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REPORTS OF THE
PRINCETON UNIVERSITY EXPEDITIONS
TO PATAGONIA, 1896-1899

J. B. HATCHER
IN CHARGE

EDITED BY
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VOLUME IV

PALÆONTOLOGY I

PRINCETON, N. J.
THE UNIVERSITY
STUTTGART
SCHWEIZERBART'SCHE VERLAGSHANDLUNG (E. NÄGELE)
1901–6

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VOLUME IV

PALÆONTOLOGY I

PART I THE MARINE CRETACEOUS INVERTEBRATES

By

TIMOTHY WILLIAM STANTON

UNITED STATES NATIONAL MUSEUM

PART II TERTIARY INVERTEBRATES

By

ARNOLD EDWARD ORTMANN

PRINCETON UNIVERSITY

PART III MAMMALIA OF THE SANTA CRUZ BEDS. MARSUPIALIA

By

WILLIAM JOHN SINCLAIR

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WASHINGTON, D. C., Jan. 14, 1901.

Prof. W. B. SCOTT,
Princeton University,
Princeton, N. J.

Dear Sir:

I have the honor to transmit herewith for publication a brief paper on "the marine cretaceous invertebrates obtained by the Princeton expedition to Patagonia in 1899."

The collection was with your permission delivered to me for study by Mr. J. B. Hatcher in October, 1899, and its examination and description have continued at intervals since that time as official and other duties permitted. The fossils proved to be unusually interesting from the fact that they represent a facies of the Cretaceous fauna not hitherto described from South America. There are about 40 species of Mollusca in the collection, of which 31 are sufficiently well represented to be named and described. These indicate the Lower Cretaceous age of the beds from which they were derived.

Very respectfully,

T. W. STANTON.

THE MARINE CRETACEOUS INVERTEBRATES.

BY

T. W. STANTON.

THE fossils discussed in the following pages were collected in March, 1899, by Mr. J. B. Hatcher, in charge of the Princeton Expedition to Patagonia, and it is through his kindness and the generous courtesy of Prof. W. B. Scott that I have had the privilege of studying the collection, which, though not large, has proved very interesting.

In a paper entitled "Sedimentary rocks of southern Patagonia," Mr. Hatcher[1] has described the section from which the fossils were obtained, and named the various Cretaceous horizons recognized. The entire collection came from two localities, only a few miles apart, in the neighborhood of Lake Pueyrrydon, south latitude 47° 30′, west longitude 72°. One of the localities is four miles east of Lake Pueyrrydon, near the mouth of the cañon of Rio Tarde, a small stream emptying into the east end of the lake. The other locality is about ten miles east of the same lake, and about two miles south of the western border of White Lake.[2]

The following description of part of Mr. Hatcher's section along the Rió Tarde is condensed from his account and gives only the features essential to the present discussion. The series about 750 to 800 feet in thickness that includes all the fossiliferous Cretaceous horizons is called the Pueyrrydon series. In it four formations are recognized, in ascending order as follows:

1. The *Gio beds*, consisting of 100 feet of soft green sands or marls with several harder, brown layers, each about two feet thick and full of the large *Ostrea tardensis*, with occasional specimens of a *Lithophagus*, form the lowest horizon exposed.

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[1] *Am. Jour. Sci.*, 4th Ser., Vol. IX., pp. 85–108, Feb., 1900, with a map of southern Patagonia.

[2] These geographic features are all shown on the map accompanying the paper just cited. In the descriptions of species the locality labels accompanying the fossils are copied.

2. The *Lower conglomerate*, 20 feet in thickness, yielded occasional pieces of petrified wood filled with boring Mollusks (*Turnus dubius*).[1]

3. The *Belgrano beds*, conformably overlying the lower conglomerate, consist of 300 feet of soft greenish sandstones and clays replaced toward the top by several layers of harder sandstones and impure limestones. These beds, especially in the upper portion, are rich in Cretaceous invertebrates and at the two localities have yielded all the species described in this paper except those just mentioned. The list of species will be given later.

4. The *Upper conglomerates*, forming the highest member of the Pueyrrydon series, consist of 330 feet of hard, fine-grained, red and variegated sandstone with occasional layers of clay, ending above in a series of very hard fine conglomerates, which have not yielded any identifiable fossils.

Resting unconformably on the upper conglomerates are the *Variegated sandstones*, 1350 feet in thickness, referred to the upper Cretaceous on stratigraphic grounds. Overlying these is a very thick series of Tertiary beds characterized by both vertebrate and invertebrate fossils.

From this brief description it is seen that all the Cretaceous fossils under discussion came from the lower 420 feet of the Pueyrrydon series, and a very large proportion of the species were collected from the upper part of the Belgrano beds about the middle of that series. All the specimens from the Gio beds and the lower conglomerate were obtained at the locality near the mouth of the cañon of Rio Tarde. The Belgrano beds at the same locality yielded the following species :

Lima sp.,
Pecten (Camptonectes) pueyrrydonensis,
Pecten argentinus,
Pecten octoplicatus,
Avicula (Oxytoma) tardensis,
Gervillia hatcheri,
Mytilus (?) argentinus,
Leda (?) corbuliformis,
Solecurtus (?) limatus,
Pleuromya latisulcata,
Corbula crassatelloides,
Martesia argentinensis,
Pleurotomaria tardensis,
Lunatia pueyrrydonensis,
Aporrhais (?) sp.,
Hatchericeras patagonense,
Hatchericeras argentinense,

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[1] The specimens of *Tubulostium pupoides* have the same field label as this species but Mr. Hatcher states that the lower conglomerate yielded no other fossils except the wood with boring Mollusks and it is almost certain that the Tubulostium came from either the Gio beds or the Belgrano beds, as the appearance of the specimens would indicate.

Trigonia subventricosa,
Astarte peralta,
Astarte postsulcata,
Hatchericeras (?) tardense,
Hatchericeras (?) pueyrrydonense.

Nine of these species together with a number of additional ones were obtained at the other locality in the Belgrano beds ten miles east of Lake Peuyrrydon. It is evident from an examination of the fossils that the collections from these two localities supplement each other and are from practically the same horizon as Mr. Hatcher determined in the field. The list of species from the second locality is as follows :

Pecten (Camptonectes) pueyrrydonensis,
Pecten argentinus,
Pecten octoplicatus,
Mytilus (?) argentinus,
Pinna sp.,
Nucula pueyrrydonensis,
Trigonia subventricosa,
Trigonia heterosculpta,
Trigonia, sp.,
Astarte postsulcata (?),
Tapes (?) patagonica,
Tapes (?) sp.,
Tellina sp.,
Solecurtus (?) limatus,
Mactra (?) sp.,
Corbula crassatelloides,
Dentalium (Laevidentalium) limatum,
Vanikoro (?) sp.,
Lunatia constricta,
Aporrhais patagonica,
Cinulia australis,
Tornatellæa patagonica,
Hatchericeras argentinense.

Combining the collections from both localities, the Belgrano beds have yielded 36 species of invertebrates that are more or less fully described in the following pages, besides several additional forms represented by material too scanty and imperfect for generic identification.

Although the specific names in the above lists are all new, the assemblage of genera at once proclaims their Mesozoic character, and the appended excellent illustrations, drawn by Dr. J. C. McConnell, give abundant proof of their Cretaceous age.

The exact position of the beds yielding them in the Cretaceous system, as developed in Europe and other parts of the world, is more difficult to determine, because the evidence is incomplete and somewhat conflicting. Perhaps the first question to suggest itself is whether more than one great subdivision of the Cretaceous is represented in the three fossiliferous horizons that Mr. Hatcher has recognized in the Pueyrrydon series. The fact that the species found in each of the three horizons appear to be peculiar to it would indicate different epochs if each horizon yielded enough species to constitute a real fauna. But the Gio beds yielded only a single species of *Ostrea* which is occasionally bored by a *Lithophagus* and the lower conglomerate contained only the small *Turnus dubius* boring in fossil wood. These are all forms that would not seem out of place if immediately associated with the fauna of the overlying Belgrano beds and probably do not differ greatly from it in age, the vertical distribution of species in this part of the section being due rather to local conditions than to great faunal changes. This conclusion is in harmony with Mr. Hatcher's observation that the beds are conformable.

