universal freedom and peace.

Yours very friendly,
IGN. BOLIVAR,
Director.

JOAQUIN GONZ. HIDALGO
LUIS LOZANO
LUCAS FR. NAVARRO
ANGEL CABRERA
ANTONIO DE ZULUETA

EDUARDO H. PACHECO
RICARDO GA. MERCET
CANDIDO BOLIVAR
ROMUALDO GONZALEZ FRAGOSO."

II. REPORT UPON THE MATERIAL DISCOVERED IN THE UPPER EOCENE OF THE UINTA BASIN BY EARL DOUGLAS IN THE YEARS 1908–1909, AND BY O. A. PETERSON IN 1912.

By O. A. Peterson.

Introduction.

The present report may be considered as the continuation of the work done by Messrs. Earl Douglass, O. A. Peterson, and C. W. Gilmore who have already written upon the Titanotheroidea and the turtles, and incidentally have briefly discussed the geology of the Uinta Basin.[1] A more complete and detailed account of the geology of the Uinta Tertiary is deferred pending a further and more complete study in the near future. The collection of fossil insects and plants will also be taken up in later publications.

The illustrations are from drawings made by Mr. Sydney C. Prentice.

I. FISHES AND REPTILES OF THE UINTA EOCENE.

(The Turtles belonging to the collections made by Mr. Earl Douglas and the author of this paper have received full treatment by Mr. C. W. Gilmore in his paper, entitled "The Fossil Turtles of the Uinta Formation," Memoirs Carn. Mus., VII, 1915, pp. 101–161.)

II. PISCES.

Above the typical Green River Shales of the Uinta Basin remains of fishes, such as the scales of gars and isolated bones, are often found in different localities and horizons. These remains are generally discovered in heavy bedded sandstones of stream origin and are very

[1] Douglass, Earl, "Preliminary Description of Some New Titanotheres from the Uinta Deposits," Ann. Car. Mus., Vol. VI, 1909, pp. 304–311; "Geology of the Uinta Formation," Bull. Geol. Surv. of America, Vol. XXV, 1914, pp. 417–420. Peterson, O. A., "A New Titanothere from the Uinta Eocene," Ann. Car. Mus., Vol. IX, 1914, pp. 29–52; "A Small Titanothere from the Lower Uinta Beds," *l.c.*, pp. 53–57; "Some Undescribed Remains of the Uinta Titanothere *Dolichorhinus*," *l.c.*, pp. 129–138. Gilmore, C. W., "The Fossil Turtles of the Uinta Formation," Mem. Car. Mus., Vol. VII, No. 2, 1915, pp. 101–161.

seldom so complete as to permit of exact identification. A mandible, No. 2382, found in Horizon B appears to belong to the *Halecomorphi* of the family *Amiidæ*, and agrees best with *Pappichthys* (*P. plicatus*) Cope, "Tertiary Vertebrata", p. 59, Plate IV, Fig. 1. A second specimen, No. 3031, with a great number of scales in position, found in horizon C, appears to belong to *Amia*, while a third, No. 2368, from horizon C (near base) are fragments of both rami, which are longer, slenderer, more rod-like, but with a single tooth-row, as in No. 2382, referred to *Pappichthys*. This specimen may or may not pertain to the same group.

III. **REPTILIA.**

CROCODILIA.

The fauna of the Uinta sediments includes a number of species of *Crocodilia* which continued from earlier epochs. These remains are generally found in sandstone of more or less coarse texture and of stream origin, as is the case with the remains of the fishes. In the collections made by the Carnegie Museum in 1908 and 1912 are a number of specimens which represent horizons A, B, and C of the Uinta. C. M., No. 2971, a skull which was found in the upper part of horizon A near White River, Utah, compares best with the description and illustrations of *Crocodilus clavis* by Professor Cope, "Tertiary Vertebrata", pp. 157–159, Plate XXII. A lower jaw, C.M., No. 2972, found in horizon B, is also referred to *C. clavis*, while No. 2988 is a pair of lower jaws found in horizon C, and represents an animal larger than either Nos. 2971 or 2972. This specimen may very possibly represent a new species, but reliable comparisons and diagnoses of characters cannot be made because of the mutilated condition of the specimen.

IV. **MAMMALIA.**

Order *CARNIVORA* (Feræ).

Family MESONYCHIDÆ Cope.

Genus HARPAGOLESTES Wortman.

1. **Harpagolestes uintensis** (Scott and Osborn).

Proc. Amer. Philos. Soc., Vol. XXIV, 1887, p. 225.

To this species is referred a lower jaw, together with other parts of the skeleton of one individual, C. M. No. 2961. The remains were found in horizon B of the Uinta formation close to the place where the hypotype of *H. uintensis* was found at the eastern end of the Uinta Basin near Wagonhound Bend Canyon on White River, Utah. The specimen represents an animal as large as, or slightly larger, than the type of *H. uintensis*, and is here recorded for the convenience of the student, because it differs from that specimen, and also from *H. immanis* Matthew, by the presence of a minute anterior cusp on $P_{\overline{3}}$. $P_{\overline{2}}$ and also $M_{\overline{3}}$ are of larger size than is the case in the type of *H. uintensis*. Since the type of the latter species consists of loose teeth, which may possibly not all belong to the same specimen, no great stress should at this time be laid on the differences noted. The presence of the anterior cusp on $P_{\overline{3}}$ may also be an individual character of the present specimen. The erection of a new species is therefore not thought prudent.

Family OXYÆNIDÆ Cope.

Genus OXYÆNODON Matthew.

Oxyænodon dysodus Matthew.

Hyænodon sp. OSBORN, Bull. Am. Mus. Nat. Hist., VII, 1895, p. 78, Fig. 3.
Oxyænodon dysodus MATTHEW, Bull. Am. Mus. Nat. Hist., XII, 1900, p. 49 (type of genus *Oxyænodon*).
Oxyænodon dysodus HAY, U. S. Geol. Surv., Bull. 179, 1902, p. 759.

(Specimen No. 1893 A.M.N.H.)

Oxyænodon dysclerus Hay.

Oxyænodon dysodus WORTMAN (*non* Matthew), Bull. Am. Mus. Nat. Hist., XII, 1900, p. 145.
Limnocyon dysodus WORTMAN, Am. Journ. Sci. (4), XIII, 1902, p. 206.
Oxyænodon dysclerus HAY, U. S. Geol. Surv., Bull. No. 179, 1902, p. 769; Matthew, Mem. Amer. Mus. Nat. Hist., IX, Pt. VI, 1909, p. 412 and 433.

(Specimen No. 2515 A.M.N.H.)

The above synonymy carefully worked out shows the status of the two species of *Oxyænodon* as known at the present time.

On comparing *Oxyænodon dysodus* Matthew with material representing *Limnocyon* the two appear to agree in the general structure of the lower jaw. They have a very thick jaw with a heavy symphysis, which extends backward even with the posterior face of $P_{\overline{3}}$. The dentition of the type of *Oxyænodon dysodus* Matthew is very imperfect and furnishes, unfortunately, small opportunity for comparison. It represents an animal larger than the type of *Oxyænodon dysclerus*, and further differs from the latter by having the chin gently turned upward, while in *O. dysclerus* the chin is turned upward more abruptly. Although *O. dysodus* may pertain to a different genus (? *Limnocyon*) it seems preferable to retain it in *Oxyænodon*, pending the discovery of more material of both *Oxyænodon* and *Limnocyon* in that horizon of the Uinta formation in which the type was found. This decision is mainly based upon the fact that a specimen representing a new species of *Limnocyon*, *vide infra*, was found during the summer of 1912 at the same locality where *Oxyænodon dysodus* was obtained,[2] and which differs from the latter. In this new form the mandible is proportionally shorter, especially in the region of the premolars. The first upper premolar is obliquely placed in the alveolar border, and the premolars are crowded, while in *O. dysodus* $P\underline{1}$ is directly fore-and-aft and the premolars occupy proportionally a greater space. These differences between the two specimens compared may be of generic importance.

$M\underline{1}$ in *Oxyænodon dysclerus* has the paracone and metacone placed closer together than in *Limnocyon*. In the latter genus $P\underline{2}$ and $P\underline{3}$ have smaller heels and $M\underline{3}$ has one instead of two median tubercles. Recently acquired material, representing the limbs of *Oxyænodon dysclerus*, described below, further show that the limbs are longer in proportion to the skull than is the case in *Limnocyon*.

2. **Oxyænodon dysclerus** Hay (Plate XXXIV, Figs. 1–2).

U. S. Geological Survey, Bull. No. 179, 1902, p. 759. (For synonymy see *ante*.)

This species is represented by a well-preserved skull with the lower jaws attached, portions of the vertebral column, and the fore-limb of one individual, No. 3051. The specimen was found by the writer on White River, Uinta County, Utah, in the same locality and in the same horizon in which the type was obtained. It was found in a fine-grained sandstone concretion in which it is still imbedded in half relief, the skull and portions of the fore-limb having been more completely worked out for further detailed study and illustration.

The differences between the present specimen and the type (No. 2515 of the American Museum) are very slight, judging from the descriptions, the illustration, and actual comparison.

The axis has a high neural spine and the cervical centra have stout transverse processes, which project rather strongly backward.

[2] Mr. Peterson collected in 1893–95 the material upon which Osborn, Matthew, Hay, and Wortman wrote. (Editor.)

The left fore-limb is quite completely preserved, and, as observed above, is longer in proportion to the length of the skull than in *Limnocyon*. The scapula is long and rather narrow, more nearly recalling such

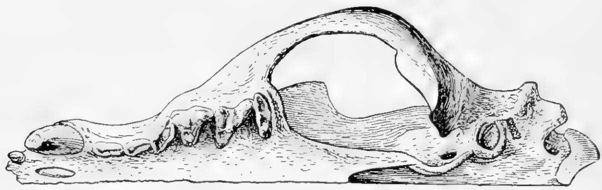


FIG. 1. *Oxyænodon dysclerus.* Carnegie Museum No. 3051. × 2/3.

a recent form as *Viverra zibetha*, the coracoid process and the metacromion being, however, proportionally more developed than in the latter. The spine, which is very high, rises close to the glenoid cavity and separates the pre- and post-scapular fossæ in nearly equal proportions.

The humerus has received considerable crushing, especially in the upper portion of the bone, but its length is not impaired. The bone

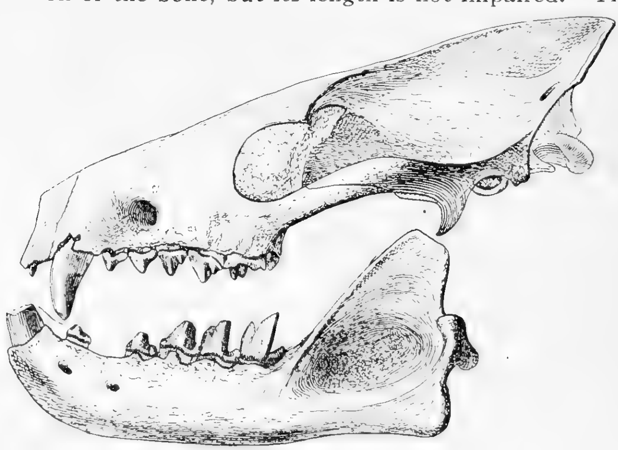


FIG. 2. *Oxyænodon dysclerus.* Carnegie Museum No. 3051. × 2/3.

is slender, the deltoid is quite prominent and extends well down on the shaft, but does not terminate as abruptly below as in the *Miacidæ*. The entepicondyle and entepicondylar foramen are quite large, having approximately the same proportions as in *Limnocyon verus*. The trochlea is also similar to the latter, except the inter-trochlear ridge, which seems to be less developed in the present species. This, however, may be partly due to crushing. The supinator ridge appears to be somewhat less developed than in *L. verus*.

The proportionate length of the ulna and radius is the same as in *Limnocyon verus*. The fore-arm answers quite well to the description given of *L. verus* by Matthew, except that the olecranon process of the present specimen is shorter.

The fore-foot is preserved with the exception of the ungual phalanges, the trapezium, a portion of the trapezoid, and Mc. I. The carpus is low and broad, the metacarpals quite long in comparison with the length of the radius and ulna, and the phalanges are long, those of the proximal row with the shafts quite convex dorsally. The scaphoid and centrale, or what I take to be a portion of the centrale, appear to be united, and the lunar is also apparently fused, or nearly fused, with the scaphoid. The cuneiform is not complete, but appears to be high, with the articulation for the ulna excavated anteroposteriorly and having a large concave facet for the pisiform. The latter is of large size, with the termination of the tuberosity considerably expanded, especially supero-inferiorly. The unciform is large and the facet for the cuneiform is very oblique. The metacarpals are moderately spread, their shafts have an oval cross-section, and are more expanded laterally near the distal end. The median phalanges are depressed. The unguals are not represented in the specimen.

Genus LIMNOCYON Marsh.

3. **Limnocyon douglassi** sp. nov.[3] (Plate XXXIV, Figs. 11–14).

Type: Fragments of skull, lower jaws, and other portions of skeleton, C. M. No. 3373.

Horizon: Uinta Eocene, horizon B.

Locality: Eastern end of Uinta Basin, Uinta County, Utah.

Specific Characters: Premolars relatively small; $P_{\overline{4}}$ *suddenly enlarged;* $P^{\underline{3}}$ *with anterior and posterior accessory cusps proportionally small. Type representing an animal slightly larger than Limnocyon potens of the Washakie Eocene.*

A portion of the right maxillary, with $P^{\underline{3}}$, $P^{\underline{4}}$, and $M_{\overline{1}}$ are very nearly complete; the roots of $M^{\underline{3}}$ and the anterior premolars are preserved in the specimen. There is also a fragment representing the

[3] In honor of Mr. Earl Douglass who found the type in 1908.

left maxillary, the base of the zygomatic arch, both upper canines, one incisor tooth, and other fragments of teeth. The upper incisor is robust, laterally compressed, with a short and thick fang and the crown heavily enameled and striated. The canine is likewise flattened and the crown deeply striated. The maxillary is broken off in the region of $P^{\underline{1}}$, but it is evident that the tooth had two roots and occupied a crowded and oblique position in the alveolar border, differing thus from *L. verus*. $P^{\underline{2}}$ is represented by two stout fangs, while $P^{\underline{3}}$ has the crown complete. The main cusp of the latter is conical and rather blunt. At the antero-internal angle there is a minute basal tubercle, while posteriorly there is a basal heel of considerable size as in *L. verus*. $P^{\underline{4}}$ has the triangular outline due to the prominent deuterocone characteristic of the genus. The anterior external tubercle of this tooth is unusually well developed, while that of the opposite tooth, though better developed than in *L. verus*, is of considerably smaller size. The median and postero-external cusps are much worn down, indicating the senility of the animal. On comparing $P^{\underline{3}}$ with that of *Limnocyon potens* Matthew, it is at once observed that the anterior and posterior cusps of the crown are proportionally smaller than in that species.

All the inferior premolars are crowded in the specimen under consideration and they carry deep vertical striæ. $P_{\overline{1}}$ is represented only by its roots in the left mandible, this tooth in the right mandible having dropped out and the alveole having been partly closed before the death of the animal. The second, third, and fourth premolars have only a slight indication of an anterior basal tubercle as in *L. potens*,[4] while posteriorly there is a considerable cusp. Cingula are feebly or not at all represented. The trigonid of $M_{\overline{1}}$ is much worn and is otherwise incomplete posteriorly; the heel is rather large and slightly basin-shaped. The trigonid of $M_{\overline{2}}$ is entirely broken off, but the heel is quite complete, and shows a sharp inner face and a more obtuse elevation along the external margin of the heel.

The vertebral column is represented only by a few centra, which appear to be very small in proportion to the remains of the head. The tail was robust, as is shown by two or three centra from the proximal region.

The limb-bones, even more than the remains of the vertebral column, appear disproportionately small, and it was with some hesita-

[4] In *L. potens* the anterior premolars are larger, while $P_{\overline{1}}$ is proportionally smaller.

tion that I originally referred them to the same individual. However, when compared with *Limnocyon verus* described by Dr. Matthew (*Mem. Amer. Mus. Nat. Hist.*, Vol. IX, Part VI, 1909, pp. 433–447) the differences are not so great, the limb-bones of the present specimen being perhaps somewhat smaller in proportion.

The pelvis is represented by fragments of the ilia and the ischium. The fragments indicate that the pelvis was quite elongated and narrow. The ilium is suddenly expanded at the contact with the sacrum, especially along the superior border, and the great sacro-sciatic notch is short. Immediately anterior to the acetabulum are heavy rugosities for muscular attachments. The ischium has a considerable inward twist when the pelvis is placed in position; the shaft is rather compressed laterally and the ischial spine is located well back of the acetabulum, similar to, though relatively of smaller size than in *Tritemnodon agilis* Matthew.

The femur is quite complete and presents characters much in accord with *Limnocyon verus*. The distal end appears to be somewhat broader than in the latter species, which may, however, be partly due to crushing. The upper end of the shaft has an inward turn similar to that in *Limnocyon verus;* the lesser trochanter is possibly located somewhat more posteriorly than in the latter species, but the third trochanter is approximately in the same position and of the same proportionate size. Distally the bone is, as already stated, broadly expanded, which is in part, at least, due to crushing. However, the rotular trochlea appears to be proportionally broader than in *Limnocyon verus*. Above the external condyle on the postero-fibular angle is a curious deep groove in the neighborhood of the attachment for the gastrocnemius. The intercondyloid notch is quite broad.

The tibia and fibula are poorly represented. It is, however, plain that the shaft of the fibula is quite stout and oval in cross-section.

Both calcanea are represented with the greater portion of the tuber calcis broken off. The bone is rather small, not much expanded laterally, due to the small development of the lesser process. The groove for the interosseous ligament is quite broad, as in many recent *Feræ*, but the bone as a whole is perhaps most suggestive of the *Miacinæ*. The peroneal tubercle is large, with the tendinal groove for the peroneus longus fairly well developed. The facet for the cuboid is oblique and on the plantar face is a truncated tuberosity for muscular attachment.

The astragalus is represented by the head, which is broad as in *L. verus.*

MEASUREMENTS.

Length of upper molar-premolar series	54 mm.
Length of mandible, condyle to point of symphysis	131 "
Depth of mandible at $P_{\overline{3}}$	25 "
Depth of mandible at $M_{\overline{2}}$	20 "
Length of lower molar-premolar series	55 "
Length of lower premolars	32 "
Length of lower molars 1 and 2	23 "
Length of femur	122 "

Family MIACIDÆ Cope.

Genus MIMOCYON gen. nov.

4. **Mimocyon longipes** sp. nov. (Plate XXXIV, Figs. 6–10.)

Type: Fragments of the left lower jaw with $P_{\overline{1}}$ and $M_{\overline{1}}$ in place, fragment of $P_{\overline{1}}$? and greater portion of the lower canine of same side; the distal end of the humerus, proximal end of the ulna, a section of the shaft of the radius, the distal articulation of the tibia, the tarsus, and proximal ends of three metatarsals, C. M. No. 3022.

Horizon: Uinta Eocene, Horizon C, near base.

Locality: Six miles east of Myton, Uinta County, Utah.

Generic Characters: Antero-posterior diameter of $P_{\overline{4}}$ and $M_{\overline{1}}$ equal. Anterior and posterior accessory cusps small and heel large. Trigonid low and small, heel large and basin-shaped. Tarsus high.

DESCRIPTION OF THE TYPE.

The ramus is not deep and is rather thin transversely. $P_{\overline{1}}$ had in all probability two roots. The succeeding alveoli of $P_{\overline{2}}$ and $P_{\overline{3}}$ indicate that they were of considerable antero-posterior diameter and were distinctly two-rooted. $P_{\overline{4}}$ is not reduced in size, its antero-posterior diameter equals that of $M_{\overline{1}}$. The principal cusp of the crown is not compressed laterally, is rather high, and has distinct ridges in front and behind. There is a small anterior basal cusp, which more appropriately might be regarded as a heavy cingulum, a prominent basal heel; and a small accessory tubercle posteriorly. The cingulum is well developed and completely surrounds the tooth, in this respect answering the description of *Miacis vulpinus* (Scott).[5] $M_{\overline{1}}$ has an unusually small and low trigonid, which is very little greater

[5] *Proc. Amer. Assoc. Adv. Sci.*, 36th meeting, New York, 1887, p. 255.

in the antero-posterior diameter than the heel. The anterior and internal tubercles of the trigonid are of moderate development, while the external is, as usual, the largest of the three. The heel is unusually large and decidedly basin-shaped. Externally this tooth has a well-developed cingulum, but internally it is smooth. $M_{\overline{2}}$ was of considerable size, judging from the alveolus. $M_{\overline{3}}$ was evidently present, but whether or not it had two roots cannot be determined from the type specimen.

The distal end of the humerus is comparatively broad, and in this respect it suggests such forms as *Miacis parvivorus* and *Oödectes proximus*, described by Matthew.[6] The entepicondyle and the entepicondylar foramen are also of large size and the trochlear portion for the radius convex, as in *M. parvivorus.* The trochlea for the greater sigmoid cavity of the ulna is wide and the supinator ridge does not extend high up on the shaft.

A fragment of the proximal end of the ulna is preserved with the type. The olecranon process appears to have a moderate expansion antero-posteriorly and the anterior border is compressed laterally immediately above the greater sigmoid cavity. The latter is quite wide and oblique, with a prominent coronoid process and a concave lesser sigmoid cavity, which indicates power to rotate the head of the radius. The shaft appears to have a considerably backward curve, and is compressed laterally, expanded antero-posteriorly, and deeply channeled on the ulnar face.

The distal trochlea of the tibia is not broad, and there is a shallow groove separating the internal malleolar facet from the external portion of the trochlea. The astragalus is high and narrow, with a long neck unlike that of *Miacis parvivorus* and more suggestive of the astragalus of *Cercoleptes.*

The trochlear groove of the astragalus is shallow, the internal ridge being low, but more developed than in the form from the Bridger and in older genera. The head is laterally broad and there is present a minute astragalar foramen. The tuber of the calcaneum is compressed laterally and terminates above in a prominent tuberosity, which is very slightly grooved. The lesser process is not greatly expanded and the facet for the cuboid is very oblique. The dorsal face of the calcaneum is broken off. The navicular is proportionally narrow,

[6] "Carnivora and Insectivora of the Bridger Basis," *Mem Amer. Mus. Nat. Hist.*, Vol. IX, 1909, pp. 368, 378.

especially when the transverse diameter of the head of the astragalus is taken into consideration. The fact, however, is, that the head of the astragalus extends laterally, as in the Oxyænids, and articulates with the cuboid perhaps even to a greater extent than in the recent Kinkajou. The cuboid is very nearly as high proportionally as in *Cercoleptes* and has, as indicated above, a facet for the astragalus on the proximal tibial angle. The facet for the distal end of the calcaneum is oblique to conform to the corresponding facet on the calcaneum described above. There is present a heavy plantar tuberosity which again suggests similarity to *Cercoleptes*. The cuneiforms are high and narrow, the entocuneiform being of considerable size and has a large facet for Mt. I, indicating that digit to be approximately proportionate in size to that in *Cercoleptes*. The metatarsals are represented only by the heads of II, IV, and V and a portion of the shafts of III.

MEASUREMENTS.

Vertical diameter of ramus at $M_{\overline{1}}$ approximately	20 mm.
Length of molar-premolar dentition approximately	60 "
Antero-posterior diameter of $P_{\overline{4}}$	11 "
Antero-posterior diameter of $M_{\overline{1}}$	11 "
Transverse diameter of distal trochlea of humerus	19 "
Greater transverse diameter of dorsal end of humerus approximately	30 "
Greatest length of calcaneum approximately	42 "
Greatest height of astragalus	25 "
Transverse diameter of trochlea of astragalus	10 "
Greatest height of cuboid	19 "
Transverse diameter of tarsus distally	24 "

The genus and species described above is most closely allied to *Miacis*. That it belongs to the branch of the Cynoid *Miacinæ* appears to be quite certain from the remains at hand, but whether or not its successors are to be found in any of the known genera from later geological formations will not be known until the discovery of more perfect material. The study of the limited material at hand suggests that the genus represents an aberrant form, especially when the oxyænid and cercoleptid features of the pes are compared with the dentition.

Genus PRODAPHÆNUS Matthew.

5. **Prodaphænus** (?) **robustus** sp. nov. (Plate XXXIV, Figs. 3–5).

Type: Fragments of lower jaws with $P_{\overline{4}}$ $M_{\overline{1}}$ and $M_{\overline{2}}$ in place; fragments of vertebræ, greater portion of right humerus, and head of femur, C. M. No. 3023.

Locality: Six miles east of Myton, Uinta County, Utah.

Horizon: Uinta Eocene, Horizon C, near base.

Specific Characters: Antero-posterior diameter of $P_{\overline{4}}$ *and* $M_{\overline{1}}$ *subequal.* $P_{\overline{4}}$ *with anterior basal cusp; absence of posterior accessory cusp, but a cutting heel of considerable size present.* $M_{\overline{1}}$ *with broad and high trigonid; small heel, not basin-shaped.* $M_{\overline{2}}$ *of proportionally small size, trigonid low, and heel small.* $M_{\overline{3}}$ *one-rooted. Animals larger than Prodaphænus scotti.*

This specimen appears to differ both from *Miacis* and *Uintacyon*[7] and may represent a new genus, nevertheless it is thought best to provisionally place it in *Prodaphænus* having regard to the incompleteness of the type. The unfortunate absence of the upper teeth prevents comparison with *Prodaphænus scotti.* It is purposely kept separate from the latter on account of its greater size and also to save a possible confusion later on, since it may not even pertain to the same genus. The description and measurements of "*Miacis*" *vulpinus* Scott and Osborn[8] do not appear to agree with the present specimen. The structure of the lower jaw and the teeth do not compare well with *Procynodictis vulpiceps* Wortman and Matthew.[9]

The general contour of the mandible is perhaps more like *Uintacyon* than *Miacis.* It is certainly heavier, deeper, and I should judge[10] relatively shorter than *Prodaphænus* (*Miacis*) *uintensis* (Osborn) the symphysis being especially heavy. The canine, as indicated by the root, is heavy and laterally compressed. $P_{\overline{1}}$ is single-rooted, $P_{\overline{2}}$ is two-rooted, but, as in *Procynodictis*, apparently of considerably smaller size than $P_{\overline{3}}$. $P_{\overline{4}}$ suggests that of *Miacis hargeri;* it is a large tooth with a prominent anterior basal tubercle, a slight and rather smooth cingulum externally, entirely smooth internally, and a large cutting heel. $M_{\overline{1}}$ has a high and broad trigonid with the anterior tubercle well developed, as in *Procynodictis vulpiceps* and later forms. The heel is rather slightly developed both antero-posteriorly and transversely. It is of a trenchant type with a moderately heavy cingulum, extending along the inner face to the base of the postero-internal tubercle of the trigonid. The antero-posterior diameter of

[7] Dr. W. D. Matthew, *Mem. Amer. Mus. Nat. Hist.*, Vol. IX, 1909, pp. 326–377.

[8] *Proc. Amer. Philos. Soc.*, Vol. XXIV, 1887, p. 255.

[9] *Bull. Amer. Mus. Nat. Hist.*, Vol. XIV, 1899, p. 121.

[10] No contact has been established between the anterior and posterior portions of the mandible, but there would appear to be little doubt that the two pieces pertain to the same individual.

the tooth is but very little greater than that of $P_{\overline{4}}$. There is a slight cingulum on the external face of the trigonid, but internally the tooth is smooth, except the cingulum of the heel just described. $M_{\overline{2}}$ is much reduced in size and in this respect suggests the condition in *Procynodictis* and *Cynodictis* rather than in *Daphœnus* and *Daphœnodon.* The trigonid of this tooth is, however, lower than in the illustration given of *Procynodictis* and suggests more nearly that found in later forms (*Cynodictis*); the heel is slightly basin-shaped. $M_{\overline{3}}$ was a small one-rooted tooth which in the type is represented only by the alveolus.

Except the mandible just described, the humerus, minus the proximal end, is the only part of the type worthy of description. The shaft is quite heavy and rather long, and the deltoid ridge is robust and extends downwards more than half the length of the shaft, terminating abruptly, which plainly furnishes the cynoid characters given by Matthew & Wortman. The ulnar border of the distal end of the shaft is not complete, but enough is preserved to show that the supinator ridge was quite prominent and extends well up, in this respect being unlike the supinator ridge of *Mimocyon longipes*, which is much less extended upwardly and more like what is found in most species of *Miacis* and of *Lycarion* (*Vulpavus*) *hargeri.* The distal trochlea, though broad, is not as broad in proportion as in *Mimocyon*, and the middle portion of the articulation for the radius is much less convex and more nearly approaches what is seen in the genera of later formations (*Daphœnus* and *Daphœnodon*). The entepicondyle and the radial border of the entepicondylar foramen is broken off. There was apparently no supra-trochlear perforation.

MEASUREMENTS.

Length of mandible, canine to $M_{\overline{3}}$ approximately	65	mm.
Depth of mandible, canine to $P_{\overline{2}}$ approximately	22	"
Transverse diameter of mandible at symphysis opposite $P_{\overline{1}}$	10	"
Length of molar-premolar series approximately	58	"
Length of premolar series approximately	36	"
Length of molar series approximately	23	"

Genus PLEUROCYON gen. nov.

6. **Pleurocyon magnus** sp. nov. (Plate XXXV).

Type: Symphysis of lower jaws with left ramus nearly complete and a portion of the dentition in place, C. M. No. 2928.

Paratype: Fragment of right maxillary and jugal, right ramus with canine in place, fragments of upper and lower teeth, and a considerable portion of the skeleton, C. M. No. 3006.

Horizon: Uinta Eocene, Horizon C, near base.

Locality: Six miles southeast of Myton, Uinta County, Utah.

Generic Characters: Mandibular rami proportionally short and deep. Lower molars decreasing in size from first to third, tuberculo-sectorial, with long trenchant heels, low trigonids, and the metaconids of moderate size.

DESCRIPTION OF THE TYPE.

In comparing some fragments of the upper teeth of the paratype, No. 3006, with the description and illustrations of the superior dentition of *Vulpavus* and *Lycarion* by Wortman[11] and Matthew[12] it is at once seen that the canine of the present form is more compressed laterally. There is also a total absence of the internal and posterior ledge-like elevation, which rises from the cingulum (hypocone) on the internal face of the molars of *Miacis* and *Lycarion*, and in this respect it is more like the condition found in *Oödectes*, except that the deuterocone is proportionally more developed antero-posteriorly and has a tendency to be sub-divided into two tubercles in the form now being described. In other words, it appears that the hypo- and proto-cones have been united as indicated in the illustration, Pl. XXXV, Fig. 11, and that there is one intermediate tubercle of small size. Whether or not there were two intermediate tubercles cannot be determined from the material at hand. The postero-external tubercle is of well proportioned size. The tooth is broken on what I take to be its antero-external angle.

The lower dentition of the type, No. 2928, is much better preserved and furnishes more satisfactory means of comparison. There were most likely three lower incisors, though this cannot be fully determined from the type. Judging from the roots, the second incisor was of rather small size, while $I_{\overline{3}}$ was quite large. The canine, premolars $\overline{1}$, $\overline{2}$, the anterior portion of $P_{\overline{4}}$ and $M_{\overline{3}}$ unfortunately were not recovered. The root of the canine presents a long oval, placed nearly in a direct antero-posterior position on the axis of the jaw. The

[11] *Amer. Journ. Sci.*, (4), Vol. XI, 1901, p. 341, *Vulpavus*; pp. 342–445, *Lycarion hargeri* (Wortman).

[12] *Mem. Amer. Mus. Nat. Hist.*, Vol. IX, 1909, p. 343, *Lycarion*; pp. 344, 346, 380, *Vulpavus palustris* Marsh.

first lower premolar is indicated by a single root separated from the canine by a short diastema, but is continuous with the series back of it. $P_{\overline{2}}$ has two roots closely crowded together. $P_{\overline{3}}$ is rather curiously oxyænid in structure, the main cusp consisting of a low conical tubercle with a prominent conical heel and the anterior and internal faces surrounded by a smoothly rounded cingulum; externally the tooth is practically smooth. As already stated, the anterior face of $P_{\overline{4}}$ is not present in the type; in the paratype, however, this tooth is present, though isolated (see Pl. XXXV, Figs. 12–13). The oxyænid feature of this tooth is again repeated, the main cusp being comparatively of rather small size, while the heel is large and of a trenchant character. The anterior basal tubercle, though small, is well defined, but there is no posterior accessory cusp, in this respect suggesting such forms as *Prodaphænus* (?) *robustus*, *p.* 50, or "*Miacis*" *vulpinus* Scott.[13] The heel is, however, proportionally larger than in the two species mentioned. There is a poorly developed cingulum on the internal angle of the heel, otherwise the tooth is smooth. $M_{\overline{1}}$ has a low trigonid with the external tubercle the largest, the internal of moderate size, and the anterior small and low, this again agreeing in a general way with Scott's description of "*Miacis*" *vulpinus*. The heel of $M_{\overline{1}}$ in the present species, though trenchant as in "*Miacis*" *vulpinus*, is of large size, with an extended inner ledge, while that of Scott's species is low and small. In comparing $M_{\overline{1}}$ of the present genus with the miacids generally, it is apparent that *Vulpavus profectus* with its low trigonids bears a closer similarity to it than any of the other genera. The basin-shaped heel of *Vulpavus* is, however, totally unlike the large trenchant heel of the genus under consideration, which in this respect is perhaps most suggestive of *Oödectes herpestoides* Wortman. In the present genus $M_{\overline{2}}$ is very little smaller than $M_{\overline{1}}$ and the two are similar in every respect, except a somewhat smaller sized anterior tubercle of the trigonid on $M_{\overline{2}}$. There are no cingula on either of the two teeth just described. $M_{\overline{3}}$ is considerably smaller than the preceding molars and is implanted by two fangs.

The only portion of the skull preserved, besides the fragments of the teeth described, is a mutilated fragment of the right maxillary, with a portion of the zygomatic arch of the jugal attached. This fragment may or may not pertain to the paratype here described. The alveolar

[13] "*Amphicyon*" (?) *vulpinum*, sp. n. Scott and Osborn, *Proc. Amer. Phil. Soc.*, XXIV, 1887, p. 255.

portion of the maxillary apparently had considerable vertical diameter and the zygomatic arch is rather slender.

The general contour of the horizontal ramus of the type as well as of the paratype is not unlike that of *Oödectes.* The diameter of the jaw is small transversely and great vertically, with the lower border suddenly rising opposite $M_{\overline{2}}$ and gradually tapering towards the symphysis (see Pl. XXXV, Figs. 10, 15). The latter is curiously suggestive of *Sinopa*, having a shallow, quite long, and loose symphysis. In fact the entire jaw is like that of the latter genus, but the canine is heavier, the premolars set closer together, the cusps of all the teeth lower, the heels of molars not basin-shaped, and $M_{\overline{3}}$ too much reduced (added to this the different structure of the limbs, *vide infra*) to permit it to be regarded as belonging to *Sinopa.*

There are two mental foramina of moderately large size, the anterior under $P_{\overline{2}}$ and the posterior under the posterior portion of $P_{\overline{3}}$. In the type the base of the ascending ramus is very close to the dental series, so that the posterior fang of $M_{\overline{3}}$ is placed at a considerable angle to the position of the roots in the rest of the cheek-teeth. This is not the case in the paratype, where there is a wider space between $M_{\overline{3}}$ and the ascending ramus. Whether or not this is a specific character cannot be determined from the material at hand. The ascending ramus of the rami of both type and paratype are broken off.

MEASUREMENTS.

	Type No. 2928.	Paratype. No. 3006
Transverse diameter of upper molar		12 mm.
Antero-posterior diameter of upper molar		7 "
" " " " horizontal ramus from incisor to and including $M_{\overline{3}}$	65 mm.	75 "
Vertical diameter of ramus at $P_{\overline{1}}$	17 "	20 "
" " " " " $M_{\overline{2}}$	23 "	26 "
Length of molar-premolar series	51 "	59 "
" " premolar series	28 "	33* "
" " molar series	25 "	26* "
Antero-posterior diameter of $M_{\overline{1}}$	9.5 "	
" " " " $M_{\overline{2}}$	9 "	

Vertebral Column: The vertebral column of the paratype, No. 3006, is represented by a few fragments of the centra, which present no features worthy of mention, except that the caudal region was long and robust, as usual in the Eocene *Feræ.*

* Indicates the measurements to be approximately correct.

Limbs: The limbs consist of the greater portion of the shaft of the left humerus with the distal end mutilated, the ulna with the distal end wanting, fragments of the shaft of the radius, and the fifth metacarpal of the left manus. There are also fragments of the pelvis, the shafts of both femora, right and left tibiæ, fragments of the shaft of a fibula, a calcaneum, cuboid, ento- and meso-cuneiforms, all the metatarsals except the fifth, a few phalanges of the proximal and median rows, and the proximal portion of one ungual phalanx.

The limbs of *Pleurocyon*, as represented in the paratype, No. 3006, are proportionally large, in this respect suggesting *Palæarctonyx meadi* Matthew. The fragmentary humerus in detailed structure is perhaps more like that of *Vulpavus* Marsh or *Miacis* Cope. As in the latter genera, the deltoid and supinator crests are prominent, the entepicondylar foramen is of large size and the entepicondyle was no doubt also of large size. The proximal end of the bone is broken off and the distal end is badly mutilated. It is, however, to be seen that the articular trochlea for the upper portion of the greater sigmoid notch of the ulna is rather deep and narrow. Neither the olecranon or the supratrochlear fossæ are deep or high. Whether or not there is a supratrochlear foramen cannot be determined from the specimen.

The shaft of the ulna is compressed laterally, and is rather straight The lower half of the ulnar face is broadly and quite deeply channeled. Directly in front it presents a prominent and sharp crest for the attachment of the interosseous membrane, and well down on the radial face there is a second prominent crest, which helps to furnish support for the pronator muscle. The upper portion of the shaft of the ulna is again channeled on its outer face, while radially the shaft is more or less smooth. The coronoid process of the sigmoid cavity is broken off in the specimen, but the broken surface indicates that it was not large. The lesser sigmoid cavity is very shallow, while immediately below, and radial to the coronoid process, there is an unusually deep and large cavity for the attachment of the lateral ligament. The upper portion of the greater sigmoid cavity is compressed in order to meet the requirements of the deep and narrow articulation of the humerus described above. The olecranon process is short and truncated. The crescentic groove, over which passes the tendon of the triceps, is narrow, not very deep, and rather obliquely placed, due to the prominent anconeus process and the small development of the inner anterior margin of the groove.

The fragments of the radius indicate that the head is oval, the articulation with the ulna flat, the vertical groove on the anterior face of the head deep and well defined. Some distance below the bicipital tubercle the shaft is round-oval in cross-section. The bicipital tubercle is large and apparently well separated from the head.

Metacarpal V, the only bone which has been recognized as belonging to the manus, is short and quite heavy. Both the head and the distal end are much expanded, and the shaft has a decided forward curve, especially when viewed from the ulnar side. The manus was probably short and broad.

MEASUREMENTS.

Humerus, total length of the fragment	149	mm.
" antero-posterior diameter of shaft at lower extremity of deltoid ridge	27	"
" transverse diameter of shaft at lower extremity of deltoid ridge.	16	"
Ulna total length of the fragment	169	"
" " " olecranon process, anterior measurement	23	"
" antero posterior diameter of olecranon process	28	"
" greatest transverse " " " "	13	"
Mc. V greatest length	42	"

Hind Limb: A mutilated fragment of the ilium (all of that portion of the pelvis at hand) has the form of a heavy trihedral bar with the gluteal surface deeply excavated. A fragment of the ischium indicates that the shaft of this is deep and laterally compressed. The ischial spine is prominent, and terminates immediately back of the acetabulum, as is generally the case in the *Feræ.*

Both femora are represented, but they are flattened by crushing and furnish few reliable characters. The shaft is rather heavy and there is a third trochanter, as in the *Miacidæ* generally. The lesser trochanter appears to be located on the postero-internal angle of the shaft. The digital fossa appears to extend well down on the shaft.

Both tibiæ are represented, the left with the distal end partly preserved. The bones are crushed flat and have lost many of the original characters. There is a well-marked rugosity, which extends far down on the heavy shaft, indicating the position and prominence of the cnemial crest. The distal end is much flattened by crushing. The astragalar trochlea appears rather flat; the oblique ridge, which separates the external and internal condyles of the astragalus, is light; the internal malleolus is shown to be of fairly large size, and the grooves for the different tendons are well developed.

A few fragments, which I judge to belong to the fibula, show that bone to have had a heavy shaft.

The pes is fairly well represented. In its proportions it approaches *Vulpavus profectus* Matthew, though the metatarsals may possibly be relatively somewhat shorter than in that genus. The tuber of the calcaneum is not long, but is quite heavy, and has an ill-defined groove for the plantar tendon. The lesser process of the distal end is quite widely expanded; on the fibular face of the greater process is located the peroneal tubercle, which is large, and has a groove for the peroneus longus fully as large proportionally as in *Cercoleptes caudivolvulus.* There is no facet for the fibula; the facet for the cuboid is triangular in general outline and not as oblique as in *Vulpavus profectus*, described by Matthew, but is perhaps more nearly like that in *Cercoleptes.* The astragalus and ectocuneiform were unfortunately not recovered. The entocuneiform is of large size and has a very oblique facet for the navicular. This great obliquity continues in a similar manner downward over the superior fibular face of the mesocuneiform, so that the facet for the entocuneiform and the facet for the navicular on the mesocuneiform form an unusually acute angle. The cuboid is low as compared with *Mimocyon*, or with such a recent form as *Cercoleptes.* There is not any evidence of an articulation for the astragalus on the proximal tibial angle as seen in the latter genera. The proximal portion of the tibial face has, however, a large rough area, which no doubt joined the navicular, but probably did not come in contact with the side of the head of the astragalus. The facet below this area is plane, subtriangular in outline, of considerable size, and articulates with the ectocuneiform. The plantar tuberosity, though quite well developed, is not nearly as large as in *Cercoleptes* or *Mimocyon*, and the groove of the peroneus longus is consequently smaller and shallower than in the latter genera. The articulation for the metatarsals is quite oblique and subtriangular in outline. The metatarsals have apparently a close resemblance to those in *Vulpavus profectus*, the first being stouter and much shorter than the other four. Mt. V is not present in the material studied. As in the *Miacidæ*, the proximal row of phalanges are long, somewhat depressed, and the shafts slightly curved dorsad. The median row of phalanges are short, with only a very slight indication of asymmetry and at their lower extremities bent slightly dorsad. The ungual phalanges are represented only by the proximal portion of one phalanx, which is high and laterally compressed, but whether or not it was cleft or whether it was retractile cannot be determined.

MEASUREMENTS.

Tibia, approximate length	160 mm.
Pes, length, calcaneum to ungual phalanx	158 "
transverse diameter from cuboid to entocuneiform, approximately	33 "
greatest length of calcaneum	50 "
greatest height of cuboid	18 "
length of Mt. I	33 "
length of Mt. III	48 "
length of Mt. IV	56 "
length of proximal phalanx digit (? IV)	30 "
length of median " " (? IV)	18 "

7. **Pleurocyon medius** sp. nov.

In the American Museum collection of Uinta material are two fragmentary specimens, No. 1969, a fragment of a lower jaw with $M_{\overline{1}}$ in place, and No. 1992, a lower jaw without teeth, and a number of fragments of limb-bones. These pertain to a considerably smaller species, which may be called *Pleurocyon medius*, the second species known from the Uinta formation.

The genus as described above should undoubtedly be placed in the family *Miacidæ*, as defined by Dr. Matthew.[14] A careful study of the type makes it possible to further place the genus in Matthew's series "B," the "Cercoleptoidei" of the subfamily *Miacinæ* (*l.c.*, p. 346). In certain respects the genus is perhaps most nearly like *Vulpavus*, having, as that genus, low trigonids, the lower molars uniform in their general characters,[15] and decreasing in size from the first to the third. However, instead of having the broad basin-like heels of the molars as in *Vulpavus*, the present genus has molars with long trenchant heels, more like what is observed in *Oödectes*. From the latter the present genus differs in having the posterior basal cusps of the lower premolars larger and better defined, the trigonids of the molars lower, and the whole animal of much larger size. The paratype presents many characters common to the *Miacidæ* which have already been mentioned.

[14] "Carnivora and Insectivora of the Bridger Basin," *Mem. Amer. Mus. Nat. Hist.*, Vol. IX, 1909, pp. 344–345.

[15] $M_{\overline{3}}$ is unfortunately lost, but judging from the space it occupied, it was of somewhat large size.

INCERTÆ SEDIS.

A fragmentary skeleton, C. M. No. 2386, from the upper B or lower C of the Uinta sediments is provisionally referred to the family *Miacidæ.*

From the proportions of the fragments of the skull and from what is known of the limb-bones, I should judge the animal to have had a head in its proportions somewhat like *Vulpavus*, or possibly as small as that of *Palæarctonyx.* The limb-bones are, however, not as robust as in the latter, and more nearly suggest *Vulpavus.* The femur is slightly longer than that of *V. ovatus* described by Matthew. The illustration of the hind foot of *V. profectus* Matthew (*l.c.*, p. 389, Fig. 31) is quite suggestive of the remains of the hind foot of the present specimen. The material very likely represents a species new to science, but I refrain from proposing a name at the present time, even though the specimen may be worthy of being named.

Order *RODENTIA* (*Glires*).

Family ISCHYROMYIDÆ Alston.

Genus PARAMYS Leidy.

8. **Paramys compressidens** sp. nov.

Type: Lower jaw with cheek-teeth. C. M. No. 2920.

Horizon: Uinta Eocene (Horizon C).

Locality: Six miles east of Myton, Utah.

Characters of Type Specimen.[16] *Smaller than P. robustus or P. (Ischyrotomus) petersoni Matthew. Teeth narrower and jaw shallower and slenderer than in P. robustus. A greater prominence and better definition of the connecting crest between the two principal outer cusps of the molars than in P. (Ischyrotomus) petersoni.*

FIG. 3. *Paramys compressidens.* Carnegie Museum No. 2920. × 1/1.

'This species resembles *P. robustus* and *P.* (*Ischyrotomus*) *petersoni* in the general smoothness of the cusps, the shallow median valley, the absence of the external intermediate cusp, which is completely fused with the connecting loph, and the relatively small size of the anterior outer cusp of $P_{\overline{4}}$' (Gidley).

[16] Mr. James W. Gidley of the U. S. National Museum, Washington, D. C., has kindly compared the Uinta Eocene rodent remains, published in this paper, with type material from different institutions now (1916) in the National Museum undergoing a study preparatory to the forthcoming work on the Recent and Fossil Rodents by Messrs. Gerritt S. Miller, Jr., and James W. Gidley.

MEASUREMENTS.

Length of cheek-dentition	18 mm.
Vertical diameter of ramus at $M_{\overline{2}}$	13 mm.

9. **Paramys medius** sp. nov. (Plate XXXIV, Figs. 15–22).

Type: Fragment of maxillary with three teeth, and fragment of lower jaw, C. M. No. 3048.

Horizon: Uinta Eocene Horizon C.

Locality: Six miles east of Myton, Utah.

'*Characters of Type: Of same size as Paramys delicatus, but with broader summits of the unworn crowns of the molars and with the inner and outer faces more vertical. The hypocone is also somewhat more set off from the protocone, and the styles of the outer cusps and the hypocone are more prominent than in the Bridger species. The wrinkled appearance of the enamel suggests that this species is referable to Paramys*' (*Gidley*).

The total length of the three upper teeth is 13.4 mm.

A few fragments of vertebræ and limb bones together with portions of hind feet representing three individuals C. M. Nos. 3374, 3374*a*, and 3376, found by Mr. Earl Douglass at the base of horizon C near Kennedy's Hole, were referred by myself provisionally to *Paramys uintensis.* Mr. Gidley who has recently very kindly compared this material with other specimens in the U. S. National Museum, advises me, that, if these remains are to be referred to any described species, he would place them with *P. medius* described above rather than with *P. uintensis* "since the former is about the size of *P. delicatus*, and this foot agrees also in size with that of *P. delicatus*, being only slightly more robust." The specimens are apparently somewhat large to be regarded as *P. sciuroides*, and too small and apparently of different proportions from *P. robustus* Marsh or *P.* (*Ischyrotomus*) *petersoni* Matthew.[17] The hind foot as a whole appears to be relatively broader and shorter, while the distal end of the metatarsals is more suddenly expanded and the articulations are more rounded than in the foot of *P. robustus* figured by Dr. Matthew.[18]

The calcaneum and astragalus appear to be very similar to these bones in *P. robustus.* Among recent forms they most nearly suggest

[17] *Bull. Amer. Mus. Nat. Hist.*, Vol. XXVII, 1910, p. 49.

[18] In a letter of May 22, 1916, Mr. Gidley says in this connection: "While this foot resembles in a general way those of *P. robustus* and *P. delicatus*, the differences are sufficiently great to make its reference to this genus very doubtful."

those of *Arctomys* (*Marmota*)[19] but with the inner keel of the astragalar trochlea heavier. The peroneal tubercle of the calcaneum is located well up, as in *Marmota* and *Sciurus*. The cuboid is possibly somewhat broader and lower than in *P. robustus*, while the entocuneiform appears to be higher, and upon comparison totally unlike that given on p. 49 of Dr. Matthew's paper. In the latter species this bone apparently does not extend as high as the proximal face of the navicular. Added to this, regard must be paid to Matthew's statement on the same page, that the presence of the pre-hallux is not demonstrated in *P. robustus*.[20] In the present specimen, the entocuneiform extends high above the navicular and terminates in a broadly rounded tubercle considerably greater in its diameters when compared with those of the marmot or *Sciurus*. From this round and rather smooth head I would judge that there was present a plantar sesamoid or pre-hallux in the case of this individual. The proportional size and shape of the metatarsals seem to agree quite well with those of the marmot, while the distal articulation is distinctly more hemispherical, in this respect disagreeing with those of *P. robustus* illustrated by Matthew. The phalanges are also broader and possibly more depressed than in *P. robustus*.

MEASUREMENTS.

Length from top of astragalus to distal end of Mt. III	60 mm.
Length from top of astragalus to proximal end of Mt. III	30 "
Transverse diameter of tarsus, approximately	23 "
Greatest length of astragalus	20 "
Transverse diameter of trochlea	12 "
Length of Mt. I	20 "
Length of Mt. II	29 "
Length of Mt. III	31 "

[19] See Palmer "North American Fauna," U. S. Dept. Agri. Bull. No. 23, p. 400.

[20] In a letter from Mr. Gidley dated May 22, 1916, he states: "In the foot of *P. robustus* figured by Matthew, the top of the entocuneiform is broken off. But in the other specimen figured, which he referred to *P. delicatus*, this bone is complete, and shows the same backwardly directed ascending process on its proximal end as in your specimen, No. 3376. It is a little more strongly developed, however, in the latter. This development of the entocuneiform is usual in rodents having pentadactyl feet with unreduced digits (Compare squirrels and *Aplodontia*). . . . Although the distal facet of the astragalus is broken off in your specimen, there seems to be evidence of its having had a pre-hallux. Matthew is certainly mistaken in his observation regarding this element in their specimen of *P. robustus*. The astragalar facet and the navicular both show evidence of a pre-hallux having been present."

Subgenus **Ischyrotomus** Matthew.[21]

10. **Ischyrotomus gidleyi** sp. nov.

Type: Fragment of lower jaw with $M_{\overline{1}}$ and $M_{\overline{2}}$ in place, fragment of caudal. C. M. No. 3461.

Horizon: Uinta Eocene, Base of Horizon C.

Locality: Four miles northeast of Well No. 2, eastern end of Uinta Basin.

Characters of Type Specimens: Teeth relatively large: a well-formed basin on the inner half of the molar crown with a large exit internally.

While the type has a suggestion of *Sciuravus* Marsh[22] in which genus this type was first placed, Mr. Gidley says: "I do not think this species can well be referred to *Sciuravus*, since the proportions and general features of the molars are more nearly those of the *Paramys*-group. It differs from the typical *Paramys*, however, in the comparatively higher tooth-crowns and especially in the greater development of the continuous external loph, which is deeply infolded on the outer side, . . . a characteristic feature of *Ischyrotomus*." The dentition in proportion to the fragment is considerably larger than that of *Sciuravus*, illustrated by Matthew (*l.c.*, p. 59). $M_{\overline{1}}$ and $M_{\overline{2}}$ of the present species each have a well-formed basin on the inner half of the crowns, from which extends a large internal exit, as stated above, and also indicated by Fig. 4. This specimen may possibly represent a new genus.

FIG. 4. *Ischyrotomus gidleyi.* Carnegie Museum No. 3461. × 2/1.*

MEASUREMENTS.

Vertical diameter of ramus at $M_{\overline{2}}$	6.5	mm.
Antero-posterior diameter of $M_{\overline{1}}$ and $M_{\overline{2}}$	7	"
Antero-posterior diameter of $M_{\overline{1}}$	3.5	"
Transverse diameter of $M_{\overline{1}}$	3.	"
Antero-posterior diameter of $M_{\overline{2}}$	3.5	"
Transverse diameter of $M_{\overline{2}}$	3.	"

[21] In the *Bulletin of the American Museum of Natural History*, Vol. XXVIII, p. 50, Dr. Matthew erected the subgenus *Ischyrotomus*. Mr. Gidley is of the opinion that Matthew's subgenus *Ischyrotomus* should be given full generic rank and that to it should be referred *Paramys robustus* and *Paramys compressidens*.

* Outer side of teeth face toward the top of the page.

[22] *Amer. Jour. Sci.*, Vol. II, 1871, p. 46; *Ibid.*, Vol. XXIII, 1907, pp. 124; 130. *Bull. Amer. Mus. Nat. Hist.*, Vol. XXVIII, 1910, p. 59.

Genus SCIURAVUS Marsh.

11. **Sciuravus altidens** sp. nov.

Type: Fragment of left maxillary with two cheek-teeth in position and the root of the third. C. M. No. 2348.

Horizon: Uinta Eocene, Horizon B, near base.

Locality: Between Bonanza and Kennedy's Hole, Uinta Basin, Utah.

Characters of Type Specimen: Position of tritocone placed well internally and in line with the deuterocone; the presence of a small metaconule on $M^{\underline{1}}$*; a small mesostyle on* $P^{\underline{4}}$*; type specimen representing a somewhat larger animal than Sciuravus nitidus.*

The most noteworthy differences which I am able to find between the present specimen and that of *Sciuravus nitidus*, illustrated by Dr. Matthew, is that the postero-internal tubercle (tritocone) is placed more internally and more nearly in an antero-posterior line with the deuterocone. There is also in the present specimen a metaconule indicated on $M^{\underline{1}}$. This is plainly shown in Fig. 5, and is not indicated in the illustration, or mentioned in the text, of Matthew's paper. The specimen is of about the same, or slightly larger, size than *S. nitidus*.

Of this specimen Mr. Gidley has the following to say: "This specimen (No. 2348) is somewhat larger than *S. nitidus*, and further differs from that species in having the inner row, or rather the inner base of the crown in the upper cheek-teeth, considerably heightened, giving a decidedly bowed outline to the inner walls of these teeth. There is also a small mesostyle on $P_{\overline{4}}$ (absent in $P_{\overline{4}}$ of *S. nitidus*), and this cusp is relatively more prominent in the molars than in those of *S. nitidus*."

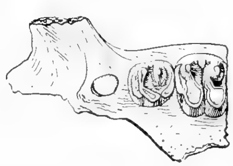


FIG. 5. *Sciuravus altidens.* Carnegie Museum No. 2348. × 3/1.

FIG. 6. *Prosciurus* Matthew. Carnegie Museum No. 2925. × 1/1.

* Outer side of teeth face toward the top of the page.

MEASUREMENTS.

Total antero-posterior diameter of $P^{\underline{4}}$ and $M^{\underline{1}}$	5	mm.
Antero-posterior diameter of P^{4}	2	"
Transverse diameter of P^{-}	2.3	"
Transverse diameter of $M^{\underline{1}}$	3.4	"
Antero-posterior diameter of M^{1}	2.3	"

Genus PROSCIURUS (?) Matthew.[23]

12. **Prosciurus** (?) **robustus** sp. nov.

Fragments of lower jaws of two individuals: C. M. Nos. 2925 and 2926 from Horizon C of the Uinta, six miles east of Myton, Utah, are here provisionally referred to Matthew's genus of the lower Oligocene, see Fig. 6.

In a note from Mr. Gidley, dated January 20, 1916, he says: "There are some peculiarities about the two forms I have provisionally referred to *Prosciurus* which indicate that better material may justify making a new genus for these species."[24]

Unfortunately there are no lower teeth with the type of *Prosciurus*, and consequently no basis of comparison except size. The present specimens appear to be at least twice the size of *Prosciurus vetustus* Matthew. To place the specimens with the latter species would seem to be out of the question. On the basis of its large size and the geological horizon in which it is found, the name *Prosciurus* (?) *robustus* sp. nov. may be proposed: No. 2925 is the type and No. 2926 is the paratype. This is mainly in order to have all the rodents from the Uinta more completely recorded.

MEASUREMENTS.

	Type No. 2925.	Paratype No. 2926.
Antero-posterior diameter of $M_{\overline{2}}$		6 mm.
Transverse diameter of $M_{\overline{2}}$		4 mm.
Antero-posterior diameter of $M_{\overline{3}}$	7 mm.	
Transverse diameter fo $M_{\overline{3}}$	5 mm.	

[23] *Bull. Amer. Mus. Nat. Hist.*, Vol. XIX, 1903, p. 213.

[24] In a later communication Mr. Gidley says that he thinks that it is possible that the species they represent may after all have been derived from the *Leptotomus* group of *Paramys*. This cannot be determined, however, until the upper teeth are known.

Family MURIDÆ Alston.

Genus PAREUMYS gen. nov.

13. **Pareumys milleri**[25] gen. et sp. nov.

Type: Lower jaw fragment with $M_{\overline{2}}$ and $M_{\overline{3}}$ in position. C. M. No. 2938.

Horizon: Uinta Eocene, Horizon C.

Locality: Six miles east of Myton, Utah.

Principal Characters revealed by the Type: $M_{\overline{2}}$ and $M_{\overline{3}}$ slightly longer than broad, distinctly quadritubercular with a heavy posterior marginal crest which extends well inward. Longitudinal crests connecting anterior and posterior tubercles. $M_{\overline{1}}$ slightly longer than $M_{\overline{2}}$. Animal about the same size as Eumys elegans of the Oligocene.

FIG. 7. *Pareumys milleri.** Carnegie Museum No. 2930. × 3/1.

In comparing the above genus with *Eumys elegans* Leidy from the Oligocene it is to be observed that $M_{\overline{2}}$ and $M_{\overline{3}}$ are more nearly subequal in size than in the latter. In the present genus the molars suggest those of *Eumys*, but are simpler, and are characterized by the absence of a fossette directly anterior to the protoconid; by the absence of a cross-crest from the protoconid to the internal median valley of the molars, and by the fact that the transverse diameter of the posterior portion of $M_{\overline{3}}$ is greater than in *Eumys*.

MEASUREMENTS.

Antero-posterior diameter of $M_{\overline{2}}$	1.6 mm.
Transverse " " $M_{\overline{2}}$	1.6 "
Antero-posterior " " $M_{\overline{3}}$	2. "
Transverse " " $M_{\overline{3}}$	1.2 "

ARTIODACTYLA.[26]

Subfamily HOMACODONTINÆ.

Small bunoselenodont Artiodactyls of the middle and upper Eocene with tetradactyl manus and pes; vestigial pollex (Bunomeryx montanus). Dentition $\frac{?}{2}$, $\frac{1}{1}$, $\frac{4}{4}$, $\frac{3}{3}$. (Bunomeryx and Hylomeryx, vide infra). Upper molars with small protoconule, or the latter and protocone united into a

[25] In recognition of the work on the Glires (Rodentia by Mr. Gerrit S. Miller, Jr.). Bull. Amer. Mus. Nat. Hist., Vol. X, 1898, p. 97.

* Outerside of teeth face toward the top of the page.

[26] This section of this paper, dealing with the artiodactyla, was read before the meeting of the Paleontological Society at Pittsburgh, 1917–18.

cross-crest. Absence of hypocone on M^3. *Presence or absence of "hypocone" on* M^1 *and* M^2. *A feebly developed paraconid on* M_3 *(in Homacodon only). A strong tendency towards the quadricuspid selenodont structure of the molar dentition.*

Genus BUNOMERYX Wortman.

14. **Bunomeryx elegans** Wortman (Plate XXXVII, Fig. 18).

Bull. Amer. Mus. Nat. Hist. Vol. X, 1898, p. 97.

Three specimens, C. M. Nos. 2951, 2949, and 3063, are referred to this species. The specimens are represented by lower jaws; they are smaller than the type specimen of *B. montanus* (see Pl. XXXVI, Figs. 3–4) and in this respect more nearly agree with *B. elegans* Wortman. There is, however, a shorter diastema between P_2 and P_3 than in the latter species, and the accessory cusps of P_3 are better developed. The tooth regarded as the canine by Wortman is of a trenchant character, with the apex a little recurved and elevated slightly above the crown of the succeeding tooth. The tooth has the appearance of a sub-caniniform premolar, in which event *Bunomeryx* would have four instead of three lower premolars. The tooth in front of this so-called canine is equally large and its crown also of the same detailed structure. It would therefore appear that P_1 in *Bunomeryx* was mistaken for a canine, while there are only two incisors. The latter are suddenly reduced in size and have typical fan-shaped crowns.

Genus HYLOMERYX gen. nov.

Type: Anterior portion of skull and lower jaws, C. M. No. 2335.

Paratype: Fragments of upper teeth, portion of cast of brain, and both mandibular rami, C. M. No. 2944.

Horizon: Near the base of Horizon C, Uinta Eocene.

Locality: Eastern border of Uinta Basin, near Vernal on the Uinta Railroad Stage-road, Uinta Basin, Utah.

Generic Characters: $I\frac{?}{2}$, $C\frac{1}{1}$, $P\frac{4}{4}$, $M\frac{3}{3}$. *Homacodon-like dentition, but with short diastema between* P^1 *and* P^2. *Premolars heavier and of relatively greater antero-posterior diameter than in Homacodon. Cingulum of the premolars rather slightly, or not at all, indicated. Absence of antero- and postero-external cuspules on* P^4 *as in Bunomeryx. Protocone and protocunule united into a cross-crest on* M^2 *and* M^3. P_3 *with distinct internal tubercle;* P_4 *with deuteroconid; antero-internal tubercle* *and heel as in Bunomeryx. Protocone and protoconule united into a cross-crest on $M^{\underline{2}}$ and $M^{\underline{3}}$. $P_{\overline{3}}$ with distinct internal tubercle; $P_{\overline{4}}$ with deuteroconid, antero-internal tubercle, and heel as in Bunomeryx, and a greater advance towards the selenodont pattern of the inferior molars than in Homacodon.*

The principal differences between *Bunomeryx* and *Hylomeryx* are as follows: the antero-external angle of $M^{\underline{2}}$ and $M^{\underline{3}}$ is more developed, giving these teeth a more perfectly quadrate outline in the present genus. Furthermore there is present in *Hylomeryx* a distinct hypocone on $M^{\underline{2}}$ as in *Homacodon*, while in *Bunomeryx* there is no hypocone. $P^{\underline{2}}$ and $P^{\underline{3}}$ of *Hylomeryx* are apparently also proportionally larger.

15. **Hylomeryx annectens** sp. nov. (Plate XXXVI, Figs. 5–6).

GENERAL DESCRIPTION OF THE MATERIAL CONSTITUTING THE TYPE.

The skull is considerably depressed by crushing, but it is possible to make out the outline of the nasals, which are long, rather slender, and extend backward to opposite the anterior border of the orbits. The frontal meets the nasal in a decided zigzag cross-line on the face, analogous to what is seen in such forms as *Limnenetes anceps* among the Oreodonts or *Stenomylus* among the Cameloids. There is no

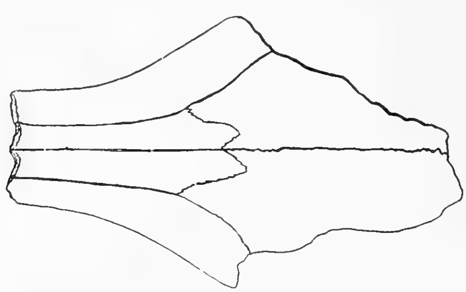


FIG. 8. *Hylomeryx annectens.* Carnegie Museum No. 2335. × 1/1.

lachrymal pit or vacuity, and the infraorbital foramen is small and located above $P^{\underline{3}}$ as in *Homacodon vagans* illustrated by Dr. Sinclair.[27] The anterior border of the orbit is opposite the median portion of $M^{\underline{2}}$. When the skull in its present crushed condition is considered, it is possible to imagine that it, when normal, was similar to that of *Homacodon* in the specimen illustrated by Sinclair.

[27] *Bull. Amer. Mus. Nat. Hist.*, Vol. XXXIII, 1914, p. 285, Fig. 19.

A partial cast of the brain-case indicates a fairly large-sized brain. The lower jaw is well proportioned, there being considerable depth to the ramus throughout. The symphysis is quite strong and extends back opposite $P^{\underline{3}}$.

From the study of the upper dentition alone one would perhaps hesitate in referring the Uinta remains to a separate genus. Thus the roots of the superior canines, which are still in position, reveal just such a powerful and recurved apex as is indicated in Sinclair's illustration. $P^{\underline{1}}$, which however is separated by a short diastema from $P^{\underline{2}}$, is larger than the preceding tooth, and has a more gentle slope of the posterior border; otherwise there is little or no difference between the two. $P^{\underline{3}}$ agrees with the description and illustration by Sinclair just referred to, except that the deuterocone is somewhat better developed. $P^{\underline{4}}$ appears to have the cingulum very little, if at all, developed; the antero- and protero-external cuspules are absent; nevertheless on the whole the tooth closely resembles that of the specimen of *Homacodon* described by Sinclair. The most pronounced modification of the molars is the union into a cross-crest of the antero-internal and median tubercles, which is especially well accomplished on $M^{\underline{2}}$ and $M^{\underline{3}}$ of the type, but which cannot be said to have taken on an advanced selenodont pattern, as is seen in *Bunomeryx* Wortman.[28] On the contrary these crests are very perissodactyl-like with the slightest indication of the intermediate tubercle on an unworn or slightly worn tooth, (see Fig. 9, $M^{\underline{2}}$ and $M^{\underline{3}}$). This condition is quite clearly foreshadowed in *Homacodon* where the intermediate closely crowds the antero-internal tubercle.

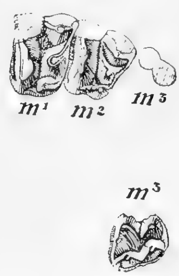


FIG. 9. *Hylomeryx annectens*. Carnegie Museum No. 2944. × 1 1/2.

When the study and comparison of the inferior dentition is taken up, it is clear that a considerable modification toward the selenodont pattern of the tooth-structure has taken place in these Uinta remains, which at once separates them from the Bridger form. In the paratype, No. 2944, both rami are preserved (the left with the symphysis complete), containing two incisors represented by moderately large roots subequal in size.[29] The canine is a large trenchant tooth with

[28] *Bull. Amer. Mus. Nat. Hist.*, Vol. X, 1898, p. 100, Fig. 2.

[29] Unfortunately there are as yet no incisors known in *Homacodon*, but I judge that genus to have two, as in the present form.

the apex slightly recurved. $P^{\underline{1}}$ is single-rooted as in *Homacodon* and has a trenchant crown. $P^{\underline{2}}$ has a considerably greater fore- and-aft diameter, but is otherwise quite similar to the preceding tooth. $P^{\underline{3}}$ differs from that in *Homacodon* by the presence of an internal

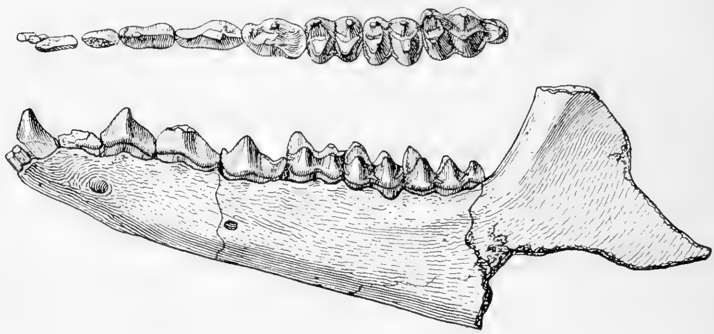


FIG. 10. *Hylomeryx annectens.* Carnegie Museum No. 2944. × 1 1/2.

tubercle situated well back, which may be regarded as the deuteroconid. $P^{\underline{4}}$ is entirely different from that tooth in *Homacodon* and more nearly suggests that in *Bunomeryx.* Thus the deuteroconid is prominent,[30] there is a decided antero-internal tubercle and a heel differing both from Professor Marsh's illustration (*Amer. Jour. Sci.*, Vol. XLVIII, 1894, p. 262, Fig. 6), and Sinclair's description (*l.c.*, p. 284). Marsh has stated that this tooth in *Homacodon vagans* has a simple crown, while Sinclair, without criticizing Marsh, says that there is no deuteroconid, but a prominent anterior tubercle and almost as prominent a posterior basal tubercle rising from a cingulum-like heel.

The lower molars are of a type further advanced toward the selenodont structure than those of *Homacodon.*

MEASUREMENTS.

	Type No. 2335.	Paratype No. 2926.
Antero-posterior diameter of skull from anterior border of orbit to canine	32 mm.	
Length of cheek dentition	39 "	38 mm.
Length of superior premolar series	22	
Length of superior molar series	16 "	
Antero-posterior diameter of $P^{\underline{1}}$	3 "	

[30] In the type, which pertains to a younger individual than the paratype, the deuterocone and antero-internal tubercle are less prominent; less distinctly separated from the protoconid, and situated higher up on the crown.

Antero-posterior diameter of P^2	5	mm.		
" " " " P^3	5	"		
Transverse diameter of P^3	5	"		
" " " P^4	5	"		
Antero-posterior diameter of "	5	"		
" " " " M^1	5.5	"	5.5	mm.
Transverse " " "	6	"	6.5	"
" " " M^2	6.5	"	7.	"
Antero-posterior " " "	6	"	6	"
" " " " M^3	5.5	"	5.5	"
Transverse " " "	6	"		
Vertical diameter of mandibular ramus at P_3	9	"	8	"
Vertical diameter of mandibular ramus at M_3	12	"	12	"
Antero-posterior diameter of inferior premolar series			20	"
Antero-posterior diameter of inferior molar series	19	"	18	"

For other measurements see text-figures 8 and 9, and Pl. xxxvi, figs. 5, 6.

Genus SPHENOMERYX gen. nov.

16. **Sphenomeryx quadricupsis** gen. et sp. nov. (Plate XXXVII, Figs. 15–16).

Type: Fragments of upper and lower jaws with teeth, C. M. No. 2346.

Paratypes: Surface fragments of two or three individuals found together, representing brain-casts and other mutilated parts of limb- and foot-bones, together with a fragment of a lower jaw with P^4 and the molars represented, C. M. Nos. 2914, 2915, 2926.

Horizon: Uinta Eocene. Base of Horizon C.

Locality: Type found about two miles south of Kennedy's Hole to the west of old Vernal-Dragon Stage-road in eastern end of Uinta Basin. Paratypes found six miles east of Myton, Utah.

Generic Characters, as shown by the Type and Paratypes: M^1 without postero-internal tubercle, but instead a heavy ledge or cingulum, which extends around the internal face of the tooth. A transverse ridge-like protocone on wear of the tooth as in Mesomeryx. Paracone conical, metacone subconical. External faces of para- and metacones sharply convex from side to side, as in Mesomeryx. Small parastyle, meso- and metastyles absent, and instead a heavy cingulum on the external face, as in Hylomeryx and Mesomeryx. Premolars heavy; deuterocone of P^3 very small and placed well back. Lower teeth like those in Bunomeryx and Hylomeryx. Animals of same size as Hylomeryx.

The present genus, as well as *Hylomeryx*, has the para- and metacones of M^1 more nearly conical than is the case in either *Bunomeryx* or *Mesomeryx*. In the latter there are, however, no mesostyles, while in *Bunomeryx montanus* they are fairly well represented. The large premolars of the present genus suggest *Hylomeryx*, while the minute deuterocone on P^3 and the absence of the postero-internal tubercle of M^1 separates the genus from both *Bunomeryx* and *Hylomeryx*. The present new genus is apparently the first of the *Homacodontinæ* marked by the absence of this hypocone on M^1. The heavy internal ledge of the postero-internal angle of the crown fills out this portion of the tooth so that it has an outline practically as quadrate as that of M^1 in *Hylomeryx*. I regard the present genus as being very close to *Hylomeryx* because of the similar meta- and paracones, the absence of the mesostyle, and the robust premolars. The protocone and protoconule have undoubtedly united into a solid cross-ridge on M^1. This supposition is expressed by the specific name, while the generic name serves to express the inter-relationship of this form with practically all the known genera of this subfamily.

The brain-casts of No. 2915 and 2926 are of quite large size, with well marked convolutions, a distinct or rather deeply constricted area between the cerebrum and cerebellum. The medulla oblongata is also quite large. In No. 2915 there is still adhering to the cast a portion of the parietals, which display a sagittal crest of considerable prominence and length. The lower jaw of the paratype, No. 2915, shows the same generally robust structure, which is seen in the type.

MEASUREMENTS.

				Type No. 2346.	
Antero-posterior	diameter	of	P^3 to M^1 inclusive	16.5	mm.
"	"	"	" P^3	6	"
Transverse		"	" "	4	"
"		"	" P^4	6	"
Antero-posterior		"	" "	5	"
"	"	"	" M^1	5.5	"
Transverse		"	" "	6	"
Antero-posterior		"	" P_3, M_3 approximately	32	"
"	"	"	" P_4	6	"
Transverse		"	" "	3.5	"
"		"	" M_1	4	"
Antero-posterior		"	" "	5.5	"
"	"	"	" M_2	5.5	"
Transverse		"	" "	4	"
"		"	" M_3	4	"
Antero-posterior		"	" " approximately	7	"

Genus MESOMERYX gen. nov.

Type: Fragment of maxillary with cheek-teeth in place, C. M. No. 3189.

Horizon: Uinta Eocene. Lower C.

Locality: Near eastern border of the Upper Eocene sediments, two miles east of Dragon-Vernal Stage-road, Uinta Basin, Utah.

Generic Characters: Molars with sharp external convexity of para- and metacones; the latter tubercles distinctly connected by a fore-and-aft ridge near the external face of the tooth, prominent parastyle, weak metastyle, absence of mesostyle. Protocone formed into an oblique cross-crest on wear. Subselenodont structure of postero-internal tubercle. $P^{\underline{3}}$ with weak, and $P^{\underline{4}}$ with strong, deuterocone.

17. **Mesomeryx grangeri**[31] sp. nov. (Plate XXXVII, Fig. 17).

General Description of the Type Specimen: The type represents an animal smaller than *Bunomeryx elegans* Wortman. The dentition has, however, advanced a step further than in the latter genus. This is especially seen in the molar teeth. The protocone is united with the protoconule, so that the two form an oblique forward and outward extended ridge on the surface of a worn tooth as in *Hylomeryx*. On close examination this ridge is seen to have a slight constriction, but whether or not there was a separation between protocone and protoconule, as in the Homacodonts generally, cannot be stated (most likely there was only a solid cross-ridge). There is no postero-internal tubercle on either $M^{\underline{1}}$ or $M^{\underline{2}}$. The present genus appears in this respect to resemble the one just described, but in the present form the para- and metacones are decidedly less conical and the whole structure of the crown more selenodont. If this postero-internal tubercle (hypocone?) had ever existed in this phylum, as for instance in *Homacodon*, *Hylomeryx*, *Bunomeryx*, and *Sphenomeryx*, it had already been completely crowded out, absorbed, or otherwise replaced by the metaconule in the Bridger or earlier genera. From what we have just seen in the true *Homacodon* phylum it would appear to add much strength to Dr. Wortman's views of the process of the development of the quadricuspid selenodont from the quinquicuspid bunodont molar.[32] There is a well-developed cingulum posteriorly on both $M^{\underline{1}}$ and $M^{\underline{2}}$,

[31] In recognition of Mr. Walter Granger of the American Museum of Natural History, New York.

[32] *Bull. Amer. Mus. Nat. Hist.*, Vol. X, 1898, p. 101.

which unites with the rather well-developed parastyle, while in the posterior molars the cingulum is rather poorly developed, as is also the metastyle. There is no mesostyle, but a well-developed ridge near the outer face of the crown, which effects a connection between para- and metacones, unlike what is seen in *Bunomeryx* or *Hylomeryx*. Internally at the exit of the median valley there is (especially on $M^{\underline{1}}$) a heavy, smooth cingulum, which is most suggestive of similar cingula on the molars of *Helohyus* and of such later Tertiary selenodont forms as *Dromomeryx*, *Palæomeryx*, and *Dicrocerus*. $P^{\underline{4}}$ has the proto- and deuterocone of equal size and a heavy cingulum anteriorly and posteriorly, which terminate externally in small basal tubercles. $P^{\underline{3}}$ has a large protocone with a quite trenchant ridge extending backward and sloping gradually. The tooth is surrounded by a cingulum especially well-developed internally, so that one may say there is a rudimentary deuterocone. This deuterocone or tubercle is located further forward on the tooth than in *Bunomeryx* or *Hylomeryx*. $P^{\underline{2}}$ is represented by two roots.

MEASUREMENTS.

Antero-posterior	diameter	$P^{\underline{2}}$ to $M^{\underline{3}}$	16	mm.
" "	"	$P^{\underline{3}}$	4.5	"
Transverse	"	P^{-}	3.7	"
"	"	$P^{\underline{4}}$	5	"
Antero-posterior	"	$P^{\underline{4}}$	3.5	"
" "	"	M^{1}	4.5	"
Transverse	"	$M^{\underline{1}}$	5	"
"	"	M^{-}	6	"
Antero-posterior	"	M^{2}	5	"

PHYLOGENY.

There is but little doubt that *Mesomeryx* belongs to the subfamily *Homacodontinæ*. From the characters of the molars one would not long hesitate in placing the genus near *Sphenomeryx* or *Bunomeryx*. The consolidation of the antero-internal and antero-median tubercles into a cross-ridge as in *Hylomeryx*, and the absence of the hypocone on $M^{\underline{1}}$ as in *Sphenomeryx*, may in this genus be looked upon as representing a line, which paralleled the evolutionary stages in the *Homacodon-Sphenomeryx* phylum.

It is quite evident that the foregoing genera are most nearly related to the Bridger genus *Homacodon*. That these upper Eocene Artiodactyls of America hold a position relatively well differentiated from the Hypertragulids, the Camelids, the Oreodonts, and other Artiodactyls must also be admitted. In my judgment these Uinta genera as well as *Homacodon* constitute a sub-family distinct from the Dichobunids of Europe.[33] They represent an American branch, whose common ancestors, no doubt, also gave rise to those of Europe. Upon the whole the details of structure in the dentition differ considerably in the genera representing the two regions. This is especially noticeable when such European genera as *Mouillacitherium* and *Metriotherium*[34] are compared with the Uinta forms. The protocone sends a spur backwards, which has a tendency to close the cross-valley in the European genera, while the valley is clear in the American genera, analogous to what is seen in *Oxacron* and *Cænotherium* of Europe. The hypocone of the European genera appears to have a greater functional value, that is: it is of proportionally larger development and apparently expresses a greater degree of permanency, which is especially emphasized in the *Oxacron-Cænotherium* phylum. These phyla are, however, not recognized by Stehlin, and others, as having any especial relation to the true dichobunids.

If we regard the *Homacodon-Hylomeryx-Bunomeryx-Sphenomeryx* and the *Mesomeryx* phyla as at all closely related, we have clearly a tendency toward the quadricuspid condition in the American forms. In *Dichobune* according to Stehlin's reconstruction (*l.c.*, p. 604; 607) we have a skull proportionally longer, lower, and narrower, with the premaxillaries heavy, in order to support the large incisors. The upper canine has specialized in size and shape, so that it differs much from that in *Homacodon* and *Hylomeryx*.

So far as I am aware, the *Homacodontinæ* are not represented in the Oligocene or later epochs of North America. Dr. Sinclair's opinion (*l.c.*, pp. 294–295), that several divergent lines of the bunodont Artiodactyls are already established in the lower and middle Eocene of North America is altogether quite likely. It is also probable that some of the lower Eocene genera, already partially known, may prove to be in the line of the *Homacodontinæ*.

[33] From our present knowledge of *Bunophorus* (*Bull. Amer. Mus. Nat. Hist.*, Vol. XXXIII, 1914, p. 273) it is perhaps premature to here include this Wasatch genus, which may, however, be a forerunner of *Homacodon* ,as Dr. Sinclair suggests.

[34] Stehlin, G. H., *Abhand. Schweiz. Paleont. Gesellsohaft*, Vol. XXXIII, 1906, pp. 628, 661.

Family ANOPLOTHERIIDÆ.

A great surprise encountered in the study of the collection from the Uinta Eocene made in 1912 is the discovery of a genus, which represents the family *Anoplotheriidæ* hitherto only known from the old world. Only surface fragments were found, which are apparently mixed with remains pertaining to other typical Uinta genera, but enough has been brought together from the lot to certainly establish the features, especially of the limb and foot structure, of an American anoplothere. There was found a second individual in the same locality and horizon, which also consists of foot-bones and other fragments of the skeleton.[35] These fragmentary remains (especially those of the limbs and feet) appear to agree most closely with the genus *Diplobune* of the European Tertiary.

Genus DIPLOBUNOPS gen. nov.

18. **Diplobunops matthewi**[36] sp. nov. (Plate XXXVII).

Type: Numerous fragments of the skeleton, C. M. No. 2974.

Paratype: Foot-bones and other fragments of the skeleton, C. M. No. 3394.

Horizon: Uinta Eocene, Horizon C.

Locality: Six miles east of Myton, Utah.

Principal Characters obtained from the Type and Paratype: radius and ulna short and stout; carpus and tarsus relatively low and broad; articulation of proximal phalanges convex, distally carnivore-like; unguals high, claw-like, compressed posteriorly and superiorly, and suddenly expanded along the plantar border in front of the subungual process; animals slightly smaller than Diplobune quercyi of Europe.

The fragments of the skull and lower jaws which were found together with the paratype of *Diplobunops*, C. M. No. 3394, are so nearly similar to corresponding parts of other Uinta protoreodonts that it is only provisionally that they are referred to the paratype of this new genus. Indeed these skull and jaw fragments were first given a separate catalog number and referred to *Protagriochœrus annectens* Scott.[37] A closer and more critical study of the specimen in connection with *Diplobune quercyi* reveals two hypotheses: of which the first and most probable is, that the remains of a new species of *Protagriochœrus* in

[35] The fragments of the skull and lower jaws are provisionally referred here.

[36] In recognition of Dr. W. D. Matthew.

[37] *Trans. Wagner Free Institute of Science*, Vol. VI, 1899, p. 100.

some way got mixed with the limb- and foot-bones of *Diplobunops;* the second is that possibly the present new genus and the protoreodonts possessed a dentition more closely similar in structure than might have been anticipated.

The upper dentition is almost completely demolished in the specimen under consideration. However, a few important characters are ascertainable. The alveolar border is longer than in the type of *Protagriochœrus annectens*, which is due to the relatively longer premolar region, a character which suggests *Diplobune.* The root of the upper canine indicates that it is like the same tooth in *Protagriochœrus*, but P^{1} is more isolated and recalls the condition in some species of *Agriochœrus.* The inner portions of M^{2} and M^{3} are preserved and show that the postero-internal crescents have more acute angles on the inner face than in *Diplobune* and thus are more like these teeth in *Protagriochœrus*, and also that the intermediate tubercle (protoconule) is smaller than in the European genus.

Although the mandible of *Diplobune* is longer and slenderer, the premolars longer and better developed behind than in the present specimen, there is a surprising similarity in the dentition of the two forms, so far as comparison can be made by means of the material at hand. While the internal tubercles of the molars are grooved on the inner face, I judge that the anterior internal tubercles were not twinned, at least not to the same extent as those in *Diplobune.* In the latter genus the inner faces of the molars are less rugose than in the specimen under description, while in some species of *Protoreodon* this feature appears to be similar to that in *Diplobunops.* M^{3} has a well developed fifth cusp as in *Diplobune* and in the Oreodonts generally.

The distal end of the scapula has a general resemblance to that bone in *Diplobune.* The distal end of the humerus has the same low and broad anconeal fossa, the large entepicondyle, the broad trochlea with the great convexity of the intertrochlear ridge, and the sharp and well defined external ridge, which articulates with a corresponding facet of the radius. The latter has an expanded head as in *Diplobune.* The ulna is short and stout, with a remarkably short and heavy olecranon process.

The material at hand clearly indicates that the carpus is lower and relatively broader than in *Diplobune.* The scaphoid is broader, but the antero-posterior and vertical diameters are less, and the distal articulating faces less distinct from one another than in the European genus. The lunar upon the whole is perhaps more suggestive of *Anoplotherium* inasmuch as the proximal articulation extends backward and downward in a similarly gentle slope to very nearly the palmar face without the sudden downward pitch, which is seen in the posterior half of this articulation in *Diplobune*. The distal articulations for the magnum and unciform, on the other hand, are more subequal than in *Anoplotherium* and in this respect the lunar in the present genus is perhaps more like *Diplobune*. The dorsal face of the cuneiform in the latter genus is of uniform height, while in the present genus it is highest radially and decreases in the ulnar direction, due mainly to the upward turn of the unciform facet in the ulnar region. (See Pl. XXXVII, Fig. 17.) The posterior portion of the lunar facet on the unciform of No. 3394 is extremely convex from side to side, and terminates supero-radially in a blunt cone, quite unlike what is seen in either *Diplobune* or *Anoplotherium*, but the general characters of the unciform are more nearly like those of that bone in *Diplobune*.

The metapodials which have been associated with the type have their distal articulation for the proximal phalanx very convex and carnivore-like. Mc. II is represented by the upper end in both type and paratype. This bone is slenderer in proportion than in *Diplobune*, but as in the latter genus there is a facet for Mc. I. The phalanges of the proximal and median rows are broad and depressed, while a terminal phalanx, belonging to specimen No. 3394, indicates that these elements are high, laterally compressed, and claw-like, with a sudden broadening along the plantar borders in front of the sub-ungual process, and that there is a large nutrient foramen on either side near the plantar face of the bone. The bone closely resembles that in *Diplobune*.

Enough is preserved of the astragalus to indicate that it was low and broad as in the European anoplotheres. The calcaneum is better preserved and only in the more minute details does it differ from that of *Diplobune*. In the latter genus the internal or tibial face of the tuber calcis is less convex, the peroneal tubercle less developed, the eminence on the dorsal border which articulates with the fibula is smaller, and the facet for the cuboid is less extensive both laterally and antero-posteriorly. The cuboid is also very suggestive of *Diplobune*, though broader, lower, and having the astragalar and calcaneal facets more unequal in size; that for the calcaneum being much the broader of the two.

The genus is provisionally referred to the subfamily *Anoplotherinæ* pending the discovery of more complete material. From the unusually low tarsus together with the hemispherical or carnivore-like distal articulation of the metapodials it is altogether likely that the American genus represents a distinct subfamily (*Diplobunopsinæ*) which may be more satisfactorily differentiated from European diplobunids upon further discovery and verification of dental and cranial characters.

MEASUREMENTS.

		Type No. 2974.
Scapula, distal end	antero-posteriorly approximately	45 mm.
	transverse	25 "
Humerus, distal end	greatest transverse diameter	62 "
	greatest antero-posterior diameter	24 "
Radius, proximal end	greatest transverse diameter	32 "
	greatest antero-posterior diameter	20 "
Ulna	olecranon process, length	19 "
	length of shaft, approximately	112 "
Carpus	greatest transverse diameter	42 "
	vertical diameter at ulnar face	9 "
Scaphoid	transverse diameter	13 "
	antero-posterior	19 "
Lunar	transverse diameter	14 "
	antero-posterior diameter	18 "
Cuneiform,	transverse diameter	18 "
Calcaneum,	total length, approximately	60 "
Cuboid	transverse diameter	26 "
	vertical diameter at fibular face	9 "

Family ACHÆNODONTIDÆ.

Family Characters: Dentition: $\frac{3}{3}, \frac{1}{1}, \frac{3}{3}, \frac{3}{3}$; *bunodont. Orbits not enclosed posteriorly; limbs short; feet tetradactyl,*[38] *animals the size of a wild boar to nearly that of an Hippopotamus.*

In this family is included *Achænodon* Cope and *Parahyus* Marsh.

Genus ACHÆNODON Cope.

19. **Achænodon insolens** Cope.

Palæontological Bulletin, No. 17, 1873, p. 2.

Two mandibular rami, C. M. Nos. 2309 and 3183, are referred to this species. No. 2309 is of the same size as the type described by

[38] The characters of the limbs and feet are obtained from Professor Osborn's publication (Bull. Amer. Mus. Nat. Hist., Vol. VII, 1895, p. 105). The skull and limbs have not as yet been found together in any representative of this family.

Cope, while No. 3183 is somewhat smaller. These specimens are easily separated from the type of *Achænodon robustus* Osborn by their slenderer and shallower form and by the relatively longer molars. Furthermore the heel of $P_{\overline{1}}$ in *A. insolens*, as exhibited by the Carnegie Museum specimen No. 2309 (see Fig. 11) is more strongly de-

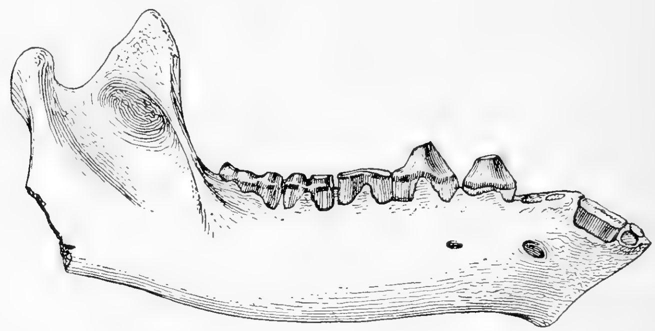


FIG. 11. *Achænodon insolens.* Carnegie Museun, No. 2309. × 1/4.

veloped than in *A. robustus*. The premolars in *A. robustus* are apparently larger than in *A. insolens*, which, however, may perhaps be partly due to imperfection of the premolar teeth in No. 2309, which are extensively repaired with plaster. The coronoid process of *A. insolens* appears to be more everted and the summit sharper than in *A. robustus*.

Both of these mandibular rami were found by Mr. Earl Douglass in Horizon B of the Uinta sediments.

20. **Achænodon uintense** (Osborn).

Bull. Amer. Mus. Nat. Hist., Vol. VII, 1895, p. 102.

This species is represented by two crania, C. M. Nos. 2160 and 3182, found by Mr. Earl Douglass in the same horizon (B.) and locality (eastern portion of Uinta Basin) in which the type of the species was obtained. In a previous publication, *Protelotherium* was referred to *Achænodon*.[39] As the result of recent careful study of the Uinta and Washakie forms I am strengthened in the opinion that they should be kept under one generic name. When a liberal allowance for the complete premaxillary and a correction of the frontal region (See Pl. XXXIX, Fig. 1) in *A. robustus* is made, there does not appear to

[39] *Memoirs Carnegie Museum*, Vol. IV, 1909, p. 145.

be as great a difference in the length of the face between *A. robustus* and *A. uintense* as appear in the original illustration and as stated by Professor Osborn.[40]

This character together with the position of the orbit was until very recently regarded by the present writer as possibly having generic importance. A thorough review of the type of *Achænodon robustus* reveals the fact that the specimen has received considerable lateral crushing in the region of the frontals and anterior portions of the parietals, which no doubt is at least a partial cause for the apparently greater elongation of the cranium than in *A. uintense*. When the orbit of the left side is carefully studied in relation to the top of the skull it becomes plain that the characters in the type of *A. robustus* and the Carnegie Museum specimens of *A. uintense* are almost identical; that is, the orbit is situated nearer the dorsal face of the frontal than is the case in the illustration by Professor Osborn.[41] This is corrected in Pl. XXXIX, Fig. 1 of this paper. The end of the muzzle in the Princeton specimen is, however, apparently heavier than in *A. uintense*, which is possibly also partly due to crushing. The chief points of difference between these species then are: the much greater development of the posterior accessory tubercle of $M^{\underline{3}}$ the thicker premolars and the larger size of *A. uintense* when compared with *A. robustus*. (See illustrations of $M^{\underline{3}}$ Pl., XXXIX, Figs. 2 and 4.)

In skull No. 3182 the occiput is perfectly preserved and for the first time gives us an accurate conception of this region. In Professor Osborn's paper on *A. uintense* (*l.c.*, p. 104) the occipital plate is represented as fan-like, while the specimen in the Carnegie Museum shows that it has a more evenly rounded appearance from side to side (see Pl. XLVII, Fig. 3).

Genus PARAHYUS Marsh.

21. **Parahyus vagus** Marsh.

Amer. Jour. Sci., Vol. XII, 1876, p. 402; Amer. Jour Sci., Vol. XLVIII, 1894, p. 261.

From casts of the types kindly communicated by the authorities of the Peabody Museum of Natural History, it is possible to determine a few significant characters, which may be regarded as possessing generic

[40] *L.c.*, p. 103.

[41] Contributions from The E. M. Museum of Geology and Archæology of Princeton College, Bull. No. 3, 1883, pl. VI.

importance. When compared with *Achænodon* the teeth of *Parahyus vagus* are proportionally larger in relation to the size of the jaw,

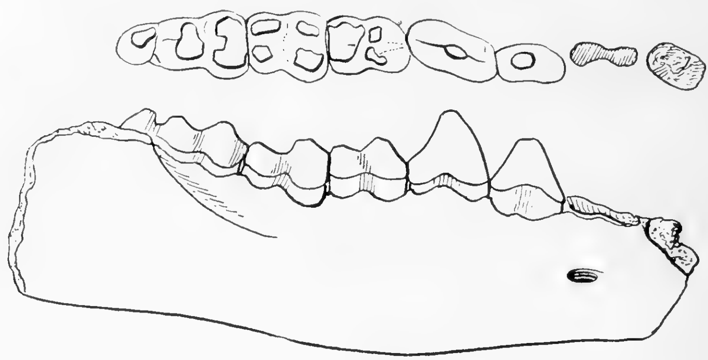


FIG. 12. *Parahyus vagus*. From a cast in the Carnegie Museum. No. 3448. Original type specimen in Peabody Museum of Natural History.

which is much slenderer and has a different contour from that of *Achænodon*, the under border being straighter fore-and-aft. Dentition $I_{?3}$, C_{1}, P_{3}, M_{3}. Premolars more compressed laterally than in *Achænodon*, especially *A. uintense*. The dentition is proportionally longer, M_{3} being one third narrower while of the same actual length as in *A. robustus*. The cross-valleys between the posterior and anterior tubercles of the molars are wider and the heel of M_{3} is more distinctly separated from the main body of the tooth than in *Achænodon*.

In the type of *Parahyus aberrans* Marsh the external tubercles of the upper molar possess more conical symmetry than in *Achænodon*, and, as in the lower teeth of the type of *Parahyus vagus*, the tubercles of the upper tooth of *Parahyus aberrans* are also separated by more clearly defined valleys than in *Achænodon*.

Family AGRIOCHŒRIDÆ.

Genus PROTOREODON Scott and Osborn.

22. **Protoreodon medius** sp. nov. (Plate XL, Figs. 1–16).