In attempting to correlate this series with horizons that have been established elsewhere the natural course is to begin comparisons with formations described in adjacent regions, or at least on the same continent, but the data for direct comparisons are almost wholly lacking. It will, doubtless, be a surprise to the reader, as it was to the writer, to find that no previously described species is recognized in this collection from southwestern Patagonia. This is the more surprising for the reason that the Cretaceous is known to be widely distributed and represented by many horizons in South America. It covers considerable areas in Brazil where it has yielded a large fauna described by White[1] but the facies is entirely different from that of the Cretaceous of Patagonia, if indeed, the same horizons are represented. Along the western Cordillera, both Upper and Lower Cretaceous fossils have been described or reported from many areas extending from Venezuela and Colombia to the Strait of Magellan and as Mr. Hatcher's localities are in this western belt, it was naturally expected that many of the species would be referable to described forms. A careful examination of the literature describing South American Mesozoic fossils failed to reveal a single species with which any of the fossils here described can be positively identified. It should be remembered in this connection, however, that none of the collections previously described was obtained within several hundred miles of Lake Pueyrrydon, and that, with few exceptions, the collections were small and not really representative of the faunas. In a few cases species that I

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[1] Contributions to the Paleontology of Brazil. Archivos do Museu Nacional do Rio Janeiro, Vol. VII, 1887.

have described as new may be represented in previous South American collections by forms referred to or compared with European species. Besides searching for similar species in the American Cretaceous faunas, comparisons with the Old World faunas have been as careful and complete as the facilities and time at my command would allow, and in many instances related species have been cited, but I do not consider it wise to identify a form with a species described from a region thousands of miles distant, unless the agreement is so complete as to leave no room for doubt as to their identity. Examples of such species that may possibly have been thus cited under other names in previous papers are the *Ostrea*, some of the Ammonites, *Trigonia subventricosa*, and the *Tubulostium*, all of which will be further discussed.

In recent reviews of the geology and palæontology of the Argentine Republic by Valentin[1] and Ameghino the data for Mesozoic invertebrates are derived almost exclusively from the observations of Steinmann[2] in southern Patagonia and the work of Behrendsen[3] on the collections of Bodenbender from the western Cordillera between 35° and 40° south latitude.

In the neighborhood of Port Famine and the Brunswick peninsula Steinmann recognized the Lower Cretaceous, from which Darwin and others had obtained a few fossils, to which he added an *Inoceramus* compared with *I. concentricus*. Two degrees north (about latitude 51°) he found well-preserved examples of an ammonite of the late Cretaceous group of "Haploceraten," which was thought to be identical with an Indian species, and with it Ananchytes, Gastropods and fossil wood. Still farther north between Lake Argentina (near latitude 50°) and Lake Rica the Cretaceous was reported to have more sandstones and more frequent fossils, including *Inoceramus labiatus* and *I. brongniarti*, or related forms. "From these finds [he states] it is evident that the clay shale system of the eastern slope of the Cordillera, whose thickness may be estimated at not less than 1,000 meters and which forms a broad zone from the Strait of Magellan to the lakes of Santa Cruz (perhaps to the latitude of Valdivia [40°]) belongs to the older and later Cretaceous."

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[1] Segundo censo de la Republica Argentina, tomo I, pp. 63–255, Buenos Aires, 1898.

[2] Reisenotizen aus Patagonien, Neues Jahrb. f. Min., 1883, Bd. II, pp. 255, 256.

[3] Zur Geologie des Ostabhanges der Argentinischen Cordillere. Zeitschr. d. Deutsch. Geol. Gesellsch. Bd. 43, pp. 369–420; Bd. 44, pp. 1–42, 1891–1892.

It seems probable that Steinmann's clay-shale system includes the Pueyrrydon series, but of the few fossils that he cites not one is represented in Mr. Hatcher's collection by similar species, nor even by the same genus, unless it is the ammonite, which is not cited with sufficient definiteness to permit comparisons.

The collections studied by Behrendsen came from a region 500 to 800 miles north of Lake Pueyrrydon. From them he determined the presence of several Jurassic and Cretaceous horizons, including Lias, Lower Oolite, Tithonian, Neocomian, Aptian (Gault), and Upper Cretaceous. The small number of species cited from some of the localities and horizons, however, must have made part of these determinations doubtful.

At one locality on the Arroyo Pequenco, between Rio Salado and Rio Malargue, strata referred to the Upper Neocomian yielded only *Exogyra couloni*, fragmentary remains of a Crustacean, a poorly preserved *Trigonia* that is compared with *T. aliformis*, a *Rhynchonella*, and *Mytilus cuvieri*. The fact that some of the European forms referred to *E. couloni* differ so much from the typical form that they may be compared with *Ostrea tardensis*, suggested that the latter may be the form referred to *E. couloni* by Behrendsen, but his description and the figures to which he especially refers for comparison indicate a very different form. A poorly preserved specimen of *Trigonia subventricosa* might also reasonably be compared with *T. aliformis*. There is a possibility therefore that the Pequenco horizon may be the same as a part of the Pueyrrydon series.

The Aptian or Gault of Behrendsen's paper is represented by a few fossils from "Portezuelo de Carqueque," some distance north of the last mentioned locality. The only forms listed from this horizon are *Ammonites* sp., *Ostrea* sp., *Pecten* sp., and *Serpula phillipsi* Roemer, the last named species evidently being the basis of the determination of the age of the bed. The *Ostrea* is a mere unidentifiable fragment and the descriptive notes on the *Ammonites* and the *Pecten* make it certain that they can not be identical with any of the Pueyrrydon species. *Serpula phillipsi*, however, as described and figured from the Gault of England and Germany has considerable resemblance to the form I have described as *Tubulostium pupoides*, though for reasons pointed out in the description of the latter species it is not considered identical nor even congeneric. It is mentioned here merely as an example of possible identity that may some time be established by comparison of specimens from the two regions. Even if the Pueyrrydon species should prove to be identical with the form from Portezuelo, which according to Behrendsen shows no essential difference from the European species, I should not consider that in itself sufficient proof of the Gault age of the beds containing it.

One other of Behrendsen's horizons, "the Neocomian of the Arroyo Triuguico and of Quili Malal," affords a slight basis of comparison. Two of the Ammonites, *Hoplites desori* and *H. neumayri*, are somewhat suggestive of two of the forms I have described as species of *Hatchericeras* and they are referred to, or compared with some of the same European species mentioned in my descriptions. It is evident, however, that none of the forms figured by Behrendsen is identical with or very closely related to any of the Pueyrrydon ammonites. Several other genera are represented in both this Neocomian and the Pueyrrydon fauna but the species are not identical.

Comparisons made with Cretaceous fossils described from other regions along the Andes from Chili northward gave similar negative results, and there are no indications of close relationship with North American Cretaceous faunas that are worthy of mention.

The very close resemblance of one of the Pueyrrydon species of *Trigonia* to *T. ventricosa* Krauss from the Uitenhage beds of South Africa led to a close examination of the fauna of that formation, and while another of its species, *T. vau*, proved to be related to a Pueyrrydon form, and there are superficial resemblances in the species of *Gervillia*, *Astarte* and *Ostrea*, the fauna as a whole is too different to permit definite correlation. The Uitenhage beds are now generally referred to the Lower Cretaceous, though they were formerly assigned to the Jurassic.

As it is impossible to correlate the Pueyrrydon series by means of identical species, it is necessary to rely on more general comparisons, attempting to give due weight to the somewhat conflicting evidence.

Ammonites and Trigonias are usually among the most trustworthy groups in determining the age of beds. In this case it has been thought necessary to refer all the species of ammonites to a new genus whose relationships are not very firmly established, but nearly all the species with which these forms are compared occur in the Lower Cretaceous, and assuming that the genus is derived from Hoplites, or its near relatives, the stage of development observed is what one would expect to find at that period. Certainly no such forms are known later than the middle of the Cretaceous.

Trigonia subventricosa belongs to a purely Cretaceous section which has similar forms in the Upper Cretaceous, but the most closely relatep form is *T. ventricosa* from the Lower Cretaceous Uitenhage beds, which also yield a form similar to the other Pueyrrydon species *T. heterosculpta*, though another species which may belong to the same section occurs in the Upper Cretaceous Quiriquina beds of Chili. The evidence of both Ammonites and Trigonias, therefore, seems to favor the Lower Cretaceous age of the series.

The specific characters of some of the other groups, such as the Ostrea, the Gervillia, the Astarte species, the Pleuromya, and the Solecurtus (?) also tend to place the beds below the middle of the Cretaceous. Certain of the other forms, such as Cinulia, Tornatellæa, Lunatia, Martesia, Turnus, Mactra (?), and Pinna, have a more modern aspect and would not be out of place in an Upper Cretaceous fauna, while the remainder are mostly of types that have a greater range within the Mesozoic.

After my preliminary examination of this collection the opinion was expressed[1] that the horizon represented is "about the middle of the Cretaceous, at least not lower than the Gault." This judgment was influenced to some extent by the supposed occurrence in the collection of the characteristic Upper Cretaceous genus Pugnellus. Further study of the material after it was better cleaned showed that this generic identification was incorrect, and the closer examination of the collection has in several cases tended to emphasize the evidence for older rather than newer Cretaceous age. The former opinion is, therefore, now modified to this extent, that the horizon is not *later* than the Gault. Although the evidence as above sketched and as given more in detail in the specific descriptions does not seem to me to justify the definite reference of the Pueyrrydon series to any one of the European Cretaceous horizons it is reasonably certain that it belongs within the Lower Cretaceous and is not younger than the Gault.

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[1] Quoted by Hatcher, Am. Jour. Sci., 4th Ser., Vol. IX, p. 90, and published in abstract of communication to Geological Soc. of Washington, Science, N. S., Vol. XI, p. 349, 1900.

PELECYPODA.

OSTREA TARDENSIS sp. nov.

Pl. I, Figs. 1 and 2, and Pl. II, Figs. 1 and 2.

Shell large, massive, subtriangular, or more or less crescentic in outline; lower valve very thick and very convex, obscurely carinate, with the beak more or less twisted laterally, but not distinctly coiled, the lower third of the valve also laterally curved, so as to give the shell its crescentic shape; upper valve thinner, flat or somewhat concave, with the beak more nearly straight and the other end curved to fit the lower valve; surface of both valves with rather coarse concentric lamellæ or imbrications, though on most of the specimens in the collection these are obscured by weathering. Some individuals also show obscure radiating plications. The pit or groove for the ligament is very large and broad and only slightly curved in both valves.

An average specimen measures 150 mm. from beak to base and 90 mm. in greatest breadth at right angles to that line. Convexity of the two valves 53 mm.

The eight specimens in the collection show some variations in form and proportion, but not more than species of Ostrea usually show. The curved form gives it the appearance of an Exogyra, but the beaks, especially of the upper valve, lack the spiral form characteristic of Exogyra.

The fact that *Exogyra couloni* Defrance has been reported from several localities in South America led to the comparison of that species with our Patagonian form. While it is true that some extreme varieties that have been figured as belonging to that very variable European Lower Cretaceous species somewhat resemble the Patagonian shell in form and general appearance, it does not seem to me that they can be identical. *O. tardensis* is certainly not at all like the typical and ordinary forms of *E. couloni*. Behrendsen[1] reports the occurrence of *E. couloni* at "Arroyo Pequenco between Rio Salado and Rio Malargue, not far from the Villa Beltran," Argentine Republic, and states that it is present in almost all the forms represented by d'Orbigny and Pictet, but agreeing especially with the figures given by Bayle and Coquand[2] of specimens from Chili.

[1] Zeitschr. Deutsche Geol. Gesellsch., Bd. 43, p. 419, 1890.

[2] Mém. Soc. Géol. de France, 2d Ser., t. IV, p. 37, pl. 7, figs. 1 and 2, 1851.

These Chilean specimens are distinctly exogyrate and have very little resemblance to the Patagonian form. In a later work by Coquand[1] they are referred to *Ostrea aquila*, which is also made to include *Exogyra imbricata* Krauss, a similar form from the Uitenhage beds of South Africa.

A species that resembles *O. tardensis* more closely than those above mentioned has been described by Stoliczka[2] under the name *Gryphæa ariana* from the Arrialoor group of the Indian Cretaceous. Judging from the figures the principal difference is in the somewhat less strongly curved form of *G. ariana*.

It is possible, though I think not probable, that the Patagonian Ostrea here described as new is specifically identical with some of the South American forms that have been referred to *Exogyra couloni*, but even if that should prove to be true, the identification of that species is believed to be erroneous in those cases and a new name is necessary.

Locality and position.—Mouth of cañon of Rio Tarde, four miles east of Lake Pueyrrydon, from a horizon (Gio beds) 400 feet below the Ammonite layer.

LIMA sp.

Shell small, ovate, slightly oblique, convex with prominent beaks and small inconspicuous ears; surface marked by about 15 rather prominent radiating ribs about equal in width to the interspaces, each of which bears a fine line. The anterior and posterior portions of the shell not covered by the ribs also bear a number of fine radiating lines and show irregular lines of growth.

The three imperfect specimens in the collection are probably immature, the largest measuring only seven millimeters in length and five millimeters in breadth.

Locality and position.—From the Ammonite (Belgrano) beds at mouth of cañon four miles east of Lake Pueyrrydon.

PECTEN (CAMPTONECTES) PUEYRRYDONENSIS sp. nov.

Pl. IV, Fig. 1.

Shell of medium size, ovate or subcircular in outline, moderately convex; right valve with unequal ears, the anterior one much larger, trian-

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[1] Monographie du Genre Ostrea, p. 158.

[2] Cretaceous Fauna of S. India, vol. 3, p. 465, pl. 43, figs. 2, 2^a, pl. 44, figs. 1–3.

gular with rounded extremity and bounded below by a deep byssal sinus, posterior ear much smaller, with the outer margin oblique and broadly rounded above, both with radiating striæ; the body of the shell marked by rather conspicuous irregularly spaced concentric lines and by very fine curved radiating impressed lines.

Height, 25 mm.; length of hinge line 11 mm.; greatest length (about the middle of the valve) 23 mm.

This description is drawn from the type, a well preserved right valve, from the locality ten miles east of Lake Pueyrrydon. The collection from four miles east of the same lake contains some less perfect specimens believed to belong to this species, and among them are two left valves having the same sculpture and general form as the type. These are slightly more convex than the right valve and the anterior ear is similar in form and only slightly larger than the posterior.

The species has the typical Camptonectes sculpture and form as seen in a number of described Jurassic and Cretaceous species, but according to Dall[1] Camptonectes is not of generic or even subgeneric rank but should be placed as a section under Pseudamusium.

Locality and position.—From the Ammonite (Belgrano) beds at the two localities above mentioned.

PECTEN ARGENTINUS sp. nov.

Pl. IV, Fig. 5.

Shell of moderate size, ovate in outline, very gently convex, with median pointed beaks; ears subequal, in the form of slender right-angled triangles, projecting beyond the beak at their outer angle, separated from the body of the shell by impressed lines that form a right angle where they intersect at the beak; basal margin forming almost a semi-circular curve; surface smooth and polished, with very fine lines of growth, occasional more prominent impressed concentric lines, and very faint indications of fine radiating lines.

The figured specimen, which is of average size, is 23 mm. in height and 21 mm. in greatest length. The corresponding dimensions of the largest example in the collection are about twice as great. The convexity of single valves is not more than two to three millimeters.

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[1] Trans. Wagner Free Institute, Vol. III, pt. IV, p. 697, Philadelphia, 1898.

The type is apparently a left valve and the right valve is probably very similar with subequal ears and without a byssal notch, since there are about twenty such valves in the collection, and there are no others of different form that could be right valves of this species. The form is like that of the group for which Meek proposed the name Entolium, but it lacks the diverging "teeth" characteristic of that subgenus. Similar forms are not uncommon in the Jurassic and Cretaceous, such as *Pecten operculiformis* Gabb from the Lower Cretaceous Horsetown beds of California, which, however, has broader ears and no radiating striæ.

Locality and position.—From the Ammonite (Belgrano) beds at mouth of cañon four miles east of Lake Pueyrrydon, and ten miles east of the lake. The figured specimen is from the latter locality.

PECTEN OCTOPLICATUS sp. nov.

Pl. IV, Figs. 2 and 3.