Type: Greater portion of the skeleton, C. M. No. 2962.

Horizon: Uinta Eocene, Horizon C.

Locality: Six miles east of Myton, on the Duchesne River, Utah.

Besides the type specimen there are numerous fragmentary remains, which are more or less doubtfully referred to the above species. Of these may be mentioned No. 2917, a pair of lower jaws mutilated in front, No. 2933, a left lower jaw, No. 3020, a portion of a skeleton including nearly the complete tail, and No. 3038, also a portion of a skeleton. C. M. Nos. 2987 and 3067 may possibly belong to a different (new) species on account of the rather small skull and large teeth, but as the specimens pertain to young individuals, I prefer to place them with *P. medius*.

Specific Characters: $I\frac{3}{3}$, $C\frac{1}{1}$, $P\frac{4}{4}$, $P\frac{1}{}$ *isolated by a diastema, upper molars with reduced intermediate cusps. Pes relatively long. Animal considerably larger than Protoreodon parvus, P. pumilus, P. paradoxicus, or P. minor.*

The cranial region is long and the face short as in *P. paradoxicus* Scott, but the infra-orbital foramen appears to be located further back than in either *P. paradoxicus* or *P. parvus*. The premaxillary is of well-proportioned size, and, as already stated, there are three incisors present in the skull. The premolars have the same development as in *P. parvus*, but the upper molars have advanced a step, the anterior intermediate cusp being reduced.

The present species is probably from a later horizon than those heretofore described. In fact it appears that even the fragmentary remains from this locality, referred to *P. parvus* and other known species of the Uinta, are possibly further advanced, especially with regard to the reduction of the anterior intermediate cusp of the molars, which is a mere remnant in nearly all of the specimens, in which the upper molars are preserved.

The new species here proposed is by far the most abundantly represented in this new fossil locality of the Duchesne Valley, the smaller species being comparatively few in number.

In general detail the skeleton answers very well to the descriptions furnished by Professor Scott and need not here be repeated. However, the illustrations herewith reproduced will serve as a correct guide to proportions, as the type of *P. medius* is represented by practically all the main parts of the skeleton, thus enabling us for the first time to effect a restoration of an Oreodent from the Uinta with approximate correctness.

Unfortunately the carpus is not represented in the type. There are, however, two metacarpals which give a fair idea of the proportions of the fore and hind foot. A feature at once noticeable is the relatively long pes, but whether this is a specific character, or whether it holds good throughout the genus *Protoreodon*, cannot be determined until more complete material of other species is secured.

In this connection it is well to draw the attention of students to the fact that Professor Scott's figure 22 of Plate 3 of his Uinta report (*Trans. Wag. Free Inst. of Science*, Vol. VI, 1899) very probably represents a hind foot of this species. The hind foot and other fragments of limbs illustrated in the "Mammalia of the Uinta Basin," Plate VII,[42] also possibly pertain to *Protoreodon medius*.

MEASUREMENTS.

	Type No. 2962.
Length of skull (occiput to and including premaxillaries)	173 mm.
" " " (occiput to end of nasals)	168 "
" " cheek-dentition (upper)	73 "
" " canine to M^1	29 "
" " molar series	37 "
Greatest length of mandible	127 "
Length of cheek dentition (lower)	74 "
Depth of ramus at M_3	31 "
Length of humerus head to distal end	137 "
Greatest transverse diameter humerus, distal end	27 "
Length of Mc. IV, approximately	43 "
Greatest antero-posterior diameter of humerus, distal end	19 "
" length of femur	153 "
" " " tibia	143 "
" " " astragalus	26 "
" " " calcaneum	50 "
Height of tarsus including astragalus	37 "
Length of Mt. IV, dorsal measurement	65 "

Restoration of **Protoreodon medius** (Plate XLI).

From the study of the articulated skeleton of *Protoreodon medius* it becomes plain that the genus combines some of the characters of *Merycoidodon* and of *Agriochœrus* of the White River Oligocene. Thus the neck, the trunk, and the caudal region almost duplicate those of *Agriochœrus*, while the structure of the limbs, and especially of the foot, more nearly suggests *Merycoidodon*. Professor W. B. Scott long ago pointed out very clearly the relationship between *Protoreodon*, *Agriochœrus*, and *Merycoidodon*.[43] Indeed as early as 1875 Professor

[42] *Trans. Amer. Philos. Soc.*, Vol. XVI, 1889, Pl. VII.

[43] "The Mammalia of the Uinta Formation," *Amer. Philos. Soc.*, Vol. XVI, Part II, 1889, pp. 487–503.

O. C. Marsh saw the close relationship between these Uinta and Oligocene genera and even referred one specimen to *Agriochœrus* (*A. pumilus*).[44]

The present restoration is effected from the remains of the type specimen No. 2962, with the exception of the posterior portion of the tail, which is reproduced from the paratype No. 3020. The portions on Plate XLI indicated in outlines are obtained from other individuals and are thought to be approximately correct.

In this connection mention should be made of the fact that the vertebral column was found dislocated at the first dorsal (see fig. 13),

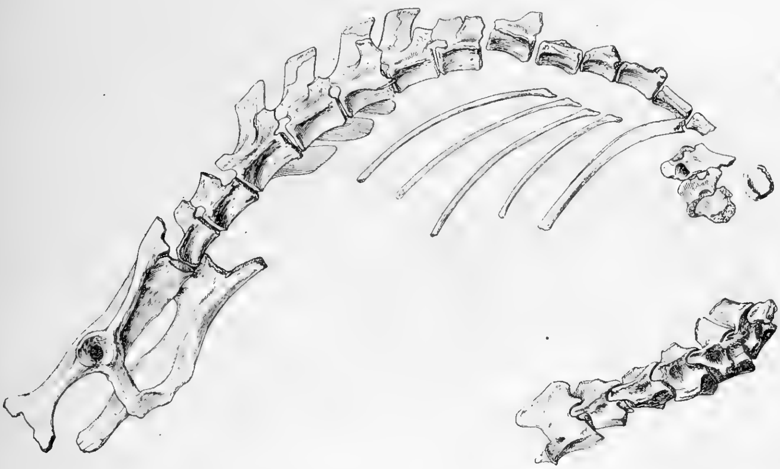


FIG. 13. *Protoreodon medius.* Carnegie Museum, No. 2962. × 1/4. Vertebral column in the original position as found in the field.

and that one or possibly two vertebræ in this region are wanting. The posterior dorsals and all the lumbars, the sacrum, and the pelvis were found in position. The skull and atlas were in nearly their proper position with reference to the location of the neck, while the limbs and feet were more or less dislocated.

From this it is plain that we cannot be positive in regard to the number of the vertebræ in the dorsal region. Thirteen dorsals, the same number as in *Merycoidodon*, are given in the illustration, which may or may not be correct. On the other hand there is no doubt in regard to the lumbar and the sacral series which are six and three

[44] *Amer. Jour. Sci.*, Vol. IX, 1875, p. 250.

respectively. In *Agriochœrus* we have the same number, while in at least two complete skeletons of *Merycoidodon* (*M. culbertsoni* of the Carnegie Museum and *M. gracilis* of the U. S. National Museum) there are seven lumbars and four sacrals.[45] The caudal region is represented by twenty-three vertebræ and is equal to or perhaps even exceeds in length that of *Agriochœrus.* The thorax is not large and the clavicle was, no doubt, relatively larger than in *Merycoidodon.*

The limbs are, as already stated, most suggestive of *Merycoidodon,* though longer and slenderer. The pollex is slightly larger than in *Merycoidodon.* There is no evidence of a hallux in the pes of the species under description. The animal was perhaps a better runner than the Oligocene genus.

MEASUREMENTS.

Total length of skeleton from premaxillary to tip of tail measured along the curves, approximately	1130 mm.
Height of skeleton at fore limbs, approximately	414 "
Height of skeleton at hind limbs	442 "

Genus PROTAGRIOCHŒRUS Scott.

23. **Protagriochœrus annectens** Scott. (Plate XL, Figs. 19–27).

Trans. Wagner Free Institute of Science, Vol. VI, 1899, p. 100, Pl. IV, Figs. 26–29.

C. M. No. 3016, the specimen referred to this genus, was found in horizon C, near Myton, Utah, and consists of the anterior portion of both maxillaries together with numerous other fragments of the skeleton. The roots of the canine and $P^{\underline{1}}$ agree in size and position with those of the type of *Protagriochœrus.* The scapula is represented by the glenoid cavity and the coracoid, which are similar in structure to *Protoreodon* and the Oligocene oreodonts generally. The distal end of the humerus which is preserved is also identical with that of *Protoreodon,* and in a general way agrees with that element in the Oligocene oreodonts, but is entirely unlike the lower end of the humerus in *Agriochœrus.* When compared with the latter the entepicondyle is less developed, the trochlea itself narrower, with the inner and outer condyles more nearly subequal in size and divided by a narrower and more prominent intertrochlear ridge. On the whole this portion of

[45] A communication recently received from Mr. Paul C. Miller of the Walker Museum, Chicago University, states that in a remarkably complete skeleton of *Merycoidodon Culbertsoni* in that institution recently freed from the matrix there are: seven cervicals, thirteen dorsals, seven lumbars, three sacrals and nineteen caudals.

the humerus is not unlike that in *Protoreodon* or the oreodonts in general. The olecranon process of the ulna is short and stout, but has apparently a smaller antero-posterior diameter and a less decided tendinal groove than is usual in the oreodonts of the Oligocene.

Fragments of the hind limb present no noteworthy differences from corresponding parts in *Protoreodon* or the later oreodonts (*Merycoidodon*). Proportionally the distal end of the femur has possibly a somewhat greater transverse diameter than in the Oligocene oreodonts and the rotular trochlea is shallower and broader. The head of the tibia is broad, corresponding to the distal end of the femur. The patella appears to have a greater dorsal convexity, or greater antero-posterior diameter, than that bone as described by Professor Scott. At the same time it is possibly flatter than is usually the case in most oreodonts.

In the type of *Protagriochœrus* the astragalus is represented only by the upper half, while in the present specimen the bone is very nearly complete.[46] Though the bone is typically that of the oreodonts it is at once recognizable by its narrowness and greater height. This feature is apparently characteristic of all the known Uinta oreodonts. In *Protagriochœrus* and also in *Protoreodon* the cuboid facet of the astragalus is not concave from side to side as in *Merycoidodon*, but is practically flat, even more so than in *Agriochœrus*. On the other hand the posterior extent of the navicular facet of the astragalus in the latter genus reaches proportionally higher up on the posterior face of the astragalus than in *Protagriochœrus*. The bone as a whole is of quite different proportions in the two genera.

With the exception of the proportionally greater length of the metatarsals in the present genus they are so similar to those in *Merycoidodon culbertsoni* that a general description would fit in either case. The phalanges are also proportionally longer than in *Merycoidodon*, but otherwise quite similar. The ungual phalanges are slightly narrower and higher than those in *Merycoidodon*. So far as one may judge from the fragmentary material of the limb-structure of this specimen the high and narrow unguals appear to be the only parts which show ancestral features leading to the characteristic high and compressed terminal phalanges of *Agriochœrus*. On the other hand

[46] The astragalus of *Protagriochœrus annectens* of the Carnegie Museum collection fits admirably well on the navicular of the type specimen in the American Museum of Natural History.

when the ungual phalanges of the present specimen are compared with those of *Protoreodon* of the Uinta there is presented little or no difference in detailed structure. When the equality in size of *Protagriochœrus* and *Agriochœrus* is considered, there is revealed a remarkable difference in the general proportions as well as the detailed structure of the limbs and especially of the feet[47] in the two genera. The radical change from the general slenderness of the Uinta form to the shorter and broader feet of the Oligocene genus, whatever caused this comparatively rapid change, could not well be due to the increase in size of the animal from the earlier to the later representative, as is claimed in other cases from earlier to later phyla of the Tertiary. While provisionally accepting *Protoreodon* as approximately in the ancestral line leading to *Merycoidodon* and also acknowledging the general mixture of similar characteristics between the Uinta protoreodonts, the Oligocene oreodonts, and *Agriochœrus*, so ably worked out and presented by Professor Scott and referred to on a preceding page of this paper, it is not clear that we should acccept *Protagriochœrus* or any protoreodont of the Uinta Eocene, so far as at present known, as being directly ancestral to *Agriochœrus*. The material of this proposed genus of the upper Eocene is still entirely too fragmentary. A critical survey of the taxonomy precludes our saying more than that most of the known features of *Protagriochœrus* are indeed very close to *Protoreodon*, if indeed, it is not congeneric with the latter.

Family CAMELIDÆ.

Genus PROTYLOPUS Wortman.

24. **Protylopus petersoni** Wortman.

Bull. Amer. Mus. Nat. Hist., Vol. X, 1898, pp. 104–110.

Among the specimens of this species the greater portion of a skeleton, C. M. No. 2948, was found in the eastern part of the Uinta Basin at the base of horizon C. The cervical region is imperfectly preserved, but enough remains to make out some of the more important features, which are for the first time described below. A brief description of the fore and hind foot is thought to be of value, especially since the tarsus presents some curious features. The material represents an old individual, of larger size than the type described by Dr. Wortman, and

[47] *Agriochœrus gaudryi* Osborn, the best preserved hind foot known, is used for this comparison.

also slightly larger than the Princeton specimen decsribed and figured by Professor Scott.[48]

The deuterocone of P^{3} is relatively larger in the present specimen than in the type. The molars are so much worn down that an accurate comparison cannot be made with the type of the genus.

The atlas resembles that of *Poëbrotherium* as described by Scott[49] that is to say, it is short and broad, has a posterior projection of the transverse processes, which extends well back of the articulation for the axis, a high and narrow neural arch with a very faint neural spine, deep emargination above the anterior cotyli and slightly indicated notches on the external margin. From the specimen in its present condition I am unable to say whether or not there is a posterior opening through the base of the transverse process as in *Poëbrotherium*. This foramen is certainly not located on the dorsal surface of the transverse process, as in the *Tylopoda*.

The axis is not as long in its general proportions as in *Poëbrotherium*. The centrum is strongly keeled throughout its length and the neural spine has perhaps even a greater development and extends further back of the zygapophyses than in *Poëbrotherium* and is on the whole quite unlike that in the tylopods. The transverse process is very small and located well back on the centrum. The arterial canal is placed laterally and well forward and was evidently bordered anteriorly by a narrow and thin bone which is broken off in the present specimen.

The third and fourth cervical vertebræ are badly mutilated by crushing and portions of them are entirely lost. The centrum of the third cervical is very nearly as long as that of the axis, while that of the fourth is slightly shorter. There is evidently throughout a prominent keel on the ventral face of the centra of these vertebræ, which is especially well indicated on the third and fifth cervicals. The entire length of the pedicle of the third cervical is probably pierced by the vertebrarterial canal. The region of the anterior exit is injured, but the posterior exit is located on the margin of the intervertebral notch and not inside the neural canal as in the camels, nor is there any apparent tendency in that direction.

A portion of the transverse process of the fifth vertebra is present and points forward and downwards, as is the case in *Poëbrotherium*.

[48] Wagner Free Institute, Vol. VI, 1899, pp. 22–47, Pl. 2, Figs. 5–9.

[49] *Journ. Morphology*, Vol. V, 1891, p. 22.

Between the origin of the transverse process and the ventral keel there is located on the centrum a deep pit, which is apparently more emphasized than in *Poëbrotherium.* As in the latter, the vertebrarterial canal extends throughout the entire length of the side of the neural canal, and is plainly visible from the side, entirely unlike what is observed in the tylopods, and more like the condition found in the *Bovidæ.* The sixth and seventh cervicals are so badly mutilated that an accurate description of them is not possible.

No dorsals are present, and there are only four posterior lumbars represented. The two vertebræ anterior to the last (the fifth and sixth) have the centra quite long, with prominent ventral keels, and also well developed neural spines. The last lumbar, as usual, has a shorter and more depressed centrum. So far as comparison is possible, these parts agree well with the description and illustration by Wortman (*l.c.*, p. 107).

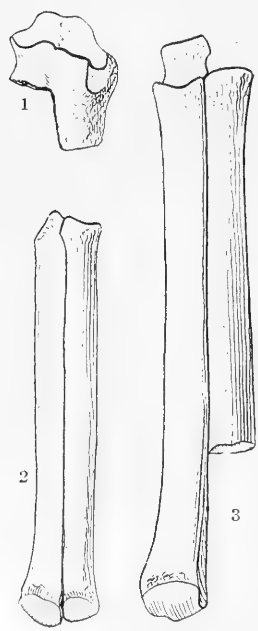


FIG. 14. *Protylopus petersoni.* Carnegie Museum No. 2948. × 1/1. 1. Left cubonavicular, dorsal face. 2. Left Mc. III and IV, dorsal face. 3. Left Mt. III. and IV. dorsal face.

This individual also presents for the first time the complete metacarpals III and IV, the proximal end only of Mc. II is preserved, while Mc. V is lost. As Professor Scott has shown (*l.c.*, p. 36) the metacarpals are relatively short and otherwise differ from those in *Poëbrotherium.* An illustration is herewith given of the metacarpals and the metatarsals (See Fig. 14).

Both hind feet are represented and the most curious feature is the characteristic bovine coössification of the cuboid and the navicular in the tarsus of both feet, which is hard to believe to be anything but purely pathological, especially since the entocuneiform of the right tarsus also has a tendency to become coössified with the cuboid.[50] In another specimen (No. 2977) of slightly larger size and also fully adult, or old, both hind feet are preserved,

[50] In certain Antelopes as *Catablepas gnu*, the entocuneiform appears to be partly coössified with the cubonavicular bone.

presenting the normal conditions. I therefore conclude that the above described features are perhaps accidental and should only serve as a warning to the student.

25. **Protylopus annectens** sp. nov. (Plate XXXVII, Fig. 14).

Type: Portions of the skull and lower jaws together with other parts of the skeleton, C. M. No. 2932.

Horizon: Uinta Eocene, Lower C.

Locality: Six miles east of Myton, Utah.

Specific Characters: A bifid posterior wing of the anterior inner crescents of the superior molars. Small basal pillars between the inner crescents of the molars. Deuterocone of $P^{\underline{3}}$ *proportionally large. Parastyle of* $M^{\underline{3}}$ *especially prominent. Metacarpals proportionally short and heavy. Animals larger than Protylopus petersoni.*

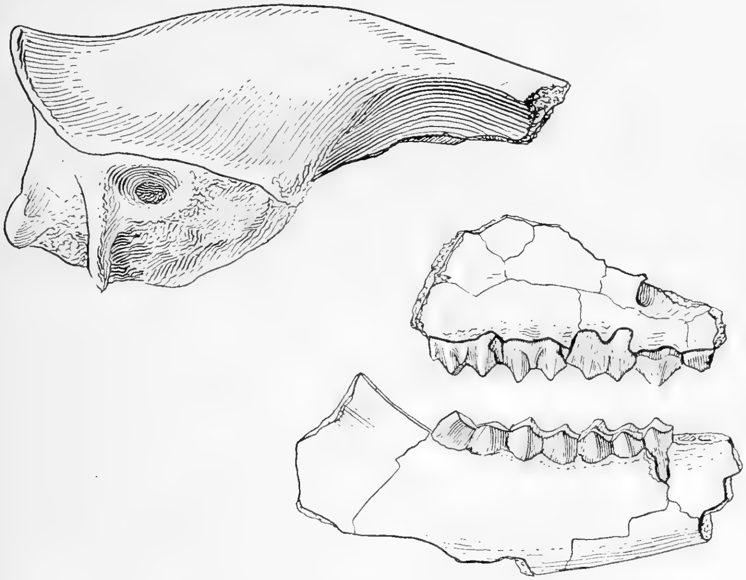


FIG. 15. *Protylopus annectens.* Carnegie Museum No. 2932. × 1/1.

In comparing the present specimen with the excellent description by Professor Scott[51] of one specimen in the Princeton collection from the Uinta the only differences appear to be the absence of the posterior bifidity of the anterior inner crescents of the molars and the small

[51] Wagner Free Institute of Science, *Trans.*, Vol. VI, 1899, p. 24.

pillar between the two inner crescents of $M^{\underline{1}}$ in the Princeton specimen.[52] In discussing the differences between the molars of various specimens of *Protylopus* in the Princeton collection Scott says (*l.c.*, p. 24): "In one case $M^{\underline{1}}$ has very small anterior and median external buttresses, and the two outer crescents are of similar size and shape, with equal prominent median ribs. In $M^{\underline{2}}$ the buttresses are very much larger, and the rib of the postero-external crescent much less prominent than the antero-external one. The buttresses of $M^{\underline{3}}$ are still larger, enclosing small fossettes, and the posterior buttress appears. On $M^{\underline{2}}$ and $M^{\underline{3}}$ a small pillar occurs between the two inner crescents." This description answers the condition found in the present specimen, so far as the buttresses of the external crescents and the minute pillars between the internal crescents of $M^{\underline{2}}$ and $M^{\underline{3}}$ go. The absence or presence of the minute pillar on the internal cingulum of $M^{\underline{1}}$-may well be a variable character. Altogether the Princeton specimen No. 11225 might provisionally be regarded as a paratype of *Protylopus annectens*. The illustration of *Protylopus petersoni* by Scott (*l.c.*, Pl. 2, Fig. 6) does not indicate this bifidity of the inner anterior crescent.

The fragments of the skeleton furnish no noteworthy characters and add little or nothing to what we already know through the studies of Wortman and Scott.

The species is interesting from the fact that it furnishes characters, which closely connect *Protylopus* with *Eotylopus* Matthew.[53] From the study of the present material the view expressed by Matthew that *Poëbrotherium* of the Oligocene is probably derived, not from *Protylopus* of the Uinta, but from some more advanced contemporary genus, is apparently much strengthened. But whether this contemporary genus will yet be found in the Uinta or a more northern locality is a question which only the future can decide.

MEASUREMENTS.

Antero-posterior diameter of superior molar series	27	mm.
" " " " $P^{\underline{4}}$	7	"
Transverse " " "	6	"

[52] An examination of this Princeton specimen, No. 11225 shows that the teeth are very much worn, so that the inner anterior crescent may or may not be bifid. There is, however, no sign of the minute pillar on the internal cingulum of $M^{\underline{1}}$, in fact the cingulum is rather less developed in the Princeton specimen.

[53] *Bull. Amer. Mus. Nat. Hist.*, Vol. XXVIII, 1910, p. 41.

MEASUREMENTS—*Continued.*

Transverse diameter of M^1	9	mm.
Antero-posterior " " "	9.5	"
" " " " M^2	9	"
Transverse " " "	10	"
" " " M^3	10	"
Antero-posterior " " "	10	"
Depth of inferior ramus at M_1	15	"
" " " " " M_3	17	"
Antero-posterior diameter of inferior molar series	31	"
" " " " M_1	8	"
Transverse " " M_1	5	"
" " " M_2	6	"
Antero-posterior " " "	8.5	"
" " " " M_3	14	"
Transverse " " "	6	"
" diameter of distal end of humerus	17.5	"
Antero-posterior diameter of distal end of humerus	12	"
Length of Mc. II	50	"

Family HYPERTRAGULIDÆ.

Genus LEPTOTRAGULUS Scott and Osborn.

26. **Leptotragulus proavus** Scott and Osborn. (Plate XXXVII, Figs. 5–13).

Proc. American Philosophical Society, Vol. XXIV, 1887, p. 258.

A number of fragments of the upper and lower jaws in the Carnegie Museum, collected from the Uinta, reveal a few anatomical points not heretofore established. It is very evident that the genus possessed three lower incisors of sub-equal size, separated from the canine by a quite short diastema. In C. M. No. 3009 the canine tooth is just appearing through the alveolar border, and it presents a crown of quite large size with an oblong outline on cross-section, a rather sharp border, posterior and anterior, and a greater convexity on the internal face than on the external. The tooth has a procumbent position, as already stated by Professor Scott. I certainly am inclined to regard the tooth as a canine. This tooth is followed by a diastema back of which is a two-rooted premolar (See Pl. XXXVII, Figs. 10–11). Unfortunately the ramus is broken back of this premolar, and we are unable to now definitely say whether or not it is isolated, but from Professor Scott's description and my own observation of the type we are assured that there are three premolars in a continuous row back of the diastema. A portion of the last deciduous molar is in position and $M_{\overline{1}}$ and $M_{\overline{2}}$ are fully erupted, but they have received very little wear. $M_{\overline{3}}$ is still buried in the jaw. In two specimens, C. M. Nos. 3195 and 3454, referred to this species, $P_{\overline{4}}$ is in position. In No. 3195 $P_{\overline{4}}$ is just appearing through the alveolar border, while that of No. 3454 is well worn (See Pl. XXXVII, Figs. 12–13). When $P_{\overline{4}}$ in these two specimens are compared with those of similar ages in *Leptomeryx*, the similarity is surprisingly close. Thus the antero-internal tubercle on $P_{\overline{4}}$ of a young or unworn tooth of *Leptotragulus* is as well marked as, though rounder than, in *Leptomeryx*, and the two ridges, which extend posteriorly from the protoconid, are quite as well developed as in the Oligocene specimen No. 226 used for comparison. It is further to be noticed that of the two ridges just described on $P_{\overline{4}}$, the one which is external connects better with the heel of the tooth than the one which is internal. This condition is similar to that of the posterior premolars of *Leptomeryx evansi* noted by Dr. Matthew.[54]

The lower molars are quite similar to those in *Leptomeryx*, the cross-valleys being relatively somewhat wider, the heel of $M_{\overline{3}}$ more compressed transversely, and the internal tubercle considerably smaller (See Pl. XXXVII, Fig. 12).

$M^{\underline{1}}$ and $M^{\underline{2}}$ of No. 3009 are not well preserved, but in a second young specimen, No. 2919, somewhat advanced in age, $M^{\underline{1}}$ and $M^{\underline{2}}$ are perfect (See Pl. XXXVII, Fig. 5). These teeth are more completely selenodont than in any known Uinta artiodactyl. The styles on the external face are not strongly developed, though quite plain, while on the internal face there are prominent cingula. There are no anterior intermediate tubercles; in fact the upper molars quite closely suggest such Oligocene forms as *Leptomeryx*, *Hypertragulus*, and *Heteromeryx*, as will be seen in the following paragraphs.

27. **Leptotragulus medius** sp. nov. (Plate XXXVII, Figs. 1–4).

Type: Fragmentary skull and portion of mandible with $M_{\overline{3}}$ present; fragments of femur; distal end of calcaneum and astragalus, C. M. No. 2986.

Paratype: Upper teeth and fragment of mandible with $M_{\overline{3}}$. C. M. No. 3453.

Horizon: Uinta Eocene; Horizon C.

[54] *Bull. Amer. Mus. Nat. Hist.*, Vol. XIX, 1903, p. 223.

Locality: Six miles east of Myton, Utah.

Specific Characters: External faces of superior molars with relatively large styles; cingula on superior molars absent. Species of approximately the same size as A. proavus.

The premaxillaries and the front of the skull of the present type are unfortunately lost. The upper dentition of this genus is therefore not yet completely known. It is, however, plain that there is a diastema in front of $P^{\underline{2}}$. The latter is represented only by the two roots. $P^{\underline{3}}$ has three roots; in general features it is much as in *Leptomeryx* of the Oligocene, except that the rib on the external face of the protocone is somewhat less developed and the deuterocone is smaller. $P^{\underline{4}}$ is proportionately somewhat small, but with the exception of the smaller median rib on the external face and a slightly smaller deuterocone, this tooth, as the preceding, is most nearly like the same tooth in *Leptomeryx.* The main reason for separating this species from *Leptotragulus proavus* is found in the larger external pillars and the absence of the cingulum internally. The external faces of both anterior and posterior external crescents have prominent ribs as in *Leptomeryx,* and the internal faces are very nearly as vertical as in the latter. The inner crescents have an equally perfect formation as in the Oligocene genus, including the anterior and posterior cingula and the slight indication of the minute median tubercle. The chief difference between the molars of *Leptotragulus* and *Leptomeryx* are the greater brachyodonty and proportionally smaller size of $M^{\underline{1}}$ in the genus from the Uinta.[55]

$M_{\overline{3}}$ of this species does not differ in any particulars from that in *L. proavus.* From *Leptomeryx* of the middle Oligocene it differs by being more brachyodont and by its narrower and simpler heel.

The skull is so badly mutilated that it does not permit of an accurate description. It is, however, possible to determine that the occipital plate is rather narrow, that there is a long and quite decided sagittal crest. The temporal crest is well defined and terminates in a prominent post-orbital process. The orbit is large, its anterior border is directly above the posterior portion of $M^{\underline{1}}$ as in *Leptomeryx* or *Hypertragulus,* but is probably widely open posteriorly. The alveolar portion of the maxillary is rather high for an animal with brachyodont teeth, but in this respect it is also like the Oligocene genera *Leptomeryx*

[55] This comparison is based on the type specimen of *Leptomeryx transmontanus* Douglass from the Upper Oligocene of Montana.

and *Hypertragulus*. The exit of the infra-orbital foramen cannot be definitely located.

The femur is much mutilated, especially in the region of the shaft. The head cannot be regarded as small; on the contrary, it is of proportionate size, well rounded, and set on a distinct neck. The pit for the *ligamentum teres* is shallow. The great trochanter does not extend much above the head, it is not of great transverse diameter, though well proportioned fore-and-aft, and there is a deep trochanteric fossa. The second trochanter is quite prominent and the shaft in this region perhaps has a greater antero-posterior than transverse diameter. Distally the condyles are crowded close together, due to crushing. The rotular trochlea is very well defined, but its internal and external borders are nearly equally prominent.

The distal end of the calcaneum is rather delicately constructed. The sustentacular facet is not prominent and the cuboid facet is very oblique fore-and-aft. The tuber is lost. The fibular facet is prominent and occupies a more lateral position than in *Leptomeryx*, and the ridge separating the latter facet from that of the astragalus is more prominent than in the Oligocene genus. The astragalus is high and narrow; its height being equal to that of this bone in *Leptomeryx*, but it is narrower. The proximal trochlea is quite broad and otherwise divided, as in *Leptomeryx*, but the proximal and distal portions are divided by a longer and more decided neck, and the cuboid articulation is decidedly narrower than in *Leptomeryx*.

The limb and foot structure of *Leptotragulus* is not well known. Professor Scott was not entirely certain that his paratype pertains to the same genus (*l.c.*, p. 480). Nevertheless it appears quite certain that the genus possessed a tetradactyl manus and didactyl pes, such as Scott describes, when we recall the tetradactyl manus and didactyl pes of the hypertragulids of the Oligocene.

When the dentition and certain cranial characters of *Leptotragulus* are compared with these elements in the Oligocene genera, there appears to be greater assurance of the taxonomic position of this Uinta genus. In the first place there does not appear to be the slightest indication of an elongation or a lateral compression of the upper cheek-teeth in *Leptotragulus*, or other Uinta genera, such as we should expect from what we see in the Oligocene *Poëbrotherium*, or in camels of later horizons. In the second place we see that, while the upper teeth of *Leptotragulus*, as now known, are very closely like those of *Leptomeryx* of the Oligocene, there are two and possibly three highly important features of *Leptotragulus* which differ from *Leptomeryx* and more closely suggest those of *Hypertragulus*, also of the Oligocene. These characters are: (*a*) the subequal size of the incisors; (*b*) the larger canine; (*c*) the reduction of the premolars to three (if that be the correct number in *Leptotragulus*). While the Uinta genus is apparently related to both of these Oligocene genera it can hardly be seriously considered to be a direct ancestor in either case.

Practically equal grounds exist for considering *Leptomeryx* as a direct descendant of *Leptotragulus*. In this Oligocene genus we have the brachyodont dentition characteristic of *Leptotragulus;* molars with a mesostyle, and an internal cingulum.[56]

Taking into consideration the known characters of *Leptotragulus*, it is perhaps most likely that the genus, if found later than the Uinta, continued in the Oligocene as an independent line, which after all remained rather more closely related to the true hypertragulids and did not constitute a transition towards the tylopods. From what we now know of *Leptotragulus* it is quite doubtful whether the Oligocene species "*Leptotragulus*" *profectus* Matthew[57] belongs to this genus. Very recently[58] Dr. Matthew has orally expressed himself as doubting that "*Leptotragulus*" *profectus* from the Lower Oligocene of Montana is in the line of the early camels.

MEASUREMENTS.

Antero-posterior diameter of upper teeth P^2 to and including M^3	35	mm.
Antero-posterior diameter of P^2 to M^1	16	"
" " " " P^3	6	"
Transverse " " "	4.5	"
" " " P^4	5	"
Antero-posterior " " "	5	"
" " " " M^1	5.5	"
Transverse " " "	7	"
" " " M^2	8	"
Antero-posterior " " "	7	"
" " " " M^3	7	"
Transverse " " "	9	"
Diameter from alveolar border at M^3 to orbital border of molar	14	"
Height of astragalus	15	"
Breadth of astragalus, lower end	8	"

[56] The cingulum of the upper molars of *L. medius* is heavier in proportion to that of the specimens in the Carnegie Museum referred to *Leptotragulus proavus*.

[57] *Bull. Amer. Mus. Nat. Hist.*, Vol. XIX, 1903, p. 224.

[58] During the meeting of the Paleontological Society at Pittsburgh, Pa., 1917–18.

Genus LEPTOREODON Wortman.

Bull. Amer. Mus. Nat. Hist., Vol. X, 1898, p. 94.

This genus is represented in the collection of the Carnegie Museum by a number of fragmentary specimens, which are not sufficiently complete to add anything of importance to what we know from the studies of Dr. Wortmann and Professor Scott.

28. **Leptoreodon marshi** Wortman.

Bull. Amer. Mus. Nat. Hist., Vol. X, 1898, p. 98.

From a recent reëxamination of the type of *Leptoreodon marshi* in the American Museum it appears that the crescents of the molars were quite high in an unworn state, and that the anterior intermediate tubercle was probably not present, as Dr. Wortman was inclined to believe.[59] The type specimen should be further cleared from its matrix and good crown-views published of the upper and lower dentition.

With regard to the genus *Camelomeryx* proposed by Prof. Scott, I feel that it is so nearly like *Leptoreodon*, that, until more material is obtained, I should hesitate to separate them generically.

Genus OROMERYX Marsh.

Amer. Jour. Sci., Vol. XLVIII, 1894, p. 269.

29. **Oromeryx** sp.

To *Oromeryx* is provisionally referred an immature specimen, C. M. No. 3027, found in horizon C, six miles east of Myton, Utah. The specimen consists of a number of mutilated fragments representing various parts of the skeleton. The most important of these is a maxillary, which contains three deciduous and two permanent teeth. The deciduous teeth do not possess any characters of diagnostic value, but the permanent molars have that curious broadness of the anterior inner crescents and the sudden transverse reduction of the posterior inner crescent seen in Professor Marsh's illustration and mentioned by Professor Scott.[60] The internal cingulum is weak, but has the mammillary structure seen in the type of *Oromeryx*. The type of *Oromeryx plicatus*, which has recently been examined, consists of right and left upper teeth; those of the right side are all broken externally except $P^{\underline{4}}$. The specimen pertains to an animal fully adult; but shows

[59] Prof. Scott ascertained from unworn specimens that the anterior intermediate cusp of the upper molars is not present.

[60] *Trans. Wagner Free Institute of Science*, Vol. VI, 1899, p. 83.

that the internal cingulum had a mammillary structure. The external face of $M^{\underline{1}}$ is not complete, as is indicated in Marsh's illustration. $P^{\underline{4}}$ has a prominent posterior heel-like extension, which is not fully represented in the figure. The different styles of the external faces, and especially the mesostyle of the molars, have sharper angles than represented in the illustration. The anterior inner crescent has a tendency to have the outline triangular, as in *Protylopus annectens*. The illustration of *Oromeryx* is a composite from the right and left sides. The specimens probably pertain to the same individual, although the cingulum and internal basal tubercle of the median valley is larger on the left than on the right side.

In this connection it is proper to publish an observation on the status of the type specimen of "*Parameryx*" Marsh,[61] recently (1915) made by the writer, while in New Haven.

So far as I was able to ascertain, the type of "*Parameryx*" *lævis* Marsh consists of a mixed lot of surface fragments representing different individuals. The upper tooth and astragalus figured as belonging to the same species are clearly too disproportionate in size, as Professor Scott has already pointed out,[61a] and most certainly pertain to separate genera. With the astragalus and the upper tooth figured by Marsh are now two other teeth and various other fragments. In this same general lot are also fragments of the lower jaw having about the right size to go with the astragalus mentioned, and altogether too large to go with the upper tooth represented in Figure 20 by Marsh. Furthermore, the figured tooth represents an animal with teeth very little worn, while the other upper molars in the same general lot of material are considerably worn. The tooth figured appears to have a less marked internal cingulum, especially on the anterior lobe, than is indicated in the illustration. The lower teeth associated with this figured tooth may or may not belong with the same specimen. These teeth have basal pillars in the external valleys similar to those in *Leptotragulus*.

Parameryx sulcatus Marsh seems to be based on a young jaw with all the teeth lost, except the anterior portion of $M_{\overline{3}?}$. This tooth is just appearing through the alveolar border. The deep groove which Marsh distinguished as his chief specific character is apparently due to the crushing of the specimen.

The tarsus referred to this genus by Marsh is high and narrow, the

[61] Amer. Jour. Sci., XLVIII, 1894, p. 269, figs. 20–21.

[61a] Wagner Free Institute of Science, *Transactions*, Vol. VI, 1899, p. 48.

distal end of the cuboid small and displaying no sign of a fifth digit, and the pes was therefore didactyl, as Marsh says.

This type material seems to me to be an unfortunate mixture of *Leptotragulus*, probably of *Protoreodon*, and possibly also of *Oromeryx*. If the tooth designated by Marsh as *Parameryx* should after all prove to be a second molar of *Oromeryx* it would further complicate matters, as we would be forced to accept *Parameryx*, and relegate *Oromeryx* to the synonymy, inasmuch as *Parameryx* was, strictly speaking, first mentioned by Professor Marsh in his address.[61b]

That the Hypertragulids of the Uinta Eocene represented by *Leptotragulus*, *Leptoreodon*, and *Oromeryx* are three closely related genera, which naturally fall into the subfamily *Leptotragulinæ*, appears to admit of little or no question. But whether or not any or all of these Uinta forms are directly ancestral to the forms from the American Oligocene we are not yet in a position to state. All who have studied them agree that they have many anatomical features in common with the Oligocene genera. However, in the cases which afford the best opportunities for comparison, there appear, grouped together in a single form from the Uinta, characters which appear to be held in common by any one of two or three different genera from the Oligocene. These characters of the specimens from the Uinta are collectively such that the animals, which the remains represent, may be said to have had a common ancestor, but it is not possible to say that they point to any particular genus of the Oligocene[62] as a derivative. Future discoveries and studies may possibly prove that all the species of the Uinta hypertragulids have individually characters which again may be recognized in the different Oligocene genera, and we know, for instance, that *Leptotragulus* has certain features in common with *Heteromeryx*, *Leptomeryx*, and *Hypertragulus*. This mixture, or combination of characters, in *Leptotragulus* which are revealed by the Oligocene genera, is then, as I regard it, the expression of a relationship springing from a common descent from the old Pecoran stock. Certain new or more recently acquired features characteristic of the *Hypertragulidæ* of the Oligocene, express progression toward types which had their origin and gradual development, as these forms were dispersed from centers where the most rapid moulding and development of new char-

[61b] *Amer. Jour. Sci.*, Vol. XIV, 1877, p. 364.

[62] The same may well be said of the Uinta protoreodonts, as pointed out by others.

acters took place.[63] Such an hypothesis makes it possible to admit that the sudden appearance in a given horizon of the remains of new forms more or less like those of the indigenous species, and sometimes the actual mingling of them in the same geological horizon, represent

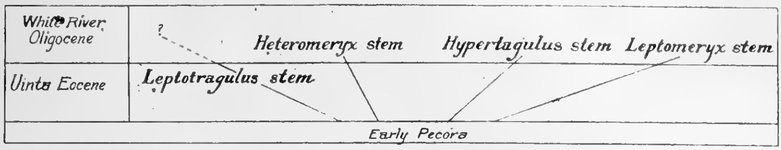


FIG. 16. Diagram expressing the relationship of the Hypertragulidæ.

invasions, which gradually filled the places formerly occupied by an older fauna.

PERISSODACTYLA.

Subfamily HYRACOTHERIINÆ.

Genus EPIHIPPUS Marsh.

30. **Epihippus gracilis** Marsh. (Plate XLIII, Figs. 4–8).

Amer. Jour. Sci., Vol. II, 1871, pp. 37–38 (*Anchitherium gracilis*).[64]

This species is represented by five individuals all in fragmentary condition. The best specimens, C. M. No. 2923 and No. 3398, each consist of a few fragments of the skeleton. The specimens, especially No. 3398, compare very closely with the description and illustrations of *Epihippus uintensis* by Granger. The latter author, however, was unable to distinguish between *E. gracilis* and *E. uintensis*.[65] The accompanying illustration is given in order to further elucidate the characters of the species (See Pls. XLII–XLIII). It is evident that $P^{\underline{4}}$ has the antero-external angle more acutely developed than in the molars, which is due to some extent to the well developed parastyle. The massive mesostyle of the molars answers well to the description given by Granger.

The glenoid cavity of the scapula is quite ovate in outline and the coracoid process is prominent, while the spine rises comparatively

[63] Dr. W. D. Matthew, *The Popular Science Monthly*, Nov., 1910, pp. 473–478. *Acad. of Science*, New York, Vol. XXIV, 1915, p. 100.

[64] Later Professor Marsh established the name *Epihippus* which was published in a foot-note in *Popular Science Monthly*, April, 1878, and Dr. O. P. Hay has designated the type, while Mr. Granger has recently pointed out the characters of the genus (*Amer. Mus. Nat. Hist.*, Vol. XXIV, 1908, p. 232.)

[65] *L.c.*, p. 258, Pl. XVIII, Figs. 4–5.

close to the border of the glenoid cavity. The proximal end of the radius is deeply grooved for the articulation of the humerus and the shaft is more suddenly constricted [66] below the head and more rod-like throughout than in *Mesohippus*. Distally the articulations for the scaphoid, lunar, and cuneiform are also more distinctly separated by ridges than in the latter genus. The facet for the cuneiform is located laterally in the specimen under description.

No. 2923 represents an animal somewhat heavier thaan the one described above. The length of the tibia is completely represented, and shows a stouter bone than in *Epihippus parvus*. The hind foot was possibly shorter and stouter. The lateral digits are apparently also slightly more reduced than in *Epihippus parvus*.

31. **Epihippus parvus** Granger[67] (Plate XLII, Figs. 12–16).

A specimen in the Carnegie Museum, No. 3397, referred to this species, consists of the right upper cheek-dentition, the lower jaws with $P_{\overline{2}-\overline{3}}$, $M_{\overline{1}-3}$ of the left side; $P_{\overline{2}-\overline{3}}$ and $M_{\overline{1}}$ of the right side; fragments of the hind limb and the greater portion of the right hind foot.

The specimen reveals an animal of slightly larger size than the type of the species. The characters of the teeth agree very closely with those of the type in the American Museum of Natural History, except $P^{\underline{2}}$, which lacks the antero-internal tubercle, which is present in the type. That this is a variable character in the species, it is quite reasonable to suppose. A distinct feature is the relatively large size of the tooth, when compared with $P^{\underline{2}}$ of such a form as *Orohippus progressus* Granger from the upper Bridger (see p. 250, and Pl. XVIII, Fig. 1).

The best preserved parts besides the upper and lower jaws are the different portions of the hind limb. The pelvis is relatively slender, the acetabulum well-formed, and relatively deeper than in *Mesohippus*. The proximal end of the femur is broken off, but the distal portion presents a slenderness which is proportional to the rest of the limb.

The tibia and fibula are completely separated. The latter bone is not represented, while the tibia is very nearly complete. There is a prominent spine, separating the femoral articulations of the tibia, which appears somewhat abnormal, especially in its anterior region. The cnemial crest is sharp, not very much extended beyond the main

[66] It is possible that this sudden constriction may be due, at least in part, to crushing.

[67] *Bull. Amer. Mus. Nat. Hist.*, Vol. XXIV, 1908, p. 258, Pl. XVIII, Fig. 3.

surface of the shaft, and reaches downward about one-third of the length of the bone. The distal trochlea is deeply excavated, oblique, and the internal malleolus is well developed.

The pes was found in an articulated position with the distal end of the tibia in place. The long and slender structure of the limb, when compared with *Mesohippus*, is at once observed. The astragalus is high and laterally compressed, the navicular and cuneiform are quite high, the median metatarsal is especially slender, while the lateral metatarsals are relatively heavier than in the Oligocene genus. There is no evidence present of the first digit. The structure of each bone of the pes is wonderfully similar in detail to that of the same bones in *Mesohippus* from the Oligocene.

PSEUDOTAPIRS OF THE NORTH AMERICAN EOCENE.[68]

While working upon the fossil tapirs of the Uinta Eocene in the collection of the Carnegie Museum it became evident that a more intensive study of the pseudotapirs of the earlier Eocene formations was necessary. Types and other material representing "*Systemodon*" = *Homogalax*[69] of the Wasatch and Wind River, *Heptodon* of the Wind River, *Helaletes böops, H. nanus, Dilophodon minusculus* "*Isectolophus*" *latidens* and *Desmatotherium guyotii* of the Bridger, and *Isectolophus annectens* of the Uinta were kindly submitted for this study by the authorities of the Peabody Museum of Natural History, the American Museum of Natural History and the Natural Science Museum of

[68] An abstract of this portion of the present paper was read before the Pittsburgh meeting of the Paleontological Society, 1917–18.

[69] "On The Names of Certain North American Vertebrates," *Science*, Vol. IX, 1899, p. 593.

In 1908 (*Bull. Amer. Mus. Nat. Hist.*, Vol. XV, p. 241) Mr. Granger was under the impression that the genus from the Bighorn, known as "*Systemodon*," species *tapirinus* (1881, *Amer. Naturalist*) though a much mutilated type, should be accepted. Since that time extensive and thorough field work by the American Museum parties in New Mexican localities reveals the fact that not a single specimen of the Bighorn "*Systemodon*" was found, and Mr. Granger is now inclined to believe, according to a communication dated by him January 20, 1916, that this form "does not occur there and that the type of *tapirinus* is a horse (*Hyracotherium*, or *Eohippus* as we call the American species)." In this connection I may further quote a portion of Mr. Granger's letter: "It seems too bad to have to give up the name *Systemodon*, it has become so firmly fixed in the literature, but there is no way out of it that I can see. If by any chance we could use it, it would not be for the form which we understand as *Systemodon*, but for a *Hyracothere*, which I now feel sure that it is."

Princeton University. The result of my work convinced me (1) that there are two distinct lines of tapir-like animals, or pseudotapirs, in the Eocene of North America, which hold a position parallel to the *Lophiodontidæ* of the European Tertiary; (2) that the decision reached by Scott, Osborn, Wortman and Earl that the Helaletids are not true ancestors of *Tapirus* is confirmed; (3) that the view that *Isectolophus* may be regarded as in the ancestral line of the recent tapirs is not substantiated, but that this Uinta genus represents a distinct side- or secondary line of pseudo-tapirs in the American Eocene; and (4), that, with the possible exception of *Dilophodon minusculus*, we have not yet discovered in the American Eocene the true ancestor of the Oligocene and recent tapirs.

Subfamily *TAPIROIDEA* Gill.

Family HELALETIDÆ Osborn and Wortman.[70]

This family includes *Heptodon* of the Wasatch and Wind River Eocene; *Helaletes boöps*, *H. nanus*, *Dilophodon minusculus* of the Bridger Eocene, and probably *Colodon* of the Oligocene. *Desmatotherium* of the Bridger Eocene should be excluded and placed in the line of the Rhinoceroses, *vide* p. 127, or more correctly in the family *Hyracodontidæ*.

Subfamily HELALETINÆ Wortman and Earl.[71]

Small perissodactyls with large anterior nares and air-sinuses analogous to those in the recent tapir; cross-crests of lower molars perfectly developed; no connecting crests between proto-, and hypoconids; hypoconulid small or absent; incisors subequal in size; limbs long and slender and of more nearly equine than tapiroid structure; astragalar trochlea very oblique.

Genus HELALETES Marsh.

32. **Helaletes boöps** Marsh. (Plate XLII, Figs. 1–9; Plate XLIII, Figs. 1–3).

Amer. Jour. Sci., Vol. IV, 1872, p. 218.

Type: Considerable portion of the skull, lower jaws and other fragments of the skeleton, No. 11807, Peabody Museum Catalogue.

Horizon: Bridger Eocene.

Locality: Grizzly Butte, Wyoming. Yale Expedition of 1871.

[70] *Bull. Amer. Mus. Nat. Hist.*, Vol. IV, 1892, p. 127.

[71] *L.c.*, Vol. V, 1893, p. 173.

Principal Generic Characters: $I\frac{3}{?3}$, $C\frac{1}{1}$, $P\frac{4}{?3}$[72], $M\frac{3}{3}$. *Premaxillaries extended well forward and anterior nares oblique, quite large, and continued backward into a distinct air-sinus analogous to that in the recent tapir. Nasals somewhat reduced in length. Skull and lower jaws gently constricted back of the incisors and canines. Superior canine isolated by diastemata. Infra-orbital foramen large and located well back. Sagittal crest prominent.* $P^{\underline{1}}$ *much reduced.* $P^{\underline{3}}$ *with slight indication of two internal tubercles.* $P^{\underline{4}}$ *with large single deuterocone. Upper molars with sharp cross-crests and deep valleys. Parastyle small and sessile, metacone trenchant and the external face not convex.*

Symphysis of mandibular rami solidly coössified. Hypoconulid of $M_{\overline{1}}$ *small. Absence of connecting crest between proto- and hypoconids Limbs slender. Astragalus high, narrow, trochlea oblique, equine-like.*[73]

Specific Characters: $P^{\underline{3}}$ *with little or no indication of a tetracone; styles at the exit of the median valley of the superior molars relatively large; cingula on anterior and posterior faces of upper molars prominent; animals about half the size of a sheep.*

GENERAL DESCRIPTION OF THE TYPE. *Skull and Lower Jaws:* Since Professor Marsh's preliminary description of *Helaletes boöps* (*l.c.*, p. 218) was published, the entire specimen has been skilfully prepared and it is now possible to furnish a more complete description.

From the generic characters it is at once evident that these remains, and especially the skull, possess remarkable similarities to the tapir. We have for instance the prominent sagittal crest, the broadness of the anterior portion of the frontals, and posterior portion of the nasals, the reduced antero-posterior diameter of the latter bones, the large premaxillaries, the oblique borders of the anterior nares, the large infra-orbital foramen and, above all else, the characteristic large excavation on the side of the face formed at the expense of the maxillary and the nasals (See Pl. XLIII, Fig. 1). This air-sinus, so far as can be determined from the crushed specimen, appears to directly communicate with the anterior nares, as in *Palæotherium medium*, and the tapir. As already stated the base of the nasal has a considerable lateral contact along the anterior termination of the frontal and

[72] See Leidy's description and illustration of "*Hyrachyus*" *nanus* in the "Extinct Vertebrate Fauna," pp. 68–69, Pl. XXVI, Fig. 11. Also Scott; Contrib. E. M. Museum, Bull. No. 3, 1883, p. 51, Pl. VIII, Fig. 4.

[73] The character of the astragalus was already pointed out by Prof. Marsh in his original description (p. 218).

meets the maxillary at the posterior termination of the border of the air-sinus. A short distance in front of the fronto-nasal suture the nasal is suddenly depressed. Anterior to this depression the bone is broken off and lost, but is indicated approximately correctly by a dotted line (See Pl. XLIII, Fig. 1). The anterior palatine foramen appears to be of large size. The palatines are not well preserved, while the zygomatic arches and the base of the skull, except the detached occipital condyles, are entirely wanting. In the region of the orbit the skull is much mutilated.

The superior incisors are subequal in size, slightly spaced, and their crowns are broad and somewhat fan-shaped. The diastemata in front and behind the superior canine are well indicated in the accompanying illustrations. The small size of the canine, which may be a sexual feature, is also plainly seen in the illustration cited above. $P^{\underline{1}}$ is much reduced, its crown rather simple, and it is inserted by a single fang. The rest of the premolars have a single internal cone (deuterocone), except $P^{\underline{3}}$, which appears to have a slight indication of two internal tubercles on the worn surface. The ectoloph of these teeth is divided into four vertical ridges consisting of the external tubercles and the anterior and posterior styles, while directly anteriorly and posteriorly, there are well-developed basal cingula.

The cross-crests of the molars are quite perfect, rather sharp, and directed inward and backward. The metacone is very characteristic, presenting a flat external face, thus forming a cutting lobe, which extends from the protoloph backward, even with the posterior face of the tooth. The paracone is more convex externally. The parastyle is rather small and quite sessile on the antero-external angle of the metaloph. There are well developed cingula directly anterior and posterior, while internally there are no cingula on proto- or hypocones. At the internal exit of the median valley there is a blunt style, and on the ectoloph, especially on $M^{\underline{2}}$ and $M^{\underline{3}}$, there is a smaller style located between the para- and metacones.[74]

The lower jaw also presents a number of tapiroid features. The inferior border is quite convex fore-and-aft. The vertical ramus in the region of the coronoid process is also directed well forward, and the temporal fossa is deep. The horizontal ramus is, however, somewhat

[74] Prof. Marsh mentioned this externally located small tubercle and regards it as a specific character differentiating from *Helaletes nanus*. A very careful examination of the type of the latter reveals an even smaller tubercle similarly located.

deep, and not of the thick and round character met with in the recent tapir. The symphysis is solidly fused and there is a long and sharp edentulous border between the front and the cheek-teeth. The actual contact is lost between the anterior and posterior portions of the lower jaws.

Unfortunately the symphysis of the jaws is broken back of the front teeth so that their characters or number cannot be stated. This is also true of the canine and the anterior premolars. $P_{\overline{4}}$, however, is completely preserved. Its crown is submolariform, the tetraconid being absent. Externally the base of the crown has a light cingulum, while internally the tooth is smooth. The molars are well represented; their cross-crests are perfectly formed and sharp. As in the upper molars, there are anterior and posterior cingula, while internally and externally the teeth are more or less smooth. The hypoconulid of $M_{\overline{3}}$ may be said to be only a heavy cingulum.

MEASUREMENTS.

Total length of skull fragment	123	mm.
Length of skull from end of premaxillary to anterior border of orbit, approximately	73	"
Length of alveolar border $I^{\underline{1}}$ to and including M^3 approximately	95	"
Length of diastema between incisors and canine	8	"
Length of diastema between canine and $P^{\underline{1}}$	16	"
Length of premolar series	26	"
Length of molar series	30	"
Antero-posterior diameter of canine at base of crown	5	"
Transverse diameter of canine at base of crown	3	"
Antero-posterior diameter of P^1	4.5	"
Transverse " " "	3	"
" " " P^2	7	"
Antero-posterior " " "	7	"
" " " " P^3	7.5	"
Transverse " " " approximately	8	"
" " " P^4	9.5	"
Antero-posterior " " "	8	"
" " " " M^1	9	"
Transverse " " "	10	"
" " " M^2	11	"
Antero-posterior " " "	10	"
" " " " M^3	9	"
Transverse " " "	10.5	"
Depth of lower jaw at $M_{\overline{1}}$, approximately	19	"
" " " " " M_3, "	21	"
Antero-posterior diameter of P_4	8	"

Transverse	diameter of	$P_{\overline{4}}$	5.5 mm.
"	"	" M_1	9 "
Antero-posterior	"	" "	6.5 "
" "	"	" M_2	10 "
Transverse	"	" "	6.5 "
"	"	" M_3	6.5 "
Antero-posterior	"	" "	12 "

Vertebral Column: The vertebral column is represented by fragments of the cervicals, the centrum of one dorsal, fragments of four lumbars, and the anterior portion of the sacrum.

From a fragment of the atlas it is evident that this bone was quite elongate and high, and that the base of the transverse process was pierced by a foramen. The centra of the anterior cervicals have a sharp ventral keel, which terminates posteriorly in an enlarged rounded tubercle, while two posterior cervicals (the fifth and sixth?), have heavy and quite high neural spines.

The centra of the lumbar vertebræ are heavy, broad, and depressed, especially those in the posterior region; they have a sharper ventral keel and are much less opisthocœlous than in the recent tapir, but the posterior face of the transverse process of the last lumbar is provided with a large articular face, which meets a corresponding face on the anterior extremity of the pleurapophysis of the first sacral vertebra as in the recent genus.

The centra of the sacrum decrease rapidly in their vertical dimension from before backward while transversely they appear to maintain a greater uniformity, which is again a tapiroid character. The pleurapophysis of the first sacral only supported the ilium, while in the tapir the second also takes a considerable part in this function.

Limbs: The fore and hind limbs are represented by numerous fragments. The glenoid cavity of the scapula is quite concave and presents a prominent descending process on its anterior margin. The coracoid process is very prominent and occupies a position slightly separated from the glenoid cavity, similar to that in the tapir, while the spine, judging from the fragment with which we are dealing, formed a more prominent median ridge on the neck and possibly rises more rapidly and nearer the glenoid cavity than in the recent genus.

The inter-trochlear ridge of the distal articulation of the humerus is shifted well over to the ulnar side and is prominently developed, as in the tapir. The entepicondyle is also similarly developed, but the supinator ridge is proportionally somewhat less prominent.

From the remains of the radius and ulna it is at once evident that this animal had the lower fore limb proportionally much longer than the tapir, while the articulating surface for the humerus is quite similar.

The carpus is represented only by the anterior portion of the magnum, which bears a striking resemblance to the corresponding portion in the recent tapir. The facet for the scaphoid rises gently in the ulnar direction to form an acute angle with the nearly vertical facet for the lunar and unciform on the ulnar face. The lunar facet does not appear to be interrupted by a sulcus before reaching the elevated posterior portion, as in the tapir, but is continuous from the dorsal face backwards. The superior and inferior facets for the trapezoid are not as well separated as in the tapir. In the tapir there is a deeply excavated area on the radial face of the magnum which distinctly separates these two facets. The facet for Mc. II is plainly represented on the lower radial angle just as in the recent genus.

On comparing the magnum with the illustration of *Isectolophus annectens* by Osborn (*l.c.*, p. 522, Pl. X, Fig. 3) there appears to be a difference in the angle of the articulations for the scaphoid, the lunar, and the unciform. In *Isectolophus* the scaphoid articulation on the magnum rises more, and in the lunar and unciform less, steeply than in *Helaletes*. This may or may not be due to faulty drawing.

The heads of metacarpals III, IV, and V are preserved and here again there is a similarity to the corresponding portions of the tapir. Mc. III was apparently enlarged in an equal ratio with that in the recent genus. The only points of difference, capable of comparison between the two, are the suddenly interrupted facet for the unciform on the head of Mc. III, and the two separate facets for the same bone (unciform) on Mc. IV in *Helaletes*, whereas in the tapir the facet on Mc. III, is more continuous and the one on Mc. IV is solidly united. The antero-posterior diameter of the shaft of Mc. III appears to be relatively greater in *Helaletes* than in *Isectolophus*. Mc. IV has facets on the radial angle of the head corresponding to those described on the ulnar angle of Mc. III.

MEASUREMENTS.

Greatest antero-posterior diameter of glenoid cavity of scapula.......	21	mm.
Greatest transverse diameter of glenoid cavity of scapula............	17	"
Greatest transverse diameter of distal end of humerus..............	23	"
Greatest antero-posterior diameter of distal end of humerus.........	20	"

Total length of fragment of radius	110	mm.
Transverse diameter of head of radius	18.5	"
Antero-posterior diameter of head of radius	12	"
Greatest height of magnum	10.5	"
Transverse diameter of magnum	8	"
" " at head of metacarpals III, IV and V in position	18	"

The blade of the ilium rises suddenly from the great sacro-sciatic notch and the gluteal surface presents a great antero-posterior extent, as in *Paloplotherium*[75] and in the recent tapir; the point of the ilium, however, extends proportionally further forward than in the recent genus. The acetabulum is deep and surrounded by a heavy border; the ligamentary pit is quite large and deep and the cotyloid notch is well developed and rather broad. The spine of the ischium is small, though quite plain, and is located opposite the posterior border of the acetabulum, as in the tapir. The obturator foramen is apparently large, judging from the broad expansion between the ischium and pubis near the acetabulum.

The great trochanter of the femur rises high above the head, which again suggests *Paloplotherium minus* and shows a marked difference from the condition in the tapir, more nearly suggesting the condition found in *Equus*. The digital fossa is deep and also extends above the top of the transverse line of the head, while in the tapir it is below this line. The bone is mutilated in the region of the lesser trochanter, but enough is preserved to indicate that this process is of some prominence. The shaft is also broken in the region of the third trochanter, but it is shown to have considerable vertical and lateral diameters (See Pl. XLII, Fig. 3). The tibial border of the rotular trochlea is very little more developed than the fibular border, a tapiroid rather than an equine character.

The tendinal groove on the outer face of the head of the tibia, the groove for the lateral ligament from the femur, is larger than in the tapir and the cnemial crest is less prominent, otherwise the head of the tibia is generally similar in the two genera. The distal end also differs from that in *Tapirus* by having the trochlea more oblique, an equine rather than a tapiroid character.

From the distal end of the fibula, the only portion of that bone preserved, I judge that the shaft is considerably reduced. On the dis-

[75] See Blainville (Osteographie) *Palæotherium minus*, Pl. VI. *Palæotherium minus* Cuvier, is now accepted as belonging to the genus *Paloplotherium* Owen.

tal posterior angle there is a distinctly rounded facet which fits neatly into a corresponding pit-like facet just above the articulation for the astragalus.

The high and narrow astragalus with its oblique trochlear groove was pointed out by Professor Marsh in his original description. This important equine feature agrees with *Heptodon* and is altogether different from what is seen in *Paloplotherium minus* and in the recent tapir, in which the bone is broader, shorter, and the trochlear groove more directly fore-and-aft. The articulation for the navicular is more concave from side to side than in the recent genus.

The calcaneum of *Helaletes boöps* agrees with that of *Heptodon* and is longer and slenderer than in the tapir. The bone as a whole, however, has a general similarity to that of the latter genus, except the round pit-like articulation for the fibula at the base of the *tuber calcis* directly dorsad, already referred to in the description of the fibula. In the recent tapir, the fibula touches the calcaneum, but this facet is only a rounded surface, which is more or less continuous with the facet for the astragalus, and is situated on the fibular angle of the latter articulation.

A fragment of the navicular plainly indicates this bone to be proportionally high when compared with that of the tapir. The cuboid is also high and the antero-posterior and transverse diameters are proportionally less than in the recent genus. The articulation for Mt. IV also differs from that of *Tapirus* in being single.

The pes is tridactyl as in the tapir. This is plainly indicated by the heads of the metatarsals of the right side which are all represented. Mt. III is enlarged in an equal proportion to Mc. III of the manus and the lateral digits, in particular Mt. II is as much, if not more, reduced, than in the tapir. There is a large facet for the entocuneiform on the tibial angle of the head of the latter bone, but no evidence of facets for metatarsals I or V. The distal trochlea of the median digit is quite symmetrical and the metapodial keel is more sharply defined than in the recent tapir, but is, as in the latter, confined to the posterior face of the articulation. On the whole the pes is very similar to that of *Heptodon* from the Wind River, described by Osborn and Wortman.

The median phalanges are broad and depressed, unlike the more elongated corresponding bones of *Heptodon* from the Wind River, while the lateral phalanges are more rounded. The phalanges as a whole are suggestive of the *Equidæ* rather more than those of the true tapirs.

MEASUREMENTS.

Length of ilium from border of acetabulum to point of ilium approximately	100	mm.
Greatest transverse diameter of femur at head[76]	42	"
Antero-posterior diameter of head of femur	18	"
Vertical " " " " "	19	"
Transverse " " " tibia	31	"
Antero-posterior " " " " "	30	"
" " " " distal end of tibia	18	"
Transverse " " " " " "	20	"
Height of tarsus, end of *tuber calcis* to distal face of cuboid	68	"
Height of astragalus	27	"
Greatest transverse diameter of astragalus	22	"
Transverse diameter of trochlea of astragalus, approximately	12	"
Total length of calcaneum	154	"
Transverse diameter of calcaneum at lesser process	20	"
Greatest height of cuboid	17	"
Antero-posterior diameter of cuboid	16	"
Transverse " " "	11	"
" " " tarsus at heads of metatarsals	20	"
Transverse diameter of head of Mt. III	12	"
Antero-posterior diameter of head of Mt. III	13.5	"
Transverse " " " " " II	6	"
Antero-posterior " " " " " "	11	"
Measured at facet for entocuneiform.		
Antero-posterior diameter of head of Mt. IV, approximately	10	"
Transverse diameter of head of Mt. IV, approximately	7	"

33. **Helaletes nanus** Marsh.

Amer. Jour. Sci., Vol. IV, 1872, p. 218.

Type: "*Lophiodon*" *nanus* Marsh.[77] Fragments of both upper jaws with all the cheek-teeth represented on right side, No. 11080, Yale Museum Catalogue.

Hypotype: "*Hyrachyus*" *nanus* Leidy.[78] $P^{\underline{4}}$ lower jaw and lower dentitions. ? Philadelphia Academy of Natural Sciences.

Horizon: Middle Eocene.

Locality: Grizzly Butte, Wyoming. One of the hypotypes, a lower jaw from near the Lodge-Pole Trail Crossing, Dry Creek Valley, Wyoming.

[76] The bone is slightly crushed in this region.

[77] *L.c.*, Vol. I, 1871, p. 37.

[78] "Extinct Vertebrate Fauna." . . . Report U. S. Geol. Surv. of the Territories, Vol. I, 1873, p. 67, Pl. XXVI, Fig. 11; Pl. VI, Fig. 42; Pl. XXVII, Figs. 21 and 22.

Specific Characters: P^{3} with tetartocone more distinctly separated from the deuterocone than in H. boöps; styles at the exit of the median valley of the superior molars smaller; cingula on anterior and posterior faces of upper molars smaller, but larger on the ectoloph near the posterior angle. Animals of same size as H. boöps.

For the present it is thought most prudent to continue to keep the above type specimen under a separate species as established by Marsh. The writer is, however, under the impression that the features of the specimen which vary from those of *H. boöps* may ultimately be regarded as only representing individual variation. In that case *Helaletes nanus* becomes the type of the genus and *H. boöps* Marsh and "*Hyrachyus*" *nanus* Leidy hypotypes.

Genus DILOPHODON Scott.

34. **Dilophodon minusculus** Scott. (Plate XLIV, Fig. 5).

Contribution from the E. M. Museum, Princeton, New Jersey, Bull. No. 3, 1883, p. 46, Pl. VIII, Fig. 4.

Type: Right lower jaw, No. 10,019, Princeton Museum Catalogue.

Horizon: Middle Eocene.

Locality: Henry's Fork? Wyoming.

Generic Characters ascertained from the type. $I_{?}$, C_{1}, P_{3}, M_{3}. *Diastema of the lower jaw proportionally shorter than in Helaletes boöps and rami more sharply constricted back of the incisors and in front of the cheek-teeth; M_{3} without hypoconulid; canine small; animal slightly smaller than Helaletes.*

There can be comparatively little or no doubt that *Dilophodon minusculus* pertains to a distinct genus, as originally determined by Professor Scott. The shorter diastema of the ramus suggests a different structure of that region than in *Helaletes.* This character together with the absence of a hypoconulid on M_{3} of the type of *Dilophodon* is regarded, by the writer as of sufficient generic value, pending the discovery of more complete material. In accepting the genus we avoid attributing two important characters to the genus *Helaletes* which do not appear to belong to the latter. Beside this fact, it is even possible that *Dilophodon* represents a third line of tapirs, which may represent a closer relation to the Oligocene and recent tapirs than to those of the Eocene, which are better known.

Although the dentition of *Helaletes, Hyrachyus,* and *Colonoceras* resemble one another, the differences between them are obvious on comparison of complete specimens.[79] The reduced nasals, the large anterior nares and air-sinus of *Heptodon* and *Helaletes* are specializations of an early origin, which obtained not only in these genera, but in all likelihood was also extended to the true ancestors of the recent tapirs, and may thus be regarded as an additional proof of the conservativeness of these Perissodactyls.

Not only did *Helaletes* have the abbreviated nasals, but the incisors were of subequal size, $P^{\underline{1}}$ much reduced, and in *Heptodon* we have the long cursorial limbs, truly a combination of specializations too conflicting and requiring too great a modification to fit them to be regarded as the true ancestors of the recent tapirs, even be they so far removed in time as the Eocene. On the other hand we have in the genus *Colodon* of the Oligocene a form which appears eminently fitted to represent the line of pseudo-tapirs in the later Tertiary, according to the determinations already reached by Osborn, Wortman, and Earl.

Dilophodon should only be provisionally included in the sub-family *Helalitinæ*, since it is too imperfectly known, and may still prove to be more closely related to the true tapirs.

When these pseudo-tapirs of the American Eocene are referred to as Lophiodonts it should be in a super-family sense (Lophiodontoidea), although with a greater restriction than that proposed by Dr. Gill.[80] In persisting in regarding these American genera as belonging strictly to the European family Lophiodontidæ[81] the taxonomy of the whole group is confused rather than cleared. That there is a relation between the European and American forms in question is not to be denied, especially when their dental structure is considered. But is this similarity much greater than that in other separate families; *e.g.*, the Palæotheres, the Chalicotheres, and the Titanotheres? When comparison of the limb structures of *Lophiodon* (*L. isselensis*)[82] and *Heptodon* or *Helaletes* is made we meet with an important degree of adaptive radiation. In *Lophiodon*, as is well known, the limbs are

[79] See *Amer. Jour. Sci.*, Vol. IV, 1897, p. 161, Fig. 2; *Bull. Amer. Mus. Nat. Hist.*, Vol. VII, 1895, p. 370; *Mem. Amer. Mus. Nat. Hist.*, Vol. I, 1898, p. 128*a*, Pl. XIII*a*.

[80] Smithsonian Mis. Coll. No. 230, 1872, p. 88. Certain genera of suids, anoplotheres, and *Coryphodon*, which were included by Dr. Gill, should, of course, be excluded.

[81] Osborn, H. F., and Wortman, J. L., *Bull. Amer. Mus. Nat. Hist.*, Vol. VII, 1895, p. 358; Osborn's "Age of Mammals," Classification Table, p. 557.

[82] Filhol, M. Henry, *Mem. Soc. Geol. de France*, Tom. V, 1888.

short and thick, while in *Heptodon* and *Helaletes* they are long and slender. In *Lophiodon* the femur has a curved shaft with the third trochanter located well down, the distal end broad; low and broad condyles and rotular trochlea; tuber of calcaneum short and thick; astragalus broad, low, with its trochlea directly fore-and-aft. In *Heptodon* and *Helaletes* the hind limb is, as we have seen, long, slender, and in structure quite equine. Such a broad inclusion of characters would necessitate, to my mind, the inclusion, of other early groups of the Perissodactyls more or less interrelated (*e.g.*, the Palæotheres, the early Equidæ, and even certain phyla of the Rhinocerotoidea) in this group an arrangement obviously out of reason, especially in view of our present accepted order in the phylogeny.

If the fragmentary material of the small lophiodont described and figured by Cuvier,[83] again referred to and figured by Blainville,[84] and also referred to under the name "*Colodon*" *minimus* by Gaudry,[85] belongs to the same species, it appears that it differs from both *Helaletes* and *Colodon* (*C. longipes* Osborn and Wortman).[86] These European remains appear to be on the whole more tapir-like, *i.e.*, they have a lower and broader tarsus, and the astragalar trochlea less oblique than in the *Heptodon-Colodon* series of America. We may well question the propriety of including them in the same family.

ISECTOLOPHIDÆ *fam. nov.*

Small Perissodactyls of the Eocene with dentition $\frac{3}{3}, \frac{1}{1}, \frac{4}{4}, \frac{3}{3}$. $P^{\underline{3}}$ *with one or two well defined internal cones.* $P^{\underline{3}}$ *with one internal cone. Para- and metacones subequal and conic. With or without diastema. Cross-crests of lower molars more or less perfectly developed. Connecting crests between proto- and hypoconids. Large hypoconulid on* $M_{\overline{3}}$.

This proposed family includes *Homogalax* ("*Systemodon*") Hay as defined by Osborn, Wortman[87] and Granger [88] and *Parisectolophus* ("*Isectolophus*") *latidens*, *vide infra*. A third genus *Schizolophodon*,

[83] Cuvier, Oss. Foss., Tom. II, 1825, p. 194, Figs. 20–25.

[84] Blainville, Osteographie, Tom. IV, Y, page 100, Pl. III (fourth specimen).

[85] Gaudry, *Bull. Soc. Geol. de France*, Tom. XXV, 1897, pp. 318–319, Pl. IX, Fig. 4.

[86] Osborn, H. F., and Wortman, J. L., *Bull. Amer. Mus. Nat. Hist.*, Vol. VI, 1894, p. 214.

[87] *Bull. Amer. Mus. Nat. Hist.*, Vol. IV, 1892, p. 124.

[88] *Op. cit.*, Vol. XV, 1908, p. 241. (See note in the present paper, page 103, in regard to Mr. Granger's identification of *Systemodon* and *Homogalax*.)

see page 122, is provisionally included, while the so-called tertiary tapir *Leptolophiodon* (*Isectolophus*) *annectens* (Rutimyer) *vide* p. 126, is doubtfully included.

This family may be subdivided into two subfamilies, the *Homogalaxinæ*, nom. nov., defined by Osborn & Wortmann under the name *Systemodontinæ* (*op. cit.*, p. 124) which cannot be used since the genus *Systemodon* has been transferred to the *Equidæ*, and the *Isectolophinæ*, subfam. nov.

Subfamily HOMOGALAXINÆ nom. nov.

(Type Gen. *Homogalax* Hay, non *Systemodon* Cope).

"*Dentition:* $\frac{3}{3}$, $\frac{1}{1}$, $\frac{4}{4}$, $\frac{3}{3}$. *Superior dental series continuous. First lower premolar contiguous to canine, followed by narrow diastema. Third and fourth superior premolars with two external cusps and a single internal lobe. Paracone and metacone subequal, conic. Protoloph and metaloph complete. Large third lobe upon third lower molar.*"[90]

ISECTOLOPHINÆ subfam. nov.

Small Perissodactyls of the middle and upper Eocene with dentition $\frac{3}{3}$, $\frac{1}{1}$, $\frac{4}{4}$, $\frac{3}{3}$. *Para- and metacones subequal and subconic.* $P^{\underline{3}}$ *with two internal cones.* $P^{\underline{4}}$ *with one internal cone. With or without diastema back of lower canine. Cross-crests of lower molars more or less perfectly developed. Connecting crests between proto- and hypoconids. Large hypoconulid on* $M_{\overline{3}}$.

Genus ISECTOLOPHUS Scott and Osborn.

35. **Isectolophus annectens** Scott & Osborn (Plate XLIV, Fig. 1).

Proc. Amer. Philos. Soc., Vol. XXIV, 1887, p. 260. "The Mammalia of the Uinta Formation," Trans. Amer. Philos. Soc., Vol. XVI, 1889, p. 520, Pl. X, Figs. 1–8.

Type: Upper and lower teeth No. 10400, Princeton Museum Catalogue.

Horizon: Uinta Eocene. Near base of Horizon C?

Locality: White River, Utah.

Hypotypes:[91] A crushed skull with fragments of the lower jaws and

* Osborn & Wortman (*l. c.*) defined the subfamily *Systemodontinæ* basing their definition upon material representing *Homogalax*, and, as *Systemodon* is now referred to the *Equidæ*, I propose the change here made.

[90] The definition is quoted from Osborn & Wortman.

[91] Fragments of lower jaws, No. 1828 in the American Museum Collection, which were found in horizon C, near Wagon Hound Canyon on White River, Uinta County, Utah, are here provisionally associated as hypotypes.

fragments of limb-bones, C. M. No. 3030. Right maxillary with cheek-teeth in place, C. M. No. 2337.

Horizon: Uinta Eocene. Near base of Horizon C.

Locality: On the Duchesne River, six miles east of Myton, Utah, and eastern end of Uinta Basin near Kennedy's Hole.

Generic Characters: (*I.* ? $\frac{3}{3}$, $C\frac{?}{1}$, $P\frac{4}{4}$, $M\frac{3}{3}$. *Long diastema back of lower canine.*[92] $P^{\underline{3}}$ *with two internal tubercles.* $P^{\underline{4}}$ *with one internal tubercle. Meta- and paracones of equal size. Ectoloph extended well back of protoloph. Parastyle large and well separated from paracone. Cross-crests of molars comparatively sharp.* $M_{\overline{3}}$ *with large hypoconulid; connecting-crests between proto- and hypoconids of molars. "Lunar with subequal magnum and cuneiform facets. Cuboid broad with an extensive astragalar facet. Manus and pes. Digits, 4 — ? 3."*[93]

Provisional Specific Characters: Long symphysis back of lower canine; the latter tooth proportionally small. Symphysis long and laterally constricted.[94]

The mashed cranium, No. 3030 and the maxillary, No. 2337, in the Carnegie Museum set definitely at rest the question of the upper premolar teeth of *Isectolophus*. Unfortunately the skull of No. 3030 when found was completely disintegrated in front of $P^{\underline{2}}$. No part of the front of either upper or lower jaws was obtained.

The present material agrees very well with the description and especially with the illustrations by Professor Osborn and serves well as a hypotype of this genus.

In reëxamining the type of *Isectolophus annectens* I find a portion of a premolar, which Osborn mistakenly referred to $P^{\underline{2}}$, but which in reality compares exactly with $P^{\underline{4}}$ of the specimen in the Carnegie Museum. Hatcher has correctly identified this tooth-fragment.[95] There is a single tooth with the type specimen, which is apparently $M^{\underline{2}}$ of the right side. The upper teeth described by Osborn as $M^{\underline{1}}$ and $M^{\underline{2}}$ agree better with $M^{\underline{2}}$ and $M^{\underline{3}}$ of the Carnegie Museum speci-

[92] As shown by the specimen of *Isectolophus* in the collection of the American Museum of Natural History, No. 1828.

[93] The generic characters inside of quotation marks are according to Osborn (*Trans. Amer. Philos. Soc.*, Vol. XVI, 1889, p. 519), and are based upon what is now regarded as a separate species, *Isectolophus scotti.*

[94] If it be hereafter found that complete specimens of *Isectolophus annectens* have this long diastema, then *Isectolophus scotti*, *vide* p. 120, must be raised to generic rank.

[95] "Recent and Fossil Tapirs," *Amer. Jour. Sci.*, Vol. I, 1896, p. 177.

mens, and reveal a mistake, by oversight in the text, since they are correctly indicated in his illustration (*op. cit.*, Pl. X, Fig. 1).

Detailed Description and Comparison of the Material.

P^2 of the Carnegie Museum specimen has two external tubercles set close together and a small blunt deuterocone not unlike some of the early tertiary forms (*Homogalax protapirinum* (Wortman) of the Big Horn Wasatch) except that the latter species has the deuterocone located slightly further back and the tooth itself has proportionally a greater transverse diameter than in the present specimen.[96] P^3 has two internal tubercles, which are slightly better developed than in *Parisectolophus latidens.* The proto- and tritocones are situated close together, the parastyle is quite prominent and is separated from the inner tubercles by a deep concavity of the ectoloph. This portion of P^3 is lost in *Parisectolophus latidens.* P^4 agrees in all its detailed structure, with that tooth in *Parisectolophus latidens.* Hatcher has already pointed out that there is only one internal tubercle of P_4 in *Parisectolophus latidens*[97] and that Osborn's generic definition of *Isectolophus* is partly erroneous.[98] The ectoloph of P^4 in *Isectolophus* consists of three subequal swellings, the trito- and protocones, and the parastyle is identical with that in the Bridger species. The molars increase gradually from the first to the last, and they differ in no important degree from those of *Parisectolophus latidens.*

A right maxillary, No. 2337, with the cheek-teeth represented, found by Mr. Earl Douglass in Horizon C, at the Devil's Play Ground near Kennedy's Hole, Uinta Basin, is interesting from the fact that a detached small premolar crown, most probably P^1, was found with the specimen and is here for the first time recorded. P^1 of this specimen is immediately in front of P^2, and is two-rooted and the crown, if correctly determined, is rather small, blunt, and conical in shape, with considerable wear from the opposite tooth. The teeth back of P^1 are identical with, though smaller than, those described in the foregoing pages. From this specimen it also appears quite clear that the infra-orbital foramen is located above the anterior portion of P^4. The maxillary is broken off immediately in front of P^1.

The inferior dentition of specimen No. 3030 is represented by the

[96] P^2 is lacking in the type specimen of *Parisectolophus.*

[97] *Amer. Jour. Sci.*, Vol. I, 1896, p. 177.

[98] *Trans. Amer. Philos. Soc.*, Vol. XVI, 1889, p. 519.

greater portion of $P_{\overline{1}}$, and fragments of the molars. As already stated, the specimen was found in a mutilated state, there being neither upper or lower incisors present. The specimen in the American Museum, No. 1828, already referred to, supplements the present specimen admirably. The symphysis of this specimen does not fit upon the back part of the jaw, due to loss of contact. If the specimen (See Fig. 17), pertains to the same individual, which appears quite likely, it is clear that there are two well-marked species of *Isectolophus* in the Uinta sediments. One of these has a long diastema back of the canine and the symphysis itself is constricted transversely as in *Triplopus*, while the other species has no diastema and no constriction of the symphysis.

The incisors and canine of the specimen in the American Museum are represented by roots only. These roots are of subequal size and have about one-half the diameter of the canine. Both incisors and canines had apparently a procumbent position. Back of the canine there is, as already stated, a long diatema with sharp superior border. The premolars are not present, while the molars are well-represented in this specimen. In comparing the molars with those of the type of *Isectolophus* it is at once clear that they pertain to *Isectolophus annectens* from their size and detailed structure.

$P_{\overline{4}}$ of the specimen in the Carnegie Museum, No. 3030, is quite

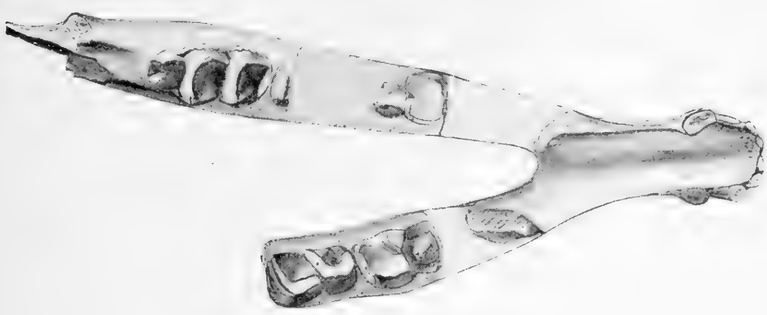


FIG. 17. *Isectolophus annectens.* No. 1828 American Museum of Natural History. × 2/3.

molariform, except for the lack of the tetartoconid. The cross-crests of the lower molars are perfect, as is the case in the specimen in the American Museum, and the third lobe (hypoconulid) of $M_{\overline{3}}$ is large, as in the type. The only noteworthy difference between No. 3030 of the Carnegie Museum collection and the type of *Isectolophus*, as well as the American Museum specimen, is the presence of two small mammillary tubercles rising from the cingulum on the antero-external portion of $M_{\overline{3}}$ in the specimen in the Carnegie Museum. These are absent both in the type and in the New York specimen, No. 1828, and may well be only an individual character (See Fig. 17).

The transverse diameter of the distal trochlea of the humerus is unusually small. This fact seems to agree with Osborn's description of the head of the radius (*op. cit.*, p. 521). The trochlea is rather deep, which is due to the very prominent capitellum. There is a decided tubercle on the dorso-ulnar face, just above the capitellum, but there is little or no articular surface on the ulnar side of the capitellum, such as is seen in the tapir, or developed more prominently in the horse.

36. **Isectolophus scotti**[99] sp. nov. (Plate XXXIV, Fig. 23).

Type: Fragments of upper and lower jaws, vertebræ, limb- and foot-bones, described by Professor Osborn as the Paratype of *Isectolophus annectens*.[100] Natural Science Museum of Princeton University, No. 10401.

Paratypes: Lower jaw fragment, No. 10399, Natural Science Museum of Princeton University, described by Professor Osborn as Paratype of *Isectolophus annectens* (*l. c.*, p. 520, Pl. X, Fig. 4). Fragments of upper and lower jaws with $M\frac{3}{3}$ present. Fragments of vertebræ, No. 3113, Carnegie Museum.

Horizon: Uinta Eocene. Near base of Horizon C.

Locality: White River, Uinta County, Utah.

Specific Characters: No diastema back of lower canine; symphysis short and not contracted laterally; canine of proportionally large size; animals smaller than Isectolophus annectens.

Pending the discovery of complete upper and lower jaws of *Isectolophus annectens* the above determination must be regarded as provisional. If the contour of the lower jaw together with the long symphysis, as exhibited in the fragmentary specimen in the American Museum, No. 1928 (See Fig. 17) proves to be the same as in *I. annectens*, then the new species here erected must take generic rank, as already stated in footnote 94.

In the specimen, C. M. No. 3113 (See Pl. XXXIV, Fig. 23) the position of the dentition in the alveolar border indicates the same con-

[99] In recognition of Prof. W. B. Scott, of Princeton University.

[100] *Trans. Amer. Philos. Soc.*, Vol. XVI, 1889, pp. 521–522, Pl. X, Figs. 3–8.

dition described and illustrated by Osborn (*op. cit.*, p. 521); *i. e.*, that the second and third premolars have two roots and $P_{\overline{1}}$ one root. The root of the canine indicates that tooth to be relatively larger that in the American Museum specimen, No. 1828.

PARISECTOLOPHUS nom. nov.

(Type *Parisectolophus latidens* (Scott & Osborn).)

37. **Parisectolophus latidens** (Scott & Osborn).

Isectolophus latidens OSBORN, "The Mammalia of the Uinta Formation," Trans. Amer. Phil. Soc., Vol. XVI, 1889, p. 513 *et seq.*

Helaletes latidens SCOTT & OSBORN, E. M. Museum Bull., Princeton Univ., 1878, p. 54, No. 3.

(Plate XLIV, Figs. 2–3).

Type specimen: Upper and lower jaws, No. 10251, Natural Science Museum, Princeton University. (*Cf.* Osborn, *l..c.*, p. 518.)

Horizon: Middle Eocene.

Locality: Henry's Fork? Wyoming.

Principal Characters: $I\frac{?}{3}$, $C\frac{?1}{1}$, $P\frac{?4}{4}$, $M\frac{3}{3}$, $P\frac{3}{}$, *with two internal tubercles;* $P\frac{4}{}$ *with one internal tubercle; light cingula on anterior, posterior, and external faces of premolars and molars. Meta- and paracones subconical; paracone larger than metacone; parastyle large and well-separated from paracone; cross-crests of molars obtuse and valleys shallow; extremely short diastema between* $P_{\overline{1}}$ *and* $P_{\overline{2}}$. *Inferior canines comparatively robust. Hypoconulid of* $M_{\overline{3}}$ *well-developed; connecting crests between proto- and hypoconids of molars. Lower jaws quite thick and slightly constricted back of canine and* P_1.

The most noteworthy differences between this genus and *Helaletes*, as exhibited by the type specimen, are the following: in *Parisectolophus*, the metacone is more subconical, the parastyle larger and more widely separated, the cross-crests of the upper and lower molars more obtuse, the hypoconulid of $M_{\overline{3}}$ longer, and the diastema between the incisors and cheek-teeth absent (See Pl. XLIV, Figs. 2–3).

Parisectolophus latidens differs from *Isectolophus* in comparatively few nevertheless well-marked and rather important characters, so far as comparison can be made. First, the molars of *Isectolophus* are considerably advanced, because of the greater posterior enlargement of the ectoloph, making the para- and metacones equal in size; secondly the cross-crests of the molars are slightly higher and sharper; the cingulum of the upper molars are much heavier.

Fig. 13 of Plate II in Leidy's "Extinct Vertebrate Fauna of the Bridger Tertiary Formation of Wyoming Territory" represents *Hyrachyus modestus*, which seems somewhat similar to *Parisectolophus*, and possibly may belong to this genus. However, the metacone appears to be located on a more direct antero-posterior line with the paracone, and the junction of the metaloph with the ectoloph is somewhat further forward than in the type of *Parisectolophus* described and figured.

Genus SCHIZOLOPHODON gen. nov.

38. **Schizolophodon cuspidens** sp. nov. (Plate XLIV, Fig. 4).

Type: A pair of lower jaws with premolars and molars fairly well preserved. C. M. No. 3045.

Paratype: Right lower jaw and symphysis with roots of canines and the anterior cheek-teeth of the right ramus, C. M. No. 3010.

Horizon: Uinta Eocene, Horizon C.

Locality: Duchesne River, Six miles East of Myton, Utah.

Principal Characters: Lower molars with incomplete cross-crests, especially on $M_{\overline{3}}$ *and the anterior cross-crest of* $M_{\overline{2}}$. *Hypoconulid of* $M_{\overline{3}}$ *comparatively small. Animals about the same size as Isectolophus annectens.*

Detailed Description of the Material: The horizontal ramus is heavy and quite deep; the symphysis is heavy, but the rami are not constricted back of the canine, and there are two or more mental foramina, of which the most anterior is directly below $P_{\overline{1}}$. The vertical ramus is not present in either type or paratype.

The incisors, of which there appear to be three on either side, are only represented by roots and are rather small.

The canines are also broken off, and are proportionally small[101] when compared with those in *Parisectolophus latidens* from the Bridger. There is no diastema between the canine and the cheek-teeth. $P_{\overline{1}}$ has a single fang and a simple crown with a small basal shelf postero-internally. $P_{\overline{2}}$ is quite suddenly enlarged, especially in the fore-and-aft direction. The anterior portion of the crown consists of a blunt trihedral elevation with the apex directed forward, while the posterior portion (the heel) is low, partly due to wear, the tetartoconid being absent. $P_{\overline{3}}$ is considerably farther advanced towards the molar pat-

[101] In the paratype the canines are apparently of larger size.

tern. The proto- and deuteroconids are rather closely united and have received much wear. The anterior margin of the crown has developed into a crescentic ridge, which extends from the protoconid forwards and inwards. The metaconid has formed a somewhat similar, though less crescentic, ridge-connection with the deuteroconid. This portion of the crown has also received considerable wear. The tetartoconid is absent. $P_{\overline{4}}$ is only represented by the posterior half of the crown and its detailed structure is practically a repetition of the tooth in advance of it, except that the crest, which connects the metaconid with the anterior cross-crest, forms the junction with the latter rather midway between the proto- and deuteroconid, instead of directly with the deuteroconid as in $P_{\overline{3}}$. In the paratype of *Isectolophus annectens* this character is observed to be similar to that just described. There is no tetartoconid, but the rise of the fold of the enamel in this region of the tooth furnishes the margin of a distinct pit. The cingulum is not well-developed on the premolar series. $M_{\overline{1}}$ is represented by the posterior portion of the crown in the type, while in the paratype only the antero-external angle is preserved. The tooth in both specimens has received much wear, so that its characters are rather unreliable. $M_{\overline{2}}$ is also much worn, but it is still possible to detect that the anterior cross-crest was interrupted by a longitudinal valley, while the posterior cross-crest is more complete. Directly in front the cingulum has formed a heavy ledge, which constitutes a conspicuous addition to the base of the crown. $M_{\overline{3}}$ may be said to have five distinct tubercles on the crown: in addition to this there is again repeated the anterior ledge (parastylid) shown on $M_{\overline{2}}$. There are no cingula on the internal face of the molars, while externally they are moderately developed.

MEASUREMENTS.

	Type No. 3045.	Paratype No. 3010.
Total length of the jaw fragment	128 mm.	
Depth of ramus at $P_{\overline{1}}$	22 "	24 mm.
Depth of ramus at $M_{\overline{2}}$	31 "	31 "
Length of cheek-teeth including canine	90 "	88* "
Length of premolars	38 "	35* "
Length of molars	45 "	45 "
Antero-posterior diameter of $P_{\overline{1}}$	7 "	7 "
Transverse diameter of "	4 "	4 "
Antero-posterior diameter of $P_{\overline{2}}$		9 "
Transverse " " "		5 "
Antero-posterior " " $P_{\overline{3}}$		10 "

Transverse diameter of $P_{\overline{3}}$	*	6 mm.
Antero-posterior " " P_4, approximately	10 mm.	9 "
" " " " $M_{\overline{1}}$ "	11 "	11 "
" " " " $M_{\overline{2}}$	13 "	
Transverse " " "	9 "	
Anter-posterior " " $M_{\overline{3}}$	18 "	
Transverse " " "	11 "	

The close relationship existing between *Isectolophus* and *Parisectolophus* was in reality recognized by Professor Osborn[102] and Mr. Hatcher;[103] the former included *Helaletes latidens* under *Isectolophus*, and the latter expressed the opinion that this same specimen should be made the type of a new genus "if it can be shown to differ generically from *Helaletes*." Dr. Wortman and Mr. Earl referred to this same Bridger specimen as *Isectolophus latidens*.

With the more complete knowledge which we now possess of the characters of the type of *Helaletes* it is obvious (1) that the genus should be separated from *Parisectolophus* as well as from *Isectolophus;* (2) that many cranial features as well as certain characters of the teeth in *Helaletes* agree as well, or better with those of the recent tapirs than is the case with the characters with which we are acquainted in *Homogalax*, *Parisectolophus*, or *Isectolophus*, (3) that the generic separation instituted by Wortman and Earl[104] between *Heptodon* and *Homagalax* should be accepted.

According to my view of the facts in the case *Heptodon* may be regarded as in the ancestral line leading to *Helaletes*, while *Homogalax* is equally clearly in the line leading to *Parisectolophus* and most probably to *Isectolophus*. But we cannot seriously claim that either *Helaletes*, *Parisectolophus*, or *Isectolophus* are direct ancestors of the modern tapirs.

Wortman, Earl, and Hatcher have questioned the view that the true ancestor of the tapirs is *Isectolophus*.[105] Wortman and Earl say: (*l. c.*, p. 171) "The crests of the inferior true molars are nearly crescentoid in form, which character we should not expect to find in a

* The jaw is crushed in this region and the measurement is not reliable.

[102] "The Mammalia of the Uinta Formation," *Trans. Amer. Philos. Soc.*, Vol. XVI, 1889, p. 519.

[103] "Recent and Fossil Tapirs," *Amer. Jour. Sci.*, Vol. I, 1896, p. 178.

[104] *Bull. Amer. Mus. Nat. Hist.*, Vol. V, 1893, pp. 178–180; *l.c.*, Vol. VIII, 1896, pp. 85–86 (Wortman).

[105] Wortman, J. L., and Earl, Charles, *Bull. Amer. Mus. Nat. Hist.*, Vol. V, 1893, p. 171; Hatcher, J. B., *Amer. Jour. Sci.*, Vol. I, 1896, p. 178.

Uinta tapir. The last lower molar has also a very large third lobe. Some of the characters above adduced as to the teeth of *Isectolophus annectens* may show by later discoveries that this species is not in the direct line leading to the true tapir." On page 180 of the same publication is found, by the same authors, the following: "In fact all the known species of both *Systemodon* [*Homogalax*] and *Heptodon* are extremely slender forms, as compared with their supposed Miocene [= Oligocene] successors, and if we derive the true tapirs and pseudotapirs from any of the known species of either of these genera we must suppose a considerable modification of their foot-structure to reach the condition found in their Miocene [= Oligocene] relatives. The dentition of these early Wasatch and Wind River Tapiroids, however, is well adapted for further evolution into later Miocene [= Oligocene] types, but in their foot-structure we find it otherwise."