Shell small, ovately subtriangular, conspicuously inequivalve, with eight strong radiating ribs on each valve. Right valve very convex, with prominent narrowed beak; anterior ear elongate-triangular, with a deep byssal notch beneath it; posterior ear much smaller and inconspicuous; ribs very prominent, about as broad as the interspaces, subangular, each bearing several obscure radiating lines and crossed by numerous fine concentric lines. Left valve much less convex, with subequal, rather broad triangular ears; ribs more rounded, much less elevated and relatively more narrow; the radiating and concentric lines also less conspicuous than on the right valve.

Height of an average specimen from beak to base 9 mm.; greatest length at right angles to above measurement 8 mm.; convexity of right valve about 4 mm., of left valve about 2 mm.

Locality and position.—Abundant in the Ammonite (Belgrano) beds at mouth of cañon four miles east of Lake Pueyrrydon and represented by three left valves apparently belonging to the species from the same horizon, ten miles east of the lake.

AVICULA (OXYTOMA) TARDENSIS sp. nov.

Pl. IV, Figs. 6 and 7.

Shell small, obliquely ovate, inequivalve; length of hinge line not quite equal to height of shell; beaks rather prominent, extending beyond the hinge line. Left valve convex; anterior ear rounded, inconspicuous; posterior ear broad, flattened and more or less mucronately produced at the extremity, though this is not preserved on most of the specimens; surface of the whole valve, except the ears, with 25 to 30 fine radiating ribs, which tend to vary in size on the posterior portion. Right valve considerably less convex, with a deep byssal sinus under the anterior ear; posterior ear broad and flattened; surface marked by much finer and more numerous radiating lines than those on the left valve.

An average specimen measures 11 mm. in height and about the same in greatest length, which is below the middle of the valve. The convexity of the two valves united is about 5 or 6 mm.

The species is similar in form and sculpture to *A. nebrascana* Evans and Shumard, as figured by Meek,[1] from the Fort Pierre formation of the western United States. The subgenus Oxytoma ranges throughout the Mesozoic and is by some authors referred to Pseudomonotis instead of Avicula.

Locality and position.—Abundant in the Ammonite (Belgrano) beds at mouth of cañon of Rio Tarde four miles east of Lake Pueyrrydon.

GERVILLIA HATCHERI sp. nov.

Pl. III, Figs. 1 and 2.

Shell very large, slender, obliquely produced, rather convex, with very thick test; beaks terminal, pointed, not conspicuous; ventral margin nearly straight from the beaks for about one-third the length of the shell, then broadly convex to the rounded posterior end; dorsal margin slightly concave from the hinge to the posterior end of the shell; posterior wing not preserved on the type but evidently narrow; hinge area almost parallel with the longer axis of the shell, broad with seven or eight large transverse pits or grooves for the ligament, and three or four obscure, obliquely elongated teeth; surface marked only by lines of growth.

Length 260 mm.; greatest breadth (at the beginning of the posterior third of the shell) 64 mm.; greatest convexity of single valve about 28 mm., and thickness of test in anterior portion about the same.

The only specimen in the collection is the left valve figured, which is in an excellent state of preservation, except that nearly all the posterior wing

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[1] U. S. Geol. Surv. Terr., Vol. IX, p. 34, pl. 16, figs. 3a, 3b.

is broken off and some of the hard, sandy matrix still clings to a part of the surface.

The species may be compared with *G. alpina* Pictet and Roux,[1] which is almost as large and somewhat similar in form, but is a straighter shell and has a more distinct anterior wing. *Gervillia dentata* Krauss[2] from the Uitenhage beds of South Africa is another large species that has some general resemblance to this form, but it is not so thick shelled, the beak is not so pointed and the shell is straighter.

Locality and position.—From the Ammonite (Belgrano) beds at mouth of cañon four miles east of Lake Pueyrrydon.

MYTILUS (?) ARGENTINUS sp. nov.

Pl. IV, Fig. 4.

Shell small, elongate-ovate, moderately convex; beaks prominent, slightly incurved; dorsal margin slightly convex without definite posterior angulation; ventral margin nearly straight, posterior end regularly and broadly rounded; surface marked only by very fine growth lines and concentric wrinkles, which are inconspicuous except when magnified.

Length of an average specimen from beak to base 8 mm.; greatest breadth 5.5 mm.; convexity of the two valves about 6 mm.

This little species has almost the form of a Crenella, and some obscure radiating lines on a weathered specimen increased the resemblance and led to its reference to that genus, when the collection was first examined. Well-preserved specimens, however, show no radiating sculpture.

Locality and position.—The figured type and four other specimens are from the Ammonite (Belgrano) beds at mouth of cañon four miles east of Lake Pueyrrydon, and one specimen from the same horizon ten miles east of the lake.

LITHOPHAGUS sp.

This genus is represented in the collection by a single small flask-shaped burrow in a fragment of oyster shell from the Ostrea horizon (Gio beds) 400 feet below the Ammonite layer at the mouth of the cañon four miles

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[1] As figured by Pictet and Campiche, Terrain Crétacé de Sainte Croix, pl. 155, figs. 2–4. According to these authors the species includes the Cretaceous forms figured by Sowerby (Min. Conch., pl. 511) under the name *G. aviculoides* but not belonging to that Jurassic species.

[2] Nova Acta, Vol. 22, p. 458, pl. 50, figs. 1*a*–1*c*.

east of Lake Pueyrrydon. The burrow, which is filled with calcareous sand and probably still contains the shell, measures 10 mm. in length and 5 mm. in greatest diameter.

PINNA sp.

A single small Pinna in the collection is too imperfect for specific description. The shell is rather slender, moderately convex, not carinate, nor distinctly angular on the median line, with the upper two thirds of the shell marked by 10 or 12 radiating lines and the rest of the surface bearing irregular, less conspicuous lines of growth. The specimen, which is probably not a mature shell, measures 90 mm. in length, 28 mm. in greatest breadth and 10 mm. in convexity of both valves.

Compared with *P. robinaldina* d'Orbigny, which Behrendsen[1] has reported from the Lower Cretaceous of the Argentine Republic, this species may be easily distinguished by its more slender and less convex form and by the absence of a median angulation. It much more closely resembles the Upper Cretaceous *P. lakesi* White[2] from the Fort Pierre formation of Colorado.

Locality and position.—From the Ammonite (Belgrano) beds ten miles east of Lake Pueyrrydon.

NUCULA PUEYRRYDONENSIS sp. nov.

Pl. IV, Figs. 8 and 9.

Shell of medium size, elongate subovate, moderately convex; beaks nearly terminal at the posterior end, which is almost vertically truncate; dorsal margin slightly convex; anterior end broadly rounded, most prominent above, passing below into the convex ventral margin; surface nearly smooth, bearing very fine, closely arranged lines of growth, with a few more conspicuous concentric furrows at wide intervals.

Length 17 mm.; height 12 mm.; convexity of the single valve about 5 mm.

The species is quite similar in form and surface to *N. simplex* Deshayes, from the Neocomian of France, as figured by d'Orbigny,[3] except that its anterior end is more broadly rounded.

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[1] Zeitschr. Deutsche Geol. Gesellsch., Bd. 44, p. 25, 1892.

[2] 12th Ann. Rep. U. S. Geol. and Geog. Surv. Terr., pt. I, p. 17, pl. 11, fig. 1, 1880.

[3] Paléont. Franç. Terr. Crét., t. III, pl. 301, figs. 11 and 12.

Locality and position.—From the Ammonite (Belgrano) beds ten miles east of Lake Pueyrrydon, represented by a left valve, an internal cast, and the imprint of the exterior of another one.

LEDA (?) CORBULIFORMIS sp. nov.

Pl. IV, Fig. 11.

Shell small, elongate-ovate, rather ventricose, with prominent, tumid submedian beaks; dorsal margin descending almost equally before and behind the beaks; anterior end broadly rounded; posterior end more narrow, subtruncate and very slightly upturned at the extremity; ventral margin gently convex; surface marked by relatively coarse, regular concentric lines.

The type measures 10 mm. in length, 7 mm. in height and 6 mm. in convexity of the two valves.

The description is drawn from a single specimen which retains most of the shell of the left valve and shows the internal cast of the right. Impressions of small nuculoid hinge teeth are faintly shown. The reference to Leda is based on the form of the shell and is somewhat doubtful.