Mr. Hatcher objects to regarding *Isectolophus* as the ancestor of the tapirs as follows: (*l. c.*, p. 178) "The metacone in *Protapirus* is placed farther in, and is less prominent and not so convex externally as in *Isectolophus*, while the same element in recent Tapirs is more prominent and has a more external position than in *Isectolophus*. Thus, according to our present phylogenetic arrangement we should have to allow for first a gradual shifting inward of the position of this cone followed by a period when it commenced to move outward to its normal position in modern Tapirs, a rather extreme case of oscillation, but not entirely inconsistent with what Scott has shown to have taken place in the equine series."

If we accept the phyletic development of the superior premolar dentition of the three Oligocene species of *Protapirus*,[106] namely, *P. simplex*, *P. validus*, and *P. obliquidens*, as well-established, we have not yet, to my mind, established any satisfactory evidence that there has been found in the American Eocene an ancestor for these forms. In *Helaletes* the deuterocone of $P^{\underline{3}}$ is already slightly divided at the apex, while in *Isectolophus* and *Parisectolophus* there are two distinct internal tubercles. On the other hand the upper premolars of *Protapirus simplex*, a much later form of the Oligocene, has only one internal cone, the paraconule of $P^{\underline{3}}$ being even less developed than in *Homogalax* from the Big Horn Eocene. From the comparative char-

[106] Hatcher, J. B., *Amer. Jour. Sci.*, Vol. I, 1896, p. 179. (Hatcher questions the propriety of referring the American species of the Oligocene tapiroids to the European genus *Protapirus*.)

acters of the upper dentition, of which we have just spoken, taking no account of the limb and foot structure of the Eocene pseudotapirs, we find difficulty in accepting as natural such a fluctuation as we must admit to have occurred were we to place *Isectolophus* or *Parisectolophus* in the direct line of ancestry to *Protapirus*. These Eocene tapirs of North America, if they continued into the Oligocene, had as their successors, not *Protapirus*, but some form contemporaneous with the genus *Colodon*. The true Eocene ancestors of the Oligocene and recent tapirs cannot logically be said to be represented by the remains heretofore found in the Eocene of North America.

Isectolophus, *Parisectolophus*, and possibly *Schizolophodon*[107] appear to form a second independent line of Eocene tapirs paralleling that represented by *Heptodon*, *Helaletes*, and *Colodon*.

Since we now know the upper dentition of *Isectolophus* better than heretofore, it is obvious that Professor Osborn's inclination to refer Rütimeyer's *Lophiodon annectens* to *Isectolophus*,[108] and the acceptance of this reference by Trouessart[109] and others, cannot now consistently be continued. Rütimeyer's illustrations [110] indicate different outlines and configurations of the grinding surfaces, besides greater height of the cross-crests and a greater amount of cement in the different elements of which the teeth are composed; in the latter respect apparently more rhinocerotic than is the case in *Isectolophus*. The name *Leptolophiodon annectens* (Rütimeyer) might be proposed for this European form, which must in any event be excluded from the American genus. Furthermore, it is questionable whether this European genus should even be included in the *Isectolophinæ*.

[107] The imperfect cross-crests of the molars of *Schizolophodon* suggest a conservative type, which recalls the condition in *Homogalax* or *Eohippus*, and may belong in a separate subfamily.

[108] *Amer. Naturalist*, Vol. XXVI, 1892, p. 763.

[109] Catalogus Mammalium, p. 765 (*rütimeyeri*).

[110] *Abhand. Schw. Pal. Ges.*, 1891, p. 26, Pl. I, Figs. 11–13. *Note*: Specimens represented by Fig. 12 in Rütimeyer's illustrations (Pl. I) are perhaps most suggestive of the American genus *Isectolophus*, but according to the illustrations, the cross-crests are more curved, the ectoloph thicker, and the teeth contain more cement.

Superfamily *RHINOCEROTOIDEA*.

Family HYRACODONTIDÆ.

Subfamily HYRACHYINÆ.

Genus DESMATOTHERIUM Scott.

39. **Desmatotherium guyotii** Scott (Plate XLIV, Fig. 6).

Contributions from The E. M. Museum, Princeton, N. J., Bull. No. 3, 1883, p. 46, Pl. VIII, Figs. 1–3.

Type: Upper jaws, No. 10166, Princeton Museum Catalogue.

Horizon: Eocene Formation (Bridger Beds).

Locality: Henry's Fork, Wyoming.

Generic Characters: Professor Scott defines the genus as follows: "Lophiodonts closely allied to *Hyrachyus*, having the molar teeth constructed exactly as in that genus, but differing from it in the pattern of the third and fourth upper premolars, which have two internal cusps instead of one. Dental formula: $\frac{?-?}{?-?}$ c. $\frac{1-1}{?-?}$ Pm. $\frac{4-4}{?-?}$ M $\frac{3-3}{?-?}$."

In his specific determination Scott states that the postero-internal cusp of $P^{\underline{4}}$ "is very small and situated somewhat exterior to the antero-internal cusp." His illustration (*l. c.*, Pl. VIII, Fig. 3) also appears to agree with this statement. Both are erroneous and clearly a mistake, since his detailed description of $P^{\underline{4}}$ apparently agrees better with the actual type specimen. Upon the reëxamination of the specimen (See Pl. XLIV, Fig. 6) it is clear that the tetartocone is on a more nearly even antero-posterior line with the deuterocone, and that the cusp represented in Professor Scott's illustration is an enlargement, or an intermediate tubercle located on the posterior crosscrest. The tetartocone is very much ground down by the opposition of the inferior tooth.[111] The true condition is better shown on $P^{\underline{4}}$ of the left side, which is completely preserved, and from which the drawing represented by the present illustration is partly restored.

Scott states (*l. c.*, p. 48) that the true molars of *Desmatotherium* are, with few minor differences, very similar to those in *Hyrachyus*, and the matter here needs no further discussion, except to say that these two genera are indeed very closely related.

COMPARISON AND RELATIONSHIP.

With regard to the taxonomic position of *Desmatotherium* I am strongly impressed with the idea that the genus is not directly ances-

[111] It is possible that this tubercle was broken off and healed over before the death of the animal.

tral to the tapirs, but that it is closer to the Rhinoceroses. Again referring to *l. c.* Plate XLIV, Fig. 3, it is quite clear that the premolars have unmistakably advanced towards such Oligocene genera as *Leptaceratherium trigonodum*, *Cœnopus mite*, or *C. platycephalum*. This implies a very early origin of the "atypical" premolar structure, to which Professor Osborn calls attention in his work on the Rhinoceroses referred to above. Nor is there any apparent reason for excluding *Hyrachyus agrarius* or *Colonoceras agrestis* as also possibly belonging to the Rhinoceroses, the latter genus to *Diceratherium* as Marsh originally suggested.[112] The *Rhinocerotidæ* had, in the Uinta, the Bridger, or even earlier Tertiary time, most likely made more than the initial start towards their varied specilizations seen in later time. I am inclined to the opinion, that, if we had found in America the true middle Eocene ancestry of the various types of Rhinoceroses, in the later epochs we would have met with even further advancements than are recorded in the Bridger or later Eocene.[113] The Amynodonts of the Uinta are certainally surprisingly advanced along their line. When the dentition of *Desmatotherium* is compared with that of *Isectolophus* and *Parisectolophus* and the earlier genus *Homogalax* the tendency toward the vertical increase of the crowns, or greater development of the cement is clearly observed in *Desmatotherium*. Besides the early origin of the tetartocone of $P^{\underline{4}}$, the cross-crests are visibly of greater prominence and the valleys deeper than in the teeth of *Parisectolophus* or even the Uinta genus *Isectolophus*. Altogether the teeth, especially the molars, are more nearly like those in *Hyrachyus*, *Colonoceras*, or *Helaletes*. In *Hyrachyus* there is, however, present a crista which is only faintly or not at all indicated in *Desmatotherium*. In *Colonoceras* the crista is slightly better developed than in *Desmatotherium* and the posterior cross-crests of the superior premolars are also located further foward in *Colonoceras*.[114] Scott's genus *Desmatotherium* should be placed with *Hyrachyus* in a line nearer to the *Rhinocerotidæ*. It certainly appears to be more closely related to that group that to the Tapiroidea, where it has been heretofore placed.

[112] *Amer. Jour. Sci.* (3), Vol. XIV, 1877, p. 362.

[113] Europe during this time was nearer, or perhaps more accessible, to the center of dispersion of the true Rhinoceroses, according to the works of Schlosser, Abel, and others.

[114] If these features in *Colonoceras* are constant they may be regarded as of considerable importance.

Genus HYRACHYUS Leidy.

Proc. Acad. Nat. Sci. Philad., 1871, p. 229.

Hyrachyus is represented by two individuals C. M. Nos. 2908 and 3112. The former consists of a pair of lower jaws minus the angle and the incisor teeth, and was found in the upper portion of horizon A, near White River, Uinta Basin, Utah, while No. 3112 is a fragment

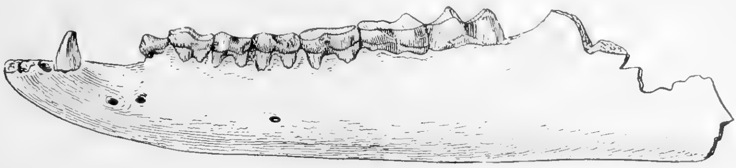


FIG. 18. *Hyrachyus grande* sp. nov. Type Carnegie Museum No. 2908. × 3/10.

of a lower jaw with $P_{\overline{1}}$ and $M_{\overline{1}}$ in place and a fragment of the maxillary with only the roots of the premolars present. The latter was found in horizon B, southeast of Kennedy's Hole, Uinta Basin, Utah. While the lower jaws, No. 2908, represent an animal larger than any pertaining to that genus heretofore found, and may probably belong to a new species, or possibly even a new genus, there are unfortunately no characters present indicating any marked advance over those found in the Bridger genus. As stated above, the incisors are lost,

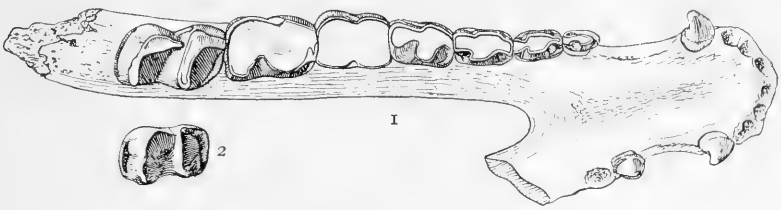


FIG. 19. 1. *Hyrachuys grande* sp. nov. Type. Carnegie Museum No. 2908. × 2/5. 2. *Hyrachyus princeps* Marsh. $M_{\overline{3}}$ of type specimen in Peabody Museum of Natural History. × 2/5.

but from their alveoli it is possible to quite definitely determine that they were all of subequal size, the two intermediates possibly somewhat larger than the laterals. The canine is possibly slightly reduced when compared with *Hyrachyus agrarius*, but this may well be a sexual character and not of specific importance. The premolars are all of the *Hyrachyus* pattern, with practically no indication of a further step towards the development of a posterior cross-crest, such as is found in *Trigonias osborni* from the base of the Oligocene. Deciduous $P_{\overline{1}}$ is present in the right ramus (see Fig. 19). $M_{\overline{1}}$ and $M_{\overline{2}}$ are much worn, the crowns furnishing no detailed characters, while $M_{\overline{3}}$ practically agrees in all details with the same tooth of the known species of the genus, except in its larger size. The ramus appears to be proportionally slenderer than in *Hyrachyus agrarius*. *Hyrachyus princeps* Marsh, which also is a large form, is smaller than the specimen under description. If the specimen does not belong to the latter species [115] it may be called *Hyrachyus grande* sp. nov. simply to indicate its extraordinarily large size (See Figs. 18 and 19).

The specimen No. 3112 is slightly larger than *Hyrachyus agrarius* Leidy, and appears moreover to differ from the latter by a proportionally greater development of the metaconid and a slight basal elevation indicating the tetartoconid.

MEASUREMENTS.

	No. 2908.	No. 3112.
Length of ramus from anterior point of symphysis to and including $M_{\overline{3}}$	215 mm.	
Depth of ramus at $P_{\overline{1}}$	40 "	
" " " " $M_{\overline{3}}$	54 "	
Antero-posterior diameter of cheek-teeth	161 "	
" " " " $P_{\overline{4}}$	21 "	15 mm.
Transverse " " "	15 "	11 "
Antero-posterior " " $M_{\overline{1}}$	26 "	22 "
Transverse " " "	19 "	14 "

Subfamily AMYNODONTINÆ.

Genus **Amynodon** Marsh (Plate XLVII, Figs. 5–7).

Amer. Jour. Sci., Vol. XIV, 1877, pp. 251–252.

This genus is represented by a number of individuals. The material has a considerable range in size and undoubtedly represents two or probably three species. Unfortunately the fragmentary condition of the greater number of the specimens does not admit of an accurate identification. The smaller individuals are therefore provisionally[116]

[115] There is unfortunately no other basis of comparison between these two specimens besides $M_{\overline{3}}$. In *H. princeps* the cingulum of the anterior face is heavier and the anterior extension of the metalophid is somewhat less developed than in the Uinta specimen. These may or may not be valid characters.

[116] All the specimens referred to *A. advenum* are too small when compared with the measurements of the type specimen by Marsh. One specimen in our Collection, No. 3217, is especially small and may represent a new species.

placed in *Amynodon advenum* (Marsh)[117] while the larger are referred to *Amynodon intermedium* Osborn.[118] Of the smaller specimens those which have the upper and lower premolars preserved show three in either jaw, which according to Osborn's reidentification (*l. c.*, 1889, page 507) would, except in size, agree with *Amynodon advenum*. The best preserved specimen representing the larger species, is C. M. No. 3200, the greater portion of a skull of an adult, perfectly symmetrical. Unfortunately, however, the dentition is represented only by the roots of the posterior premolars, the roots of the molars, and a portion of the crown of $M\frac{3}{}$ (Pl. XLVII, Fig. 5). This portion of $M\frac{3}{}$ and the general large size of the teeth agree with *A. intermedium* and an outline drawing of the dentition of the type as figured by Osborn (*l. c.*, Pl. X, Fig. 10) is here added in connection with the palatal view, in order to better aid the student in comparative work (See Pl. XLVII, Fig. 6). A side view of the specimen in the Carnegie Museum is given in Fig. 7 on the same plate, in order to supplement the figures given by Osborn of the dentition and maxillary region, the only portions of the type specimen preserved. The description of the skull, which belongs to the articulated young skeleton exhibited in the American Museum of Natural History, referred to *A. intermedium* by Osborn[119] appears to agree quite well with the present cranium.

Subfamily HYRACODONTINÆ.

Genus PROTHYRACODON Scott and Osborn.

40. **Prothyracodon obliquidens** Scott & Osborn (Plate XLVI, Figs. 1–9).

Proc. Amer. Philos. Soc., Vol. XXIV, Sept. 2, 1887, p. 260.

Generic Characters: $I\frac{3}{3}$, $c\frac{1}{1}$, $P\frac{4-3}{4-3}$, $M\frac{3}{3}$. *Incisors subequal in size; upper canine followed by a short diastema, lower canine close to* $I_{\overline{3}}$; *a general advance of the cheek dentition towards the Hyracodonts and Rhinoceroses of the Oligocene; that is, a decided development of the crista, crochet, and anticrochet together with the Rhinocerotic structure of* $M\frac{3}{}$ (*Prothyracodon uintense, vide infra*). *Fore limb proportionally shorter than in Triplopus. Animals larger than Triplopus.*

It is a matter of surprise to find such differences in the proportionate

[117] *Amer. Jour. Sci.*, Vol. IX, 1875, p. 244.

[118] "The Mammalia of the Uinta Formation," *Trans. Amer. Philos. Soc.*, Vol. XVI, 1889, p. 508.

[119] *Bull. Amer. Mus. Nat. Hist.*, Vol. VII, 1895, p. 95.

length of the humerus and radius of Professor Cope's genus of the Washakie Eocene *Triplopus cubitalis* and the recently acquired material of *Prothyracodon* from the Uinta deposits. It is thus seen that the genus from the Uinta has the fore limb much more like that of the Oligocene genus *Hyracodon* than is the case with the genus from the Washakie. The type of the latter was, according to Professor Cope, "cut from a block of calcareous sandstone" and Dr. Matthew of the American Museum of Natural History assures the writer that there is no doubt as to the correct association of the parts of the type specimen upon which Cope founded the genus.[120] A restudy of the type of *Triplopus cubitalis*, compared with the material in the Carnegie Museum, results in definitely placing the form from the Uinta in a separate genus, *Prothyracodon*, as was originally done by Scott and Osborn. The generic rank of the form from the Uinta was called into question by Professor Osborn in a later publication.[121]

Prothyracodon obliquidens is represented in the Carnegie Museum by a number of individuals. These are all more or less fragmentary, but serve to throw further light on the limb-structure of this cursorial Rhinoceros from the Uinta Eocene. C. M. No. 2942 is represented by both fore limbs and is of approximately the same size as the type of *Prothyracodon obliquidens*. A second specimen, C. M. No. 3199, not fully adult, and slightly smaller, is represented by both fore and hind limbs. The former was found by the writer in the lower portion of horizon C, six miles East of Myton, Utah, while the latter was found by Mr. Earl Douglass in horizon C further east in the Uinta Basin. The scapula of No. 2942 is represented only by a fragment of the proximal end (See Pl. XLVI, Fig. 5). It agrees with the description and illustration by Professor Cope.[122] In a specimen, which probably pertains to another species, described on page 134, the scapula is fairly well-preserved. This bone is quite elongated, with a long neck. The spine, however, rises more rapidly than that in *Hyracodon* of the Oligocene and differs further from that genus by having apparently the acromion process situated lower down or nearer the glenoid cavity,[123] and by having a proportionally shorter and broader blade.

[120] Tertiary Vertebrata, p. 684, Pl. LVI*a*.

[121] "The Mammalia of the Uinta Formation," *Trans. Amer. Philos. Soc.*, Vol. XVI, 1889, p. 524.

[122] Tertiary Vertebrata, p. 684, Pl. LVI*a*.

[123] The spine in this region is broken, but what still remains is proportionally higher and differs otherwise from that in *Hyracodon* and is more suggestive of *Mesohippus*.

The humerus is laterally compressed proximally, which is in part due to crushing. The greater tuberosity rises considerably above the head. There is a large deltoid groove and the deltoid ridge is prominent, but does not have the large and rugose tuberosity seen in *Hyracodon*, and the supinator ridge is also less developed. The distal trochlea is relatively slightly narrower than in the latter genus, but resembles it closely in height, its very prominent and narrow intercondylar ridge, and narrow outer condyle (Pl. XLVI, Fig. 4).

The radius is only very slightly longer than the humerus, and in this respect is quite similar to the same bone in *Hyracodon*, though slenderer. Its head is not greatly expanded and the shaft is broad and rather compressed antero-posteriorly, with a considerable bow in the same direction, while distally it is expanded both laterally and antero-posteriorly, with deeply excavated facets for the scaphoid and the lunar. The shaft of the ulna is more reduced than in *Hyracodon* of the Oligocene, but, as in that genus, it is at no place coössified with the radius.

The carpus agrees with the description given by Osborn (*l. c.*, pp. 527, 547) except the trapezium, which according to Osborn is greatly reduced. This is probably a mistake, since the trapezium of one individual (No. 2336) of the Carnegie Museum is of considerable size, and the large facet on the radial palmar angle of the trapezoid of the specimen under description indicates a bone proportionally quite as large as in *Hyracodon*.

The metacarpals are all complete, and plainly show that they are much shorter proportionally than in *Mesohippus*, the genus with which Professor Osborn compared the pes of *Triplopus*. Mc. I is entirely absent, Mc. II and IV are reduced in size, but not quite as much as in *Hyracodon*, while their length in comparison with Mc. III is fully as much or even more reduced than in that genus. Mc. V is reduced to about the same extent as in *Hyracodon* (See Plate XLVI, Fig. 2).

The median phalanx of the proximal row is broad and depressed, while those of the lateral digits are higher. The ungual phalanges are also depressed, somewhat pointed and cleft, suggesting the features of the early horses to a remarkable degree.

With No. 3199, already referred to above, there is unfortunately only preserved a fragment of the pelvis, the femur, and the metatarsals, while the entire length of the tibia, except the epiphysis of the proximal end, and the greater portion of the tarsus is present.

The length of the tibia is very little, if any, greater than the radius. The bone is quite symmetrically formed with a prominent cnemial keel well confined to the proximal end, unlike what occurs in *Hyracodon*, in which it extends somewhat further down. The shaft has a slightly backward curve, while the distal trochlea is deeply excavated and is very oblique, in this respect closely suggesting the *Hyracotheres*.

The astragalus of No. 3199 has received slight lateral crushing, which makes it appear narrow in comparison with the specimen illustrated by Professor Osborn (*l. c.*, Pl. XI, Fig. 9). The pes as a whole is in reality slightly smaller than in the type, which is, no doubt, due to the incomplete maturity of the specimen at hand. The different bones of the tarsus agree quite well with the description of the material in Princeton University furnished us by Osborn (*l. c.*, p. 549), and needs no further description, except to say that the entocuneiform, though quite large, and with the plantar process somewhat like that of *Hyracodon* described and figured by Professor Scott,[124] has not formed an articulating facet with the plantar process of Mt. III, and the process itself has not attained the prominence seen on the entocuneiform of the Oligocene genus (See Plate XLVI, Figs. 7–8).

41. **Prothyracodon uintense** sp. nov. (Plate XXXVI, Fig. 1; Plate XLV; Plate XLVI, Figs. 10–16).

Type: Skull and lower jaws of young individual C. M. No. 3007*a*.[125]

Horizon: Uinta Eocene, horizon C.

Locality: Six miles east of Myton, Utah.

With the type specimen are provisionally associated three other specimens in the Carnegie Museum as probably pertaining to the same species. Of these No. 2990 consists of fragments of the lower jaws, limbs, and foot-bones; No. 3097, portion of vertebral column, scapulæ, and humerus, and No. 3399, fragments of vertebræ. Of these specimens No. 3007 was found together with the type, but is of an adult individual, the others were found in the same general locality and in the same horizon.

Specific Character: Protoloph of molars with a well-marked antecrochet. $M\frac{3}{}$ with smooth posterior face, no spur of the ectoloph at all indicated. Teeth proportionally large, when compared with P. obliquidens. Animals larger than P. obliquidens.

[124] "Osteology von *Hyracodon* Leidy," Festschrift für Carl Gegenbaur, Leipzig, 1887, p. 377, Pl. I, Fig. 7.

[125] The type specimen was found together with the remains of other individuals of different genera.

In the type, No. 3007*a*, there are three lower incisors, which are procumbent in position, of subequal size, with laterally expanded or fan-shaped crowns (Pl. XXXVI, Fig. 1). The canine is placed close to $I_{\overline{3}}$ and is but very little larger than the incisors in the type, while in an adult specimen No. 2990[126] it is slightly larger in proportion. On the whole the tooth in this species is relatively larger than in the Oligocene genus *Hyracodon* and it is also more oval in cross-section. In the type there are four upper and lower milk-teeth, while in the adult specimen, No. 2990, $P_{\overline{1}}$ is absent.[127] In the Uinta genus there is not developed the strong rib near the median portion of the ectoloph on the lower molars and premolars, nor is the heavy cingulum seen in *Hyracodon* present. There is in the type specimen a decided swelling on the posterior face of the protoloph, representing the antecrochet, and the prefossette is well indicated, but the crista is little or not at all represented, while in *Hyracodon* the crista is much better developed and the antecrochet is prominent. $M^{\underline{3}}$ is just appearing through the alveolar border. This young tooth has the posterior face of the ectoloph perfectly smooth, there being no spur of the ectoloph represented as in *Triplopus cubitalis* or *Prothyracodon obliquidens.* This feature was thought to be due to the immaturity of this tooth in the Carnegie Museum specimen, but it is perhaps more probable that the present well calcified crown would not before its final eruption add the characteristic spur seen in *Hyracodon* of the Oligocene or in the contemporary species of the Uinta deposits. Too much stress, however, should not be laid upon this highly interesting Rhinocerotic feature of $M^{\underline{3}}$ in the specimen at hand, until the discovery of fully adult upper dentitions. If this character is found in $M^{\underline{3}}$ of fully adult specimens, *P. uintense* should be placed in a distinct genus.

The base of the skull appears to be proportionally broader than in *Hyracodon*, which may be due to crushing. Whether or not there is a tympanic bulla cannot be determined. Unfortunately the important region of the external ear is also too much mutilated to determine whether it is like that in *Hyracodon* or whether it is closed inferiorly as in *Triplopus cubitalis.* There is a long and well defined sagittal crest and the supra-orbital ridges are also indicated in this young individual.

[126] No. 2990 is provisionally referred to *P. uintense* on account of its large size, which is taken as an indication that it pertains to the same species.

[127] The first premolar above and below are very rudimentary, and their absence or presence in this genus is perhaps not of great phyletic importance.

The postglenoid process is unusually heavy. In a specimen, No. 3201, referred to *P. obliquidens* the post-tympanic and paroccipital processes are separated, as shown in Plate XLVI, Fig. 1, and answers quite well to Cope's description. Furthermore the actual specimens have been compared, and are found to be quite alike in this respect. There are a number of similarities in the contour of the present specimen and the young specimen on which Cope established his *Triplopus cubitalis*.

These similarities may be regarded as of comparatively little importance since both specimens pertain to young animals.

In comparing *Prothyracodon* with Doctor Koch's *Prohyracodon*[128] as described and illustrated in Doctor O. Abel's work[129] it is at once seen that $M^{\underline{1}}$ and $M^{\underline{2}}$ of *Prohyracodon*, though mutilated, show the proto- and metalophs to be at a more nearly right angle to the ectoloph, the proto- and metalophs are also of more nearly subequal size than in the American genus. Furthermore there is in *Prothyracodon* a better defined antecrochet, a proportionally longer $M^{\underline{2}}$, and $M^{\underline{3}}$ has a more nearly triangular outline, than in the specimen preserved at Budapest.

MEASUREMENTS.

Total length of skull from condyle to and including d. $P^{\underline{1}}$				165 mm.
Antero-posterior diameter of deciduous upper dentition				42 "
"	"	"	" $M^{\underline{1}}$ and $M^{\underline{2}}$	36 "
"	"	"	" "	18 "
Transverse		"	" $M^{\underline{1}}$	16 "
"		"	" M^{2}	19 "
Antero-posterior		"	" "	22 "
"	"	"	" deciduous lower dentition	42 "
"	"	"	" permanent M_1 and M_2	32 "
"	"	"	" $M_{\overline{1}}$	15 "
Transverse		"	" "	10 "
"		"	" M_2	10 "
Antero-posterior		"	" "	16 "

On comparing the atlas of No. 3007 with that of *Hyracodon*, the similarities are remarkably close. Thus it is seen, that, as in the latter genus, the bone is high[130] and rather short, with a backward

[128] Koch, A., Termeszetrazi Fuzetek, Budapest, XX, 1897, pp. 490–500, Pls. XII–XIII.

[129] *Abhandl. der K. K. Geolog. Reichsanstalt*, Bd. XX, 1910, pp. 24–25, Pl. II, Fig. 1.

[130] The atlas of *Prothyracodon* appears to be proportionally higher than in *Hyracodon*, which is to a certain extent due to crushing.

projecting transverse process, perforated by a canal of considerable size, which again appears on the under surface of the transverse process and forms a deep atlantal groove (not foramen), at the anterior base of the same process. The anterior cotyles are deep and broadly excavated above and below, as in *Hyracodon*, but the accessory facets for the base of the occipital condyle are less developed than in the latter genus. The above description also agrees with that of *Triplopus cubitalis* by Professor Cope.

The axis of No. 3399, a specimen approximately of the same size as No. 3007, is considerably longer than the atlas. The bone again agrees with the description of *Triplopus cubitalis* by Cope,[131] and of *Hyrachyus* by Scott.[132] Thus the bone is relatively longer and slenderer than in the Rhinoceroses and suggests the axis of the horses through its prominent spine and odontoid process, ventral keel, and the oblique and concave posterior face of the centrum.

The remaining cervicals, which are represented in specimen No. 3007, appear to gradually shorten from the axis backward, and agree generally, so far as comparison can be made, with those in contemporaneous Uinta species as well as *Hyracodon*.

MEASUREMENTS.

	No. 3007.	No. 3399.
Transverse diameter of anterior cotyle	39 mm.	
Vertical " " " "	22 "	
Greatest vertical diameter of atlas	33 "	
" length of axis, odontoid process not included		48 mm.
Length of odontoid process		14 "

Besides the specimens described above, there are in the Carnegie Museum a number of individuals from the same locality and horizon, which perhaps pertain to a third species intermediate in size between *Prothyracodon obliquidens* and *P. uintense.* It is thought best to defer adding more species until more complete specimens are obtained. Two species of *Prothyracodon* from the Uinta were originally proposed by Scott and Osborn, which Osborn united in 1889 (*l. c.*, p. 525).

I do not hesitate in expressing my agreement with earlier workers (Scott, Osborn, Wortman, Earl and others), in regard to the phylogeny of *Prothyracodon.* From the evidence at hand there is comparative certainty that some genus closely allied to *Hyrachyus* should

[131] Tertiary Vertebrata, p. 683.

[132] "Die Osteologie von Hyracodon Leidy," *Festschrift für Carl Gegenbaur*, p. 363.

be regarded as the Bridger representative of this line of cursorial Rhinoceroses.[133] The Washakie genus *Triplopus* and the Uinta form *Prothyracodon uintense*[134] obviously represent independent lines, which may or may not be represented in the Oligocene,[135] while *P. obliquidens* is in all the obtainable characters so very closely related to the Oligocene genus *Hyracodon* that one cannot deny the phylogenetic relationship here displayed. It is very unfortunate that we have not in the recently acquired collection from the Uinta a skull sufficiently complete in the region of the tympanum and the external ear to verify Professor Cope's studies of *Triplopus cubitalis.* Considering all the known characters of *Prothyracodon* which are so very suggestive of *Hyracodon*, I believe that the Uinta form did not have the meatus closed inferiorly as in *Triplopus cubitalis.* This would substantiate Cope's position in placing *Triplopus* in a separate systematic position. Together with this equine feature of the external ear in *Triplopus* we now know that the limbs were also proportionally longer than in the Uinta genus. The genus apparently does, in fact, represent a subfamily (*Triplopodinæ*) of the *Hyracodontidæ* which holds an equal rank to the *Prothyracodon-Hyracodon* phylum.

Together with the highly Rhinocerotic feature of $\underline{M^3}$ in *Prothyracodon uintense* the first upper and lower premolars are altogether too much reduced in size[136] to be seriously regarded as a forerunner of the rhinoceroses of the Oligocene. Furthermore the lower canine and incisor series are typically those of *Hyracodon*, plainly excluding this species from the true rhinoceroses of the later Tertiary. In my opinion it is altogether possible, that, if this line continued in later epochs, we may find a Hyracodon-like form in the Oligocene with $\underline{M^3}$ reduced to the characteristic features of the *Rhinocerotidæ* so strongly suggested in the Uinta genus.

[133] The actual type of *Hyrachyus implicatus* Cope I have not seen, but from the splendid illustrations (Tertiary Vertebrata, Pl. LVIII, Figs. 6, 6*a*, 7) by Professor Cope, it appears to be in this line. Its dentition seems to be advanced in the direction of the Hyracodonts.

[134] With the exception of M^3, *Prothyracodon uintense* bears a closer relation to *Hyracodon nebrascencis* than does *Triplopus cubitalis.*

[135] The different forms of *Hyracodon* of the lower and upper Oligocene are as yet comparatively little known.

[136] Both the upper and lower first premolars may well be absent in fully adult specimens of *P. uintense* as they are, in fact, seen to be in individuals in the Carnegie Museum.

CHALICOTHEROIDEA.[137]

Subfamily SCHIZOTHERIINÆ? Holland and Peterson.

Genus EOMOROPUS Osborn.

42. **Eomoropus annectens** sp. nov. (Plate XXXVI, Fig. 2).

Type: Portion of skull with the cheek-dentition in position, C. M. No. 3109.

Horizon: Uinta Eocene, Horizon B.

Locality: Eastern portion of Uinta Basin, near Wagon-hound Bend, on White River, Utah.

Specific Characters: Skull comparatively narrow across the orbit and palate, long in the cranial region, less suddenly contracted laterally in the region of the orbit, and a lighter post-glenoid process when compared with E. amarorum. The type also indicates a considerable smaller animal than the latter.

From the character available for comparison with the type specimen of *Eomoropus amarorum* (Cope) the present species is, as already said, of considerably smaller size, especially in the dentition. *Eomoropus amarorum* differs from *E. annectens* by the relatively greater measurements across the maxillary from the inner face of $M^{\underline{3}}$ to the lower external face of the jugal, as seen in the illustrations given by Professors Cope[138] and Osborn,[139] as well as on the actual comparison of the specimens by the writer. The entire posterior portion of the skull of *E. annectens*, except the postglenoid process, was weathered out of the sandstone in which the maxillaries were found. The process appears to be in its natural position with relation to the zygomatic arch and maxillaries. From this fact it is presumed that there is a relatively greater distance between $M^{\underline{3}}$ and the postglenoid process in the present species than in *E. amarorum*.

There were probably only three premolars present. Through their relatively small size and the details of structure the premolars suggest those of *Schizotherium priscum* (Gaudry) in a remarkable manner. The molars on the other hand are proportionally shorter and broader. Furthermore the parastyle is more loosely connected with the paracone, and the vertical ridge on the external face of the paracone is

[137] Professor Osborn has recently (*Bull. Amer. Nat. Hist.*, Vol. XXXII, 1913, pp. 261–274) placed *Triplopus amarorum* Cope in a distinct genus of the Superfamily Chalicotheroidea.

[138] Tertiary Vertebrata, Pl. LVIII*a*, Fig. 2*a*.

[139] *L.c.*, page 262, Fig. 2*a*.

more prominent. The general construction of the molars in the two genera is, however, strikingly similar. On comparing the present specimen with other European genera, it may be said that *Eomoropus annectens* and *Macrotherium grande* Lartet resemble each other, more especially in the proportions of the molars. It thus appears that if *Eomoropus* is in the ancestral line leading directly to *Moropus* the molar series underwent a considerable lengthening during the Oligocene period. On the other hand, if the postglenoid process, as found, is in its correct position in the type of *E. annectens*, which seems quite likely, then this region of the skull had already taken on the characters found in *Moropus* to a greater degree than seems to be the case in *E. amarorum*. More perfect remains must be found and consulted before anything final in regard to the true phylogeny of these Eocene Chalicotheres of America can be stated.

MEASUREMENTS.

Length of skull P^2 to postglenoid process	129	mm.
Length of skull from M^3 to postglenoid process	58	"
Transverse diameter from internal face of M^3 to inferior border of jugal opposite the orbit	31	"
Length of the cheek-dentition	73	"
Length of the premolars	29	"
" " " molars	47	"
Antero-posterior diameter of P^1	10	"
Transverse diameter of P^1	9.5	"
Antero-posterior diameter of P^2	11	"
Transverse " " "	12.5	"
Antero-posterior diameter of P^4	10	"
Transverse " " "	13	"
Antero-posterior " " M^1	14	"
Transverse " " "	13.5	"
Antero-posterior " " M^2	17.5	"
Transverse " " "	18	"
Antero-posterior " " M^3	17.5	"
Transverse " " "	19.8	"

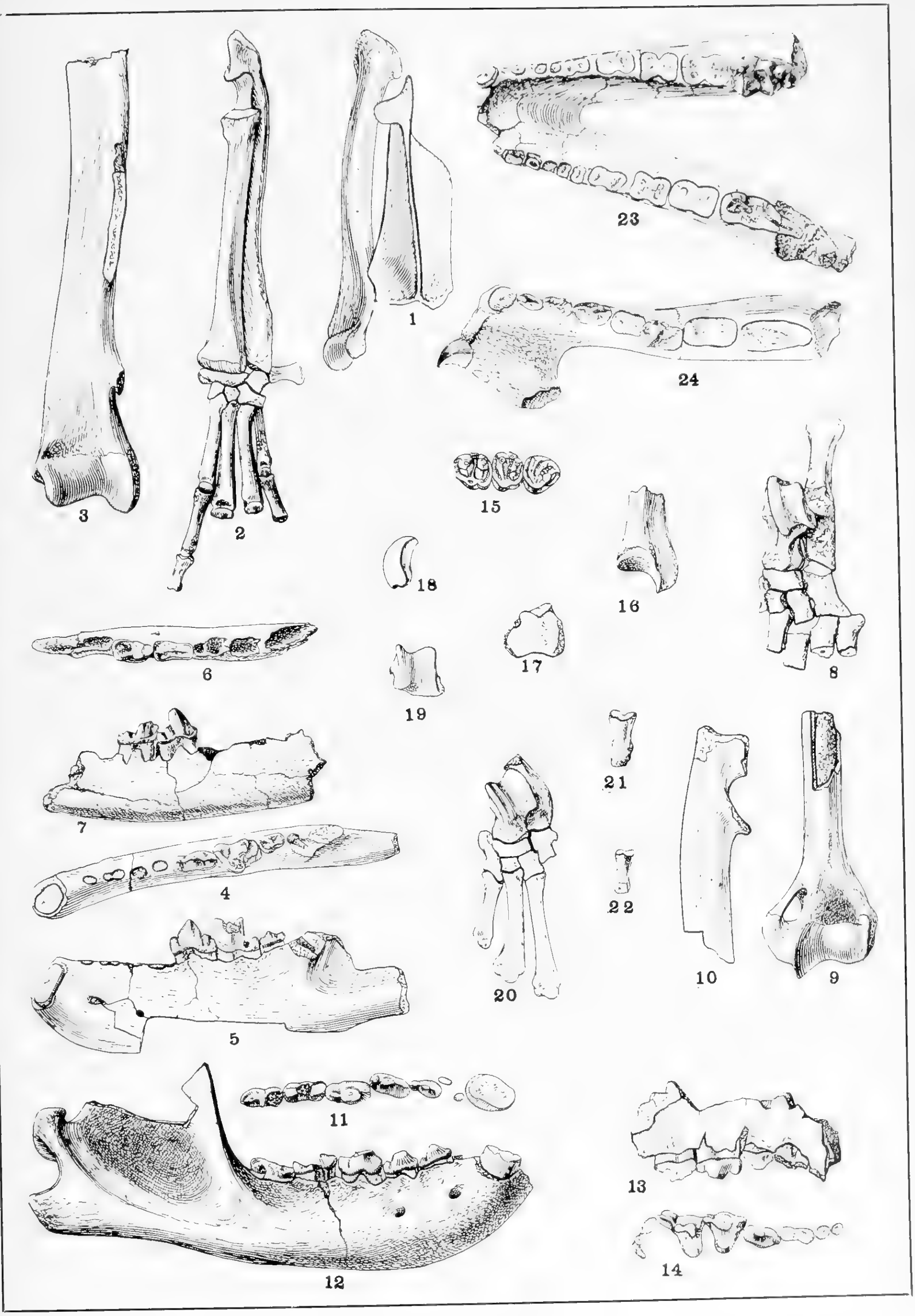
CARNEGIE MUSEUM,
May 29, 1916.

SYNOPSIS OF CONTENTS OF PAPER.

PLATE XXXIV.

FIG. 1. *Oxyænodon dyclerus.* Scapula and humerus. C,M., No. 3051.
FIG. 2. *Oxyænodon dyclerus.* Radius, ulna, and manus. C,M., No. 3051.
FIG. 3. *Prodaphænus? robustus,* type. Humerus, anterior face.
FIG. 4. *Prodaphænus? robustus,* type. Crown view of lower teeth
FIG. 5. *Prodaphænus? robustus,* type. Side view of lower jaw.
FIG. 6. *Mimocyon longipes,* type. Crown view of lower teeth.
FIG. 7. *Mimocyon longipes,* type. Side view of lower jaw.
FIG. 8. *Mimocyon longipes,* type Dorsal view of pes.
FIG. 9. *Mimocyon longipes,* type. Anterior view of humerus.
FIG. 10. *Mimocyon longipes,* type. Side view of ulna.
FIG. 11. *Limnocyon douglassi,* type. Crown view of lower teeth, right.
FIG. 12. *Limnocyon douglassi,* type. Side view of lower jaw, right.
FIG. 13. *Limnocyon douglassi,* type. Side view of maxillary, right.
FIG. 14. *Limnocyon douglassi,* type. Crown view of upper teeth, right.
FIG. 15. *Paramys medius,* type. Crown view of upper teeth.
FIG. 16. *Paramys medius,* type. Lower end of tibia, side.
FIG. 17. *Paramys medius,* type. Trochlea, distal end of tibia.
FIG. 18. *Paramys medius,* type. Patella.
FIG. 19. *Paramys medius,* type. Trochlea of astragalus.
FIG. 20. *Paramys medius,* type. Pes, dorsal view.
FIG. 21. *Paramys medius,* type. Proximal phalanx, dorsal view.
FIG. 22. *Paramys medius,* type. Median phalanx, dorsal view.
FIG. 23. *Isectolophus scotti* paratype. Alveolar border of lower jaw. C. M. No. 3113.
FIG. 24. *Schizolophodon cuspidens,* type. Alveolar border of lower jaw and crown view of lower teeth.

All figures one half natural size, except Fig. 15, which is natural size.

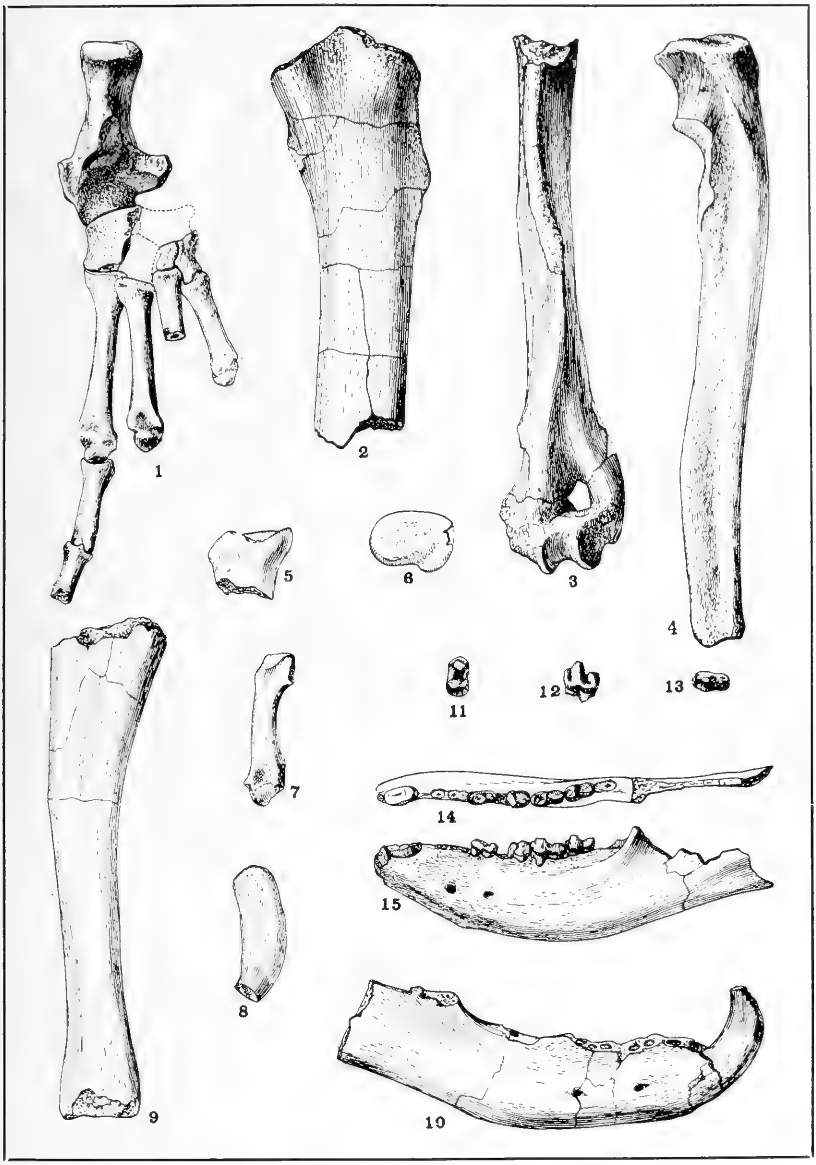


Canids from the Uinta.
(For explanation see opposite page.)

PLATE XXXV.

FIG. 1. *Pleurocyon magnum*, paratype. Dorsal view of pes.
FIG. 2. *Pleurocyon magnum*, paratype. Anterior view of femur.
FIG. 3. *Pleurocyon magnum*, paratype. Anterior view of humerus.
FIG. 4. *Pleurocyon magnum*, paratype. Side view of ulna.
FIG. 5. *Pleurocyon magnum*, paratype. Anterior view, head of radius.
FIG. 6. *Pleurocyon magnum*, paratype. Articulating surface, head of radius.
FIG. 7. *Pleurocyon magnum*, paratype. Dorsal view of Mc. V.
FIG. 8. *Pleurocyon magnum*, paratype. Side view of upper canine tooth.
FIG. 9. *Pleurocyon magnum*, paratype. Anterior view of tibia.
FIG. 10. *Pleurocyon magnum*, paratype. Right lower jaw from the side.
FIG. 11. *Pleurocyon magnum*, paratype. Upper molar, crown view.
FIG. 12. *Pleurocyon magnum*, paratype. $P_{\overline{4}}$, external view.
FIG. 13. *Pleurocyon magnum*, paratype. $P_{\overline{4}}$, crown view.
FIG. 14. *Pleurocyon magnum*, paratype. Alveolar border of jaw and crown view of lower teeth, left ramus.
FIG. 15. *Pleurocyon magnum*, paratype. External view of left ramus.

All figures are one-half natural size.



Canids from the Uinta.
(For explanation see opposite page.)

PLATE XXXVI.

FIG. 1. *Prothyracodon uintense*, type. Alveolar border of lower jaw and crowns of dentition.

FIG. 2. *Eomoropus annectens*, type. Palate and crown view of upper teeth.

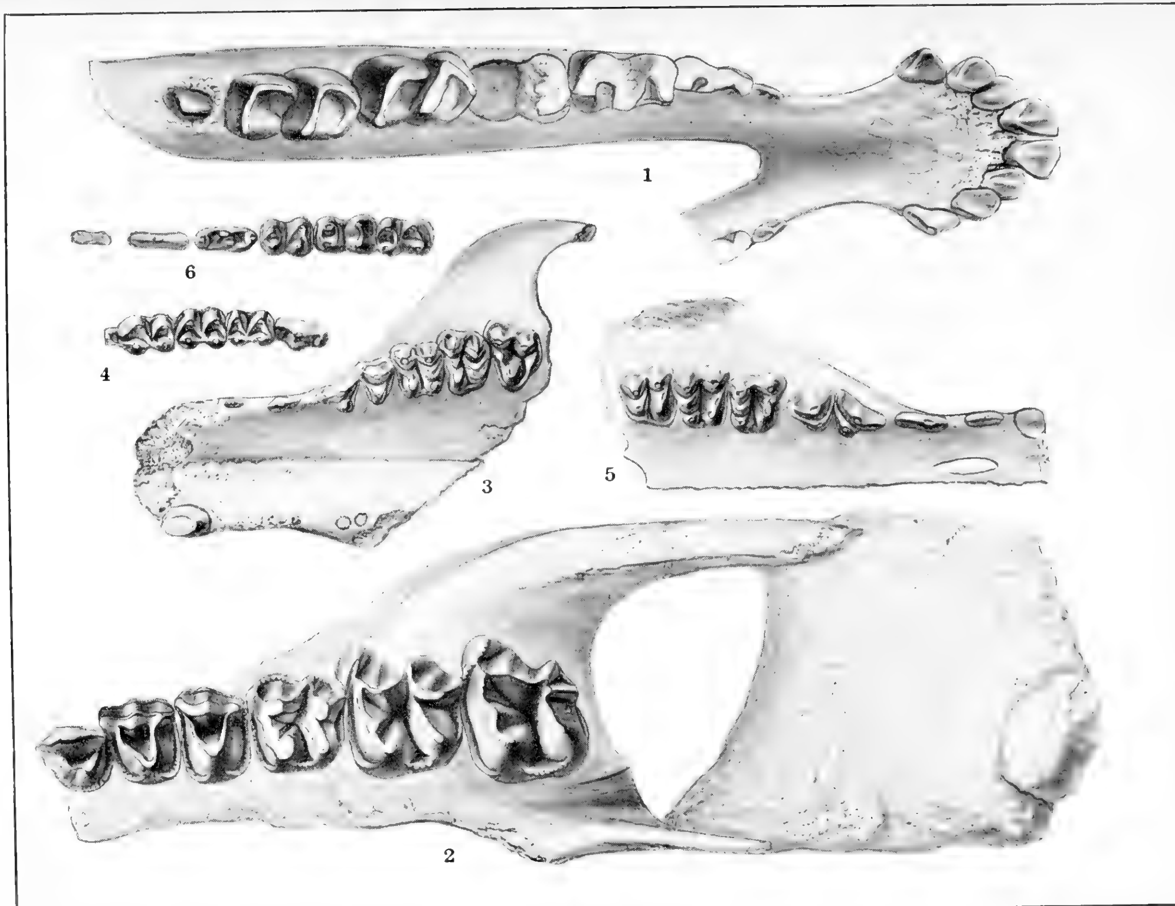
FIG. 3. *Bunomeryx montanus*. Palate and crown view of upper teeth.

FIG. 4. *Bunomeryx montanus*. Crowns of lower teeth.

FIG. 5. *Hylomeryx annectens*, type. Palate and crown view of upper teeth.

FIG. 6. *Hylomeryx annectens*, type. Crowns of lower teeth.

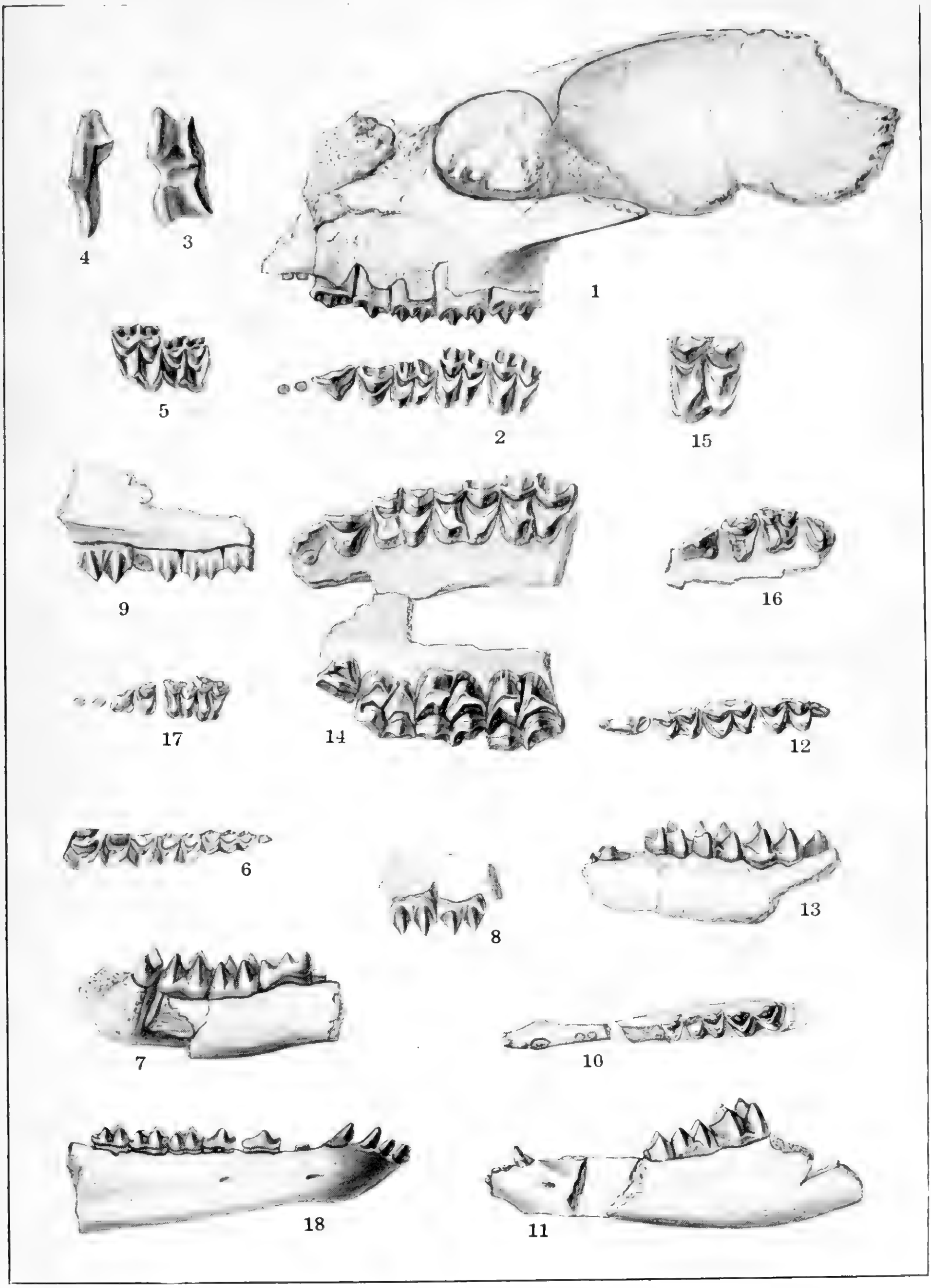
Figs. 1 and 2 natural size. Figs. 3, 4, 5, and 6 are slightly more than one and a third of nature.



Ungulates from the Uinta.
(For explanation see opposite page.)

PLATE XXXVII.

FIG. 1. *Leptotragulus medius*, type. Left side of skull.
Fig. 2. *Leptotragulus medius*, type. Crowns of upper teeth.
FIG. 3. *Leptotragulus medius*, type. Astragalus, dorsal face.
FIG. 4. *Leptotragulus medius*, type. Calcaneum, dorsal face.
FIG. 5. *Leptotragulus proavus*. Crowns of upper teeth, No. 2919.
FIG. 6. *Leptotragulus proavus*. Crowns of upper teeth, No. 2919.
FIG. 7. *Leptotragulus proavus*. Lower jaw, side view, No. 2919.
FIG. 8. *Leptotragulus proavus*. Upper jaw, side view, No. 2919.
FIG. 9. *Leptotragulus proavus*. Upper teeth, outer face, No. 3009.
FIG. 10. *Leptotragulus proavus*. Alveolar border of lower jaw and crowns of teeth, No. 3009.
FIG. 11. *Leptotragulus proavus*. Outer face of left jaw, No. 3009.
FIG. 12. *Leptotragulus proavus*. Crowns of lower teeth, No. 3195.
FIG. 13. *Leptotragulus proavus*. Outer face of lower jaw, No. 3195.
FIG. 14. *Protylopus annectens*, type. Palate.
FIG. 15. *Sphenomeryx quadricuspis*, type. Crown, upper molar.
FIG. 16. *Sphenomeryx quadricuspis*, type. Palate.
FIG. 17. *Mesomeryx grangeri*, type. Crowns of upper teeth.
FIG. 18. *Bunomeryx elegans*. Outer face, right lower jaw. C. M., No. 2951.
All figures natural size except Fig. 15, which is twice natural size.

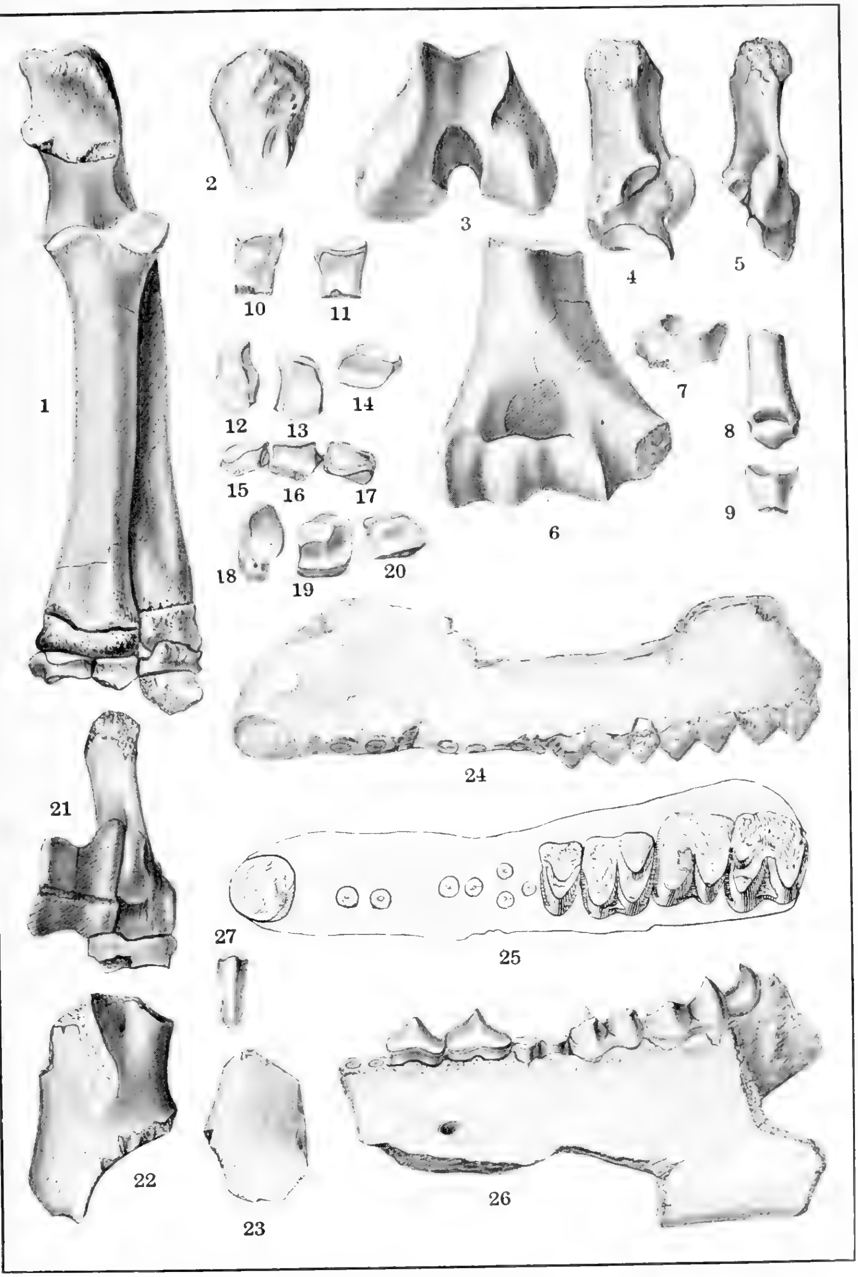


Artiodactyls from the Uinta.
(For explanation see opposite page.)

PLATE XXXVIII.

FIG. 1. *Diplobunops matthewi*, type. Radius ulna and carpus, dorsal face.
FIG. 2. *Diplobunops matthewi*, type. Patella, anterior face.
FIG. 3. *Diplobunops matthewi*, type. Femur, distal end.
FIG. 4. *Diplobunops matthewi*, type. Calcaneum, fibular face.
FIG. 5. *Diplobunops matthewi*, type. Calcaneum, dorsal face.
FIG. 6. *Diplobunops matthewi*, type. Humerus, anterior face.
FIG. 7. *Diplobunops matthewi*, type. Cuboid, dorsal face.
FIG. 8. *Diplobunops matthewi*, type. Metapodial, dorsal face.
FIG. 9. *Diplobunops matthewi*, type. Proximal phalanx, dorsal face.
FIG. 10. *Diplobunops matthewi*, type. Mc. II, dorsal face.
FIG. 11. *Diplobunops matthewi*, type. Mc. III, dorsal face.
FIG. 12. *Diplobunops matthewi*, type. Scaphoid proximal face.
FIG. 13. *Diplobunops matthewi*, type. Lunar proximal face.
FIG. 14. *Diplobunops matthewi*, type. Cuneiform proximal face.
FIG. 15. *Diplobunops matthewi*, type. Scaphoid dorsal face.
FIG. 16. *Diplobunops matthewi*, type. Lunar, dorsal face.
FIG. 17. *Diplobunops matthewi*, type. Cuneiform, dorsal face.
FIG. 18. *Diplobunops matthewi*, type. Scaphoid distal view.
FIG. 19. *Diplobunops matthewi*, type. Lunar distal view.
FIG. 20. *Diplobunops matthewi*, type. Cuneiform distal view.
FIG. 21. *Diplobunops matthewi*, type. Tarsus, dorsal face.
FIG. 22. *Diplobunops matthewi*, type. Scapula, distal end.
FIG. 23. *Diplobunops matthewi*, type. Distal end of tibia, anterior face.
FIG. 24. *Diplobunops matthewi*, paratype. Maxillary, outer face.
FIG. 25. *Diplobunops matthewi*, paratype. Crowns of upper teeth.
FIG. 26. *Diplobunops matthewi*, paratype. Lower jaw, external face.
FIG. 27. *Diplobunops matthewi*, paratype. Ungual phalanx, dorsal face.

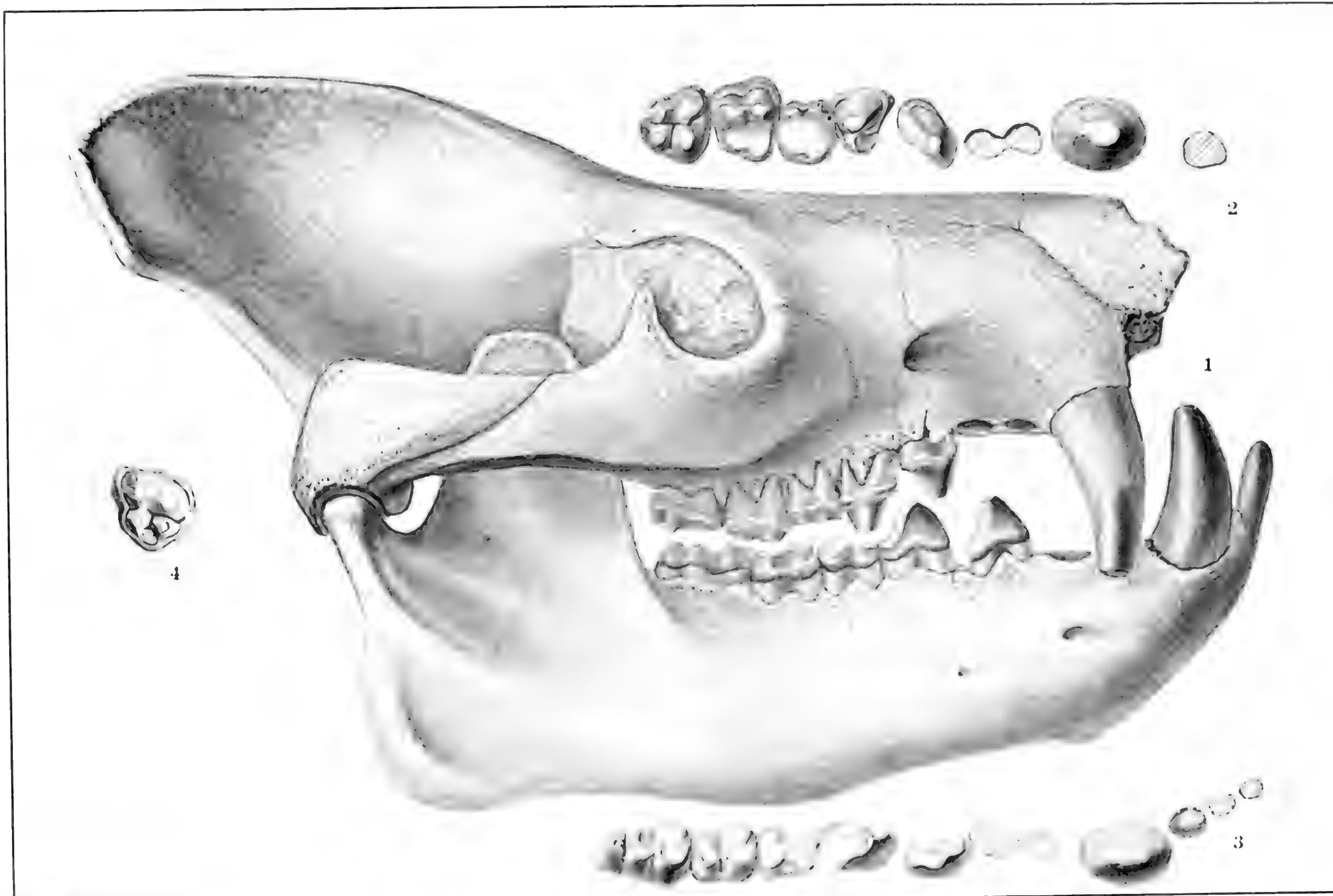
All figures one-half natural size except Figs. 24, 25, and 26, which are 3/4 natural size.



Artiodactyls from the Uinta.
(For explanation see opposite page.)

PLATE XXXIX.

FIG. 1. *Achænodon robustus*, type. Skull and jaws, right side.
FIG. 2. *Achænodon robustus*, type. Crowns of upper teeth.
FIG. 3. *Achænodon robustus*, type. Crowns of lower teeth.
FIG. 4. *Achænodon uintense*. Crown of M^3. C. M. No. 3182.
All figures 3/8 of nature.



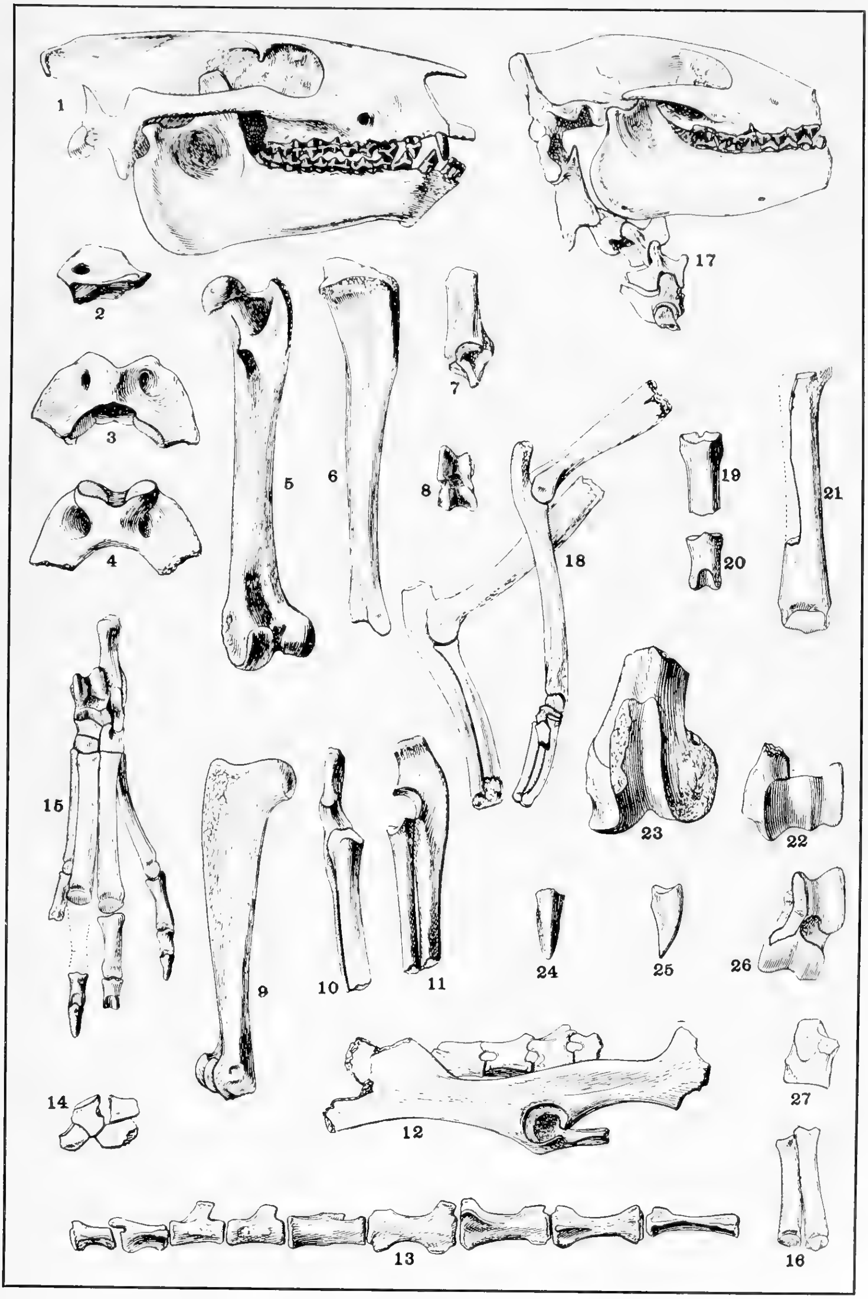
Achænodon.

(For explanation see opposite page.)

PLATE XL.

FIG. 1. *Protoreodon medius*, type. Skull and lower jaws from the side.
FIG. 2. *Protoreodon medius*, type. Atlas, from the side.
FIG. 3. *Protoreodon medius*, type. Atlas, from above.
FIG. 4. *Protoreodon medius*, type. Atlas, from below.
FIG. 5. *Protoreodon medius*, type. Femur, posterior face.
FIG. 6. *Protoreodon medius*, type. Tibia, tibial face.
FIG. 7. *Protoreodon medius*, type. Calcaneum, tibial face.
FIG. 8. *Protoreodon medius*, type. Astragalus, dorsal face.
FIG. 9. *Protoreodon medius*, type. Humerus, radial face.
FIG. 10. *Protoreodon medius*, type. Radius and ulna, anterior face.
FIG. 11. *Protoreodon medius*, type. Radius and ulna, radial face.
FIG. 12. *Protoreodon medius*, type. Pelvis, from the left side.
FIG. 13. *Protoreodon medius*, type. Caudals from the right side.
FIG. 14. *Protoreodon medius*, type. Carpus, dorsal face.
FIG. 15. *Protoreodon medius*, type. Pes, dorsal face.
FIG. 16. *Protoreodon medius*, type. Metacarpals, dorsal face.
FIG. 17. *Protoreodon minor*. Skull, jaws, and neck. C. M. No. 3032.
FIG. 18. *Protoreodon minor*. Fore limbs, from the right side. C. M. No. 3032.
FIG. 19. *Protagriochœrus annectens*. Proximal phalanx, dorsal face. C. M. No. 30.
FIG. 20. *Protagriochœrus annectens*. Median phalanx, dorsal face. C. M. No. 30.
FIG. 21. *Protagriochœus annectens*. Metatarsal, dorsal face. C. M. No. 30.
FIG. 22. *Protagriochœrus annectens*. Humerus, anterior face of trochlea. C. M. No. 30.
FIG. 23. *Protagriochœrus annectens*. Femur, anterior face of trochlea. C. M. No. 30.
FIG. 24. *Protagriochœrus annectens*. Ungual phalanx, dorsal face. C. M. No. 30.
FIG. 25. *Protagriochœrus annectens*. Ungual phalanx, from the side. C. M. No. 30.
FIG. 26. *Protagriochœrus annectens*. Astragalus, from the front. C. M. No. 3016.
FIG. 27. *Protagriochœrus annectens*. Cuboid, from the front. C. M. No. 3016.

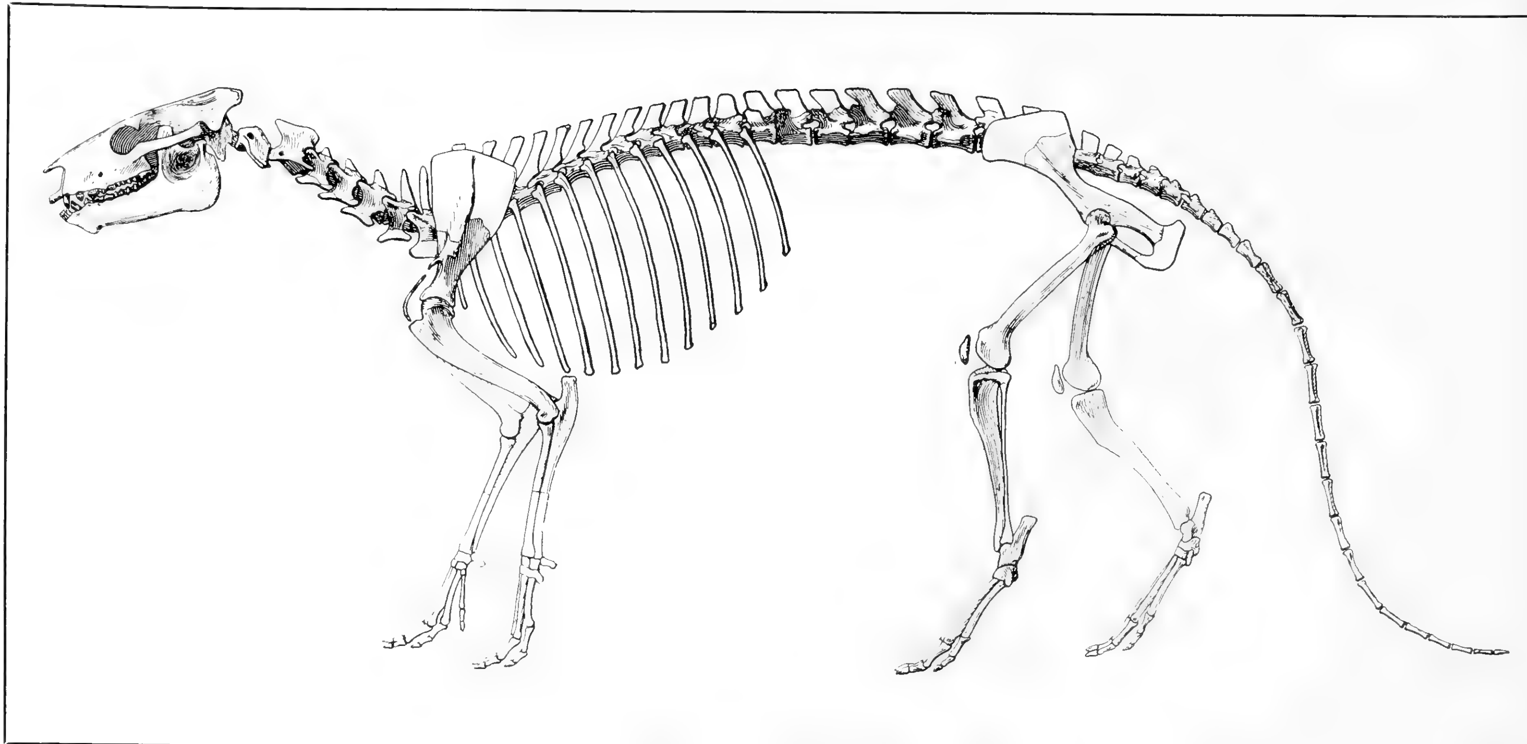
All figures 1/3 natural size, except Figs. 19–27, which are one-half natural size.



Protoreodon from the Uinta.
(For explanation see opposite page.)

PLATE XLI.

Protoreodon medium, type, restoration of skeleton, one-sixth natural size.

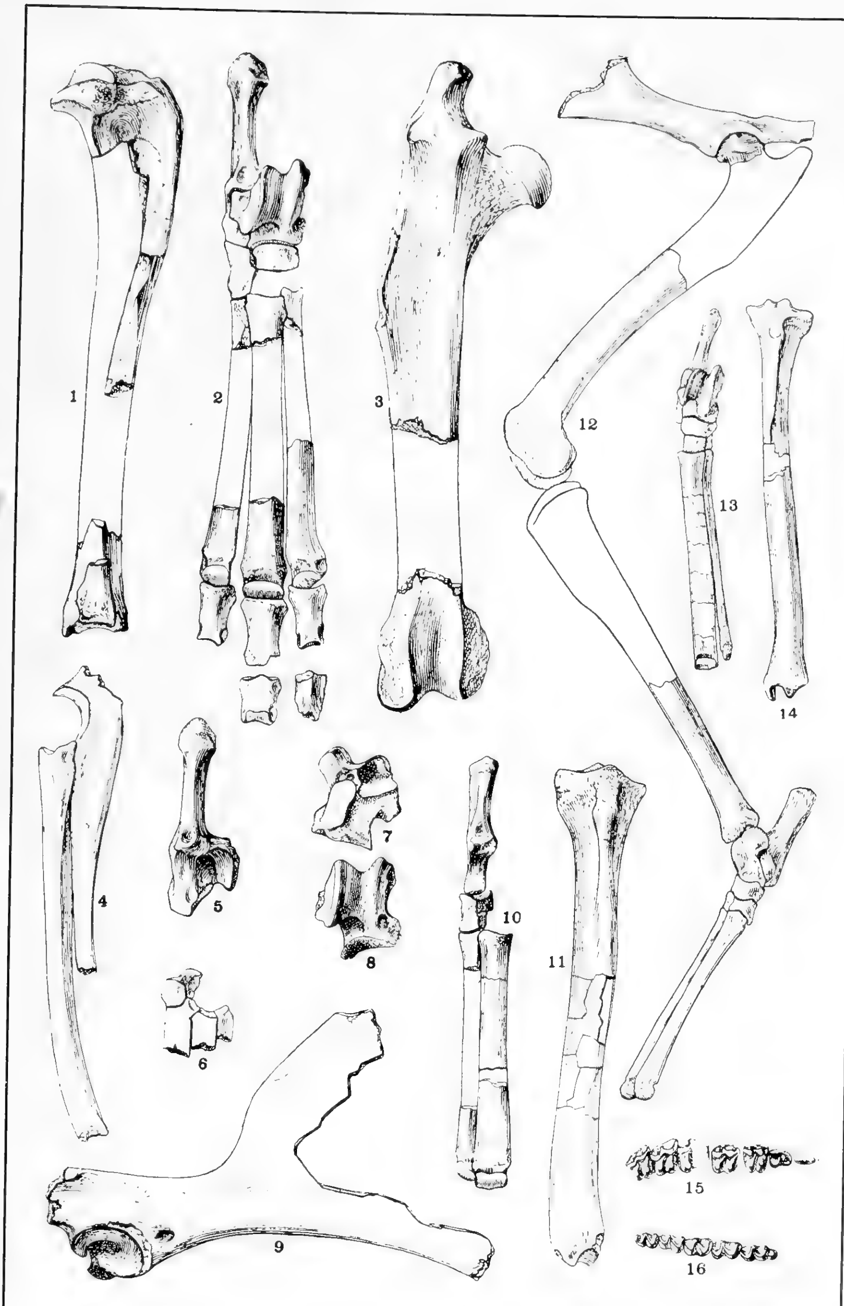


Restoration of Skeleton of *Protoreodon medium* Peterson.

PLATE XLII.

FIG. 1. *Helaletes boöps*, type. Tibia and fibula, fibular face.
FIG. 2. *Helaletes boöps*, type. Pes, dorsal face.
FIG. 3. *Helaletes boöps*, type. Femur, anterior face.
FIG. 4. *Helaletes boöps*, type. Radius and ulna, radial face.
FIG. 5. *Helaletes boöps*, type. Calcaneum, anterior face.
FIG. 6. *Helaletes boöps*, type. Metacarpals and magnum, anterior face.
FIG. 7. *Helaletes boöps*, type. Astragalus, plantar face.
FIG. 8. *Helaletes boöps*, type. Astragalus, dorsal face.
FIG. 9. *Helaletes boöps*, type. Pelvis, external face.
FIG. 10. *Epihippus gracilis.* Pes, dorsal face. C. M. No. 2923.
FIG. 11. *Epihippus gracilis.* Tibia anterior face. C. M. No. 2923.
FIG. 12. *Epihippus parvus.* Hind limb, tibial face. C. M. No. 3397.
FIG. 13. *Epihippus parvus.* Pes, dorsal face. C. M. No. 3397.
FIG. 14. *Epihippus parvus.* Tibia, anterior face. C. M. No. 3397.
FIG. 15. *Epihippus parvus.* Crowns of upper dentition. C. M. No. 3397.
FIG. 16. *Epihippus parvus.* Crowns of lower dentition. C. M. No. 3397.

All figures one-half natural size.

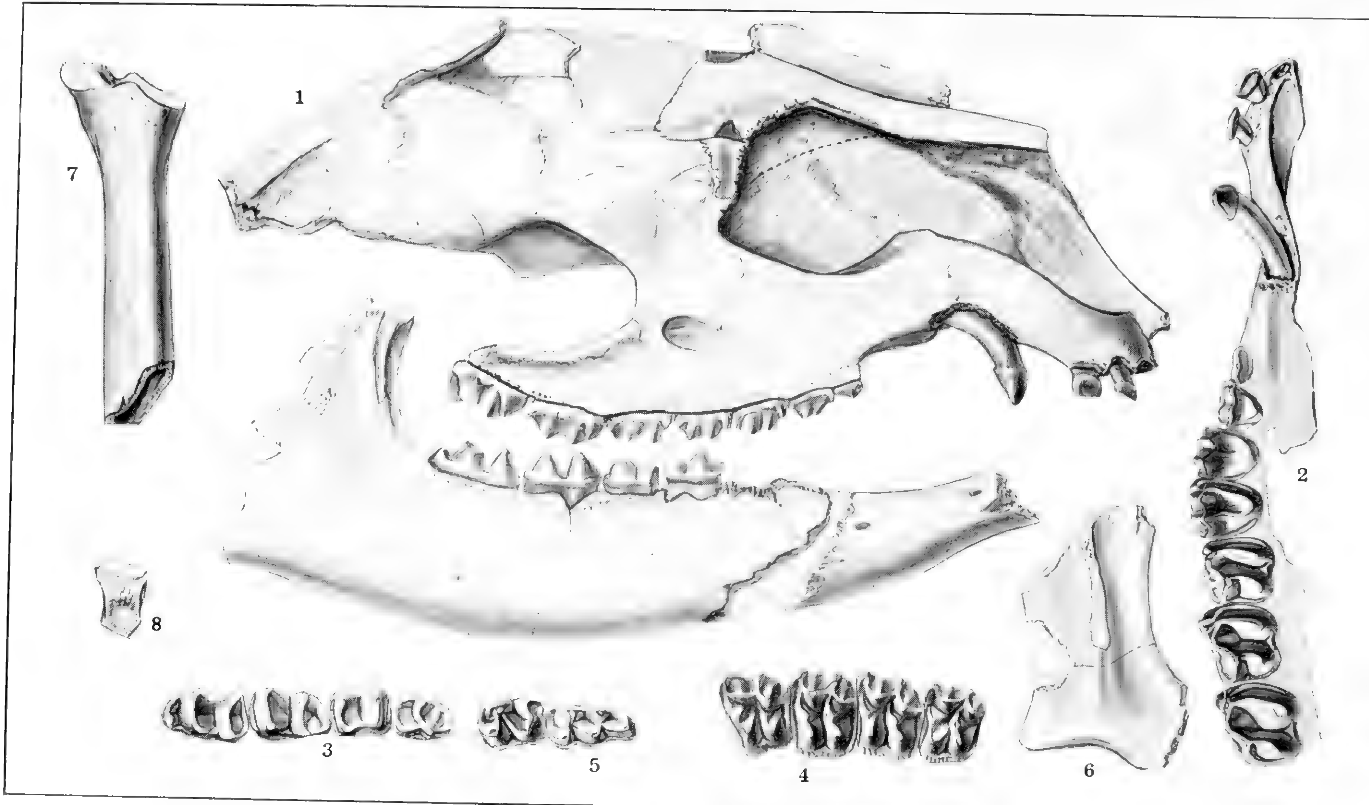


Perissodactyls from the Uinta.
(For explanation see opposite page.)

PLATE XLIII.

FIG. 1.	*Helaletes boöps*, type.	Skull and lower jaws.
FIG. 2.	*Helaletes boöps*, type.	Palate and crowns of upper teeth.
FIG. 3.	*Helaletes boöps*, type.	Crowns of lower teeth.
FIG. 4.	*Epihippus gracilis.*	Crowns of upper teeth. C. M. No. 3398.
FIG. 5.	*Epihippus gracilis.*	Crowns of lower teeth. C. M. No. 3398.
FIG. 6.	*Epihippus gracilis.*	Scapula, distal end. C. M. No. 3398.
FIG. 7.	*Epihippus gracilis.*	Radius, anterior face. C. M. No. 3398.
FIG. 8.	*Epihippus gracilis.*	Lunar, dorsal face. C. M. No. 3398.

All figures natural size.



Helaletes and *Epihippus*.
(For explanation see opposite page.)

PLATE XLIV.

FIG. 1. *Isectolophus annectens.* Crowns of upper dentition. C. M. No. 3030.

FIG. 2. *Parisectolophus latidens*, type. Alveolar border of lower jaw and crowns of inferior dentition.

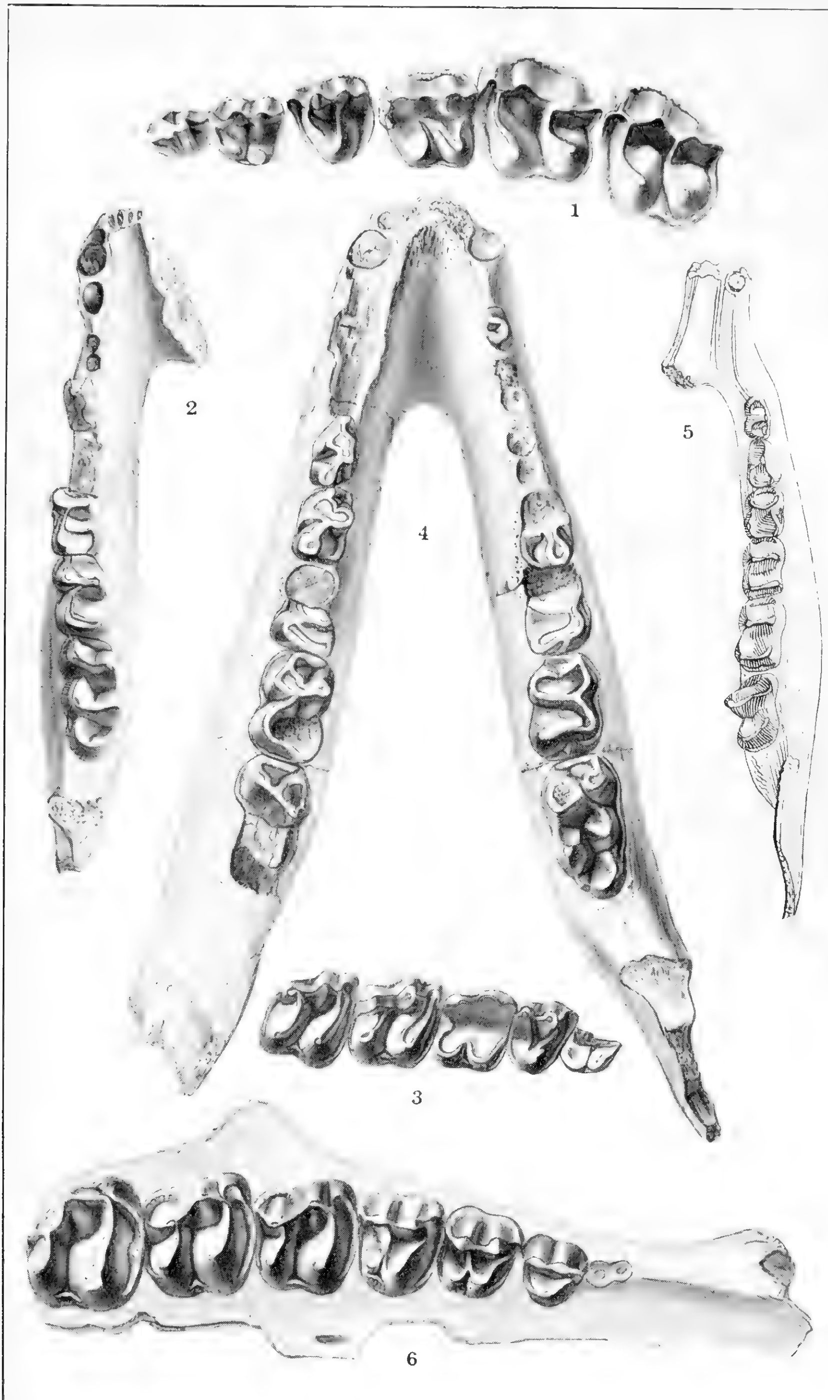
FIG. 3. *Parisectolophus latidens*, type. Crown view of upper dentition.

FIG. 4. *Schizolophodon cuspidens*, type. Lower jaws.

FIG. 5. *Dilophodon minusculus*, type. Alveolar border of lower jaw and crown view of dentition.

FIG. 6. *Desmatotherium guyotii*, type. Palate and crowns of upper dentition.

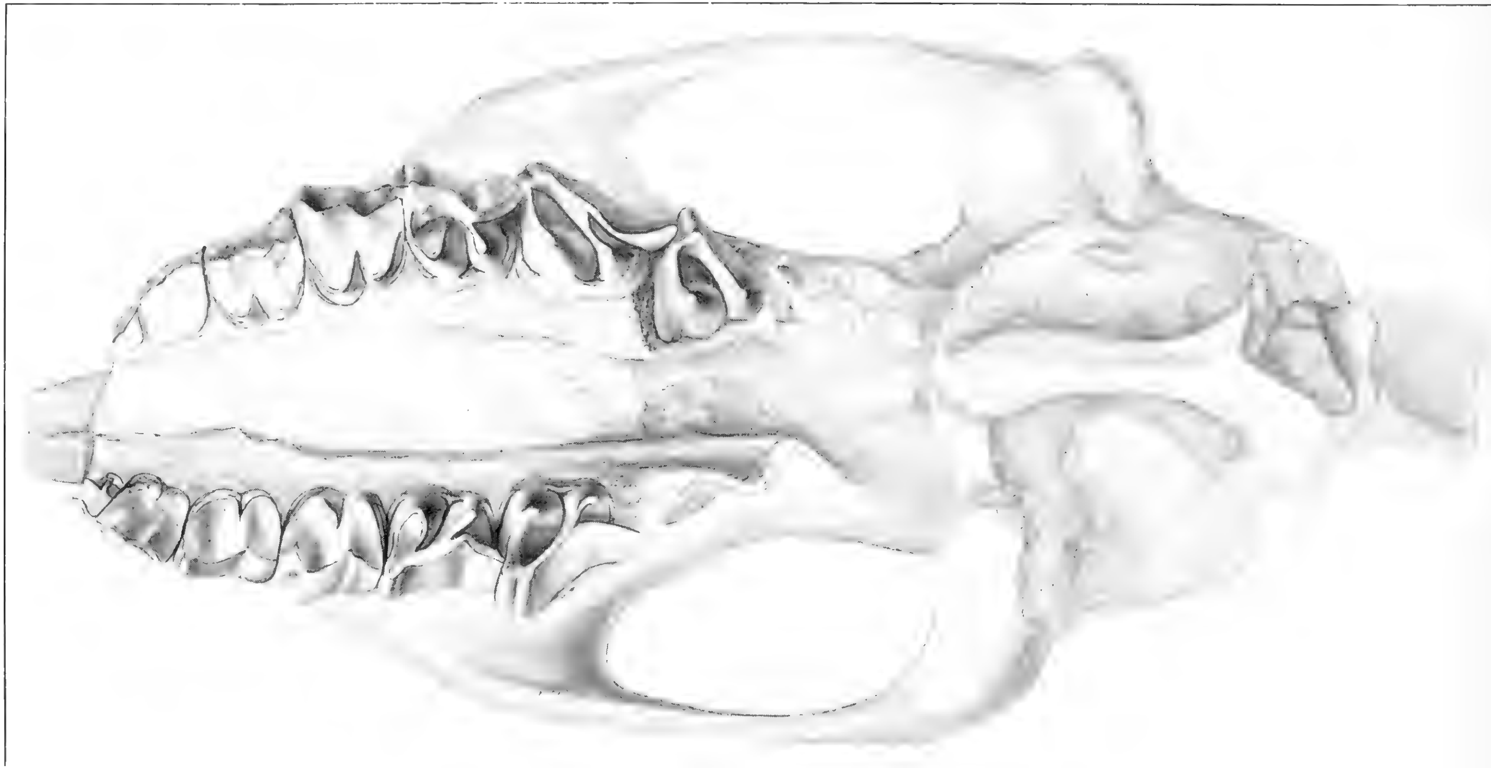
All figures natural size except Figs. 2 and 3 which are × 8/9 of nature.



Perissodactyls from the Uinta.
(For explanation see opposite page.)

PLATE XLV.

Prothyracodon uintense, type. Palatal view, natural size.

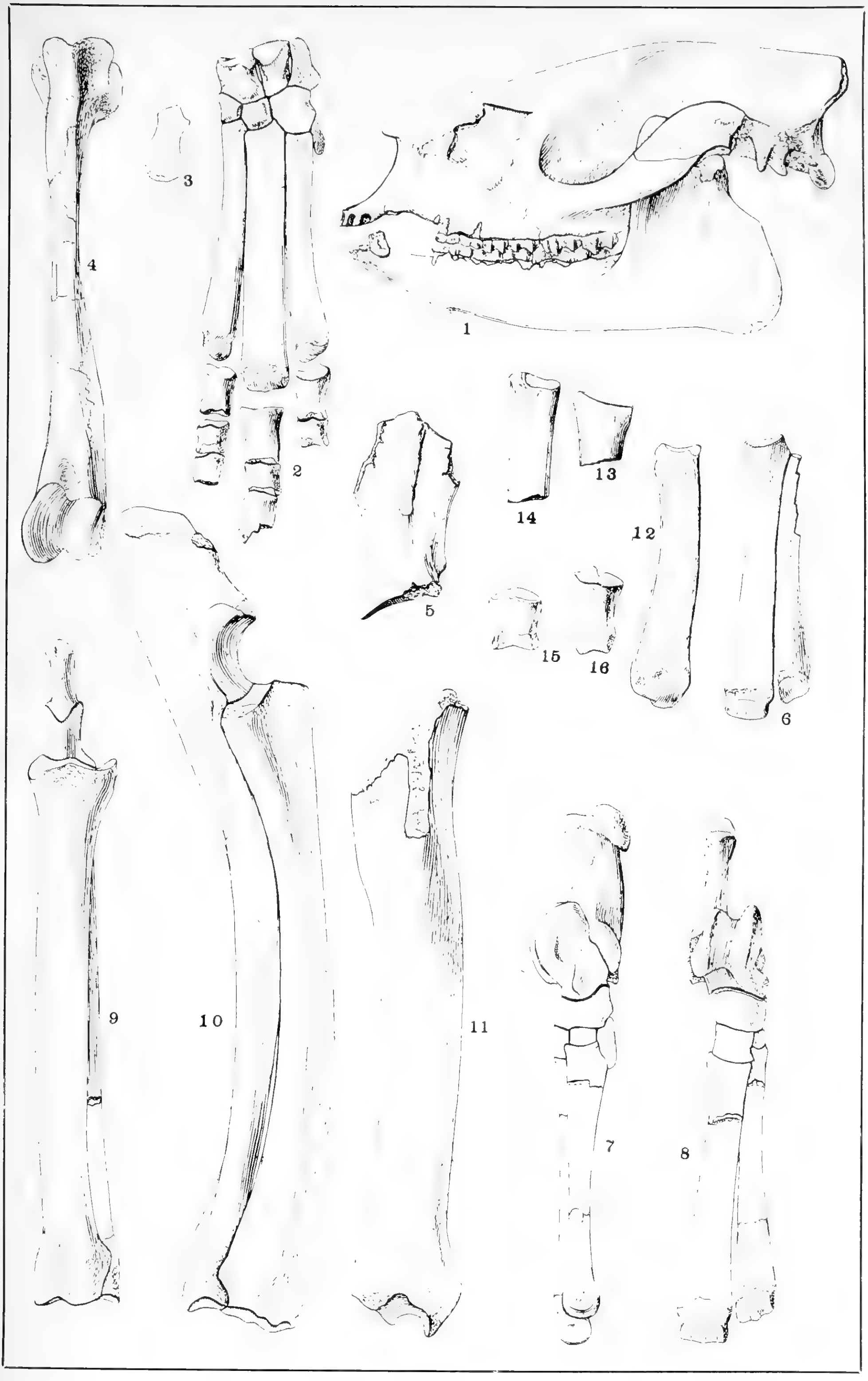


Prothyracodon uintense Peterson (type.)