Locality and position.—Ammonite (Belgrano) beds at mouth of cañon four miles east of Lake Pueyrrydon.

TRIGONIA SUBVENTRICOSA sp. nov.

Pl. IV, Figs. 19 and 20.

Shell rather large, sublunate, inflated and broadly rounded in front, much contracted and considerably produced behind; beaks prominent, near the anterior end; ventral margin very convex and prominent in its middle third, where the strongest costæ terminate, in front passing imperceptibly into the anterior margin by a more gentle curve, and behind passing almost straight or with a slightly concave curve toward the posterior end; dorsal margin concave; area rather narrow, convex, divided above the middle by a narrow groove, with inconspicuous lines of growth, not bounded by distinct carinæ; escutcheon also nearly smooth, large, deeply excavated, bearing only faint costellæ, that near the front are very short, directed backward very obliquely from the area, while toward the posterior end they become somewhat larger, more nearly transverse, passing entirely across the escutcheon and sometimes curving forward near the margin; remainder of the shell bearing about 22 to 24 strong costæ, radiating from the margin of the area and divided into two rather distinct sets. The anterior 10 or 11 are very strong, distant, coarsely and irregularly tuberculate, curved forward near the margin of the shell, occupying the inflated anterior two thirds. Successive costæ become larger and more nearly straight, the 9th or 10th usually being the largest. The other costæ on the contracted posterior third of the shell are much finer, more closely arranged and nearly straight or slightly irregular and sinuous, without tubercles, and directed obliquely downward and backward. The surface also bears rather conspicuous, closely arranged lines of growth.

The figured type, which has lost a small portion of the posterior end, measures 73 mm. in length, 63 mm. in height, and about 57 mm. in convexity of the two valves. The corresponding dimensions of another specimen are 82 mm., 66 mm., and 60 mm., respectively. In each case the length is measured from the front margin to the posterior end, and the height somewhat obliquely from the beak to the most prominent part of the ventral margin.

This species belongs to the section Scabræ, which is characteristic of the Cretaceous, and it is somewhat closely related to *T. aliformis* Parkinson. The form which most closely resembles it, however, is *T. ventricosa* (Krauss),[1] from the Uitenhage beds of South Africa.

Comparisons have been made with some small specimens collected by Dr. Holub on Zwartkop river, as well as with the published figures, and while the general resemblance is very great, the Patagonian form differs in being somewhat longer and less inflated, and the tubercles on the anterior ribs are coarser, less regular and more distant. *T. tuberculifera* Stoliczka from the Upper Cretaceous Trichinopoly beds of southern India is also similar in general form and sculpture, but it is still shorter than *T. ventricosa* and the costæ on the posterior portion are coarser and not so numerous.

In beds referred to the Upper Neocomian at Arroyo Pequenco, Argentine Republic, several hundred miles north of these Patagonian localities, Dr. Bodenbender collected a Trigonia, listed by Behrendsen[2] as *Tri-*

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[1] Nova Acta Acad. Caes. Leopold-Carolin. Nat. Cur., Vol. 22, p. 456, pl. 49, figs 2a–2d. Better figures have been published by Lycett in Brit. Foss. Trigoniæ, p. 119, and by Stoliczka in Cret. Fauna of S. India, vol. 3, pl. 15, figs. 9, 9*a*.

[2] Zeitschr. Deutsche Geol. Gesellsch., Bd. 43, 1891, p. 418.

gonia conf. *aliformis* Park., which may possibly be identical with our species, but the single specimen collected was too imperfect for full description. It was associated with an oyster identified with *Exogyra couloni* Defr.

Locality and position.—Represented by 13 specimens from the Ammonite (Belgrano) beds at mouth of cañon four miles east of Lake Pueyrrydon and by four specimens from the same horizon ten miles east of the lake.

TRIGONIA HETEROSCULPTA sp. nov.

Pl. IV, Figs. 16–18.

Shell rather small, ovately trigonal, moderately convex; anterior end broadly rounded, rather prominent; ventral margin gently convex; posterior end slightly produced, narrowly rounded at the extremity and very obliquely subtruncate above; dorsal margin almost straight (very slightly concave) from the beak to the posterior end; beaks not very prominent, situated about one third the length of the shell from the anterior end; area and escutcheon narrow, not very sharply defined on the adult shell, both being destitute of sculpture other than rather prominent lines of growth and a broad furrrow above the middle of the area. The sculpture of the young shell, as seen on the beaks and on small specimens, is entirely different from that of the adult, and the form also is different. In young shells, seven millimeters or less in length, the height and length are about equal and the sculpture consists of strong concentric ribs, parallel to the growth lines and about as prominent on the area as on the anterior portion of the shell. At this stage the area is bounded above and below by well-marked carinæ and the small escutcheon is smooth. As the shell grows, the next two or three ribs become swollen and bent downward a short distance in front of the area, then one or two form V-shaped angles there, and finally in the adult form of sculpture there are two distinct sets of costæ—one set consisting of slender, smooth costæ resembling those of the young shell, but ranging obliquely backward and downward from the front of the shell until they almost meet the other set, the number varying from 6 to 12 or more according to age; the posterior set consisting of fewer and larger, more nearly vertical, smooth costæ that range downward from the margin of the area to the ventral border.

The sculpture is thus seen to agree closely with that of the Undulatæ section of Trigonia, except that the area is not so well defined. The largest specimen illustrated is so badly weathered that the anterior set of costæ has been almost obliterated, and the figure is therefore misleading in that respect. The other figures, though smaller, show the sculpture better.

The largest specimen in the collection (Pl. IV, Fig. 18) measures 51 mm. in length, 38 mm. in height and about 19 mm. in convexity of the single valves. The corresponding dimensions of another specimen are 29 mm., 22 mm. and about 9 mm., respectively.

The only American Cretaceous Trigonia that resembles this one in general appearance is *T. hanetiana* d'Orbigny,[1] from the Quiriquina beds of Chili, which may be easily distinguished by differences in the sculpture, the posterior set of costæ radiating from the beak instead of from the margin of the area, and tending to break up into large irregular tubercles toward the ventral margin. *T. vau* Sharpe[2] from the Uitenhage beds of South Africa is more nearly related, as its sculpture is of the same type. It differs, however, in outline, the posterior end being more prolonged and broader, and the anterior ribs are more oblique, while the posterior set also have a different inclination. *T. robinaldina* d'Orbigny,[3] a French Neocomian species, has somewhat similar sculpture but differs in outline and is more convex.

T. heterosculpta is not easily assigned to any of the described sections of Trigonia. The costæ are similar to those of the Undulatæ but the ill-defined area and escutcheon seem to prevent its reference to that group, which is said to be characteristic of the Jurassic.

Locality and position.—From the Ammonite (Belgrano) beds ten miles east of Lake Pueyrrydon, represented by about 20 valves.

TRIGONIA sp.

Associated with the preceding from the locality ten miles east of Lake Pueyrrydon, are two specimens evidently belonging to a distinct species of Trigonia, but too imperfect for specific description, as they do not show the character of the posterior end, area and escutcheon. The form is rather ventricose and short and the anterior portion of the shell bears nine

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[1] Voyage dans l'Amerique Merid., t. III, pt. 4, p. 127, pl. 12, figs. 14–16. The species is also figured by Steinmann, Neues Jahrb. f. Min., etc., Beilageband X, p. 101, pl. 7, figs. 8, 9.

[2] Trans. Geol. Soc. Lond., 2d Ser., Vol. VII, p. 194, pl. 22, fig. 5.

[3] Paléont. Franç. Terr. Crét., t. III, pl. 299, figs. 1, 2.

or ten large smooth ribs, that radiate from the beak and are broader than the interspaces.

ASTARTE PERALTA sp. nov.

Pl. V, Figs. 1 and 2.

Shell very large and massive, ovate, moderately convex, considerably higher than long, with prominent submedian beaks, from which the outline descends rapidly and almost equally, with a gentle convex curve behind, and concave in front to the extremity of the lunule, which is rather large and deeply excavated with abrupt walls; ventral margin regularly rounded; surface marked by fine lines of growth and by rather prominent concentric ridges, which are less prominent on the middle of the valve than toward the ends, and become broader and less conspicuous toward the ventral margin of the adult; hinge broad and massive, showing in the right valve a small anterior cardinal tooth, a very large middle cardinal, two large sockets for the reception of the cardinals of the left valve, and traces of anterior and posterior laterals; posterior cardinal not developed. The free border of the shell is not crenulated on the interior.