PLATE XLVI.

FIG. 1. *Prothyracodon obliquidens.* Skull and lower jaws, from the side. C. M. No. 3201.
FIG. 2. *Prothyracodon obliquidens.* Manus, dorsal face. C. M. No. 2942.
FIG. 3. *Prothyracodon obliquidens.* Pisiform, dorsal face. C. M. No. 2942.
FIG. 4. *Prothyracodon obliquidens.* Humerus, anterior face. C. M. No. 2942.
FIG. 5. *Prothyracodon obliquidens.* Scapula, proximal end. C. M. No. 2942.
FIG. 6. *Prothyracodon obliquidens.* Metatarsals III & IV, dorsal face. C. M. No. 3199.
FIG. 7. *Prothyracodon obliquidens.* Pes, tibial face. C. M. No. 3199.
FIG. 8. *Prothyracodon obliquidens.* Pes, dorsal face. C. M. No. 3199.
FIG. 9. *Prothyracodon obliquidens.* Radius and ulna, anterior face. C. M. No. 2942.
FIG. 10. *Prothyracodon uintense,* paratype. Radius and ulna, ulnar face. C. M. No. 2990.
FIG. 11. *Prothyracodon uintense.* Tibia, anterior face. C. M. No. 2990.
FIG. 12. *Prothyracodon uintense.* Mc. IV,, dorsal face. C. M. No. 2990.
FIG. 13. *Prothyracodon uintense.* Mt. III, dorsal face. C. M. No. 2990.
FIG. 14. *Prothyracodon uintense.* Mt. IV, dorsal face. C. M. No. 2990.
FIG. 15. *Prothyracodon uintense.* Median phalanx, dorsal face. C. M. No. 2990.
FIG. 16. *Prothyracodon uintense.* Proximal phalanx, dorsal face. C. M. No. 2990.

All figures one-half natural size except Fig. 1, which is one-third of nature.

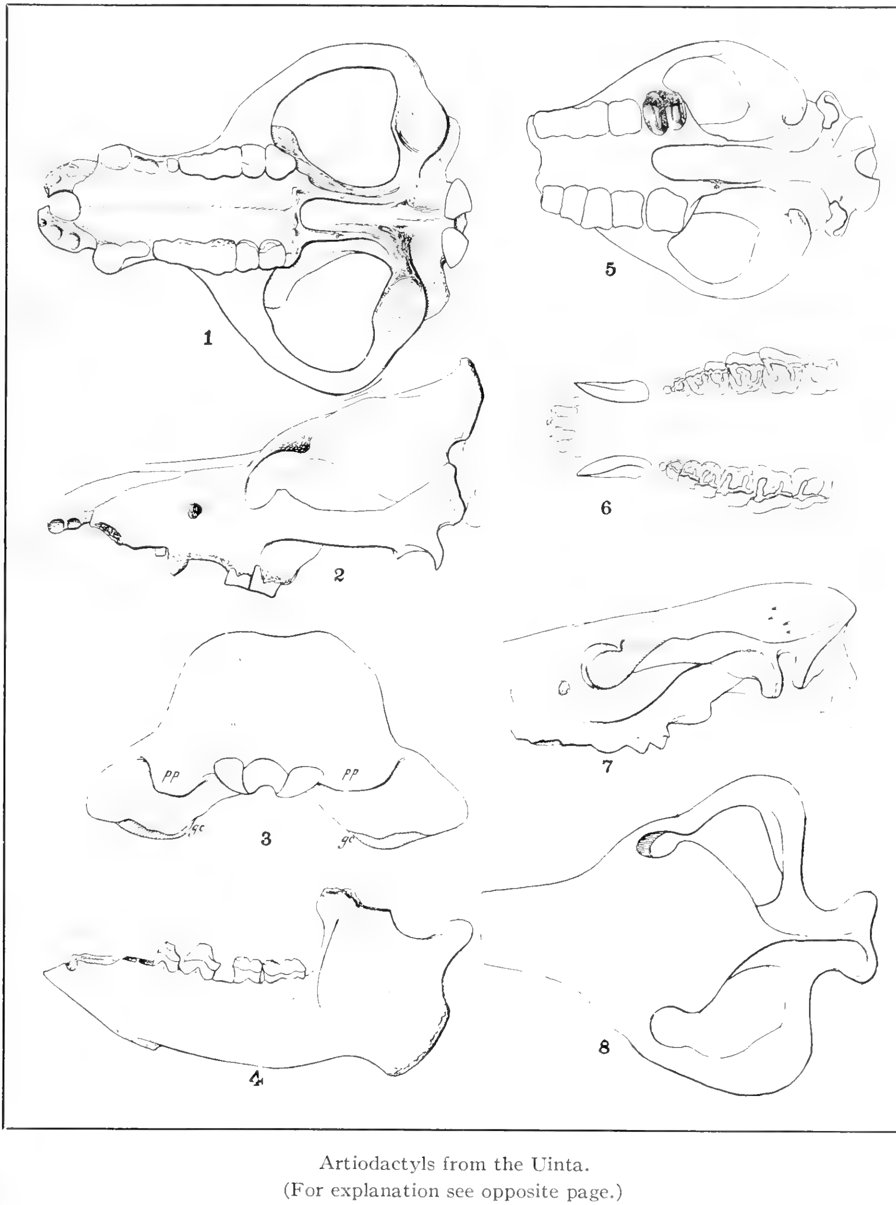


Prothyracodon from the Uinta.
(For explanation see opposite page.)

PLATE XLVII.

FIG. 1. *Achænodon uintense.* Skull, palatal view.
FIG. 2. *Achænodon uintense.* Skull from the side.
FIG. 3. *Achænodon uintense.* Skull from the back.
FIG. 4. *Achænodon uintense.* Lower jaws, outer face.
FIG. 5. *Amynodon intermedium.* Skull, palatal view. C. M. No. 3200.
FIG. 6. *Amynodon intermedium,* type. Crowns of upper dentition.
FIG. 7. *Amynodon intermedium.* Skull, from the side. Same as Fig. 5.
FIG. 8. *Achænodon robustus,* type. Skull, top view.

All figures one-sixth natural size. Fig. 6 is redrawn from Professor Osborn's paper, *Trans. Amer. Philos. Soc.*, XVI, 1889, Part II, Pl. X, Fig. 10.



Artiodactyls from the Uinta.
(For explanation see opposite page.)

III. CONTRIBUTIONS TO THE STUDY OF THE FRESH WATER FISHES OF THE ISLAND OF FORMOSA.

By Masamitsu Oshima.

Of the Institute of Science, Government of Formosa.

(Plates XLVIII–LIII.)

Introduction.

The Island of Formosa, lies in the western Pacific Ocean, between the Southern and Eastern China Seas and is separated from the Chinese mainland by the Formosan Strait, which has a width of about ninety miles in its narrowest part. It is two hundred and five miles long and from sixty to eighty miles broad, having seven hundred and thirty-one miles of coast-line and an area of 13,429 square miles, being thus nearly of the same size as Kiushiu, the southernmost island of Japan proper.

The island is traversed throughout its length by a fine mountain range, which reaches an altitude of from 8,000 to 12,000 feet, Mt. Niitaka (14,270 ft.) stands in the middle and Mt. Silvia (12,480 ft.) in the north. In addition, along the eastern shore there are coast ranges of considerable height, the bases of which form magnificent cliffs from fifteen to twenty-five hundred feet high. Thus the middle part and the eastern side of the island are mountainous, while the west is covered by fertile plains.

Because of the above mentioned topography, there are very few rivers on the eastern coast, while on the western coast there are many of considerable length, namely, Tamusui, Hozan, Koro, Daian, Daito, Dakusui, Seira, Shinkobi, Sobun, and Shimo-Tamusui, of which the last-named is the largest. In addition to these, there is a lake called Jitsugetsutan (Lake Candidius), which has a small outlet into the River Dakusui.

Until a comparatively recent date the Island of Formosa was a "terra incognita" to the naturalist, and the fresh-water fishes, which are especially valuable as confirming the geographical relationship between isolated islands and continents, were quite unknown.

When Albert Günther published his "Catalogue of Fishes" in 1859–1870, he had only sixteen species of Formosan fresh-water fishes to enumerate. After a lapse of more than twenty years Jordan and Evermann reported one hundred and eighty-six species of Formosan fishes, including twenty-seven which were found in the fresh waters. Since that publication the efforts of Regan, Jordan and Richardson, and Boulenger have raised the total number of Formosan fresh-water fishes from thirty-two to forty-three.

In the present paper is given a record of an extensive collection of the fresh-water fishes of the Island of Formosa, chiefly made by Mr. Takeo Aoki, my assistant, during the years 1915–1917, making an addition of seven new genera, fifteen new, and eighteen unrecorded species.

NEW GENERA.

1. *Formosania.*
2. *Spinibarbus.*
3. *Scaphesthes.*
4. *Acrossocheilus.*
5. *Phoxiscus.*
6. *Aristichthys.*
7. *Cultriculus.*

NEW SPECIES.

1. *Pseudobagrus taiwanensis.*
2. *Pseudobagrus adiposalis.*
3. *Liobagrus nantoënsis.*
4. *Formosania gilberti.*
5. *Labeo jordani* (introduced).
6. *Puntius snyderi.*
7. *Spinibarbus hollandi.*
8. *Scaphesthes tamusuiensis.*
9. *Gnathopogon iijimæ.*
10. *Phoxiscus kikuchii.*
11. *Culter aokii.*
12. *Macropodus filamentosus.*
13. *Rhinogobius taiwanus.*
14. *Rhinogobius formosanus.*
15. *Glossogobius parvus.*

SPECIES NOT HITHERTO RECORDED.

1. *Parasalanx ariakensis.*
2. *Cobitis tænia.*
3. *Capoeta semifasciolata.*
4. *Pseudorasbora parva.*
5. *Distæchodon tumirostris.*
6. *Rhodeus ocellatus.*
7. *Zacco temminckii.*
8. *Hypophthalmichthys molitrix* (introduced).
9. *Aristichthys nobilis* (introd.).
10. *Cultriculus kneri.*
11. *Oryzias latipes.*
12. *Gambusia affinis* (introd.).
13. *Mugil cephalus.*
14. *Mugil carinatus.*
15. *Polyacanthus operculatus.*
16. *Sicyopterus japonicus.*
17. *Butis butis.*
18. *Glossogobius grammepomus.*

It is very difficult to draw a hard and fast line between true fresh-water fishes and brackish-water fishes. Therefore in the following pages the descriptions of all the fishes which were found in the fresh waters are given. For the sake of completeness I have added the descriptions of five known species, namely: *Parasalanx acuticeps*, *Liobagrus formosanus*, *Ischikauia macrolepis*, *Anguilla sinensis*, and *Glossogobius abacopus*, of which I have not seen specimens.

The typical portions of the collections, including the type specimens, and the others which are described in the present paper, are preserved in the Carnegie Museum in Pittsburgh. A second set, including cotypes of the new species, is deposited in the Museum of Leland Stanford Junior University. The remainder is reserved for the Institute of Science, Government of Formosa.

It has been my good fortune during a visit to Leland Stanford Junior University to be able to examine types and other specimens, and to use the reference books and literature quite freely. For this privilege I wish to express my sincere gratitude to the authorities of the University. In the preparation of the present paper I have received the kind and valuable assistance of Dr. David Starr Jordan, Dr. Charles Henry Gilbert, and Prof. John Otterbein Snyder, for whose courtesy I express my hearty thanks.

Family SALMONIDÆ.

Genus PLECOGLOSSUS Temminck & Schlegel.

1846. *Plecoglossus* TEMMINCK & SCHLEGEL, Fauna Japonica, Poiss., p. 229. (Type *Plecoglossus altivelis* Temminck & Schlegel.)

Body moderately elongate, covered with very small scales. Mouth wide, the premaxillaries with a few, small, conical, pointed teeth. Maxillaries and lower jaw with teeth of peculiar form, lamelliform, broad, truncate, serrate, movable, seated in folds of the skin; mandibles each ending in a small knob, not jointed at the symphysis. Mucous membrane of interior of mouth between terminal halves of the mandible forming a peculiar organ, raised in folds with two pouches in front and one behind. Tongue very small, with minute teeth, its tip toothless; no teeth on vomer, palatines with teeth. Pyloric cæca very numerous. Eggs small. Small fishes inhabiting the clear streams of Japan and Formosa, migratory like the salmon, and among the very finest of food-fishes. One species is known (Jordan & Snyder).

Distribution: Japan proper; Corea; Formosa.

1. **Plecoglossus altivelis** (Temminck & Schlegel).

1846. *Plecoglossus altivelis* TEMMINCK & SCHLEGEL, Fauna Japonica Poiss., p. 229, Pl. CV, Fig. 1; no locality.—GÜNTHER, Cat. Fish., VI, 1866, p. 165; Japan; Formosa.—ISHIKAWA, Zoöl. Mag. Tokyo, VII, 1895, p. 129; Japan.—JORDAN & SNYDER, Proc. U. S. Nat. Mus., XXIII, 1901, p. 349; Lake Biwa.—Proc. U. S. Nat. Mus., XXIII, 1901, p. 744; Numata, Tsushima.—Proc. U. S. Nat. Mus., XXIV, 1902, p. 584; Ishikari River, Niigata; Aomori; Same; Matsushima; Sendai; Morioka; Tokyo; Tama River; Daiya River; Gifu; Lake Biwa; Osaka; Wakanoura; Kobe; Hiroshima; Kurume; Nagasaki; Tamusui River, Formosa.—JORDAN, Ann. Zoöl. Jap., IV, 1902, p. 75.—JORDAN & EVERMANN, Proc. U. S. Nat. Mus., XXV, 1903, p. 323; Formosa.—JORDAN & RICHARDSON, Mem. Carneg. Mus., IV, no. 4, 1909, p. 167; Formosa.—SMITH & POPE, Proc. U. S. Nat. Mus., XXXI, 1905, p. 463; Gifu.—SNYDER, Proc. U. S. Nat. Mus., XLII, 1912, p. 403; Tsuruga.—JORDAN; SNYDER, and TANAKA, Journ. Coll. Sci., Tokyo, XXXIII, 1013, p. 44, Japan; Hokkaido; Corea; Formosa.—JORDAN & METZ, Mem. Carneg. Mus., VI, 1913, p. 10, Fusan, Corea.

Ayu (Japan); Kyarihii (Formosa).

Head 4.88 in length; depth 4.27; D. 10, A. 17; P. 14; V. 8; width of head 2 in its length; eye 5.33 in head; interorbital space 2.76; snout 2.76; maxillary 2; scales in the lateral line about 150, in an oblique series between origin of dorsal and lateral line 20, between the latter and the middle of belly 20, between lateral line and the root of ventral 13; pectoral 1.22 in head; ventral 1.22; gill-rakers 16 + 19.

Body oblong, a little compressed, curvature of the dorsal profile stronger than the ventral; head rather small, triangular, its dorsal surface slightly convex; snout rather long, acutely pointed; interorbital space slightly convex; mouth large, oblique, its angle reaching a vertical through the posterior border of orbit; lips thick; premaxillary well-developed; lower jaw shorter than the upper; palatines with minute teeth; six premaxillary teeth, minute and sharply pointed; maxillary teeth modified into serrated plates, twelve on both jaws; eyes moderate, superior and anterior; nostrils close together; gill-rakers short and slender.

Origin of the dorsal nearer tip of snout than base of caudal, opposite the ventral, rather high, each ray rather stiff; adipose dorsal very small, inserted above posterior third of the base of anal; pectoral as long as the ventral, not reaching the latter; ventral inserted below origin of dorsal, not reaching the vent; anal fin elongate, rather low, outer margin concave; caudal peduncle slender, its depth 2.18 in the length of head.

Body covered with small cycloid scales; head naked; lateral line complete, extending along the middle of the sides, a little decurved.

Color light bluish green above, paler below; belly yellowish; dorsals, pectorals, adipose dorsal, and caudal fin dusky; ventrals and anal whitish.

Total length 273 mm.

Described from a specimen from Tamusui River near Shinten, collected by T. Aoki in December, 1915 (Female).

Habitat: Tamusui River; Choso River; Taiko, Giran.

Remarks: The anal fin of the male is higher and shorter than that of the female. The present species is distributed only in the rivers of the northern part of the island, mainly in the Tamusui River.

MEASUREMENTS OF *Plecoglossus altivelis.*

Locality	Head.	Depth.	D.	A.	P.	V.	Width of Head.	Interorbital.	Snout.	Eye.	Scales.	Length, Mm.
Tamusui River.....	5.37	4.25	10	17	13	8	1.88	2.94	2.76	5	21–150–20	283
Tamusui River.....	4.88	4.27	10	17	14	8	2	2.76	2.76	5.33	20–150–20	273
Choso River.......	4.30	4.52	11	17	14	8	2	2.90	2.75	5	21–155–20	172
Taiko.............	4.44	4.44	11	17	15	8	2.15	2.89	2.80	5	20–145–21	140

Family SALANGIDÆ.

Genus PARASALANX Regan.

1908 *Parasalanx* REGAN, Ann. Mag. Nat. Hist. (8), II, p. 444. (Type *Parasalanx gracillimus* Regan.)

Body slender, translucent, elongate, cylindrical, flattened anteriorly, compressed posteriorly, naked. Head elongate, much depressed, with long, flat, pointed snout; premaxillaries forming an anterior triangular expansion; lower jaw not projecting, ending in a distinct, more or or less movable presymphysial bone, with double series of teeth; tongue toothless. Dorsal fin partly above the anal; adipose fin present, small and low; caudal fin forked.

Distribution: China; Formosa; Japan.

KEY TO THE FORMOSAN SPECIES.

a. Depth of body 11 times in length............................... *acuticeps.*
aa. Depth of body more than 15 times in length..................... *ariakensis.*

2. **Parasalanx acuticeps** (Regan).

1908. *Salanx acuticeps* REGAN, Ann. Mag. Nat. Hist. (8), II, p. 360; Lake Candidius, Formosa.

1908. *Parasalanx acuticeps* REGAN, Ann. Mag. Nat. Hist. (8), II, p. 446; Lake Candidius, Formosa.—JORDAN & RICHARDSON, Mem. Carneg. Mus., Vol. IV, no. 4, 1909, p. 167; Lake Candidius (after Regan).

Depth of body 11 in length, length of head 5.5 to 5.66. Head three times as long as broad; snout acutely pointed, shorter than postorbital part of head; diameter of eye eight times in the length of head. Lower jaw not projecting, with a toothed predentary bone and with anterior canines which perforate the roof of the mouth; tongue toothless. Dorsals 13–14. Anal 26–27, originating below the second ray of dorsal. Pectoral with nine or ten rays; origin of pelvic nearer to anal than to base of pectoral.

Two specimens, 115 mm. in total length. (Regan).

Habitat: Lake Candidius (Regan).

Remarks: Not seen.

3. **Parasalanx ariakensis** (Kishinouye).

1902. *Salanx ariakensis* (KISHINOUYE) JORDAN & SNYDER, Proc. U. S. Nat. Mus., XXIV, p. 592; Ariake Sea, Japan.—JORDAN, SNYDER & TANAKA, Journ. Coll. Sci., XXXIII, 1913, p. 47; Ariake Sea.

1908. *Hemisalanx ariakensis* REGAN, Ann. Mag. Nat. Hist. (8), II, p. 445; Ariake Sea (after Jordan & Snyder).

Head 5.85 in length; depth at insertion of the anal 15 in length; depth of caudal peduncle 4.5 in head; eye 6; interorbital space 3; snout 2.166 D. 13; A. 28; P. 9; V. 7.

Body elongate, cylindrical, strongly flattened anteriorly, posterior part compressed, highest in front of the insertion of anal; head flat, much broader than body, height 2.5 in its width; snout spatulate, premaxillaries forming an anterior triangular expansion, tip sharply pointed; jaws subequal; teeth on both jaws and vomers in a single row, those on the upper jaw stronger and set apart, recurved and canine-like; vomerine teeth minute; three pairs of sharp, recurved canine-like teeth near the tip of lower jaw, which are received into a pouch-like concavity of the upper jaw behind premaxillaries; tongue toothless; eyes lateral, prominent.

Dorsal fin inserted on posterior four-fifteenths of body, partly above the anal; adipose dorsal low, originating at the end of base of anal; pectoral subhorizontal; origin of ventral midway between tip of snout and base of caudal, anterior ray longest; caudal fin deeply forked, the tip of each lobe sharply pointed.

Head and body naked.

Color white, except eyes; two longitudinal series of small black spots along the ventral median line.

Total length 80 mm.

Described from a specimen from Tamusui River near Taihoku, collected by Oshima in February, 1917.

Habitat: Tamusui River.

Remarks: All the characters of the present species agree quite well with those of the cotype in the Stanford University collections.

In the year 1908, Regan noted in his paper (Ann. Mag. Nat. Hist. (8), II, p. 445) that *Salanx ariakensis* (Kishinouye) described by Jordan & Snyder might belong to the genus *Hemisalanx*. However, the lower jaw of the present species does not project and the premaxillaries form an anterior triangular expansion. Such being the case, it seems reasonable to include *Salanx ariakensis* in the genus *Parasalanx*.

MEASUREMENTS OF *Parasalanx ariakensis*.

Locality.	Head.	Depth.	D.	A.	P.	V.	Width of Head.	Snout.	Eye.	Interorbital.	Length, Mm.
Tamusui River	5.85	15	13	28	9	7	2.60	2.166	6	3	80
Tamusui River	5.83	15.75	13	26	9	7	2.75	2.40	6	3.66	70
Tamusui River	5.92	15.60	13	28	8	7	2.60	2.33	6	3.5	77
Tamusui River	6	15	13	27	9	7	2.60	2.166	6.5	3.5	78
Tamusui River	6.16	17.75	13	28	9	7	2.75	2.20	5.5	3.33	74
Ariake Sea											
(Cotype; No. 8574); S. U.	5.33	16.57	13	28	9	7	3	2.33	6.33	3.66	125
(Cotype; No. 8574); S. U.	5.42	17.33	13	29	9	7	2.71	2.375	7	3.5	112

Family SILURIDÆ.

ARTIFICIAL KEY TO THE FORMOSAN GENERA.

I. Dorsal fin spineless; anal very long.
- *a.* Dorsal fin many-rayed, very long, uniformly composed of feeble rays; four pairs of barbels . . . . *Clarias.*
- *aa.* Dorsal fin very short, rudimentary; two pairs of barbels . . *Parasilurus.*

II. Dorsal fin with a pungent spine; anal moderate.
- *a.* Adipose dorsal fin not adnate, free behind; mental barbels as usual, median pair not notably distant; dorsal spine smooth or denticulated; pectoral spine denticulated behind . . . . *Pseudobagrus.*
- *aa.* Adipose dorsal fin adnate to the back and connected with the caudal; median mental barbels far apart; dorsal and pectoral spines smooth, sharp, and imbedded in the skin . . . . *Liobagrus.*

Genus PARASILURUS Bleeker.

1856. *Glanis* AGASSIZ, Proc. Amer. Acad., p. 333 (Name pre-occupied by *Glanis* Gronow, 1854). (Type *Glanis aristotelis* Agassiz.)

1863. *Parasilurus* BLEEKER, Nederl. Tydschr. Dierk., p. 114. (Type *Silurus asotus* Linnæus.)

Body elongate, the profile of the back almost horizontal. Head depressed and covered with soft skin; eyes anterior and subcutaneous; mouth broad, transverse; four barbels, two maxillary, which are very long, two mental, which are short; teeth cardiform or villiform, in broad bands in the jaw and on vomer; no teeth on palatines. Gill-opening wide, not confluent with isthmus, and narrowly jointed together. Dorsal small, without spine, and anterior; adipose fin absent; anal more or less united with the caudal, very long; pectorals with spine; ventral behind dorsal. Air-bladder not inclosed in bone. (Jordan & Fowler.)

Distribution: India; East Indies; Formosa; China; Corea; Amur Province; Japan.

4. **Parasilurus asotus** (Linnæus).

Namadzu (Japan); Ryamhii (Formosa).

1758. *Silurus asotus* LINNÆUS, Syst. Nat. Ed. X, p. 501; Asia.—BLOCH & SCHNEIDER, Syst. Ichth., 1801, p. 375.—Basilewsky, Nouv. Mem. Soc. Nat. Mosc., X, 1855, p. 240, Pl. 3, Fig. 4; China.—GÜNTHER, Cat. Fish., V, 1864, p. 33; Japan; China.—Ann. Mus. St. Petersb., 1896, p. 11; Huihsien, China.—ISHIKAWA, Prel. Cat., 1897, p. 23; Japan.—GÜNTHER, Ann. Mag. Nat. Hist. (7), I, 1898, p. 261; Newchang.—POPTA, Zoöl. Anz., XXXII, 1907, p. 250; Kiautschau, China.

1846. *Silurus xanthosteus* RICHARDSON, Ichthyol. China, p. 281; Canton; Chusan. —Voy. Sulph., Fishes, p, 133, Pl. 56, Fig. 12–14.

1846. *Silurus japonicus* SCHLEGEL, Fauna Japonica, Poiss., p. 226, Pl. CIV, Fig. 1; Higo; Satsuma; Nagasaki.—BLEEKER, Verh. Batav. Genootsch., XXV, 1855, pp. 30 and 51.

1846. *Silurus sinensis* RICHARDSON, Ichthyol. China, p. 281; Chusan.

1867. *Silurus (Parasilurus) asotus* KNER, Novara, Fisch, III, p. 303; Shanghai.

1901. *Parasilurus asotus* JORDAN & SNYDER, Ann. Zoöl. Jap., III, p. 45; Yokohama.—*Abbott*, Proc. U. S. Nat. Mus., XXIII, 1901, p. 83; Pei-ho, China.—JORDAN & FOWLER, Proc. U. S. Nat. Mus., XXVI, 1903, p. 903; Tokyo; Niigata; Morioka; Tama River; Kawatana; Sendai; Ichinoseki; Chikugo River; Tsuchiura; Lake Biwa; Formosa.—JORDAN & RICHARDSON, Mem. Carneg. Mus., IV, no. 4, 1909, p. 163; Formosa.—BERG, Ichthyol. Amur., 1909, p. 175; Amur Province.—SNYDER, Proc. U. S. Nat. Mus., XLII, 1912, p. 403; Tokyo; Takamatsu River.—Jordan & Metz, Mem. Carneg. Mus., VI, No. 2, 1913, p. 12; Corea.

1903. *Glanis asotus* JORDAN & EVERMANN, Proc. U. S. Nat. Mus., XXV, p. 320; Tamusui River, Formosa.

1913. *Parasilurus asotus* JORDAN, SNYDER, & TANAKA, Journ. Coll. Sci. Tokyo, XXXIII, p. 58; Japan.

Head 4.83 in length; depth 6.20; D. 5; A. 75; P. I.12; V. II; width of head 1.33 in its length; eye 8 in head, 3 in snout, 4 in interorbital space; interorbital space 2 in head; pectoral 1.66; ventral 2.14.

Body elongate, posterior part compressed, anterior part more or less depressed; tail long and tapering; head flat and broad; snout depressed, broadly rounded anteriorly; lips thin and smooth, lower jaw somewhat protruding; eyes oval, supra-lateral, and anterior; nostrils far apart, distance between anterior and the posterior nostril equal to the distance between the latter and eye, anterior nostril in a short tube; mouth very broad and superior; teeth sharp, in broad villiform bands in the jaws, vomers, and palatines; barbels four, two maxillary, nearly as long as head, two mental, very short, about 4 in head; interorbital space very broad, its middle part somewhat depressed; gill-openings large; gill-rakers 1 + 10, rather short, and widely set; gill-membranes entirely separated.

Dorsal fin shorter than ventral, distance to pectoral twice as long as the distance to ventral; anal fin very long, united with caudal behind, of uniform height, its origin much in advance of the middle of the length; pectoral armed with a short strong spine, both edges of which bear denticulations, inner ones stronger; ventral fins shorter than the pectoral, reaching behind the origin of anal; caudal fin very slightly emarginate, each lobe obtusely rounded; anal papilla present.

MEASUREMENTS OF *Parasilurus asotus*.

Locality.	Head.	Depth.	D.	A.	P.	V.	Width of Head.	Eye.	Snout.	Interorbital.	Pectoral.	Ventral.	Length. Mm.
Jitsugetsutan	4.83	6.20	5	75	I, 12	11	1.33	8	2.64	2	1.66	2.14	330
Tamusui River	5	6.5	5	78	I, 11	11	1.4	8.5	3	2.5	1.83	2.5	242
Inzanpo	4.57	6.4	5	75	I, 12	11	1.33	7.33	3.6	2	2	2.2	180
Ritakukan	4.33	6.23	5	73	I, 12	11	1.73	7	3	2.4	1.72	2.28	150

Body smooth, naked; lateral line distinct, extending along the middle of sides, continuous.

Color in formalin uniformly dark gray, lower surface of head and abdomen whitish.

Total length 330 mm.

Described from a specimen from Jitsugetsutan (Lake Candidius), collected by T. Aoki in September, 1916.

Habitat: Distributed throughout the island. My specimens are from Jitsugetsutan (Lake Candidius); Tamusui River; Inzanpo; Ritakukan.

Genus PSEUDOBAGRUS Bleeker.

1860. *Pseudobagrus* BLEEKER, Act. Soc. Indo-Nederl., VII, p. 87. (Type *Bagrus aurantiacus* Temminck & Schlegel).

Body moderately elongate. Head broad and compressed, covered above by moderately thick, smooth skin; eyes moderate or rather small; snout broad, obtuse; mouth broad, tranverse, and with bands of villiform teeth in the jaws; a continuous transverse band of teeth on the roof of the mouth; nostrils remote, the anterior usually in a small tube; eight barbels, the maxillaries longest, and the mentals more or less evenly distributed. Dorsal fin short, with five to seven rays, and like the pectoral with a stout spine; caudal rounded or subtruncate; anal with twenty or more radii; ventrals broad, with six rays. (Jordan & Fowler.)

SYNOPSIS OF THE FORMOSAN SPECIES.

A. Depth of body 6.43–7.40 in length; origin of the dorsal in advance of the tip of the pectoral.

a. Maxillary barbels long, reaching the tip of operculum; adipose dorsal shorter than the anal; anal fin 15-rayed; pectoral I, 7; caudal fin slightly emarginate . . . . *taiwanus*.

aa. Maxillary barbels short, not reaching the tip of operculum; adipose dorsal longer than the anal; anal fin 18–19-rayed; pectoral I, 8–9; caudal fin rounded . . . . *adiposalis*.

B. Depth of body 4.5–5.33 in length; origin of the dorsal above the tip of the pectoral.

a. Maxillary barbels long, reaching beyond the tip of operculum; adipose dorsal longer than the anal; anal fin 15-rayed; pectoral I, 7; caudal fin slightly emarginate . . . . *brevianalis*.

5. **Pseudobagrus brevianalis** Regan.

Sankakuko (Formosa).

1908. *Pseudobagrus brevianalis* REGAN, Ann. Mag. Nat. Hist. (8), Vol. I, p. 149; Lake Candidius, Formosa.

Head 4 in length; depth 5.33; D. I, 7; A. 15; P. I, 7; V. 6; width of head 1.33 in its length; eye 8.5 in head; snout 2.5; inter-orbital space 2.33; pectoral 1.75; ventral 2.28.

Body elongate, higher in front, posterior part compressed, cross-section of the anterior part triangular; head rather flat, its top gradually inclining anteriorly; snout broad, obtusely rounded anteriorly, projecting beyond the lower jaw; mouth inferior, transverse, crescent-shaped, with fleshy thick lips, the upper more or less papillose; lower jaw much thinner, and distinct at the angle of the mouth only; both jaws with broad bands of villiform teeth; a subcrescentic narrow band of villiform teeth on the palate; eight barbels, four on the snout, the other four on the mentum; maxillaries long, one and one-half times in the length of head, scarcely reaching the base of the pectoral, nasal barbels as long as median mentals; eyes small, covered with thin skin, lateral and superior; nostrils separated, the anterior in a short tube, situated in a shallow groove just behind the upper lip, posterior nostrils behind the root of nasal barbels; gill-openings large, extending to upper part of the base of the pectorals; gill-membranes not confluent with the skin of isthmus, their posterior margins entirely free; gill-rakers 3 + 8, slender.

Origin of the dorsal above the tip of pectoral, its spine rather slender, nearly two-thirds as long as the dorsal; adipose dorsal rather short, above the anal, and inserted in front of anus, slightly longer than the anal; pectoral with a spine, its inner edge strongly serrated; ventral short, tip reaching the anus; anal fin rather short; anal papilla not well developed, very short; caudal fin emarginate, each lobe rounded at the tip; caudal peduncle elongate, slightly higher posteriorly, its deepest part twice in length of head.

Body naked, smooth; lateral line continuous, extending along the middle of the sides.

Color in formalin uniformly brownish gray, without any markings; belly and throat whitish.

Total length 130 mm.

The present description is from a specimen from Jitsugetsutan (Lake Candidius), collected by T. Aoki in August, 1916.

Habitat: Jitsugetsutan (Lake Candidius); Dainansho, Nanto.

Remarks: Regan's type specimen is provided with a 16–18-rayed anal fin, instead of being 15-rayed as in the present specimen.

MEASUREMENTS OF *Pseudobagrus brevianalis.*

Locality.	Head.	Depth.	D.	A.	P.	V.	Width of Head.	Snout.	Interorbital.	Pectoral.	Ventral.	Length, Mm.
Jitsugetsutan......	4	5.33	I, 7	15	I, 7	6	1.32	2.5	2.33	1.75	2.28	130
Dainansho.........	3.75	4.5	I, 7	15	I.7	6	1.31	2.66	2.43	1.7	2	78

6. **Pseudobagrus taiwanensis** sp. nov. (Plate XLVIII, Fig. 1).

Head 3.875 in length; depth 7.14; D. I, 7; A. 15; P. I, 7; V. 6; width of head 1.4 in its length; snout 2.75 in head; interorbital space 3; eye 8; pectoral 1.55; ventral 2.11.

Body elongate, depth rather uniform, tail compressed; head broad, depressed; snout flattened, bluntly rounded anteriorly; upper jaw projecting beyond the lower; mouth inferior, transverse, crescent-shaped; lips moderately thick, fleshy, lower lip distinct at the angle of the mouth only; jaws with broad bands of villiform teeth; palate with a transverse, crescent-shaped band of villiform teeth; 8 barbels, four on the snout, the other four on the mentum, maxillaries the longest, reaching tip of operculum; nasal barbel as long as median mental; eyes small, laterally superior, covered with thin skin; nostrils separated, the anterior tubular, in contact with posterior margin of the upper lip; posterior nostrils just behind the root of nasal barbel; interorbital space broad, middle part depressed longitudinally; gill-openings large, extending backwards to the base of pectoral; gill-membranes entirely separated; gill-rakers 3 + 10, proximal ones on the lower arm minute.

Origin of the dorsal in advance of the tip of pectoral, with a sharp spine; adipose dorsal very short and low, originating behind the base of anal, much shorter than the latter, and ending in front of the tip of the anal; pectoral fin rather elongate, armed with a sharp spine, its inner edge strongly denticulated; ventral fin scarcely reaching the base of anal, overlapping anus and the well-developed anal papilla; anal fin rather short; caudal fin slightly emarginate, the tip of each lobe rounded; caudal peduncle elongate, deeper posteriorly, its depth about twice in the length of head.

Body smooth; lateral line continuous, nearly straight, extending along the middle of the sides.

Color in formalin uniformly dark brown, belly and lower part of head whitish.

Total length 152 mm.

Described from a specimen from Tozen River near Taichu, collected by T. Aoki in December, 1916.

Habitat: Tozen River; Taito River; Shinchiku.

Remarks: The nearest relative of the present species is *Pseudobagrus brevianalis* Regan. These two species differ as follows:

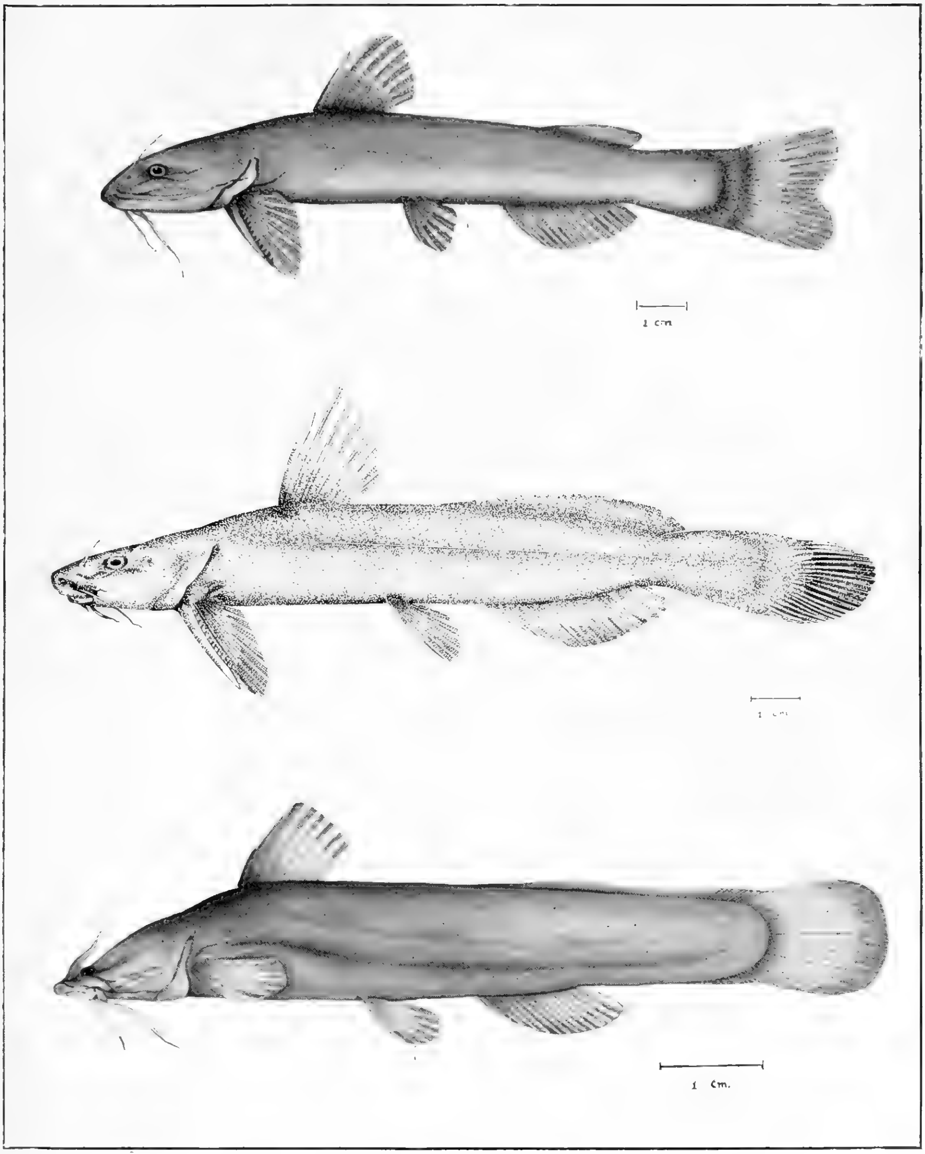


FIG. 1. *Pseudobagrus taiwanensis* Oshima, sp. nov.
FIG. 2. *Pseudobagrus adiposalis* Oshima, sp. nov.
FIG. 3. *Diobagrus nantoënsis* Oshima, sp. nov.

a′. Depth of body 6.42 to 7.14; maxillary barbels long, reaching the tip of operculum; adipose dorsal shorter than the anal; origin of the dorsal in advance of the tip of pectoral..*taiwanensis.*

a″. Depth of body 4.5 to 5.33; maxillary barbel short, reaching only to the base of the pectoral; adipose dorsal longer than the anal; origin of the dorsal above the tip of pectoral..*brevianalis.*

MEASUREMENTS OF *Pseudobagrus taiwanensis.*

Locality.	Head.	Depth.	D.	A.	P.	V.	Width of Head.	Snout.	Interorbital.	Eye.	Length, Mm.
Tozen River............	3.87	7.14	I, 7	15	I, 7	6	1.40	2.75	3	8.	152
Shinchiku..............	3.58	6.83	I, 7	15	I, 7	6	1.33	2.60	3	8.	52
Daito River............	3.91	6.42	I. 6	15	I, 7	6	1.33	2.75	3	7.5	50

7. **Pseudobagrus adiposalis** sp. nov. (Plate XLVIII, Fig. 2).

Sankakufu (Formosa).

Head 4.28 in length; depth 7.16; D. I, 7; A. 19; P. I, 8; V. 6; width of head 1.5 in its length; interorbital space three times in head; snout 2.8; width of mouth 2.5; pectoral 1.33; ventral 1.86; eye eight times in head; three times in interorbital space.

Body elongate, depth rather uniform, tail compressed; head broad, triangular, depressed and smooth; snout flattened, obtusely rounded anteriorly, projecting beyond the lower jaw; mouth inferior, transverse, crescent-shaped; lips thick, more or less papillose; jaws with broad bands of villiform teeth; eyes small, lateral and superior, covered with thin skin; nostrils separated, the anterior tubular, in a shallow pit behind the upper lip, the posterior in contact with the root of the nasal barbel; eight barbels, four on the snout, the other four on the mentum, the maxillary barbels the longest, reaching beyond the posterior margin of orbit, the median mental barbels the shortest; interorbital space broad, somewhat elevated; gill-openings large, reaching upward beyond the base of pectoral; gill-membranes deeply notched, entirely separated from each other; gill-rakers 3 + 10; slender.

Dorsal fin inserted on anterior third of the distance between tip of snout and base of caudal, armed with a sharp spine; adipose dorsal very long, inserted behind the base of ventral, reaching beyond the posterior end of base of anal, its height gradually increasing posteriorly; the pectoral with a strong spine which is strongly serrated behind;

ventral fin broad, entirely behind the dorsal, reaching the anal papilla; anal fin well-developed, shorter than the adipose dorsal, inserted behind the origin of the latter, elongate and higher in front; caudal fin slightly diverging posteriorly, its tip very slightly emarginate; caudal peduncle much compressed, deeper posteriorly; depth twice in head.

Body smooth; lateral line continuous, straight, extending along the middle of the sides.

Color in formalin dark reddish gray, darker above, paler below; lower parts whitish.

Total length 172 mm.

Described from a specimen from Tamusui River near Shinten, collected by T. Aoki in December, 1915.

Habitat: Tamusui River; Taito River; Sobun River.

Remarks: The present species is closely related to *Pseudobagrus aurantiacus*[1] from Japan. The specific differences may be expressed as follows:

a'. Anal fin 20–22-rayed; pectoral I, 7; gill-rakers 3 + 7; the dorsal inserted above tip of pectoral; adipose dorsal shorter than the anal; maxillary barbel long, reaching the tip of operculum .... *aurantiacus.*

aa''. Anal fin 18–19-rayed; pectoral I, 8 or I, 9; gill-rakers 3 + 10; origin of the dorsal in advance of the tip of pectoral; adipose dorsal much longer than the anal; maxillary barbel short, not reaching the base of pectoral.... *adiposalis.*

MEASUREMENTS OF *Pseudobagrus adiposalis.*

Locality.	Head.	Depth.	D.	A.	P.	V.	Width of Head.	Interorbital.	Snout	Eye.	Length, Mm.
Tamusui River..........	4.5	7	I. 7	18	I, 9	6	1.4	3	3	6.5	165
Tamusui River..........	4.28	7.16	I, 7	19	I, 8	6	1.5	3	2.8	8	172
Tamusui River..........	4.16	7	I, 7	18	I, 9	6	1.4	3	3	7	147
Tamusui River..........	4.25	6.6	I, 7	19	I, 9	6	1.75	3	3	7	190
Tamusui River..........	4.5	7	I, 7	19	I, 9	6	1.43	3	3	6	160
Heirinbi................	4.26	6.74	I, 7	19	I, 8	6	1.43	3	2.58	6	141
Sobun River............	4.42	7	I, 7	18	I, 9	6	1.33	3	3	9	310

Genus LIOBAGRUS Hilgendorf.

1878. *Liobagrus* HILGENDORF, Sitzungs. Gesellsch. Freund. Berlin, p. 1. (Type *Liobagrus reinii* Hilgendorf.)

Body elongate, with compressed tail and rounded caudal. Head broad and depressed; top of head smooth, the humeral process smooth;

[1] *Bagrus aurantiacus* Temminck & Schlegel, Fauna Japonica, Poiss., 1846, p. 227, Pl. CIV, Fig. 2; Japan.

Pseudobagrus aurantiacus Bleeker, Act. Soc. Sci. Indo-Neerl., VIII, 1860, p. 85.

eyes small and covered with thin skin, anterior in position; snout broad, obtuse, and projecting; teeth in jaws only, in broad villiform bands; eight barbels, the median mental barbels widely separated. Dorsal fin placed anteriorly; dorsal and pectoral spines smooth, sharp, and imbedded in skin; adipose fin long and low, joined to the caudal as in *Notrius;* ventral fins small, not reaching the anal, which has fifteen rays (Jordan & Fowler).

Distribution: Formosa; China; Corea; Japan.

SYNOPSIS OF THE FORMOSAN SPECIES.

a. Dorsal fin with seven soft rays; anal with twelve; upper jaw slightly longer than the lower..*nantoënsis.*

aa. Dorsal fin with five soft rays; anal with fifteen; jaws equal anteriorly. *formosanus.*

8. **Liobagrus nantoënsis** sp. nov. (Plate XLVIII, Fig. 3).

Head 4.33 in length; depth 6; D. I, 6; A. 12; P. I, 7; V. 6; width of head once in its length; snout three times in head; interorbital space 2.5; pectoral 1.25; ventral 1.8.

Body compressed, dorsal profile abruptly inclined anteriorly at the base of dorsal fin; head large, round, flattened, with a median shallow groove, both sides of which are slightly swollen; interorbital space depressed; snout very short, anterior margin broadly rounded, projecting beyond lower jaw; mouth anterior, transverse, with thick fleshy lips; upper jaw with a band of villiform teeth, similar bands on the lower jaw, crescent-shaped, narrower, but longer than that of upper jaw; no teeth on palatine and vomer; eight barbels, four on snout, others on mentum, all barbels thick at the base, nasal barbel nearly as long as inner mental, maxillary barbels slightly shorter than outer mentals, scarcely reaching the base of pectoral; nostrils superior, separated, anterior nostril in a short tube, the posterior in contact with root of nasal barbel; eyes very small, superior, imbedded in skin; gill-openings rather large; gill-membranes entirely separated.

Dorsal fin small, its spine nearly half as high as the fin, hidden beneath skin; adipose dorsal low and long, opposite to the anal; pectoral armed with a sharp smooth spine, which is hidden beneath the skin, tip of the fin reaching beyond the middle of dorsal; ventral fin entirely behind the dorsal, reaching beyond anus; the anal much shorter than adipose dorsal; caudal fin rather long, its tip rounded; depth of caudal peduncle uniform. Body smooth; lateral line indistinct. Color in formalin brownish gray, fins somewhat paler.

Total length 88 mm.

Described from a specimen from Dainansho, Nanto, collected by T. Aoki in December, 1916.

Habitat: Dainansho, Nanto.

Remarks: The present species differs from *Liobagrus formosanus* Regan from Lake Candidius in having a 7-rayed dorsal, a 12-rayed anal, and a slightly protruded upper jaw.

MEASUREMENTS OF *Liobagrus nantoënsis*.

Locality.	Head.	Depth.	D.	A.	P.	V.	Width of Head.	Interorbital.	Snout.	Eye.	Length. Mm.
Dainansho	4.33	6	I, 7	12	I, 7	6	1	2.5	3	11	88
Dainansho	4.50	5.61	I, 7	12	I, 7	6	1.23	2.66	3	10	48

9. **Liobagrus formosanus** Regan.

1908. *Liobagrus formosanus* REGAN, Ann. Mag. Nat. Hist. (8), II, p. 360; Lake Candidius, Formosa.—JORDAN & RICHARDSON, Mem. Carneg. Mus., IV, no. 4, 1909, p. 168; Lake Candidius (after Regan).

Depth of body six times in the length, length of head 4.33. Head a little longer than broad; interocular width nearly three times in the length of head. Jaws equal anteriorly; premaxillary band of teeth apparently two and one-half times as long as broad; posterior mandibular barbel extending to basal part of pectoral. Dorsal I, 5; spine one-fourth the length of head. Pectoral spine half the length of the fin, which is eight-tenths the length of the head. Anal 15. Caudal rounded. Grayish; fins dusky; anal and caudal with a narrow pale edge.

A single specimen, 37 mm. in total length; Lake Candidius, Formosa (Regan).

Habitat: Jitsugetsutan (Lake Candidius). Not seen.

Remarks: According to Regan the present species is closely related to *Liobagrus andersoni* Regan[2] from Corea.

Genus CLARIAS Gronovius.

1763. *Clarias* GRONOVIUS, Zoöphyl., p. 100 (non binomial).
1777. *Clarias* SCOPOLI, Intr. Hist. Nat., p. 455. (Type *Clarias orontis* Günther.)
1803. *Macropteronotus* LACÉPÈDE, Hist. Nat. Poiss., V, p. 84. (Type *Macropteronotus charmuth* Lacépède.)

Adipose fin none; dorsal long, extending from the nape to the

[2] *Liobagrus andersoni* Regan, Proc. Zoöl. Soc. London, 1908, p. 61; Kimhoa, Corea.

caudal; anal long. Jaws with a band of villiform teeth; a band of villiform or granular teeth across the vomer; cleft of mouth transverse, anterior, of moderate width; barbels eight, one pair of nasal, one of maxillary, and two pairs of mandibular barbels. Eyes small, with a free orbital margin. The upper and lateral parts of the head are osseous, or covered with only a very thin skin. A dendritic, accessory branchial organ is attached to the convex side of the second and fourth branchial arches, and received in a cavity behind the gill-cavity proper. Ventrals six-rayed; only the pectoral has a pungent spine.

Distribution: Africa; Syria; Bengal; India; Sumatra; Java; Borneo; Ceylon; Luzon; Mindanao; Formosa; China; Cochin-China.

10. **Clarias fuscus** (Lacépède).

Tosa or Tause (Formosa).

1803. *Macropteronotus fuscus* LACÉPÈDE, Hist. Nat. Poiss., V, p. 88, pl. 2, fig. 2.

1846. *Clarias pulcaris* RICHARDSON, Voy. Sulph., Fish., p. 135, pl. 62, fig. 56; Canton, China.

1864. *Clarias fuscus* GÜNTHER, Cat. Fish., V, p. 18; China.—Jordan & Evermann, Proc. U. S. Nat. Mus., XXV, 1903, p. 321; Taihoku, Formosa.—JORDAN & RICHARDSON, Mem. Carneg. Mus., IV, no. 4, 1909, p. 168; Taihoku; Takao.—VAILLANT, Bull. Mus. Hist. Nat., VI, 1904, p. 297; Tongking.

1897. *Clarias fuscus* RUTTER, Proc. Acad. Nat. Sc. Philad., Jan., p. 57; Swatow, China.

1908. *Clarias sauteri* REGAN, Ann. Mag. Nat. Hist. (8), I, p. 151; Kagi; Formosa.

Head 4.11 in length; depth 5.66; D. 58; A. 42; P. I, 9; V. 6; width of head 1.2 in its length; eye twelve times in head, five times in snout, six and one-half times in interorbital space, which is contained 1.75 in head; pectoral 1.33; ventral 2.66.

Body compressed, higher in front; head flattened, inclined anteriorly, with two oval depressions along the median longitudinal line, one on the interorbital space, the other on occiput; tail long and tapering; snout flattened, truncated in front; mouth slightly inferior, transverse; lips granulated, upper lip much thicker than the lower; jaws with a band of villiform teeth, upper jaw protruding; vomer with a crescent-shaped band of villiform teeth, which is narrower than that of the inter-maxillary; eyes very small, supra-lateral; nostrils separated, anterior nostril in contact with upper lip, in a short tube, posterior nostril superior, just behind the base of rostral barbel; eight barbels, one pair rostral, one maxillary, two mandibular, of which the maxillary pair are the longest, about 1.2 in the length of head; gill-openings low; gill-membranes entirely separated; gill-rakers 4 + 14, slender and pointed.

Dorsal fin very long, originating at anterior third of body without caudal, extending posteriorly to the base of the caudal; anal fin long, inserted slightly posterior to a point midway between tip of snout and base of caudal; pectoral fin armed with a strong, short spine, which has a fine serration below the skin; the ventral very small, its tip reaching beyond base of anal fin; caudal fin separated from the dorsal and anal; rather long, the tip rounded.

Body naked, with numerous undulating vertical striations on the sides; lateral line descends a little at the commencement and runs straight at mid-height.

Color in formalin uniformly dark brown, lower parts whitish; sides with about eight vertical rows of minute white spots, descending from the back to the lateral line, and two or more longitudinal rows of the same below the lateral line.

Total length 192 mm.

The present description from a specimen from Jitsugetsutan, collected by T. Aoki, in August, 1916.

Habitat: Very common in the fresh waters of Formosa. My specimens came from Jitsugetsutan (Lake Candidius); Taihoku; Tamusui River near Shinten; Maruyama near Taihoku; Giran.

MEASUREMENTS OF *Clarias fuscus*.

Locality.	Head.	Depth.	D.	A.	P.	V.	Width of Head.	Interorbital.	Snout.	Eye.	Length, Mm.
Jitsugetsutan	4.11	5.66	58	42	I, 9	6	1.20	2	3	12	192
Jitsugetsutan	4.28	5.45	55	36	I, 9	6	1.16	1.75	2.33	10	100
Maruyama	4.44	5.83	54	35	I, 9	6	1.14	1.83	2.28	11.66	162
Maruyama	4.35	5.32	53	41	I, 9	6	1.12	1.86	2.36	10.33	132
Maruyama	4.09	6	52	39	I, 9	6	1.20	2	2.55	10	110
Giran	4.27	5.50	55	40	I. 9	6	1.60	1.8	2.50	10.33	218

Remarks: In the year 1908, Mr. C. Tate Regan described a new catfish from Kagi, Formosa, giving it the name *Clarias sauteri*, and made the following statement: "*C. sauteri* is close to the Chinese *C. fuscus* Lacépède, which differs notably in having villiform teeth on the palate." It is observed, however, that large specimens of *C. fuscus* are provided with more or less enlarged vomerine teeth, instead of being villiform, as in small specimens. Thus the size of the vomerine teeth is an individual difference, not specific. Therefore it is unreasonable to separate *C. sauteri* from *C. fuscus*.

Family COBITIDÆ.

ARTIFICIAL KEY TO THE FORMOSAN GENERA.

a. No erectile spines below the eye; ten or twelve barbels; four about the mandible; lateral line medium ....*Misgurnus.*

aa. An erectile spine below the eye; six barbels, only on the upper jaw; lateral line incomplete ....*Cobitis.*

Genus MISGURNUS Lacépède.

1803. *Misgurnus* LACÉPÈDE, Hist. Nat. Poiss., p. 16. (Type *Cobitis fossilis* Linnæus.)

Body elongate, compressed. Head triangular, elongate, compressed; snout projecting; mouth inferior, with fleshy lips; barbels ten or twelve, of which four are mandibular; eye small. Gill-openings lateral; lateral line complete. No spine below the eye. Body with small scales, except on the head, which is naked. Origin of the dorsal about in the middle of the length of the fish, over the ventrals; anal entirely behind dorsal; pectorals more or less equal to the head; caudal nearly equal to head, and rounded. Air-bladder in a bony capsule (Jordan & Fowler).

Distribution: Europe; Bengal; India; Siam; Indo-China; China; Formosa; Amur Province; Japan.

SYNOPSIS OF THE FORMOSAN SPECIES.

a. Scales relatively small, 140–150 in lateral series; body slender, the depth 7–8 in length; barbels short, the longest, about 2.5 in head; color dark gray, above spotted and marbled with dark, base of the caudal above with a black spot. *anguillicaudatus.*

aa. Scales relatively large, 106–115 in lateral series; body plump, the depth 5.86–6.50 in length; barbels long, the longest about 1.8 in head; color relatively plain, obtusely speckled with minute dark spots, not marbled, base of the caudal above with no black spot ....*decemcirrosus.*

11. **Misgurnus anguillicaudatus** (Cantor).

Dojo (Japan); Horyu (Formosa).

1842. *Cobitis anguillicaudatus* CANTOR, Ann. Mag. Nat. Hist. IX, p. 485.—RICHARDSON, Voy. Sulph., Fish., 1846, p. 143, Pl. 55, Figs. 9 and 10; China.

1868. *Misgurnus anguillicaudatus* GÜNTHER, Cat. Fish. VII, p. 345; China; Japan; Formosa.—Ann. Mag. Nat. Hist., Sept., 1873, p. 250; Shanghai.—

PETERS, Monatb. Königl. Akad. Berlin, 1880, p. 926.—SAUVAGE, Nouv. Arch. Mus., 1881, p. 190.—GÜNTHER, Ann. Mus. St. Petersburg, 1896, p. 19; Kansu; China.— RUTTER, Proc. Acad. Nat. Sc. Philad., 1897, p. 60; Swatow.—FOWLER, Proc. Acad. Nat. Sc. Philad., 1899, p. 179; Tan-lan-ho, China.—JORDAN & SNYDER, Proc. U. S. Nat. Mus., XXIII, 1901, p. 340; Japan.—REGAN, Ann. Mag. Nat. Hist. (7), XIII, 1904, p. 192; Yunnan-Fu, China.—VAILLANT, Bull. Mus. Hist. Nat., 1904, VI, p. 298; Tongking.—JORDAN & SNYDER, Proc. U. S. Nat. Mus., XXX, 1906, p. 834; Japan.—SNYDER, Proc. U. S. Nat. Mus., XLII, 1912, p. 404; Hakodate; Tokyo; Takamatsu River.—JORDAN, SNYDER, & TANAKA, Journ. Coll. Sci. Tokyo, XXXIII, 1913, p. 60; Japan.

1846. *Cobitis maculata* TEMMINCK & SCHLEGEL, Fauna Japonica, Poiss., p. 221, Pl. CIII, Fig. 2; near Nagasaki.

1846. *Cobitis rubripinnis* TEMMINCK & SCHLEGEL, Fauna Japonica, Poiss., p. 220, Pl. CIII, Fig. 1; near Nagasaki.

1846. *Cobitis micropus* CUV. & VAL., Hist. Nat. Poiss., XVIII, p. 29, China.

1846. *Cobitis psammismus* RICHARDSON, Ichthyol. China, p. 300; Canton, China.

1860. *Cobitichthys enalios* BLEEKER, Act. Soc. Indo-Neerl., VIII; Japan.—IV, p. 88, Pl. II, Fig. 4; Japan.

1860. *Cobitichthys dechachraus* BLEEKER, Act. Soc. Sci. Indo-Neerl., VIII; Japan. —IV, p. 89, Pl. II, Fig. 2; Tokyo.

1868. *Misgurnus dechachraus* GÜNTHER, Cat. Fish., VII, p. 346; Tokyo.

1878. *Misgurnus crossochilus* SAUVAGE, Bull. Sc. Philom., Jan., p. 4; Koaton, Cochinchina.

1907. *Misgurnus fossilis anguillicaudatus* BERG, Proc. U. S. Nat. Mus., XXXII, p. 435; Amur Province.

Head 6 in length; depth 7; D. 9; A. 7; P. I, 9; V. 6; width of head 2 in its length; eye 3 in snout, 1.66 in interorbital space; snout 2.5 in head; pectoral 1.6; ventrals 2; scales about 140.

Body elongate, compressed; head small, triangular, compressed; snout rather long, obtuse, somewhat produced; eyes small, anterior and superior; mouth inferior, with thick fleshy lips; ten barbels, four belonging to the mandible; the longest barbel 2.5 in head; nostrils close together, in front of eye, the anterior in a short tube; interorbital space slightly convex; gill-openings lateral; gill-membranes joined below in front of the base of the pectoral.

Origin of dorsal about midway between tip of snout and tip of caudal, a little in front of the ventral; anal fin entirely behind the dorsal, nearer the origin of the ventral than the base of caudal; pectoral fin short and low; the caudal oblong, broad, rounded, nearly as long as head; caudal peduncle long and deep, its depth about two-thirds of the length of head.

Head naked, trunk covered with small cycloid scales; lateral line extends along the middle of the sides.

Color in formalin dark gray, upper half of the body spotted and marbled with darker; base of the caudal above with a black spot; dorsal and caudal fins with several rows of dark small spots; sides of body with a number of obscure longitudinal black stripes; belly together with pectorals, ventrals, and anal whitish.

Total length 107 mm.

Described from a specimen from Giran, collected on December 2, 1916.

Habitat: Very abundant in all the rivers and rice-fields of the island. My specimens came from the Tamusui River near Taihoku; Maruyama; Giran; Jitsugetsutan (Lake Candidius); Rato and Raupi; Giran.

MEASUREMENTS OF *Misgurnus anguillicaudatus.*

Locality.	Head.	Depth.	D.	A.	P.	V.	Width of Head.	Interorbital.	Snout.	Eye.	Scales.	Length, Mm.
Giran.............	6	7	9	7	I, 9	6	2	4.25	2.40	7	140	107
Giran.............	6	6.87	7	6	I, 9	6	1.6	4.33	2.66	8	140	120
Maruyama........	5.6	7.29	8	7	I, 9	6	1.69	4.80	2.30	9	150	150
Maruyama........	5.42	7.6	9	7	I, 9	6	1.75	4	2.28	8	148	90
Maruyama........	5.56	8	8	7	I, 9	6	1.75	4	2.33	8.66	—	90
Maruyama........	6	7.4	8	6	I, 9	6	1.86	4	2.16	7.33	149	88

12. **Misgurnus decemcirrosus** (Basilewsky).

1855. *Cobitis decemcirrosus* BASILEWSKY, Mem. Soc. Nat. Moscow, p. 239, Pl. 7; near Peking.

1888. *Misgurnus mizolepis* GÜNTHER, Ann. Mag. Nat. Hist., June, p. 434; Kiu-Kiang, China.

1901. *Misgurnus anguillicaudatus* ABBOTT, Proc. U. S. Nat. Mus., XXIII, p. 489; Tientsin, China.—JORDAN & EVERMANN, Proc. U. S. Nat. Mus., XXV, 1903, p. 321; Tiaholu, Formosa.

1906. *Misgurnus decemcirrosus*, JORDAN & SNYDER, Proc. U. S. Nat. Mus., XXX, p. 834; Tientsin, China.—JORDAN & RICHARDSON, Mem. Carneg. Mus., IV, No. 4, 1909, p. 169; Formosa.

Head 7 in length; depth 6.2; D. 7; A. 6; P. I, 9; V. 6; width of head 2.33 in its length; eye 7 in head, 3 in snout; 2 in interorbital space; snout 2.5 in head; pectoral 1.33; ventral 2; scales about 112 in lateral series, 23 in transverse series from origin of dorsal to the ventral.

Body elongate and compressed; head small, triangular, compressed; snout long, pointed and produced; eyes small, superior, and nearer tip of snout than gill-opening; mouth inferior, with thick fleshy lips; ten barbels, four belonging to the mandible, the longest barbel 1.8 in head; nostrils in front of eye, separated a little, the anterior in a short tube; interorbital space convex, 1.66 in snout; cheeks slightly swollen; gill-openings lateral; gill-membranes joined below in front of the base of the pectoral.

Origin of the dorsal about midway in the length of body including caudal, slightly in front of the origin of ventral; anal fin entirely behind the dorsal, nearer to origin of ventral than base of caudal; caudal squarish, with obtusely rounded tip, nearly as long as head; pectoral fin short and low; the ventral short; caudal peduncle deep and long, its depth about three-fourths the length of head.

Head naked; trunk covered with relatively large cycloid scales; lateral line extends along the middle of the sides.

Color in formalin uniformly dark gray, obscurely speckled with small dark spots, not marbled; dorsal, anal, and caudal fins dusky, with numerous small dark spots; the pectoral and the ventral whitish, some dusky on the longer rays; belly yellowish white.

Total length 145 mm.

The present description is taken from a specimen from the fish-market of Taichu, collected by T. Aoki in December, 1915.

Habitat: Taihoku; Taichu.

Remarks: In the year 1888 Günther recorded a Chinese species of *Misgurnus* under the name of *Misgurnus mizolepis* and stated that it has larger scales than any other species of the genus known to himself. According to his description, the scales of *Misgurnus mizolepis* are arranged in thirteen longitudinal rows between the dorsal fin and the lateral line, and ten between the lateral line and the ventral fin. Scales of *Misgurnus decemcirrosus* are also much larger than any other species of the genus, numbering 112 in the lateral series and 23 in an oblique series from the origin of the dorsal to the ventral. Moreover, as all other characters of that species agree quite well with those of *M. mizolepis*, there is no doubt that these two are the same species.

Though Jordan & Snyder believe that *M. decemcirrosus* from Northern China differs from *M. anguillicaudatus* in having large scales (about 112 in lateral series), rather deep body, long barbels, and relatively plain color, Berg denies that the former is different from the latter. After examining a vast number of specimens of *M. anguillicaudatus* he comes to the conclusion that *M. decemcirrosus* is a nominal species, because there is no difference between Japanese and North Chinese specimens of *M. anguillicaudatus* in respect of the number of scales and the depth of the body. In addition he asserts: "If we regard the specimens from near Peking as a distinct species we shall be obliged to regard many varieties of the same species found in other parts of China and in Japan also as distinct species, which is inadmissible in consequence of the known variability of *anguillicaudatus*."

It is certain that there is no specific difference between Chinese and Japanese *M. anguillicaudatus;* however, it is also true that in China and Formosa there exists a large-scaled species of *Misgurnus* (Basilewsky's *Cobitis decemcirrosus* or Günther's *Misgurnus mizolepis*) which is distinctly separate from common *M. anguillicaudatus.* According to Berg's statement all the specimens of *Misgurnus* which were examined by him belonged to *M. anguillicaudatus,* not *M. decemcirrosus,* differing in having more than 145 scales in the lateral series. Not only is the large-scaled *Misgurnus decemcirrosus* not a nominal species, but it is proved that it is distributed in Northern and Southern China as well as in Formosa, distinctly differing from the common loach, *Misgurnus anguillicaudatus.* Therefore Berg's opinion with reference to *M. decemcirrosus* is incorrect.

Measurements of *Misgurnus decemcirrosus.*

Locality.	Head.	Depth.	D.	A.	P.	V.	Width of Head.	Interorbital.	Snout.	Eye.	Scales.	Length, Mm.
Taichu............	6.5	6.2	7	6	I, 9	6	2.33	3.6	2.50	7	112	145
Taichu............	6	5.86	7	6	I, 9	6	2	3.6	2.25	7.33	112	123
Taihoku...........	6	6.5	7	6	I, 9	6	1.88	3.75	2.66	6	115	108
Taihoku...........	6	6.2	7	6	I,10	6	2	4	2.50	7	106	100
Taihoku...........	6	6.2	7	6	I,10	6	1.86	4	2.60	6	106	98
Taihoku...........	6	6	7	6	I,10	6	2	4	2.50	7	110	105
Taihoku...........	6	6.5	7	6	I,10	6	1.88	3.66	2.60	6	112	105

Genus Cobitis Linnæus.

1738. *Cobitis* Artedi, Genera (non binomial).

1758. *Cobitis* Linnæus, Syst. Nat., Ed X, p. 303. (Type *Cobitis tænia* Linnæus.)

1835. *Acanthopsis* Agassiz, Mem. Soc. Sci. Nat. Neuchatel, I, p. 36. (Type *Cobitis tænia* Linnæus.)

Body elongate, more or less compressed, and the trunk not arched. Head elongate, compressed; eyes small; snout produced, blunt and rounded; mouth small, inferior, and with six barbels about the upper jaw; below the eye an erectile bifid spine. Dorsal fin about over the ventrals; anal behind dorsal; caudal rounded or truncate; pectorals less than the head; ventrals below dorsal. Air-bladder inclosed in a bony capsule. Lateral line incomplete. Small fresh-water fishes of Europe and Asia (Jordan & Fowler).

Distribution: Europe; Assam; Bengal; China; Formosa; Corea; Amur province; Japan.

13. **Cobitis tænia** Linnæus.

1758. *Cobitis tænia* LINNÆUS, Syst. Nat. Ed. X., p. 303; Europe.—GÜNTHER, Cat. Fish., VII, 1868, p. 362; Europe; Japan.—JORDAN & FOWLER, Proc. U. S. Nat. Mus., XXVI, 1903, p. 771; Japan.

1846. *Cobitis tænia japonica* SCHLEGEL, Fauna Japonica, Poiss., p. 222, Pl. CIII, Fig. 2; near Nagasaki,

1875. *Cobitis sinensis* SAUVAGE & DE THIERSANT, Ann. Sci. Nat., Ser. 6, I, p. 8; Setchuan, China.—FOWLER, Proc. Acad. Nat. Sci. Philad., 1899, p. 182; Tan-lan-ho, China.—JORDAN & METZ, Mem. Carneg. Mus., VI, 1913, p. 12; Suigen; Gensan; Fusan, Corea.

1901. *Cobitis biwæ* JORDAN & SNYDER, Proc. U. S. Nat. Mus., XXIII, p. 748; Lake Biwa (substitute for *Cobitis japonica* pre-occupied).—JORDAN, SNYDER, & TANAKA, Journ. Coll. Sci. Tokyo, XXXIII, 1913, p. 62; Japan.

Head 5 in length; depth 6.166; D. 8; A. 7; P. 10; V. 7; width of head a little over two in its length; snout two times in head; interorbital space 5.33; eye 5.5; pectoral 1.5; ventral 1.66.

Body elongate and compressed; head elongate, strongly compressed, with convex upper profile; snout long, somewhat produced, anterior border bluntly rounded; eyes small, superior and lateral, located midway between tip of snout and gill-opening; mouth small, inferior, with fleshy lips, the lower bilobed; eight barbels, two of which are mandibular; nostrils nearer the eye than the tip of snout, close together, the anterior in a short tube; interorbital space narrow; gill-openings large, lateral; gill-membranes united below the base of the pectoral in front.

Origin of dorsal nearer the base of caudal than the tip of snout, somewhat in advance of ventral, length of dorsal when depressed a little less than the length of head; pectoral a little longer than one-third the distance between its base and origin of ventral; ventral twice in the space between its origin and that of the ventral; anal fin entirely behind the dorsal, reaching two-thirds of the space between its origin and the base of caudal; caudal peduncle compressed, its depth slightly less than twice in head.

Head naked, trunk covered with very small cycloid scales; lateral line very short, extending a little beyond the middle of the pectoral.

Color in formalin pale grey above, lower parts and belly yellowish white; sides with two rows of dark blotches, the upper one forming a continuous longitudinal band anteriorly, blotches of the lower row larger; between the two rows a narrow paler marbled brown streak, occupying the anterior half the interspace; eight blotches of dark brown between the nape and the origin of the dorsal, seven more between the latter and the base of the caudal; base of the caudal above with a jet-black spot; dorsal and caudal fins with several rows of dark small spots; other fins whitish; head marbled and spotted with brown above; back with mottlings; a black streak from eye to snout.

Total Length 122 mm.

Described from a specimen from Shinchiku, collected by T. Aoki on September 17, 1916.

Habitat: Shinchiku; Jitsugetsutan (Lake Candidius); Rigyokutsu, Nanto; Maruyama, Giran.

Remarks: The markings of the present species are more or less variable. The other example from Shinchiku has the brown blotches on the sides distinctly separated into spots, while the example from Rigyokutsu has the upper blotches on the sides merged into continuous longitudinal bands.

MEASUREMENTS OF *Cobitis tænia.*

Locality.	Head.	Depth,	D.	A.	P.	V.	Width of Head.	Interorbital.	Snout.	Eye.	Length, Mm.
Shinchiku	5	6.16	8	7	10	7	2.75	6.75	2	5.33	122
Shinchiku	5	6.18	8	7	10	7	2.80	6	2	5.66	82
Jitsugsetsutan	5	7.50	8	6	10	7	2.60	6	2	5	82
Rigyokutsu	5	6.88	8	6	10	7	2.60	6	2	5	67

Family HOMALOPTERIDÆ.

ARTIFICIAL KEY TO THE FORMOSAN GENERA.

a. Body elongate, rather high, anterior part depressed; mouth inferior; upper lip fleshy, with a distinct inner fold; barbels numerous, one pair of maxillary, two transverse series of minute ones on upper jaw, and three pairs on the lower jaw; dorsal fin inserted in advance of the ventral; pectoral with one simple outer ray, horizontal. . . . . *Formosania.*

aa. Body much depressed, nearly twice as broad as high; mouth inferior, with fringed upper lip; six barbels, two pairs on the extremity of the snout, the other at the angle of mouth, minute and subequal; dorsal fin inserted behind the origin of the ventral; pectoral with eleven simple outer rays, subhorizontal. *Hemimyzon.*

Genus FORMOSANIA gen. nov.

Type *Formosania gilberti* Oshima.

Body elongate, rather high, anterior part depressed; snout spatulate; mouth inferior; upper lip fleshy, with a distinct inner fold; lower jaw with a sharp horny edge; barbels numerous, inferior, upper jaw with two transverse rows of minute barbels and one pair of thick maxillary barbels, lower jaw with three pairs of small barbels; scales minute; lateral line continuous; dorsal fin high, inserted in front of the origin of the ventral; pectoral fin large, not reaching the ventral; the anal large, when depressed reaching the root of caudal; pectoral and ventral fins horizontal, one outer ray simple.

Remarks: Well distinguished from other genera of the *Homalopteridæ* by the presence of numerous barbels, especially by the rostral barbels which are arranged in two series.

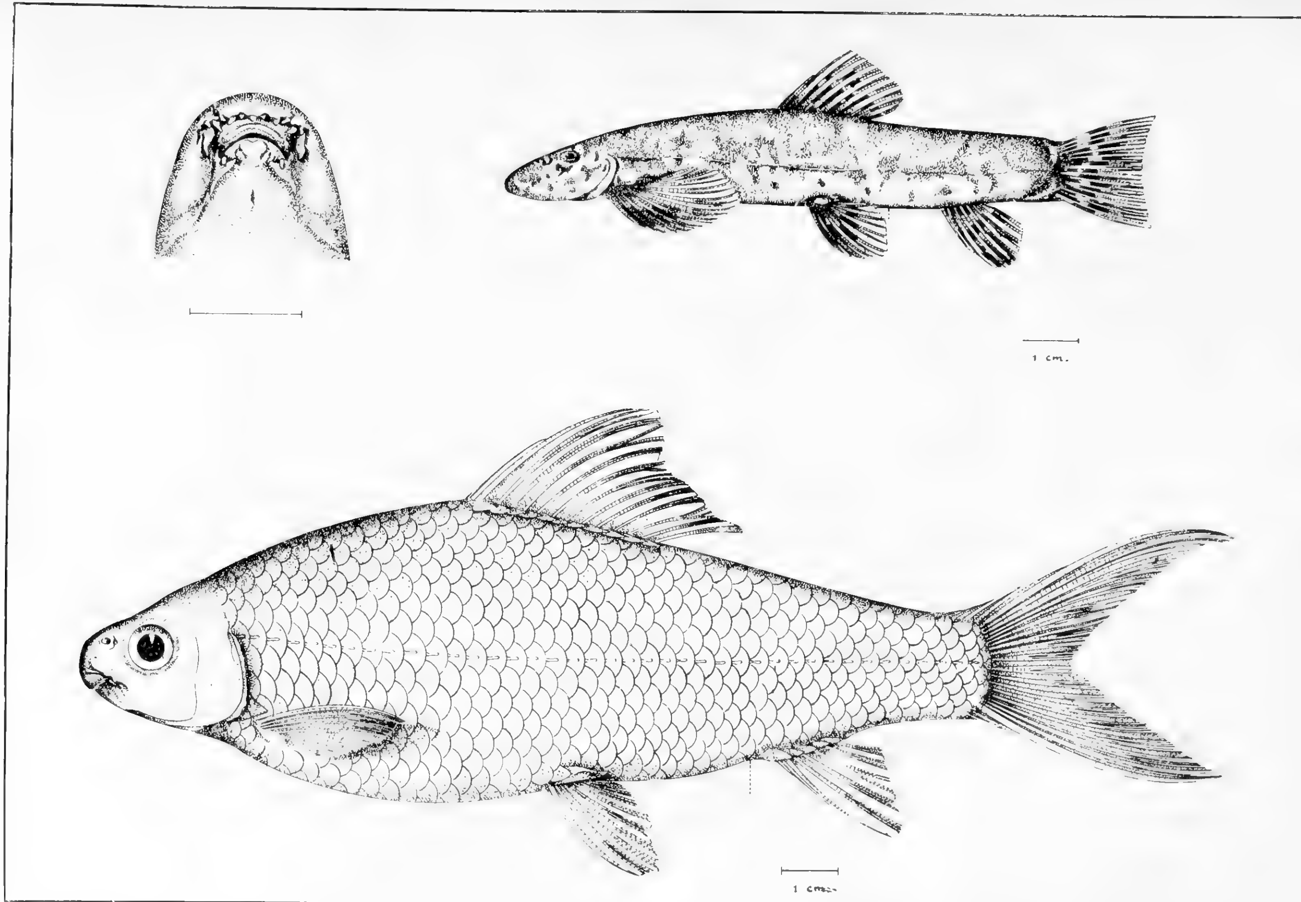
Distribution: Formosa and China.

14. **Formosania gilberti** sp. nov. (Plate XLIX, Figs. 1–2).

Head 4.66 in length; depth 6.2; D. 2.8; A. 2, 5; P. 15; V. 9; width of head 1.22 in its length; eye 6 in head; interorbital space 2.63; snout 1.75; ventral 1.31; pectoral longer than head; scales about 120 in the lateral line.

Body elongate, lower surface flat, tail compressed, cross-section of body triangular, anterior part feebly depressed; head moderate, top nearly flat; snout spatulate, much longer than postocular part, shorter than width, anterior margin broadly rounded; skin of the snout extending to the lower surface, but not overlapping upper lip; mouth inferior, transverse; upper lip thick and fleshy, with a distinct inner fold; lower jaw much shorter than the upper, anterior margin rounded, horny; mentum with a broad fleshy tubercle, the tip of which is bilobed; barbels numerous, inferior, rostral barbels minute, arranged in two transverse rows, each with about five barbels, maxillary pair thick and longest, lower jaw with six barbels, posterior mental pair the longest, the others short and tubercle-like; eyes small, supra-lateral, posterior, nearer angle of gill-cover than tip of snout; nostrils close together, in front of eye; boundary between head and trunk distinct, occiput pointed posteriorly.

Origin of dorsal nearer tip of snout than base of caudal, in advance of that of the ventral, rather high, the anterior ray longest; pectoral horizontal, flattened, large, outer margin broadly rounded, not



Formosania gilberti, Oshima, sp. nov. ventral view of snout, *Do.* lateral view.
Labeo jordani Oshima, sp. nov.

reaching the ventral, one outer ray undivided; ventral inserted beneath the middle of base of dorsal, ovoid, middle ray the longest; anal fin large, when depressed scarcely reaching the root of caudal; caudal fin elongate, weakly emarginate, each lobe sharply pointed.

Body covered with minute scales, head and lower surface naked; lateral line nearly straight, extending along the middle of the sides.

Color in formalin dark yellow, mottled with irregular dark brown blotches, lower surface white; head uniformly dark, with few yellowish markings; fin-rays of the dorsal with elongate black spots; caudal fin with a number of black cross-bars; other fins dusky, with numerous dark spots.

Total length 117 mm.

The present description is from a specimen from Tamusui River near Shinten, collected by T. Aoki in December, 1916.

Habitat: Tamusui River (four specimens).

Remarks: The present species is very closely related to Boulenger's *Homaloptera stenosoma* (misprinted *Homalosoma*) from Ningpo, China (Proc. Zoöl. Soc. London, March, 1901, p. 270), which seems to belong to the genus *Formosania*. The latter differs from *F. gilberti* in having seven-branched dorsal rays, a smaller number of scales in the lateral line, and slightly shorter head and pectorals.

MEASUREMENTS OF *Formosania gilberti.*

Locality.	Head.	Depth.	D.	A.	P.	V.	Width of Head.	Interorbital.	Snout.	Eye.	Scales.	Leugth, Mm.
Tamusui River....	4.66	6.2	2.8	2.5	15	9	1.22	2.625	1.75	6	120	117
Tamusui River....	4.72	5.36	2.8	2.5	16	9	1.21	2.666	1.60	6	130	90

Genus HEMIMYZON Regan.

1911. *Hemimyzon* Regan. Ann. Mag. Nat. Hist. (8), p. 31. (Type *Homaloptera formosanus* Boulenger.)

Body much depressed, nearly twice as broad as high; head disc-shaped, flattened; snout broad, with sharp anterior margin; mouth inferior, transverse, with fringed upper lip; edge of the lower jaw sharp, horny; six barbels, inferior, two pairs on the extremity of the snout, the others at the angle of mouth, minute and subequal; origin of ventral in advance of that of dorsal; the pectoral subhorizontal, eleven outer rays simple; ventral fin horizontal, four outer rays simple;

the anal minute, not reaching the caudal; scales minute; lateral line nearly straight, continuous.

Distribution: Formosa.

15. **Hemimyzon formosanus** (Boulenger).

1894. *Homaloptera formosanus* BOULENGER, Ann. Mag. Nat. Hist., Ser. 6, XIV, p. 463; Central Formosa.

1911. *Hemimyzon formosanus* REGAN, Ann. Mag. Nat. Hist. (8), VIII, p. 32; Formosa (after Boulenger).

Head 4.25 in length; depth 6 in length and 1.5 in width; D. 2, 7; A. 1, 5; P. 22; V. 15; width of head 1 in its length; eye 5.66 in head; snout 1.71; interorbital space 2.3; pectoral 1.33 times as long as head; ventral very slightly shorter than the pectoral; scales about 70 in the lateral line.

Body strongly depressed, low, tail compressed, middle part of body broadest, belly and throat flat; head flattened, disc-shaped; gill-opening rather large; snout broad, with rounded sharp anterior margin; interorbital space rather flat; mouth inferior, transverse, crescent-shaped; upper lip fringed with a fleshy inner fold; lower jaw shorter than the upper; lower lip with a smooth horny inner fold, its anterior margin sharp; six barbels, short, subequal, two pairs on the lower extremity of snout and the other at the angles of mouth; eyes small, superior and posterior, considerably nearer the angle of operculum than tip of snout; nostrils close together, superior, in front of eye, anterior nostril in a short tube.

Origin of the dorsal very slightly nearer tip of snout than base of caudal, above anterior third of the base of ventral; pectoral fin sub-horizontal, with eleven simple rays, outer margin broadly rounded, extending beyond the origin of ventral; ventral fins horizontal, flat, distinctly separated, with four simple rays, not reaching the anus; the anal very small, entirely behind the dorsal; caudal fin forked, the tip of each lobe pointed, lower lobe slightly longer than the upper.

Scales minute; belly and throat naked; lateral line nearly straight, slightly upcurved above the pectoral, extending along the middle of the sides.

Color in alcohol dark gray above, lower surface yellowish white; caudal fin with four dark brown cross-bars; other fins provided with a number of dark elongate spots.

Total length 64 mm.

Described from a specimen from Taiko River, collected by T. Aoki in December, 1916.

Habitat: Taiko River (five specimens).

MEASUREMENTS OF *Hemimyzon formosanus.*

Locality.	Head.	Depth.	D.	A.	P.	V.	Width of Head.	Interorbital.	Snout.	Eye.	Length, Mm.
Taiko River...........	4.25	6	2.7	1.5	22	15	1	2.5	1.71	7	64
Taiko River...........	4	7	2.7	1.5	21	15	1.125	2	1.6	6.5	43

Family CYPRINIDÆ.

ARTIFICIAL KEY TO THE FORMOSAN GENERA.

I. Anal fin very short, with five or six branched rays.

A. Lateral line running along the median line of the tail; dorsal fin opposite to ventrals.

a'. Dorsal fin with more than nine branched rays.

b'. Pharyngeal teeth in three series, the outer molar-like; barbels two on each side; a strong dorsal spine...........*Cyprinus.*

b''. Pharyngeal teeth in a single series, barbels none; a strong dorsal spine.......................................*Carassius.*

b'''. Pharyngeal teeth in three series, not molar-like; without osseous dorsal rays.

Snout more or less swollen; each lip with an inner transverse fold, which is covered with a deciduous horny substance forming a sharp edge; dorsal 13–20......................*Labeo.*

a''. Dorsal fin with no more than nine branched rays.

b'. Pharyngeal teeth in three series.

c'. Lower jaw transverse, with a narrow lip which is not continuous, with a sharp inner transverse edge; barbels four. *Acrossocheilus.*

c''. Mouth transverse, inferior; lower jaw not covered by lip, with a horny layer inside, rather sharp; barbels two, minute. *Scaphesthes.*

c'''. Mouth arched, without inner fold or other peculiarities; lips fleshy.

d'. A recumbent spine in front of the dorsal; barbels four. *Spinibarbus.*

d''. No recumbent spine; barbels four, or two, or none.

e'. Head with mucous cavities; scales large; lips thick; barbels two......................*Hemibarbus.*

e''. Head without mucous cavities; scales moderate; lips thin.

f'. Barbels four.....................*Barbodes.*

f''. Barbels two.....................*Capœta.*

f'''. Barbels none....................*Puntius.*

b''. Pharyngeal teeth in two series.

c'. Lips thin; mouth terminal, oblique; dorsal nearly over the ventral . . . . *Gnathopogon.*

c''. Lips broad and papillose; mouth small, protracted downwards; dorsal inserted well in advance of the ventral. *Pseudogobio.*

b'''. Pharyngeal teeth in a single series.

c'. Mouth very small, transverse, directed upwards; mandible with a hard, trenchant eege, no barbels . . *Pseudorasbora.*

B. Lateral line running along the lower half of the tail; dorsal fin inserted behind the origin of ventrals.

a'. Pharyngeal teeth in two series, 4, 4–4, 4; lateral line complete. *Pararasbora.*

II. Anal fin short or of moderate length, with from seven to eleven branched rays, not extending forwards to below the dorsal fin.

A. Dorsal fin with osseous ray.

a'. Dorsal fin rather short, with two smooth spines and seven branched rays; barbels none; pharyngeal teeth in a double series . *Distœchodon.*

B. Dorsal fin without osseous ray.

a'. Lateral line incomplete; dorsal inserted behind the origin of the ventral; pharyngeal teeth in double series, slender and hooked, 5, 3–4, 4 . . . . *Phoxiscus.*

a''. Lateral line complete; dorsal inserted in advance of the origin of the ventral; pharyngeal teeth in double series, their outer surfaces deeply folded, 5, 2–2, 5 . . . . *Ctenopharyngodon.*

III. Anal fin of moderate length, extending forwards to below the dorsal; lateral line, if complete, running into, or nearly into the middle of the tail; pharyngeal teeth in a single series; no dorsal spine.

A. Lateral line complete; anal fin with eight to ten rays . . . . . . *Acheilognathus.*

B. Lateral line incomplete; anal fin with about twelve rays . . . . *Rhodeus.*

IV. Anal fin of moderate length; lateral line running along the lower half of the tail; pharyngeal teeth in three series.

A. Barbels, none.

a'. Body moderately elongate and compressed; pharyngeal teeth 1 or 2, 4, 4 or 5–5, or 4, 4, 2 or 1; dorsal fin inserted a little behind or opposite to the origin of ventrals . . . . *Zacco.*

a''. Body deep and strongly compressed; pharyngeal teeth 2, 4, 4–4, 4, 2; dorsal fin inserted above the interspace between ventrals and anal. *Metzia.*

B. Barbels, two.

a'. Body elongate, laterally compressed; pharyngeal teeth 1, 4, 5–5, 4, 1; dorsal fin inserted opposite to ventrals . . . . *Candidia.*

V. Anal fin elongate; lateral line running along the middle of the tail; no dorsal spine; pharyngeal teeth in a single series, 4–4.

a'. Entire abdominal edge carinated; gill-rakers continuous, forming a crescentic horny membrane . . . . *Hypophthalmichthys.*

a''. Postventral edge carinated; gill-rakers separated, slender and long. *Aristichthys.*

VI. Anal fin elongate; abdomen, or a part of abdomen, compressed and carinated.

A. Lateral line with no conspicuous curve, slightly decurved; entire, or a part of abdomen carinated.

a'. Abdomen behind the ventral compressed to an edge; before ventrals rounded; anal elongate, of seventeen rays; first dorsal ray more or less enlarged and spine-like . . . . *Ischikauia*.

a''. Postventral edge carinated; rounded before ventrals; profile of the nape remarkably convex; lower jaw not protruding; anal fin elongate with more than twenty rays; dorsal fin armed with strong spines; scales rather large . . . . *Chanodichthys*.

a'''. Entire or postventral edge carinated; profile of the nape slightly convex; lower jaw protruding; anal fin elongate; with more than twenty rays; dorsal fin armed with strong spines; scales small. *Culter*.

B. Lateral line abruptly bent downwards above the pectoral.

a'. Abdominal edge entirely carinated; anal fin rather short, with fifteen to seventeen rays; dorsal fin with two smooth spines; scales large. *Cultriculus*.

Genus CARASSIUS Nilsson.

1832. *Carassius* NILSSON, Prodromus Ichthyol. Scand. (Type *Cyprinus carassius* Linnæus.)

Body oblong, compressed and elevated. Mouth terminal, without barbels. Teeth 4–4, molar, but compressed. Scales large. Lateral line continuous. Dorsal fins very long, with third ray developed into a stout spine, which is serrated behind; anal short with a similar spine. Ventrals well forward. Large species of the fresh waters of Europe and Asia; often domesticated. (Jordan & Fowler.)

Distribution: Central and Northern Europe; Siberia; China; Cochin-China; Formosa; Corea; Amur Province; Japan.

16. **Carassius auratus** (Linnæus).

Funa (Japan); Chiira or Chirahii (Formosa).

1758. *Cyprinus auratus* LINNÆUS, Syst. Nat. Ed. X, p. 323.—GÜNTHER, Ann. Ac. St. Petersb., 1896, p. 12; Huihsien; Chang-tu-fu.—RICHARDSON, Ichthyol. China, p. 293; Tse-Kiang.

1863. *Carassius auratus* BLEEKER, Atl. Ichthyol. Cypr., p. 74.—GÜNTHER, Cat. Fish., VII, 1868, p. 32; China; Japan.—BLEEKER, Cypr. China, 1871, p. 7; Pekin.—GÜNTHER, Ann. Mag. Nat. Hist., Sept., 1873, p. 246; Shanghai.—SAUVAGE, Bull. Soc. Zoöl. France, IX, 1884, p. 1; Tonkin.—RUTTER, Proc. Acad. Nat. Sc. Philad., 1897, p. 58; Swatow.—FOWLER, Proc. Acad. Sc. Philad., 1899, p. 179; China.—ABBOTT, Proc. U. S. Nat. Mus., XXIII, 1901, p. 484· Pei-ho, China.—JORDAN & FOWLER, Proc. U. S. Nat. Mus., XXVI, 1903, p. 860; Japan.—JORDAN & EVERMANN, Proc. U. S. Nat. Mus., 1903, p. 321; Formosa.—VAILLANT, Bull. Mus. Hist. Nat., VI, 1904, p. 298;

Ton-kin.—JORDAN & SEALE, Proc. U. S. Nat. Mus., XXIV, 1905, p. 519; Hongkong.—SNYDER, Proc. U. S. Nat. Mus., XLII, 1912, p. 404; Niigata; Same; Takamatsu River; Yamaguchi; Dogo Island.—JORDAN & METZ, Mem. Carneg. Mus., VI, No. 2, 1913, p. 14; Corea.—JORDAN, SNYDER & TANAKA, Journ. Coll. Sci. Tokyo, XXXIII, 1913, p. 76; Japan.

1842. *Cyprinus gibeloides* CANTOR, Ann. Mag. Nat. Hist., IX, p. 485.—Richardson, Ichthyol. China, 1846, p. 292.

1846. *Carassius langsdorfii* SCHLEGEL, Fauna Japonica, Poiss., p. 192, pl. 98, Fig. 1; Japan.—KNER, Novara, Fisch, III, 1867, p. 346; Shanghai.—PETERS, Monatsb. Ak. Berlin, 1880, p. 924.—SAUVAGE, Bull. Soc. Philom., 1881, p. 7; Swatow.—Bull. Soc. Zoöl. France, 1884, p. 1; Tonkin.

1855. *Carassius pekinensis* BASILEWSKY, Nouv. Mem. Soc. Nat. Mosc., X, p. 229, Tab. 3, Fig. 3; China.

1855. *Carassius discolor* BASILEWSKY, *l. c., p.* 229; China.

1855. *Carassius coeruleus* BASILEWSKY, *l. c.*, p. 229; China.

1855. *Cyprinus macrophthalmus* BASILEWSKY, *l. c.*, p. 230, Tab. V, Fig. 5.

1846. *Cyprinus carassioides* RICHARDSON, Ichthyol. China, p. 291.

1846. *Cyprinus burgeri* RICHARDSON, *l. c.*, p. 292.

1846. *Cyprinus abbreviatus* RICHARDSON, *l. c.*, p. 292; Canton.

Head 3 in length; depth 2.25; D. II, 16; A. III, 5; P. 15; V. 9; scales 6–28–8; snout 3 in head; eye 5; interorbital space 2.4; pectoral 1.66; ventral 1.66; teeth 4–4.

Body stout, rather high, compressed, dorsal and ventral profiles about equally arched; head small, its top slightly depressed; snout blunt; mouth small, terminal and oblique; upper jaw protractile, more or less projecting; eyes large, superior and anterior; nostrils very large, in front of eyes, the anterior in a short tube.

Origin of the dorsal nearer the tip of snout than base of caudal, one scale in advance of the origin of ventral, with strong spines, soft rays shortening posteriorly, the first dorsal ray longest, 1.83 in length of

MEASUREMENTS OF *Carassius auratus*.

Locality.	Head.	Depth.	D.	A.	P.	V.	Interorbital.	Snout.	Eye.	Scales.	Length, Mm.
Ritakukan	3	2.25	II, 16	III, 5	15	9	2.40	3	5	6–28–8	210
Giran	3.5	2.40	III, 16	III, 5	16	9	2.33	3	4.33	6–29–6	150
Giran	3.25	2.42	III, 17	III, 5	16	9	2.50	3	4.60	6–28–8	152
Giran	3.45	2.32	III, 16	III, 5	16	9	2.33	3.25	4.33	5–27–7	130
Shori	3	2.23	III, 17	III, 5	16	8	2.33	3	4.75	5–28–8	107

head; the anal squarish, armed with very strong spines, its rays longer in front, inserted nearer the base of caudal than that of the pectoral, its origin just below the fourteenth soft dorsal ray; pectoral fin round, its tip scarcely reaching ventral; ventral fin not reaching the anus; caudal peduncle deep and long, its depth twice in head.

Body covered with large cycloid scales; lateral line nearly straight, extending along the middle of sides from upper part of gill-opening to the base of caudal.

Color in formalin uniformly dark gray, somewhat paler below; lower parts whitish; all the rays uniformly gray.

Total length 210 mm.

Described from a specimen from Ritakukansho, Giran.

Habitat: Abundant in the fresh waters of Formosa, very common.

Genus CYPRINUS (Artedi) Linnæus.

1858. *Cyprinus* (ARTEDI) LINNÆUS, Syst. Nat. Ed. X, p. 320, (Type *Cyprinus carpio* Linnæus.)

Body robust, compressed. Mouth moderate, anterior, with four long barbels. Snout blunt, rounded. Teeth molar, broad and truncate, 1, 1, 3–3, 1, 1. Scales large. Lateral line continuous. Dorsal fin very long, with a stout spine, serrated behind; anal fin short, also with a spine. Large fishes of the fresh waters of Asia. (Jordan & Fowler.)

Distribution: Temperate parts of Europe and Asia; introduced into North America.

17. **Cyprinus carpio** Linnæus.

Koi (Japan); Taihii (Formosa).

1758. *Cyprinus carpio* LINNÆUS, System. Nat., Ed. X, p. 320.—GÜNTHER, Cat. Fish., VII, 1868, p. 25; Europe and Asia.—PETERS, Monatsb. Ak. Berl. 1880, p. 924 and 1029; Hongkong.—SAUVAGE, Bull. Soc. Philom., 1881, p. 7; Swatow.—Bull. Soc. Zoöl. France, IX, 1884, p. 1; Tonkin.—GÜNTHER, Ann. Mag. Nat. Hist. (7), 1889, p. 224; Yang-tsze-kiang.—Ann. Ac. St. Petersb., 1896, p. 12; Cheng-tu-fu.—RUTTER, Proc. Acad. Nat. Sc. Philad., 1897, p. 57; Swatow.—GÜNTHER, Ann. Mag. Nat. Hist. (7), I, 1898, p. 261; Newchang.—ABBOTT, Proc. U. S. Nat. Mus. XXIII, 1901, p. 484; Pei-ho.—JORDAN & EVERMANN, Proc. U. S. Nat. Mus., XXVI, 1903, p. 321; Formosa.—REGAN, Ann. Mag. Nat. Hist. (7), XIII, 1904, p. 191; Yunnan.—JORDAN & RICHARDSON, Mem. Carneg. Mus., IV, No. 4, p. 169; Formosa.—JORDAN & SEALE, Proc. Davenport Acad. Sc., X, 1905, p. 3; Hongkong.—Proc. U. S. Nat. Mus., XXXIII, 1906, p. 537; Buitenzorg; Java.—JORDAN & METZ, Mem. Carneg. Mus., VI, No. 2, 1913, p. 14; Corea.—JORDAN, SNYDER, and TANAKA, Journ. Coll. Sci., Tokyo, XXXIII, 1913, p. 76; Japan.

1798. *Cyprinus rubro-fuscus* LACÉPÈDE, Hist. Nat. Poiss., V, p. 530, Pl. 16, Fig. 1.—CUV. & VAL., Hist. Nat. Poiss., 1846, XVI, p. 74.—RICHARDSON, Ichthy. China, 1846, p. 288.

1798. *Cyprinus nigroauratus* LACÉPÈDE, Hist. Nat. Poiss., V, p. 547, Pl. 16, Fig. 2. —CUV. & VAL., Hist. Nat. Poiss., 1846, XVI, p. 73.—RICHARDSON, Ichthy. China, 1846, p. 290.

1798. *Cyprinus viridi-violaceus* LACÉPÈDE, Hist. Nat. Poiss., V, p. 547, Pl. 16, Fig. 3.—CUV. & VAL., Hist. Nat. Poiss., XVI, 1846, p. 75.—RICHARDSON, Ichthy. China, 1846, p. 288.

1846. *Cyprinus flavipinnis* CUV. & VAL., Hist. Nat. Poiss., XVI, p. 71.

1846. *Cyprinus vittatus* CUV. & VAL., Hist. Nat. Poiss., XVI, p. 72.

1846. *Cyprinus atrovirens* RICHARDSON, Ichthy. China, p. 287.

1846. *Cyprinus flammans* RICHARDSON, Ichthy. China, p. 288.

1846. *Cyprinus acuminatus* RICHARDSON, Ichthy. China, p. 289.

1846. *Cyprinus sculponeatus* RICHARDSON, Ichthy. China, p. 290.

1846. *Cyprinus hæmatopterus* SCHLEGEL, Fauna Japonica, Poiss., p. 189, Pl. 96.

1846. *Cyprinus melanotus* SCHLEGEL, Fauna Japonica, Poiss., p. 190, Pl. 97, Fig. 1.

1846. *Cyprinus conirostris* SCHLEGEL, Fauna Japonica, Poiss., p. 191, Pl. 97, Fig. 2.

1855. *Cyprinus chinensis* BASILEWSKY, Nouv. Mem. Soc. Nat. Mosc., X, p. 227, Tab. 2, Fig. 3.

1855. *Cyprinus obesus* BASILEWSKY, Nouv. Mem. Soc. Nat. Mosc., X, p. 228, Tab. 1, Fig. 2.

1863. *Carpio flavipinna* BLEEKER, Atl. Ichthyol. Cyprin., p. 74, Tab. 7, Fig. 3.

1871. *Carpio vulgaris* BLEEKER, Mem. Cyprin. China, p. 6.

Head 3 in length; depth 2.86; D. III, 19; A. III, 5; P. 16; V. 9. Scales 5–35–5; width of head 1.66 in its length; snout 2.5 in head; interorbital space 2.4; eye 7; pectoral 1.33; ventral 1.4; teeth 1, 1, 3–3, 1, 1.

Body stout, more or less compressed; head moderate, triangular; snout obtusely rounded; mouth oblique, with fleshy thick lips, maxillary reaching a vertical through anterior margin of anterior nostril; maxillary protractile; upper jaw more or less projecting; four barbels, two maxillary and two rostral, the former nearly twice as long as the latter, scarcely reaching the anterior border of orbit; eyes moderate, superior and slightly anterior; nostrils large, close together, in front of eye, the anterior in a short tube.

Origin of dorsal midway between tip of snout and base of caudal, two scales before the origin of ventral, triangular and elongate, higher anteriorly, its longest ray about twice in the length of head; pectoral fin large, round, its tip exceeding the origin of ventral; ventrals inserted below the first soft dorsal ray, not reaching the anus; origin of anal nearer base of caudal than base of ventral, inserted below the fourteenth ray of dorsal; caudal fin deeply emarginate, tip of lobes sharply pointed; caudal peduncle long and deep, its depth 2.11 in head.

Body covered with large scales with fine concentric rings and radiated striations; lateral line straight, extending along the middle of sides from upper part of gill-opening to the base of caudal.

Color in formalin uniformly dark grey above, paler below; sides of body below the lateral line yellowish white; lower parts of body together with the pectoral, ventral, and anal white; dorsal and caudal fins dusky; most of scales provided with a black spot on the base.

Total length 280 mm.

Described from a specimen from Taihoku, collected by Oshima in October, 1916.

Habitat: The present species is common throughout the island; and is the most important food-fish among the Chinese people.

MEASUREMENTS OF *Cyprinus carpio.*

Locality.	Head.	Depth.	D.	A.	P.	V.	Width of Head.	Interorbital.	Snout.	Eye.	Scales.	Length, Mm.
Taihoku	3	2.86	III, 19	III, 5	16	9	1.66	2.40	2.50	7	5–35–5	280
Tensonpi, Giran	3.61	2.86	III, 17	III, 5	17	9	1.50	2.66	2.76	5	5–34–5	193
Inzanpo	3.33	2.94	III, 17	III, 5	16	9	1.57	2.66	2.47	5	6–33–5	132
Maruyama	3.35	3	III, 18	III, 5	16	9	1.45	2.45	2.53	6	5–35–5	193

Genus LABEO Cuvier.

1817. *Labeo* CUVIER, Regne Animal, p. 192. (Type *Cyprinus niloticus* (Forskål) Geoffroy).

1842. *Rohita* CUV. & VAL., Hist. Nat. Poiss., XVI, p. 242. (Type *Cyprinus nandina* Hamilton.)

Body oblong, more or less compressed. Snout broadly rounded or obtusely pointed, prominent, mostly covered with tubercles or pores and sometimes having a lateral lobe or projection, its anterior pendulous border forming an entire, or superficially incised, rostral fold. Mouth moderate or large, protractile, inferior. Lips thick, continuous, the upper and the lower one fringed, lobed, or not lobed. The lower lip is distinctly separated by a deep groove from isthmus, or this postlabial groove is divided by a broad or narrow connection between isthmus and lip, and therefore restricted to behind the lateral part of the lower lip or even to the corner of the mouth. Lower lip with an inner transverse fold. Jaws with a fleshy covering carrying a deciduous horny sheath. A pair of rostral and maxillary barbels, one of them may be absent. Eye with a free circular rim. Dorsal elongate, without osseous rays, commencing before ventrals and ending before or above anal, with more than eight branched rays. Anal short, with five branched rays. Scales moderate or small. Lateral line running into the middle of the tail, sensory tubes undivided. Gill-membranes broadly united with isthmus. Gill-rakers usually short. Pharyngeal teeth in three series, hooked, 5, 4, 2–2, 4, 5 (Weber & Beaufort).

Distribution: Sumatra; Java; Borneo; Africa; India; Ceylon; Burma; Cochin-China; China; Formosa.

18. **Labeo jordani** sp. nov. (Plate XLIX, Fig. 3).

Kenhii (Formosa).

1903. *Rohita decora* JORDAN & EVERMANN, Proc. U. S. Nat. Mus., XXV, p. 321; Formosa (not of Peters).

Head 5 in length; depth 3; D. 3, 12; A. 3, 5; P. 15; V. 9; forty scales in the lateral line, eight scales in an oblique series between origin of dorsal and lateral line, nine scales between the latter and the middle of belly; width of head 1.83 in its length; snout 2.33 in head; interorbital space 2; eye 5; pectoral 1.076; ventral slightly longer than head; teeth 5, 4, 2–2, 4, 5.

Body compressed, rather high, abdomen rounded; head short, lateral parts of the occiput slightly depressed; snout obtusely rounded anteriorly, overhanging the upper lip, with no tubercle nor lateral prolongation; mouth inferior, transverse, crescent-shaped, with thick lips; upper lip entirely fringed, with a distinct inner fold below; lower lip not fringed, with an inner fold, its edge sharp and covered with a horny substance; barbels two, rostral, nearly one-third as long as snout; maxillary barbels none; eye rather small, slightly anterior and superior; nostrils close together, in front of the eye; pharyngeal teeth high, their grinding surface flat, brown-colored; gill-rakers numerous, minute, setiform, and closely set.

Origin of dorsal nearer tip of snout than base of caudal, its upper margin concave, its base covered with a series of pointed scales, anterior ray longest; anal fin entirely behind the dorsal, nearer the base of caudal than origin of ventral; ventral long, with well-developed scaly flap, inserted below fourth divided dorsal ray; pectoral fin shorter than ventral, reaching three-fifths of the distance to ventral; caudal fin bilobed, tip of each lobe sharply pointed; caudal peduncle rather short, its depth 1.4 in head.

Body covered with large scales with fine concentric rings and radiated striations; lateral line nearly straight, extending along the middle of sides from base of the caudal to the upper part of gill-opening.

Color in alcohol uniformly dark grey above, sides and lower parts silvery; dorsal and caudal fins grayish; other fins dusky white; scales on the upper part of body with a black lunar-shaped spot near the base.

Total length 340 mm.

Described from a specimen from the hatchery at Shori.

Habitat: A species introduced from China, propagated throughout the island, and bred artificially in ponds.

Remarks: The nearest relative of the present species is *Labeo decorus* Peters from Hongkong. It differs, however, in having an upper lip which is fringed at the sides only, and a distinctly fringed lower lip.

Jordan and Evermann recorded a Formosan species of the genus *Labeo* under the name *Rohita decora* (= *Labeo decorus* Peters). The descriptions given by these authors are very inadequate. But the briefly described characters, except the number of rays of the pectoral, agree quite well with those of the present species. Moreover, as there is no record with reference to the occurrence of any species of *Labeo* in Formosa except the introduced species, it seems reasonable to unite Jordan & Evermann's *Rohita decora*, which distinctly differs from Peters' *Labeo decorus*,[3] with the present species.

In the year 1910, Mr. Seno, Expert of the Fisheries Bureau of the Japanese Government, described the present species, giving it the name *Labeo kontius* (Jordan). (Cf. Report on the Fisheries of the Island of Formosa). The Indian species of that name distinctly differs from the Formosan species in having a higher body, longer head, tuberculated snout with a fleshy lateral prolongation, fringed lower lip, and no barbels.

Such being the case, I propose for the present species a new name *Labeo jordani*.

"Kenhii" is one of the important fresh-water food-fishes in Formosa, though it is not a native of the island. Early in the summer, newly hatched larvæ of this fish are collected in the rivers near Swatow, South China, and are imported to Formosa. At first they are bred in small ponds, living mainly upon zoö-plankton, the growth of which is encouraged by human excrement. As soon as they are large enough to

[3] *Labeo decorus* Peters, Monatsb. Ak. Berlin, 1880, p. 1031; Hongkong.

be safe under natural conditions (30–60 mm. long), they are sold to the Chinese farmers. Usually, at the end of one year they grow to the length of 150–160 mm. According to the Chinese breeders' information this fish never spawns in Formosa.

MEASUREMENTS OF *Labeo jordani*.

Locality.	Head.	Depth.	D.	A.	P.	V.	Width of Head.	Interorbital.	Snout.	Eye.	Scales.	Length, Mm.
Shori.......	5	3	3, 12	3, 5	15	9	1.83	2	2.33	5	8–40–9	340
Shori.......	5	3.11	3, 12	3, 5	14	9	1.83	2	2.50	5	8–40–9	209

ACROSSOCHEILUS gen. nov.

Type *Gymnostomus formosanus* Regan.

Body elongate, compressed; head smooth, with many mucous cavities around the eye; snout obtuse, its tip not projecting beyond the upper lip, without lateral lobe. Mouth inferior, transverse; upper lip fleshy, not fringed; lower lip thick, not continuous, distinct at the side of the mouth only; upper jaw projecting beyond the longer; anterior edge of the lower jaw sharp and naked. Four barbels, two maxillary and two rostral. Dorsal fin without osseous ray, with not more than nine rays, opposite the ventral; anal fin rather short, with five divided rays. Scales moderate, about forty in the lateral line; lateral line running along the middle of the tail. Pharyngeal teeth 5, 3, 2–2, 3, 5.

Distribution: Formosa; China.

Remarks: The present genus is very closely related to *Crossocheilus* Van Hasselt. Four barbels and smooth upper lip are the characteristics of *Acrossocheilus*, which distinguish it from the latter.

19. **Acrossocheilus formosanus** (Regan).

Chopien or Choppan (Formosa).

1908. *Gymnostomus formosanus* REGAN, Ann. Mag. Nat. Hist. (8), I, p. 149; Lake Candidius, Formosa.

1908. *Gymnostomus labiatus* REGAN, Ann. Mag. Nat. Hist. (8), II, p. 358; Lake Candidius, Formosa.

Head 4 in length; depth 4; D. 3, 8; A. 3, 5; P. 14; V. 9; width of head 1.8 in its length; interorbital space 3 in head; snout 2.5; eye 5; pectoral 1.16; ventral 1.25; forty scales in a longitudinal series, five and one-half in a transverse series from origin of dorsal to lateral line, five between the latter and middle of belly, three and one-half scales between lateral line and origin of ventral; pharyngeal teeth 5, 3, 2–2, 3, 5; gill-rakers 5 + 9.

Body elongate, depth equal to the length of head, dorsal profile more convex than the ventral; head smooth, with many mucous cavities around the eye; snout not projecting beyond the upper lip, with strongly curved profile; sides of snout pitted, in the centre of each pit a small round tubercle; upper jaw projecting beyond the lower; mouth inferior, transverse, its angle not reaching the anterior border of orbit; upper lip fleshy, rather thin; lower lip thick, divided into two lobes by a median longitudinal notch, anterior border naked, with a sharp inner transverse horny edge; four barbels, the rostral two-thirds as long as the maxillary barbels, the latter reaching the posterior border of orbit; eye superior and slightly anterior; nostrils close together, in front of eye, anterior nostril in a short tube.

Origin of dorsal slightly in advance of a point midway between tip of snout and base of caudal, opposite the ventral; pectoral fin not reaching the ventral; ventral inserted one scale behind the origin of dorsal; anal entirely behind the dorsal, its rays rather long, when depressed, tip of the anterior ray extending beyond the others; caudal fin strongly forked, tip of each lobe sharply pointed.

Body covered with uniform scales; lateral line continuous, nearly straight, extending along the middle of the tail.

Color in formalin olive-brown above the lateral line, yellowish gray beneath; sides with seven black vertical bars; lower parts of body pale reddish yellow; membrane of the dorsal with black streaks; caudal and pectoral fins gray; other fins dusky white.

Total length 115 mm.

The present description is from a specimen from Shinchiku, collected by T. Aoki in December, 1916.

Habitat: Tamusui River at Shinten and Heirinbi; Shinchiku; Tozen River; Horisha; Jitsugetsutan (Lake Candidius).

Remarks: The type of the genus *Gymnostomus* Heckel is *Cyprinus ariza* Buchanan-Hamilton. Although it is provided with moderately large scales (thirty-seven in the lateral line), it differs distinctly from the species which belong to *Acrossocheilus* in having two small barbels instead of four.

In February, 1908, Mr. C. Tate Regan described the present species naming it *Gymnostomus formosanus* (from Lake Candidius). But as it is provided with four rather long barbels, it is incorrect to include it in the genus *Gymnostomus*.

In October of the same year Regan described *Gymnostomus labiatus* from the same locality. According to his description it differs from the former in having lower lips which are separated anteriorly by a deep narrow notch instead of being separated widely. In my specimens which came from the type locality and other places, the width of the inter-space between the lower lips is not definite; even in the specimens which came from the same locality there are deviations with regard to that character. Therefore it seems inadvisable to separate the two forms.

MEASUREMENTS OF *Acrossocheilus formosanus*.

Locality.	Head.	Depth.	D.	A.	P.	V.	Width of Head.	Interorbital.	Snout.	Eye.	Scales.	Length, Mm.
Heirinbi	4.25	3.64	3, 8	3, 5	15	9	1.73	2.77	2.40	4.33	6 –42–5	120
Heirinbi	4.18	3.47	3, 8	3, 5	16	9	1.75	2.80	2.25	4.50	6 –42–5	140
Tamusui River	4	3.50	3, 8	3, 5	16	9	2	3	2.28	4.50	6 –41–5	165
Tamusui River	4.12	3.44	3, 8	3, 5	16	9	2	2.66	2.50	5	$5\frac{1}{2}$–42–5	202
Jitsugetsutan	4.40	3.20	3, 8	3, 5	14	9	1.50	2.60	2.50	5	6 –41–6	165
Horisha	4	3.74	3, 8	2, 5	16	9	1.91	3	2.75	4.66	6 –41–5	105
Shinchiku	4	4	3, 8	3, 5	14	9	1.80	3	2.50	5	$5\frac{1}{2}$–40–5	115
Shinchiku	4.5	3.86	3, 8	3, 5	15	9	1.71	2.75	2.60	4.50	5 –42–6	125
Tozen River	4.16	3.66	3, 8	3, 5	15	9	1.71	3	2.77	4	$5\frac{1}{2}$–41–5	120
Tozen River	4.14	3.73	3, 8	3, 5	15	9	1.86	2.66	2.45	4.83	6 –42–6	135

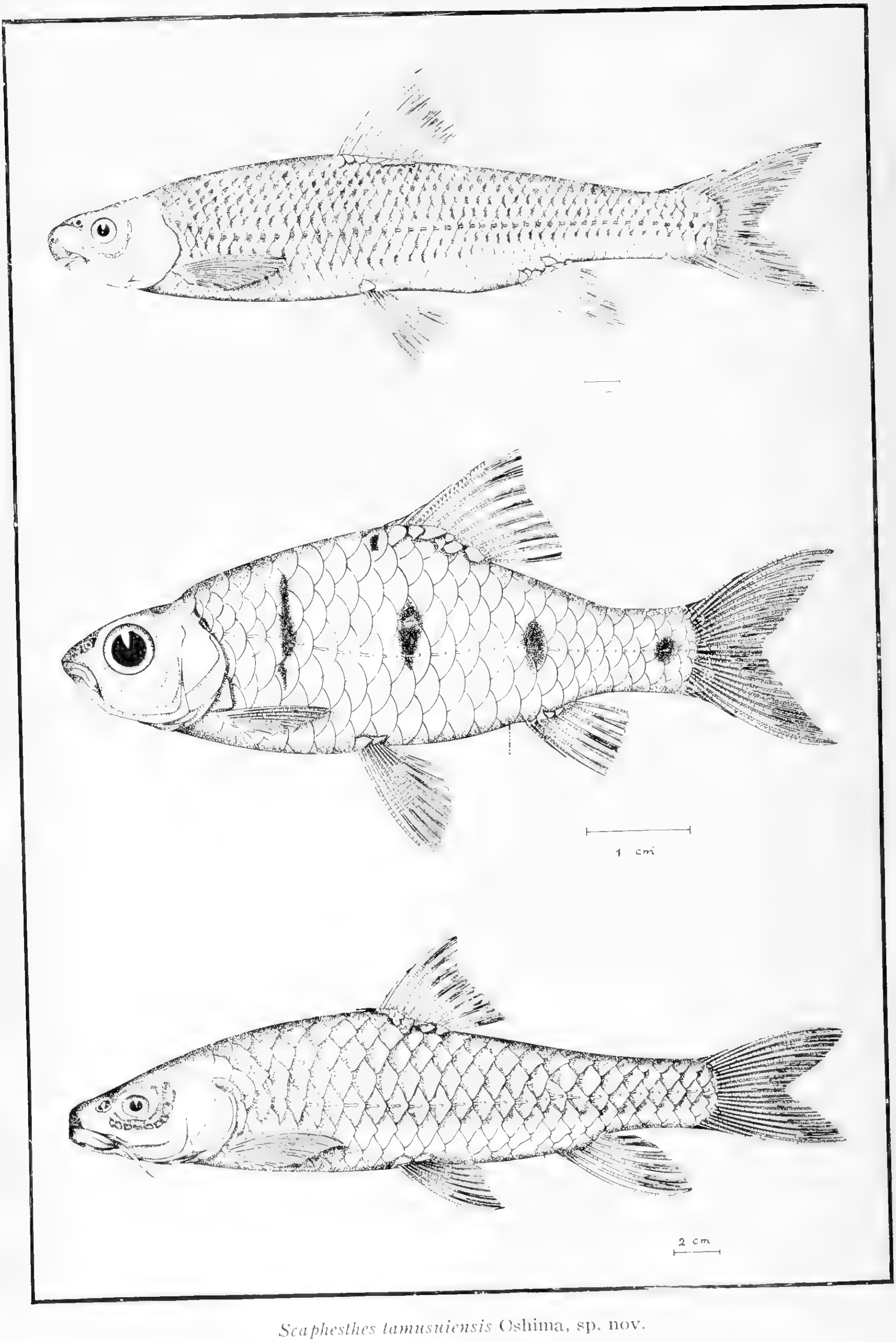
SCAPHESTHES gen. nov.

Body elongate, slightly compressed. Snout rounded, tip of the skin extends downwards and partially overlaps the upper lip. Mouth transverse, inferior, lower jaw with no lip, its anterior margin sharp and covered with a horny brown layer. Barbels two, ninute, at the corner of the mouth. Dorsal fin without osseous rays, with not more than nine branched rays, opposite to the ventrals. Anal fin rather short. Scales large, less than fifty in a longitudinal series. Pharyngeal teeth in three rows, 5, 3, 2–2, 3, 5. Lateral line running along the middle of the tail.

Distribution: Formosa; Hainan.

Remarks: The type of the present genus is closely related to the species of *Scaphiodon*. It differs, however, in having larger scales and no osseous dorsal ray.

In the year 1899, Boulenger described a species of Cyprinoid fish



Scaphesthes tamusuiensis Oshima, sp. nov.
Puntius snyderi Oshima, sp. nov.
Spinibarbus hollandi Oshima, sp. nov.

from the interior of Hainan giving it the name *Gymnostomus lepturus*.[4] Although there is no statement with regard to the barbels it seems to belong to the present genus, because of the peculiar shape of the mouth, large scales, and the absence of an osseous dorsal spine. The barbels of *Scaphesthes* are very small, and hidden beneath the labial fold. Therefore, they might have been overlooked by that author.

20. **Scaphesthes tamusuiensis** sp. nov. (Plate L, Fig. 1).

Kooye (Formosa).

Head 5 in length; depth 4.5; D. 3, 8; A. 3, 5; P. 17; V. 9; width of head 1.87 in its length; eye 4.33 in head; interorbital space 2.5; snout 2.6; pectoral 1.2; ventral 1.33; scales forty-six in the lateral line, seven in an oblique series between origin of dorsal and lateral line, six from the latter to the middle of belly; pharyngeal teeth 5, 3, 2–2, 3, 5; gill-rakers 5 + 27.

Body elongate, slightly compressed, abdomen rounded; head rather small, its top more or less convex; snout obtusely rounded; tip of the skin extends downwards and partially overlaps the upper lip; mouth transverse, inferior, crescent-shaped; upper lip smooth, without labial fold; lower jaw with no lip, mandibular edge nearly straight, sharp, covered with a horny brown layer; barbels four, two rostral and two maxillary, very minute, the latter hidden in the deep lateral fissure behind the angle of mouth; eyes moderate, superior and anterior; nostrils close together in front of eyes, the anterior nostril covered with a flap; pharyngeal teeth in three rows, those of the outer row canine-like, slender, slightly curved, those of the inner rows are smaller; gill-rakers very minute; gill-openings large.

Dorsal fin inserted nearer tip of snout than base of caudal, armed with smooth soft spines, anterior ray the longest; anal fin entirely behind the dorsal, slightly in advance of a point midway between origin of ventral and base of caudal; the ventral inserted behind the origin of dorsal; the pectoral reaches three-fifths the distance to ventrals; caudal fin deeply forked, the lobes pointed; caudal peduncle elongate, its depth 2.2 in head.

Body covered with uniform cycloid scales; the ventral with scaly flaps, no scaly pectoral flap; lateral line continuous, extending along the middle of the sides, slightly decurved anteriorly.

[4] *Gymnostomus lepturus* Boulenger, Proc. Zoöl. Soc. London, 1899, p. 961, Pl. LXIX, Fig. 1; Hainan.

Color in formalin grayish brown above, paler below the lateral line, lower surface silvery; dorsal and caudal gray, outer margin of the former with a series of black streaks; pectorals fuscous; other fins whitish.

Total length 230 mm.

Described from a specimen from Tamusui River near Shinten, collected by T. Aoki in December, 1916.

Habitat: Tamusui River (Shinten, Heirinbi); Choso River; Giran River (Inzanpo, Kiburan).

Remarks: Scaphesthes lepturus from Hainan is closely related to the present species. It differs, however, in having a larger eye, the dorsal inserted midway between the end of snout and base of caudal, the ventral below middle of dorsal, six divided anal rays, and forty-nine scales in the lateral line. There is no statement with reference to the barbel in Boulenger's original description.

MEASUREMENTS OF *Scaphesthes tamusuiensis.*

Locality.	Head.	Depth.	D.	A.	P.	V.	Width of Head.	Interorbital.	Snout.	Eye.	Scales.	Length, Mm.
Tamusui River.....	5	4.50	3, 8	3, 5	17	9	1.83	2.50	2.40	4.8	6½–46–6	230
Tamusui River.....	4.75	4.16	3, 8	3, 5	16	10	1.60	2.50	2.60	4.5	7 –47–6	183
Tamusui River.....	4.75	4.25	3, 8	3, 5	16	10	1.75	2.33	2.83	4.66	6½–47–6	200
Choso River........	4.71	3.84	3, 8	3, 5	17	10	2.21	3	3.26	4	7 –47–6	255
Giran River........	4.42	4.20	3, 8	3, 5	17	10	1.58	2.50	2.85	4	7 –47–6	102
Heirinbi............	4.20	4.20	3, 8	3, 5	16	10	1.78	2.66	2.66	3.66	6 –47–6	80
Taishu..............	4.33	4.64	3, 8	3, 5	15	10	1.66	2.50	3	3.66	6 –47–6	78
Taishu..............	4.41	4.42	3, 8	3, 5	16	10	1.78	2.40	3	3.66	6 –47–6	90

Genus HEMIBARBUS Bleeker.

1861. *Hemibarbus* BLEEKER, Prodr. Cyprin., p. 281. (Type *Gobio barbus* Temminck & Schlegel.)

1869. *Gobiobarbus* DYBOWSKI, Verh. Zoöl.-Bot. Gesell. Wien, XIX, p. 951. (Type *Cyprinus labeo* Pallas.)

Body elongate, rather slender, and compressed. Head elongate, somewhat pointed, and with many mucous cavities about the eyes and along the edge of the pre-operculum; snout long, blunt at the tip; eye rather large, high; mouth inferior, the maxillary not reaching eye; lip fleshy; each maxillary with a barbel as long as eye; teeth 5, 3, 1–1, 3, 5. Gill-rakers short; intestine short. Peritoneum silvery; scales cycloid, about forty-nine. Dorsal inserted nearer tip of snout than base of caudal, and armed with a slender, sharp, strong, and smooth spine; anal inserted far behind tip of compressed dorsal; caudal deeply emarginate, the lobes pointed; ventrals inserted behind origin of the dorsal. Lateral line slightly decurved and continuous. (Jordan & Fowler.)

Distribution: Formosa; China; Corea; Amur Province; Japan.

21. **Hemibarbus labeo** (Pallas).

Migoi (Japan); Tekotau (Formosa).

1776. *Cyprinus labeo* PALLAS, Reise III, p. 207, 703; Onon.—N. Acta Acad. Petrpol., I, 1787, p. 355, T. XI, figs. 8, 9; Onon; Ingoda; Schilka.—Zoögr. Ross. Asiat., III, 1811, p. 305; Dauria; Ingoda; Onon; Schilka.

1842. *Gobio barbus* SCHLEGEL, Fauna Japonica, Poiss., p. 198, Pl. XCIX, Fig. 1; Nagasaki.

1860. *Hemibarbus barbus* BLEEKER, Prods. Cyprin., p. 281.—JORDAN & EVERMANN, Proc. U. S. Nat. Mus., XXV, 1902, p. 322; Formosa.—JORDAN & FOWLER, Proc. U. S. Nat. Mus., XXVI, 1903, p. 824; Japan (Yodo River; Lake Janzabrobata; Aomori; Chikugo River; Tokyo).

1868. *Barbus schlegeli* GÜNTHER, Cat. Fish., VII, p. 135; Formosa; Japan.

1869. *Gobiobarbus labeo* DYBOWSKI, Verh. Zoöl.-Bot. Gesell. Wien, XIX, p. 951, T. XV, Fig. 3; Onon; Ingoda.

1892. *Barbus schlegeli* STEINDACHNER, Denkschr. Akad. Wien, LIX, p. 370; Seoul, Korea.

1896. *Acanthogobio güntheri* GÜNTHER, Ann. Mus. Zoöl. St. Petersb., I, p. 215; Hui-hsien; Huang-ho; Sinin River, China.

1904. *Acanthogobio oxyrhynchus* NILOLSKY, Ann. Mus. Zoöl. St. Petersb., VIII, p. 358; Ussuri.

1907. *Barbus labeo* BERG, Ann. Mus. Zoöl. St. Peterb., XII, p. 3; Corea.

1909. *Hemibarbus labeo* BERG, Ichthyol. Amus., p. 75.—JORDAN & METZ, Mem. Carneg. Mus., VI, no. 2, 1914, p. 15; Corea.

Head 3.44 in length; depth 4.83; D. III, 6; A. III, 6; P. 20; V. 9; width of head 2 in its length; interorbital space 3.75 in head; eye 5; snout 2.15; pectoral 1.38; ventral 1.91; forty-nine scales in the lateral line, seven scales in an oblique series between origin of dorsal and lateral line, six scales from the latter to the middle of belly, four scales between lateral line and the root of ventral; pharyngeal teeth 5, 3, 1–1, 3, 5; gill-rakers 7 + 10.

Body elongate and compressed; head elongate, pointed, its top compressed, with many mucous cavities around the eye and below and behind the pre-operculum; snout long, pointed and produced; eyes large, superior and slightly posterior; mouth inferior, with fleshy lips, its angle not reaching the orbit; upper jaw protractile, longer than the lower; barbels two, maxillary, slender, as long as the diameter of eye; nostrils together, in front of the eye, much nearer the eye than the tip of snout, anterior nostril in a short tube; interorbital space broad and flattened; gill-openings large; gill-rakers short and fleshy.

Dorsal fin inserted nearer tip of snout than base of caudal, rays straight and strong, longer in front, when depressed first ray reaches beyond the others, spine straight, smooth, and long; pectorals reach three-fourths the distance to ventrals; origin of ventral behind that of dorsal, about midway between tip of snout and base of caudal; the anal entirely behind the dorsal, inserted midway between origin of ventral and base of caudal; caudal fin deeply emarginate, the tip of each lobe pointed; caudal peduncle elongate, its depth 3 in head.

Scales large, of more or less uniform size, cycloid; pectoral with scaly flap, ventral flap moderate, pointed; lateral line continuous, anterior part slightly decurved.

Color in formalin grayish brown above, paler below; sides and lower parts silvery, with no dark spots; dorsal and caudal fins pale gray, the rest of fins whitish.

Total length 290 mm.

Described from a specimen from Tamusui River, collected by T. Aoki in December, 1915.

Habitat: Tamusui River near Shinten and Heirinbi; Rigyokutsu, Nanto.

Remarks: The present species is very closely related to *Hemibarbus maculatus* from China, differing from it only in color. Color of *H. maculatus* in alcohol (Stanford Collections No. 8414; Pei-ho, China,

MEASUREMENTS OF *Hemibarbus labeo*.

Locality.	Head.	Depth.	D.	A.	P.	V.	Width of Head.	Interorbital.	Snout.	Eye.	Scales.	Length, Mm.
Tamusui River....	3.80	4.83	III, 7	III, 6	20	9	2	3.75	2.15	5	7–49–6	290
Tamusui River....	3.50	5	III, 7	III, 6	20	9	2.50	3.40	2.11	4.50	7–49–6	260
Rigyokutsu.......	3.50	4.33	III, 7	III, 6	20	9	2.33	4	2.25	5	7–48–6	265
Heirinbi..........	3.31	4.66	III, 7	III, 6	20	9	2	3.66	2.42	3.87	7–48–6	128

290 mm. long; described by Jordan and Starks under the name; *Hemibarbus joiteni*) pinkish yellow, with a longitudinal series of eight large spots above the lateral line; smaller spots irregularly placed on back and sides; dorsal and caudal with similar black spots; other fins without markings. Although faint dark spots are present in the

young specimen of *Hemibarbus labeo*, they are not permanent; the color of the adult is always uniformly grayish brown.

Genus BARBODES Bleeker.

1860. *Barbodes* BLEEKER, Nat. Tijdschr. Ned. Ind., XX, p. 431. (Type *Barbodes belinka* Bleeker.)

Body strongly compressed, more or less elevated, with the profile of the back arched; head of moderate size, its length being one-fourth of the length without caudal; snout shorter than the postorbital part. Mouth subinferior, arched, without inner fold. Barbels four, two maxillary and two rostral, rather short. Scales of moderate size, about forty in the lateral line. Lateral line continuous, running along the middle of the sides. Dorsal fin with three osseous spines, the third the longest, inner border of which is coarsely serrated or smooth; with not more than nine branched rays, inserted above or a little behind the origin of the ventral. Pharyngeal teeth 4, 3, 2—2, 3, 4.

Distribution: Philippine Islands; Malay Archipelago; India to South China; Formosa.

22. **Barbodes paradoxus** (Günther).

1868. *Barbus paradoxus* GÜNTHER, Cat. Fish., VII, p. 97. Formosa.

Head 4 in length; depth 3.5; D. III, 9; A. 2, 6; P. 15; V. 9; width of head 1.86 in its length; interorbital space 2.66 in head; snout 3; eye 3; pectoral 1.18; ventral 1.20; thirty-nine scales in the lateral line, six scales in an oblique series between origin of dorsal and lateral line, six scales between the latter and the middle of the belly, three scales from lateral line to the root of the ventral; pharyngeal teeth, 4, 3, 2—2, 3, 4; gill-rakers 4 + 9; branchiostegals 3.

Body oblong, slightly compressed; abdomen rounded; head moderate, its top convex; snout shorter than postorbital part, obtusely pointed anteriorly, its dorsal profile rounded; mouth subinferior, arched, its angle not reaching the orbit; lips fleshy, lower lip distinct only near the angle of mouth; lower jaw shorter than the upper, its tip naked; four barbels, two maxillary and two rostral; eyes moderate, slightly superior and anterior; nostrils close together, in front of eye, the anterior in a short tube.

Origin of dorsal midway between the tip of snout and base of caudal, opposite the root of ventral; inner border of third spine not serrated, its length 1.71 in head; pectorals not reaching the ventral;

ventral beneath the dorsal, not reaching the anal; anal rather short, anterior ray the longest; caudal fin emarginate, tip of each lobe pointed.

Scales moderate, cycloid; lateral line nearly straight, extending along the middle of sides, very slightly decurved.

Color in formalin dark gray above, lower parts of sides dusky yellow; belly whitish; sides with seven dark brown cross-bars, of which the third and fifth reach the back, the others shorter; membrane of the dorsal with a black streak between each ray; caudal fin dusky; other fins whitish.

Total length 61 mm.

The present description is from a specimen from Taiko River, collected by T. Aoki in December, 1916.

Habitat: Taiko River (a single specimen, young fish).

Remarks: In Günther's original description there is no statement about the dark cross-bars on the sides. Probably they had disappeared, as his specimens from Formosa were adults, measuring from eight to eight and one-half inches in length.

Genus CAPOETA Cuv. & Val.

1842. *Capoeta* CUV. & VAL., Hist. Nat. Poiss., XVI, p. 278. (Type *Capoeta fundulus* Cuv. & Val.)

Body elongate, compressed, rather deep; head moderate; snout somewhat pointed, nearly as long as the eye. Mouth narrow, subinferior; upper jaw slightly overlapping the lower; barbels two, maxillary, slender. Scales large, about twenty-five in the lateral line. Dorsal fin with three osseous spines, the third strongly serrated behind; eight branched rays, fin inserted in advance or opposite to the origin of the ventral; anal fin rather short. Pharyngeal teeth 5, 3, 2—2, 3, 5; lateral line running along the middle of the sides.

Distribution: Malay Archipelago, India to South China.

23. **Capoeta semifasciolata** (Günther).

Anbakutai (Formosa).

1868. *Barbus fasciolatus* GÜNTHER, Cat. Fish., VII, p. 140; China (not of page 108).
1868. *Barbus semifasciolatus* GÜNTHER, Cat. Fish., VII, p. 484; China (substitute for *B. fasciolatus* of page 140; *B. fasciolatus* pre-occupied).
1871. *Puntius* (*Capoeta*) *güntheri* BLEEKER, Mem. Cyprin. Chine, p. 9 (substitute for *B. fasciolatus* Günther of page 140, *l. c.*).

Head 3.66 in length; depth 2.8; D. III, 8; A. 2, 6; P. 13; V. 9; width of head 1.71 in its length; eye 3 in head; interorbital space 2.33;

snout 3; pectoral 1.375; ventral 1.33; twenty-five scales in the lateral line; four scales in an oblique series from origin of dorsal to lateral line, two between the latter and the root of ventral, four scales between lateral line and the middle of belly; pharyngeal teeth 5, 3, 2—2, 3, 5; gill-rakers rudimentary.

Body elongate, compressed, rather deep; head moderate, top more or less convex; snout short, obtusely rounded anteriorly; mouth subinferior, arched, its angle not reaching the orbit; lip fleshy; lower jaw slightly shorter than the upper; barbels two, maxillary, slender; eyes moderate, anterior; nostrils close together, in front of eye, the anterior in a short tube.

Origin of dorsal midway between the tip of snout and base of caudal, nearly opposite that of the ventral, first spine minute, third spine strongly serrated behind, its length 1.66 in head; pectoral fin not reaching the ventral; anal short, anterior ray the longest; caudal fin emarginate, the tip of each lobe pointed.

Scales rather large; base of the dorsal and anal provided with scaly sheath; ventral flap present, scaly; no pectoral flap; lateral line continuous, extending along the middle of the sides, slightly decurved.

Color in formalin pale gray above, paler below; belly whitish; sides with about seven short black cross-bars, none of them reaching the back or belly; a round black spot on the end of lateral line; back with numerous small black spots; a large dark spot on the top of the head; an obscure black longitudinal streak along the median dorsal line; dorsal and caudal fins dusky, the rest of fins whitish.

MEASUREMENTS OF *Capoeta semifasciolata.*

Locality.	Head.	Depth.	D.	A.	P.	V.	Width of Head.	Interorbital.	Snout.	Eye.	Scales.	Length, Mm.
Akō..............	3.66	2.80	III, 8	2, 6	13	9	1.71	2.33	3.00	3	4–25–4	51
Akō..............	3.33	2.86	III, 8	2, 5	13	9	1.71	2.40	3.00	3	4–24–4	49
Akō..............	3.25	3	III, 8	2, 5	13	9	1.71	2.60	3.25	3.25	4–24–4	48

Total length 51 mm.

Described from a specimen from Akō, collected by T. Aoki in December, 1916.

Habitat: Akō (nine specimens).

Genus PUNTIUS Hamilton.

1822. *Puntius* HAMILTON, Fishes of the Ganges, p. 388. (Type *Cyprinus puntio* Hamilton.)

Body oblong, rather high, slightly compressed. Mouth anterior and oblique, with no labial fold; lower lips continuous, without horny covering. Barbels none. The osseous dorsal spine of moderate strength, smooth or serrated behind, the fin inserted in advance of, or a little behind, the origin of the ventral; anal with five or six divided rays. Scales large, less than thirty in the lateral line. Lateral line continuous, extending along the middle of the tail. Pharyngeal teeth in three series, 5, 3, 2—2, 3, 5.

Distribution: Malay Archipelago; British India.

Remarks: Dr. Bleeker restricted the present genus to include a group of fishes, the type of which is *Cyprinus sophore* Hamilton, but the type of the genus *Puntius* has no barbel, thus being distinguished from *C. sophore* which has four barbels.

24. **Puntius snyderi** sp. nov. (Plate L, Fig. 2).

Anbakutai (Formosa).

Head 3.58 in length; depth 3; D. IV, 9; A. 2, 6; P. 13; V. 9; width of head 1.7 in its length; eye 3 in head; interorbital space 2.66; snout 3; pectoral 1.42; ventral 1.42; twenty-four scales in the lateral line, four scales in an oblique series between origin of the dorsal and lateral line, four scales between the latter and the middle of belly, three scales between lateral line and the root of the ventral; pharyngeal teeth 5, 3, 2—2, 3, 5; gill-rakers 1 + 4.

Body oblong, slightly compressed, abdomen rounded; head moderate, its top more or less convex, profile on the nape slightly concave; snout rather short, anterior margin obtusely rounded; mouth anterior and oblique, its angle not reaching the orbit; lower jaw slightly shorter than the upper; lips fleshy; no barbel; nostrils close together, nearer than orbit the tip of snout, the anterior nostril in a short tube; eyes moderate, slightly anterior and superior; pharyngeal teeth sharp and hooked; gill-rakers short, rudimentary.

Origin of the dorsal midway between tip of snout and base of caudal, slightly behind that of the ventral, first and second spines minute, third spine about one-third as long as the fourth, which is the strongest and is serrated behind; the pectoral slender, not reaching the ventral; ventral fin inserted in front of origin of the dorsal; the anal short, entirely behind the dorsal; caudal fin emarginate, each lobe sharply pointed.

Scales rather large, cycloid; base of the dorsal fin covered with scaly sheath; lateral line continuous, very slightly decurved, extending along the middle of the tail.

Color in formalin dark gray above, paler below; sides with three black cross-bars, a black spot near the base of the caudal; above the gill-opening a short dark brown streak; a brown semilunar spot on the occiput; all the fins uniformly dusky white.

Total length 77 mm.

The present description is from a specimen from Rigyokutsu, Nanto, collected by T. Aoki in December, 1916.

Habitat: Rigyokutsu, Nanto; Maruyama near Taihoku; Daito River.

MEASUREMENTS OF *Puntius snyderi.*

Locality.	Head.	Depth.	D.	A.	P.	V.	Width of Head.	Interorbital.	Snout.	Eye.	Scales.	Length, Mm.
Rigyokutsu........	3.58	3	IV, 9	2, 6	13	9	1.70	2.66	3	3	4 –24–4	77
Rigyokutsu........	3.60	3	IV, 8	2, 6	13	9	1.87	2.66	3.33	3.33	3½–24–4	66
Maruyama........	3.50	3	IV, 8	2, 5	13	9	1.83	2.50	3	3	3½–24–4	43
Daito River.......	3.16	3	IV, 8	2, 5	13	9	2	2.60	3.5	3.25	3½–23–4	48
Daito River.......	3.50	3	IV, 8	2, 5	13	9	1.86	2.80	3.4	3.4	3½–23–4	58
Daito River.......	3.50	3	IV, 8	2, 5	13	9	1.83	2.60	3.25	3.75	4–24–45	50

Genus SPINIBARBUS gen. nov.

Body elongate, more or less compressed, abdomen rounded. Dorsal fin short, slightly in advance of the origin of ventral, with eight branched rays and three unserrated osseous spines, the third spine stronger than the others. Anal fin rather short, with five branched rays. Mouth somewhat inferior, with the margin of the lower jaw obtuse; lips without inner fold. Four barbels the maxillary much longer than the rostral. A recumbent spine in front of the dorsal, pointing forward, its basal portion hidden by the scales. Scales large; lateral line running along the middle of the tail. Gill-openings extend to below the angle of operculum. Gill-rakers short and fleshy. Pharyngeal teeth 5, 3, 2—2, 3, 5.

Distribution: Formosa.

Remarks: Although the type of the present genus agrees very well with Günther's *Mystacoleucus* (Günther, Cat. Fish. Brit. Mus., VII, 1868, p. 206), it differs remarkably from it in having unserrated dorsal spines, a less number of divided anal rays, pharyngeal teeth of 5, 3, 2—2, 3, 5 instead of 4, 3, 2—2, 3, 4, and large scales.

25. **Spinibarbus hollandi** sp. nov. (Plate L, Fig. 3; Plate LI, Fig. 1).

Head 3.8 in length; depth 4; D. III, 8; A. II, 5; P. 16; V. 9; width of head 1.85 in its length; eye 7 in head; interorbital space 3, snout 3; pectoral 1.25; ventral 1.33; twenty-six scales in the lateral line, four in an oblique series between origin of dorsal and lateral line, four between the latter and the middle of belly, three scales between lateral line and the root of the ventral; pharyngeal teeth 5, 3, 2—2, 3, 5; gill-rakers 4 + 9.

Body elongate, more or less compressed; head elongate, pointed, top compressed, tith many mucous cavities around the orbit; snout long, pointed; eyes rather small, superior and anterior; nostrils close together, in front of eye above; mouth inferior, its angle not reaching the orbit; lips fleshy, rather thin; upper jaw very slightly longer than the lower; barbels four, the rostral reaching the orbit, much slenderer and shorter than the maxillary which is nearly as long as the snout; interorbital space broad and flattened; gill-openings moderate; gill-rakers short and fleshy.

Dorsal fin inserted nearer tip of snout than the base of caudal, spines smooth, not serrated, anterior dorsal ray the longest; a recumbent spine in front of the dorsal, pointing forwards, its basal portion hidden by the scales; the pectoral reaching beyond two-thirds the distance to ventral; origin of ventral one scale behind that of the dorsal; anal fin entirely behind the dorsal, inserted midway between origin of ventral and base of caudal; caudal fin deeply forked, the tip of each lobe pointed; caudal peduncle elongate, its depth 2.5 in head.

Body covered with large cycloid scales; ventral fin with scaly flaps; lateral line continuous, slightly decurved anteriorly, extending along the middle of sides.

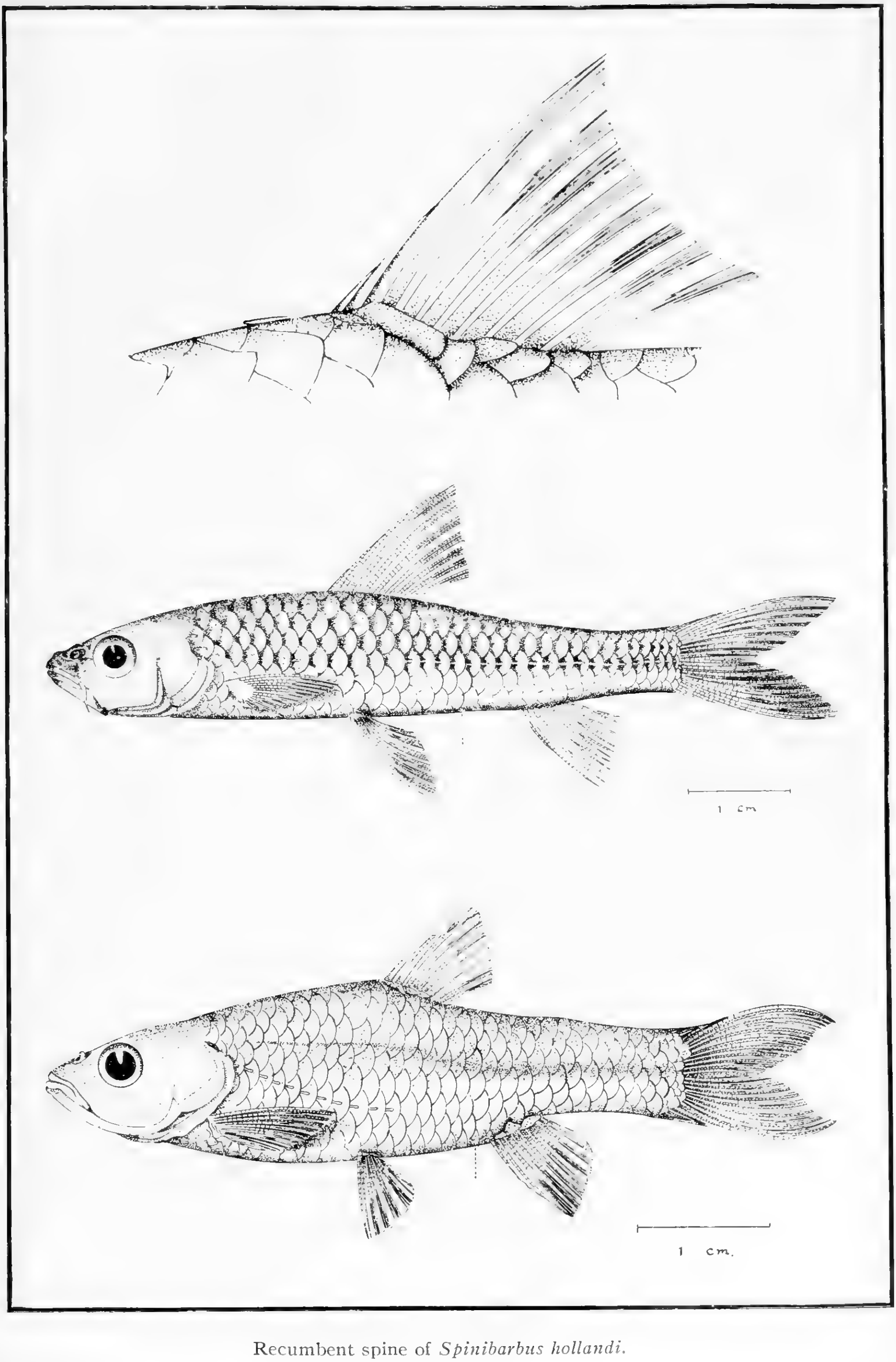
Color in formalin grayish brown above, paler below; sides and lower parts silvery; edge of the dorsal fin with a series of dark streaks, the rest of the fins dusky.

Total length 340 mm.

Described from a specimen from Sobun River near Tabani, collected by T. Aoki in December, 1916.

Habitat: Sobun River near Tabani (four specimens).

Remarks: Named for Dr. W. J. Holland, Director of the Carnegie Institute, Pittsburgh, U. S. A.



Recumbent spine of *Spinibarbus hollandi.*
Gnathopogon iijimæ Oshima, sp. nov.
Phoxiscus kikuchii Oshima, sp. nov.

MEASUREMENTS OF *Spinibarbus hollanei*.

Locality.	Head.	Depth.	D.	A.	P.	V.	Width of Head.	Interorbital.	Snout.	Eye.	Scales.	Length, Mm.
Sobun River.........	3.80	4	III, 8	2, 5	16	9	1.85	3	3	7	4–26–4	340
Sobun River.........	3.85	4	III, 8	2, 5	16	9	1.66	2.66	3	6	4–27–4	215

Genus GNATHOPOGON Bleeker.

1860. *Gnathopogon* BLEEKER, Ichth. Archipel. Indic. Prodr., II, p. 434. (Type *Capoeta elongata* Temminck & Schlegel.)

1872. *Squalidus* DYBOWSKI, Verh. Zoöl.-Bot. Ges. Wien, XXII, p. 215. (Type *Squalidus chankænesis* Dybowski.)

1896. *Leucogobio* GÜNTHER, Ann. Ac. Sci. Petersb., p. 212. (Type *Leucogobio hersensteini* Günther.)

Body elongate, compressed; abdomen not carinated. Scales of moderate size; lateral line continuous, running along the middle of the tail. Mouth anterior and oblique, with a minute maxillary barbel at the corner; both jaws with simple, narrow lips. Dorsal fin short, without spine, inserted in front of, or behind, that of the ventral. Anal fin short, with not more than six branched rays. Gill-rakers rudimentary; pharyngeal teeth 5, 3 or 2 or 1—1 or 3, 5, slightly hooked.

Distribution: Formosa; China; Corea; Japan; Amur Provinces.

26. **Gnathopogon iijimæ** sp. nov. (Plate LI, Fig. 2).

Head 3.70 in length; depth 4.85; D. 3, 7; A. 2, 6; P. 16; V. 7; width of head twice in its length; eye three times in head; interorbital space 3.6; snout 3; pectoral 1.3, thirty-three scales in the lateral line, four scales in an oblique series between origin of dorsal and lateral line, four scales between the latter and the middle of belly; pharyngeal teeth 5, 3—3, 5; gill-rakers rudimentary; five branchiostegals.

Body elongate, compressed, abdomen not carinated; head moderate, its top more or less convex; snout pointed anteriorly, its tip swollen, interorbital space rather flat, with bony ridge along superior margin of the orbit; mouth oblique, with very thin lips; upper jaw longer than the lower; barbels two, maxillary, minute, about half as long as the diameter of eye; eyes large, superior and slightly anterior; nostrils close together, nearer to eye than to tip of snout.

Origin of the dorsal slightly nearer the tip of snout than the base of caudal, first simple ray very short, the second about half as long as the third, anterior divided ray the longest, nearly as long as the head;

pectoral scarcely reaching the base of ventral; ventral fin opposite the dorsal, inserted beneath the first branched dorsal ray; anal entirely behind the dorsal, anterior ray the longest; caudal fin deeply emarginate, tip of each lobe sharply pointed; the depth of caudal peduncle 2.83.

Body covered with thin cycloid scales; lateral line continuous, extending along the middle of the tail, slightly decurved.

Color in alcohol pale yellowish gray above, lower parts whitish; most of the scales speckled with black; top of the head rather dark; dorsal fin white, each ray with black spots; caudal fin dusky, spotted with black; other fins whitish.

Total length 79 mm.

Described from a specimen from Tozen River, collected by T. Aoki in December, 1916.

Habitat: Tozen River (a single specimen).

Remarks: Named for Prof. Isao Iijima of the Science College, Imperial University of Tokyo.

This species resembles *Gnathopogon coreanus* (Berg)[5] from Corea, but has shorter barbels and thirty-three scales instead of thirty-five in the lateral line.

Genus Pseudogobio Bleeker.

1863. *Pseudogobio* Bleeker, Atlas Ichthyol., Cyprin., p. 29. (Type *Gobio esocinus* Temminck & Schlegel.)

Body elongate, rather slender and tapering behind. Head elongate, pointed; snout long, concave above, and slightly produced, with its tip bluntly rounded; eye small, nearer posterior edge of opercle than tip of snout; mouth small, protractile downwards, inferior, the maxillary not reaching nostrils; lips broad, fleshy, and covered with well-developed papillæ; a rather short, thick maxillary barbel; teeth small, 6 or 5, 2–2, 5 or 6; interorbital space broad and concave. Intestine short. Peritoneum silvery. Scales moderate, cycloid, about forty-two. Origin of the dorsal nearer tip of snout than base of caudal; origin of anal far behind tip of depressed ventral; caudal emarginate; ventrals inserted well behind origin or dorsal. Lateral line almost straight or very slightly decurved and continuous. Dorsal and caudal with distinct narrow blackish cross-bands. (Jordan and Fowler.)

Distribution: Formosa; China; Japan.

[5] *Leucogobio coreanus* Berg, Ann. Mag. Nat. Hist. (7), 1906, p. 394; River Sambau, Kyong-sang-do, Corea.

27. **Pseudogobio brevirostris** Günther.

1868. *Pseudogobio brevirostris* GÜNTHER, Cat. Fish., VII, p. 174; Formosa.

Head 4.44 in length; depth 5; D. 2, 7; A. 2, 6; P. 13; V. 8; width of head 1.5 in its length; eye 4 in head; interorbital space 3; snout 2; ventral 1.28; pectoral slightly longer than the head; thirty-eight scales in the lateral line, four and one-half scales in an oblique series between origin of dorsal and lateral line, five scales between the latter and the middle of belly; between lateral line and the root of the ventral two scales; pharyngeal teeth 5–5; twenty-seven gill-rakers on first arch.

Body elongate, not compressed, dorsal profile nearly straight, abdomen rounded; head squarish, its top flat; snout pointed anteriorly, suddenly depressed in front of the nostrils, tip slightly swollen; mouth inferior, suctorial; upper lip distinctly fringed, lower lip densely tuberculated; each jaw with a transverse, sharp horny edge; eyes moderate, superior, and a little posterior; nostrils close together, anterior nostril in a short tube; interorbital space flat; pharyngeal teeth hooked; gill-rakers quite short, set very closely.

Origin of the dorsal much nearer the tip of snout than the base of caudal, in advance of that of the ventral, its longest ray nearly as long as the head; pectoral fin horizontal, extending beyond the origin of dorsal, middle rays longer; the ventral inserted beneath the middle of base of dorsal; anal fin moderate, second branched ray the longest; caudal fin emarginate, tip of each lobe obtusely pointed.

Scales rather large, thin, with radiated striæ and concentric rings; lateral line continuous, nearly straight, extending along the middle of the sides.

Color in alcohol pale grayish brown above; lower part of sides and belly whitish, with a longitudinal black band along the lateral line, all the fins whitish, roughly speckled with brown; top of head uniformly gray.

Total length 92 mm.

The present description is from a specimen from Tamusui River near Shinten, collected by T. Aoki in December, 1916.

Habitat: Tamusui River (four specimens).

Remarks: The nearest relative of the present species is *Pseudogobio sinensis*[6] from China. It differs, however, in having fewer scales in

[6] *Tylognathus sinensis* Kner, Novara Fisch., III, 1865, p. 354; Shanghai, China. *Pseudogobio sinensis* Günther, Cat. Fish., VII, 1868, p. 175; Shanghai (after Kner).

the lateral line (36–37) and six scales between origin of dorsal and lateral line.

MEASUREMENTS OF *Pseudogobio brevirostris*.

Locality.	Head.	Depth.	D.	A.	P.	V.	Width of Head.	Interorbital.	Snout.	Eye.	Scales.	Length, Mm.
Tamusui River........	4.44	5	2, 7	2, 6	13	8	1.50	3	2	4	4½–38–5	92
Tamusui River........	5	4.64	2, 7	2, 6	13	8	1.42	3	2	4	4½–39–5	94

Genus PSEUDORASBORA Bleeker.

1860. *Pseudorasbora* BLEEKER, Act. Soc. Indo-Neerl., VI, p. 97. (Type *Leuciscus parvus* Temminck & Schlegel.)

Body elongate. Head pointed, compressed; snout bluntly pointed; eye rather large; mouth terminal, above, oblique, and mandible projecting and the maxillary not reaching nostril; no barbels; teeth 5–5; interorbital space broad and flat. Inside of gill-openings with a notch below. Intestine short. Peritoneum silvery. Scales large, cycloid, and about thirty-eight in lateral line; breast scaled. Origin of dorsal nearer tip of snout than base of caudal; origin of anal begins below origin of the depressed dorsal; caudal emarginate; ventrals inserted below origin of dorsal. Lateral line slightly decurved and continuous. Breeding males with the snout and sides of the head with horny tubercles (Jordan and Fowler).

Distribution: Formosa; China; Amur Province; Corea; Japan.

28. **Pseudorasbora parva** (Schlegel).

Moroko or Haya (Japan); Chasui or Bohoe (Formosa).

1846. *Leuciscus parvus* SCHLEGEL, Fauna Japonica, Poiss., p. 215, Pl. CII, Fig. 3; streams near Nagasaki.

1846. *Leuciscus pusillus* SCHLEGEL, *l. c.*, p. 216, Pl. CII, Fig. 4.

1867. *Pseudorasbora parva* KNER, Novara, Fisch., III, p. 355, Pl. XVII, Fig. 2; Shanghai.—GÜNTHER, Cat. Fish., VII, 1868, p. 186; Japan; China.—BLEEKER, Mem. Cyprin. Chine, 1871, p. 11; Shanghai; Tji-kiang.—GÜNTHER, Ann. Mag. Nat. Hist., Sept., 1873, p. 247; China.—ISHIKAWA, Zoöl. Mag. Tokyo, VII, 1875, p. 128; Otsu; Maebara; Matsubara.—PETERS, Monatsb. Ak. Berlin, 1880, p. 925; China.—JORDAN & SNYDER, Proc. U. S. Nat. Mus., XXIII, 1900, p. 344; Lake Biwa.—JORDAN & FOWLER, Proc. U. S. Nat. Mus., XXVI, 1903, p. 840; Tsuchiura; Nagoya; Lake Yogo; Lake Biwa; Iwai River; Chikugo River; Yodo River.—SMITH & POPE, Proc. U. S. Nat. Mus., XXXI, 1905, p. 461; Japan.—JORDAN & METZ, Mem. Carneg. Mus., VI, No. 2, 1913, p. 16; Suigen, Corea.—Berg. Ichthyol. Amur, p. 94; Amur Province

Head 4 in length; depth 4; D. 3, 7; A. 2, 6; P. 14; V. 8; width of head 1.78 in its length; eye 3.66 in head; interorbital space 2.5; snout 3; pectoral 1.25; ventral 1.25; thirty-eight scales in the lateral line, five scales in an oblique series between origin of dorsal and lateral line, five scales between the latter and the middle of belly, three scales between lateral line and the root of ventral; pharyngeal teeth 5–5; gill-rakers rudimentary, merely fleshy rudiments.

Body elongate, compressed; head triangular, pointed, compressed, upper surface more or less compressed, interorbital space rather broad; snout truncated in front, anterior part very slightly swollen; mouth anterior, transverse, its angle not reaching the nostril; upper lip rather thick and fleshy; lower jaw projecting, with horny anterior edge; eyes large, slightly anterior and superior; nostrils together, in front of eye above; no barbel; gill-openings moderate; peritoneum silvery.

Origin of the dorsal nearer tip of snout than base of caudal, one scale in advance of that of the ventral, first single ray minute, the second about half as long as the third, anterior divided ray the longest; pectorals elongate; but not reaching the root of the ventral; ventrals beneath the dorsal; anal fin entirely behind the dorsal, its origin much nearer to that of the ventral than base of the caudal; caudal fin bifurcate, tip of each lobe sharply pointed.

MEASUREMENTS OF *Pseudorasbora parva.*

Locality.	Head.	Depth.	D.	A.	P.	V.	Width of Head	Interor-bital.	Snout.	Eye.	Scales	Length, Mm.
Taihoku	4	4	3, 7	2, 6	14	8	1.77	2.50	3	3.66	5 –38–5	77
Taihoku	4	4	3, 7	2, 6	14	8	2	2.50	3	3.75	5 –36–5	75
Taihoku	4	4	3, 7	2, 6	13	8	1.75	2.33	3	3.50	5 –36–5	70
Taihoku	4	4	3, 7	2, 6	13	8	1.77	2.28	3	3.66	5 –37–5	77
Taihoku	4.28	4	3, 7	2, 6	13	8	1.75	2.33	3	3.50	5 –37–5	71
Taihoku	4	3.87	3, 7	2, 6	13	8	1.75	2.33	3	3.80	5 –36–5	69
Raupi	3.6	4	3, 7	2, 6	13	8	2	3	3	4	5 –36–5	47
Raupi	3.4	4	3, 7	2, 6	13	8	2	3	3	3.50	5 –36–5	38
Rigyokutsu	4.25	4.14	3, 7	2, 6	14	8	1.82	2.50	2.86	4	5 –36–5	100
Shori	4.5	3.64	3, 7	2, 6	13	8	1.64	2.25	3	3.80	5 –38–5	96
Shori	4.5	3.5	3, 7	2, 6	14	8	1.54	2.13	3	3.66	5 –36–5	93
Ako	4.29	4.11	3, 7	2, 6	13	8	1.80	2.37	2.71	3.66	5 –35–5	88
Shinchiku	4.5	3.29	3, 7	2, 6	13	8	1.89	2.37	3	3.66	5 –37–5	88
Bokusekikaku	4	3.60	3, 7	2, 6	13	8	1.75	2.36	2.66	4	5½–38–6	75

Body covered with rather large cycloid scales; lateral line very slightly decurved, extending along the middle of the sides.

Color in alcohol dark grayish above, sides beneath lateral line and lower surface silvery; a slaty gray lateral band along the middle of sides; most of the scales with black edges; all the fins grayish.

Total length 77 mm.

Described from a specimen from Taihoku, collected by Oshima in December, 1916.

Habitat: The present species is very abundant in pools and rivers in Formosa. I have a number of specimens from the Tamusui River; Taihoku; Raupi, Giran; Tozen River; Nanto; Rigyokutsu, Nanto; Shinchiku; Ako; Shori, Toyen; Bokusekikaku.

Remarks: The length of head and the depth of body are variable.

Genus PARARASBORA Regan.

1908. *Pararasbora* REGAN, Ann. Mag. Nat. Hist. (8), II, p. 360. (Type *Pararasbora moltrechti* Regan.)

Scales large, 5.5–6 scales in an oblique series between origin of dorsal and lateral line, 2 scales between the latter and the root of ventral. Lateral line decurved, running along the lower part of the tail. Dorsal fin with seven branched rays, inserted behind the ventral; the anal entirely behind the dorsal, with seven branched rays. Mouth oblique, its angle extending to the anterior border of the orbit; lower jaw slightly shorter than the upper, with no prominence in front, upper jaw entire, with no emargination. Barbels none. Gill-rakers rudimentary. Pharyngeal teeth in two series, 4, 4—4, 4.

Distribution: Formosa.

29. **Pararasbora moltrechti** Regan.

Baahii (Formosa).

1908. *Pararasbora moltrechti* REGAN, Ann. Mag. Nat. Hist. (8), II, p. 360; Lake Candidius, Formosa.

1909. Jordan & Richardson, Mem. Carneg. Mus., IV, No. 4, 1909, p. 170; Lake Candidius (after Regan.)

Head 4.11 in length; depth 4; D. 3, 7; A. 2, 7; P. 14; V. 7; width of head 1.75 in its length; eye 3.25 in head; interorbital space 2.1; snout 3.25; pectoral 1.2; ventral 1.4; thirty-six scales in the lateral line, six scales in an oblique series between origin of dorsal and lateral line, two scales between the latter and the root of ventral, four scales between lateral line and the middle of belly; pharyngeal teeth 4, 4—4, 4; gill-rakers 2 + 6, rudimentary.

Body elongate, compressed; dorsal and ventral profiles equally arched; head moderate, pointed anteriorly, upper surface more or less depressed; snout bluntly pointed, interorbital space broad and flattened; mouth oblique, its angle reaching beneath the anterior border of orbit; upper lip thin; lower jaw slightly shorter than the upper, with a sharp edge; five branchiostegals; nostrils close together, in front of the eye above.

Origin of dorsal nearer to base of caudal than tip of snout, inserted above the space between the ventral and anal, anterior ray longest; pectoral fin not reaching the ventral, origin of ventral much in advance of that of dorsal; anal fin entirely behind the dorsal, its origin nearer to that of ventral than base of caudal, its base covered with a series of scales; caudal fin emarginate, tip of each lobe obtusely pointed; caudal peduncle elongate, its depth about twice in the length of head.

Body covered with rather large cycloid scales; lateral line much decurved, running along the lower half of the tail.

Color in formalin dark gray above, lower parts yellowish white; top of head black; a dark brown stripe from occiput to base of the caudal above, running along the dorsal median line; side with a broad dark brown lateral band, distinct posteriorly; all the fins grayish.

Total length 83 mm.

The present description is drawn from a specimen from Jitsugetsutan, collected by T. Aoki in August, 1916.

Habitat: Restricted to Jitsugetsutan (Lake Candidius). Two specimens.

MEASUREMENTS OF *Pararasbora moltrechti.*

Locality.	Head.	Depth.	D.	A.	P.	V.	Width of Head.	Interorbital.	Snout.	Eye.	Scales.	Length, Mm.
Jitsugetsutan........	4.11	4	3, 7	2, 7	14	7	1.75	2.11	3.25	3.25	6–36–4	83
Jitsugetsutan........	4.13	4	3, 7	2, 7	14	7	1.88	2.25	3.20	4	6–35–4	81

PHOXISCUS gen. nov.

Body elongate, compressed; postventral part keeled. Head moderate, its top rather flat; snout obtusely rounded. Mouth oblique; lower jaw slightly longer than the upper; lips thin, normal. Barbels none. Teeth hooked, in double series, 5, 3—4, 4. Lateral line incomplete, visible only in the anterior part of the body. Scales large, about thirty in a lateral series. Dorsal fin short, without osseous spine, inserted behind the origin of the ventral; anal fin of moderate length, with seven branched rays, not extending forwards to below the dorsal.

Distribution: Formosa.

Remarks: The present genus is closely related to *Hemitremia* Cope. It differs, however, in having three and four teeth in the second row, instead of two as in the latter, as also in the carinate belly.

30. **Phoxiscus kikuchii** sp. nov. (Plate LI, Fig. 3).

Head 3.5 in length; depth 3.5; D. 2, 7; A. 2, 7; P. 13; V. 7; width of head 1.75 in its length; eye four in head; interorbital space 2.33; snout 3; pectoral 1.5; ventral 1.75; thirty scales in a lateral series, five scales in an oblique series between origin of dorsal and lateral line, six scales between the latter and the middle of belly, two scales between lateral line and the root of ventral; pharyngeal teeth 5, 3—4, 4; gill-rakers 2 + 5.

Body elongate, compressed, postventral part weakly keeled; head moderate, its top rather flat; snout obtusely rounded anteriorly, interorbital space broad, more or less convex; mouth oblique, with thin lips; lower jaw slightly longer than the upper; no barbel; maxillary scarcely reaching a vertical through anterior border of orbit; eye moderate, superior and anterior; nostrils close together, the anterior in a short tube; pharyngeal teeth slender and hooked; gill-rakers on the first arch short and separated.

Dorsal fin short, nearer the base of caudal than the tip of snout, anterior ray the longest, its height 1.4 in length of head; pectoral fin not reaching the ventral, with a small fleshy flap; the ventral inserted in front of the origin of dorsal, rather slender; anal fin entirely behind the dorsal, rather short, anterior ray the longest, its height 1.66 in head; caudal fin emarginate, tip of each lobe pointed.

Body covered with large imbricated scales; lateral line incomplete, decurved, reaching posterior third of the ventral.

Color in alcohol brownish gray above, lower parts yellowish; top of head and dorsal median line purplish; sides with a bluish gray longitudinal band; all the fins uniformly cream-colored.

Total length 60 mm.

Described from a specimen from Bokusekikaku, collected by Yonetaro Kikuchi of the Taihoku Museum.

Habitat: Bokusekikaku (a single specimen).

Remarks: Named for Yonetaro Kikuchi, collector of the Taihoku Museum.

Genus DISTŒCHODON Peters.

1880. *Distœchodon* PETERS, Monatsb. Königl. Ak. Wiss. Berlin, p. 924. (Type *Distœchodon tumirostris* Peters.)

Scales large; lateral line decurved, running along the middle of the tail. Dorsal fin short, with seven branched rays and two smooth spines, opposite the ventral. Anal fin of moderate length, with nine branched rays, not extending forwards to below the dorsal. Abdomen not carinated. Snout swollen, produced anteriorly, tip of its skin overlapping the upper lip. Mouth subinferior, transverse. Upper lip with a transverse inner fold; anterior border of the lower jaw rather sharp. Barbels none. Gill-rakers setiform, set very closely; pharyngeal teeth 7, 3—3, 7, compressed, with grinding surface.

Distribution: China; Formosa.

31. **Distœchodon tumirostris** Peters.

Gonhii (Formosa).

1880. *Distœchodon tumirostris* Peters, Monatsb. Königl. Ak. Wiss. Berlin, p. 925; Ningpo, China.

Head 4.64 in length; depth 3.92; D. II, 7; A. 3, 9; P. 17; V. 9; width of head 1.80 in its length; eye four in head; interorbital space 2.5; snout 3; pectoral 1.28; ventral 1.5; seventy-two scales in the lateral line, thirteen scales in an oblique series between origin of dorsal and lateral line, ten scales between the latter and the middle of belly, six scales between lateral line and the root of ventral; pharyngeal teeth 7, 3—3, 7; gill-rakers on the first arch 75.

Body elongate, compressed, dorsal profile slightly depressed at the occiput, abdomen rounded, not carinated; head rather small, triangular, its top more or less convex, profile on the nape concave; interorbital space broad, rather flat; snout obtusely rounded anteriorly, the tip swollen, the end of its skin overlapping the upper lip; no barbel; mouth subinferior, transverse; upper lip fleshy, not fringed, with a thin inner fold, lower jaw nearly as long as the upper, with a sharp anterior edge, lower lip not continuous; a deep oblique fissure, crossing the angle of mouth and extending downwards and backwards to the vertical from the nostril; eye large, anterior; nostrils close together, in front of eye above; pharyngeal teeth on the outer row very strong, with grinding surface and sharply pointed tip, strongly compressed laterally, those on the inner row exceedingly small and slender, with grinding surface; gill-rakers minute, setiform, set very closely.

Origin of dorsal midway between tip of snout and base of caudal, armed with two strong osseous smooth spines, opposite the ventral; pectorals reaching midway of the distance to origin of ventral, with a fleshy flap; ventral rather slender, with a scaly flap; anal fin entirely behind the dorsal, short, anterior ray the longest; caudal fin bifurcate, tip of each lobe pointed; caudal peduncle rather long, its depth 2.25 in length of head.

Body covered with uniform cycloid scales; lateral line slightly decurved, extending along the middle of the tail.

Color in formalin uniform dark gray above, paler below; lower parts silvery; pectoral, dorsal, and caudal fins dusky, other fins whitish.

Total length 230 mm.

Described from a specimen from Giran.

Habitat: Taihasho, Giran. (Two specimens).

Genus ISCHIKAUIA Jordan & Snyder.

1901. *Ischikauia* JORDAN & SNYDER, Proc. U. S. Nat. Mus., XXIII, p. 346. (Type *Opsariichthus steenackeri* Sauvage.)

Body compressed; caudal peduncle deep. Mouth oblique; lower jaw slightly projecting; maxillary freely protractile, not extending to edge of orbit; no barbels. Teeth, all slightly hooked, with a narrow grinding surface; in three rows; three or four on first, or outer row, five on second, two on third, or inner row. Pseudobranchiæ present. Gill-rakers on first arch 13 + 4; low, pointed. Alimentary canal twice as long as body. Air bladder in two divisions, extending posteriorly to vent. Peritoneum with black pigment. Scales of moderate size, about sixty-five in lateral line; thirteen from lateral line to insertion of dorsal. Lateral line sharply decurved anteriorly, gradually curving upward and extending posteriorly along middle of caudal peduncle. Dorsal inserted a little behind origin of ventrals, composed of nine rays; first ray short, and closely adnate to the next; second ray, spine-like, strong; the other rays branched. Seventeen anal rays; the first two spine-like, weak. Caudal forked, the tips sharp. Pectorals pointed. (Jordan & Snyder.)

Distribution: Formosa; Indo-China; Japan.

32. **Ischikauia macrolepis** Regan.

1908. *Ischikauia macrolepis* REGAN, Ann. Mag. Nat. Hist. (8), I, p. 150; Kagi, Formosa.

Depth of body 3.33 in the length, length of head 4. Snout a little shorter than eye, the diameter of which is 3.25 to 3.50 in the length of head and less than the interorbital width. Mouth oblique. Dorsal rays ten, seven branched, its origin behind the ventrals and nearer to the base of caudal than to the end of snout. Anal rays sixteen to seventeen, thirteen or fourteen branched. Pectoral extending to the ventrals. Thirty-eight to forty scales in a longitudinal series, seven or eight in a transverse series from origin of dorsal to lateral line, three between lateral line and base of ventral.

Three small specimens, the largest 60 mm. in total length, from Kagi, Formosa, collected by Herr Sauter. This species is very similar to the Japanese *I. steenackeri* (Sauvage), which, however, has much smaller scales. (Regan.)

Habitat: Kagi. (Regan.)

Remarks: Not seen.

Genus CTENOPHARYNGODON Steindachner.

1866. *Ctenopharyngodon* STEINDACHNER, Verh. Zoöl.-Bot. Ges. Wien, p. 782. (Type *Leuciscus idella* Cuv. & Val.)

Body oblong. Scales of moderate size; lateral line complete, running nearly into the middle of the side of tail. Dorsal fin short, without spine, opposite the ventral, anal fin short. Mouth of moderate width, anterior, with upper jaw somewhat longer. Both jaws with simple lips, the lower distinct at the angle of the mouth only. Upper jaw slightly protractile. Barbels none. Gill-rakers rather short, lanceolate, rather widely set. Pseudobranchiæ present. The attachment of the branchial membrane to the isthmus takes place behind a vertical from the orbit. Pharyngeal teeth 5, 2—2, 5, those of the outer series very strong, strongly compressed, with the outer layer deeply folded. (Günther.)

Distribution: Formosa; China; Amur Province.

33. **Ctenopharyngodon idellus** (Cuv. & Val.).

Tsauhii (Formosa).

1844. *Leuciscus idella* CUV. & VAL., Hist. Nat. Poiss., XVII, p. 362.—RICHARDSON, Ichthyol. China, 1846, p. 297; Canton.—BLEEKER, Mem. Cyprin. Chine., 1871, p. 47; Canton; Yang-tze-kiang.

1855. *Leuciscus tschiliensis* BASILEWSKY, Nouv. Mem. Soc. Nat. Mosc., X, p. 233; Northern China.

1866. *Ctenopharyngodon laticeps* STEINDACHNER, Verh. Zoöl.-Bot. Ges. Wien, p. 782, Taf. XVIII, Figs. 1–5; Hongkong.

1868. *Ctenopharyngodon idellus* GÜNTHER, Cat. Fish. VII, p. 261, China.—Ann. Mag. Nat. Hist., Sept., 1873, Shanghai.—PETERS, Monatsb. Königl. Ak.

Berlin, 1880, p. 926; China.—JORDAN & EVERMANN, Proc. U. S. Nat. Mus., XXV, 1903, p. 322; Taihoku, Formosa.—JORDAN & RICHARDSON, Mem. Carneg. Mus., IV, 1909, No. 4, p. 169; Formosa.—BERG, Ichthyol. Amur., 1909, p. 120; Amur.

Head 4.09 in length; depth 3.4; D. 3, 7; A. 3, 7; P. 18; V. 9; width of head 1.33 in its length, eye 6 in head; interorbital space 1.8; snout 2.5; pectoral 1.33; ventral 1.71; forty scales in the lateral line, seven scales in an oblique series between origin of dorsal and lateral line, five scales between the latter and the root of ventral, eight between lateral line and the middle of belly; pharyngeal teeth 5, 2—2, 5; gill-rakers 6 + 10.

Body stout, dorsal and ventral profiles about equally arched, tail compressed, head small, flattened; snout broad and short, anterior margin obtusely rounded; mouth subinferior, its angle reaching a vertical through anterior border of the anterior nostril; upper jaw somewhat longer than the lower; upper lip rather thin, thicker in front; lower lip distinct at the angle of the mouth only; eyes moderate, superior and anterior; interorbital space very broad; nostrils together, in front of eye above; gill-membranes united, scarcely reaching to isthmus behind a vertical through the anterior border of orbit; gill-rakers long and slender, widely set; pharyngeal teeth of the outer row strong, laterally compressed, apical half comb-shaped, with a series of folds on both sides; those of the inner row very small, laterally compressed, the apical part comb-shaped.

Origin of dorsal slightly nearer tip of snout than base of caudal, anterior rays longer, pectorals reaching beyond half or the distance to ventrals; ventral rather small, inserted one scale behind the origin of dorsal; anal fin entirely behind the dorsal; its origin nearer to base of caudal than that of the ventral.

Body covered with large scales with radiating striæ and concentric rings; lateral line continuous, slightly decurved, extending along the middle of the sides.

Color in formalin uniformly gray above, paler below; lower parts and ventral fins whitish; upper surface of the pectoral dusky; other fins pale gray.

Total length 360 mm.

Described from a specimen from Shori, Toyen.

Habitat: Bred in ponds throughout the island.

Remarks: The present species is one of the important fresh-water food-fishes among the Chinese people, though it is not a native of the Island. Every year larvæ of this fish are imported from Southern China and are bred artificially by Chinese farmers.

Genus ACHEILOGNATHUS Bleeker.

1860. *Acheilognathus* BLEEKER, Ichth. Archipel. Indic. Prodr., II, p. 228. (Type *Acheilognathus melanogaster* Bleeker.)

Body more or less deep and compressed; head short; eye more or less large; snout rather short and blunt; mouth small, the maxillary not reaching the eye; maxillaries each with a barbel; teeth 5–5, smooth, with a narrow grinding surface; interorbital space rather broad. Intestine long. Peritoneum black. Scales large, some of those on the sides imbricated, 36–39. Origin of the dorsal about midway in the length of the body without caudal, base of fin moderate, with eight to ten developed rays; caudal deeply emarginate; ventrals generally inserted a little before origin of dorsal. Lateral line slightly decurved, and continuous. (Jordan and Fowler.)

Distribution: Formosa; China; Corea; Amur Province; Japan.

34. **Acheilognathus himantegus** Günther.

1868. *Acheilognathus himantegus* GÜNTHER, Cat. Fish., VII, p. 277; Formosa.

Head 4.58 in length; depth 2.89; D. 2, 8; A. 2, 11; P. 12; V. 7; width of head 1.66 in its length; eye 2.66 in head; interorbital space 2; snout 3; pectoral 1.2; ventral 1.33; thirty-four scales in the lateral line, six scales in an oblique series between origin of dorsal and lateral line, four scales between the latter and the middle of belly, three scales between lateral line and the root of the ventral; pharyngeal teeth 5–5; gill-rakers 3 + 9.

Body compressed, rather deep; head small, its top convex, with a median horny ridge; snout short, obtusely rounded anteriorly, its tip with a bony prominence, tip of its skin overlapping the upper lip; interorbital space broad, interspace between nostrils swollen; mouth subinferior and oblique, its angle reaching the nostrils below; lips thin; lower jaw slightly shorter than the upper; two maxillary barbels; eyes moderate, slightly anterior and superior; nostrils close together, in front of eye above.

Origin of dorsal midway between tip of snout and base of caudal, much behind that of the ventral, anterior rays longer; pectoral fin not reaching the ventral; ventral slender, scarcely reaching the root of anal; anal fin inserted below the middle of dorsal, elongate, its origin nearer to base of pectoral than the base of caudal; caudal fin emarginate, the tip of each lobe sharply pointed; caudal peduncle rather long, its depth 1.6 in length of head.

Scales moderate, with a black marking at the tip; lateral line strongly decurved on the trunk, extending along the lower part of the tail.

Color dark gray above, paler below; lower part of the sides sky-green; a short yellow lateral band on the nape; a black lateral band runs along the middle of the tail, terminating in a black band-like spot between the middle caudal rays; interspace between each dorsal ray with a black streak; dorsal and anal fins pinkish, the other fins dusky; no black spot on the shoulder.

Total length 67 mm.

The present description is from a specimen from Taihoku, collected by Oshima in September, 1916.

Habitat: Taihoku; Wodensho, Taichu; Shimotamusui River.

Remarks: The nearest relative of the present species is *Acheilognathus cyanostigma* Jordan & Fowler[7] from Japan. It differs from *A. himantegus* in having shorter barbel, smaller number of anal rays, and thirty-nine scales instead of thirty-four in lateral line.

MEASUREMENTS OF *Acheilognathus himantegus.*

Locality.	Head.	Depth-	D.	A.	P.	V.	Width of Head.	Interorbital.	Snout.	Eye.	Scales.	Length, Mm.
Taihoku...........	4.58	2.89	2, 8	2, 11	12	7	1.66	2	3	2.66	6–34–4	67
Taihoku...........	4.33	2.74	2, 8	2, 11	12	7	1.71	2.16	3	2.66	6–34–4	67
Taihoku...........	4.58	2.84	2, 8	2, 12	12	7	1.71	2.16	3	3	6–34–4	67
Taihoku...........	4.45	2.72	2, 8	2, 11	12	7	1.71	2	3.33	2.66	6–34–4	62
Taihoku...........	4.27	2.87	2, 8	2, 10	12	7	1.71	2.40	3	3	6–33–4	58
Taihoku...........	4.55	3	2, 8	2, 11	12	7	1.80	2.25	3	3	6–34–4	53
Shimotamusui River.	4.30	2.58	2, 8	2, 11	12	7	1.83	2.20	3	3	6–34–4	57
Shimotamusui River.	4.20	3	2, 8	2, 11	12	7	1.83	2.25	3	3	6–34–4	53
Shimotamusui River.	4	3	2, 8	2, 11	12	7	1.75	2.50	3	3	6–34–4	35
Wodensho.........	4	3	2, 8	2, 11	12	7	1.60	2.33	3	3	6–34–4	39

Genus RHODEUS Agassiz.

1835. *Rhodeus* AGASSIZ, Mem. Soc. Hist. Neuchat., I, p. 37. (Type *Cyprinus amarus* Bloch.)

Scales of moderate size; lateral line incomplete, only on the anterior part of the trunk. Dorsal fin with from nine to twelve branched rays,

[7] *Acheilognathus cyanostigma* Jordan & Fowler, Proc. U. S. Nat. Mus., XXVI, 1903, p. 820; Lake Biwa; Lake Yogo.

extending from the ventrals to beyond the origin of the anal. Anal fin rather elongate, with about twelve rays. Mouth subinferior, small, arched; lower jaw without labial fold. Barbels none. Gill-rakers very short; pseudobranchiæ. Pharyngeal teeth 5-5, compressed, not denticulated, the bevelled surface with a simple groove.

Male, during the spawning season, with tubercles on the snout, and the female with a long external urogenital tube. (Günther).

Distribution: Europe; Caucasus; China; Formosa; Basin of Amur; Corea; Japan.

35. **Rhodeus ocellatus** (Kner).

1859. *Pseudoperilampus* (?) *ocellatus* KNER, Novara, Fisch., III, p. 365, Taf. 15, Fig. 6; Shanghai.

1868. *Rhodeus ocellatus* GÜNTHER, Cat. Fish., VII, p. 280; China.—BLEEKER, Mem. Cyprin. Chine., 1871, p. 34, Pl. VI, Fig. 3; Yang-tze-kiang.—GÜNTHER, Ann. Mag. Nat. Hist., Sept., 1873, p. 249; Shanghai.—JORDAN & SEALE, Proc. U. S. Nat. Mus., XXIX, 1905, p. 518; Shanghai.—JORDAN & METZ, Mem. Carneg. Mus., VI, 1913, p. 20; Suigen, Corea.

Head 4.23 in length; depth 2.28; D. 2, 12; A. 2, 13; P. 11; V. 6; width of head 2 in its length; eye 3 in head; interorbital space 2.5; snout 3; pectoral 1.25; ventral 1.33; thirty-four scales in a longitudinal series, thirteen scales in an oblique series between origin of dorsal and the middle of belly; pharyngeal teeth 5-5; gill-rakers 2 + 10.

Body much compressed, deep and rhomboidal; head small, its dorsal profile slightly concave above the eyes; snout as long as the diameter of eye, tip obtusely rounded, with a bony oval swelling, which is provided with a number of minute tubercles, more or less overlapping the upper lip; interorbital space broad, rather flat; mouth subinferior, rather transverse, its angle reaching the anterior border of nostril below; lower jaw slightly shorter than the upper; no barbel; nostrils close together, approximated to eyes, posterior nostril widely opened; pharyngeal teeth compressed, the sides not serrated, with a grinding surface.

Dorsal fin elongate, its origin nearer tip of snout than base of caudal, inserted behind the origin of ventral, base of the fin one and one-third times as long as the head; pectoral fin reaching to within a short distance to ventral; the ventral slender, scarcely reaching the origin of anal; anal fin elongate, inserted beneath the middle of the base of dorsal, anterior ray longest; caudal fin deeply emarginate, the tip of each lobe pointed.

Scales moderate, imbricated; lateral line incomplete, visible only on four or five scales near gill-openings.

Color dark gray above, paler below; lower parts of the sides bluish anteriorly; scales on the back and sides with black edges; a black lateral band runs along the middle of the posterior half of the side, commencing near the origin of the dorsal below; a black spot above the gill-opening and a dusky cross-bar on the shoulder; dorsal and caudal fins dusky, the pectoral and ventral whitish, anal fin pinkish.

Total length 68 mm.

Described from a specimen from Taihoku, collected by Oshima in September, 1916.

Habitat: Abundant in the ponds and rivulets near Taihoku. My specimens came from Taihoku and Nanto.

MEASUREMENTS OF *Rhodeus ocellatus*.

Locality.	Head.	Depth.	D.	A.	P.	V.	Width of Head.	Interorbital.	Snout.	Eye.	Scales.	Length, Mm.
Taihoku	4.23	2.28	2, 12	2, 13	11	6	2	2.50	3	3	34–13	68
Taihoku	3.91	2.60	2, 11	2, 11	10	7	2	2.50	3	3	34–11	55
Taihoku	3.90	2.29	2, 12	2, 12	11	6	2	2.50	3.50	3	34–11	50
Taihoku	3.80	2.37	2, 12	2, 12	11	7	2	2.33	3	3	34–11	48
Taihoku	4	2.52	2, 12	2, 12	11	6	2	2.33	3.66	3	34–11	46
Taihoku	3.80	2.22	2, 12	2, 12	11	6	2	2.50	3.50	3	34–11	50
Nanto	4.40	2.25	2, 12	2, 11	10	7	2	2.33	3	3	32–11	55

Genus ZACCO Jordan & Evermann.

1902. *Zacco* JORDAN & EVERMANN, Proc. U. S. Nat. Mus., XXV, p. 322. (Type *Leuciscus platypus* Temminck & Schlegel.)

Body moderately elongate and compressed; head compressed; snout conical, pointed; eyes moderate; mouth oblique, not notched; no barbels; teeth 5 or 4, 4, and 2 or 1—1 or 2, 4 and 4 or 5; interorbital space convex. Intestine short. Peritoneum black. Scales cycloid, narrowly imbricated, forty to sixty in the lateral line. Dorsal nearer tip of snout than base of caudal, or midway between, its developed rays seven; anal inserted below, or a trifle before, tip of depressed dorsal; its basis long, and composed of nine or ten developed rays; caudal emarginate; pectorals sometimes reaching ventrals; ventrals inserted a little before or below the origin of dorsal. Lateral line continuous and decurved. Breeding males have the head, the lower surface of the caudal peduncle, and the anal fin furnished with horny tubercles, not as numerous as those in *Opsariichthys*, and larger in proportion. The anal fin also has the developed rays elongated and with adipose expansions. (Jordan & Fowler.)

Distribution: Japan; Corea; Formosa.

SYNOPSIS OF THE FORMOSAN SPECIES.

a. Scales in the lateral line 42–44; 8 scales between lateral line and the origin of dorsal; 2 scales between lateral line and the root of ventrals........*platypus.*

aa. Scales in the lateral line 49–52; 9–10 scales between lateral line and the origin of dorsal; 3 scales between lateral line and the root of ventrals....*temmincki.*

aaa. Scales in the lateral line 53–55; 12 scales between lateral line and the origin of dorsal; 4 scales between lateral line and the root of ventrals..*pachycephalus.*

36. **Zacco platypus** (Temminck & Schlegel).

Oikawa, Haya or Hae (Japan); Chopien or Anoye (Formosa).

1846. *Leuciscus platypus* TEMMINCK & SCHLEGEL, Fauna Japonica, Poiss., p. 297, Pl. CI, Fig. 1; streams near Nagasaki.

1863. *Opsariichthys platypus* GÜNTHER, Cat. Fish., VII, p. 296; Japan & Formosa. —ISHIKAWA, Zoöl. Mag. Tokyo, 1895, p. 121; Hakone; Matsubara on Lake Biwa.—Prel. Cat., 1897, p. 11; Tega Lake; Tokyo; Chichibu; Lake Suwa; Lake Biwa; Kyoto; Tsuyama.—BOULENGER, Proc. Zoöl. Soc. London, 1899, p. 961; Hainan.

1900. *Barilius platypus* JORDAN & SNYDER, Proc. U. S. Nat. Mus., XXII, p. 344; Lake Biwa.

1903. *Zacco platypus* JORDAN & FOWLER, Proc. U. S. Nat. Mus., XXVI, p. 851; Tsuchiura; Kinu River; Yodo River; Chikugo River; Yabe River; Tama River; Nagoya; Kawatana; Lake Biwa.—SMITH & COPE, Proc. U. S. Nat, Mus., XXXI, 1908, p. 462.—JORDAN & THOMPSON, Mem. Carneg. Mus., VI, no. 4, 1914, p. 232; Lake Biwa; Okayama.—SNYDER, Proc. U. S. Nat. Museum, XLII, p. 404; Takamatsu River.—JORDAN, SNYDER, & TANAKA. Journ. Coll. Sci. Tokyo, XXXIII, 1913, p. 75; Japan.

1846. *Leuciscus macropus* TEMMINCK & SCHLEGEL, Fauna Japonica, Poiss., p. 209, Pl. CI, Fig. 2; Nagasaki.

1846. *Leuciscus minor* TEMMINCK & SCHLEGEL, Fauna Japonica, Poiss., p. 210, Pl. CI, Fig. 3; Nagasaki.

1903. *Zacco evolans* JORDAN & EVERMANN, Proc. U. S. Nat. Mus., XXV, p. 323; Taihoku, Formosa.