Height 125 mm., length 101 mm.; convexity of both valves about 80 mm.

This description is drawn from a well-preserved right valve showing all the essential specific and generic features, though a fragment has been broken from the posterior end. There is another imperfect specimen showing the beak of a left valve.

The species is distinguished by its large size and its great height, as compared with its length. In these features it recalls some of the gigantic species of Astarte from the Jurassic, such as *Astarte damesi* Boehm,[1] though differing from them in outline and other details.

The growth lines of *A. peralta* show that its height, as compared with the length, increases rapidly with age and these two dimensions are equal at least until they reach 25 mm. At that size the shell resembled *A. postsulcata*, except that the sculpture was considerably coarser and the anterior end was less prominent.

Locality and position.—From the (Belgrano) Ammonite beds at mouth of cañon four miles east of Lake Pueyrrydon.

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[1] Palaeontographica, Supplement II, Die Bivalven der Stramberger Schichten, p. 561, pl. 63, figs. 1–3.

ASTARTE POSTSULCATA sp. nov.

Pl. V, Figs. 3–7.

Shell of medium size, subcircular in outline, moderately convex, subequilateral, the anterior end of the shell being slightly more prominent than the posterior; beaks prominent, angular; lunule rather large, deeply excavated, with abrupt walls; surface marked by rather coarse lines of growth, by occasional more prominent concentric furrows and by a broad, shallow depression or furrow extending in a curve from the beak to the postero-ventral margin: hinge with two well-developed cardinal teeth in each valve, and both anterior and posterior laterals considerably developed. Margin of the shell not crenulate within.

An average specimen measures 25 mm. in height, 26 mm. in length and 18 mm. in convexity of the two valves. Shells of this size have comparatively thick massive shells, as shown in figures 5, 6 and 7, while other specimens only slightly smaller and agreeing in all other respects, have very much thinner shells. This comparative thinness of test is believed to be due to immaturity.

This species belongs to the same group as *A. peralta*, the young of which it evidently closely resembles, but it may be distinguished even from specimens of the same size by its much finer lines of growth, by the presence of the radiating posterior furrow, and by slight differences in outline, especially the greater prominence of the anterior end.

Locality and position.—Represented by over 20 specimens from the Ammonite (Belgrano) beds at mouth of cañon four miles east of Lake Pueyrrydon.

TAPES (?) PATAGONICA sp. nov.

Pl. IV, Figs. 12 and 13.

Shell small, rounded subquadrate, moderately convex; beaks prominent, situated on the anterior third of the shell; dorsal margin excavated in front of the beaks, gently convex behind them; anterior end broadly rounded, passing imperceptibly into the convex ventral margin; posterior end broad, obliquely subtruncate; surface marked by rather coarse, regular concentric lines and grooves, with occasional deeper furrows, the sculpture being strongest on the middle of the valve and fading out toward the ends. There is no distinct lunule and the narrow escutcheon is about half filled by the ligament.

Length of the type, 17 mm.; height, 15 mm.; convexity of the two valves, 8 mm.

Besides the well-preserved type, the species is represented by a cast of one valve and possibly by two other imperfect valves, that are referred with some doubt to the species. The hinge and other internal characters are unknown and the generic reference is, therefore, very uncertain.

Locality and position.—From the Ammonite (Belgrano) beds ten miles east of Lake Pueyrrydon.

TAPES (?) sp.

Associated with the preceding species at the same place and horizon is another form of about the same size, but considerably more elongate, with the beaks nearer the anterior end, less convex and with smoother surface. The pallial sinus is deep, rather broad and horizontal. Represented by a nearly complete internal cast retaining small portions of the shell and by the imprint of a part of the surface of the same individual.

TELLINA sp.

A single small internal cast retaining small portions of the shell is referred to this genus on account of its form and general aspect. The valves are slightly twisted laterally; anterior end broadly rounded; posterior end obliquely subtruncate, much more narrow and somewhat shorter, than the front end; ventral margin slightly convex; beaks rather prominent; surface apparently smooth.

Length, 21 mm.; height, 13 mm.; convexity of the two valves, 5 mm.

Locality and position.—Ammonite (Belgrano) beds ten miles east of Lake Pueyrrydon.

SOLECURTUS (?) LIMATUS sp. nov.

Pl. IV, Fig. 10.

Shell small, elongate oval, subequilateral, with very small, inconspicuous beaks; dorsal and ventral margins very slightly convex; anterior end regularly rounded; posterior end slightly contracted, broadly rounded into the ventral margin below, more abruptly rounded or subangular above; surface with a polished appearance but marked by numerous fine growth lines that vary somewhat in size.

Internal casts show imprints of two very small teeth and subequal ovate adductor muscle impressions. The pallial line is very faint and the sinus not distinctly seen.

Length of an average specimen 20 mm.; height 9 mm.; convexity of both valves about 4 mm.

This species closely resembles *Solen æqualis* d'Orbigny [1] which the same author afterward referred to Solecurtus. It is smaller than that species and not quite so slender.

Locality and position.—The figured specimen is from the Ammonite (Belgrano) beds 10 miles east of Lake Pueyrrydon. It also occurs at the locality four miles east of the lake, and is represented by about a dozen specimens from the two places.

PLEUROMYA LATISULCATA sp. nov.

Pl. VI, Figs. 1 and 2.

Shell of medium size, oblong ovate, or subcuneate in form, the greatest convexity near the front end midway between the beak and the ventral margin; anterior end broadly rounded, posterior end more narrowly rounded and slightly gaping; ventral margin very slightly convex; dorsal margin descending abruptly in front of the beaks and rather rapidly behind them; beaks prominent, approximate, somewhat flattened, situated near the anterior end of the shell; a rather prominent broad ridge, on which the sculpture is most strongly marked, extending from the beak almost vertically to the antero-ventral angle, a much more obscure posterior umbonal ridge running obliquely to the posterior end, and the side between these two ridges flattened; surface marked by very prominent concentric ribs separated by broader furrows, and the whole covered with finer growth lines.

Length, 38 mm.; height, 25 mm.; convexity of the two valves, 20 mm.

Locality and position.—From the Ammonite (Belgrano) beds at mouth of cañon four miles east of Lake Pueyrrydon. Represented by a single specimen.

MACTRA (?) sp.

Shell rather small, elongate, moderately convex, with prominent beaks slightly in advance of the middle; anterior end broadly rounded; posterior end narrow, obliquely subtruncate; ventral margin gently convex: an

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[1] Pal. Fr. Terr. Crét., t. 3, p. 321, pl. 350, figs. 5–7.

angular umbonal ridge extending near and almost parallel with the dorsal margin from the beak to the posterior end; surface marked by regular, comparatively rather coarse, concentric lines and furrows; hinge and other internal features unknown.

Length of the best preserved specimen 28 mm.; height 16 mm.; convexity of single valve about 5 mm. Another fragment indicates a specimen with corresponding measurements about one third greater.

The material is too imperfect and fragmentary for a satisfactory specific description or figure and as the hinge is unknown no definite generic reference can be made. The form, sculpture, and other features observed indicates that it belongs to the Mactridae though probably not to Mactra in the restricted sense as defined by Dall. It has a greater resemblance to Spisula.

Locality and position.—From the Ammonite (Belgrano) beds ten miles east of Lake Pueyrrydon.

CORBULA CRASSITELLOIDES sp. nov.

Pl. IV, Figs. 14 and 15.

Shell small, subtriangular, rather convex; beaks prominent, broad, situated slightly in advance of the middle; dorsal margin descending almost equally forward and backward from the beaks; ventral margin convex; anterior end broadly rounded; posterior end obliquely subtruncate; umbonal ridge distinct, angular, descending obliquely to the postero-ventral angle; surface marked by regular fine concentric lines.

Length of an average specimen, 5.5 mm.; height, 4 mm.; convexity of the two valves, 4 mm.

This abundant little species resembles *C. bodenbenderi* Behrendsen[1] from the Neocomian of Arroyo Triuguico, Argentine Republic. It is somewhat smaller than Behrendsen's species, more inequilateral, more convex, and the posterior end is relatively broader. In general form it resembles the young of some species of Crassatella.