Head 4 in length; depth 3.71; D. II, 7; A. 3, 9; P. 15; V. 9; width of head 1.92 in its length; eye 4 in head; interorbital space 2.78; snout 3; ventral 1.32; pectoral a little longer than the head; forty-three scales in the lateral line, eight scales in an oblique series between origin of the dorsal and lateral line, four scales between the latter and the middle of belly, two scales between lateral line and the root of the ventral; pharyngeal teeth 5, 4, 1—1, 4, 5; gill-rakers 2 + 8.

Body elongate, compressed; dorsal profile more or less arched, head moderate, its top very slightly arched; snout bluntly pointed anteriorly; mouth oblique, its angle extending to a vertical through anterior border of orbit; lower jaw slightly shorter than the upper; eye moderate, superior; nostrils close together, in front of eye, anterior nostril in a short tube; lower part of pre-operculum and sides of the snout with a number of colorless tubercles; extremity of the snout, upper lip, and outer part of lower jaw with a series of minute tubercles.

Origin of dorsal nearer tip of snout than base of caudal, opposite the ventral, short, rather high, but not exceeding the length of head; pectoral elongate, extending beyond the root of ventral; ventral fin rather short, reaching the root of anal; anal fin elongate, its middle ray much longer than the head, when depressed reaching beyond the root of caudal, two or three of the anal rays provided with tubercles; caudal fin strongly bifurcated; depth of caudal peduncle 2.4 in length of head.

Scales thin and cycloid; lateral line decurved, extending along the lower half of the tail.

Color in alcohol brownish gray above, paler below; lower parts silvery; sides with about twelve dark cross-bars; membrane of dorsal and anal fins with a series of black streaks; dorsal and caudal fins dusky; the pectoral and ventral whitish.

Total length 120 mm.

Described from a specimen from Choso River near Koshiryo, collected by T. Aoki in August, 1917.

Habitat: Tamusui River (Shinten and Heirinbi); Shinchiku; Choso River.

Remarks: In the year 1903, Jordan and Evermann described a species of the genus *Zacco* from Formosa, giving the name *Zacco evolans*. According to their statement it agrees fairly well with the Japanese species, *Zacco platypus*, except in the much greater length of the pectorals. All the characters, especially the length of the pectoral fin, of the above described specimen agree quite well with those of the type of *Zacco evolans* in the Stanford collections (No. 7129; Taihoku, Formosa). But, after a close examination of a vast number of specimens of the present species from the same locality, I found that the length of the pectoral fin is variable. Even the co-type of *Z. evolans* in the Stanford collections (No. 7333; Taihoku) is provided with shorter pectoral fins which scarcely reach to the root of the ventral.

Such being the case, it is inadvisable to specifically separate the Formosan form from the Japanese *Z. platypus.*

DESCRIPTION OF THE TYPE SPECIMEN OF *Zacco evolans*, JORDAN & EVERMANN.

(No. 7129; Stanford collection; Taihoku; Tada coll.)

Head 4.22 in length; depth 3.42; D. II, 7; A. 3, 9; P. 15; V. 9; width of head 2 in its length; eye 3.33 in head; interorbital space 3; snout 3; forty-four scales in the lateral line, eight scales in an oblique series between origin of the dorsal and lateral line, four scales between the latter and the middle of belly, two scales between lateral line and the root of the ventral; ventral 1.20 in head; pectoral considerably longer than the head.

Body elongate, compressed; dorsal profile convex; head moderate, its top very slightly arched; snout pointed anteriorly; mouth oblique, its angle extending to a vertical through the anterior border of orbit; jaws subequal; eyes moderate, superior; nostrils close together, in front

MEASUREMENTS OF *Zacco platypus.*

Locality.	Head.	Depth.	D.	A.	P.	V.	Interorbital.	Snout.	Eye.	Scales.	Pectoral.	Length, Mm.
Choso River......	4	3.71	II, 7	3, 9	15	9	2.77	3	4	8–43–4	Beyond V.	120
Tamusui River...	4	4.66	II, 7	3, 9	15	9	3	3	3.33	9–44–4	Reaching V.	115
Tamusui River...	3.86	4.61	II, 7	3, 9	15	9	3	3	3.33	8–44–4	Reaching V.	100
Tamusui River...	4	5	II, 7	3, 9	16	9	3	3	3.33	8–43–4	Reaching V.	108
Tamusui River...	4	4.25	II, 7	3, 9	15	9	3	3	3.40	8–42–4	Reaching V.	107
Shinchiku........	4	4.35	II, 7	3, 9	13	9	3	3	3	8–44–4	Not to V.	92
Taihoku (Type *Z. evolans*) .	4.22	3.42	II, 7	3, 9	15	9	3	3	3.33	8–44–4	Beyond V.	98
Tsuchiura (S. No. 7340).....	4	3.80	II, 7	3, 9	15	9	3	3	4	8–44–4	Reaching V	135
Tsuchiura (S. No. 7340).....	4.30	3.64	II, 7	3, 9	15	9	3	3	4.50	8–44–4	Reaching V.	150
Tsuchiura (S. No. 7340).....	4.24	4.50	II, 7	3. 9	15	9	3	3	3.66	8–44–4	Not to V.	148
Lake Biwa (S. No. 22623)....	4	4.75	II, 7	3, 9	15	9	3	3	4	8–44–4	Not to V.	112
Lake Biwa (S. No. 22623)....	4.50	5	II, 7	3, 9	15	9	3	3	4	8–44–4	Not to V.	138
Lake Biwa (S. No. 22623)....	4	4.71	II, 7	3, 9	15	9	3.25	3.25	4	8–42–4	Not to V.	120

of eye; lower part of pre-operculum, sides of the snout, and outer part of the lower jaw with a number of round tubercles.

Origin of the dorsal nearer tip of snout than base of caudal, opposite the ventral, the fin very high, rays longer than the head; pectoral fins elongate, reaching to the root of anal; anal fin very large, its rays nearly twice as long as head; caudal fin deeply bifurcate, the tip of each lobe pointed.

Scales thin and cycloid; lateral line decurved, low, extending along the lower half of the tail.

Color in alcohol brownish gray above, silvery; sides with about eleven dark cross-bars; membrane of dorsal and anal fins with a series of dark streaks; other fins pale.

Total length 98 mm.

37. **Zacco temmincki** (Schlegel).

Chopien (Formosa).

1846. *Leuciscus temminckii* SCHLEGEL, Fauna Japonica, Poiss., p. 210, Pl. CI, Fig. 4; Nagasaki.

1868. *Opsariichthys temminckii* GÜNTHER, Cat. Fish., VII, p. 295; Japan.—ISHIKAWA, Zoöl. Mag. Tokyo, 1895, p. 121; Hikone; Matsubara.

1901. *Barilius temminckii* JORDAN & SNYDER, Check-list, Fish. Japan, p. 47; Lake Biwa.

1903. *Zacco temminckii* JORDAN & FOWLER, Proc. U. S. Nat. Mus., XXVI, p. 852; Kawatana; Mogi River.—SNYDER, Proc. U. S. Nat. Mus., XLII, 1912, p. 404; Yamaguchi.—JORDAN & Metz, Mem. Carneg. Mus., VI, no. 2, 1913, p. 21; Fusan; Pung-tung, Corea.

1901. *Opsariichthys acanthogenys* BOULENGER, Proc. Zoöl. Soc. London, p. 269; Ningpo.

1903. *Zacco pachycephalus* JORDAN & EVERMANN, Proc. U. S. Nat. Mus., XXV, p. 322; Taihoku, Suwata, Formosa (not of Günther).

Head 4 in length; depth 4.5; D. II, 7; A. 3, 9; P. 15; V. 9; width of head 2 in its length; eye 4 in head; interorbital space 2.75; snout 3; ventral 1.5; pectoral as long as head; fifty scales in the lateral line, nine scales in an oblique series between origin of the dorsal and lateral line, six scales between the latter and the middle of belly, three scales between lateral line and the root of the ventral; pharyngeal teeth 4, 4, 1–1, 4, 5; gill-rakers 3 + 7.

Body elongate, compressed, deeper anteriorly, postventral edge rather sharp, but not carinated; head moderate, its top more or less convex; snout bluntly pointed anteriorly; mouth oblique, its angle reaching beyond the anterior border of orbit; upper jaw normal, lower jaw not protruding; eyes superior and anterior; nostrils close together, in front of eye; sides of snout, cheeks, and lower jaws with a number of tubercles.

Origin of dorsal at a point midway beween tip of snout and base of caudal, slightly behind that of ventral, fin short and high, its ray not exceeding the length of head; pectoral elongate, scarcely reaching the root of ventral; ventral fins reaching the origin of anal; anal fin rather long, its middle rays considerably elongate, when depressed reaching beyond the root of caudal, furnished with horny tubercles; caudal fin forked, rather long; depth of caudal peduncle 2.5 in length of head.

Scales thin and cycloid; lateral line strongly decurved, extending along lower half of the tail.

Color in formalin dark gray above, paler below; belly and lower part of sides silvery; sides with ten black cross-bars and two irregular

MEASUREMENTS OF *Zacco temminkii.*

Locality.	Head.	Depth.	D.	A.	P.	A.	Interorbital.	Snout.	Eye.	Teeth.	Scales.	Sc. Bet. Lat. Line & V.	Length, Mm.
Ako	4	4.50	II, 7	3, 9	15	9	2.75	3	4	4, 4, 1—1, 4, 5	9–50–6	3	96
Ako	3.80	3.80	II, 7	3, 9	14	9	3	3	3.75	4, 3, 1—1, 4, 5	10–49–6	3	92
Tamusui River	3.30	4.25	II, 7	3, 9	16	9	3	3.18	4.50	4, 4, 1—1, 4. 4	11–53–6	2	125
Giran River	3.87	3.31	II, 7	3, 9	15	9	2.66	3	5	4, 4, 1—1, 4, 5	10–52–6	3	145
Heirinbi	3.33	3.88	II, 7	3, 9	15	9	3	3	4.50	....	10–49–6	3	117
Inzanpo	4	3.71	II, 7	3, 9	15	9	3	3	4	....	10–51–6	3	108
Inzanpo	3.60	4.	II, 7	3, 9	15	9	3	3	5	....	10–49–6	3	130
Tensonpi	3.50	4.66	II, 7	3, 9	15	9	3.25	3.25	4.33	....	10–49–6	3	110
Suwo	3.72	4.14	II, 7	3, 9	15	9	3	3	4.75	....	10–49–6	3	110
Shimotamusui R.	4	4	II, 7	3, 9	15	9	3	3	3.5	4, 4, 1—1, 4, 5	10–49–6	3	86
Shimotamusui R.	4	3.89	II, 7	3, 9	15	9	2.75	3.33	3.66	4, 4, 1—1, 4, 5	9–52–6	3	80
Sobun River	3.82	4	II, 7	3, 9	15	8	3	3	4	4, 4, 1—1, 4, 5	10–49–6	3	97
Rigyokutsu	3.75	3.75	II, 7	3, 9	15	9	3	3.25	4	4, 4, 1—1, 4, 5	10–49–6	3	100
Lakusui River	3.33	4	II, 7	3, 9	15	9	3	3	4	4, 4, 1—1, 4, 4	10–51–6	3	100
Lakusui River	3.31	4	II, 7	3, 9	15	9	3.25	3	4	....	11–50–6	3	89
Taihoku (*Z. pachycephalus*) S. 12232 (7720)	3.60	4	II, 7	3, 9	15	9	3	3	4.50	....	10–50–6	3	...
Suwata (*Z. pachycephalus*) S. 12076 (7720)	3.60	3.75	II, 7	3, 9	15	9	3.25	3	4	....	10–48–6	3	...

dark spots on the tail; nape just behind the gill-opening dark; dorsal fin with a series of black streaks; dorsal, anal, and caudal fins dusky; other fins whitish.

Total length 96 mm.

Described from a specimen from Ako, collected by T. Aoki in December, 1916.

Habitat: One of the most abundant of the Formosan *Cyprinidæ*. My specimens came from Tamusui River; Daiko River; Daito River; Shinchiku; Dakusui River; Rigyokutsu, Nanto; Sobun River; Shimotamusui River; Ako; Heirinbi; Inzanpo; Tensonpi; Suwo; Giran.

Remarks: Jordan and Evermann described a species of the genus *Zacco* from Suwata and Taihoku, Formosa, under the name *Zacco pachycephalus* (Günther) (Proc. U. S. Nat. Mus., XXV, 1903, p. 322). As shown in the following table, the two specimens which are contained in the Stanford collections have ten scales between origin of dorsal and lateral line, three scales between the latter and the root of ventral, and forty-eight to fifty scales in lateral line, instead of 12–55–4 as in the type of Günther's *Z.* (*Opsariichthys*) *pachycephalus*. Moreover, the other characters of these two specimens agree quite well with those of *Zacco temmincki*. It is reasonable, therefore, to transfer Jordan & Evermann's *Zacco pachycephalus* to the present species.

38. **Zacco pachycephalus** Günther.

1868. *Opsariichthys pachycephalus* GÜNTHER, Cat. Fish., VII, p. 297; Formosa.

Head 3.63 in length; depth 4; D. II, 8; A. 3, 9; P. 14; V. 9; width of head 2 in its length; eye 3.6 in head; interorbital space 3.14; snout 3; pectoral 1.22; ventral 1.66; fifty-three scales in the lateral line, twelve scales in an oblique series between origin of dorsal and lateral line, nine scales between the latter and the middle of belly, four scales between lateral line and the root of the ventral; pharyngeal teeth 5, 3, 1—1, 3, 4; gill-rakers 2 + 8.

Body oblong, compressed; head moderate, its top more or less flattened, cheek with traces of tubercles; snout pointed anteriorly, its dorsal profile curved; mouth oblique, its angle extending beyond the vertical through the anterior margin of the orbit; lower jaw very slightly shorter than the upper; eye superior; nostrils close together, supra-lateral, in front of the eye.

Origin of dorsal at a point midway between tip of snout and base of caudal, opposite to that of the ventral; pectoral fin not extending to the root of ventral; ventral reaching vent; four anterior branched rays of the anal elongate, reaching beyond the root of caudal; caudal fin deeply emarginate, tip of each lobe pointed.

Scales minute, thin; lateral line decurved, extending along the lower half of the tail.

Color in formalin dark gray above, lower half of the sides and belly silvery; sides with about twelve indistinct dark cross-bars; a black longitudinal streak runs along the middle of the tail; membrane of the dorsal with a series of dark streaks; dorsal and caudal fins dusky, other fins whitish.

Total length 102 mm.

The present description is from a specimen from the Tamusui River near Shinten, collected by T. Aoki in December, 1916.

Habitat: Tamusui River (a single specimen).

Genus METZIA Jordan & Thompson.

1914. *Metzia* JORDAN & THOMPSON, Mem. Carneg. Mus., VI, no. 4, p. 227. (Type *Acheilognathus mesembrinum* Jordan & Evermann.)

Body short, deep, very greatly compressed; head small and pointed; mouth moderate, somewhat oblique; the jaws subequal, maxillary reaching anterior edge of orbit; pharyngeal teeth in three rows, 4, 4, 2—2, 4, 4, with brown tip. Scales large and well imbricated; lateral line complete, decurved. Origin of the dorsal slightly nearer tip of snout than tip of caudal fin, anal inserted behind last dorsal ray; ventrals and pectorals moderate, the latter falcate; caudal fin lunate. Peritoneum black; intestine elongate. No barbel.

Distribution: Botel Tobago Island (Near Formosa).

39. **Metzia mesembrina** (Jordan & Evermann).

1903. *Acheilognathus mesembrinum* JORDAN & EVERMANN, Proc. U. S. Nat. Mus., XXV, p. 323; Kotosho, Formosa.

Head 4 in length; depth 3.18; D. 2, 7; A. 3, 14; P. 15; V. 8; width of head 2 in its length; eye 3.6 in head, interorbital space 2.57; snout 3.6; thirty-six scales in the lateral line, eight scales in an oblique series between origin or dorsal and lateral line, five scales between the latter and the middle of belly, three scales between lateral line and the root of the ventral; pharyngeal teeth 4, 4, 2—2, 4, 4.

Body deep, very greatly compressed; head small and pointed; snout short, truncated in front; mouth oblique, its angle reaching beyond the anterior border of orbit; the jaws subequal, with thin lips;

eyes large, anterior; nostrils superior, close together, in front of eye above; tip of the pharyngeal teeth brown.

Origin of the dorsal much nearer base of caudal than tip of snout, inserted opposite the interspace between the ventral and anal, the fin short and high, its anterior ray slightly shorter than the head; pectoral fin reaching the ventral; ventral inserted much in advance of the dorsal, not reaching the vent; the anal elongate, entirely behind the dorsal, its base oblique, free edge somewhat concave, anterior ray the longest; caudal fin emarginate, the tip of each lobe pointed; caudal peduncle rather short, its depth 2.33 in length of head.

Scales large, well imbricated; lateral line decurved, extending along the lower half of tail.

Color in alcohol grayish above; belly and lower part of sides silvery, with no markings; all the fins whitish.

Total length 84 mm.

Described from a specimen from Kotosho (Botel Tobago Island), collected by T. Tada. (Cotype; No. 7151, Stanford collections).

Habitat: Botel Tobago Island (Kotosho).

MEASUREMENTS OF *Metzia mesembrina.*

Locality.	Head.	Depth.	D.	A.	P.	V.	Width of Head.	Interorbital.	Snout.	Eye.	Scales.	Length, Mm.
Kotosho (Type; S. U. No. 7131	4	2.8	8	15	—	–	–	2.50	4	3.50	8–38–5	83
Kotosho (Cotype; S. U. No. 7151).....	3.89	3	2, 7	3, 13	15	8	2	2.85	3.80	3.40	7–36–5	90
Kotosho (Cotype; S. U. No. 7151).....	4	3.18	2, 7	3, 14	15	8	2	2.57	3.60	3.60	8–36–5	84

Genus CANDIDIA Jordan & Richardson.

1909. *Candidia* JORDAN & RICHARDSON, Mem. Carneg. Mus., IV, No. 4, p. 169. (Type *Opsariichthys barbatus* Regan.)

Body covered with small scales. Lateral line slightly decurved, running along the lower part of the tail. Dorsal fin short, with seven branched rays, inserted opposite the root of ventrals, midway between tip of snout and base of caudal. Anal fin with nine branched rays. Barbels two, minute, maxillary. The angle of mouth extends beyond anterior margin of orbit. Gill-rakers very short, conical. Pharyngeal teeth 5, 4, 1—1, 4, 5.

Distribution: Formosa.

40. **Candidia barbata** (Regan).

Koeko or Gogahii (Formosa).

1908. *Opsariichthys barbatus* REGAN, Ann. Mag. Nat. Hist. (8), II, p. 359; Lake Candidius, Formosa.

1909. *Candidia barbata* JORDAN & RICHARDSON, Mem. Carneg. Mus., IV, no. 4, p. 169; Lake Candidius (after Regan).

Head 3.6 in length; depth 3.66; D. 3, 7; A. 3, 9; P. 15; V. 9; width of head 2 in its length; snout 3 in head; interorbital space 2.7; eye 5; pectoral 1.5; ventral 1.75; fifty-six scales in the lateral line, three between the latter and the root of ventral, eight between lateral line and middle of belly; gill-rakers 3 + 8; pharyngeal teeth 5, 4, 1—1, 4, 5.

Body elongate, compressed, curvature of the dorsal profile equal to that of the ventral; head rather long, lower parts of operculum and suborbicular parts with a number of tubercles; snout truncated in front, partially covering the upper lip, its sides provided with conical tubercles, of which the anterior ones are larger; a notch in front of eye; mouth oblique, extending beyond the anterior border of orbit; upper lip thicker than the lower, the proximal half of which is provided with a series of large conical tubercles; upper jaw slightly protruding; two very short maxillary barbels; eyes anterior and superior; nostrils close together, superior, in front of eye.

Origin of dorsal midway between tip of snout and base of caudal, inserted above the origin of ventral, anterior rays longer; pectorals not reaching ventrals; anal entirely behind the dorsal, middle rays prolonged, each ray with traces of tubercles; caudal fin forked, each lobe sharply pointed; depth of caudal peduncle 2.33 in head.

Body covered with small scales; lateral line continuous, slightly decurved, extending along the lower part of the tail.

Color in formalin yellowish gray above, paler below, belly whitish; basal two-thirds of the membrane of the dorsal black; caudal fin grayish; the rest of the fin dusky white, with faint black mottlings; a black longitudinal band from the nape to the base of caudal.

Total length 120 mm.

Described from a specimen from Jitsugetsutan, collected by T. Aoki in August, 1916.

Habitat: Jitsugetsutan (Lake Candidius); Shito, Giran.

Remarks: The tubercles on the head and anal fin are very distinct in male specimens, while the anal of the female is nearly smooth. Lower parts of caudal peduncle of male sometimes tuberculated.

MEASUREMENTS OF *Candidia barbata.*

Locality.	Head.	Depth.	D.	A.	P.	V.	Width of Head.	Interor-bital.	Snout.	Eye.	Scales.	Length, Mm.
Jitsugetsutan......	3.60	3.66	3, 7	3, 9	15	9	2	2.70	3	5	12–56–8	120
Jitsugetsutan......	3.48	3.73	3, 7	3, 9	15	9	1.77	2.71	2.71	5.33	11–57–8	159
Jitsugetsutan......	3.64	3.83	3, 7	3, 9	15	9	1.92	2.66	3	4.80	12–54–8	109
Jitsugetsutan......	3.66	3.66	3, 7	3, 9	14	9	2	2.70	2.89	5	11–54–8	117
Shito.............	3.54	4	3, 7	3, 9	15	9	1.85	2.77	3	4.50	12–57–8	100

Genus HYPOPHTHALMICHTHYS Bleeker.

1860. *Hypophthalmichthys* BLEEKER, Prodr. Cypr., p. 405. (Type *Leuciscus molitrix* Cuv. & Val.)

1869. *Abramocephalus* STEINDACHNER, Wien, Sitzungsb., LX, p. 383. (Type *Abramocephalus microlepis* Steindachner.)

1872. *Onychodon* DYBOWSKY, Verh. Zoöl.-Bot. Ges. Wien, XXII, p. 211. (Type *Cephalus mantschuricus* Basilewsky.)

Body stout, compressed, back rounded, abdomen strongly compressed, with a sharp keel from throat to vent. Head rather small; mouth anterior, broader than deep, its angle not reaching the orbit; lips thin; barbel none. Eye situated in the lower half of the head, its lower margin being below the level of the angle of mouth. Gill-rakers continuous, forming a broad, crescentic, horny membrane, its basal portion perforated. Dorsal fin short, inserted behind the origin of ventral; anal fin triangular, entirely behind the dorsal. Gill-membranes united, forming a broad bridge across the isthmus. Scales small, about 115 in the lateral line. Pharyngeal teeth in one row, 4–4, compressed on the longitudinal axis of the bone. Lateral line decurved, running along the middle of the tail.

Distribution: China; Indo-China; Formosa; Amur Province.

41. **Hypophthalmichthys molitrix** (Cuv. & Val.).

Renhii (Formosa).

1844. *Leuciscus molitrix* CUV. & VAL., Hist. Nat. Poiss., XVII, p. 360.—RICHARDSON, Ichthyol. China, 1846, p. 259; Canton, China.

1844. *Leuciscus hypophthalmus* (GRAY) RICHARDSON, Ichthyol. Voy. Sulph., p. 139, Pl. 63, Fig. 1; Canton.

1855. *Cephalus mantschuricus* BASILEWSKY, Mem. Soc. Nat. Mosc., X, p. 235, T. VII, Fig. 3; Manchuria.

1860. *Hypophthalmichthys molitrix* BLEEKER, Ichth. Arch. Ind. Prods. II, Cyprin., p. 288.

1863. *Hypophthalmichthys molitrix* BLEEKER, Atlas Cyprin., III, p. 28.—GÜNTHER, Cat. Fish. VII, 1868, p. 298; China.—BLEEKER, Mem. Cyprin. China, 1871,

p. 83, Pl. XII, Fig. 1; Yang-tze-kiang.—GÜNTHER, Ann. Mag. Nat. Hist., Sept., 1889, p. 223; Ichang.—Ann. Mag. Nat. Hist. (7), I, 1898, p. 362; Newchang.—BERG, Ichthyol. Amur., 1909, p. 154; Amur Provinces.

1872. *Onychodon mantschuricus* DYBOWSKI, Verh. Zoöl.-Bot. Ges. Wien, XXII, p. 211; Ussuri.

1878. *Hypophthalmichthys dabryi* BLEEKER, Versl. en Mededel. Konin. Akad. Wetensch. Amst. (2), XII, p. 210.

Head 3.58 in length; depth 3.25; D. 3, 7; A. 3, 12; P. I, 17; V. 8; width of head 1.48 in its length; eye 6 in head; interorbital space 2; snout 3.16; pectoral 1.30; ventral 1.48; one and fifteen scales in the lateral line, twenty-eight scales in an oblique series between origin of the dorsal and lateral line, twenty-one scales between the latter and the middle of belly, fifteen scales between lateral line and the root of ventral; pharyngeal teeth 4–4.

Body stout, compressed, back rounded, abdomen strongly compressed, with a sharp keel from throat to vent; head moderate, smooth, postoperculum with radiated striæ; snout blunt, obtusely rounded anteriorly; mouth anterior, broader than deep, its angle not extending to the orbit; lips rather thin; lower jaw slightly longer than the upper; eyes rather small, anterior and inferior; nostrils close together, superior; pharyngeal teeth stout, high, laterally compressed, inner surface with a large oval concavity of brown color; gill-membranes strongly extending beyond the gill-covers united across the isthmus; gill-rakers continuous, forming a broad, crescentic, horny membrane, its basal portion perforated.

Origin of dorsal midway between tip of snout and base of caudal, very short, anterior ray the longest, when depressed its tip reaching beyond all other rays; pectoral fin armed with a smooth spine, reaching the root of ventral; origin of ventral much in advance of that of dorsal, rather slender, not reaching the vent; anal fin triangular, entirely behind the dorsal, its origin nearer to that of ventral than base of caudal; caudal fin deeply emarginate, tip of each lobe sharply pointed; caudal peduncle elongate, its depth 1.5 in the length of head.

Scales minute, cycloid; lateral line decurved, continuous, extending along the middle of tail.

Color in formalin grayish above, sides and belly silvery; dorsal and caudal fins pale gray; upper surface of the pectoral speckled with fine black spots, lower surface whitish; other fins whitish.

Total length 370 mm.

Described from a specimen from Shori, Toyen.

Habitat: Bred in ponds throughout the island.

Remarks: The present species is one of the important food-fishes, though it is not a native of the island. In the spring, young of *H. molitrix* are imported from Southern China and are bred artificially like other Chinese fishes.

MEASUREMENTS OF *Hypophthalmichthys molitrix.*

Locality.	Head.	Depth.	D.	A.	P.	V.	Width of Head.	Interorbital.	Snout.	Eye.	Scales.	Length, Mm.
Shori..........	3.58	3.25	3, 7	3, 11	I, 17	8	1.41	2	3.16	6	28–115–21	370
Giran..........	3.14	3.33	3, 7	3, 11	I, 17	8	1.75	2.20	3	6	28–119–21	330

ARISTICHTHYS gen. nov.

Type *Leuciscus nobilis* (Gray) Richardson.

Body stout, compressed, rather high in front; abdomen rounded, with a keel only in the postventral part. Head large; snout rather short, obtusely rounded. Mouth oblique, anterior, its angle reaching below the center of eye; lips thin; barbel none. Eye inferior and much anterior. Gill-rakers separated, slender and long, set very closely, with many membranous septa. Dorsal fin short, inserted behind the origin of ventral; anal fin triangular, entirely behind the dorsal. Gill-membranes united, forming a broad bridge across the isthmus. Scales small, about 115 in the lateral line. Pharyngeal teeth in one series, 4–4, strongly compressed laterally. Lateral line strongly decurved anteriorly, running along the middle of the tail.

Distribution: Formosa; South China.

Remarks: The present genus is a near relative of *Hypophthalmichthys.* It differs distinctly from the latter in having clearly separated gill-rakers, large head, and rounded abdomen, which has no keel in front of the ventral.

42. **Aristichthys nobilis** (Richardson).

Chikuyoren (Formosa).

1844. *Leuciscus nobilis* (GRAY) RICHARDSON, Ichthyol. Voy. Sulph., p. 140, Pl. 63, Fig. 3; Canton, China.

1866. *Cephalus hypophthalmus* STEINDACHNER, Verh. Zoöl.-Bot. Gesell. Wien, p. 383; Hongkong.

1867. *Hypophthalmichthys manchuricus* KNER, Novara Fisch, III, p. 350; Shanghai.

1868. *Hypophthalmichthys nobilis* GÜNTHER, Cat. Fish., VII, p. 299; Amoy.—

BLEEKER, Mem. Cyprin, Chine, 1871, p. 85; Yang-tze-kiang.—GÜNTHER, Ann. Mag. Nat. Hist., Sept., 1873, p. 249; China.—PETERS, Monatsb. Ak. Berlin, 1880, p. 926.—SAUVAGE, Bull. Soc. Philom., 1881, p. 7; Swatow. —GÜNTHER, Ann. Mag. Nat. Hist. (6), IV, 1889, p. 228; Yang-tze-kiang.— RUTTER, Proc. Acad. Nat. Sc. Philad., 1897, p. 60; Swatow.

Head 2.8 in length; depth 3.28; D. 3, 7; A. 3, 11; P. I, 19; V. I, 7; width of head 1.76 in its length; eye 7.75 in head; interorbital space 2.11; snout 2.5; pectoral 1.28; ventral 1.83; one hundred and fifteen scales in the lateral line, twenty-five scales in an oblique series between origin of dorsal and lateral line, twenty-five scales between the latter and the middle of belly, seventeen scales between lateral line and root of ventral; pharyngeal teeth 4–4.

Body compressed, rather high in front; abdomen rounded, post-ventral part with a keel; head large, postoperculum with radiated striæ; snout rather short, broad, obtusely rounded anteriorly; mouth oblique, anterior, its angle reaching below the center of eye; lower jaw more or less protruding; middle part of the upper lip thick; eye inferior, much anterior; nostrils close together, superior, in front of eye above; gill-openings very large, with broad gill-membranes which are united on the throat and not attached to isthmus; pharyngeal teeth very high, strongly compressed laterally, inner surface with a large oval concavity; gill-rakers slender and long, set very closely, with many membranous septa.

Origin of dorsal nearer to base of caudal than tip of snout, rather short, anterior ray the longest, the depressed tip of the ray reaching beyond the others; pectoral large, reaching beyond the root of ventral, armed with a smooth osseous ray; ventral slender, the tip reaching vent, its origin in advance of that of the dorsal; anal fin entirely behind the dorsal, triangular, external margin more or less concave, inserted nearer origin of ventral than base of caudal; caudal fin deeply emarginate, tip of each lobe pointed; caudal peduncle elongate, its depth 3 in the length of head.

Body covered with small cycloid scales; lateral line strongly decurved in front, extending along the middle of the tail.

Color in formalin grayish above, paler below; sides and lower parts silvery; dorsal, anal, and caudal fins grayish, speckled with minute black spots; lower surface of pectorals and ventrals white, upper surface grayish and finely spotted with black.

Total length 455 mm.

Described from a specimen from Shori, Toyen.

Habitat: The present species is not a native of Formosa. Propagated artificially throughout the island.

Remarks: Aristichtyhs nobilis is a native of Southern China. Its young which are collected in the rivers near Swatow, Amoy, or Foochow are imported to Formosa and are bred in ponds, mingling with *Hypophthalmichthys molitrix.* Sometimes it reaches an enormous size, though it never spawns in Formosa.

Genus CHANODICHTHYS Bleeker.

1860. *Chanodichthys* BLEEKER, Nat. Tijdschr. Ned. Ind., XX, p. 432. (Type *Leptocephalus mongolicus* Basilewsky.)

1865. *Parabramis* BLEEKER, Nedrl. Tijdschr. Dierkunde, II, p. 21. (Type *Abramis pekinensis* Basilewsky.)

Body oblong, very greatly compressed; scales large. Snout convex; profile of the nape convex; mouth small, lower jaw not protruding, upper jaw more or less overlapping the former. Eye very large. Gill-openings not extending as far as the orbit below. Lateral line slightly curved. Dorsal fin short, inserted somewhat nearer to tip of snout than base of caudal, armed with two smooth, strong spines. The anal elongate, with numerous rays. Pharyngeal teeth 4, 4, 2—2, 4, 4.

Distribution: Formosa; China; Amur Province.

43. **Chanodichthys macrops** Günther.

Toabakon (Formosa).

1868. *Chanodichthys macrops* GÜNTHER, Cat. Fish., VII, p. 326; Formosa.

Head 4.31 in length; depth 3.375; D. II, 7; A. 3, 23; P. 16; V. 9; width of head 1.81 in its length; eye 3 in head; interorbital space 3.25; snout 3; pectoral 1.14; ventral 1.28; sixty scales in the lateral line, eleven scales in an oblique series between origin of dorsal and lateral line, eight scales between the latter and the middle of belly, five scales between lateral line and the root of ventral; pharyngeal teeth 4, 4, 2—2, 4, 4; gill-rakers 3 + 9.

Body strongly compressed, rather deep, postventral part carinate, dorsal profile abruptly arched behind the occiput; head rather small; snout obtusely pointed, as long as the diameter of eye; mouth subinferior and oblique, its angle reaching beneath the hind margin of nostril; lips thin; lower jaw shorter than the upper; eye very large, anterior and lateral; nostrils close together, large, in front of eye.

Origin of dorsal nearer tip of snout than base of caudal, armed with two smooth spines, of which the second is very strong, anterior ray longest; pectoral fin long, with a fleshy flap, almost reaching the root of ventral; ventral fin inserted in advance of that of dorsal, with a scaly flap; anal fin elongate, rays numerous, entirely behind the dorsal, posterior rays very low; caudal fin strongly emarginate, tip of each lobe sharply pointed; caudal peduncle rather short, its depth 2.25 in length of head.

Scales moderate, cycloid; lateral line more or less decurved, extending along lower half of the tail.

Color in formalin dark gray above, lower half of sides and belly silvery; all the fins except ventrals dusky.

Total length 207 mm.

Described from a specimen from Tamusui River near Shinten, collected by T. Aoki in December, 1916.

Habitat: Tamusui River (Shinten and Heirinbi).

Remarks: The present species is very closely allied with *Chanodichthys stenzi* from Kiautschau, China, differing from it in having a smaller number of anal rays.

MEASUREMENTS OF *Chanodichthys macrops*.

Locality.	Head.	Depth.	D.	A.	P.	V.	Width of Head.	Interorbital.	Snout.	Eye.	Scales.	Length, Mm.
Shinten..........	4.31	3.37	II, 7	3, 23	16	9	1.81	3.25	3	3	11–60–8	207
Shinten..........	4.10	3.40	II, 7	3, 22	16	9	2	3.45	3	3	11–58–8	185
Heirinbi..........	4.16	3.42	II, 7	3, 23	15	9	2.09	3	3	2.75	10–61–8	122

Genus CULTER Basilewsky.

1855. *Culter* BASILEWSKY, Nouv. Mem. Soc. Nat. Moscou, X, p. 236. (Type *Culter alburnus* Basilewsky as restricted by Günther.)

Body oblong, much compressed, the entire or postventral abdominal edge being trenchant. Scales of moderate or small size; lateral line without conspicuous curvature. Mouth directed upwards; barbels none. Dorsal fin short, with strong smooth spines, inserted above the interspace between ventral and anal; anal fin long, many-rayed; caudal fin forked, pectorals elongate. Gill-openings very wide; gill-rakers long, setiform. Pseudo-branchiæ present. Pharyngeal teeth in a triple series, slender and hooked. Intestinal tract short. Air-bladder tripartite. (Günther).

Distribution: China; Formosa; Corea; Amur Province.

SYNOPSIS OF THE FORMOSAN SPECIES.

a. Postventral edge only carinate; scales about 85 in the lateral line; 18 scales between lateral line and the origin of dorsal; 10 scales between lateral line and the root of ventrals . . . . *aokii.*

aa. Abdomen entirely carinate; scales about 64 in the lateral line; 11–12 scales between lateral line and the origin of dorsal; 6 scales between lateral line and the root of ventrals . . . . *brevicauda.*

44. **Culter aokii** sp. nov. (Plate LII, Fig. 1).

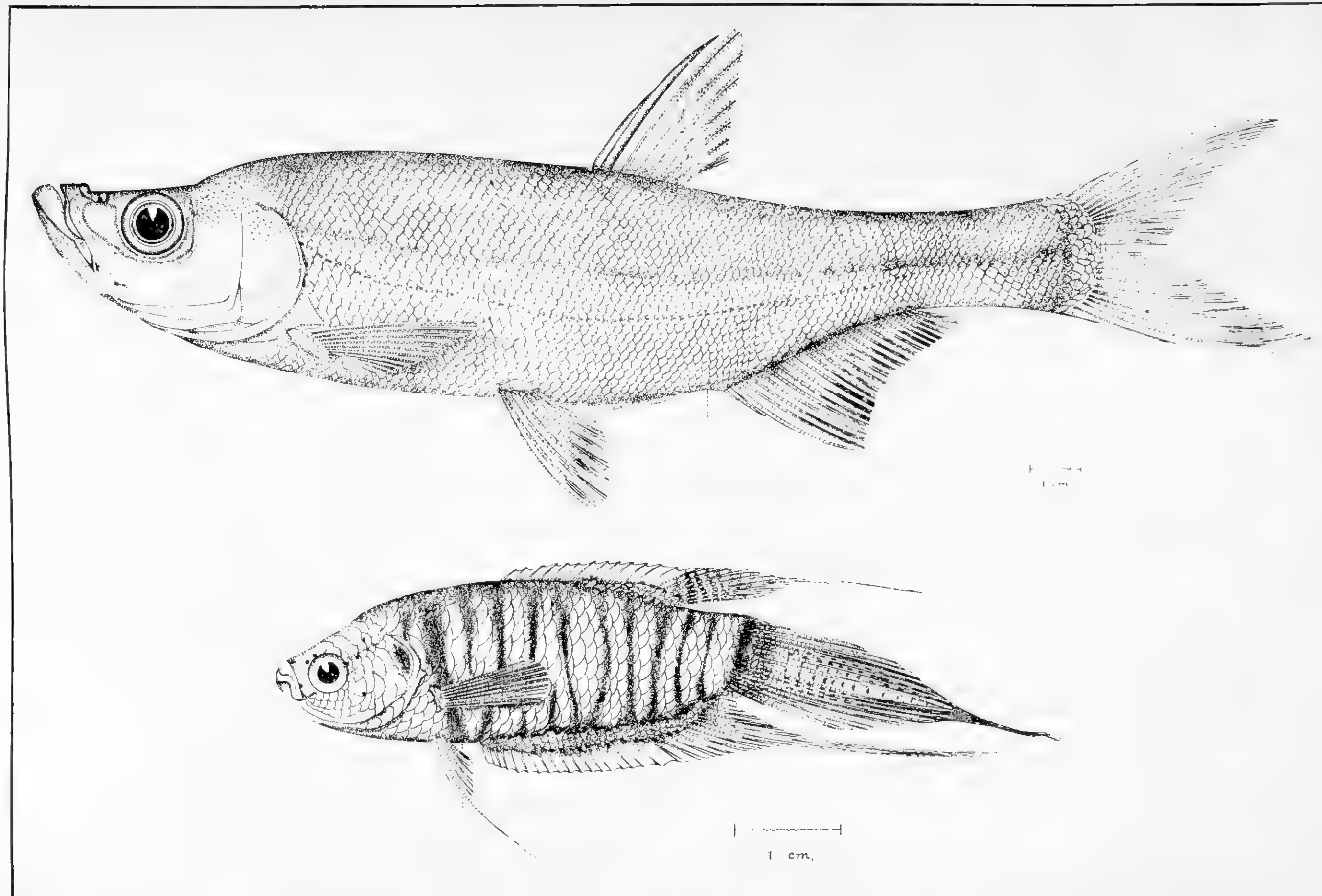
Kyauyo (Formosa).

Head 4.05 in length; depth 4.6; D. III, 7; A. III, 23; P. 15; V. 9; width of head 2.6 in its length; eye 4 in head; interorbital space 6; snout 3.75; eighty-six scales in the lateral line, eighteen scales in an oblique series between origin of dorsal and lateral line, ten scales between the latter and the middle of belly, six scales between lateral line and the root of ventral; pharyngeal teeth 5, 4, 2—2, 4, 5; gill-rakers 5 + 22.

Body oblong, much compressed, postventral abdominal edge carinate, dorsal profile convex; head rather long, laterally compressed, the top osseous, with two bony ridges between the eyes; interorbital space very narrow, slightly convex; many mucous cavities below and behind the orbit; snout bony, tip swollen, a slight depression in front of eye above, tip of its skin not overlapping the upper lip; mouth anterior, subvertical, its angle not reaching the vertical through anterior margin of orbit; lips thin; lower jaw more or less protruding; mentum provided with two strong osseous ridges which are united in front, extending backward to the operculum; isthmus entirely hidden beneath those ridges; eyes large, anterior; nostrils close together, more or less superior; gill-openings very large, gill-membranes entirely separated; gill-rakers slender and long.

Origin of dorsal in a point midway between tip of snout and base of caudal, with three smooth spines, the first spine very short, hidden beneath the skin, second shorter than half the length of the third, anterior ray the longest; pectoral armed with an osseous spiny ray, reaching the base of ventral; origin of ventral in advance of that of dorsal; anal fin entirely behind the dorsal, elongate, length of its base 1.17 in head; caudal fin emarginate, the tip of each lobe sharply pointed; caudal peduncle elongate, its depth 3 in length of head.

Body covered with thin cycloid scales; lateral line continuous, very slightly decurved, extending along near the middle of tail.



Culter aokii Oshima, sp. nov.
Macropodus filamentosus Oshima, sp. nov.

Color in alcohol pale gray above, belly and lower parts of the sides silvery; caudal fin grayish, other fins dusky white.

Total length 280 mm.

Described from a specimen from Jitsugetsutan, collected by T. Aoki in August, 1916.

Habitat: Restricted to Jitsugetsutan (Lake Candidius).

Remarks: This species is most nearly allied to *Culter sieboldi* Dybowski[8] from Amur Province. The differences are as follows: a lesser number of scales in the lateral line, a lesser number of scales between lateral line and the middle of belly, as well as small size of the body. The above described species is one of the largest forms which is found in Lake Candidius.

Named for Mr. Takeo Aoki of the Bureau of Fisheries, Government of Formosa.

MEASUREMENTS OF *Culter aokii*.

Locality.	Head.	Depth.	D.	A.	P.	V.	Width of Head.	Interorbital.	Snout.	Eye.	Scales.	Length, Mm.
Jitsugetsutan..	4.06	4.60	III, 7	III, 23	I, 15	9	2.60	6	3.75	4	18–86–10	280
Jitsugetsutan..	3.88	4.33	III, 7	III, 22	I, 14	9	2.60	5.89	3.71	3.85	18–85–10	254

45. **Culter brevicauda** Günther.

1868. *Culter brevicauda* GÜNTHER, Cat. Fish., VII, p. 329; Formosa.—BLEEKER Mem. Cyprin. Chine, 1871, p. 69, Tab. XI, fig. 3; Yang-tze-kiang.—GÜNTHER, Ann. Mag. Nat. Hist., Sept., 1873, p. 250; Shanghai.

Head 4.38 in length; depth 3.79; D. II, 7; A. 3, 27; P. 16; V. 9; width of head 2.5 in its length; eye 4 in head; interorbital space 4; sixty-four scales in the lateral line, eleven scales in an oblique series between origin of dorsal and lateral line, eight scales between the latter and the middle of belly, six scales between lateral line and the root of the ventral; pharyngeal teeth 4, 4, 2—2, 4, 4; gill-rakers 6 + 23.

Body much compressed, abdominal edge entirely carinate, dorsal profile broadly convex, top of the head more or less fallen from the back, ventral profile undulating at the base of the ventral; head rather small, narrow, pointed, its top more or less convex; snout as long as the diameter of eye, truncated in front; mouth anterior and

[8] *Culter sieboldi* Dybowski, Verh. Zoöl.-Bot. Gesell. Wien, XXII, 214; Middle Amur; Ussuri; Sungari; Chanka.

oblique, its angle reaching the nostril below; upper lip thin; lower jaw slightly protruding; eyes moderate, anterior; nostrils close together, in front of the eye above.

Origin of dorsal nearer base of caudal than tip of snout, opposite the interspace between ventral and anal, armed with two smooth spiny rays, the second spine is very strong; pectoral elongate, reaching beyond the base of ventral; ventrals rather slender, inserted much in advance of that of dorsal; anal fin very long, anterior ray the longest; caudal fin strongly forked, the tip of each lobe sharply pointed; caudal peduncle rather short, its depth 2.33 in the length of head.

Body covered with moderate cycloid scales; lateral line slightly decurved, extending along the lower half of the tail.

Color in alcohol grayish above, belly and lower half of the sides silvery; fins dusky white.

Described from a specimen from Kagi, collected by Y. Kikuchi.

Habitat: Kagi (a single specimen).

Remarks: This species is closely related to *Culter recurviceps* (Richardson)[9] from which it differs in having an entirely carinate abdominal edge and a lesser number of scales in the lateral line.

CULTRICULUS gen. nov.

Type *Culter leucisculus* Kner (not of Basilewsky) = *Hemiculter kneri* Kreyenberg.

Body oblong, much compressed, abdominal edge entirely carinate. Scales of moderate size; lateral line continuous, abruptly bending downward above the pectoral, scarcely reaching the tip of the fin, thence advancing backward, ascending gradually, and running along the middle of the sides of the tail. Mouth oblique; jaws subequal; barbels none. Dorsal fin short, with no smooth spines, inserted behind the origin of ventral; pectoral moderate, not reaching the ventral; anal fin rather short, with fifteen to seventeen rays. Gill-rakers slender and long. Pharyngeal teeth 5, 4, 2—2, 4, 5.

Distribution: Formosa; China; Indo-China.

Remarks: Bleeker's *Hemiculter* is the genus most closely related to *Cultriculus*. It differs from the present genus in having the abdomen non-carinate or only partially carinate (postventral part only).

[9] *Leuciscus recurviceps* Richardson, Ichthyol. China, 1845, p. 259; Canton, China. *Cultur recurviceps* Günther, Cat. Fish., VII, 1868, p. 328, China.

46. **Cultriculus kneri** (Kreyenberg).

Unahii or Kirara (Formosa).

1867. *Culter leucisculus* KNER, Novara Fisch., III, p. 362; Shanghai.
1868. *Chanodichthys leucisculus* GÜNTHER, Cat. Fish., VII, p. 327; Shanghai (after Kner.)
1873. *Hemiculter leucisculus* GÜNTHER, Ann. Mag. Nat. Hist. Sept., p. 249; Shanghai.—Ann. Mag. Nat. Hist., 1888, p. 433; Yang-tze-kiang.—BERG, Ichthyol. Amur., 1909, p. 146.
1908. *Hemiculter kneri* KREYENBERG, Berlin Sitzb. Ges. Natf. Freunde, p. 105 (*nom. nov.* for *Culter leucisculus* Kner).

Head 4.56 in length; depth 4.56; D. II, 7; A. 2, 11; P. 15; V. 9; width of head 2.17 in its length; eye 4 in head; interorbital space 3.5; snout 3.25; pectoral 1.11; ventral 1.5; fifty-two scales in the lateral line, eight scales in an oblique series between origin of dorsal and lateral line, 3.5 scales between the latter and the middle of belly, 2 scales between lateral line and the root of the ventral; pharyngeal teeth 5, 4, 2—2, 4, 5; gill-rakers 4 + 17.

Body elongate, much compressed; entire abdominal edge carinate; head moderate, narrow; snout pointed anteriorly, its tip slightly swollen; mouth anterior and oblique, its angle scarcely reaching the anterior margin of the nostril below; lower jaw slightly shorter than the upper, with rather sharp edge; eyes moderate, anterior and superior; nostrils close together, in front of eye above.

Origin of dorsal about midway between tip of snout and base of caudal, inserted behind that of the ventral, with two smooth spines, of which the second is stronger, anterior ray the longest; pectoral fin moderate, not reaching the ventral; ventrals slender, inserted in front of the origin of dorsal; anal entirely behind the dorsal, rather short, triangular, anterior ray the longest; caudal fin bifurcate, tip of each lobe sharply pointed; caudal peduncle elongate, its depth 2.66 in length of head.

Body covered with thin cycloid scales; lateral line continuous, abruptly bending downward above the pectoral; thence passing backward, making a weak curve, extending along the middle of the sides of the tail.

Color in formalin olive-gray above, lower half of the body white; dorsal and caudal fins grayish, other fins white.

Total length 182 mm.

Described from a specimen from Jitsugetsutan, collected by T. Aoki in August, 1916.

Habitat: Jitsugetsutan (Lake Candidius); Shimotamusui River.

Remarks: According to the description by Kner the type of the present species has 4, 3, 2—2, 3, 4 pharyngeal teeth instead of 5, 4, 2—2, 4, 5.

The Chinese people who live near Lake Candidius use two vernacular names for the present species, namely, "Unahii" and "Kirara." They treat these two as different fishes. But there is no doubt that "Kirara" is the young form of "Unahii," for no morphological differences exist between them.

DESCRIPTION OF "KIRARA."

Head 4.5 in length; depth 5; D. II, 7; A. 2, II; P. 15; V. 9; width of head 2.33 in its length; eye 3 in head; interorbital space 3.5; snout 3.5; ventral 1.5; pectoral as long as the head; fifty-two scales in the lateral line, eight scales between origin of dorsal and lateral line, four scales between the latter and the middle of belly, two and one-half scales between lateral line and the root of the ventral; pharyngeal teeth 5, 4, 2—2, 4, 5; gill-rakers 5 + 16.

Body slender, elongate, compressed, entire abdominal edge carinate; head moderate, narrow, its top very slightly convex; snout pointed anteriorly, upper surface flat, tip swollen; mouth anterior and oblique, its angle scarcely reaching a vertical through anterior margin of nostril; lower jaw slightly shorter than the upper, with rather sharp anterior edge; eyes large, anterior; nostrils close together, supralateral, the anterior nostril in a short tube.

Origin of the dorsal midway between tip of snout and base of caudal, inserted behind the origin of the ventral, with two smooth spines; height of the fin equal to the length of head; pectoral elongate, scarcely reaching the root of ventral; ventral fin small, inserted in advance of the dorsal; anal fin entirely behind dorsal, triangular, anterior ray the longest; caudal fin slender, elongate, deeply emarginate, tip of each lobe sharply pointed; caudal peduncle elongate, strongly compressed laterally, its depth 2.75 in the length of head.

Body covered with thin cycloid scales; lateral line continuous, abruptly bending downward from the nape to the tip of the pectoral, thence passing backward and ascending gradually, running along the middle of the sides of tail.

Color in formalin pale olive-gray, lower parts whitish; top of head brown; a dark brown longitudinal band runs from nape to the base of the caudal; median dorsal line with a pale brown band; all the fins whitish.

Length of body 64 mm.

Described from a specimen from Jitsugetsutan, collected by T. Aoki in August, 1916.

Measurements of *Cultriculus kneri*

Locality.	Head.	Depth.	D.	A.	P.	V.	Width of Head.	Interor-bital.	Snout.	Eye.	Scales.	Lehgth, Mm.
Jitsugetsutan......	4.56	4.56	II, 7	2, 11	15	9	2.17	3.50	3.25	4	8–52–3½	182
Jitsugetsutan......	4.34	4.86	II, 7	2, 12	14	8	2.20	3.30	3.56	3.56	8–51–4	170
Jitsugetsutan......	4.45	4.90	II, 7	2, 13	15	8	2.44	3.66	3.66	3.66	8–52–4	117
Jitsugetsutan......	4.50	5	II, 7	3, 11	15	9	2.33	3.50	3.50	3	8–52–4	64
Shimotamusui River	4.50	4.50	II, 7	2, 12	14	8	2.33	3.38	3.71	3.71	8–50–4	145
Shimotamusui River	4.35	5	II, 7	2, 12	15	8	2.66	3.60	3.60	3.60	8–49–3	90

Doubtful Species.

In the year 1903, Jordan and Evermann mentioned two species of cyprinoid fishes from Formosa under the name *Cirrhina* sp. and *Dillonia sp.* (*Proc. U. S. Nat. Mus.*, XXV, p. 322 and 324). For the sake of completeness I give the original descriptions by those authors. I have no specimens which belong to the general *Cirrhina* and *Dillonia*; therefore nothing more can be said of them at present.

Cirrhina sp. Jordan & Evermann.

"Closely allied to *Cirrhina chinensis* Günther. D. 15; A. 7; scales 37; teeth 5, 4, 2. (No. 837, Formosa; Imperial Fisheries Institute, Japan.)"

Dillonia sp. Jordan & Evermann.

"Allied to *Dillonia aculeata* Cuvier and Valenciennes. Head shaped as *Scaphiodon*. Mandibles with barbels; D. 10; A. 11; scales 39."

Family PŒCILIIDÆ.

Genus Oryzias Jordan & Snyder.

1906. *Oryzias* Jordan & Snyder, Proc. U. S. Nat. Mus., XXXI, p. 289. (Type *Pœcilia latipes* Temminck & Schlegel.)

Body elliptical in form, compressed, covered with large scales; mouth small, with two rows of small, simple, pointed teeth; no teeth on vomer; gill-opening not restricted above; intestinal canal short, about as long as body; peritoneum black. Dorsal fin short, inserted above middle of anal; anal very long, having from seventeen to twenty rays; caudal fin truncate. Sexes similar, except in color; anal fin not modified in the male. (Jordan & Snyder.)

Distribution: Japan; Corea; Formosa.

47. **Oryzias latipes** (Temminck & Schlegel).

Medaka (Japan); Tamhii (Formosa).

1846. *Pœcilia latipes* TEMMINCK & SCHLEGEL, Fauna Japonica, Poiss., p. 224, Pl. CII, Fig. 5; Nagasaki.

1866. *Haplocheilus latipes* GÜNTHER, Cat. Fish., VI, p. 311, Nagasaki.

1901. *Aplocheilus latipes* JORDAN & SNYDER, Proc. U. S. Nat. Mus., XXIII, p. 350.

1906. *Oryzias latipes* JORDAN & SNYDER, Proc. U. S. Nat. Mus., XXXI, p. 289; Japan.—SNYDER, Proc. U. S. Nat. Mus., XLII, 1912, p. 407; Shiogama; Yamaguchi; Akune; Nanao; Dogo Island.—JORDAN & METZ, Mem. Carneg. Mus., VI, no. 2, 1913, p. 24; Fusan; Suigen, Corea.—JORDAN, Snyder, & TANAKA, Journ. Coll. Sci. Tokyo, XXXIII, 1913, p. 91; Japan.

Head 4 in length; depth 4.5; depth of caudal peduncle 9.5; eye 2.5 in head; interorbital space 2; snout 4; D. 6; A. 18; P. 9; V. 5; thirty-one scales in a lateral series; five branchiostegals.

Posterior half of the body compressed, becoming broader anteriorly, highest in front of the anal; head flattened; interorbital space broad; snout shorter than the diameter of eye, broadly rounded anteriorly; mouth anterior, transverse; lower jaw slightly projecting, each jaw with two rows of minute pointed teeth, those on the posterior row smaller; vomer smooth; thirteen short, pointed gill-rakers on the first arch; eyes very large, anterior and superior.

Dorsal fin short, on the posterior half of body, its origin above the posterior two-thirds of anal, its height equal to the distance between tip of snout and posterior margin of orbit; pectoral inserted on the median line of body, its length contained 5.5 in the length of body; the ventral small, reaching vent; base of the anal very long, its posterior end opposite to that of the dorsal, anterior ray longest; tip of the caudal fin rounded.

Top and sides of head, throat, and chin naked; body covered with thin cycloid scales; lateral line absent.

Color in formalin pale gray above, lower parts silvery; a black longitudinal streak from the nape to the origin of the dorsal; sides of body with a faint dusky stripe along the middle line, top of head dark; the edges of scales dusky; fin-rays of the ventral and anal dotted with minute black spots; all the fins whitish; peritoneum black.

Length of body 28 mm.

The present description is from a specimen from Shori, collected by T. Aoki in February, 1917.

Habitat: The present species is very common in rice-fields and pools on the island. My specimens came from Shori; Ako; and Giran (Kizanto and Taiko).

MEASUREMENTS OF *Oryzias latipes.*

Locality.	Head.	Depth.	Caudal Peduncle.	D.	A.	P.	V.	Inter-orbital.	Snout.	Eye.	Scales.	Length, Mm.
Shori	4	4.50	9.50	6	18	9	5	2	4	2.50	31	28
Kizanto	3.33	4	9.50	6	18	9	5	2.33	3.33	2.33	31	32
Kizanto	4	4	9	6	18	9	5	2.33	3	2.33	31	40
Kizanto	3.66	4.33	9	6	18	9	5	2.50	3	2.33	31	27
Kizanto	3.88	4.40	8.66	6	17	9	5	2.33	3	2.33	30	35
Taiko	3.50	4.50	9	6	17	8	5	2	3	2.50	30	21
Taiko	3.50	4	8.66	6	17	9	5	2	3	2.33	29	20

Genus GAMBUSIA Poey.

1855. *Gambusia* POEY, Mem. Cub., I, p. 382. (Type *Gambusia punctata* Poey.)

Body moderately elongate, becoming deep in the adult female. Mouth moderate, the lower jaw projecting, the bones well joined; both jaws with a band of pointed teeth which are not movable; snout not produced. Eyes normal, not divided. Scales large. Gill-openings not restricted. Dorsal and anal fins both rather short and small, the anal more or less in advance of the dorsal; anal fin of the male much advanced and modified into a long intromittent organ, which is about as long as head. Intestinal canal short. Six branchiostegals. Vertebræ about thirty-two. (Jordan & Evermann.)

Distribution: Mexico; Cuba; Southern States of North America.

48. **Gambusia affinis** (Baird & Girard).

Top-minnow.

1853. *Heterandria affinis* BAIRD & GIRARD, Proc. Ac. Nat. Sci. Philad., p. 390; Texas.

1859. *Gambusia speciosa* GIRARD, Proc. Ac. Nat. Sci. Philad., p. 121; Rio San Diego, New Ulm, Mexico.

1859. *Gambusia gracilis* GIRARD, Proc. Ac. Nat. Sci. Philad., p. 121; Mexico.

1866. *Gambusia humilis* GÜNTHER, Cat. Fish., VI, p. 334.

1866. *Gambusia affinis* GÜNTHER, Cat. Fish., VI, p. 336; Texas.—EVERMANN & KENDALL, Bull. U. S. Fish. Comm., XII, 1892, p. 107, Pl. 25; Fig. 2.—JORDAN & EVERMANN, Bull. U. S. Nat. Mus., 47, 1896, p. 680 (in part).

Head 3.8 in length; depth 4.33; D. 7; A. 10; P. 12; V. 6; eye 3 in head; interorbital space 2; snout 2.66; pectoral 1.33; ventral 2.5; thirty-one scales in a lateral series.

Posterior part of body compressed, anterior half high and broad, curvature of the dorsal profile stronger than that of the ventral; head moderate, broad, depressed; snout short, obtusely rounded anteriorly, upper surface flattened; mouth anterior, transverse; lower jaw longer than the upper; jaws with a broad band of villiform teeth, palatine with a narrow transverse band of villiform teeth; eye moderate, superior and slightly anterior; five branchiostegals; thirteen gill-rakers on the first arch; gill-openings large.

Origin of the dorsal slightly in advance of the end of the base of anal, distance to the base of the caudal about half of that to tip of snout, first ray shortest; pectorals inserted just below the middle of sides, their tips reaching beyond the origin of the ventral; ventral fins rather slender; the anal higher than the dorsal, anterior rays shorter, middle rays prolonged; caudal fin broad, tip obtusely rounded; caudal peduncle rather deep, its depth twice in the length of head.

Body covered with large scales; snout and cheek smooth; no lateral line.

Color in formalin dusky above; sides and belly whitish; the edges of scales dusky; top of head dark; a dark longitudinal stripe from occiput to the origin of the dorsal; a very narrow dark band along the middle of the sides; no dark marking below the eye; dorsal fin-rays speckled with black; all the fins whitish.

Length of body 44 mm.

Described from a specimen from the Government Hatchery at Shori. (Female).

Habitat: The present species is not a native of the island. About five years ago it was imported from Hawaii in order to exterminate anopheline mosquitoes and has been propagated artificially. It was introduced from Galveston, Texas, into Hawaii, and later into the Philippines by Mr. Alvin Seale, for the purpose of destroying mosquitoes.

Remarks: The male fish is very small; the anal modified into a sword-like intromittent organ. Measurements of a male specimen are as follows: Head 3.66 in length; depth 4.5; D. 7; A. 8 (third ray prolonged); P. 12; V. 6; snout 3 in head; interorbital space 2; eye 2.5; total length 24 mm.

MEASUREMENTS OF *Gambusia affinis.*

Locality.	Head.	Depth.	D.	A.	P.	V.	Interorbital.	Snout.	Eye.	Scales.	Length, Mm.
Shori (♀)	3.80	4.33	7	10	12	6	2	2.66	3	31	44
Shori (♀)	3.50	4	7	10	12	6	2	2.50	3	30	41
Shori (♀)	3.66	4.13	7	10	12	6	1.8	3	3.33	30	40
Shori (♀)	3.33	4.14	7	9	12	6	2	2.66	3.33	31	37
Shori (♂)	3.66	4.50	7	8	12	6	2	3	2.50	30	24
Shori (♂)	3.17	4.25	7	8	12	6	3	4	4	30	23
Shori (♂)	3.50	4.40	7	8	12	6	2	3	3	30	22

Family MONOPTERIDÆ.

Genus FLUTA Bloch & Schneider.

1798. *Monopterus* LACÉPÈDE, Hist. Nat. Poiss., II, p. 139. (Type *Monopterus javanensis* Lacépède). Not *Monopterus* of Volta, 1796, a genus of fossil fishes.

1801. *Fluta* BLOCH & SCHNEIDER, Ichth., p. 565. (Type *Monopterus javanensis* Lacépède.)

1845. *Ophicardia* MCCLELLAND, Calcutta Journ. Nat. Hist., V, p. 191. (Type *Ophicardia pharyriana* McClelland.)

1855. *Apterigia* BASILEWSKY, Nouv. Mém. Soc. Nat. Mosc., X, p. 247. (Type *Apterigia saccogularis* Basilewsky.)

Body elongate, naked; tail short, tapering to a point; no barbels; margin of the upper jaw formed by the premaxillaries, the maxillaries well developed, lying behind them and parallel with them; lips thick; palatine teeth small, in a narrow band; gill-opening confluent into a ventral slit, the membrane united to the isthmus; gill-arches three, with gill-fringes rudimentary, and with moderate slit between them; no accessory breathing sac; lateral line present; no pectoral or ventral fins; dorsal and anal reduced to low folds; ribs present; no air-bladder; stomach without cæcal sac or pyloric appendages. Ovaries with oviducts. (Jordan & Snyder).

49. **Fluta alba** (Zuiew).

Taunagi (Japan); Senhii (Formosa).

1793. *Muræna alba* ZIEW, Nov. Act. Sci. Petropol, p. 229, Pl. VII, Fig. 2.

1798. *Monopterus javanois* LACÉPÈDE, Hist. Nat. Poiss., II, p. 139; Java.

1801. *Monopterus javanensis* BLOCH & SCHNEIDER, Syst. Ichth., p. 565, after Lacépède.—CANTOR, Malayan Fishes, 1850, p. 339, Pl. V, Figs. 6–8.—BLEEKER, Atlas Ichth. Mur., 1864, p. 118, Pl. XLVII, Fig. 1; Java; Sumatra; Banka; Bintang, Borneo; Celebes.—GÜNTHER, Cat. Fish., VIII, 1870, p. 14; Batavia; Borneo; Siam; Formosa; China; Japan.—DAY, Fish. Brit.

India, 1876, p. 656, Pl. CLXIX, Fig. 1; Burma; China.—GÜNTHER, Ann. Mus. St. Petersburg, 1896, p. 219; Kansu; Sze-chuen.—REGAN, Ann. Mag. Nat. Hist. (7), XIII, 1904, p. 194; Yunnan.

1803. *Unibranchapertura lævis* LACÉPÈDE, Hist. Nat. Poiss., V, p. 658, Pl. XVII, Fig. 3.

1846. *Monopterus lævis* RICHARDSON, Voy. Sulph., Ichth., p. 116; Hongkong.

1845. *Ophicardia pharyriana* MCCLELLAND, Calcutta Journ. Nat. Hist., V, pp. 191, 218, Pl. XII, Fig. 1; River Ganges.

1846. *Monopterus cinereus* RICHARDSON, Voy. Sulph. Ichth., p. 117, Pl. LII, Figs. 1–6; Chusan; Woosung.

1846. *Monopterus* (?) *xanthognathus* RICHARDSON, Voy. Sulph. Ichth., p. 118, Pl. LII, Fig. 7; Canton.

1846. *Monopterus marmoratus* RICHARDSON, Ichthyol. China, p. 315; Chusan.

1846. *Monopterus helvolus* RICHARDSON, Ichthyol. China, p. 316; Canton.

1855. *Apterigia saccogularis* BASILEWSKY, Nouv. Mem. Soc. Nat. Mosc., X, p. 247, Pl. II, Fig. 2; Tschili.

1855. *Apterigia nigromaculata* BASILEWSKY, *l.c.*, p. 248, Pl. II, Fig. 2; Peking.

1855. *Apterigia immaculata* BASILEWSKY, *l.c.*, p. 248; Peking.

1897. *Monopterus albus* RUTTER, Proc. Acad. Nat. Sc. Philad., p. 61; Swatow.—JORDAN & SNYDER, Proc. U. S. Nat. Mus., XXIII, p. 838; Okinawa; Amami-Oshima.—JORDAN & EVERMANN, Proc. U. S. Nat. Mus., XXV, 1903, p. 324; Hokota, Formosa.—JORDAN & RICHARDSON, Mem. Carneg. Mus., IV, 1909, p. 171; Hokoto.—JORDAN & METZ, Mem. Carneg. Mus., VI, 1913; No. 2, p. 24; Suigen, Corea.—JORDAN, SNYDER & TANAKA, Journ. Coll. Sci. Tokyo, XXXIII, 1913, p. 76; Corea; Japan; Riukiu.

Head 10.17 in total length, its depth greater than that of the body, 1.66 in its length; depth 20.33 in total length; tail 3.5 in the length of body; snout 5 in head; interorbital space 6.

Body elongate, compressed, tapering towards the tip of tail, greatest diameter at the occiput, dorsal profile ascending suddenly at the nape and descending slowly to the tip of snout; cross-section of the body oval; head swollen; throat pouch-like; snout rather short, compressed, pointed anteriorly; lips broad and fleshy; maxillaries contained twice in head; teeth on both jaws granular, forming a band tapering towards the angle of mouth; palatine and vomerine teeth granular, forming two bands parallel to the former, lower jaw with corresponding bands of granular teeth along the inner side of the outer teeth; eyes very small, eight times in head and covered by thin skin; nostrils very small, separated, one in front of eye above, the other on the extremity of the snout; gill-openings inferior, confluent into a ventral slit; branchial arches three.

Dorsal fin very low, membranous, commencing above the vent, hind part reaching to tip of tail; anal fin indistinct, about half as long as the dorsal; no pectorals and ventrals; tail short and pointed.

Body naked, smooth; lateral line continuous, slightly depressed, running along the middle of the sides.

Color in formalin brownish gray above, mottled with darker spots, with traces of paler and darker streaks; lower surface, lips, and throat whitish.

Length of body 305 mm.

Described from a specimen from Shokwa, collected by T. Aoki in December, 1916.

Habitat: The present fish is very common in streamlets and canals. My specimens came from Jitsugetsutan (Lake Candidius); Shokwa; Taihoku; Kiburan, Giran.

Remarks: The color of the lower parts is variable. In two specimens from Taihoku the belly is mottled with brown, while another from the same locality has a nearly white belly with indistinct brown markings.

Fluta alba is capable of living a considerable time out of water.

MEASUREMENTS OF *Fluta alba.*

Locality.	Head.	Depth.	Depth of Head.	Tail in Trunk.	Interorbital.	Snout.	Length, Mm.
Shokwa..............	10.17	20.33	1.66	3.50	6	5	305
Taihoku.............	10.83	21.66	1.66	3.33	6.50	5.40	318
Taihoku.............	9.71	22.33	1.66	2.26	6.33	5.40	332
Taihoku.............	11.33	24.28	1.66	2.24	6.33	4.83	332
Kiburan.............	12.50	23.44	1.68	3.17	6	5	390

Family ANGUILLIDÆ.

Genus ANGUILLA Shaw.

1804. *Anguilla* SHAW, General Zoölogy, IV, p. 15. (Type *Murœna anguilla* Linnæus.)

Body elongate, compressed behind, covered with imbedded scales which are linear in form and placed obliquely, some of them at right angles to others. Lateral line well-developed. Head long, conical, moderately pointed, the rather small eye well forward and over the angle of mouth. Teeth small, subequal, in bands on each jaw and a long patch on the vomer. Tongue free at tip. Lips rather full, with a free margin behind, attached by a frenum in front. Lower jaw projecting. Gill-openings rather small, slit-like, about as wide as base of pectorals and partly below them. Nostrils superior, well-separated, the anterior with a slight tube. Vent close in front of anal. Dorsal inserted at some distance from the head, confluent with the anal around the tail. Pectorals well-developed. (Jordan & Snyder.)

Distribution: Cosmopolitan, but not extending into the arctic regions.

SYNOPSIS OF THE FORMOSAN SPECIES.

A. Mandibulary band of teeth is longitudinally divided by a groove, the outer strip containing a series of somewhat larger teeth.

a. Length of head less than the distance between the origins of dorsal and anal . . . . *mauritiana.*

aa. Length of head longer than the distance between the origins of dorsal and anal . . . . *japonica.*

B. Mandibulary teeth in narrow bands, without longitudinal groove.

a. Angle of mouth below the posterior margin of eye; lips thick. . *sinensis.*

50. **Anguilla mauritiana** Bennett.

Ounagi (Japan); Roma (Formosa).

1831. *Anguilla mauritiana* BENNETT, Proc. Comm. Zoöl. Soc., p. 128.—GÜNTHER, Cat. Fish. VIII, 1870, p. 25; East Indian Ocean and Archipelago; Formosa, Amboyna; Almorah; Ceylon; Philippine Islands; Islands of Johanna.—JORDAN & EVERMANN, Proc. U. S. Nat. Mus., XXV, 1903, p. 325; Kotosho, Formosa.—EVERMANN & SEALE, Bull. U. S. Bur. Fish., XXVI, 1907, p. 56; Tarlac.—JORDAN & RICHARDSON, Bull. U. S. Bur. Fish., XXVII, 1908, p. 238; Calayan, Mindoro.—SEALE & BEAN, Proc. U. S. Nat. Mus., XXXIII, 1907, p. 239, Zamboanga.—ISHIKAWA, Journ. Coll. Agric. Tokyo, IV, 1914, p. 427; Japan proper; Bonin Island.

1864. *Muræna maculata* BLEEKER, Ned. Tydschr. Dierk. I, p. 237.

1864. *Muræna manilensis* BLEEKER, Atl. Ichthyol. IV, p. 10; Manila.—JORDAN & EVERMANN, PROC. U. S. Nat. Mus., XXV, 1903, p. 325; Kotosho, Formosa.—JORDAN & RICHARDSON, Mem. Carneg. Mus., IV, no. 4, 1909, p. 171, Kotosho.

1867. *Anguilla (Muræna) marmorata* KNER, Novara Fisch., III, p. 369; Hongkong.

Length of head 6.05 in the total length, .89 in the distance of the gill-opening from the origin of the dorsal, 1.68 in its distance from the vent; distance between origin of dorsal and anal slightly longer than head, length of head contained 1.03 in the former; distance from tip of snout to the origin of dorsal 3.03 in total length; length of the pectoral 3.64 in head; snout 4.77; length of upper jaw 2.7; diameter of eye 2.6 in snout, 2.4 in interorbital space; height of body in front of anus 15.62 in total length; length of pre-anal part 1.03 in post-anal part.

Body stout; angle of mouth extending far beyond the posterior margin of orbit; lips well developed, fleshy; jaws subequal; teeth on both jaws, maxillary and mandibular teeth divided by a longitudinal groove into two strips, teeth on both rows in a single series, those on the outer row larger; palate with a band of sub-equal, villiform teeth, which is slightly broader and shorter than that of the maxillary and tapers posteriorly; nostrils separated, the anterior in a long tube, hanging over antero-lateral margin of snout, the posterior minute, in front of eye.

Body covered with rudimentary imbedded scales, linear in form, arranged in small groups and placed obliquely, at right angles to those of neighboring groups.

Color in formalin brownish gray above, mottled with dark brown; lower parts whitish; vertical fins grayish, mottled with dark; the pectoral dark gray with white outer margin.

Length of body 375 mm.

Described from a specimen from Giran.

Habitat: Very common on the island, often attaining a large size. My specimens came from Giran and Jitsugetsutan (Lake Candidius).

MEASUREMENTS OF *Anguilla mauritiana*.

Locality.	Giran.	Giran.
Total length	370 mm.	445 mm.
Length of head	62 "	67 "
Distance of gill-opening from origin of dorsal	55 "	60 "
Distance of gill-opening from the vent	110 "	125 "
Distance between origin of dorsal and anal	64 "	80 "
Distance between tip of snout and origin of dorsal	113 "	122 "
Length of the pectoral	17 "	18 "
Length of snout	13 "	14 "
Length of upper jaw	20 "	23 "
Diameter of eye	5 "	6 "
Interorbital space	12 "	13 "
Height of body in front of vent	24 "	27 "
Length of pre-anal part	170 "	190 "
Length of post-anal part	205 "	255 "

51. **Anguilla japonica** Temminck & Schlegel.

Unagi (Japan); Pehmoa (Formosa).

1847. *Anguilla japonica* TEMMINCK & SCHLEGEL, Fauna Japonica, Poiss., p. 258, Pl. CXIII, Fig. 2; Nagasaki.—BLEEKER, Verh. Bot. Gen., XXV, p. 51; Japan.—KNER, Novara Fisch., III, 1867, p. 370; Shanghai.—JORDAN & SNYDER, Proc. U. S. Nat. Mus., XXIII, 1901, p. 348; Yokohama.—SNYDER, Proc. U. S. Nat. Mus., XLII, 1912, p. 406; Mororan; Shiogama; Tokyo, Misaki.—JORDAN & METZ, Mem. Carneg. Mus., VI, no. 2, 1913, p. 24, Fusan; Suigen, Corea.—JORDAN, SNYDER, & TANAKA, Journ. Coll. Sci., Tokyo, XXXIII, 1913, p. 76; Hakodate to Nagasaki.—ISHIKAWA, Journ. Coll. Agric. Tokyo, IV, 1914, p. 417; Japan; Formosa; Corea.

1855. *Murœna pekinensis* BAKSILEWSY, Nouv. Mem. Soc. Nat. Mosc., X, p. 246, Pl. III, Fig. 2; Peking.

1870. *Anguilla bostonensis* GÜNTHER (*part.*), Cat. Fish., VIII, p. 31; Japan; Formosa; China.—GÜNTHER, Ann. Mag. Nat. Hist. (7), 1898, I, p. 263; Newchang.

1903. *Anguilla remifera* JORDAN & EVERMANN, Proc. U. S. Nat. Mus., XXV, p. 325; Holoto, Formosa.

1909. *Anguilla sinensis* JORDAN & RICHARDSON (*part.*), Mem. Carneg. Mus., IV, no. 4, p. 171; Takao, Formosa.

Head 7.77 in the total length, 1.25 in the distance between gill-opening and origin of the dorsal; 1.94 in the distance between tip of snout and origin of the dorsal; distance between origins of dorsal and anal shorter than head, contained 1.24 in the latter; distance between tip of snout and origin of the dorsal 3.51 in total length; snout 5.09 in head; maxillary 3.11; pectoral 2.8; eye 2.2 in snout, 1.8 in interorbital space; length of body in front of anus 2.23 in total length; pre-anal part 1.72 in postanal part.

Angle of mouth extending to the posterior margin of the orbit; lips thick and fleshy; lower jaw slightly longer than the upper; teeth on both jaws and palatines in villiform bands, palatine band slightly longer and broader than that of maxillary, tapering posteriorly; maxillary and mandibulary bands of teeth divided into two strips by a distinct deep groove, outer strip with two rows of teeth, inner strip somewhat broader than the outer, with two rows of teeth, in both strips number of rows increases anteriorly and their arrangement becomes irregular; nostrils separated, the anterior in a long tube, situated near antero-lateral extremity of the snout, the posterior nostril in front of eye, slit-like.

Pectoral fins longer than broad, marginal end acutely rounded; tip of the tail rounded.

Body covered with rudimentary imbedded scales, linear in form, arranged in small groups and placed obliquely at right angles to those of neighboring groups; lateral line continuous, running along the middle of the sides.

Color in formalin brownish gray above, lower parts whitish; dorsal and caudal fins disky; pectoral and anal fins whitish.

Length of body 445 mm.

Described from a specimen from Taihoku, collected by Oshima, in February, 1917.

Habitat: Very common in the fresh waters of Formosa.

Remarks: After examining forty-seven individuals of the common Formosan eel, Dr. Ishikawa expressed his belief that it is only a local variety of *Anguilla japonica*, though minor differences exist between these two forms, as shown in the following table of relative proportions:

	A. Japonica.	Formosan Eel.
Total length	100.00	100.00
Distance from gill-opening to the origin of dorsal	18.18	18.41
Length of head	12.35	12.70
Distance from gill-opening to vent	27.20	28.45
Distance from tip of snout to origin of dorsal	30.54	31.11
Distance between origins of dorsal and anal fins	9.76	10.31
Length of pectoral	4.01	4.77
Length of upper jaw	3.24	3.20
Length of snout	2.16	2.14
Diameter of eye	1.02	1.11
Interorbital space	1.92	2.06
Height of body in front of anus	5.21	5.40
Ratio of pre-anal and post-anal parts	1:1.53	1:1.47
Number of vertebræ	115.65	115.57

Moreover, he has regarded *Anguilla remifera* from Hokoto which was described by Jordan & Evermann (*Proc. U. S. Nat. Mus.*, XXV, 1903, p. 325) as being also a variety of *A. japonica*, because the distinctive characters of that species, that is, longer and rather pointed pectoral fins (2.17 in head) and the distance from front of dorsal to front of anal slightly more than length of head, are the points which are to be seen in extreme variations among examples of *A. japonica* (*Journ. Coll. Agricul.*, IV, 1914, p. 426).

Four specimens of an eel in the Stanford collections (No. 21181; Takao, Formosa) which had been described by Jordan and Richardson under the name *Anguilla sinensis* were examined and compared with my specimens of the common Formosan eel. It appears that in the former the distance from gill-opening to origin of dorsal, distance from gill-opening to vent, distance from tip of snout to origin of dorsal, diameter of eye, and height of body in front of anus (average length) are somewhat greater, while the length of head, distance between origins of dorsal and anal, length of pectoral, length of upper jaw, length of snout, interorbital space are smaller. As shown in the following tables (III, V), however, these characters are variable and have no specific value.

I. THE AVERAGE LENGTH OF THE PARTS OF BODY OF FORMOSAN EEL.

	A. japonica.	*A. sinensis.*
Total length	100.00	100.00
Distance from gill-opening to origin of dorsal	17.01	18.43
Length of head	12.42	12.12
Distance from gill-opening to vent	26.55	26.72
Distance from tip of snout to origin of dorsal	28.95	29.40
Distance between origins of dorsal and anal	10.72	9.64
Length of pectoral	4.15	4.09
Length of upper jaw	4.04	3.56
Length of snout	2.51	2.26
Diameter of eye	1.13	1.38
Interorbital space	2.19	1.73
Height of body in front of anus	4.51	4.73
Ratio of pre-anal and postanal parts	1:58	1:60

II. MEASUREMENTS OF ANGUILLA JAPONICA.

Actual Length in Mm.

Locality.	Taihoku.	Taihoku.	Taihoku.	Taihoku.	Taihoku.	Giran.
Total length	310 mm.	357 mm.	445 mm.	355 mm.	355 mm.	182 mm.
Head	41 "	46 "	56 "	47 "	46 "	22 "
Gill-opening to dorsal	57 "	61 "	70 "	70 "	60 "	27 "
Gill-opening to vent	87 "	98 "	110 "	96 "	95 "	46 "
Dorsal to anal	33 "	40 "	45 "	37 "	39 "	20 "
Upper jaw	12 "	15 "	18 "	12 "	14 "	7 "
Pectoral	13 "	16 "	20 "	14 "	15 "	6.5 "
Snout	8 "	9 "	11 "	8 "	10 "	4.5 "
Eye	3 "	5 "	5 "	4 "	4 "	2 "
Interorbital space	7 "	8 "	9 "	7 "	9 "	4 "
Height of body	18 "	19 "	22 "	17 "	19 "	9 "
Snout to vent	124 "	142 "	163 "	141 "	138 "	68 "
Vent to tip of caudal	186 "	215 "	282 "	214 "	217 "	114 "
Snout to dorsal	95 "	107 "	124 "	110 "	105 "	50 "

III. LENGTH IN PERCENT OF THE TOTAL LENGTH.

Locality.	Taihoku.	Taihoku.	Taihoku.	Taihoku.	Taihoku.	Giran.
Total length	100.00	100.00	100.00	100.00	100.00	100.00
Head	13.22	12.85	12.58	13.23	12.95	12.08
Gill-opening to dorsal	18.38	17.08	15.73	19.71	16.90	14.28
Gill-opening to vent	28.06	27.45	24.71	27.04	26.76	25.28
Dorsal to anal	10.64	11.20	10.11	10.42	10.98	10.98
Upper jaw	3.87	4.20	4.04	3.38	3.94	3.82
Pectoral	4.19	4.47	4.49	3.97	4.22	3.57
Snout	2.58	2.52	2.47	2.25	2.81	2.47
Eye	0.96	1.40	1.11	1.12	1.12	1.09
Interorbital space	2.25	2.24	2.02	1.97	2.53	2.18
Height of body	5.80	5.32	4.94	4.78	5.35	4.92
Snout to vent	40.00	39.80	36.62	39.71	38.87	37.35
Vent to tip of caudal	60.00	60.22	63.37	60.28	61.12	62.69
Snout to dorsal	30.64	30.00	27.86	30.98	26.76	27.47

IV. MEASUREMENTS OF ANGUILLA SINENSIS, JORDAN & RICHARDSON.

(No. 21181, Stanford Collection, Takao.)

Actual Length in Mm.

Locality.	Taihoku.	Taihoku.	Taihoku.	Giran.
Total length	405 mm.	425 mm.	375 mm.	435 mm.
Head	50 "	54 "	44 "	51 "
Gill-openings to dorsal	80 "	74 "	68 "	79 "
Gill-openings to vent	120 "	110 "	94 "	114 "
Dorsal to anal	43 "	41 "	33 "	41 "
Upper jaw	15 "	15 "	12 "	13 "
Pectoral	18 "	15 "	15 "	19 "
Snout	10 "	10 "	8.5 "	9 "
Eye	4 "	4.5 "	3.5 "	4 "
Interorbital space	7 "	7 "	7 "	7.5 "
Height of body	23 "	19 "	16 "	20 "
Snout to vent	169 "	160 "	139 "	165 "
Vent to tip of caudal	236 "	265 "	236 "	270 "
Snout to dorsal	123 "	124 "	110 "	125 "

V. LENGTH IN PERCENT OF THE TOTAL LENGTH.

Locality.	Taihoku.	Taihoku.	Taihoku.	Giran.
Total length	100.00	100.00	100.00	100.00
Head	12.34	12.70	11.73	11.72
Gill-opening to dorsal	19.75	17.70	18.13	18.16
Gill-opening to vent	29.87	25.88	25.06	26.20
Dorsal to anal	10.64	9.64	8.99	9.42
Upper jaw	3.70	3.52	3.20	2.98
Pectoral	4.44	3.52	4.06	4.36
Snout	2.44	2.29	2.26	2.06
Eye	0.98	1.00	0.93	0.91
Interorbital space	1.72	1.64	1.85	1.72
Height of body	5.68	4.47	4.27	4.59
Snout to vent	41.72	36.64	37.06	37.93
Vent to tip of caudal	58.27	62.35	62.93	62.06
Snout to dorsal	30.37	29.17	29.33	28.73

52. **Anguilla sinensis** McClelland.

1844. *Anguilla sinensis* McCLELLAND, Calc. Journ., IV, p. 406, Tab. 25, Fig. 2; China.—JORDAN & EVERMANN, Proc. U. S. Nat. Mus., XXV, 1903, p. 325; Taihoku, Formosa.—JORDAN & RICHARDSON, Mem. Carneg. Mus., IV, no. 4, 1909, p. 171; Taihoku.

1870. *Anguilla latirostris* GÜNTHER, Cat. Fish., VIII, p. 32; China (*part*).

1914. *Anguilla sinensis* (?) ISHIKAWA, Journ. Coll. Agric. Tokyo, p. 428; Tokyo.

A small specimen, No. 6447, from Taihoku. It agrees with Günther's account of *A. latirostris*, but that species was originally described from Nice. The long head, greater than the distance from front of dorsal to front of anal, is characteristic of this species. (Jordan & Evermann.)

Habitat: Taihoku (Jordan & Evermann).

Remarks: This specimen may not be different from the common eel, *Anguilla japonica.* As I have no specimens to examine, nothing more can be said of it at present.

Family MUGILIDÆ.

ARTIFICIAL KEY TO THE FORMOSAN GENERA OF MUGILIDÆ.

A. An adipose eye-lid well developed, covering at least a third of the iris posteriorly. *Mugil.*

B. Adipose eye-lid not developed .... *Liza.*

Genus MUGIL (Artedi) Linnæus.

1758. *Mugil* (APTEDI) LINNÆUS, Syst. Nat., Ed. X, p. 316. (Type *Mugil cephalus* Linnæus.)

Body more or less oblong and compressed, covered with cycloid scales of moderate size; no lateral line. Mouth more or less transverse; anterior margin of the mandible sharp, sometimes ciliated. No true teeth in the jaws. Gill-openings wide; gills four. Eyes lateral, with adipose eyelids. Two dorsal fins, the first consisting of four stiff spines; anal slightly longer than the second dorsal; ventrals abdominal, with one spine and five rays. Branchiostegals from four to six; pseudobranchiæ present.

Distribution: Migratory fishes of all the temperate and tropical regions.

SYNOPSIS OF THE FORMOSAN SPECIES.

A. Median dorsal line not carinate.
- *a*. Mandibular angle obtuse; cleft of mouth contained two times in the distance between the angles of mouth .... *cephalus.*
- *aa*. Mandibular angle a right angle; cleft of mouth contained less than two times in the distance between the angles of mouth .... *oeur.*

B. Median dorsal line carinate in front and back of the spinous dorsal.
- *a*. Mandibulary angle obtuse; cleft of mouth contained less than two times in the distance between the angles of mouth .... *carinatus.*

53. **Mugil cephalus** Linnæus.

Bora (Japan); Oahii (Formosa).

1758. *Mugil cephalus* LINNÆUS, Syst. Nat., Ed. X, p. 316; Europe.—CUV. & VAL., Hist. Nat. Poiss., XI, 1830, p. 307.—GÜNTHER, Cat. Fish., III, 1861, p. 417; Mediterranean; Coast of Madeira; Nile; fresh-water lakes of Tunis; West coast of Africa.—JORDAN & STARKES, Proc. U. S. Nat. Mus., XXXI, 1906, p. 516; Port Arthur.—JORDAN & SEALE, Proc. U. S. Nat. Mus., XXIX, 1906, p. 521; Hongkong; Shanghai.—JORDAN & RICHARDSON, Bull. U. S. Bur. Fish., XXVII, 1908, p. 244; Calayan, p. 1.—SNYDER, Proc. U. S. Nat. Mus., XLII, 1912, p. 416; Misaki; Tokyo.—Proc. U. S Nat. Mus., XLII, 1912, p. 459; Okinawa.—JORDAN, SNYDER, & TANAKA, Journ. Coll. Sci. Tokyo, XXXIII, 1913, p. 113; Hawaii; Tahiti; Atlantic coast of the United States; Panama; Southern California; Red Sea; Mediterranean; New Guinea; Nukahiva; Solomon Island.—JORDAN & METZ, Mem. Carneg. Mus., VI, no. 2, 1913, p. 26; Fusan, Corea.—JORDAN & THOMPSON, Mem. Mem. Carneg. Mus., VI, no. 4, 1914, p. 239; Matsushima; Osaka.

1855. *Mugil soiuy* BASILEWSKY, Ichthyol. China, p. 226, Pl. IV, Fig. 3; China.

Head 3.86 in length; depth 4.42; D. IV, 1, 8; A. III, 8; P. 17; V. I, 5; width of head 1.55 in its length; eye 4.23 in head; interorbital space 2; snout 3.5; forty-two scales in a lateral series, fifteen scales in an oblique series between origin of dorsal and middle of belly, thirteen scales between origins of dorsal and ventral.

Body rather robust, elongate, somewhat compressed, dorsal profile nearly straight, ventral profile broadly rounded; head rather small, broad, its top flattened; snout short and obtuse, broadly rounded anteriorly, interorbital space very broad, rather flat; mouth subinferior, slightly oblique, its angle reaching a vertical through posterior nostril; cleft of mouth half as deep as broad (between the angles of mouth); lips thin; the angle between two mandibulary bones obtuse; lower jaw shorter than the upper, outer edge rather sharp, with an obtuse short median keel at the anterior part which fits into the corresponding concavity on the roof of upper jaw; teeth along the outer edges of both jaws minute, scarcely visible without lens; eyes hidden anteriorly and posteriorly by a broad adipose membrane; nostrils separated, anterior nostril in a very short tube, posterior nostril slit-like, in front of eye above.

Dorsal fins well separated, origin of the spinous dorsal midway between tip of snout and base of caudal, with a pointed scaly flap at the base, length of the anterior spine 2.2 in head; soft dorsal inserted behind the origin of anal, anterior ray longest; pectoral reaching beyond the origin of ventral, not reaching the spinous dorsal, its base above the middle of body; ventral a little nearer the root of pectoral than the spinous dorsal; anal fin opposite the soft dorsal, inserted in advance of the origin of the latter; caudal fin bifurcate; depth of the caudal peduncle 2.66 in the length of head.

Head and body covered with large cycloid scales, those on top of head slightly enlarged; soft dorsal, anal, and pectoral with very few scales; base of caudal covered with large scales.

Color in alcohol grayish above, lower parts silvery; sides with dark longitudinal stripes along the rows of scales; pectorals, dorsals, and caudal fin dusky; ventrals and anal whitish.

Length of body 255 mm.

Described from a specimen from Daitotei Fish Market, Taihoku, collected by Oshima in March, 1917.

Habitat: Taihoku (?). A very common species in Formosa.

Remarks: All the characters of the present species agree quite well with those of *M. cephalus* from Italy in the Stanford University Collections.

MEASUREMENTS OF *Mugil cephalus*.

Locality.	Head.	Depth.	D.	A.	P.	V.	Width of Head.	Interorbital.	Snout.	Eye.	Cleft of Mouth.	Scales.	Length, Mm.
Taihoku..........	3.86	4.42	IV, 1, 8	III, 8	17	I, 5	1.55	2	3.50	4.23	2	42–15	255
Taihoku..........	3.95	4.79	IV, 1, 8	III, 8	16	I, 5	1.50	2.38	3.11	4.58	2	40–15	284
Venice, Italy. (No. 1479, S. U.)..	3.94	4.14	IV, 1, 8	III, 8	16	I, 5	1.45	2.80	3.20	4.73	2	42–15	260
Naples, Italy. (No. 1469, S. U.)..	3.69	4.09	IV, 1, 8	III, 8	16	I, 5	1.50	2.52	3.65	4.85	2	41–15	220

54. **Mugil oeur** Forskål.

1775. *Mugil oeur* FORSKÅL, p. XIV, No. 109.—RUTTER, Proc. Acad. Nat. Sc. Philad., 1897, p. 70; Swatow, China.—JORDAN & SNYDER, Proc. U. S. Nat. Mus., XXIII, 1901, p. 744; Yokohama.—JORDAN & EVERMANN, Proc. U. S. Nat. Mus., XXV, 1903, p. 332; Taihoku, Formosa.—JORDAN & RICHARDSON, Mem. Carneg. Mus., IV, No. 4, 1909, p. 176; Giran; Keelung; Taihoku, Formosa.

1836. *Mugil cephalotus* CUV. & VAL., Hist. Nat. Poiss., XI, p. 110; India.—GÜNTHER, Cat. Fish., III, 1861, p. 419; Red Sea; Coast of Pondicherry, Chinese and Japanese Seas.—KNER, Novara Fisch., II, 1865, p. 224; Manila.

1846. *Mugil japonicus* SCHLEGEL, Fauna Japonica, Poiss., p. 134, Pl. 72, Fig. 1.—RICHARDSON, Ichthyol. China, 1846, p. 247; China.—BLEEKER, Verh. Batav. Genootsch., XXV, 1853, p. 41

1846. *Mugil macrolepidotus* RICHARDSON, Ichthyol. China, p. 249; China.

1905. *Mugil cephalus* JORDAN & SEALE (not of Linnæus), Proc. Davenport Acad. Sc., X, p. 4; Hongkong.

Head 3.6 in length; depth 4; D. IV, 1, 8; A. III, 8; P. 16; V. I, 5; width of head 1.58 in its length; eye 4 in head; interorbital space 2.64; snout 3.75; thirty-nine scales in a lateral series, fifteen scales between origin of the spinous dorsal and ventral.

Body oblong, compressed posteriorly, dorsal and ventral profiles equally arched; head rather small, its top very slightly convex; snout short, moderately broad, truncate in front, interorbital space rather flat; mouth subinferior, slightly oblique, its angle reaching a vertical through anterior margin of orbit, cleft of mouth 1.66 in the transverse distance between angles of mouth; lips rather thin, upper lip much thicker than the lower; the angle between two mandibulary bones a right angle; lower jaw shorter than the upper, its outer edge rather sharp, with a short median keel at the tip which fits into the corresponding concavity on the roof of the upper jaw; teeth on the upper jaw minute, scarcely visible without a lens, closely set; eyes hidden anteriorly and posteriorly by a broad adipose membrane; nostrils separated, anterior nostril in a very short tube, posterior nostril slit-like, in front of eye above.

Dorsal fins well separated; origin of the spinous dorsal midway between tip of snout and base of caudal, with pointed scaly flaps on both sides of the base, length of the anterior spine twice in head; soft dorsal inserted behind the origin of anal, anterior ray longest; pectoral not reaching spinous dorsal, its base above the middle of body; ventral inserted nearer the origin of the spinous dorsal than that of the pectoral, with a scaly, pointed flap near the base; anal fin opposite the soft dorsal, inserted in front of the origin of the latter, caudal fin forked; depth of caudal peduncle 2.66 in head.

Head and body covered with large cycloid scales; all the fins except the spinous dorsal with very few scales; base of the caudal covered with large scales.

Color in alcohol dark gray above, belly and lower half of the sides silvery; sides with dark longitudinal stripes along the rows of scales; pectorals, dorsals, and caudal fin dusky, other fins whitish; a black spot near the base of pectoral.

Length of body 132 mm.

Described from a specimen from Inzanpo, Giran, collected by T. Aoki in August, 1917.

Habitat: Inzanpo and Ritakukan, Giran. Giran; Keelung; Taihoku. (Jordan and Evermann.)

Remarks: The present species is very closely related to *Mugil cephalus* Linnæus, differing mainly in the angle between the two mandibulary bones. In the latter it is always obtuse instead of being a right angle, and the cleft of the mouth is contained twice in the distance between the angles of mouth.

MEASUREMENTS OF *Mugil oeur*.

Locality.	Head.	Depth.	D.	A.	P.	V.	Width of Head.	Interorbital.	Snout.	Eye.	Cleft of Mouth.	Scales.	Length, Mm.
Inzanpo.	3.6	4	IV, 1, 8	III, 8	16	I, 5	1.58	2.64	3.75	4	1.66	39–15	132
Ritakukan.	3.5	4	IV, 1, 8	III, 8	16	I, 5	1.58	2.50	3.75	4.66	1.50	39–15	133
China. . . . . (No. 1606, S. U.)	3.91	4.37	IV, 1, 8	III, 8	16	I, 5	1.50	2.58	3.92	1.77	1.77	40–15	226
Hongkong (No. 9884, S. U.) .	3.89	4.58	IV, 1, 8	III, 8	16	I, 5	1.61	2.47	3.70	3.70	1.57	38–15	166
Hongkong (No. 9884, S. U.) .	3.87	4.38	IV, 1, 8	III, 8	16	I, 5	1.57	2.62	3.55	3.55	1.50	40–15	152
Hongkong (No. 9884, S. U.) .	3.42	4.50	IV, 1, 8	III, 8	16	I, 5	1.61	2.75	3.66	3.66	1.57	41–16	150
Hilo, Hawaii. (No. 7852, S. U.). .	4.11	4.25	IV, 1, 8	III, 8	16	I, 5	1.48	2.14	3.75	3.75	1.75	38–15	236
Hilo, Hawaii. (No. 7852, S. U.). .	3.96	4.10	IV, 1, 8	III, 8	16	I, 5	1.47	2.18	3.64	4	1.89	40–15	260
Hilo, Hawaii. (No. 7852, S. U.) .	3.85	4.12	IV, 1, 8	III, 8	17	I, 5	1.24	2.47	3.60	4	1.71	41–15	176

55. **Mugil carinatus** (Ehrenberg) Cuv. & Val.

1830. *Mugil carinatus* (EHRENBERG) CUV. & VAL., Hist. Nat. Poiss., XI, p. 148; Red Sea.—DAY, Fish. Brit. India, 1888, Suppl., p. 800; Sea of India.

Head 4 in length; depth 4.19; D. IV, 2, 7; A. III, 9; P. 15; V. I, 5 width of head 1.58 in its length; eye 3.7 in head; interorbital space 2.79; snout 4; thirty-nine scales in a lateral series, thirteen scales in a transverse series between origin of the dorsal and the middle of belly, eleven scales between origins of the dorsal and ventral; pectoral 1.5 in head; ventral 1.73.

Body elongate, compressed posteriorly, curvature of the dorsal profile weaker than that of the ventral, median dorsal line keeled in front and behind the spinous dorsal; head rather small, top more or less convex; snout short, truncate in front; mouth subinferior, its angle reaching a vertical through the posterior nostril, depth of the mouth 2.66 in its width; upper lip rather thick; lower jaw shorter than the upper; the angle between the mandibulary bones obtuse; upper jaw with a series of minute uniform teeth along the outer border, lower jaw with a series of fleshy tubercles along its inner margin; pre-orbital not scaled, wavy, lower margin finely serrated; extremity of maxillary visible; eyes moderate, anterior, with narrow adipose eyelids; posterior nostril slit-like, nearer to the anterior nostril than the orbit.

Dorsal fins well separated; spinous dorsal inserted much nearer tip of snout than base of caudal, higher than the soft dorsal, height of the first spine equal to the width of head; tenth and twenty-eighth scales of lateral series below the origins of the two dorsals, soft dorsal inserted behind the origin of the anal; pectoral fin extending beyond the root of the ventral, tip reaching to tenth scale of lateral series; ventrals inserted midway between pectorals and spinous dorsal; anal fin opposite the soft dorsal, anterior ray longest; caudal fin forked; depth of caudal peduncle 2.22 in the length of head.

Body covered with large cycloid scales; head entirely scaled; soft dorsal, anal, pectorals, ventrals, and base of the caudal covered with small scales; spinous dorsal and ventrals with pointed scaly flaps.

Color in formalin grayish above, lower parts silvery; pectorals, dorsals and caudal dusky, the rest of the fins whitish.

Length of body 185 mm.

Described from a specimen from Shimo-Tamusui River, collected by T. Aoki in December, 1916.

Habitat: Shimo-Tamusui River, Taihoku (collected in the fish-market).

MEASUREMENTS OF *Mugil carinatus.*

Locality.	Head.	Depth.	D.	A.	P.	V.	Width of Head.	Interorbital.	Snout.	Eye.	Scales.	Length. Mm.
Shimo-Tamusui R. . .	4	4.19	IV, 2, 7	III, 9	15	I, 5	1.58	2.78	4	3.7	39–13	185
Taihoku............	4.13	4.38	IV, 2, 7	III, 9	16	I, 5	1.57	2.94	4	4	39–13	220
Taihoku............	4.26	4.85	IV, 2, 7	III, 9	16	I, 5	1.74	2.61	3.5	4	40–13	277

Genus LIZA Jordan & Swain.

1884. *Liza* JORDAN & SWAIN, Proc. U. S. Nat. Mus., VII, p. 261. (Type *Mugil capito* Cuvier.)

Body robust, more or less oblong and compressed, head and body covered with large cycloid scales; lateral line none. Mouth subinferior, more or less transverse; anterior margin of the mandible thin and sharp. Gill-openings wide. Eyes lateral and anterior, adipose eyelid obsolete. Two dorsal fins, the first consisting of four stiff spines; anal opposite the soft dorsal, slightly longer than the latter; ventrals abdominal, with one spine and five rays.

Distribution: British and Scandinavian coast; Canary Islands; Mediterranean; Nile; Freshwater lakes of Tunis; From Red Sea through Indian Ocean and Archipelago to the coasts of Australia and to Polynesia; India; Ceylon; Philippine Islands; Indo-China; China; Formosa; Japan; Riukiu Islands.

56. **Liza troscheli** (Bleeker).

1858. *Mugil troscheli* BLEEKER, Nat. Tijdschr. Ned. Ind., XVI, p. 277.—Act. Soc. Sc. Indo-Neerl., VIII, 1860, p. 80; Sumatra.—GÜNTHER, Cat. Fish., III, 1861, p. 448; Coast of Java, Borneo, and Ceylon.—DAY, Fish. Brit. India, 1878, p. 358; Indian Sea to Malay Archipelago.—RUTTER, Proc. Acad. Nat. Sc. Philad., 1897, p. 70; Swatow.

1903. *Liza troscheli* JORDAN & EVERMANN, Proc. U. S. Nat. Mus., XXV, p. 332; Hokoto, Formosa.—JORDAN & SEALE, Bull. U. S. Bur. Fish., XXVI, 1906, p. 11; Cavite, P. I.—JORDAN & RICHARDSON, Bull. U. S. Bur. Fish., XXVII 1908, p. 244; Iloilo.—SMITH & SEALE, Proc. Biol. Soc. Wash., XIX, 1906, p. 76; Mindanao.—SEALE & BEAN, Proc. U. S. Nat. Mus., XXXIII, 1907, p. 240; Zamboanga.—JORDAN & RICHARDSON, Mem. Carneg. Mus., IV, No. 4, 1909, p. 176; Takao; Hokoto.—SNYDER, Proc. U. S. Nat. Mus., XXXII, 1912, p. 495; Okinawa.—JORDAN & STARKS, Ann. Carneg. Mus., XI, Nos. 3 and 4, 1917, p. 439; Ceylon.

Head 4.3 in length; depth 4; D. IV, 2, 7; A. III, 9; P. 14; V. I, 5; width of head 1.46 in its length; eye 4 in head; interorbital space 2.28; snout 3.64; pectoral 1.31; ventral 1.42; thirty-one scales in lateral series, eleven scales in an oblique series between origin of dorsal and the middle of belly, nine scales between origins of dorsal and ventral.

Body robust, compressed posteriorly, the ventral profile much more curved than the dorsal, deepest in front of the vent; head rather small, top slightly convex; snout nearly as long as the diameter of eye, obtusely rounded anteriorly; mouth subinferior, its cleft one-third as deep as the distance between the angles of mouth; upper lip thick, no lower lip; lower jaw slightly shorter than the upper, angle between two mandibulary bones obtuse, outer edge of mandible thin and sharp; upper jaw with no teeth, lower jaw with a series of minute fleshy tubercles along the inner margin; pre-orbital edge more or less wavy, lower part indistinctly denticulated; eyes moderate, anterior, adipose eyelid not well developed; nostrils separated, the anterior in a very short tube, the posterior slit-like.

Dorsal fins well separated; origin of the spinous dorsal nearer to base of caudal than tip of snout, as high as the soft dorsal, length of the first spine shorter than the width of head; soft dorsal inserted behind the origin of anal, eleventh and twentieth scales of lateral series below the origins of the dorsals; pectorals a little above the middle of body, reaching eighth scale of lateral series; the ventral inserted midway between origin of pectoral and that of spinous dorsal; the anal inserted in advance of the origin of soft dorsal; caudal fin emarginate; depth of caudal peduncle twice in the length of head.

Head and body covered with large cycloid scales; soft dorsal, anal, and base of ventral and caudal covered with small scales; spinous dorsal and ventral with pointed scaly flaps.

Color in formalin grayish above, lower parts silvery; sides with longitudinal stripes along the rows of scales; pectorals, dorsals, and caudal dusky, the rest of the fins whitish.

Length of body 215 mm.

Described from a specimen from Sobun River near Tabani, collected by T. Aoki in December, 1916.

Habitat: Sobun River near Tabani (two specimens). Hokoto (Jordan and Evermann); Takao (Jordan and Richardson).

MEASUREMENTS OF *Liza troscheli*.

Locality.	Head.	Depth.	D.	A.	P.	V.	Width of Head.	Interorbital.	Snout.	Eye.	Scales.	Length, Mm.
Sobun River......	4.3	4	IV, 2, 7	III, 9	14	I, 5	1.46	2.28	3.64	4	31–11	215
Sobun River......	4.3	3.58	IV, 1, 8	III, 9	15	I, 5	1.42	2.13	3.40	4.17	31–11	272

Family LABYRINTHICI.

ARTIFICIAL KEY TO THE FORMOSAN GENERA.

a. Teeth fixed in the jaws; none on the palate; ventrals well-developed; 13–20 dorsal or anal spines; dorsal and anal rays not filamentous; caudal fin rounded. *Polyacanthus.*

aa. Teeth fixed in the jaws; none on the palate; ventrals well-developed; 13–18 dorsal or anal spines; middle rays of the dorsal and anal filamentous; caudal fin forked or ending in a bundle of long filaments............... *Macropodus.*

Genus POLYACANTHUS (Kuhl) Cuvier.

1829. *Polyacanthus* (KUHL) CUVIER, Regne Animal, Ed. II, Vol. II, p. 227. (Type *Chætodon chinensis* Bloch = *Labrus operculatus* Gmelin, as restricted by Cuvier & Valenciennes.)

Body compressed, oblong; operculum without spine or serrature; cleft of mouth small, more or less oblique, not extending beyond a vertical from orbit, and little protractile. Small fixed teeth in the jaws, none on the palate. Dorsal and anal spines numerous (13–20); ventral fins composed of one spine and five well-developed rays; the soft dorsal and anal, the caudal and ventral more or less elongate in the mature specimens, but not filamentous; caudal rounded. Lateral line interrupted or absent. Branchial arches with toothed tubercles. Air-bladder simple; pseudobranchiæ none (glandular). Pyloric appendages in small number; intestine with many circumvolutions.

Distribution: Java; Sumatra; Borneo; Ceylon; Malabar; China; Formosa.

57. **Polyacanthus operculatus** (Linnæus).

Taiwan-kingyo (Formosa).

1735. *Labrus opercularis* LINNÆUS, Amœn. Acad., IV, p. 428 (not binomial).
1789. *Labrus operculatus* GMELIN, Syst. Nat., p. 1286; Asia (after Linnæus).
1785. *Chætodon chinensis* BLOCH, Ichthyologie, VII, p. 3, Taf. 218, Fig. 1; China.
1831. *Polyacanthus chinensis* CUV. & VAL., Hist. Nat. Poiss., VII, p. 357.—RICHARDSON, Ichthyol. China, 1846, p. 250; Canton.
1842. *Macropodus ocellatus* CANTOR, Ann. Mag. Nat. Hist., IX, p. 484; Chusan.
1846. *Polyacanthus? opercularis* RICHARDSON, Ichthyol. China, p. 250; China.
1846. *Polyacanthus ? paludosus* RICHARDSON, Ichthyol. China, p. 250; Canton.
1861. *Polyacanthus opercularis* GÜNTHER, Cat. Fish, III, p. 379; Chusan; Hongkong; China.—Ann. Mag. Nat. Hist., Sept., 1873, p. 243; Shanghai.—PETERS, Monatsb. Ak. Berlin, 1880, p. 923.—Abbott, Proc. U. S. Nat. Mus., XXIII, 1901, p. 490; Tien-tsin.

Head 3 in length; depth 2.75; D. 14, 6; A. 20, 13; P. 10; V. 2, 4; width of head 1.66 in its length; eye 3.66 in head; interorbital space 2.8; snout 4; twenty-eight scales in a lateral series, six scales between orbit and posterior margin of operculum, twelve scales in an oblique series between origin of dorsal and the root of ventral.

Body oblong, compressed, dorsal and ventral profiles equally arched; head moderate, triangular, entirely covered with scales; operculum with no spine or serrature; snout pointed anteriorly, interorbital space more or less convex; mouth small, terminal and subvertical, its angle not reaching the orbit; lower jaw slightly protruding; both jaws with small, fixed, villiform teeth; eyes rather large, anterior; nostrils separated, the anterior approximating the upper lip, the posterior in contact with eye.

Origin of the dorsal much nearer tip of snout than base of caudal, inserted behind that of anal, soft rays much longer than the spinous, the anterior longest, reaching middle of caudal; pectoral fins thoracic, the tips reaching beyond the anterior third of anal; anal fin very long, its base longer than that of dorsal, soft rays elongate, extending beyond the middle of caudal; caudal fin oblong, rounded at the tip;

caudal peduncle very short, its depth less than twice in the length of head.

Scales large, ctenoid; lateral line indistinct, visible only on the anterior nine scales.

Color greenish gray, with ten brown cross-bars on the sides, one of which is on the nape; a dark brown, round spot on the extremity of gill-cover, a somewhat paler short streak between the orbit and that spot; caudal fin with two brown cross-bars near the base; dorsal and caudal fins speckled with brown; base of the anal brownish; pectoral and ventral fins whitish.

Length of body 58 mm.

Described from a specimen from Taihoku, collected by Oshima in February, 1917.

Habitat: Abundant in the ditches and stagnant pools throughout the Island. My specimens came from Taihoku; Wodensho, Taichu.

MEASUREMENTS OF *Polyacanthus operculatus*.

Locality.	Head.	Depth.	D.	A.	P.	V.	Width of Head.	Interorbital.	Snout.	Eye.	Scales.	Length, Mm.
Taihoku	3	2.75	14, 6	20, 13	10	2, 4	1.66	2.80	4	3.66	28–12	58
Taihoku	2.83	2.83	14, 6	19, 13	10	2, 4	1.71	3	4	3.33	28–12	43
Taihoku............	2.91	2.91	14, 6	19, 13	10	2, 4	1.83	2.75	4	3.50	28–12	42
Taihoku............	2.90	2.90	13, 7	19, 13	10	2, 4	1.83	2.75	3.50	3	28–12	39
Taihoku............	2.77	2.77	13, 7	18, 13	10	2, 4	2	3	3.33	3.66	28–12	48

Genus MACROPODUS Lacépède.

1802. *Macropodus* LACÉPÈDE, Hist. Nat. Poiss., III, p. 416. (Type *Macropodus viridiauratus* Lacépède).

1861. *Macropus* GÜNTHER, Cat. Fish., III, p. 381. (Type *Macropodus viridiauratus* Lacépède.)

Body compressed, oblong; operculum without spine or serrature; cleft of mouth rather small, not extending beyond a vertical from the orbit. Small fixed teeth in the jaws, none on the palate. Dorsal and anal spines numerous (thirteen to eighteen); ventral fins composed of one spine and five rays, which are well-developed; soft dorsal, anal and caudal with long filamentous rays. Caudal fin forked or ending in a bundle of long filaments. Lateral line absent. Branchial arches with toothed tubercles. Pyloric appendages in small number; intestine of moderate length.

Distribution: Fresh waters of China, Cochin-China, and Botel Tobago.

58. **Macropodus filamentosus** sp. nov. (Plate LII, Fig. 2).

Head 3.2 in length; depth 3; D. 13, 8; A. 18, 15; P. 10; V. 1, 5; width of head 1.66 in its length; eye 3.5 in head, interorbital space 2.75; snout 3.5; twenty-eight scales in a lateral series, twelve scales in an oblique series between origin of dorsal and the root of the ventral, six scales between orbit and the posterior end of operculum.

Body oblong, compressed, tapering posteriorly, dorsal and ventral profiles equally arched; tail slightly turned downward (probably distorted); head moderate, triangular, entirely covered with scales, top convex; snout short, pointed anteriorly, interorbital space rather broad, slightly convex; operculum with no spine; minute denticulations at the pre-orbital and the angle of the pre-operculum; mouth anterior, oblique, its angle not reaching the orbit; both jaws with a band of fixed, villiform teeth, the lower jaw slightly protruding; nostrils separated, the anterior in a short tube, situated nearer the lip than orbit, the posterior nearly in contact with eye.

Dorsal fin elongate, inserted midway between tip of snout and base of caudal, soft rays much longer than the spines, fifth ray filamentous, reaching the middle of caudal; ventral with one spine and five rays, first ray filamentous, reaching anterior two-thirds of the base of anal; anal fin very long, its origin in advance of that of dorsal, posterior end of the base nearly in contact with the base of caudal, soft rays longer than the spines, middle rays longest, seventh to ninth rays filamentous, reaching beyond the end of dorsal filament; caudal fin gradually tapering posteriorly, middle rays elongated, forming a bundle of delicate filaments, not forked.

Scales moderate, ctenoid; with no lateral line; head provided with many mucous pores, four along the posterior margin of the upper lip, one on each side behind the posterior nostril, one in contact with the hind border of the orbit, three on the posterior part of pre-operculum; bases of the dorsal and anal covered with scales.

Color in alcohol pale grayish white, with about eleven brownish cross-bars on the sides and one of the same color on the base of the caudal; a dark brown round spot at the extremity of the operculum; postorbital space with traces of two brown streaks; membrane of the soft dorsal and upper half of the caudal speckled with black; base of the anal brownish, the rest of the fin whitish.

Length of the body excluding the caudal 43 mm. (caudal fin about 33 mm. long).

Described from a specimen from Kotosho (Botel Tobago Island), collected by Yonetaro Kikuchi.

Habitat: Kotosho (Botel Tobago Island). A single specimen.

Remarks: Macropodus viridi-auratus Lacépède[10] = *Macropodus venustus* Cuv. & Val., may be identical with the present species. According to the description and figure by Cuvier and Valenciennes it is provided with a distinctly forked caudal, instead of forming a bundle of long filaments as in *M. filamentosus.*

Family KUHLIIDÆ.

Genus KUHLIA Gill.

1861. *Kuhlia* GILL, Proc. Ac. Nat. Sci. Philad., p. 48. (Type *Perca ciliata* Cuv. & Val.)

1863. *Moronopsis* GILL, Proc. Ac. Nat. Sci. Philad., p. 82. (Type *Dules marginata* Cuv. & Val.)

1872. *Paradules* BLEEKER, Nederl. Tijdschr. v. Dierk. I, p. 257. (Type *Dules marginata* Cuv. & Val.)

Body elongate, fusiform. Head conical. Six branchiostegals. All the teeth villiform, without canines; teeth on the palatine bones. Anterior dorsal fin sustained by nine spines, the posterior with a spine and about eleven articulated rays; anal fin with three spines. Operculum with two or three flat spines; pre-operculum serrated. Scales moderate, minutely serrated.

Distribution: Rivers of the intertropical regions (Java, Philippines, India, Ceylon, Formosa, Japan).

59. **Kuhlia marginata** (Cuv. & Val.).

Dokugyo (Japan).

1829. *Dules marginata* CUV. & VAL., Hist. Nat. Poiss., III, p. 116, Pl. LII; Java.—GÜNTHER, Cat. Fish., I, 1859, p. 268; Seas of Java, Amboyna, Vanicolo, Fiji Islands.—DAY, Fish. Brit. India, 1876, p. 67, Pl. XVIII, Fig. 1; Seas of India, Malay Archipelago.

1903. *Kuhlia marginata* JORDAN & EVERMANN, Proc. U. S. Nat. Mus., XXV, p. 340; Kotosho, Formosa.—JORDAN & RICHARDSON, Bull. U. S. Bur. Fish., XXVIII, 1907, p. 254; Mindoro Island.—JORDAN & RICHARDSON, Mem. Carneg. Mus., IV, no. 4, 1909, p. 183; Formosa.—JORDAN, SNYDER & TANAKA, Journ. Coll. Sci., Tokyo, XXXIII, 1913, p. 146; Japan.

Head 3.19 in length; depth 2.69; D. X, 11; A. III, 10; P. 14; V. I, 5; width of head 1.86 in its length; eye 4.5 in head; interorbital space 3;

[10] *Macropodus viridi-auratus* Lacépède, Hist. Nat. Poiss., III, 1802, p. 417, Pl. 16, Fig. 1.

Macropodus venustus CUV. & VAL., Hist. Nat. Poiss., VII, 1831, p. 375, Pl. 197.

snout 3.4; pectoral 1.69; ventral 1.64; forty-two scales in the lateral line, four and one-half scales in an oblique series between origin of dorsal and lateral line, twelve scales between the latter and the middle of belly, nine scales between lateral line and the ventral; gill-rakers 5 + 18; six branchiostegals.

Body oblong, compressed, rather deep, dorsal and ventral profiles strongly convex; head moderate, with two sharp flat spines on the posterior margin of operculum, pre-opercles finely serrated; ventral surface of head convex and smooth; snout smooth, pointed anteriorly, interorbital space more or less convex; mouth oblique, with thin fleshy lips, its angles extending backward to the middle of the orbit below; lower jaw protruding; teeth on both jaws in villiform bands, vomer and palatines with a band of villiform teeth, no canine teeth; nostrils approximated, supralateral, in front of eye above, anterior nostril in a short tube.

Origin of the dorsal opposite that of ventral, much nearer tip of snout than base of caudal, elongate, fourth and fifth spines longest, soft rays higher than spines, the base covered with a scaly sheath; pectoral lateral, reaching beyond the middle of ventral; ventrals close ogether, each armed with a short strong spine, the end of the fin-membrane adnate to the belly, tip not reaching the anal; anal fin rather long, with three strong spines, second strongest but shorter than the third, inserted in front of the origin of first dorsal ray, the base of the fin covered with a scaly sheath; caudal fin rather broad, divergent, very slightly emarginate; caudal peduncle rather long, its depth 2.33 in length of head.

Body covered with moderate ctenoid scales; cheeks and operculum covered with scales; lateral line continuous, slightly upcurved, running along the middle of the tail.

Color in formalin dark grey above, belly and lower parts of sides yellowish; posterior margin of scales of the sides spotted with dark, their anterior margins finely speckled with black; dorsal fin dark gray, soft rays fuscous; pectorals dusky; ventrals white; membrane of the anal finely speckled with black; caudal fin dark brown.

Length of body 205 mm.

Described from a specimen from Tamusui River, collected by T. Aoki in December, 1916.

Habitat: Tamusui River near Shinten; Choso River at Koshiryo; Giran River near Inzanpo; Bokusekikaku.

Remarks: The present species is one of the brackish water fishes which enter the streams.

MEASUREMENTS OF *Kuhlia marginata.*

Locality.	Head.	Depth.	D.	A.	P.	V.	Width of Head.	Interorbital.	Snout.	Eye.	Scales.	Length, Mm.
Tamusui River....	3.19	2.69	x, 11	III, 10	14	I, 5	1.86	3	3.40	4.50	4½–42–12	205
Tamusui River....	3	2.72	x, 11	III, 10	14	I, 5	1.81	3.27	3.27	4.18	5 –40–13	181
Tamusui River....	3	2.63	x, 11	III, 10	14	I, 5	1.76	3.18	3.25	3.80	5 –40–13	132
Inzanpo..........	3.12	2.75	x, 11	III, 10	14	I, 5	2	3	3.40	4	4 –40–12	132
Koshiryo.........	3.28	2.66	x, 11	III, 10	14	I, 5	2	3	3.50	3.25	4½–40–12	104

Family OPHICEPHALIDÆ.

ARTIFICIAL KEY TO THE FORMOSAN GENERA OF OPHICEPHALIDÆ.

A. Ventral fins present.. *Ophicephalus.*
B. Ventral fins absent.. *Channa.*

Genus OPHICEPHALUS Bloch.

1794. *Ophicephalus* BLOCH, Naturg. Ausl. Fische, VIII, p. 137. (Type *Ophicephalus punctatus* Bloch.)

Body elongate, subcylindrical anteriorly; head depressed, covered with plate-like scales. Eyes lateral. Gill-openings wide, the membranes of the two sides connected beneath the isthmus; four gills; pseudobranchiæ none. A cavity accessory to the gill-cavity, for the purpose of retaining water; no suprabranchial organ developed. Teeth in the jaws, vomer, and palate. One long dorsal and anal fin, without spines; ventral fins thoracic, composed of four to six rays, the outer of which is not branched. Lateral line interrupted. Air-bladder present.

Distribution: British India; Ceylon; Borneo; Sumatra; Mindanao; Luzon; Bengal; Siam; Hindostan; Indo-China; Formosa; China; Amur Province.

SYNOPSIS OF THE FORMOSAN SPECIES.

a. Depth of body less than 6 in the length; nine scales between orbit and the tip of operculum; eleven scales between lateral line and the root of ventrals. *tadianus.*

aa. Depth of body more than 6 in the length; twelve scales between orbit and the tip of operculum; fourteen scales between lateral line and the root of ventrals. *maculatus.*

60. **Ophicephalus tadianus** Jordan & Evermann.

Raihii (Formosa).

1903. *Ophicephalus tadianus* JORDAN & EVERMANN, Proc. U. S. Nat. Mus., XXV, p. 330; Formosa.—JORDAN & RICHARDSON, Mem. Carneg. Mus., IV, no. 4, 1909, p. 193; Formosa.—VAILLANT, Bull. Mus. Hist. Nat., VI, 1904, p. 298; Tongking.

Head 3 in length; depth 5.33; D. 44; A. 28; V. 4; P. 16; width of head 2 in its length; eye 8 in head; interorbital space 5; snout 6; maxillary 3; mandible 2.25; pectoral 2.2; ventral 3; fifty-seven scales in a longitudinal series, four scales between origin of dorsal and lateral line, eleven scales between the latter and the root of ventral, sixteen scales between lateral line and the middle of belly; nine scales between orbit and the angle of pre-operculum.

Body torpedo-shaped, posterior part compressed, anterior part depressed; head rather elongate, depressed, its dorsal profile gradually inclined anteriorly; snout more or less produced, anterior margin obtusely rounded, interorbital space flat; eyes relatively small, superior and exceedingly anterior; nostrils separated, superior, the anterior in a short tube, in contact with the upper lip, the posterior in front of eye above; mouth oblique, large, its angle extending beyond the posterior margin of orbit; a band of small teeth on outer edge of jaws, a band of large, wide-set, caniniform teeth on palatine and inner side of lower jaw; upper jaw protractile, slightly shorter than the lower.

Dorsal fin very long, with numerous spine-like rays, low anteriorly, gradually lengthening posteriorly, when depressed the tip of fin reaching beyond root of caudal; the pectoral obtusely rounded, nearly twice as long as broad, reaching beyond the middle of ventral; ventral fins small, not reaching vent; anal similar to the dorsal, inserted beneath anterior third of the base of dorsal, when depressed reaching beyond the root of caudal; caudal fin squarish, with rounded tip; caudal peduncle very short, deep, strongly compressed laterally.

Body covered with rather large cycloid scales with irregular concentric rings and radiated striæ; top of head and cheeks covered with large scales; lateral line discontinuous, undulating, running along the center of body from base of caudal to just over third anal ray, thence upward for two rows of scales, forward sixteen rows, downward one row, and then forward to edge of gill-opening.

Color in formalin olivaceous brown above, paler below; a row of twelve dark gray blotches along the base of dorsal, partly on the fin, partly on body; below these, but above the lateral line, another row of nine similar, but larger, blotches, extending anteriorly to the upper posterior border of eye, running below the upward curve of lateral line and forming a continuous longitudinal band; below this another row of about seventeen similarly colored, irregular blotches, extending from the base of pectoral posteriorly along lower edge of lateral line to base of caudal; below this another row of irregular and lighter-colored blotches; head olivaceous brown, streaked with irregular lines of black above; a band of dark brown as wide as pupil, but becoming wider posteriorly, running from postero-inferior edge of eye to the middle of base of pectoral; lower part of head paler; dorsal fin marbled with dark; membrane of caudal fin dark, its rays dusky brown, two vertical stripes of gray color near the base; anal fin with seven dark blotches at the base of posterior half, its membrane dusky; the ventral pale; pectorals grayish, with no marking.

Length of body 220 mm.

Described from a specimen from Taihoku, collected by Oshima in October, 1916.

Habitat: Widely distributed throughout the Island. My specimens came from Taihoku, Raupi, Giran; Tozen River; Nanshisho, Giran.

MEASUREMENTS OF *Ophicephalus tadianus.*

Locality.	Head.	Depth.	D.	A.	P.	V.	Width of Head.	Interorbital.	Snout.	Eye.	Scales.	Length, Mm.
Taihoku	3	5.33	44	28	16	4	2	5	6	8	4–57–14	220
Taihoku	2.83	5.50	41	25	15	4	2.2	4.66	6.33	8.25	4–54–14	215
Raupi	3	5.11	44	27	16	4	2	5.30	5.60	7.33	5–56–14	196

61. **Ophicephalus maculatus** Lacépède.

1802. *Bostrichus maculatus* LACÉPÈDE, Hist. Nat. Poiss., III, p. 140, 143.

1831. *Ophicephalus maculatus* CUV. & VAL., Hist. Nat. Poiss., VII, p. 437.—KNER, Novara, Fisch., II, 1865, p. 234; Hongkong.—BLEEKER, Naturk. Verh. A. K. Amst., XIX, 1879, p. 50; Philippine Islands.—RUTTER, Proc. Acad. Nat. Sc. Philad., 1897, p. 69; Swatow.—JORDAN & EVERMANN, Proc. U. S. Nat. Mus., XXV, 1903, p. 330; Formosa.—JORDAN & RICHARDSON, Mem. Carneg. Mus., IV, No. 4, 1909, p. 193; Formosa.—JORDAN & RICHARDSON, Check-List Philip. Fish., 1910, p. 34; Manila.

1861. *Ophiocephalus maculatus* GÜNTHER, Cat. Fish., III, p. 480; China.

Head 3.66 in length; depth 6.18; D. 40; A. 28; P. 17; V. 6; width of head 1.8 in its length; eye 8 in head; interorbital space 5; snout 6;

pectoral 2.19; ventral 3.45; fifty-six scales in a lateral series, five scales between origin of dorsal and lateral line, fourteen scales between the latter and the root of ventral, sixteen scales between lateral line and the middle of belly, twelve scales between orbit and the end of pre-operculum.

Body spindle-shaped, posterior part compressed; head broad, depressed; snout rather short, obtusely rounded anteriorly, inter-orbital space flat; eyes small, superior, and exceedingly anterior; nostrils separated, the anterior in a short tube, on upper edge of maxillary, the posterior in front of eye above; mouth oblique, large, its angle extending beyond the posterior margin of orbit; maxillary 3 in head; mandible 2.66; lower jaw slightly longer than the upper; a row of large caniniform teeth on palatine and inner side of lower jaw, a band of small teeth on outer edge of both jaws.

The dorsal very long, with numerous spine-like rays, low anteriorly, when depressed reaching beyond the root of caudal; pectoral oval, outer margin rounded; ventrals rather small and slender, not reaching the vent; the anal similar to the dorsal, but not so long, inserted beneath the anterior third of the base of dorsal; caudal fin squarish, with rounded tip; caudal peduncle short and deep, greatly compressed.

Body covered with large cycloid scales with irregular concentric rings and radiating striæ; head and cheek covered with plate-like scales; lateral line broken anteriorly, running along the middle of sides from the base of caudal to just above the second anal ray, thence upward for two rows of scales, forward thirteen rows, downward one row, then forward to the upper edge of gill-opening.

Color in formalin dark bluish gray above, paler below; belly dusky; eight large dark gray blotches above the lateral line, extending anteriorly to the middle of and beneath the upward curve of the lateral line, forming a more or less continued longitudinal band; below this another row of about fourteen similarly colored, large, irregular blotches, extending from the base of pectoral posteriorly to the base of caudal, running below the lateral line; interspace between the upper row of markings and the base of dorsal irregularly mottled with dark; upper surface of the head uniformly bluish gray, lower parts paler; a dark brown band from the upper posterior corner of the orbit running backward, entering the upper row of markings of the sides; below this is an irregular, more or less undulating streak of the same color from eye to middle of base of the pectoral; upper part of the dorsal grayish, paler below, its membrane with a series of dark spots along the base; caudal fin uniformly gray, with a faint stripe near the base; anal fin gray, with indications of dark blotches at the posterior half of the base; ventral fins whitish, rays dusky; the pectoral gray.

Length of body 285 mm.

Described from a specimen from Wodensho, Taichu, collected by T. Aoki in December, 1916.

Habitat: Wodensho, Taichu (a single specimen).

Remarks: The present species is easily distinguished from *Ophicephalus tadianus* by its lower body; the greater number of scales between orbit and posterior angle of pre-operculum; and the greater number of scales in an oblique series between the lateral line and the root of ventral.

Genus CHANNA Gronow.

1763. *Channa* GRONOW, Zoöphyl., p. 135. (Type *Channa orientalis* Bloch & Schneider.)

Body elongate, subcylindrical anteriorly, compressed posteriorly; head slightly depressed, covered with plate-like scales. Eyes lateral and anterior. Gill-openings wide, membranes of the two sides connected beneath the isthmus. Fine teeth in the jaws, on the vomer, and the palatine bones, intermixed with larger ones in the lower jaw. Pyloric appendages none. One long dorsal and anal fin, without spine; ventral fins none. Lateral line broken anteriorly.

Distribution: Ceylon; China; Formosa.

62. **Channa formosana** Jordan & Evermann.

Kotai (Formosa).

1903. *Channa formosana* JORDAN & EVERMANN, Proc. U. S. Nat. Mus., XXV, p. 330; Formosa.—JORDAN & RICHARDSON, Mem. Carneg. Mus., IV, No. 4. 1909, p. 193; Suwata (after Jordan & Evermann).

Head 3.4 in length; depth 5; D. 44; A. 27; P. 14; width of head 1.6 in its length; eye 7 in head; interorbital space 3.5; snout 5; maxillary 2.5; mandible 2.2; pectoral 1.6; fifty-four scales in a lateral series, five scales between origin of dorsal and lateral line, thirteen scales between the latter and the middle of belly, about six scales between orbit and the angle of pre-operculum.

Body elongate, anterior part subcylindrical, compressed posteriorly; head rather broad, its top depressed; snout short, obtusely rounded anteriorly; mouth large, oblique, its angle extending beyond the posterior margin of orbit; lower jaw slightly longer than upper; teeth in both jaws and on vomer, cardiform; eyes moderate, superior, and much anterior; nostrils widely separated, the anterior in a long tube, just behind the upper lip, the posterior in front of eye.

Dorsal fin elongate, beginning over the base of pectoral, the rays quite uniform in length, when depressed reaching beyond the root of caudal; anal fin similar to dorsal but shorter, beginning beneath the fifteenth dorsal ray and ending under the forty-second; rays of the dorsal and anal all unbranched; pectoral fin broad, not reaching the vent; no ventral fins; caudal fin broad and rounded; caudal peduncle short and deep, greatly compressed.

Lateral line broken anteriorly, running along the middle of the sides from the base of caudal to just above second anal ray, thence upward one row for one scale, again upward for one row, extending forward on seven scales, thence dropping one row, reaching to the upper extremity of gill-opening; body covered with large cycloid scales with irregular concentric lines and radiating striæ; head and cheeks covered with plate-like scales.

Color in formalin yellowish brown above, paler below; the sides with about nine V-shaped dark cross-bars, the apex pointing forward, these markings clearer posteriorly and more or less broken and irregular in front; a large round black spot, bordered by white, on caudal

MEASUREMENTS OF *Channa formosana*.

Locality.	Head.	Depth.	D.	A.	P.	Width of Head.	Interorbital.	Snout.	Eye	Scales.	Length, Mm.
Taihoku................	3.40	5	44	27	14	1.60	3.5	5	7	5–54–13	210
Taihoku................	3.64	5.5	45	28	15	1.57	3.5	4.5	6.86	5–53–13	200

peduncle near the base of caudal fin; sides of head with two broad, dark streaks from eye to the posterior edge of operculum, more or less undulating; dorsal and anal fins uniformly dusky gray, their edge somewhat darker; other fins grayish white.

Length of body 210 mm.

The present description is from a specimen from Taihoku, collected by Oshima in September, 1916.

Habitat: Taihoku; Shori, Toyen; Tamusui River; Jitsugetsutan (Lake Candidius). One of the commonest fishes in ponds and stagnant pools.

Remarks: This species is very closely allied to *Channa ocellata*[11] from China. It differs in having no teeth on palatines and a greater number of scales in a transverse series.

Family GOBIIDÆ.

ARTIFICIAL KEY TO THE FORMOSAN GENERA.

A. Ventral fins entirely separated; pectorals normal; eyes not erectile.
- *a.* Pre-opercle with a concealed, hook-like spine; scales moderate, ctenoid; dorsal spines low; interorbital space without ridge............ *Eleotris.*
- *aa.* Pre-opercle without spine; scales moderate, ctenoid; dorsal spine low; interorbital space with prominent ridges........................ *Butis.*

B. Ventrals joined at least at base.
- *a.* Ventrals adherent to the belly; body scaly; teeth of the upper jaw movable, in a single series................................ *Sicyopterus.*
- *aa.* Ventrals not adherent to the belly; body scaly; teeth conical, fixed, those of the upper jaw in several series.
  - *b.* Soft dorsal and anal short, each composed of nine to twelve soft rays.
    - *c.* Tongue truncate or rounded or pointed at tip; gill-openings chiefly confined to the sides; pectorals without silk-like rays above; dorsal spines rather weak, some of them often elongate. *Rhinogobius.*
    - *cc.* Tongue emarginate at tip; gill-openings extending forward below; pectorals without silk-like rays above; scales rather large, about fifty..................................... *Glossogobius.*
  - *bb.* Soft dorsal and anal long, the former composed of fourteen to thirty rays, dorsal spines seven to nine.
    - *c.* Scales moderate; soft dorsal composed of fourteen or fifteen rays; cheeks scaly at least above; pectorals without free silk-like rays above.. *Acanthogobius.*

Genus ELEOTRIS (Gronow) Schneider.

1763. *Eleotris* GRONOW, Zoöphyl., p. 83 (non binomial).
1801. *Eleotris* SCHNEIDER, Syst. Ichth., p. 65. (Type *Gobius pisonis* Gmelin).
1874. *Culius* BLEEKER, Archiv. Neerl., IX, p. 303 (*Pœcia fusca* Schneider).

Body long and low, compressed behind. Head long, low, flattened above, without spines or crests, almost everywhere scaly. Mouth large, oblique, lower jaw projecting. Lower pharyngeals rather broad, the teeth small, bluntish. Pre-opercle with a small concealed spine below, its tip hooked forward. Branchiostegals unarmed. Tongue broad, rounded. Posttemporal bones very strongly divergent, their insertions close together; top of skull somewhat elevated and declivous; interorbital area slightly convex transversely; dorsal fins well apart,

[11] *Channa ocellata* Peters, Monatsb. Acad. Wiss. Berlin, 1864, p. 384. China.

the first composed of five or six low, flexible spines; ventrals separate. Scales moderate, ctenoid, forty-five to seventy in a longitudinal series; vertebrae (*pisonis*) 11–15. Tropical seas, entering fresh waters (Jordan & Snyder).

Distribution: Freshwater fishes of the tropics, some of the species entering the sea; cosmopolitan.

SYNOPSIS OF THE FORMOSAN SPECIES.

a. Scales of moderate size, about 50 in a lateral series, 15 between origins of the second dorsal and anal .... *oxycephala.*

aa. Scales small, about 60 in a lateral series, 16 between origins of the second dorsal and anal .... *fusca.*

63. **Eleotris oxycephala** (Schlegel).

Doman (Lake Biwa, Japan); Onkora (Formosa).

1845. *Eleotris oxycephala* SCHLEGEL, Fauna Japonica, Poiss., p. 150, Pl. LXXVII, Fig. 4, 5; Nagasaki.—GÜNTHER, Cat. Fish., III, 1861, p. 116; China.—KNER Novara, Fisch., II, 1865, p. 185; China.—JORDAN & SNYDER, Proc. U. S. Nat. Mus., XXII, 1900, p. 371; Lake Biwa.—Proc. U. S. Nat. Mus., XXIV, 1901, p. 46; Haneda; Wakayama.—JORDAN & RICHARDSON, Mem. Carneg. Mus., IV, No. 4, 1909, p. 200; Takao, Formosa.

1846. *Eleotris canthrinus* RICHARDSON, Ichthyol. China, p. 209; Macao.

1905. *Eleotris balia* JORDAN & SEALE, Proc. U. S. Nat. Mus., XXIX, p. 526; Hongkong.

Head 3.33 in length; depth 5; D. VI, 8; A. 9; P. 18; V. 5; depth of caudal peduncle 2.33 in head; eye 6; interorbital space 3; snout 4; fifty scales in a lateral series, fifteen scales between origins of second dorsal and anal.

Body deep, caudal peduncle strongly compressed; head long, much depressed, considerably broader than the body, a longitudinal groove along the median line of the top; snout rather short, broadly rounded anteriorly, interorbital space flat; mouth large, terminal, slightly oblique, its angle extending to a vertical through the anterior border of orbit; lips thick; lower jaw projecting beyond the upper; teeth on both jaws, simple, in rather broad bands, inner ones larger; palatines and vomers without teeth; eyes superior and anterior; tongue oblong, anterior edge rounded; nostrils separated, very small, anterior nostril in a short tube; gill-openings lateral, not extending very far forwards; posterior border of the pre-opercle with a hidden spine, which projects downward and forward; gill-rakers 3 + 9, short and covered with delicate setæ.

Two pairs of dorsal fins; first dorsal rather small, when depressed reaching the insertion of the second dorsal, posterior ray of the latter longest; pectorals acutely rounded, reaching to the posterior end of the base of the first dorsal; ventrals separated, rather small; the anal inserted beneath the third soft ray, when depressed reaching so far as the end of second dorsal; caudal fin rounded; anal flap developed.

Head with minute scales except snout, chin, and throat; occiput and cheeks with small cycloid scales; body covered with uniform ctenoid scales, those on belly, breast, and nape are minute and cycloid.

Color in formalin uniformly dark brown, ventral parts whitish, densely speckled with minute brown spots; a wide black stripe, made up of small black dots, extending from opercle to caudal; a distinct narrow black line through eye from snout to origin of dark stripe on body; another short black line from posterior margin of orbit to posterior margin of pre-opercle; first dorsal with two brown bands which run horizontally; second dorsal and anal with numerous dark spots; caudal and pectorals with small brownish spots arranged in vertical rows.

Length of body 112 mm.

Described from a specimen from Tozen River, collected by T. Aoki in December, 1916.

Habitat: Tamusui River near Maruyama; Tozen River; Giran River near Inzanpo and Kiburan; Buroko River near Suwo.

MEASUREMENTS OF *Eleotris oxycephala*.

Locality.	Head.	Depth.	D.	A.	P.	V.	Depth of Caudal Peduncle.	Interorbital.	Snout.	Eye.	Scales.	Length, Mm.
Tozen River	3.33	5	VI, 8	9	18	5	2.33	3	4	6	50–15	112
Tamusui River	3.26	5.22	VI, 9	9	17	5	2.33	3.37	3.83	6.50	48–15	109
Tamusui River	3.35	4.81	VI, 9	9	18	5	2.13	3	3.66	7	50–16	120
Inzanpo	3.15	4.25	VI, 9	9	19	5	2.22	3.25	3.90	7	48–15	150
Kiburan	3.28	4.50	VI, 8	9	19	5	2.40	3.50	4	6	48–15	105
Kiburan	3	4	VI, 9	9	17	5	2.50	3.44	4	5.40	46–15	113
Kiburan	3.45	5.26	VI, 9	9	19	5	2.50	3.40	3.77	6.66	48–15	130
Kiburan	3	4.60	VI, 9	9	18	5	2.50	3.75	4	5.66	48–15	110
Giran	3.26	4.66	VI, 9	8	19	5	2.25	3	3.44	7	50–15	165

64. **Eleotris fusca** (Schneider).

1801. *Pœcia fusca* SCHNEIDER, Bloch. Syst., p. 453.

1861. *Eleotris fusca* GÜNTHER, Cat. Fish., III, p. 125; Ganges; Calcutta; Bengal; Amboyna; Aneitum; Oualan; Wanderer Bay; Ceylon; Canton.—ISHIKAWA, Prel. Cat. Fishes, 1897, p. 31; Riukiu Islands.—DAY, Proc. Zoöl. Soc. London, 1869, p. 519.—KNER, Novara Fisch., II, 1865, p. 186; Ceylon; Nicobar; Tahiti.—DAY, Fish. Brit. India, p. 313.—PETERS, Monatsb. König. Akad. Wiss. Berl., 1868, p. 268; Luzon; Samar.—BOULENGER, Ann. Mag. Nat. Hist. (6), XV, 1895, p. 186; Palawan.—JORDAN & SNYDER, Proc. U. S. Nat. Mus., XXIV, 1902, p. 45; Honolulu.—JORDAN & EVERMANN, Proc. U. S. Nat. Mus., XXV, 1903, p. 361; Suwata, Formosa.—JORDAN & RICHARDSON, Mem. Carneg. Mus., IV, no. 4, 1909, p. 200; Formosa.—Bull. U. S. Bur. Fish., XXVII, 1908, p. 274; Sibuyan; Apari.—Check-list Philip. Fish., 1910, p. 45.

1822. *Cheilodipterus culius* BUCHANAN-HAMILTON, Fish. Ganges, p. 55, Pl. V, Fig. 16; Ganges.

1824. *Eleotris nigra* QUOY & GAIMARD, Zoöl. Voy. Freycinet, p. 259, Pl. LX, Fig. 2; Guam, Waigiou.—CUV. & VAL., Hist. Nat. Poiss., XII, 1837, p. 235; Isle de France; Ganges; Malabar; India; Java; Otaiti; Borabora; Society Island; Madagascar.

1831. *Eleotris mauritianus* BENNETT, Proc. Comm. Zoöl. Soc., I, p. 166; Mauritius.

Head 3.39 in length; depth 5.33; depth of caudal peduncle 2 in head; eye 5; interorbital space 3.66; snout 4; maxillary 2.4; D. VI, 9; A. 9; P. 18; V. I, 5; sixty-four scales in a lateral series, sixteen scales between origins of the second dorsal and anal.

Body rather depressed, posterior part compressed; head long, depressed, broader than body, a shallow longitudinal groove along the median line of the top; snout rather short, broadly rounded anteriorly, interorbital space more or less concave; mouth large, terminal, slightly oblique, its angle reaching a vertical through the anterior border of orbit; lips thick; lower jaw protruding; teeth in villiform bands, those on the outer series somewhat enlarged; palatines with no teeth; eyes superior and anterior; tongue oblong, with rounded anterior margin; nostrils separated, minute, the anterior located just behind the upper lip, the posterior approximated to eye above; gill-openings lateral, not extending very far forward; a spine at the angle of preoperculum, projecting downward and forward.

Dorsal fin separated; first dorsal rather small, when depressed scarcely reaching the root of second dorsal; second dorsal without filamentous rays, posterior ray the longest; pectoral fins acutely rounded, reaching beyond the posterior end of base of first dorsal; ventrals separated, rather short; the anal inserted beneath third dorsal ray, when depressed reaching end of second dorsal; caudal fin rounded; anal flap developed.

Body covered with minute ctenoid scales; scales on the upper surface of the head small and cycloid, extending forward to the interorbital space; cheeks covered with minute scales; those on the belly minute and cycloid.

Color in formalin dark gray above; lower surface pale brown, with minute brown spots; pectorals and anal with a number of rows of faint brown spots; dorsal and caudal fins with several series of brown spots; ventral fins indistinctly spotted with dark.

Length of body 94 mm.

Described from a specimen from Buroko River near Suwo, collected by T. Aoki in August, 1917.

Habitat: Buroko River near Suwo (a single specimen).

Remarks: The head of the above-described specimen is a little longer than that of the specimen described by Günther or Day. But as the specimens of *Eleotris fusca* from Sumatra, which are contained in the Stanford collection have longer heads, there is no doubt with reference to the identity of the present species.

MEASUREMENTS OF *Eleotris fusca.*

Locality.	Head.	Depth.	D.	A.	P.	V.	Depth of Caudal Peduncle.	Interorbital.	Snout.	Eye.	Scales.	Length, Mm.
Buroko River...............	3.39	5.33	VI, 9	9	18	I, 5	2	3.66	4	5	64–16	94
Sumatra (No. 8009; S. U.)...	3.37	4.71	VI, 9	9	18	I, 5	2.21	3.55	4	6	60–16	128
Sumatra (No. 8009; S. U.)...	3.43	5.39	VI, 9	9	18	I, 5	2.23	3.22	4	6.5	60–16	116

Genus BUTIS Bleeker.

1874. *Butis* BLEEKER, Arch. Neer. Sc. Nat., IX, p. 543. (Type *Cheilodipterus butis* Hamilton.)

Body elongate, posterior part compressed, somewhat cylindrical in front. Head elongate, strongly depressed, its upper surface gradually inclining anteriorly; snout produced; interorbital space provided with a pair of bony ridges along the superior margin of the orbit. Cheeks rather rough, sometimes with striæ. Teeth in many series, set close together, minute and subequal, those of the outer row somewhat larger; tongue and palate edentulous. Pre-operculum without a spine. Scales large, about thirty in a longitudinal series; scales on occiput extending to the interorbital space; cheek covered with scales.

Distribution: Philippine Islands; Malayan Archipelago; India to China; Formosa.

65. **Butis butis** (Hamilton).

1822. *Cheilodipterus butis* HAMILTON, Fish. Ganges, pp. 57, 367.

1849. *Eleotris butis* CANTOR, Catal. Malay. Fish., p. 196—Günther, Cat. Fish., III, 1861, p. 116; China; Philippine Islands; Borneo; Amboyna; Penang; India.—DAY, Fish. Brit. India, p. 315; Pl. LXVIII, Fig. 3; Seas and estuaries of India to the Malay Archipelago.—SAUVAGE, Bull. Soc. Philom., 1883, p. 8; Siam.

1861. *Butis butis* BLEEKER, Versl. Akad. Amst., XII, p. 77; Penang.—BOULENGER, Ann. Mag. Nat. Hist., Ser. 6, XV, p. 186; Palawan.—JORDAN & RICHARDSON, Bull. U. S. Bur. Fish., XXVII, 1908, p. 125; Manila; Iloilo.

1849. *Butis melanostigma* BLEEKER, Verh. Bat. Gen., XXII, p. 23; Madras Straits. —BLEEKER, Arch. Neerl. Sc. Nat., X, 1875, p. 68.

1905. *Butis leucurus* JORDAN & SEALE, Proc. U. S. Nat. Mus., XXVIII, p. 794, Fig. 13; Negros.—JORDAN & SEALE, Bull. U. S. Bur. Fish., XXVI, 1906; p. 40; Negros.—EVERMANN & SEALE; Bull. U. S. Bur. Fish., XXVI, 1906 (1907), p. 104; Bacon.

Head 3 in length; depth 4.33; depth of caudal peduncle 3 in head; eye 5; interorbital space 3.83; snout 2.5; D. VI, 9; A. 9; P. 20; V. 1, 5; thirty scales in a lateral series, nine scales between origins of second dorsal and anal; gill-rakers 2 + 6.

Body elongate, compressed, deepest in front of the first dorsal; head long, flattened, its upper surface and cheeks covered with minute scales; pre-operculum with no spine; snout depressed and produced, tip slightly swollen, anterior margin rounded; interorbital space more or less flat, covered with minute scales; mouth large, oblique, its angle not reaching the vertical through anterior margin of orbit; lower jaw protruding; teeth in villiform bands; palatines and vomers with no teeth; eyes separated, superior, slightly nearer to tip of snout than end of operculum; nostrils separated, the anterior in a very short tube; a finely serrated ridge along the posterior and superior edge of the orbit, interspace between the ridge and orbit covered with two series of small scales.

Dorsal fin separated; spinous dorsal rather small, when depressed reaching to the origin of soft dorsal; height of soft dorsal rays subequal; pectorals lateral, middle ray elongate; ventrals separated, inserted in advance of the origin of pectoral; anal fin opposite the soft dorsal, inserted beneath the third ray, posterior rays longer; caudal fin rather short, squarish, tip rounded.

Body covered with large ctenoid scales, those on the head are minute and cycloid.

Color in alcohol uniformly dark gray, with lighter longitudinal stripes along the sides; a deep brown spot on the lower half of the base of the pectoral; spinous dorsal nearly black; soft dorsal somewhat paler, with dark spots; caudal and anal fins dusky with darker spots; pectoral fins pale gray.

Length of body 93 mm.

Described from a specimen from Daitotei fish-market, Taihoku.

Habitat: Taihoku (a single specimen).

Genus SICYOPTERUS Gill.

1860. *Sicyopterus* GILL, Proc. Acad. Nat. Sci. Philad., p. 101. (Type *Sicydium stimpsoni* Gill.)

Body subcylindrical, covered with ctenoid scales of rather small size; head as broad as high; mouth nearly horizontal, with the upper jaw prominent; lips very thick and fleshy. The upper jaw with a series of numerous small teeth, implanted in the gum and movable; lower jaw with a series of conical, widely set teeth. Eyes of moderate size. Two dorsal fins, the anterior with six flexible spines, of which the third is filiform; caudal fin quite free; ventral fins united to a small semicircular disc, more or less adherent to belly. Gill-openings of moderate width; four branchiostegals; no air-bladder.

Distribution: Hawaii; Japan; Philippine Islands; Formosa.

66. **Sicyopterus japonicus** (Tanaka).

Bozuhaze (Japan); Fushunhii (Formosa).

1909. *Sicydium japonicum* TANAKA, Journ. Coll. Sci., Tokyo, XXVII, p. 22; Tosa, Japan.

1913. *Sicyopterus japonicus* JORDAN, SNYDER, & TANAKA, Journ. Coll. Sci., XXXIII, p. 431; Tosa; Kii; Kinokawa.—TANAKA, Fishes of Japan, XI, p. 203; Kii; Hiuga.

Head 4.21 in length; depth 5.88; D. VI, 11; A. 10; P. 19; eye 6.5 in. head; interorbital space 2.66; snout 2.18; depth of caudal peduncle 1.71; fifty-nine scales in a lateral series; sixteen scales in a transverse series.

Body elongate, subcylindrical, slightly compressed; head rather large, round, its top slightly depressed; snout broadly rounded anteriorly; mouth horizontal, its angle reaching the vertical through anterior margin of orbit; upper jaw prominent; lips thick and fleshy, a series of numerous minute teeth in upper jaw, implanted in the gum and movable; lower jaw with a series of conical widely-set teeth; eyes small, superior, and in the middle of the head; nostrils widely separated, the anterior in a small round hole, the posterior slit-like and minute; gill-openings lateral, in front of the base of the pectoral; gill-membranes broadly united to isthmus.

Two dorsal fins, the first dorsal inserted above the posterior half of pectoral, nearer to the origin of second dorsal than to the tip of snout, with six flexible spines, of which the third is filiform, reaching the anterior third of the base of second dorsal, fin-membrane united to the back behind the last spine; second dorsal opposite to the ventral, elongate, its rays subequal in height; pectoral fins lateral, leaf-shaped, with rather sharp tip, reaching midway between origin of ventral and that of the anal; ventrals united, forming a small semicircular disk, more or less adherent to the belly; origin of the anal slightly behind that of the second dorsal, similar in form to the latter; caudal fin rounded.

Body covered with ctenoid scales, those on the anterior parts of body and the base of caudal cycloid; head entirely naked; no lateral line.

Color in formalin brownish gray, paler below; dorsal surface with about ten black cross-bands, some of which extend downwards, first band in front of the base of pectoral, second one in front of the origin of first dorsal; head uniformly dark gray; all the fins dark gray; first dorsal sparingly spotted with dark, each ray of the second dorsal with a series of pale brown spots; proximal part of caudal fin darker.

Length of body 120 mm.

Described from a specimen from Tamusui River near Shinten, collected by T. Aoki in December, 1916.

Habitat: Tamusui River; Tozen River; Koranronsho, Taichu; Shinchiku; Bokusekikaku; Choso River (Koshiryo); Taiko.

MEASUREMENTS OF *Sicyopterus japonicus*.

Locality.	Head.	Depth.	D.	A.	P.	Interorbital.	Snout.	Eye.	Depth of Caudal Peduncle.	Scales.	Length, Mm.
Tamusui River	4.21	5.85	VI, 11	10	19	2.66	2.18	6.50	1.71	59–16	120
Tamusui River	4.13	6.33	VI, 11	10	18	2.44	2	6	1.64	58–16	116
Tamusui River	4.32	6.25	VI, 11	11	18	2.44	2	6.50	1.64	59–16	120
Tamusui River	4.32	6.33	VI, 11	11	19	2.40	2	6	1.64	60–16	115
Tozen River	4.38	5.88	VI, 11	11	19	2.75	2.10	7	1.62	58–16	113
Tozen River	4.40	5.65	VI, 11	11	19	2.50	2.27	6.66	1.47	58–16	140
Choso River	4.47	5.80	VI, 11	10	19	2.50	2.33	6	1.12	60–15	105
Heirinbi	4.18	4.42	VI, 11	10	19	2.40	2	6.75	1.69	59–16	112
Taiko	4.34	5.41	VI, 11	10	19	2.31	2.31	7	1.53	60–16	166

Genus RHINOGOBIUS Gill.

1859. *Rhinogobius* GILL, Proc. Ac. Nat. Sci. Philad., p. 145. (Type *Rhinogobius similis* Gill.)

Body oblong, compressed. Head oblong, not much compressed. Eyes high, anterior, close together; opercles unarmed. Mouth moderate, the lower jaw unusually short. Teeth on jaws only; conical, in few or several series, those in the outer row enlarged; no large canines; tongue usually truncate. Isthmus broad. Shoulder-girdle without fleshy flaps or papillæ. Skull depressed, abruptly widened behind the eyes and without distinct median keel. Scales moderate or large, ctenoid, permanently covering the body; cheeks naked; opercles naked, or scaled above only; belly generally scaly. Dorsal with six rather weak spines; pectoral well-developed, the upper rays without free or silk-like tips; ventrals completely united, not adnate to the belly; caudal fin usually obtuse. (Jordan & Snyder.)

Distribution: Philippine Islands; Formosa; China; Corea; Japan; North America.

SYNOPSIS OF THE FORMOSAN SPECIES.

I. Opercles entirely naked.
- *a.* Nape with a naked area.
  - *b.* Dorsal spines filamentous.
    - *c.* Scales about thirty-six; head with many mucous pores. *taiwanus.*
  - *bb.* Dorsal spines not filamentous.
    - *c.* Scales thirty-six to thirty-eight; head without mucous pores. *candidius.*
    - *cc.* Scales twenty-nine; head without mucous pores..... *formosanus.*
- *aa.* Nape closely scaled.
  - *b.* Scales about twenty-nine; dorsal spines not filamentous; teeth in two series .... *giurinus.*
  - *bb.* Scales about twenty-eight; dorsal spines not filamentous, teeth in villiform band, lower jaw with two canine teeth on each side. *caninus.*

67. **Rhinogobius candidius** (Regan).

1908. *Ctenogobius candidius* Regan, Ann. Mag. Nat. Hist. (8), I, p. 153; Lake Candidius, Formosa.

Head 3.77 in length; depth 5.5; caudal peduncle 2.11 in head; eye 5; interorbital space 4.75; snout 2.71; D. VI, 9; A. 9; P. 20; thirty-six scales in a lateral series, ten scales between origins of the second dorsal and anal; gill-rakers 3 + 6.

Body robust, a little deeper than wide; caudal peduncle compressed; head slightly depressed; snout rather long and sharp; mouth terminal, a little oblique, its angle not reaching a vertical through the anterior margin of orbit; jaws subequal; lips thick; teeth on both jaws in villiform bands, those on the outer series conical and somewhat larger; tongue broad, anterior border rounded; nostrils separated, the anterior in a short tube; eyes high, upper margin more or less projecting; interorbital space concave.

Dorsal fin separated, none of the spines elongated, when depressed not reaching the base of second dorsal, soft rays a little longer than the spines, rather high; pectorals large, not reaching the vent; ventrals united, forming a concave disk which is not adnates to the belly; anal fin inserted below the third dorsal ray, when depressed extending beyond the end of second dorsal, sixth and seventh rays the longest; caudal fin quadrate, tip rounded.

Head and nape entirely naked; scales in front of first dorsal as well as those on the breast and belly minute and cycloid, rest of the scales ctenoid.

Color in alcohol pale olive-gray, sides with seven brownish broad cross-bars; back mottled with dark; a black elongated spot on the base of the caudal; lower surface whitish; first dorsal dusky, second dorsal spotted with black; caudal fin dusky; other fins whitish.

Length of body 84 mm.

Described from a specimen from Bokusekikaku. collected by Yonetaro Kikuchi.

Habitat: Bokusekikaku; Heirinbi; Tozen River; Shinchiku; Daiko River; Taito River. Lake Candidius (Regan).

Remarks: The nearest relative of the present species is *Rhinogobius bedfordi* (Regan)[12] from Corea. It differs in having the second spine of the first dorsal produced into a filament.

MEASUREMENTS OF *Rhinogobius candidius*.

Locality.	Head.	Depth.	D.	A.	P.	Depth of Caudal Peduncle.	Interorbital.	Snout.	Eye.	Scales.	Length, Mm.
Bokusekikaku	3.77	5.50	VI, 9	9	20	2.11	4.75	2.71	5	36–10	84
Bokusekikaku	3.52	5.35	VI, 9	9	20	2	4.66	2.63	5.50	38–10	90
Heirinbi	3.63	6.22	VI, 9	9	19	2.66	5	2.42	4.66	37– 9	70
Tozen River	3.58	5.25	VI, 9	9	16	2	5	2.42	4.50	35–10	72
Shinchiku	3.33	5.66	VI, 9	9	19	2.28	5	2.50	4	35–10	61
Daiko River	3.75	5.50	VI, 9	9	19	2.16	5	2.60	4	36–10	55
Daiko River	3.25	5.42	VI, 9	9	17	2.16	6	2.60	4.50	35–10	48
Daito River	3.62	5.33	VI, 9	9	18	2	4.66	2.75	4.50	35–10	57

[12] *Ctenogobius bedfordi* Regan, Proc. Zoöl. Soc. London, 1908, p. 62; Chong-ju, Corea.

68. **Rhinogobius giurinus** (Rutter).

1897. *Gobius giurinus* RUTTER, Proc. Acad. Nat. Sc. Philad., p. 86; Swatow, China.

1901. *Gobius giurus* ABBOTT, Proc. U. S. Nat. Mus., XXIII, p. 491; Tiensin.

1903. *Ctenogobius platycephalus* JORDAN & EVERMANN, Proc. U. S. Nat. Mus., XXV, p. 362; Taihoku.

1909. *Rhinogobius giurinus* JORDAN & RICHARDSON, Mem. Carneg. Mus., IV, no. 4, p. 200; Kotosho; Taihoku, Formosa.

Head 3.47 in length; depth 4.33; depth of caudal peduncle 2.5 in head; eye 4; interorbital space 7.66, snout 2.5; D. VI, 9; A. 10; P. 19; twenty-nine scales in a lateral series, nine scales between origins of the second dorsal and anal.

Body elongate, a little deeper than wide, posterior part compressed; head broader than deep; snout rather long, sharp, anterior margin acutely rounded; interorbital space concave, narrow; mouth moderate, somewhat oblique, its angle scarcely reaching a vertical through anterior margin of orbit; lips thick; jaws subequal; teeth in two series, outer ones small, canine-like, second series in upper jaw minute, no large caniniform teeth; tongue broad, the tip truncate; eye high in head, upper margin projecting, situated midway between tip of snout and posterior edge of opercle; gill-openings not extending far forwards; gill-rakers 2 + 8 on first arch; no barbels on lower jaw.

Dorsal fin separated, rather short, spinous rays not filamentous, when depressed not reaching the second dorsal; soft rays a little longer than the spines; pectorals rounded, extending to the vent above; ventrals united, not adnate to the belly, the tips not reaching the vent; the anal inserted below second ray of second dorsal, when depressed extending as far posteriorly as the second dorsal; caudal fin rounded.

Head, except the occiput, naked; body covered with large, regular ctenoid scales; those on the occiput smooth and cycloid.

Color in formalin pale olive-gray above, lower parts whitish; head spotted with dark, cheek with oblique, rather wavy bars; sides with a number of irregular black spots; back mottled with dark; occiput with closely crowded dark blotches; dorsal fins with dusky spots arranged in longitudinal rows; caudal fin fuscous, with indistinct wavy cross-band near the base; pectoral fins dark; ventrals and anal whitish.

Length of body 65 mm.

Described from a specimen from Shimo-Tamusui River near Ako, collected by T. Aoki in December, 1916.

Habitat: Shimo-Tamusui River near Ako; Tozen River; Wodensho, Taichu; Daito River; Tamusui River; Shori, Toyen; Hyoko and Maruyama, Giran.

Remarks: In the year 1903, Jordan and Evermann described the present species from Kotosho and Taihoku under the name *Ctenogobius platycephalus* (Richardson), though there were some doubts with reference to its identity. In Jordan and Richardson's paper, however, the name has been changed to *Rhinogobius giurinus* (Rutter).

The present species is very closely allied to *Rhinogobius hadropterus*[13] from Japan. But it differs in having a greater number of scales in the lateral series.

MEASUREMENTS OF *Rhinogobius giurinus*.

Locality.	Head.	Depth.	D.	A.	P.	Depth of Caudal Peduncle.	Interorbital.	Snout.	Eye.	Scales.	Length, Mm.
Shimo-Tamusui River.....	3.47	4.33	VI, 9	10	19	2.50	7.66	2.50	4	29–9	65
Shimo-Tamusui River.....	3.25	5.17	VI, 10	10	20	3	7.66	2.71	4.33	29–9	78
Shimo-Tamusui River.....	3.28	5.70	VI, 9	9	20	2.83	6	2.71	4	30–9	74
Tamusui River...........	3.47	6	VI, 9	9	20	2.83	6.66	2.63	4.25	30–8	73
Shori....................	3.47	5	VI, 9	9	20	2.80	7.50	2.50	4.66	30–8	60
Shori....................	3.48	5.36	VI, 10	10	19	2.63	7	2.50	4.60	29–8	89
Daito River..............	3	5.66	VI, 9	9	19	3.14	7.50	2.55	5	31–8	83
Wodensho...............	3.33	5.10	VI, 9	9	20	2.66	6.66	2.80	4.25	29–8	63
Tozen River..............	3.22	5.21	VI, 9	9	19	2.75	6.50	2.44	5.40	30–9	90
Heirinbi.................	3.40	5.75	VI, 10	10	19	2.71	5.66	2.50	4.66	30–8	82
Hyoko....................	3	5.66	VI, 9	9	19	3	5	3	4	30–8	50
Maruyama................	3.33	5	VI, 9	9	19	2.33	5	2.50	4	30–9	59
Swatow (Type)..........	3.58	6	VI, 9	9	20	2.57	7.33	2.57	4	30–9	73

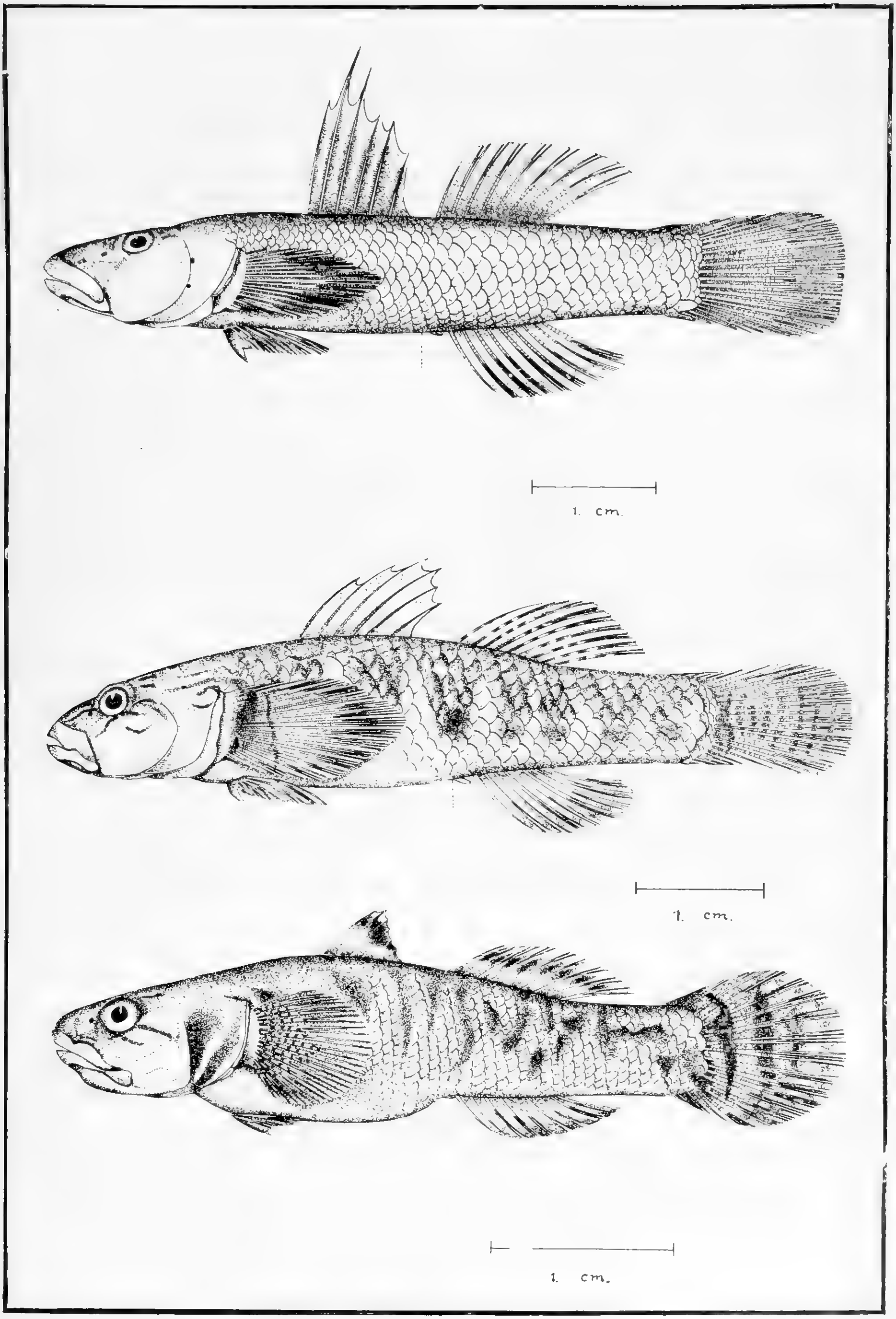
69. **Rhinogobius taiwanus** sp. nov. (Plate LIII, Fig. 1.)

Head 3.35 in length; depth 5.6; depth of caudal peduncle 2.25 in head; eye 5; interorbital space 7; snout 2.38; D. VI, 9; A. 9; P. 17; V. 1, 5; thirty-six scales in a lateral series, twelve scales in a transverse series between origin of second dorsal and anal; gill-rakers 2 + 7.

Head and body of nearly the same depth throughout, caudal peduncle slightly low and compressed; head long and depressed, its width contained 1.64 in its length, cheeks slightly bulged out; snout rather long, sharply pointed anteriorly; mouth terminal, slightly oblique, its angle not reaching to a vertical through the anterior margin of orbit;

[13] *Ctenogobius hadropterus* Jordan & Snyder, Proc. U. S. Nat. Mus., 1901, XXIV, p. 60; Nagasaki; Kurume; Tsuruga; Kawatana.

Rhinogobius hadropterus, Jordan, Snyder, & Tanaka, Journ. Coll. Sci. Tokyo, XXXIII, 1913, p. 343.



Rhinogobius taiwanus Oshima, sp. nov.
Rhinogobius formosanus Oshima, sp. nov.
Glossogobius parvus Oshima, sp. nov.

upper jaw more or less projecting; lips fleshy; teeth on both jaws in villiform bands, those on outer row enlarged; eyes superior, situated midway between tip of snout and posterior angle of opercles; interorbital space concave and narrow; anterior nostril in a short tube.

Dorsal fins well separated; spinous dorsal greatly elevated, second spine the longest, filamentous, its height 3.8 in total length without caudal, the third a little shorter than the second, the last spine about one-third as long as the second; soft dorsal high, posterior ray the longest, when depressed scarcely reaching the root of caudal; pectorals extending beyond the posterior end of base of spinous dorsal; ventrals united, forming a round, concave cup, the tip of which reaches middle of pectoral, free from the belly; anal fin inserted below second ray of soft dorsal, posterior ray the longest, when depressed reaching end of soft dorsal; caudal fin rounded.

Body covered with large ctenoid scales; small cycloid scales near the base of spinous dorsal and on the belly; head and occiput entirely naked.

Head with a number of mucous pores nearly as large as the nostril, one on each side above and before the eyes, one on the posterior part of

MEASUREMENTS OF *Rhinogobius taiwanus*.

Locality.	Head.	Depth.	D.	A.	P.	Depth of Caudal Peduncle.	Interorbital.	Snout.	Eye.	Scales.	Length, Mm.
Shinchiku	3.35	5.40	VI, 9	9	17	2.25	7	2.38	5	36–12	69
Shinchiku	3.21	5.44	VI, 9	8	17	2.33	7	2.66	5	36–11	55
Shinchiku	3.20	6.25	VI, 9	9	16	2.42	7	2.42	4.50	35–10	59
Shinten	3.14	6.27	VI, 9	9	18	2.63	7	2.33	4.60	36–10	80
Sobun River	3.19	6	VI, 9	9	18	2.42	6	2.66	5	35–10	64
Jitsugetsutan	3.35	5.23	VI, 9	10	18	2.10	6	2.25	5	36–12	81
Dakusui River	3.19	6	VI, 10	9	18	2.14	6	2.42	5	36–11	60
Dakusui River	3.18	6.09	VI, 10	9	18	2.40	6	2.50	5	36–11	44
Dainansho	3.47	5.20	VI, 10	9	18	2.14	6.5	2.50	5	35–12	61
Bokusekikaku	3.17	5.80	VI, 9	8	18	2.57	5	2.50	5	37–10	70
Inzanpo	3.31	5.88	VI, 9	8	18	2.66	7	2.33	4.50	37–10	65

interorbital space, one behind each eye, two along the posterior edge of pre-operculum.

Color in alcohol pale brown, somewhat darker anteriorly; all the fins pale brown, soft dorsal and anal bordered with white.

Length of body 69 mm.

Described from a specimen from Shinchiku, collected by T. Aoki in December, 1916.

Habitat: Shinchiku; Tamusui River near Shinten; Dakusui River; Sobun River; Jitsugetsutan (Lake Candidius); Dainansho, Nanto; Bokusekikaku; Inzanpo, Giran.

Remarks: This species is near *Rhinogobius similis*[14] from Japan, but differs distinctly in the smaller number of mucous pores and in the greater number of scales in the lateral series.

Rhinogobius candidius is another closely related species. It differs, however, in having no mucous pores and the spines of the first dorsal which are not filamentous.

70. **Rhinogobius formosanus** sp. nov. (Plate LIII, Fig. 2).

Head 3.53 in length; depth 4.25; depth of caudal peduncle 2 in head; eye 5; interorbital space 5.5; snout 2.8; D. VI, 9; A. 9; P. 19; twenty-nine scales in lateral series, nine scales in an oblique series between origins of second dorsal and anal.

Body rather robust, highest in front of first dorsal; tail slightly compressed; head elongate, entirely naked; snout pointed anteriorly; mouth moderate, more or less oblique, its angle reaching a vertical through anterior margin of orbit; jaws subequal; lips fleshy, upper lip rather wide; tongue broad, with rounded tip; teeth on the upper jaw in a single series, conical and minute, those on the lower jaw in a narrow villiform band, outer ones pointed and in a single row; eyes high in head, upper margin projecting above the contour of head, situated nearer to tip of snout than the posterior edge of opercle; interorbital space convex; nostrils separated, anterior nostril in a short tube.

Dorsal fins well separated, none of the spines elongated, when depressed not reaching the base of second dorsal; second dorsal rather short, middle ray longest; pectorals rhomboidal, pointed at the tip, not reaching the vent; ventrals united, forming a concave disk, not adnate to the belly; anal fin inserted below the third ray of second dorsal, when depressed extending to end of second dorsal, posterior ray longest; caudal fin rounded.

Body covered with large ctenoid scales, those on the belly smaller and cycloid; cheeks, operculum, and tip of head entirely naked.

Color in alcohol pale olive-gray, back mottled with dark; sides with about seven squarish dark cross-bars; lower surface whitish; top of

[14] *Rhinogobius similis* Gill, Proc. Ac. Nat. Sci., Philad., 1859, p. 145; near Shimoda, Japan.

head, cheeks, and snout with a number of wavy, pale-brown, longitudinal streaks; membrane of the dorsal fins grayish, spines fuscous, soft rays spotted with dark; ventral fin whitish; pectoral and anal dusky, the latter bordered with white; caudal fin with wavy vertical cross-bands.

Length of body 65 mm.

Described from a specimen from Shinchiku, collected by T. Aoki in December, 1916.

Habitat: Shinchiku (a single specimen).

Remarks: The present species much resemble *Rhinogobius hadropterus*[15] from Japan. It differs, however, in having an entirely naked head.

71. **Rhinogobius caninus** (Cuv. & Val.).

1837. *Gobius caninus* Cuv. & Val., Hist. Nat. Poiss., XII, p. 86.—Bleeker, Verh. Batav. Gen., XXII, 1849, p. 27.—Günther, Cat. Fish., III, 1861, p. 38; China; East Indian Archipelago.

1905. *Rhinogobius caninus* Jordan & Seale, Proc. U. S. Nat. Mus., XXVIII, p. 796; Negros.—Jordan & Richardson, Bull. U. S. Bur. Fish., XXVII, 1908, p. 259; Iloilo; Lubang.—Jordan & Richardson, Mem. Carneg. Mus., IV, no. 4, 1909, p. 200; Takao, Formosa.

1912. *Ctenogobius caninus* Snyder, Proc. U. S. Nat. Mus., LXII, p. 514; Okinawa.

Head 3.45 in length; depth 5.42; caudal peduncle 2.44 in head; eye 4.8; interorbital space 8; snout 3.28; D. VI, 1, 9; A. 9; P. 19; twenty-eight scales in a lateral series, ten scales between the origin of soft dorsal and that of the anal.

Body oblong, compressed, depth nearly subequal throughout the body, gradually tapering posteriorly; head rather high, not depressed; snout rounded anteriorly, its profile slightly arched, interorbital space narrow; mouth oblique, its angle reaching beyond a vertical through anterior margin of orbit; lower jaw longer than the upper, with two large canine teeth on each side; teeth on both jaws in a villiform band, outer ones larger; tongue rather short, truncated in front; eyes high in head, much nearer tip of snout than the end of opercle; nostrils separated, in front of eye, the posterior slightly larger than the anterior.

Dorsal fins well separated, none of the spines elongated, when

[15] *Ctenogobius hadropterus* Jordan & Snyder, Proc. U. S. Nat. Mus., XXIV, 1901, p. 60.

Rhinogobius hadropterus Jordan, Snyder, & Tanaka, Journ. Coll. Sci. Tokyo. XXXIII, 1913, p. 343.

depressed scarcely reaching the origin of soft dorsal; soft dorsal rather long, armed with a short, slender undivided ray, posterior ray the longest, when depressed reaching root of caudal; pectorals quadrate, reaching a vertical through the vent; ventrals united, forming a shallow concave disc, not adnate to the belly; anal fin inserted below the third dorsal ray, posterior ray the longest, when depressed reaching the end of soft dorsal; caudal fin obtusely rounded.

Body covered with large ctenoid scales, those on the belly and occiput small and cycloid; cheek naked; occiput covered with minute scales.

Color in alcohol pale yellowish brown, sides with large irregular brown spots disposed in two longitudinal series; a dark round spot above the base of pectorals; head with no markings; spinous dorsal and pectorals dusky; membrane of the soft dorsal with longitudinal series of dark spots; outer margin of the anal black; caudal fin uniformly dusky.

Length of body 100 mm.

Described from a specimen from Takao, collected by Hans Sauter (Stanford Collections, No. 20995).

Habitat: Takao.

Genus GLOSSOGOBIUS Gill.

Body rather elongate, tail slightly compressed; head broad and depressed anteriorly, naked; interorbital space flat. Mouth very large, terminal and oblique; teeth moderate, in broad bands, the inner teeth depressible; tongue emarginate at tip. Sides of head naked; no barbels; eyes well separated; isthmus very narrow; the gill-openings ending forward below; pseudobranchiæ well-developed; no fleshy flaps on shoulder-girdle. Dorsal fins both short, the first composed of six slender spines; pectorals without silk-like rays above; ventrals united, not adnate to the belly; anal with nine soft rays; caudal free from the dorsal and anal. Body covered with rather large scales, which number about forty in the lateral series.

Distribution: Formosa; Philippine Islands; China; Japan; Malay Archipelago; Ceylon.

SYNOPSIS OF THE FORMOSAN SPECIES.

a. Dorsal fin VI, 10; anal composed of 9 rays; scales 31–32 in a lateral series, 9–10 in an oblique series between origins of the soft dorsal and anal. *brunneus.*

aa. Dorsal fin VI, 11; anal composed of 11 rays; scales 54 in a lateral series, 13–14 in an oblique series between origins of the soft dorsal and anal. *grammepomus.*

aaa. Dorsal fin VI, 9; anal composed of 9 rays; scales 41 in a lateral series, 13 in an oblique series between origins of the soft dorsal and anal............*parvus.*

aaaa. Dorsal fin VI, 10; anal composed of 10 rays; scales 28–30 in a lateral series. *abacopus.*

72. Glossogobius brunneus (Schlegel).

Urohaze (Japan); Kaugam (Giran, Formosa).

1847. *Gobius brunneus* SCHLEGEL, Fauna Japonica, Poiss., p. 142, Pl. LXIV, Fig. 2; Nagasaki.—GÜNTHER, Cat. Fish., III, 1861, p. 65; after Schlegel.—ISHIKAWA, Cat. Fish., 1897, p. 39; Tokyo; Bosha.

1847. *Gobius olivaceus* SCHLEGEL, Fauna Japonica, Poiss., p. 143, Pl. LXXIV, Fig. 3; Nagasaki.

1901. *Glossogobius brunneus* JORDAN & SNYDER, Proc. U. S. Nat. Mus., XXV, p. 74; Wakanoura; Onomichi; Hakodate; Kurume; Nagasaki.—JORDAN & EVERMANN, Proc. U. S. Nat. Mus., XXV, 1903, p. 361; Kotosho; Keelung, Formosa.—JORDAN & RICHARDSON, Mem. Carneg. Mus., IV, no. 4, 1909, p. 200; after Jordan & Evermann.—JORDAN, SNYDER, & TANAKA, Journ. Coll. Sci. Tokyo, XXXIII, 1913, p. 350; Hakodate to Nagasaki.

1846. *Gobius platycephalus* RICHARDSON, Ichthyol. China, p. 204; Macao.

1846. *Gobius fasciato-punctatus* RICHARDSON, Ichthyol. China, p. 204; Canton.

1897. *Gobius giurus* RUTTER, Proc. Acad. Sci. Philad., Jan., p. 85; Swatow.

Head 3.16 in length; depth 4.88; depth of caudal peduncle 2.84; D. VI, 10; A. 9; P. 20; V. 1, 5; eye 5.71 in head, interorbital space 6.83; snout 3; maxillary 2.44; thirty-one scales in a lateral series, ten scales in a transverse series; gill-rakers 3 + 10.

Body robust, elongate, posterior part slightly compressed, highest near the insertion of spinous dorsal; head very large, depressed, broader than body, with a deep longitudinal groove on the top; snout more or less pointed, interorbital space rather flat; eyes supralateral, diameter nearly as long as the interorbital space; mouth large, terminal and oblique, its angle extending to a vertical through anterior third of the orbit; lower jaw protruding beyond the upper; lips broad; teeth simple, in two series, inner one depressible and somewhat larger; tongue broad, deeply notched at the tip; gill-openings lateral, running far forward below; width of isthmus nearly equal to the interorbital space; gill-rakers on the first arch short, reduced to mere elevations near the end of arch; nostrils separated, the anterior in a short tube; chin smooth.

Body covered with large ctenoid scales; head naked; no lateral line.

Dorsal fins separated; anterior dorsal inserted behind the base of the pectoral, second spine the longest, when depressed, reaching beyond the origin of second dorsal; fin-rays of second dorsal subequal in height, a little shorter than first dorsal; pectoral fins lateral, large, rounded; ventrals united, forming an oval disc, not adnate to belly; anal inserted below third dorsal ray, posterior rays longer, reaching as far backward as do those of the dorsal, both not reaching the root of caudal; caudal fin rounded.

Color in formalin dark gray above, lower parts white; upper parts of sides mottled with black; dorsal fins grayish, with small dusky spots in more or less definite longitudinal series; pectorals and caudal with vertical rows of small dark spots; ventral fins whitish; the anal dusky.

Length of body 145 mm.

Described from a specimen from Taihoku, collected by T. Aoki in September, 1916.

Habitat: Taihoku; Tamusui River; Ritakukan, Giran.

MEASUREMENTS OF *Glossogobius brunneus.*

Locality.	Head.	Depth.	Depth of Caudal Peduncle.	D.	A.	P.	V.	Interorbital.	Snout.	Eye.	Scales.	Length, Mm.
Taihoku.............	3.16	4.88	2.85	VI, 10	9	20	I, 5	6.83	3	5.71	31–10	145
Taihoku.............	3.07	5.34	3	VI, 10	9	20	I, 5	7	3.25	6.33	32–10	150
Taihoku.............	3.21	5.89	2.91	VI, 10	9	20	I, 5	6.60	3.09	5.60	32–10	132
Taihoku.............	3	5.15	3	VI, 10	9	20	I, 5	7	3	5.66	32– 9	127
Ritakukan...........	3.18	5.15	2.73	VI, 10	9	20	I, 5	6.25	3	6.33	32– 9	173
Ritakukan...........	3.25	5.60	2.87	VI, 10	9	20	I, 5	6	3	6.18	32– 9	180
Ritakukan...........	3.42	5.76	2.73	VI, 10	9	20	I, 5	6.66	2.93	6.33	32– 9	177

73. **Glossogobius grammepomus** (Bleeker).

1849. *Gobius grammepomus* BLEEKER, Verh. Batav. Gen., XXII, p. 34.—GÜNTHER, Cat. Fish., III, 1861, p. 64; Malay Archipelago.

1849. *Gobius melanocephalus* BLEEKER, Verh. Batav. Gen., XXII, p. 34.—Naturk. Tydschr. Nederl. Ind., 1851, I, Fig. 4.—DAY, Fish, Brit. India, p. 292, Pl. LXIII, Fig. 6; Seas of India to Malay Archipelago.

1861. *Gobius litturatus* STEINDACHNER, Sitzsb. Wien, Acad., XLII, p. 289, Figs. 4, 5; Philippine Islands.

Head 3.17 in length; depth 4.5; D. VI, 11; A. 11; P. 17; V. 1, 5; width of head 1.42; eye 5.5 in head; interorbital space 4.42; snout 2.39; maxillary 2; depth of caudal peduncle 2.58; fifty four scales in a lateral series, fourteen scales between origin of second dorsal and that of the anal; gill-rakers 2 + 4.

Body thick, dorsal profile arcuate, ventral profile nearly straight, deepest in front of the spinous dorsal, tail compressed; head very large, broader than the body; cheek more or less bulged out; snout rather long, broadly rounded anteriorly; eyes moderate, superior, but directed laterally; interorbital space broad, more or less concave; mouth slightly oblique, with very thick lips, its angle reaching a vertical through center of the orbit; upper jaw a little longer than the lower; teeth in a broad villiform band, no canine teeth, those in outer row somewhat larger; tongue broad, deeply notched in front; gill-openings run forward below; inner edge of shoulder-girdle without papillæ; gill-rakers very short; nostrils separated, the anterior in a short tube.

Head naked, except the occiput; body covered with large ctenoid scales, those on the nape and belly small and cycloid.

Dorsal fins separated; spines not filamentous, third spine longest, contained 1.82 in head, soft rays a little shorter than the spines, anterior longest; pectorals large, reaching the posterior end of the base of spinous dorsal; ventrals united, free from belly; anal flap well developed; anal fin inserted below second dorsal ray, when depressed reaching to the root of caudal; caudal fin rounded.

Color in formalin dark brown above, paler below, sides and upper part of the body with a number of vermiculated black spots; membranes of the dorsal fins dusky, spines and rays with a series of dark spots; caudal fin with a number of vertical cross-bars; the rest of the fin grayish.

Length of the body 118 mm.

Described from a specimen from Inzampo, Giran, collected by T. Aoki in August, 1917.

Habitat: Inzampo, Giran (two specimens).

MEASUREMENTS OF *Glossogobius grammepomus.*

Locality.	Head.	Depth.	D.	A.	P.	V.	Width of Head.	Interorbital.	Snout.	Eye.	Scales.	Length, Mm.
Inzanpo..............	3.17	4.50	VI, 11	11	17	1, 5	1.42	4.42	2.39	5.5	54–14	118
Inzanpo..............	3.39	4.75	VI, 11	11	17	1, 5	1.44	5	2.40	5.5	54–13	97

74. **Glossogobius parvus** sp. nov. (Plate LIII, Fig. 3).

Head 3.18 in length; depth 4; D. VI, 9; A. 9; P. 16; V. 1, 5; width of head 1.5 in its length; eye 4 in head; snout 3; interorbital space 2.5; depth of caudal peduncle 2.25; maxillary 2.2; scales about forty-one in a lateral series, thirteen scales between origins of the soft dorsal and anal; pectoral 1.5 in head; ventral 2.

Body rather slender, laterally compressed; head more or less depressed, broader than body, cheek fleshy, somewhat bulged out laterally; snout flat, broadly rounded anteriorly, interorbital space rather flat; eyes superior, directed laterally; mouth oblique, its angle reaching a vertical through centre of orbit; lips fleshy; upper jaw slightly longer than the lower; teeth in villiform bands, no caniniform teeth; tongue quadrate, emarginate at the tip; nostrils widely separated, the anterior in a short tube, just behind the upper lip; gill-openings extending downward and a little forward; gill-rakers very short.

Dorsal fin separated; spinous dorsal rather small, triangular, the anterior spine longest, no filamentous spines, when depressed not reaching the origin of soft dorsal; soft dorsal rather low, the posterior ray longest, its height contained twice in the length of head; pectorals rounded, reaching beyond the middle of base of spinous dorsal; ventrals united, not adnate to the belly, cup round and deep; anal flap well developed, elongate; the anal inserted below the second ray of soft dorsal, as high as the soft dorsal; caudal fin rounded.

Body covered with thin minute ctenoid scales; head, except occiput, naked; scales on the occiput and belly minute and cycloid; base of the pectoral fleshy and scaly.

Color in formalin brownish gray, sides with a number of irregular dark cross-bars; cheek with two longitudinal brown stripes originating at the orbit; dorsal fins brownish gray; tip of the spinous dorsal black, interspace between each ray with a black streak; caudal fin dusky, with three dark cross-bars; the rest of the fins uniformly dusky.

Length of body 44 mm.

Described from a specimen from Kizanto, Giran, collected by T. Aoki in August, 1917.

Habitat: Kizanto, Giran (a single specimen).

Remarks: Kizanto is a small island near Giran; the present species is probably a marine fish.

75. **Glossogobius abacopus** Jordan & Richardson.

1909. *Glossogobius abacopus* JORDAN & RICHARDSON, Mem. Carneg. Mus., IV, no. 4, p. 200; Takao, Formosa.

Head to tip of lower jaw three times in length; depth 5.5; eye 4 in head; dorsal VI, 10; anal 10; scales 28–30; snout 3.4 in head; maxillary 2.4; interorbital space slightly greater than width of pupil. Body elongate, rather depressed in front, tapering gradually backward to the depressed caudal peduncle; depth of caudal peduncle 3.4 in head; head pointed; lower jaw projecting width of pupil; mouth large, maxillary reaching vertical from back of pupil; jaws, vomers and palatines with rows of fine, sharp-pointed teeth; tongue deeply notched; origin of spinous dorsal nearly an eye-length behind insertion of ventrals, its base 2.4 in head; base of soft dorsal 1.5 in head; longest dorsal spine 2.25; longest ray twice in head; origin of anal under second ray of soft dorsal, equidistant between base of caudal and back of eye; pectoral 1.3 in head; ventrals 1.4; depth of membranous cup of united ventrals two-thirds of length of eye; caudal 1.3 in head, rounded; a large anal papilla with notch behind.

Color in spirits brownish-olive, back and caudal peduncle crossed obliquely by four broad saddle-like bands of dark color; membranes of dorsals and of anal chiefly blackish, with some small spot-like intervals of paler on these and on rays; caudal and ventrals barred or checkered with dark; pectorals lightly speckled with dusky, with darker and denser specks below at base; under parts unevenly punctulated, the dots forming indistinct bars on chin and lower jaws; tip of lower jaw blackish.

This species is near *Glossogobius vaisiganis* from Samoa, but differs in the details of coloration, notably in the sharply checkered ventral fin. (Jordan & Richardson).

Habitat: Takao. (Jordan & Richardson). Not seen.

Genus ACANTHOGOBIUS Gill.

1859. *Acanthogobius* GILL, Proc. Ac. Nat. Sci. Philad., p. 145. (Type *Gobius flavimanus* Temminck & Schlegel.)

1863. *Synechogobius* GILL, Proc. Ac. Nat. Sci. Philad., p. 266. (Type *Gobius hasta* Temminck & Schlegel.)

Body oblong, little compressed, covered with medium-sized roughish scales; cheeks with small scales; snout rather long, the head rounded in profile; mouth moderate, oblique, the jaws about equal, the teeth moderate; tongue truncate or very slightly notched; isthmus rather broad, the gill-openings slightly continued forward below; no flaps on shoulder-girdle. Dorsal fins rather long, the first composed of seven to nine slender spines, the second of fourteen or fifteen soft rays; anal of twelve to thirteen rays. (Jordan & Snyder).

76. **Acanthogobius ommaturus** (Richardson).