Locality and position.—Represented by numerous specimens from the Ammonite (Belgrano) beds ten miles east of Lake Pueyrrydon and at mouth of cañon four miles east of the same lake.

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[1] Zeitschr. deutsch. geol. Gesellschaft, Bd. 44, 1892, p. 19, pl. 3, figs. 6^a–6^d.

MARTESIA ARGENTINENSIS sp. nov.

Pl. VI, Figs. 3 and 4.

Shell small to medium in size, elongate ovate or cuneate, very inflated, with a spherical aspect from the front, regularly tapering to the posterior end, which gapes rather widely, anterior hiatus shield-shaped, closed by a callum; a single broad accessory umbonal valve present (form not accurately determined), other accessory valves unknown; surface marked by fine regular lines of growth, parallel with the margins of the shell, and by two faint umbonal furrows that diverge slightly in passing obliquely from the beaks to the ventral margin just behind its most prominent portion, and are more prominent on internal casts than on the shell itself; the burrows in fossil wood, in which the shells are found, not lined with a calcarous shell.

An average specimen measures 13 mm. in length; 7.5 mm. in height, and 8 mm. in greatest convexity.

The two umbonal furrows in this species suggest its reference to Parapholas, which is represented in the Cretaceous by somewhat similar forms, but that genus has paired umbonal valves, or a single one formed of two fused pieces.

Locality and position.—From the Ammonite (Belgrano) beds at mouth of cañon four miles east of Lake Pueyrrydon, represented by a dozen specimens, most of which are immature.

TURNUS DUBIUS sp. nov.

Pl. VI, Figs. 5–8.

Shell small, subglobose, or broadly ovate, gaping widely behind, and in front with a broad, shield-shaped hiatus, which in some specimens seems to be filled by a callum, its upper corners almost rectangular; beaks prominent, approximate, in front of the middle of the shell; dorsal margin nearly straight, posterior end and venter very broadly rounded; umbonal groove slightly oblique, narrow, inconspicuous, somewhat more prominent on internal casts than on the exterior, extending from the beak to the most prominent part of the ventral margin; surface also marked by very fine, closely arranged, regular lines of growth that cross the umbonal furrow obliquely and are sharply bent upward in front of it, parallel with the margin of the anterior gape.

The internal cast also shows a deep groove, corresponding to a heavy internal rib, extending back from the beak to the posterior margin above the umbonal ridge, and some specimens show a much fainter furrow in the same position on the exterior of the shell.

On one specimen near the beak there is a small subtriangular structure that appears to be an accessory valve (protoplax) and indicates by its form that there were two of them, as in Xylophaga.

The animal burrowed in wood, forming long more or less tortuous shelly tubes like those of Teredo, the surface of the tubes bearing irregular annular wrinkles, or lines of growth.

Length of a medium sized specimen, 7 mm.; height, 6.5 mm.; convexity of both valves, 6 mm. The larger tubes measure 7 mm. in diameter and some of them, though broken, are over 30 mm. long.

This species is quite similar in habit and general form to some species of Teredo, such as *T. torulosa* Stoliczka from the Cretaceous of southern India, but the apparent presence of a callum and of accessory valves and the strong internal rib prevent its reference to Teredo. In the presence of a callum closing the anterior hiatus, it differs also from the type of Turnus, but in other characters, including the supposed "protoplax," it agrees with that genus, for although described as without accessory valves, a specimen of the type species (*T. plenus*) from the Cretaceous of Cottonwood Creek, California, shows a structure precisely like that described as a probable protoplax in this species. The presence or absence of a callum in the adult is considered less important than the other features described.

Several fragments of fossil wood in the collection are filled with the tubes and these have yielded 19 more or less perfect specimens of the shells.

Locality and position.—From mouth of cañon of Rio Tarde, four miles east of Lake Pueyrrydon, Lower conglomerate, 300 feet below Ammonite bed.

SCAPHOPODA.

DENTALIUM (LÆVIDENTALIUM) LIMATUM sp. nov.

Pl. VI, Fig. 9.

Shell rather large, slightly arcuate, with circular cross-section; surface appearing smooth and highly polished, but showing when magnified very fine, closely arranged lines of growth that pass directly around the shell.

The figured specimen measures 55 mm. in length and 7 mm. in diameter at the larger end. The test itself rather thick and the surface is not well preserved on the specimen figured but another fragment shows it perfectly. None of the specimens are well enough preserved to show the apertures unbroken, and the subgeneric reference is therefore uncertain.

Locality and position.—From the Ammonite (Belgrano) beds ten miles east of Lake Pueyrrydon, represented by four fragmentary specimens.

GASTROPODA.

PLEUROTOMARIA TARDENSIS sp. nov.

Pl. VII, Figs. 1 and 2.

Shell large, broadly conical, consisting of not more than seven or eight convex whorls; apical angle about 90°; base broadly rounded, not umbilicated; slit rather broad (5 mm. in the type), extending back over about one-fifth of the last whorl, situated above its middle, so that the slit-band on the whorls of the spire is near the middle of their visible portion; aperture obliquely subovate; outer lip simple, acute; inner lip rounded below and forming a distinct callus above, which is especially prominent and thick over the umbilical region where it spreads out in a broadly crescentic form; surface marked by numerous inconspicuous spiral lines, by an obscure furrow a short distance below the smooth slit-band and another a little farther above it, and by rather coarse, irregular lines of growth.

The type measures 110 mm. in height (with apex of spire restored) and 127 mm. in greatest breadth.

The species is based on a single specimen, which, though lacking the apex of the spire and a part of the test, is otherwise in an excellent state of preservation. It probably should be referred to the section Perotrochus, which Fischer established for *P. quoyana* Fischer and Bernardi and to which he provisionally referred a number of Jurassic species which have the same general features as this shell, though none of them is so stout in form. No Cretaceous species known to me is so closely related as to require detailed comparison.

The specific name is derived from the Rio Tarde, near which the fossil was found.

Locality and position.—From the Ammonite (Belgrano) beds at mouth of cañon four miles east of Lake Pueyrrydon.

TUBULOSTIUM PUPOIDES sp. nov.

Shell of medium size, dextral, subglobose, or very stout pupiform, with a very broad, rounded apex, umbilicated, with the umbilicus broader in the young than in the adult, when it is almost closed; whorls four or five, slightly flattened on the sides, convex above and below, the last one much contracted and produced in a short free tube near the circular aperture; surface marked by obscure irregular transverse wrinkles and by a small spiral furrow near the middle of the whorl. On the best preserved specimen the sutures are linear and inconspicuous, but two other specimens, believed to belong to the same species that have lost the outer layer of shell, show rounded whorls and deep sutures.

The type measures 10 mm. in height and 9 mm. in greatest breadth. The contracted aperture is 3 mm. in diameter.

This species was overlooked until after the drawings were all made and arranged in plates and for that reason a figure is not given. It is evidently congeneric with *Tubulostium callosum* Stoliczka,[1] from which it differs in its more nearly pupoid form, in its rounded base and in the absence of the "external callosity." Stoliczka refers the genus to the Vermetidæ. Somewhat similar forms have been described as Annelids, and one such, *Serpula phillipsi* Roemer, is mentioned by Behrendsen[2] as occurring in the Aptian of Portzuelo de Carqueque, Argentine Republic. In fact the determination of the Aptian or Gault at that place seems to be based on the presence of that species. As figured by Phillips[3] under the name *Vermicularia sowerbii* it is somewhat larger than our species, its apex is more conical, the umbilicus is broader, and the last whorl is not narrowed and produced in a free tube. These differences are certainly sufficient to seperate the Patagonian form from Roemer's species, and yet the general resemblance is close enough to suggest a possibility that Behrendsen may have had the Patagonian species. He states, however, that he had nu-

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[1] Cretaceous Fauna of S. India, Gastropoda, p. 241, pl. 18, figs. 26–32.

[2] Zeitschr. Deutsch. Geol. Gesellsch., Bd. 43, p. 418, 1891.

[3] Geology of Yorkshire, pl. 2, fig. 29.

merous well-preserved examples and he could find no essential difference between them and the European forms. Stoliczka refers *Serpula phillipsi* to Burtinella, a Gastropod genus related to Tubulostium.