1846. *Gobius ommaturus* RICHARDSON, Voy. Sulph. Fish., p. 146, Pl. LV, Figs. 1–4; Woosung, Yang-tze-kiang.—GÜNTHER, Cat. Fish., III, 1861, p. 77; Amoy.—RUTTER, Proc. Nat. Sc. Philad., Jan., 1897, p. 85; Swatow.

1905. *Acanthogobius ommaturus* JORDAN & SEALE, Proc. U. S. Nat. Mus., XXIV, p. 528; Shanghai.

Head 3.56 in length; depth 7.5; D. IX, 18; A. 15; P. 21; V. 1, 4; width of head 1.81; eye 5.33 in head; interorbital space 7.5; snout 2.75; depth of caudal peduncle 3.75; seventy scales in a longitudinal series, eighteen scales between origins of second dorsal and anal; gill-rakers 3 + 8.

Body elongate, slender, anterior part somewhat cylindrical, tail compressed; head large, slightly depressed, its top scaly, cheek covered with minute scales; snout somewhat produced, acutely rounded anteriorly, tip slightly swollen; mouth large, inferior, its angle not reaching a vertical through anterior border of orbit; lips thick and fleshy; upper jaw slightly longer than the lower; teeth conical and fixed, in several rows, those of the outer series somewhat larger; eyes high up, interorbital space concave; nostrils separated; tongue broad, truncated in front; gill-openings not extending far forward; isthmus rather broad.

Dorsal fin separated; spinous dorsal slender, anterior spine longest, when depressed not reaching second dorsal; soft dorsal elongate, with many rays, length of each ray subequal; pectorals rather large, without free silk-like rays above, their bases smooth and muscular; ventrals completely united, forming a concave round disk which is not adnate to belly; anal inserted below fourth dorsal ray, when depressed reaching posteriorly as far as the dorsal, both not extending to the root of caudal; caudal fin rhomboidal, pointed at middle; caudal peduncle elongate.

Body covered with thin ctenoid scales; scales on head small and cycloid.

Color in alcohol pale gray above, lower half of the sides and belly whitish; rays of the dorsal fins spotted with black, caudal fin yellowish olive, with a number of dark markings near the base; the rest of the fins whitish.

Length of body 140 mm.

Described from a specimen from Taihoku, collected by T. Aoki.

Habitat: Taihoku (two specimens).

SUMMARY.

Family SALMONIDÆ.

1. PLECOGLOSSUS Temminck & Schlegel.

1. *altivelis* Temminck & Schlegel; Tamusui River.

Family SALANGIDÆ.

2. PARASALANX Regan.

2. *acuticeps* (Regan); not seen.
3. *ariakensis* (Kishinouye); Tamusui River.

Family SILURIDÆ.

3. PARASILURUS Bleeker.

4. *asotus* (Linnæus); Jitsugetsutan; Tamusui River; Inzampo; Ritakukan.

4. PSEUDOBAGRUS Bleeker.

5. *brevianalis* (Regan); Jitsugetsutan; Dainansho.
6. *taiwanensis* Oshima; Tozen River; Daito River; Shinchiku.
7. *adiposalis* Oshima; Tamusui River; Daito River; Sobun River.

5. LIOBAGRUS Hilgendorf.

8. *nantoënsis* Oshima; Dainansho.
9. *formosanus* Regan; not seen.

6. CLARIAS Gronovius.

10. *fuscus* (Lacépède); Jitsugetsutan; Taihoku; Tamusui River; Maruyama, Giran.

Family COBITIDÆ.

7. MISGURNUS Lacépède.

11. *anguillicaudatus* (Cantor); Tamusui River; Maruyama; Giran; Rato; Raupi; Jitsugetsutan.
12. *decemcirrosus* (Basilewsky); Taihoku; Taichu.

8. COBITIS Linnæus.

13. *tænia* Linnæus; Shinchiku; Jitsugetsutan; Rigyokutsu; Maruyama, Giran.

Family HOMALOPTERIDÆ.

9. FORMOSANIA Oshima.

14. *gilberti* Oshima; Tamusui River.

10. HEMIMYZON Regan.

15. *formosanus* (Boulenger); Taiko River.

Family CYPRINIDÆ.

1. CARASSIUS Nilsson.

16. *auratus* (Linnæus); Taihoku; Giran.

12. CYPRINUS (Artedi) Linnæus.

17. *carpio* Linnæus; Taihoku; Temsonpi; Inzampo; Maruyama.

13. LABEO Cuvier.

18. *jordani* Oshima; Shori.

14. ACROSSOCHEILUS Oshima.

19. *formosanus* (Regan) Tamusui River; Tozen Rivor; Shinchiku; Horisha; Jitsugetsutan.

15. SCAPHESTHES Oshima.

20. *tamusuiensis* Oshima; Tamusui River; Choso River; Giran River.

16. HEMIBARBUS Bleeker.

21. *labeo* (Pallas); Tamusui River; Rigyokutsu.

17. BARBODES Bleeker.

22. *paradoxus* (Günther); Taiko River.

18. CAPOETA Cuvier & Valenciennes.

23. *semifasciolata* (Günther); Ako.

19. PUNTIUS Hamilton.

24. *snyderi* Oshima; Rigyokutsu; Maruyama; Daito River.

20. *Spinibarbus* Oshima.

25. *hollandi* Oshima; Sobun River.

21. GNATHOPOGON Bleeker.

26. *iijimæ* Oshima; Tozon River..

22. PSEUDOGOBIO Bleeker.

27. *brevirostris* Günther; Tamusui River.

23. PSEUDORASBORA Bleeker.

28. *parva* (Schlegel); Tamusui River; Taihoku; Raupi; Tozon River; Nanto; Rigyokutsu; Shinchiku; Ako; Shori; Bokusekikaku.

24. PARARASBORA Regan.

29. *moltrechti* Regan; Jitsugetsutan.

25. PHOXISCUS Oshima.

30. *kikuchii* Oshima; Bokusekikaku.

26. DISTŒCHODON Peters.

31. *tumirostris* Peters; Taihasho, Giran.

27. ISCHIKAUIA Jordan & Snyder.

32. *macrolepis* Regan; not seen.

28. CTENOPHARYNGODON Steindachner.

33. *idellus* (Cuvier & Valenciennes); Shori.

29. ACHEILOGNATHUS Bleeker.

34. *himantegus* Günther; Taihoku; Wodensho; Taichu; Shimo-Tamusui River.

30. RHODEUS Agassiz.

35. *ocellatus* (Kner); Taihoku; Nanto.

31. ZACCO Jordan & Snyder.

36. *platypus* (Schlegel); Tamusui River; Shinchiku; Choso River.
37. *temmincki* (Schlegel); Tamusui River; Daiko River; Daito River; Shinchiku; Dakusui River; Rigyokutsu; Sobun River; Shimo-Tamusui River; Ako; Heirinbi; Inzampo; Tensonpi; Suwo; Giran.
38. *pachycephalus* Günther; Tamusui River.

32. METZIA Jordan & Thompson.

39. *mesembrina* (Jordan & Evermann); Kotosho.

33. CANDIDIA Jordan & Richardson.

40. *barbata* (Regan); Jitsugetsutan; Shito, Giran.

34. HYPOPHTHALMICHTHYS Bleeker.

41. *molitrix* (Cuvier & Valienciennes); Shori.

35. ARISTICHTHYS Oshima.

42. *nobilis* (Gray) (Richardson); Shori.

36. CHANODICHTHYS Bleeker.

43. *macrops* Günther; Tamusui River.

37. CULTER Basilewsky.

44. *aokii* Oshima; Jitsugetsutan.
45. *brevicauda* Günther; Kagi.

38. CULTRICULUS Oshima.

46. *kneri* (Kreyenberg); Jitsugetsutan; Shimo-Tamusui River.

Family PŒCILIIDÆ.

39. ORYZIAS Jordan & Snyder.

47. *latipes* (Temminck & Schlegel); Shori; Ako; Giran.

40. GAMBUSIA Poey.

48. *affinis* (Baird & Girard); Shori.

Family MONOPTERIDÆ.

41. FLUTA Bloch & Schneider.

49. *alba* (Zuiew); Jitsugetsutan; Shokwa; Taihoku; Kiburan, Giran.

Family ANGUILLIDÆ.

42. ANGUILLA Shaw.

50. *mauritiana* Bennett; Giran; Jitsugetsutan.
51. *japonica* Temminck & Schlegel; Taihoku; Giran.
52. *sinensis* McClelland; not seen.

Family MUGILIDÆ.

43. MUGIL (Artedi) Linnæus.

53. *cephalus* Linnæus; Taihoku.
54. *oeur* Forskål; Inzampo; Ritakukan.
55. *carinatus* (Ehrenberg) Cuvier & Valenciennes; Taihoku; Shimo-Tamusui River.

44. LIZA Jordan & Swain.

56. *troscheli* (Bleeker); Sobun River.

Family LABYRINTHICI.

45. POLYACANTHUS (Kuhl) Cuvier.

57. *operculztus* (Linnæus); Taihoku; Wodensho.

46. MACROPODUS Lacépède.

58. *filamentosus* Oshima; Kotosho.

Family KUHLIIDÆ.

47. KUHLIA Gill.

59. *marginata* (Cuvier & Valienciennes); Tamusui River; Choso River; Giran River; Bokusekikaku.

Family OPHICEPHALIDÆ.

48. OPHICEPHALUS Bloch.

60. *tadianus* Jordan & Evermann; Taihoku; Raupi; Tozen River; Nanshisho.
61. *maculatus* Lacépède; Wodensho.

49. CHANNA Gronow.

62. *formosana* Jordan & Evermann; Taihoku; Toyen; Tamusui River; Jitsugetsutan.

Family GOBIIDÆ.

50. ELEOTRIS (Gronow) Schneider.

63. *oxycephala* (Schlegel); Tamusui River; Tozen River; Giran River; Buroko River.
64. *fusca* (Schneider); Buroko River.

51. BUTIS Bleeker.

65. *butis* (Buchanan-Hamilton); Taihoku.

52. SICYOPTERUS Gill.

66. *japonicus* (Tanaka); Tamusui River; Tozen River; Koanronsho; Shinchiku; Bokusekikaku; Choso River; Raoko.

53. RHINOGOBIUS Gill.

67. *candidius* (Regan); Bokusekikaku; Heirinbi; Tozen River; Shinchiku; Daiko River; Daito River.
68. *giurinus* (Rutter); Shimo-Tamusui River; Tozen River; Wodensho; Daito River; Tamusui River; Shori; Hyoko; Maruyama, Giran.
69. *taiwanus* Oshima; Tamusui River; Dakusui River; Sobun River; Shinchiku; Jitsugetsutan; Dainansho; Bokusekikaku; Inzampo.
70. *formosanus* Oshima; Shinchiku.
71. *caninus* (Cuvier & Valenciennes); Takao (not seen).

54. GLOSSOGOBIUS Gill.

72. *brunneus* (Schlegel); Taichu; Tamusui River; Ritakukan.
73. *grammepomus* (Bleeker); Inzampo.
74. *parvus* Oshima; Kizanto.
75. *abacopus* Jordan & Richardson; not seen.

55. ACANTHOGOBIUS Gill.

76. *ommaturus* (Richardson); Taihoku.

Of the seventy-six species above enumerated the following twenty-nine are artificially introduced species or semi-marine fishes or species which have been collected in an outlying island, and therefore have no bearing on the problems of the geographical distribution of the Formosan fresh-water fishes.

Introduced Species.

1. *Labeo jordani.*
2. *Ctenopharyngodon idellus.*
3. *Hypophthalmichthys molitrix.*
4. *Aristichthys nobilis.*
5. *Gambusia affinis.*

Semi-marine Species.

6. *Plecoglossus altivelis.*
7. *Parasalanx acuticeps.*
8. *Parasalanx ariakensis.*
9. *Fluta alba.*
10. *Anguilla mauritiana.*
11. *Anguilla japonica.*
12. *Anguilla sinensis.*
13. *Mugil cephalus.*
14. *Mugil oeur.*
15. *Mugil carinatus.*
16. *Liza troscheli.*
17. *Kuhlia marginata.*
18. *Eleotris oxycephala.*
19. *Eleotris fusca.*
20. *Butis butis.*
21. *Rhinogobius giurinus.*
22. *Rhinogobius caninus.*
23. *Glossogobius brunneus.*
24. *Glossogobius abacopus.*
25. *Glossogobius parvus.*
26. *Glossogobius grammepomus.*
27. *Acanthogobius ommaturus.*

The Species from Botel-Tobago.

28. *Metzia mesembrina.*
29. *Macropodus filamentosus.*

Of the the remaining forty-seven species twenty-six (55%) are peculiar to the island.

Peculiar Species.

1. *Pseudobagrus brevianalis.*
2. *Pseudobagrus taiwanensis.*
3. *Pseudobagrus adiposalis.*
4. *Liobagrus nantoënsis.*
5. *Liobagrus formosanus.*
6. *Formosania gilberti.*
7. *Hemimyzon formosanus.*
8. *Scaphesthes tamusuiensis.*
9. *Barbodes paradoxus.*
10. *Puntius snyderi.*
11. *Spinibarbus hollandi.*
12. *Acrossocheilus formosanus.*
13. *Gnathopogon iijimæ.*
14. *Pseudogobio brevirostris.*
15. *Pararasbora moltrechti.*
16. *Phoxiscus kikuchii.*
17. *Ischikauia macrolepis.*
18. *Acheilognathus himantegus.*
19. *Zacco pachycephalus.*
20. *Candidia barbata.*

21. *Chanodichthys macrops.*
22. *Culter aokii.*
23. *Channa formosana.*
24. *Rhinogobius candidius.*
25. *Rhinogobius taiwanus.*
26. *Rhinogobius formosanus.*

At present the percentage of peculiar species is extraordinarily high. But it is quite possible that some of them may be found in adjacent regions, probably in Southern China, and sooner or later a slight reduction may have to made.

Of the above-mentioned twenty-six species, the relationship of five is somewhat dubious, namely, *Hemimyzon formosanus*, *Spinibarbus hollandi*, *Pararasbora moltrechti*, *Candidia barbata*, and *Phoxiscus kikuchii*. One is very closely related to a species from the interior of Hainan, namely *Scaphesthes tamusuiensis*. Five have their nearest relatives in China, four in Corea, one in Amur Province, and eight in Japan. There is no record regarding near relatives of the remaining two, namely, *Barbodes paradoxus* and *Capoeta snyderi*. But the majority of the fishes which belong to these genera are distributed in British India, Indo-China, and China. Therefore, there is no doubt with reference to their relationship with the continental forms.

	Formosan Species.	*Nearest Relatives.*
1.	*Scaphesthes tamusuiensis.*	*Scaphesthes lepturus* from Hainan.
2.	*Formosania gilberti.*	*Formosania stenosoma* from China.
3.	*Acrossocheilus formosanus.*	*Acrossocheilus kreyenbergi* from China.
4.	*Chanodichthys macrops.*	*Chanodichthys stenzi* from China.
5.	*Pseudogobio brevirostris.*	*Pseudogobio sinensis* from China.
6.	*Channa formosana.*	*Channa ocellata* from China.
7.	*Liobagrus nantoënsis.*	*Liobagrus andersoni* from Corea.
8.	*Liobagrus formosanus.*	*Liobagrus andersoni* from Corea.
9.	*Gnathopogon iijimæ.*	*Gnathopogon coreanus* from Corea.
10.	*Rhinogobius candidius.*	*Rhinogobius bedfordi* from Corea.
11.	*Culter aokii.*	*Culter sieboldi* from Amur.
12.	*Pseudobagrus taiwanensis.*	*Pseudobagrus aurantiacus* from Japan.
13.	*Pseudobagrus adiposalis.*	*Pseudobagrus aurantiacus* from Japan.
14.	*Pseudobagrus brevianalis.*	*Pseudobagrus aurantiacus* from Japan.
15.	*Ischikauia macrolepis.*	*Ischikauia steenackeri* from Japan.

16. *Zacco pachycephalus.*	*Zacco temmincki* from Japan.
17. *Acheilognathus himantegus.*	*Acheilognathus cyanostigma* from Japan.
18. *Rhinogobius formosanus.*	*Rhinogobius hadropterus* from Japan.

Not only such a relationship is manifested by the peculiar species, but by the rest of the fresh-water fishes as well. Of the twenty-one species, which occur outside of Formosa, *Clarias fuscus, Capoeta semifasciolata, Distœchodon tumirostris, Culter brevicauda, Cultriculus kneri, Ophicephalus tadianus,* and *Ophicephalus maculatus* are species of southern affinities, because they are distributed in Indo-China and South China, but not to the north of the Yang-tze-kiang. *Polyacanthus* is a genus of the Indo-Malayan type, extending into the Malay Archipelago, but not occuring in eastern Asia. Such being the case, *Polyacanthus operculatus* may be included in this category, though it has been recorded from Tien-tsin, North China.

Eleven species are of more or less general distribution, extending from South China to Corea and Japan proper, and one occurs only upon the Chinese mainland. Finally, *Sicyopterus japonicus* is one of the peculiar species of Japan, and its relationship is somewhat dubious, as it is not known to occur on the Asiatic continent.

It will thus be seen that all the Formosan fresh-water fishes which have Chinese affinities differentiate into more or less distinct species, while those of southern affinities have remained unchanged. Moreover, eight per cent of the non-peculiar species have been recorded from the Chinese mainland. These two facts explain very clearly that the island had been preoccupied by the fresh-water fishes of the Chinese fauna when those of the southern affinities appeared through South China.

Next to the prevalence of Chinese affinities, the total absence of any indication of affinity to the fresh-water fish fauna of the Philippine Islands and Malay Archipelago is a very striking fact. As shown in the table, only one species is recorded from the Philippines, namely *Ophicephalus maculatus.* However, as it also occurs in South China, its way of dispersal is clearly indicated, though there is no record of it in India and the Malay Acrhipelago. *Cyprinus carpio* is another species which has been recorded from Java. But it is evident that the carp is not a native of Java, but an introduced species.

According to Leonhard Stejneger, there exists the same relationship between Formosa and the Philippine Islands with regard to the her-

GEOGRAPHICAL DISTRIBUTION OF THE FORMOSAN FRESH-WATER FISHES.

	British India.	Burma.	Siam.	Malay Peninsula.	Indo-China.	Hainan.	Formosa.	South China.	North China.	Corea.	Amur Province.	Japan.	Sumatra.	Java.	Celebes.	Borneo.	Philippine Islands.
Family SILURIDÆ:																	
Parasilurus asotus	—	—	—	—	—	—	×	×	×	×	×	×	—	—	—	—	—
Pseudobagrus brevianalis	—	—	—	—	—	—	×	—	—	—	—	—	—	—	—	—	—
Pseudobagrus taiwanensis	—	—	—	—	—	—	×	—	—	—	—	—	—	—	—	—	—
Pseudobagrus adiposalis	—	—	—	—	—	—	×	—	—	—	—	—	—	—	—	—	—
Liobagrus nantoënsis	—	—	—	—	—	—	×	—	—	—	—	—	—	—	—	—	—
Liobagrus formosanus	—	—	—	—	—	—	×	—	—	—	—	—	—	—	—	—	—
Clarias fuscus	—	—	—	—	×	—	×	×	—	—	—	—	—	—	—	—	—
Family COBITIDÆ:																	
Misgurnus anguillicaudatus	—	—	—	—	×	—	×	×	×	—	×	×	—	—	—	—	—
Misgurnus decemcirrosus	—	—	—	—	—	—	×	×	×	—	—	—	—	—	—	—	—
Cobitis tænia	—	—	—	—	—	—	×	×	×	×	×	×	—	—	—	—	—
Family HOMALOPTERIDÆ:																	
Formosania gilberti	—	—	—	—	—	—	×	—	—	—	—	—	—	—	—	—	—
Hemimyzon formosanus	—	—	—	—	—	—	×	—	—	—	—	—	—	—	—	—	—
Family CYPRINIDÆ:																	
Carassius auratus	—	—	—	—	×	—	×	×	×	×	×	×	—	—	—	—	—
Cyprinus carpio	—	—	—	—	×	—	×	×	×	×	×	×	—	×	—	—	—
Acrossocheilus formosanus	—	—	—	—	—	—	×	—	—	—	—	—	—	—	—	—	—
Scaphesthes tamusuiensis	—	—	—	—	—	—	×	—	—	—	—	—	—	—	—	—	—
Hemibarbus labeo	—	—	—	—	—	—	×	—	×	×	×	×	—	—	—	—	—
Barbodes paradoxus	—	—	—	—	—	—	×	—	—	—	—	—	—	—	—	—	—
Capoeta semifasciolata	—	—	—	—	—	—	×	×	—	—	—	—	—	—	—	—	—
Puntius snyderi	—	—	—	—	—	—	×	—	—	—	—	—	—	—	—	—	—
Spinibarbus hollandi	—	—	—	—	—	—	×	—	—	—	—	—	—	—	—	—	—
Gnathopogon iijimæ	—	—	—	—	—	—	×	—	—	—	—	—	—	—	—	—	—
Pseudogobio brevirostris	—	—	—	—	—	—	×	—	—	—	—	—	—	—	—	—	—
Pseudorasbora parva	—	—	—	—	—	—	×	×	—	×	×	×	—	—	—	—	—
Pararasbora moltrechti	—	—	—	—	—	—	×	—	—	—	—	—	—	—	—	—	—
Phoxiscus kikuchii	—	—	—	—	—	—	×	—	—	—	—	—	—	—	—	—	—
Distœchodon tumirostris	—	—	—	—	—	—	×	×	—	—	—	—	—	—	—	—	—
Ischikauia macrolepis	—	—	—	—	—	—	×	—	—	—	—	—	—	—	—	—	—
Acheilognathus himantegus	—	—	—	—	—	—	×	—	—	—	—	—	—	—	—	—	—
Rhodeus ocellatus	—	—	—	—	—	—	×	×	—	×	—	—	—	—	—	—	—
Zacco platypus	—	—	—	—	—	×	×	—	—	—	—	×	—	—	—	—	—
Zacco temmincki	—	—	—	—	—	—	×	×	—	×	—	×	—	—	—	—	—
Zacco pachycephalus	—	—	—	—	—	—	×	—	—	—	—	—	—	—	—	—	—
Candidia barbata	—	—	—	—	—	—	×	—	—	—	—	—	—	—	—	—	—
Parabramis macrops	—	—	—	—	—	—	×	—	—	—	—	—	—	—	—	—	—
Culter aokii	—	—	—	—	—	—	×	—	—	—	—	—	—	—	—	—	—
Culter brevicauda	—	—	—	—	—	—	×	×	—	—	—	—	—	—	—	—	—
Cultriculus kneri	—	—	—	—	—	—	×	×	—	—	—	—	—	—	—	—	—
Family PŒCILIIDÆ:																	
Oryzias laticeps	—	—	—	—	—	—	×	—	—	×	—	×	—	—	—	—	—
Family LABYRINTHICI:																	
Polyacanthus opercularis	—	—	—	—	—	—	×	×	×	—	—	—	—	—	—	—	—

GEOGRAPHICAL DISTRIBUTION OF THE FORMOSAN FRESH-WATER FISHES.—*Continued.*

	British India.	Burma.	Siam.	Malay Peninsula.	Indo-China.	Hainan.	Formosa.	South China.	North China.	Corea.	Amur Province.	Japan.	Sumatra.	Java.	Celebes.	Borneo.	Philippine Islands.
Family OPHICEPHALIDÆ:																	
Ophicephalus tadianus	—	—	—	—	×	—	×	—	—	—	—	—	—	—	—	—	—
Ophicephalus maculatus	—	—	—	—	—	—	×	×	—	—	—	—	—	—	—	—	×
Channa formosana	—	—	—	—	—	—	×	—	—	—	—	—	—	—	—	—	—
Family GOBIIDÆ:																	
Sicyopterus japonicus	—	—	—	—	—	—	×	—	—	—	—	×	—	—	—	—	—
Rhinogobius candidius	—	—	—	—	—	—	×	—	—	—	—	—	—	—	—	—	—
Rhinogobius taiwanus	—	—	—	—	—	—	×	—	—	—	—	—	—	—	—	—	—
Rhinogobius formosanus	—	—	—	—	—	—	×	—	—	—	—	—	—	—	—	—	—

petological fauna. He states that "A number of wide-ranging species of southern origin occur in both faunas, but as these also occur in southern China, on the mainland opposite Formosa, their way of dispersal is clearly indicated. There are only two species of this category which have not yet been collected in Chinese territories, namely, *Dasia smaragdina*, of wide distribution, and which may owe its occurence in Formosa to introduction by human agency, the other being a snake, *Psammodynastes pulverulentus*, the discovery of which within the limits of China would not cause surprise, as its known distribution includes Sikkim, Assam., and the Shan states." (*Proc. U. S. Nat. Mus.*, XXXVIII, 1911, pp. 93–94.) Finally he has expressed his belief that there has been no direct land connection between Formosa and the Philippine Islands since Formosa received its batrachians and reptiles, because of the total absence of the Formosan herpetological fauna in the latter. The case of the fresh-water fishes is quite the same. Therefore it is reasonable to support his view with reference to the relationship between Formosa and the Philippine Islands.

On the contrary, the occurence of all Japanese species in the mainland opposite to Japan is another interesting fact. There seems to be good reason for asserting the prehistoric land connection between Japan proper and the Asiatic continent, though the relationship between Japan and Formosa is somewhat dubious on account of the total absence of fresh-water fishes in the Riu Kiu Islands which cover the interspace between the two.

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By David Starr Jordan.

(Plates LIV–LVIII.)

In the *Atti Soc. Nat. Italiana* of Milan in 1903, p. 137, fig. 6, Dr. Cristoforo Bellotti described a peculiar fish from near Yokohama, Japan, under the name of *Pteraclis macropus*.

This fish, extremely fragile in structure, and with an exceedingly high dorsal fin, is obviously not a true *Pteraclis*, as in that genus the anal fin is about as long as the dorsal, and the scales are firm and hard, while in *P. macropus*, the base of the anal is only about half as long as that of the dorsal, and the scales are small, thin, and caducous.

In 1905, Gill and Smith described from the Japanese island of Shikoku, a species bearing a striking resemblance to Bellotti's fish, under the name of *Caristius japonicus* (Proc. Biol. Soc. Washington, XVIII, 1905, p. 249). In Proc. U. S. Nat. Mus. XXXI, 1906, p. 490, fig. 10, Smith & Pope published a figure of this species which we here reproduce (Plate LIV, upper figure). In the American Naturalist, December, 1912, p. 748, I printed a notice of the work of Dr. R. H. Shufeldt on the genus *Pterycombus*, a relative of *Pteraclis*, remarking that "the singular *Caristius*, lately described from Japan by Dr. Smith, is an ally of *Pterycombus* and belongs to the same family". This view, I repeated in a memoir by Jordan & Thompson, "Record of the Fishes obtained in Japan in 1911" (Memoirs Carnegie Mus., VI, September, 1914, p. 245). In this paper we reprinted the plate of *Caristius japonicus* Smith & Pope with a new plate of Bellotti's fish, which we called *Caristius macropus*. Of the genus *Caristius* we said, "Its affinities seem obviously to be with the scombroid forms, especially with *Pteraclis*, the genus in which Bellotti placed it."

This opinion was based on a specimen of *Pteraclis macropus* from the Kuro Shiwo, or Gulf Stream of Japan, obtained by me for the Carnegie Museum from Mr. Alan Owston in 1911. I regarded this as a *Caristius* and I called it *Caristius macropus*. Meanwhile Dr. Erich Zugmayer of Munich (Result. Camp. Sci. Monaco, XXXV, 1911, p. 101, Pl. V, fig. 5) had described a deep sea berycoid fish under the name of *Platyberyx opalescens* (Plate LV, upper figure). This fish strongly resembles *Caristius japonicus*. Mr. C. Tate Regan (Ann. Mag. Nat. Hist. (8), Vol. X, Dec., 1912, p. 637, compared *Platyberyx* to *Caristius* and expressed the belief that both are berycoid fishes, "probably congeneric and perhaps not specifically distinct from each other."

I now think Mr. Regan is right in aligning *Caristius* with the berycoid fishes. In *Caristius* as in *Platyberyx*, there are numerous short, stiff rays, or fulcra, at the base of the caudal fin both above and below. There are only about sixteen developed rays in the caudal fin, and the presence of but I, 5 rays in the ventral fins in both, is not decisive, as some of the varied genera referred to the berycoid group, notably *Bathyclupea*, show the same number.

I was mistaken, however, in placing *Pteraclis macropus* in the genus *Caristius*, and in taking my idea of *Caristius* from that species. I was quite right, I think, in rejecting the idea of berycoid affinities for *P. macropus*. In spite of superficial resemblance, *P. macropus* has really very little in common with *Caristius* or *Platyberyx*. It has no true fulcra on the caudal fin and the slender rays of that fin are more than twenty in number. Moreover all the rays of the dorsal fins are slender, unjointed spines. The species is, in fact, allied to the *Pteraclidæ* and forms the type of a new genus which I may call *Elephenor*.[1] But its divergence from the known genera of *Pteraclidæ* is very strong, entitling it, I think, to distinction, as representing a separate family. For the present at least, we consider it as belonging to a new family, *Elephenoridæ*, distinguished by its small, weak scales, and its relatively short anal fin.

In the type of *Caristius japonicus* the dorsal and anal rays are nearly all broken off short, and it is impossible from the plate to know whether any or all of them were spines. The dorsal fin is elevated in front and the numbers of the rays are about as in *Elephenor*.

In *Platyberyx* the dorsal and anal fins are scarcely elevated, and the rays are nearly all jointed and branched, the numbers being D. II. 28; A. II, 16. In *Platyberyx*, as in *Caristius* and *Elephenor* the ventral fins are well developed, their rays I, 5. The difference in the form of the dorsal fin would seem to indicate that *Platyberyx* is generically distinct from *Caristius*.

[1] Ελεφήνωρ, chief of the fleet Abantes of Eubœa, "with long hair flowing behind," captain of one of the ships of Achilles.

ANALYSIS OF GENERA RELATED TO PTERACLIS.

(Dorsal and anal fins composed exclusively of spines.)

A. Dorsal and anal spines very slender, close set, most of them almost hair-like.

B. PTERACLIDÆ. Scales rather large, firm and hard, more or less lobate; anal fin beginning far forward, before the pectorals, its base almost as long as that of dorsal; dorsal fin very high, continuous, its spines very slender and flexible, highest anteriorly, dorsal spines about fifty-three, anal spines about forty-three; both dorsal and anal depressible in a basal sheath of large scales; ventral fins very small, weak, I, 5 (or perhaps sometimes I, 3) jugular, inserted below (or before) the eye; form of body ovate-elliptical, much compressed; nape not greatly elevated; forehead rounded, not subvertical.

C. Dorsal and anal fins each with one of the anterior spines much thickened; dorsal fin beginning on tip of snout, and beginning just behind eye, the long rays of dorsal and anal nearly reaching caudal. Dorsal with about eight graduated spines in front, the eighth longest; ventrals very small, the rays I, 5; vent directly below eyes.................................... BENTENIA.[2]

CC. Dorsal fin beginning on the snout before the eye, with two to four graduated spines, none of them notably thickened; anal fin similar, both very high; longest dorsal spine when depressed reaching past middle of fin; ventral rays I, 5 or I, 3.. PTERACLIS.[3]

CCC. Dorsal fin beginning behind the eye with nine to thirteen graduated spines in front, none of them enlarged; ventral rays I, 5.

D. Anal fin high, its first ray reaching beyond middle of fin; graduated spines of dorsal 10 to 13.............. CENTROPHOLIS.[4]

[4] *Centropholis* Hilgendorf, Sitzungsberichte Naturforschende Freunde, Berl., 1878, p. 1; type *Centropholis petersi* Hilgendorf; off Tokyo.

DD. Anal fin of moderate height, its first long ray reaching only to middle of fin; dorsal beginning over preopercle, with nine graduated spines......................... PTERYCOMBUS.[5]

BB. ELEPHENORIDÆ; Scales very small, thin, caducous; dorsal sheath probably caducous;[6] ventral fins large, 1, 5, inserted just before pectorals.

[2] Bentenia Jordan & Snyder, Journ. College Sci. Imp. Univ. Tokyo, XV; 1901, 306; type *Bentenia æsticola* Jordan & Snyder from the Kuro Shiwo (Japan Current) off Misaki, Japan (*Cf.* Plate LVI of this Article.)

[3] *Pteraclis* Gronow; Zoophylaceum, 1763, p. 136 and also in Acta Helvetica, VII, 1772, p. 44. Type *Coryphœna velifera* Pallas; Indian Ocean. *Pteridium* Scopoli (1777) and *Oligopodus* Lacépède (1800) are based on the same species. (*Cf.* Pl. LV, lower figure, of this articles.)

[5] *Pterycombus* Fries, Kongl. Vet. Akad. Handl. Stockholm, 1837, pp. 14, 22, Pl. II; type *Pterycombus brama* Fries; Arctic Coast of Norway. (*Cf.* Plate LVII, upper figure of this article.)

[6] Bellotti's figure shows plainly a dorsal and anal sheath of scales. There is no trace of these in our specimen.

Anal fin beginning notably behind insertion of pectorals, the length of its base only about half that of the dorsal; dorsal fin exceedingly high, its first two rays short, graduated, the third longest, reaching past base of caudal. Anal moderate, its longest ray about reaching middle of fin; upper and lower rays of caudal with fine recurved hooks; front of head straight, subvertical, the nape elevated. Dorsal spines 34, anal spines 22. ELEPHENOR.

AA. DIANIDÆ. Dorsal and anal spines somewhat pungent, wide set, not specially elevated (about twenty-two in the dorsal, eighteen in the anal); anal shorter than dorsal beginning just behind base of pectoral, the spines rather low, the longest behind middle of fin; ventral very small, jugular, under posterior part of gill-opening; nape greatly elevated, the dorsal beginning just behind eye; caudal peduncle very slender; scales reduced to small, star-like tubercles; no sheath at base of dorsal or anal............DIANA.[7]

We may note that *Pteraclis papilio* Lowe, from Madeira, is said to have one of the anterior spines of dorsal and anal notably enlarged. It probably belongs to *Bentenia*. *Pteraclis carolinus* Cuv. & Val. from off South Carolina and *Pteraclis trichipterus* Cuv. & Val. (Plate LVII, lower figure) from unknown locality (but doubtless in the Pacific, having been collected by Quoy & Gaimard) are said to have the third or fourth dorsal spine somewhat enlarged. Nothing is said as to the position of the ventral fin, but it may be assumed that this is jugular as in *Pteraclis ocellatus*. Until we have further information we may leave these in *Pteraclis*. The figure of *Pteraclis ocellatus* (Plate LVIII, upper figure) does not show any spine to be enlarged, but the description states that the third spine is thick and easily divides itself into two halves, left and right. The number of rays in the ventral fins is also uncertain. *Pteraclis papilio* is said to have the ventrals I, 5 as in *Bentenia*. *P. ocellatus* was thought to have these rays I, 3, but Valenciennes regards this count as doubtful. In *P. velifera* but one ray is indicated, the soft rays being probably all broken off. As these fins are extremely fragile, it is likely that I, 5 is the normal number in all the species.

The figure of the type of *Pteraclis*, (*P. velifera*) as copied by Bonnaterre from Pallas, shows the third spine apparently slightly enlarged and nearly as long as the spines succeeding. The copy of this plate given by Schneider is erroneous in several respects.

The species called *Pteraclis carolinus* by Goode & Bean (Oceanic Ichthyology, p. 212, pl. LIX, fig. 218) has none of the dorsal spines

[7] *Diana* Risso, Europe Meridionale, III, p. 267, 1826; type *Diana semilunata* Risso, from off Nice. *Astrodermus guttatus* Bonelli 1829, is the same species.

enlarged, while the first ten are graduated. (*Cf.* Plate LVIII, of this article, lower figure.) The dorsal fin begins behind the eye. It cannot be the same as the original *P. carolinus*. It is plainly a *Centropholis* and it may stand as a new species, *Centropholis goodei* Jordan. The ventral rays are I, 5, as in *Centropholis*.

The type-specimen of *Bentenia æsticola* is in the Imperial Museum of Tokyo. In connection with the description of Jordan and Snyder, Dr. Mitsukuri published a photograph of this example. A drawing made from this photograph, with the torn vertical fins restored is given on Plate LVI. In this photograph, an appendage resembling the ventral fins appears under the lower jaw. Mr. Shigeho Tanaka, ichthyologist of the Imperial University, has reëxamined the type, and finds this appendage to be a detached piece of the left branchiostegal membrane, torn loose by accident. The ventral fins were described as "I, 5" and "jugular" by Jordan and Snyder. They do not appear in this photograph and Mr. Tanaka says that they are not present on the actual specimen, and he finds no scar where the fins might have been torn off. Being very fragile, they have probably been broken off in manipulation.

If one of the dorsal spines is really enlarged in the type species of *Pteraclis*, the genus *Bentenia* must be very close to it. The tip of the shoulder-girdle, the presumable insertion of the ventral fins, is a little farther forward in *Bentenia*.

It is a curious fact that nearly all of the species noted in this paper are each known from only a single specimen, and the others from very few. As surface fishes of the ocean currents they are very rarely taken, and are doubtless nowhere abundant.

The *Pteraclidæ*, *Pterocyidæ*, and *Dianidæ* differ from the related families in having all the dorsal rays simple, not jointed, nor branched. In the *Bramidæ*, also closely related, the rays of dorsal and anal are nearly all soft and articulate.

The *Veliferidæ* of Japan, resemble superficially the *Pteraclidæ*, but have a very different mouth-structure, and the posterior part of the dorsal and anal is made up of soft rays, as in related families.

The species here discussed may be recapitulated.

Family PTERACLIDÆ.

Genus BENTENIA Jordan & Snyder.

1. *Bentenia æsticola* Jordan & Snyder; Japan Current.
2. *Bentenia papilio* (Lowe); off Madeira.

Genus PTERACLIS Gronow.

1. *Pteraclis trichipterus* (Cuv. & Val.); South Seas (?).
2. *Pteraclis carolinus* (Cuv. & Val.); Gulf Stream.
3. *Pteraclis velifera* (Pallas); Indian Ocean.
4. *Pteraclis ocellatus* (Cuv. & Val.); off Mozambique.

Genus CENTROPHOLIS Hilgendorf

1. *Centropholis petersi* Hilgendorf; Japan Current.
2. *Centropholis goodei* Jordan; Gulf Stream.

Genus PTERYCOMBUS Fries.

?. *Pterycombus brama* Fries; Arctic seas of Europe.

Family ELEPHENORIDÆ.

Genus ELEPHENOR Jordan.

?. *Elephenor macropus* (Bellotti); Japan Current.

Family DIANIDÆ.

Genus DIANA Risso.

?. *Diana semilunata* Risso; South Coast of France.

Family CARISTIIDÆ.

Genus CARISTIUS Gill & Smith.

?. *Caristius japonicus* Gill & Smith; Shikoku, Japan.

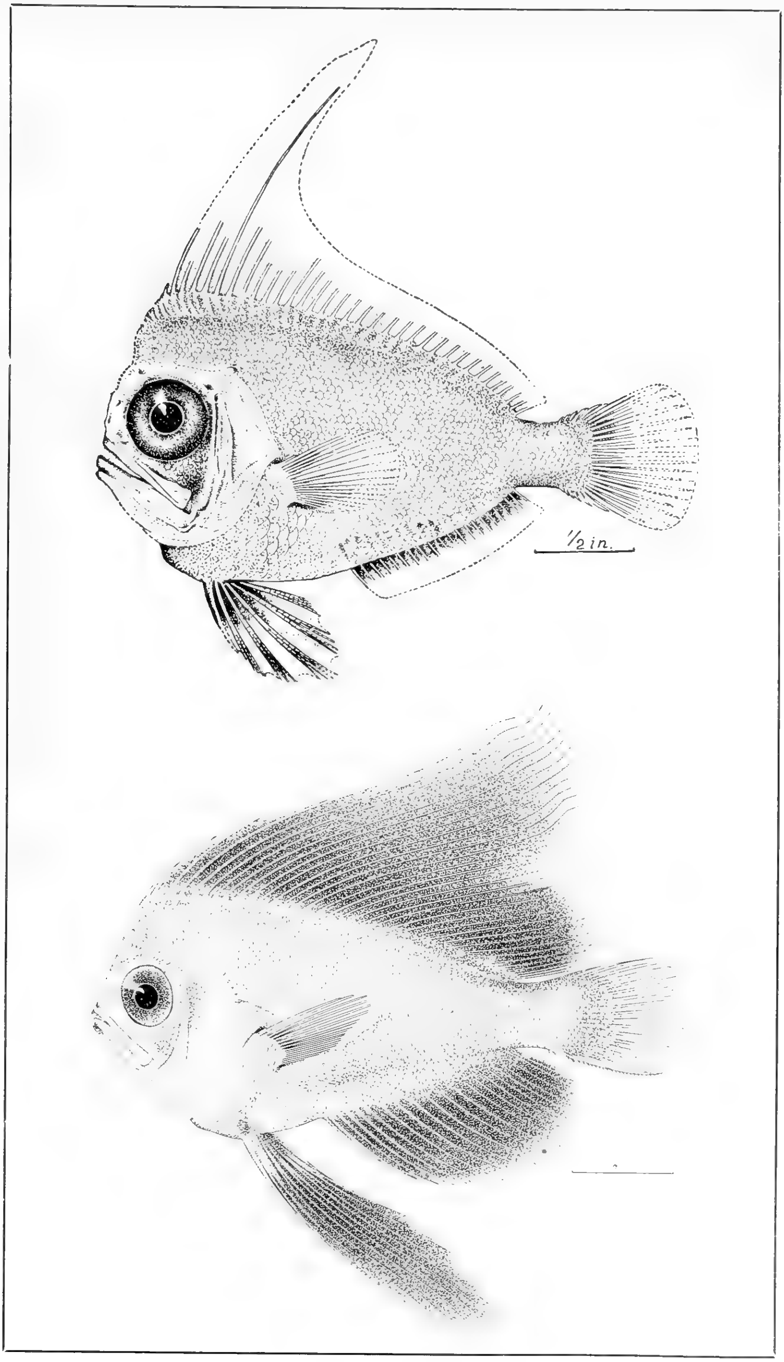
Genus PLATYBERYX Zugmayer

?. *Platyberyx opalescens* Zugmayer; off Gibraltar.

EXPLANATION OF PLATE LIV.

Upper Figure: *Caristius japonicus* Gill & Smith. After Smith & Pope, Proc. U. S. N. M., Vol. XXXI, p. 491. (Reduced.)

Lower Figure: *Elephenor macropus* (Bellotti) Jordan. Reproduced from Figure of *Caristius macropus* (Bellotti) Memoirs Carnegie Museum, Vol. VI, Pl. XXVIII. (Reduced.)

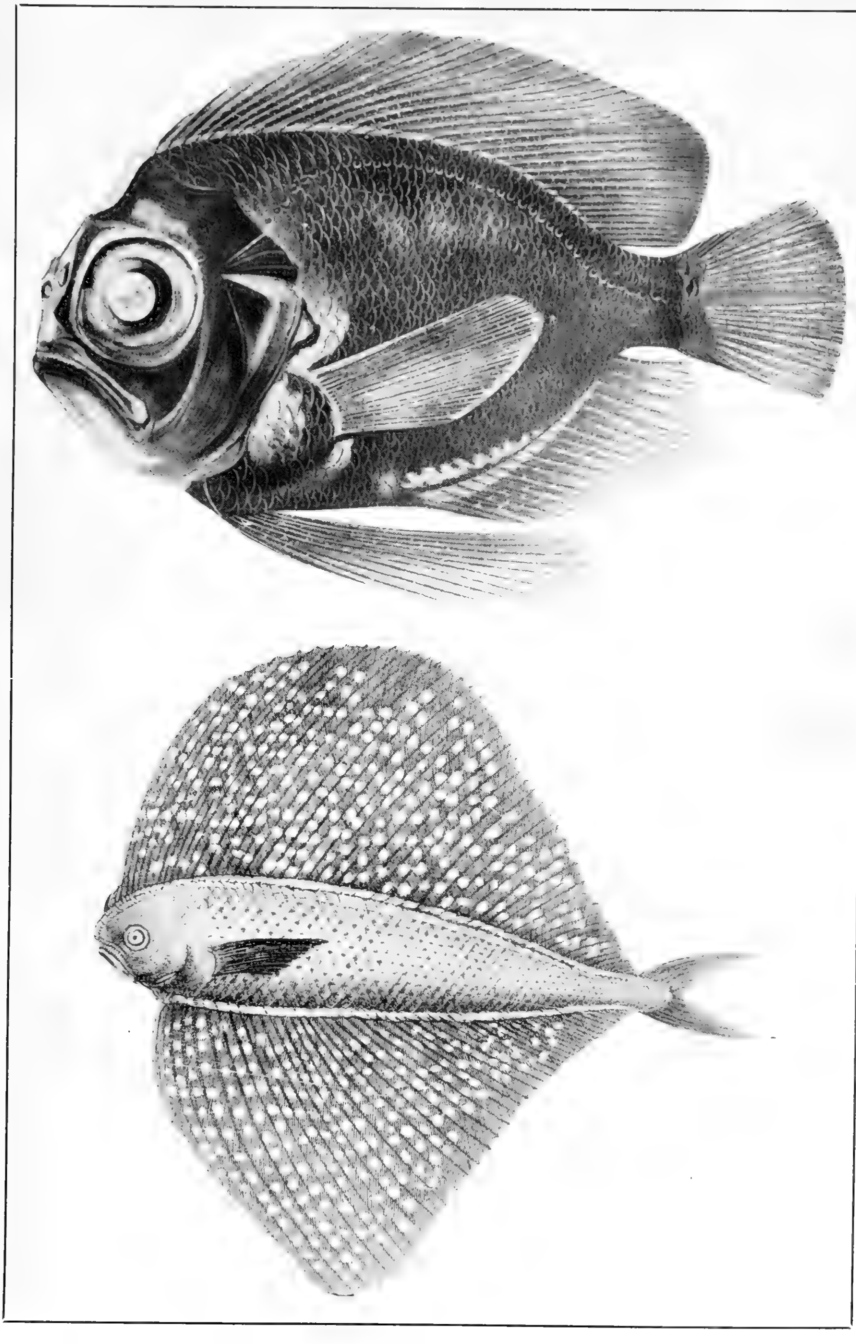


(For explanation see opposite page.)

EXPLANATION OF PLATE LV.

Upper Figure: *Platyberyx opalescens* Zugmayer. Reproduced from Result. Campagnes Scient. Albert I, Prince de Monaco, Fasc. XXXV, Pl. V, Fig. 5. (Reduced.)

Lower Figure: *Pteraclis velifera* (Pallas). After Bonnaterre, Encyc. Méthodique, a copy of the figure given by Pallas, Spicil., viii, p. 19, Pl. 3, fig. 7. (Reduced.)



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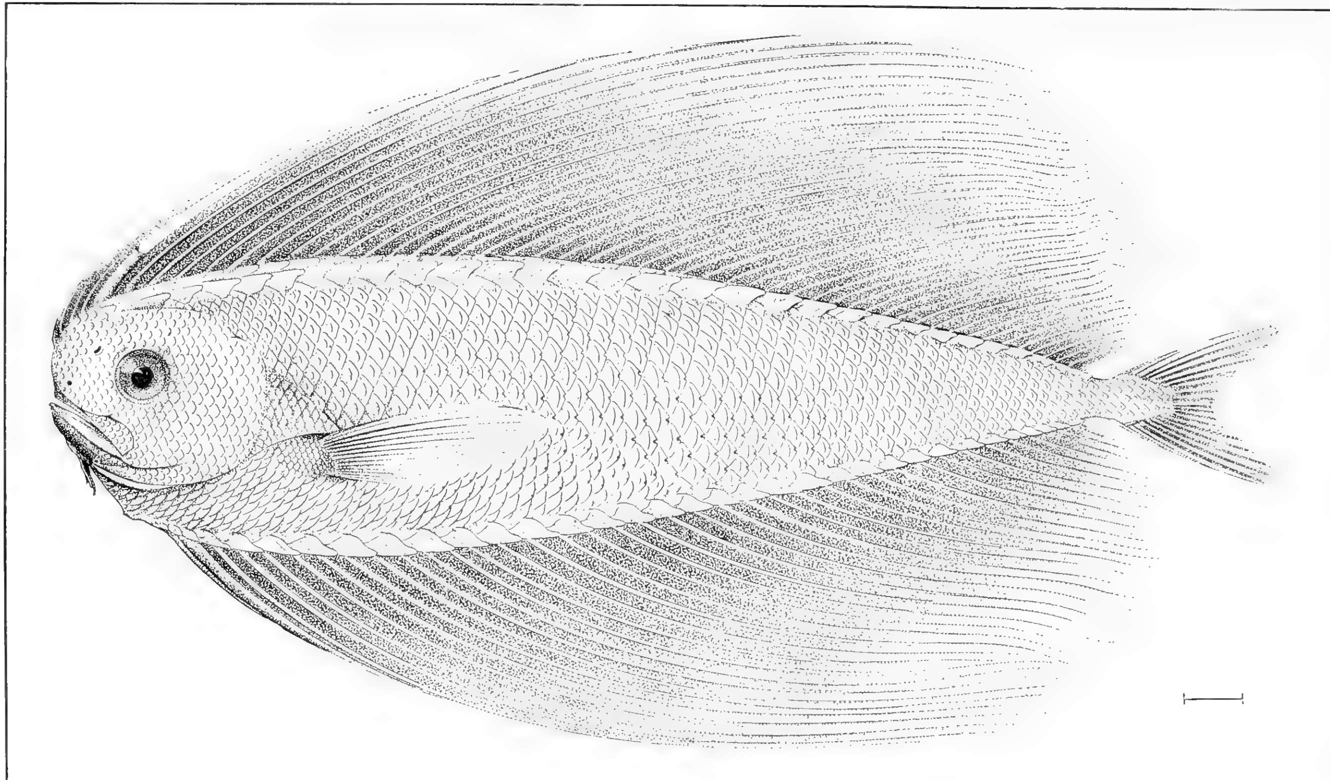


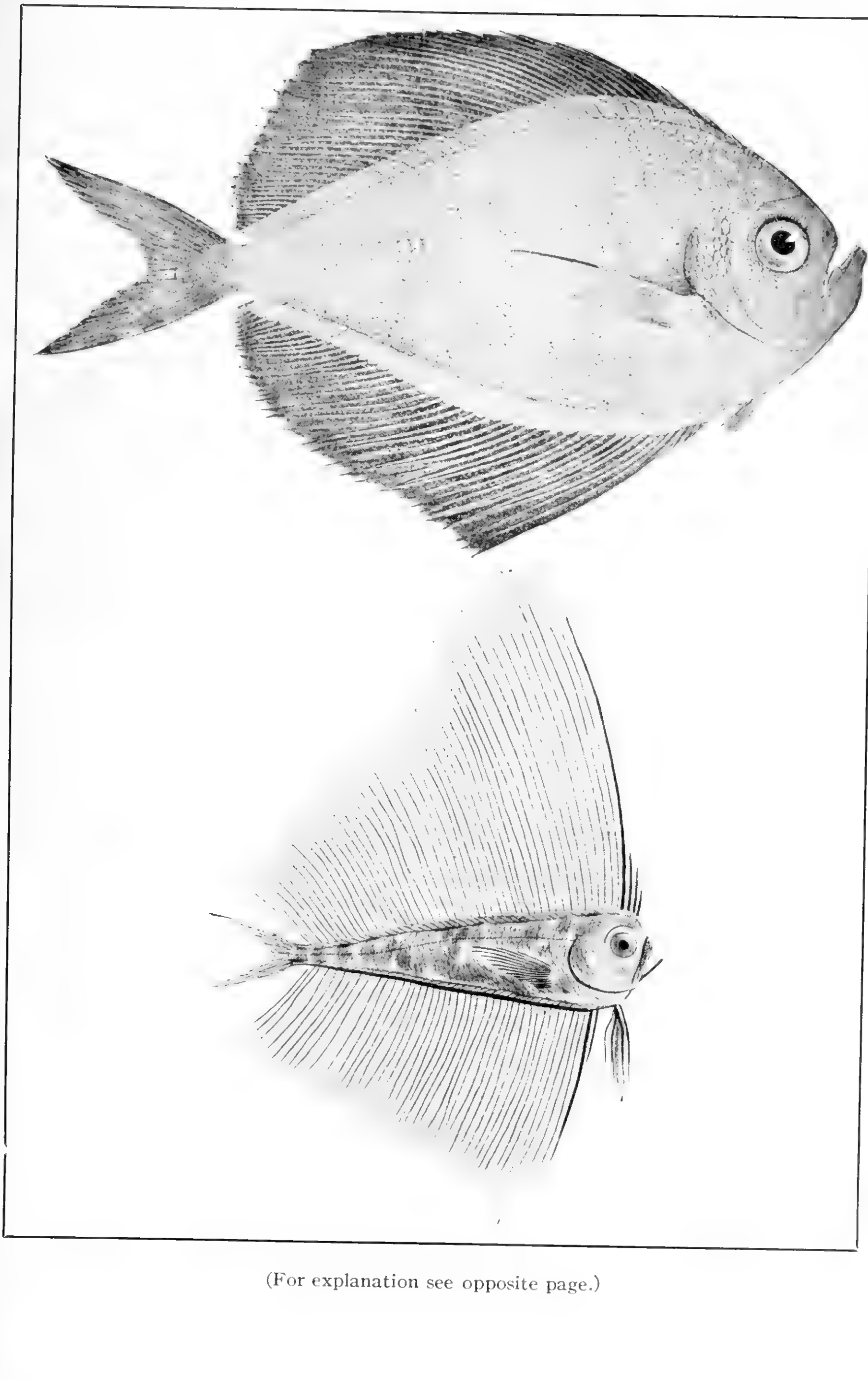
Bentenia æsticola Jordan and Snyder.

(From photograph taken by Mr. Kakichi Mitsukuri.)

EXPLANATION OF PLATE LVII.

Upper Figure: *Pterycombus brama* Fries. Reproduced from Proc. Biol. Soc. Washington, Vol. XXV, Pl. II. (Reduced.)

Lower Figure: *Pteraclis trichipterus* Cuv. & Val. After figure in Cuvier's Animal Kingdom (translated by Griffith), Vol. X, 1834, Pl. 32, fig. 2. (Reduced.)

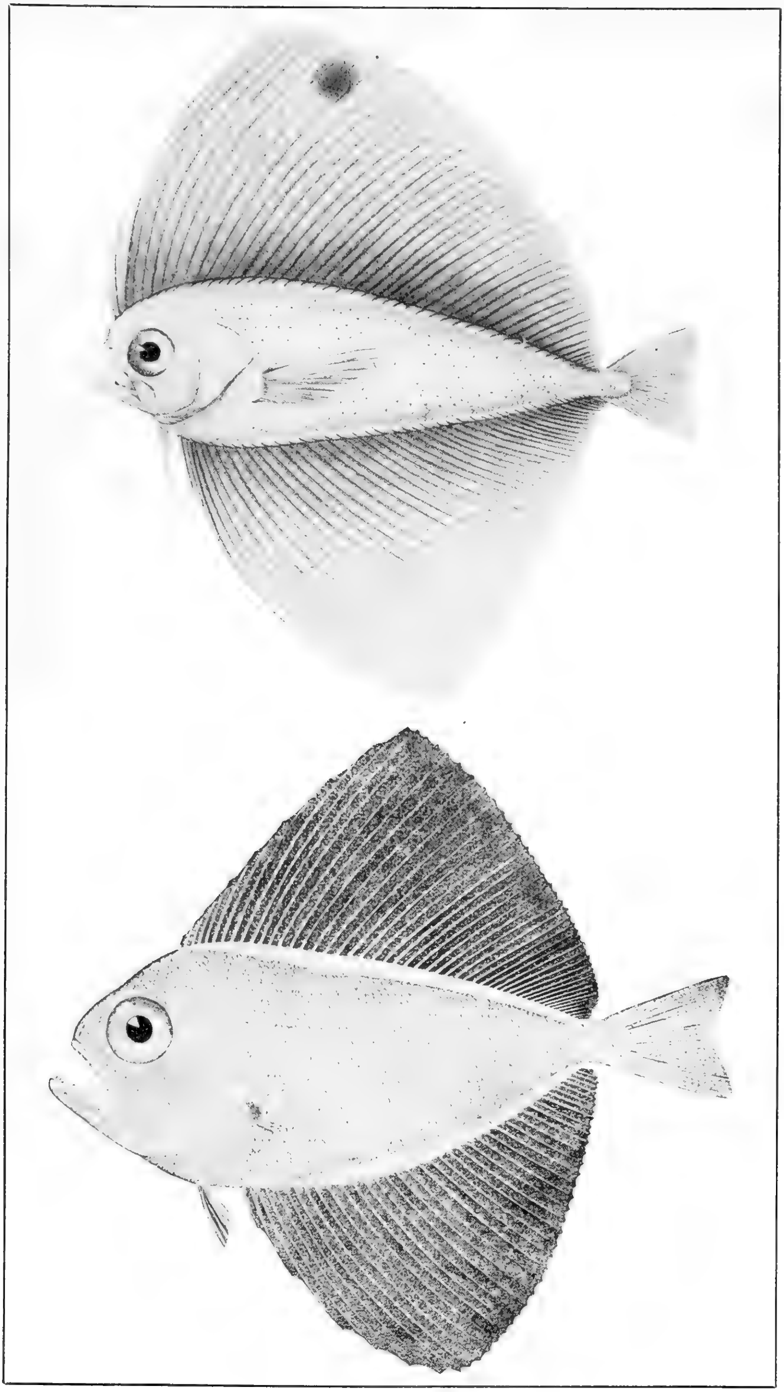


(For explanation see opposite page.)

EXPLANATION OF PLATE LVIII.

Upper Figure: *Pteraclis ocellatus* Cuv. & Val. After Cuvier & Valenciennes, Hist. Nat. Poiss., Vol. IX, p. 363, Pl. 271. (Reduced.)

Lower Figure: *Centropholis goodei* Jordan, nom. nov. Not = *Pteraclis carolinus* Cuv. & Val., Hist. Nat. Poiss., Vol. IX, p. 368. Reproduced from "Oceanic Ichthyology," by Good & Bean, Pl. LIX, fig. 218.



(For explanation see opposite page)

V. A DESCRIPTION OF CYPRIPEDIUM PASSERINUM

By Otto E. Jennings.

(Plate LIX.)

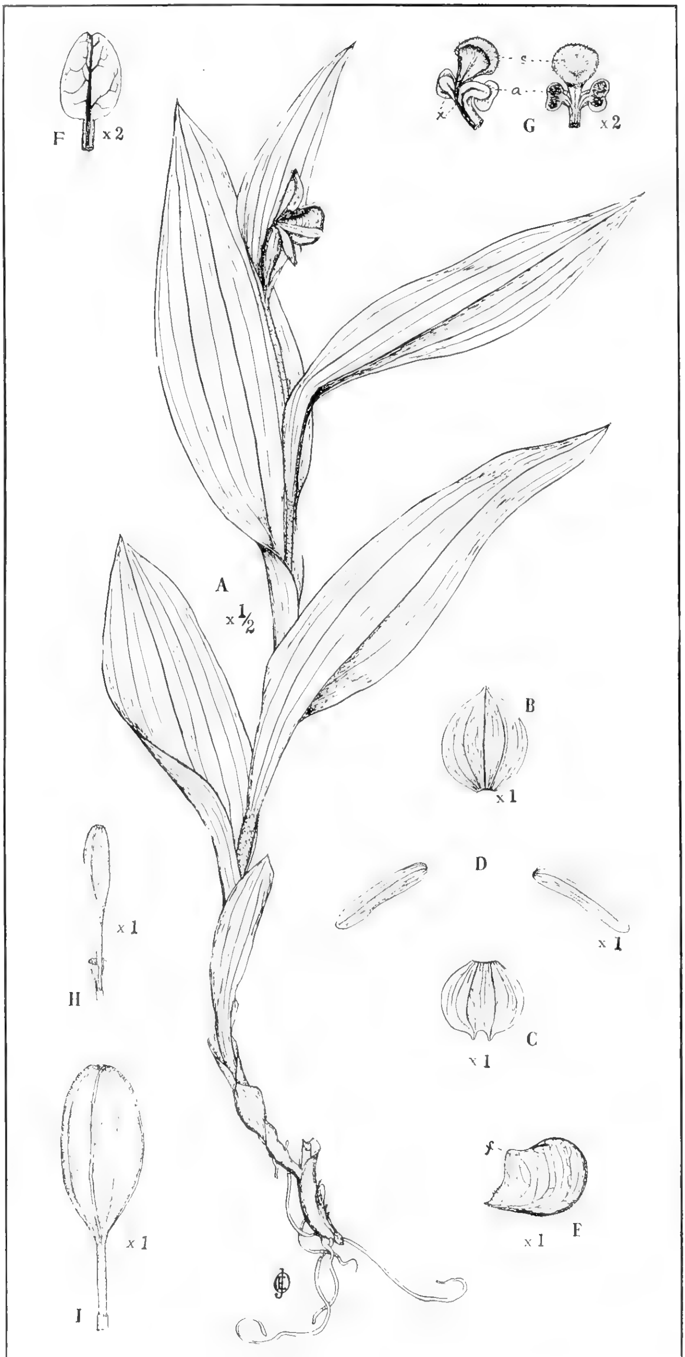
Cypripedium passerinum was originally described by Richardson from specimens collected in northern Canada by the Sir John Franklin Expedition, 1819 to 1822. (Narrative of a Journey to the Shores of the Polar Sea, in the Years 1819, 20, 21, and 22, by John Franklin, p. 762, second edition.)

A number of good herbarium specimens of this rare *Cypripedium* were collected in flower near Moose Factory, northwestern Ontario, July 2–3, 1908, by Mr. M. A. Carriker, Jr., and in view of the fact that this species is as yet but sparsely represented in American herbaria, and that the published descriptions and figures are somewhat at variance with respect to certain characters, it seems desirable to here present a detailed description, with figures. That our material is quite typical of the species as described by Richardson is evidenced by the closeness with which the original description applies to our specimens and it may be further mentioned that the Sir John Franklin Expedition made collections at Moose Factory, the locality at which our specimens were obtained.

Description of Species.

Cypripedium passerinum Richardson. Plants 2–3.5 dm. high, erect from an ascending base, which often consists of the basal portion of the stems of the two previous years. Stems leafy, rather densely puberulent, bearing from 3 to 5 leaves and a leaf-like floral bract of variable size, the lower part of the stem being enveloped in from 2 to 4 sheathing, more or less bract-like, leaves. Leaves 7–15 cm. long, 2.5–4 cm. wide, lanceolate-ovate, with 5 to 7 prominent nerves, leaf-surfaces sparsely puberulent, apex acute, base gradually narrowed and completely sheathing the stem. Floral bract similar to the leaves, varying from 3–8 cm. long, lanceolate-ovate, acute to acuminate, narrowed to a sheathing base. Flower one, terminal, erect, general color pale yellow with the lip lined and spotted with violetpurple. Upper sepal orbicular, apiculate, with 3 to 5 prominent veins, about 1.5 x 1.3 cm. Lateral sepals united into a doubly apiculate structure, the apiculations being about 2.5 mm. apart, each half of the double sepal having a prominent mid-vein with forking and often anastomosing lateral veins, the double sepal orbicular, about 1.2 cm. each diameter. Lateral petals slightly longer than the sepals, about 1.6 cm. long, 3 mm. wide, linear elliptic, rounded at the apex, the base rounded on the upper side. Lip 15 cm. long by 1 cm. vertical diameter, general profile obovate, veins variously forking and anastomosing, puberulent, and more or less glandular below, exteriorly, and also laterally at the base inside. Midway on each side of the orifice a flap about 3 mm. long and widely obtuse is folded into the cavity of the lip; the orifice is circular, about 1.1 cm. in diameter. The ovary is about 2.5 cm. long, elliptic, tapering to a peduncle below, obtusely angled, minutely glandular-puberulent. Stigma with an orbicular and somewhat concave disk about 3 mm. in diameter; staminodium expanded into a flat ovate structure about 6 mm. long and 4 mm. wide, arching or ascending over the stigma, obtuse or sub-cordate at the base and retuse or with a recurved tip at the apex. Stamens with flat, obtusely ovate appendages extending dorsally over the anthers, free from them, but of about the same length. Capsule erect, 2.5 cm. long, 1.5 cm. thick, obtuse at the apex, tapering into a slender peduncle 1.2 cm. in length, sometimes remaining at the apex of the defoliated stem during the next season.

CARNEGIE MUSEUM,
April 17, 1919.



Cypripedium passerinum.

EXPLANATION OF PLATE LIX.

A. *Cypripedium passerinum* Richardson. One half natural size.
B. Upper sepal. Natural size.
C. Double sepal. Natural size.
D. Lateral petals. Natural size.
E. Lip, split open lengthwise, and flap, *f*, bent upward. Natural size.
F. Staminodium, ventral view. Twice natural size.
G. Stigma, *S*, anthers, *a*. Figure at the left represents a dorsal view; at the right a ventral view. *x*, free tips of stamens. Twice nat. size.
H. Ovary from which flower has been removed. Natural size.
I. Capsule. Natural size.

CHARLES ROCHESTER EASTMAN.

Born January 5, 1868; Died September 27, 1918.

(PLATE LX.)

Although not connected with the Carnegie Museum at the time of his death, Charles Rochester Eastman held more or less intimate relations with the institution for more than sixteen years, during three of which he was a member of its staff.

Professor Eastman was born at Cedar Rapids, Iowa, on January 5, 1868, the son of Austin V. and Mary (*m.n.* Scoville) Eastman. He was graduated B.A. at Harvard in 1890, and in the following year received the degree of M.A. In 1893 he married Caroline A. Clark, daughter of the late Alvan G. Clark, the famous maker of telescopes, and with his bride repaired to Munich to prosecute his studies under Professor Karl von Zittel, receiving his degree of Ph.D. in 1894. He then returned to Cambridge, Massachusetts, and was given a post in the Museum of Comparative Zoölogy. He there continued his studies upon the fossil fishes begun at Munich, and subsequently almost continuously devoted himself to this, his chosen field of research. Later he studied at Johns Hopkins, and also in Europe, whither he occasionally went. His studies as a specialist were utilized in researches upon material submitted to him by the Geological Survey of the United States, and of several of the individual States, and he taught geology and palæontology in Harvard and Radcliffe Colleges.

The writer of these lines first became personally acquainted with Dr. Eastman on the occasion of a visit which the latter paid to Pittsburgh for the purpose of examining our collections and urging upon Professor J. B. Hatcher the importance of endeavoring to make a collection of Palæozoic fishes. At this time the fact that the collection belonging to Baron Ernst Bayet of Brussels was on the market was mentioned, and Dr. Eastman volunteered to obtain more information as to the collection than was in the possession of Professor J. B. Hatcher and myself at that time. It was finally

Sincerely yours,
C. R. Eastman.

decided by Mr. Carnegie on conference with me to acquire the Bayet Collection for the Carnegie Museum. Inasmuch as Professor J. B. Hatcher, our Curator of Palæontology, in the spring of 1903, was unable to go to Europe, the task of arranging for the safe transfer of the collection fell upon my shoulders, and at the urgent entreaty of Dr. Eastman I took him along to assist in the work. He was especially interested in the fossil fishes, and received permission to take a certain number of specimens with him to Paris for comparison with the types of the elder Agassiz, which are preserved in the National Museum of France, and later he returned them to the Carnegie Museum. It had been arranged by the writer and Professor Hatcher that the fossil fishes of the Bayet Collection should be assigned to Dr. Eastman for study and description. However, an unfortunate disagreement between Professor Hatcher and Dr. Eastman led to the abandonment of this plan, and it was not until a number of years after Professor Hatcher's death that the writer again decided to employ Dr. Eastman for the accomplishment of the task, for which he was eminently fitted. He came to Pittsburgh in the early summer of 1910, and thereafter for three years was almost constantly occupied with the work of classifying and arranging the fossil fishes in our collection, at the same time holding a minor position in the University of Pittsburgh. The results of his labors upon the material in this Museum are contained in the following papers from his pen:

In the *Memoirs*—

Vol. II, No. 3. "Fossil Avian Remains from Armissan," 8 pp., 4 pls.

" IV, No. 7. "Catalog of the Eocene Fishes from Monte Bolca in the Carnegie Museum," 66 pp., 12 pls.

" VI, No. 5. "Supplement to the Catalog of the Fishes from the Upper Eocene of Monte Bolca," 34 pp., 6 pls.

" " No. 6. "Catalog of Fossil Fishes from the Lithographic Stone of Cerin, France," 40 pp., 9 pls.

" " No. 7. "Catalog of Fossil Fishes from the Lithographic Stone of Solenhofen, Bavaria," 35 pp., 17 pls.

In the ANNALS—

Vol. V. "A New Species of Helodus," 2 pp.

" VIII. "Jurassic Saurian Remains Ingested in Fish," 6 pp., 2 pls.

" " "Tertiary Fish Remains from Spanish Guinea, West Africa," 9 pp., 2 pls.

" IX. "Notes on Triassic Fishes belonging to the Families Catopteridæ and Semionotidæ," 10 pp., 3 pls.

" " "Dipterus Remains from the Upper Devonian of Colorado," 5 pp.

Having completed the work for which he was employed, he repaired to Washington, where he was for a short time engaged in scientific work at the United States National Museum, and then went to the American Museum of Natural History in New York, undertaking the preparation of a Bibliography of Fishes, which that Museum was engaged in getting out, the first two volumes of which have already appeared. For this task he was extremely well qualified, because of his erudition and linguistic attainments.

Professor Eastman's contributions to the literature of science number about one hundred titles, a number of these being notes of a bibliographic or semi-historical character. He will best be remembered by his translation in three volumes of Karl von Zittel's *Text-Book of Paleontology*, published by the Macmillans, by the *Bibliography of the Fishes*, issued by the American Museum of Natural History, and by his Catalogues of the *Fishes of Monte Bolca* and *Solenhofen* and other papers published by the Carnegie Museum. His systematic contributions to his favorite science consist of the definition of three new families, twelve new genera, and one hundred and fifteen new species of fossil fishes, many of which were first published by the Carnegie Museum.

Professor Eastman early devoted himself in his studies to the investigation of the placoderm fishes of the Devonian, which have proved a puzzle to students ever since their existence became known. Probably no individual ever devoted more time to the study of these interesting forms than he. We have in the Carnegie Museum an interesting series of models and a mounted skull of one of the hugest of these fishes, to the preparation of which he devoted a great deal of time.

In his chosen field of research he was easily the foremost among his American contemporaries, and his great erudition and perfect familiarity with the literature of his subject caused him to be constantly consulted by others who had not devoted themselves, as he had done, to the intricacies of that branch of science which was his special delight.

Professor Eastman came to his end under tragic circumstances. He had been for some time employed by the War Trade Board in Washington, where his linguistic attainments made his services valuable. He suffered an attack of influenza, and, when convalescent, repaired to Long Beach, N. J. On the evening of his arrival, September 27, 1918, although suffering, he went out to take the air upon the boardwalk. He apparently wandered far in the darkness, to a place where the walk had become dilapidated, and either fell from the walk or stumbled through an opening, was stunned, washed out by the tide and drowned, his body being found the next day.

His premature end robbed science of one of its most industrious and indefatigable workers. W. J. H

(For the portrait of Dr. Eastman accompanying this article we are indebted to the Editor and Secretary of the Geological Scoiety of America, who first published it in the Bulletin of that Society, March, 1919.)—*Editor.*

ANDREW ARNOLD LAMBING.

Born February 1, 1842; Died December 24, 1918.

(PLATE LXI.)

Among the names of those who were originally appointed by Mr. Carnegie as members of the Board of Trustees of the Carnegie Institute was that of the Reverend Father Andrew Arnold Lambing, and he continued to hold an honored place on the Board from the time of his appointment until the day of his death. During a portion of this time he served as a member of the Committee upon the Museum, and during almost the whole of the time he was the Honorary Curator of the Historical Collections of the Museum.

Andrew Arnold Lambing was born at Manorville, Armstrong County, Pennsylvania, on February 1, 1842. He was a descendent of Christopher Lambing, who migrated from Germany, and settled in Bucks County, Pennsylvania, in 1749, dying there in 1817, at the age of ninety-nine years. His son Matthew married and settled in New Oxford, Adams Co., Pa., where the father of Andrew Arnold Lambing, Michael A. Lambing, was born, in 1806. In 1823 the family came across the mountains to Armstrong County, where Michael A. Lambing married Annie Shields on December 1, 1837. There were born of this union five sons and four daughters, of whom the subject of this brief sketch was the third son and child. In his boyhood and early youth he labored on his father's farm, and also was employed in a brickyard. He worked for a while as a day-laborer helping in the grading of the Pennsylvania Railroad. In the winter months he attended the country schools. He acquired a taste for reading, and became profoundly interested in matters relating to the local history of the region in which he lived. His native ability was presently recognized by those who knew him, and ways and means were found for obtaining an education, qualifying him for the priesthood in the church of his fathers. After his ordination he held a number of appointments, the first being as a teacher in St. Francis' College, Loretto. He then served as the Priest of St. Patrick's Church, Cameron Bottom, Indiana County; then ministered at St. Mary's Church, Kittan-

Monsignor Andrew Arnold Lambing, D.D.

ning, and the church at Freeport, which were jointly under his care. He later became chaplain at St. Paul's Orphan Asylum, Pittsburgh, and then on January 7, 1874 took charge of St. Mary's of Mercy congregation, Pittsburgh. He remained there for some time, when he was transferred to St. James Church in Wilkinsburg, where he served for more than a third of a century, the congregation growing under his care to be one of the largest in western Pennsylvania.

In 1884 he undertook the publication of a quarterly magazine called *Catholic Historical Researches*, the first of its kind devoted to the history of the Catholic Church in this country. It is now continued in Philadelphia as a monthly. For some years afterward he was an active member of "The Old Settlers' Association," a society out of which grew "The Historical Society of Western Pennsylvania," of which for some years he was the President. In 1915 he was honored by the Pope with the title of "Monsignor."

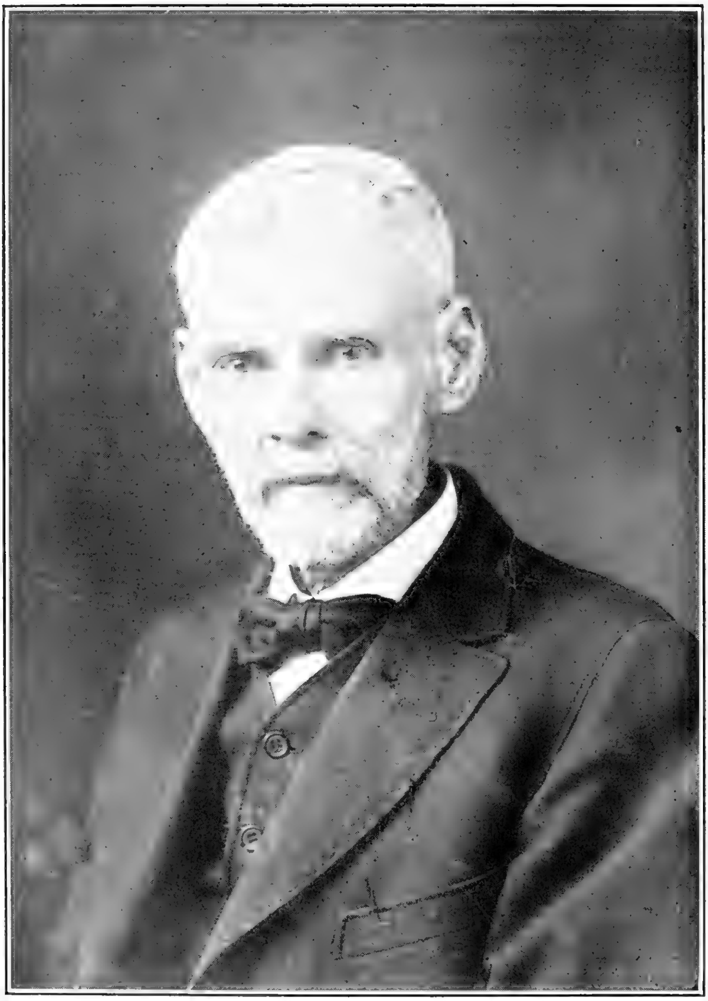
Father Lambing published a number of important historical papers, one of the most excellent of which is the "Baptismal Register of Fort Duquesne," by Frère Denys Baron, to which he prefixed an historical account, and which he copiously annotated. He also published "A History of the Catholic Church in the Dioceses of Pittsburgh and Allegheny." He was a constant contributor to the pages of church periodicals, and was greatly in demand on anniversary occasions, where he frequently made addresses replete with historical information.

The writer of these lines recalls with gratitude Father Lambing's faithful discharge of his duties as a member of the Committee upon the Museum, and later as Honorary Curator of the Historical Collections. In quite recent years, owing to age and growing infirmities, he was not able to do much, but still faithfully attended the meetings of the Board of Trustees, and whenever information of an historic character was called for, he was ready to put the stores of his knowledge at the service of his associates in the Museum.

Personally Father Lambing was a most delightful companion, abounding in good nature and wit. He was a man of very venerable appearance, and one who attracted the immediate attention of those who saw him. His tales of the early vicissitudes through which he passed when western Pennslyvania was still regarded in a measure as on the frontier, were replete with interest and with humor. He was greatly beloved, not only by his parishioners, but by a wide circle of friends outside of his own immediate ecclesiastical relationship. In his death the church to which he belonged lost one of its most beloved parish-priests and ablest men, and the entire city of Pittsburgh experienced a sense of genuine bereavement.

He died on December 24, 1918, in the seventy-seventh year of his age.

W. J. H.



HERBERT HUNTINGDON SMITH.
(OBIIT A. D. 1918, ANNO ÆTATIS SUÆ LXVII.)

HERBERT HUNTINGTON SMITH.[1]

Born January 21, 1851; died March 22, 1919.

(PLATE LXII.)

The wide circle of his friends and acquaintances were shocked to read in the daily journals that on March 22 Mr. Herbert Huntington Smith, the curator of the Alabama Museum, had been killed by being run over by a freight train. In recent years he had become very deaf, and it was owing to this infirmity that he came to his untimely end. Once before, in the city of Pittsburgh, he had been struck by an electric car, the approach of which he had not observed, but fortunately escaped at that time with only a few bruises.

A number of years ago Lord Walsingham in an address before the Entomological Society of London in speaking of the work of field naturalists and the additions made by them to the sum of human knowledge, made the statement that the two ablest collectors were Americans, one of them the late William H. Doherty, the other Herbert Huntington Smith. With both of these men the writer of these lines was intimately associated, both of them having made extensive collections for him in foreign parts, and both came to their end under tragic circumstances. Doherty died in Uganda, as the result of nervous prostration brought about partly by exposure, partly by the fact that his camp was haunted by man-eating lions, which had killed several of his assistants. Smith passed away in the midst of important activities, as the result of a horrible accident.

My acquaintance with Mr. Herbert Huntington Smith, which has covered nearly thirty years of his life, enables me to speak of him with an appreciation founded upon intimate knowledge.

He was born at Manlius, New York, on January 21, 1851. He studied at Cornell University from 1868 to 1872. In 1870 he accompanied his friend and teacher, the late Professor C. F. Hartt,

[1] This article is a reproduction of the substance of biographies by the writer published in *Science*, N.S., Vol. XLIX, No. 1273, pp. 481–483, and in the *Entomological News*, Vol. XXX, pp. 211–214.

on an excursion to the Amazons. He thus caught his first glimpse of tropical life, which wove about him a spell, which always thereafter bound him.

In 1874 he returned to Brazil for the purpose of collecting and studying the fauna of the Amazonian regions. Two years were spent in the neighborhood of Santarem, and subsequently he passed a year in explorations upon the northern tributaries of the Amazons and the Tapajós, after which he stayed about four months in Rio de Janeiro. Returning to the United States he was commissioned by the Messrs. Scribner to write a series of articles upon Brazil for their magazine, and accordingly made two more trips to that country, studying the industries, social and political conditions, and investigating the famine district in Ceará. On one of these journeys he was accompanied by Mr. J. Wells Champney, who was employed to prepare illustrations for his articles. One of the results of these journeys was the volume entitled "Brazil, the Amazons, and the Coast," which was issued by Charles Scribner's Sons in 1879. On October 5, 1880, Mr. Smith married Miss Amelia Woolworth Smith, of Brooklyn, New York. She entered with zest into his labors, and in all the years which followed was his devoted and most capable assistant. There was a remarkable accord in their tastes and Mrs. Smith developed unusual skill and efficiency in the manipulative processes involved in collecting specimens of natural history. Indeed, it is no exaggeration to say that her learned husband would not have been able to accomplish the vast amount of work, which was achieved in later years, had it not been for her facile fingers. She became an accomplished taxidermist, and was able to prepare the skins of birds and preserve insects, in the most approved manner. Mr. Smith and his wife spent the years from 1881 to 1886 in Brazil. He made his general headquarters in Rio de Janeiro, where he received much encouragement from the Emperor, Dom Pedro II., who was deeply interested in scientific research. During these years he traveled extensively and spent a long time in exploring the then little known territory along the upper waters of the Rio Paraguay and the Rio Guaporé on the western confines of Brazil, in the vicinity of Matto Grosso and Chapada. The extensive series of specimens which he gathered during these years of fruitful collecting were acquired partly by the

National Museum in Rio de Janeiro, partly by Mr. F. D. Godman of London, and partly by the writer of these lines, who subsequently purchased most of the lepidoptera, and, at a later date by the Carnegie Museum, which secured most of the vast collection of other insects, which Mr. Smith had made, numbering approximately thirty thousand species and not far from two hundred thousand specimens.

In 1886 there appeared in Portuguese from his pen an account of some of his travels, entitled "De Rio de Janeiro á Cuyabá." Mr. F. D. Godman, whose monumental work, the "Biologia Centrali-Americana," called for an intensive study of the fauna of Mexico, commissioned Mr. Smith to make collections for him in that country, and he labored there during the year 1889. He spent much of his time in the years 1890–1895 in the employment of the West Indian Commission of the Royal Society in making collections in Trinidad and the Windward Islands, and in reporting upon the same. These collections are in the British Museum. During the same years he was actively engaged as one of the staff of writers employed in the preparation of the "Century Dictionary," the "Century Cyclopedia of Names," and "Johnson's Cyclopedia." In these works almost everything relating to South and Central America and the fauna and flora of these lands is from his pen.

When plans were being formed for the development of the Carnegie Museum, Mr. Smith took occasion, not only in letters, but by personal visits to the writer, to urge the desirability of selecting as one of the major objects of the new institution, a biological survey of South America. While it was not at that time possible to fully accept his proposals, one of the results of his visits to Pittsburgh, was his employment by the infant museum to act in a curatorial capacity, devoting himself to the formation of collections illustrating the natural resources of the region of which Pittsburgh is the metropolis. Assisted by his wife and various volunteers he made extensive collections representing the flora and fauna of western Pennsylvania and West Virginia. These collections number many tens of thousands of insects, shells, and plants, as well as fishes, reptiles, birds, and small mammalia. When not in the field, he devoted his time to the arrangement of collections which began to rapidly come into the possession of the museum.

He was not, however, entirely happy in the confinement of the walls of a museum. He constantly heard "the call of the wild," and his heart longed for the life of the tropics, in which he had passed so many happy years. He proposed to the authorities of the Carnegie Museum that he should be allowed to go to the United States of Colombia to make collections. The writer agreed himself to become the purchaser of the collections of lepidoptera which might be made, the Carnegie Museum agreed to purchase the birds, a set of the mammals, the ethnological material which might be gathered, and to take one or more sets of the botanical specimens collected. Accompanied by his wife and young son he set out for Colombia to begin his work in the Province of Santa Marta. One of the chronic revolutions of that period developed and he encountered much difficulty. The period from the fall of 1898 to the spring of 1902 was spent in this work. It was a period of trial and hardship. Mr. Smith finally fell ill and it was feared that he would not recover. When at last he was pronounced to be out of danger, the party hastened to return to the United States, and thenceforth all thought of further investigations in the tropics was abandoned. The collections made in the face of hardship and disease were nevertheless large and valuable and contained many species wholly new to science.

Mr. Smith and his wife on their return resumed their employment at the Carnegie Museum, devoting themselves to the arrangement of the Colombian material and to the classification of the large and increasing collections of mollusca belonging to the museum. One of the results of this period is the "Catalog of the Genus *Partula*," which was published in 1902. After about a year in Pittsburgh Mr. and Mrs. Smith felt the need of a change and resolved upon removal to Wetumpka, Ala., where they began the systematic collection of fresh-water shells, belonging to the family *Strepomatidæ*, which abound in the Coosa and other rivers of that region. They were supported in their work by four ardent conchologists: Mr. George H. Clapp, of Pittsburgh, Messrs. John B. Henderson and T. H. Aldrich, of Washington, D. C., and Mr. Bryant Walker, of Detroit, Mich., who formed a "syndicate" to enable the work to be done. When Mr. Aldrich dropped out of their number, Professor H. A. Pilsbry, of the Academy of Natural

Sciences in Philadelphia, took the vacant place for such time as he was able to command the necessary funds. In 1910 Dr. Eugene A. Smith, of the Geological Survey of Alabama, induced Mr. and Mrs. H. H. Smith to take charge of the museum at the University of Alabama, and here they have been engaged for nearly a decade in arranging and caring for the collections which have been accumulated principally by the Geological Survey of Alabama. For the past two or three years the Alabama Museum and the Carnegie Museum have been working conjointly in the exploration of the Tertiary deposits of Alabama, under the oversight of Mr. Smith, and the result has been the discovery of a number of new and rich deposits of Tertiary mollusca. Vast series of specimens had been gathered by our indefatigable friends, and the last letter received by the writer contained a request for a fresh supply of labels. It was written only a day or two before the lamented death of the sender.

The work done by Mr. Smith in the field of entomology was particularly great. The entomological collections made by him are mainly contained in the National Museum at Rio de Janeiro, in the British Museum (derived from the gift of the collections of F. D. Godman) and in the Carnegie Museum, though parts of his collections are scattered widely in other museums. There are in the Carnegie Museum in the neighborhood of 25,000 species of Brazilian Coleoptera assembled by him and many thousands of species of insects in other orders. A memorandum recently received by the writer from Mrs. Smith states that the Arthropoda collected during the years of Mr. Smith's journeys in Brazil up to May, 1886, aggregated approximately 40,000 species, distributed as follows:

Hymenoptera	5,000
Diptera	2,500
Lepidoptera	2,600
Coleoptera	23,000
Hemiptera	3,300
Orthoptera	600
Neuroptera	300
Arachnida	2,000
Crustacea	250
Total	39,550 species

The collections contained an aggregate of at least half a million of individual specimens. Portions of the collections have been carefully studied and reported upon. Ashmead, Cresson, and others have in part worked over the Hymenoptera. Williston did something with part of the Diptera. The Lepidoptera so far as they represented the species of Middle-America were studied by Godman and by Herbert Druce. Champion wrote up a part of the Coleoptera, but the beetles of Brazil as a whole remain for the most part to be studied; P. R. Uhler has described many of the Hemiptera, as did also W. L. Distant. The Orthoptera have been studied by Dr. Lawrence Bruner and the Odonata by Dr. P. P. Calvert.

Mr. Smith was not a mere collector of natural history specimens. He was a naturalist in the true sense of that much abused word. He had a wide and accurate knowledge of the major divisions of the animal kingdom and keen powers of discrimination. He was especially well versed in conchology, though he wrote and published but little. He was a systematist of far more than ordinary ability, whose opinions were received with great respect by those who employed him. He was an accomplished linguist. He was familiar with the Greek and Latin classics, spoke Spanish readily and used Portuguese as if it were his mother tongue. He also had a good knowledge of French and German, sufficient to enable him to consult works in those languages. He was one of the survivors of a group of naturalist explorers and investigators to whom we are indebted for much of our knowledge of the fauna and flora of tropical America. He belonged to an illustrious company which, beginning with Humboldt and Bonpland, included in its ranks such men as Alfred Russel Wallace, Henry W. Bates, J. N. Natterer, J. J. Tschudi, J. B. Hatcher and J. D. Haseman, who courageously faced dangers in the wilderness in order to secure information at first hand as to the fauna and flora of the great continent where they labored.

W. J. H.

HENRY JOHN HEINZ.
(BORN OCT. 11, 1844; DIED MAY 14, 1919.)

HENRY JOHN HEINZ.

Born October 11, 1844; Died May 14, 1919.

(Plate LXIII.)

The death of Mr. Henry John Heinz which occurred on May 14, 1919, robbed Pittsburgh of one of its most successful men of affairs, who had won an international reputation, not only in the broad fields of manufacture and commerce, but as a lover of men and as a doer of good deeds.

Like the vast majority of Americans who have achieved fortune and fame, he began his career under circumstances which the thoughtless often speak of as "adverse," but which for earnest souls provide the best stimulus for endeavor. Mr. Heinz was born in Pittsburgh, October 11, 1844, the eldest child of Henry and Anna Margaretta (*m.n.* Schmitt) Heinz. His parents had recently come from Germany. His father was a man of industry, who did not always find the battle of life easy. His mother possessed much force, and was an earnest and faithful Christian woman, who attended well in the sphere of the household to her domestic duties. From their infancy onward she endeavored to fill the minds of her children with devotion to those things which are "pure" and "lovely" and of "good report." She and her husband had dedicated their son to the Christian ministry, and with this end in view they exerted themselves to secure for him a good education. He made excellent progress in the schools to which he was sent; but there came a time in his youth when it became plain to the family that their united efforts would be required to meet the battle of life in the field where they found themselves, and the lad, full of devotion to his parents, laid aside the ambitions which they had fostered in him, and manfully addressed himself to the task of helping to win the daily bread which was needed.

When he was but a little child the family had removed to Sharpsburg, a suburb of Pittsburgh. Sharpsburg was then but a straggling village. The father there continued his occupation of manufacturing building-brick and added to it the erection of houses. In this enterprise the son, when he became older, assisted him.

The family home was situated on a plot of ground containing some three acres of fertile soil. The boy, in his teens, resolved to cultivate a portion of this land as a garden, and finding that it produced more than was necessary for the consumption of the family, conceived the idea of preserving the surplus and marketing it in the neighborhood. His mother, who was a mistress of the culinary arts, aided him, and the products of the garden, converted into sauces, pickles, and condiments, put up in neat form, and most savory, found ready purchasers. The business begun under the family roof was so successful that the young manufacturer resolved with the profits of his early sales to enlarge the enterprise, and after attaining his majority associated with himself a partner, and removing to Pittsburgh, began the conservation of pure food products on a liberal scale. He experienced many difficulties, but, nothing daunted, he went forward, until to-day the establishment which bears his name has come to be one of the greatest, if not the greatest, in the entire world. The manufacturing plant in Pittsburgh at the time of his death covered thirty acres, to which are to be added other manufacturing plants in the United States, Canada, Great Britain, and Spain, covering an area of seventy acres of buildings equipped with all modern appliances; forty thousand acres of land under cultivation; tens of thousands of people in his employment, with four hundred traveling salesmen going forth from forty-five distributing centers located in the leading cities of the world. The viands prepared by skilful hands in his vast establishments are found on the tables of the poor and the rich alike in every clime. His motto from the beginning of his career to its end, as he often told the writer, was "to do common things uncommonly well."

But it is not as a preëminently successful manufacturer and merchant-prince that Mr. Heinz claims our chief attention. He won and held the regard and friendship of men not so much because of his success in business affairs, as because of his loving kindness to all about him and his enthusiasm for the higher things which adorn life. In his youth, though the dream of entering the ministry was not to be fulfilled, he found a sphere of kindred usefulness in the Sunday-school of the little church which he and his parents attended, and where he became the Superintendent. His interest in the work of Sunday schools lasted throughout life. For many years he was the President of the Pennsylvania Sabbath School Association, and Chairman of the Executive Committee of the World's Sunday School Association. In 1916 he was elected Vice-President of the Sunday School Union of London, the oldest organization of its kind in existence. He was looking forward at the time of his death with great expectancy to the International Convention of the Friends of Sunday-Schools, which is to take place in 1920 in the city of Tokyo, and was, deeply occupied in making preliminary plans for this great gathering. No more faithful and helpful friend to the cause of Sabbath-schools has lived in our Commonwealth.

He was also intensely interested in the cause of higher education. He was largely instrumental in founding, and was one of the chief supporters of the University of Kansas City, and was the President of the Board of Trustees of that institution. He was a faithful friend of the University of Pittsburgh and did much for it during his lifetime, and by his last will and testament gave the University two hundred and fifty thousand dollars for the purpose of providing a building for the social and religious activities of the student body. He was active in almost all movements looking towards the welfare of his native city, and participated in all benevolent and public-spirited enterprises which arose during the last four decades. No good cause ever appealed to him in vain for help.

Mr. Heinz traveled very extensively in the later years of his life, not only in America, but also in Europe, Asia, and North Africa. He made it a habit in the early days of his wanderings to and fro to bring back with him souvenirs of the places which he had visited, selecting them for their beauty, or for some association with the spot. He thus was led gradually to become a collector. The first number of the present volume of the ANNALS of the Carnegie Museum is a catalog of the collection of watches which he made. He had become interested in the story of the evolution of this form of timepiece, and the beautiful assemblage of specimens which he made was placed by him in the Carnegie Museum, that others might enjoy what he had found so much pleasure in gathering together and studying. He became interested in the art of the ivory-carver, and the ivory-carvings, principally Japanese and older Chinese, which he accumulated, is one of the most extensive collections of its kind in existence. In recent years he took up the study of antique Chinese jades, and amassed a very great and beautiful collection, which is in his palatial home, the latter having during the last two decades become a storehouse of beautiful and interesting objects which he had gathered. He not only had the instincts of a collector, but he desired that others should share with him the pleasure which he derived from his pursuits, and he converted a group of buildings in the rear of his home into a museum, to which access was freely given at stated times to the entire community. The beautiful conservatory which stood nearby was also thrown open to the public, that his neighbors and the people in the vicinity might enjoy the sight of the plants and flowers which grew and bloomed there.

For a number of years Mr. Heinz proved himself deeply interested in the work of the Carnegie Museum, established by his fellow townsman and friend as a department of the Carnegie Institute. He accepted the position of Honorary Curator of Ivory-Carvings and of Textiles in the Museum, and spent as much time as he could command in the midst of his multifarious occupations, in arranging and looking after the collections which he had either donated to the Museum or deposited there as loans. Many delightful hours were spent by the writer in his company. Though loaded down with cares and responsibilities, he always was filled with a certain spirit of gaiety and mirth, which made him a most attractive companion. His removal from our midst has subtracted from the sunshine of life, and yet, 'though dead he still speaks,' through his works, which follow him, and which are destined for years to come to be a blessing and source of instruction, of mental and spiritual advancement to his fellow-men. All honor to his memory.

W. J. H.

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ANNALS

OF THE

CARNEGIE MUSEUM

VOL. XII. No. 1.

November, 1917.

For sale by Messrs. Wm. Wesley & Sons, 28 Essex St. Strand, London, England; Maruzen Company, Ltd., 11–16, Nihonbashi Tori Sanchome, Tokyo, Japan; and at the Carnegie Museum, Schenley Park, Pittsburgh, Pa., U. S. A.

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ANNALS

OF THE

CARNEGIE MUSEUM

Vol. XII. Nos. 2-4.

October, 1919.

For sale by Messrs. Wm. Wesley & Sons, 28 Essex St. Strand, London, England; Maruzen Company, Ltd., 11-16, Nihonbashi Tori Sanchome, Tokyo, Japan; and at the Carnegie Museum, Schenley Park, Pittsburgh, Pa., U. S. A.

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