Locality and position.—From mouth of cañon four miles east of Lake Pueyrrydon, 300 feet below the Ammonite beds, according to the labels. The material has more the appearance of specimens from the underlying Gio beds or the overlying Belgrano beds.

VANIKORO (?) sp.

A single, small, probably immature, specimen has the form and sculpture of this genus. The form is stout, consisting of three rapidly increasing whorls, with the surface marked by rather prominent transverse lines, or small costæ crossed by numerous much finer spiral lines; aperture broadly ovate; umbilicus rather narrow.

Height, 6 mm.; breadth, 5.5 mm.; height of aperture, 4 mm.; breadth of same, 3.5 mm.

Locality and position.—From the Ammonite (Belgrano) beds ten miles east of Lake Pueyrrydon.

LUNATIA CONSTRICTA sp. nov.

Pl. VI, Figs. 10 and 11.

Shell rather small, ovate, consisting of about four convex whorls that are slightly flattened or compressed on the upper third; suture deeply impressed; aperture ovate, broadly rounded below; inner lip forming a moderately heavy callus, reflected below, so as to partially cover the narrow umbilicus; surface marked by numerous coarse lines of growth and by sharply marked narrow constrictions, or furrows, of which there are four, parallel with the growth lines on the last whorl of the type.

Height of type specimen, 24 mm.; greatest breadth, 21 mm.; height of aperture, 19 mm.; breadth of same, 12 mm.

The species is represented by four fairly well-preserved specimens, the best of which is figured. Associated with these are about a dozen more imperfect specimens, some of which seem to have a smoother surface and less elevated form and may belong to a distinct species.

Locality and position.—From the Ammonite (Belgrano) beds, ten miles east of Lake Pueyrrydon.

LUNATIA PUEYRRYDONENSIS.

Pl. VI, Fig. 12.

Shell of moderate size, broadly subovate, consisting of about four rapidly increasing convex whorls; suture impressed, bordered by a narrow, flattened shoulder; aperture subovate, narrow above, broadly rounded below; callus of the inner lip rather narrow and thin, slightly reflected over the narrow umbilicus below; surface marked by numerous distinct, crowded lines of growth.

Height, 33 mm.; greatest breadth, 34 mm.; height of aperture, 28 mm.; breadth of same, 18 mm.

This species is easily distinguished from the preceding by its stouter form, shouldered whorls and different sculpture.

It is possible that these two species may prove to be synonyms of European forms, but in the absence of actual specimens for comparison I consider it safer to treat them as distinct species, rather than to attempt to identify such simple forms by descriptions and figures only, especially when the associated faunas are different.

Locality and position.—Represented by a single specimen from the Ammonite (Belgrano) beds at mouth of cañon four miles east of Lake Pueyrrydon.

APORRHAIS PROTUBERATUS sp. nov.

Pl. VI, Figs. 13–15.

Shell of medium size, rather stout, consisting of six or seven convex whorls, of which the last on approaching the aperture becomes carinate above the middle and flattened below, the carina extending in a curve to the upper extremity of the wing; aperture rather narrow and elongate; outer lip prolonged upward beyond the preceding whorl and produced in a broad, very thick, subquadrate wing, whose outer margin is broadly rounded below and extended above in a short blunt process; inner lip with a heavy callus that forms a subspherical protuberance just above the anterior canal and extends in a thinner deposit over a large part of the spire; anterior canal short, broad and nearly straight, with a slight notch or emargination at the extremity; posterior canal not distinctly developed, but apparently represented by the callus extending up the spire; surface of the spire marked by numerous fine, thread-like, spiral lines, and by rather prominent, slightly curved transverse ribs, with a tendency to form blunt tubercles on the middle of the whorl, giving it a subangular appearance. The transverse ribs nearly or quite disappear from the back of the last whorl when it becomes carinate, and on the front aspect of the shell the sculpture is almost entirely concealed by the callus.

Height of the largest type specimen, with apex of spire restored, 27 mm.; greatest breadth, 21 mm.; breadth of last whorl, exclusive of wing, 11 mm.

In the general form of the aperture, the excessive thickening of the outer lip and the heavy deposits of callus, this little shell resembles some forms of Pugnellus, and in the preliminary examination of this collection it was referred to that genus. *Pugnellus manubriatus* Gabb,[1] on which the subgenus Gymnarus was based, especially resembles it in the form of the wing-like expansion of the outer lip and in the callus restricted to the front of the shell. On cleaning some specimens of the Patagonian species more thoroughly, however, it was found that the anterior canal is much shorter and straighter than in any species of Pugnellus, that it lacks the well-developed anterior notch or sinus and is not bent inward toward the aperture at the extremity, and the affinities of the species seem to be with Aporrhaidæ rather than Strombidæ. It is not a typical Aporrhais. It has many features in common with the recent *A. occidentalis* Beck, for which Gabb proposed the subgenus Arrhoges, though the heavy callus on the inner lip and spire and the greater development of an anterior canal prevent its reference to that subgenus. The peculiar rounded boss at the lower end of the callus is not duplicated in that position in any other Aporrhaid species known to me.

Locality and position.—Abundant in the Ammonite (Belgrano) beds, ten miles east of Lake Pueyrrydon. Represented in the collection by over 30 individuals, most of which are very imperfect.

APORRHAIS (?) sp.

A larger species, apparently belonging to the Aporrhaidæ, is represented by a single specimen consisting of four whorls of the spire from the locality four miles east of Lake Pueyrrydon. The whorls are convex and each

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[1] Palæont. of California, Vol. I, p. 125, pl. 29, fig. 229.

bears about fifteen prominent transverse costæ, crossed by numerous fine, thread-like, spiral lines. There is also a prominent spiral ridge, which is just covered by the succeeding whorl and below which the surface bears only the spiral lines. Species with similar form of whorl and sculpture are common in Anchura, Aporrhais and other genera of this family.

TORNATELLÆA PATAGONICA sp. nov.

Pl. VI, Figs. 18 and 19.

Shell of medium size, ovate, consisting of four or five rapidly increasing convex whorls, of which the last constitutes about five-sevenths of the total height; apex of spire obtuse, not prominent; aperture elongate, narrow above, rounded and apparently somewhat sinuous or emarginate below; outer lip slightly thickened and smooth within; inner lip forming a moderate callus and bearing two distinct folds, one of which is near the lower end and the other below the middle of the aperture; surface marked by rather coarse spiral furrows, of which there are about 25 on the last whorl.

Height of the larger specimen, 14 mm.; breadth, 10 mm.; height of aperture, 10 mm.; breadth of aperture, 4 mm.

The species is represented by only two specimens, both of which are figured. Similar forms have frequently been described as Actæon and Solidula, but according to Cossmann's[1] revised descriptions of those groups such forms should be referred to Conrad's genus Tornatellæa, which ranges from the lower Jura to the Miocene.

It should be stated, however, that the types of this species have the outer lip and lower part of the aperture broken and the generic reference is therefore not absolutely certain.

Locality and position.—From the Ammonite (Belgrano) beds, ten miles east of Lake Pueyrrydon.

CINULIA AUSTRALIS sp. nov.

Pl. VI, Figs. 16 and 17.

Shell small, subglobose, consisting of about four convex whorls, of which the last forms three-fourths of the total height; suture slightly impressed; surface marked by numerous inconspicuous, impressed, spiral lines (about

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[1] Essais de Paléoconchologie comparée, Liv. I, pp. 45–50, Paris, 1895.

30 on last whorl); aperture not perfectly preserved, but evidently entire and rounded below, with outer lip thickened and reflected, so as to form a smooth band two millimeters wide externally, and columella with two strong folds.

Height, 10 mm.; greatest breadth, 9 mm.; height of aperture, 7.5 mm.; breadth of aperture, 4 mm.

The type specimen is very well preserved, but the outer lip is broken, so that the form of the upper part of the aperture cannot be determined accurately, and it is not certain whether the inside of the outer lip is crenulated. There are two other imperfect specimens in the collection. Behrendsen[1] reports imperfectly preserved specimens of a Cinulia from the Neocomian at Arroyo Triuguico near its junction with the Rio Neuquen, but it is not possible to determine from his descriptive note whether they are identical with the present form or not.

Locality and position.—From the Ammonite (Belgrano) beds, ten miles east of Lake Pueyrrydon.

CEPHALOPODA.

Genus HATCHERICERAS gen. nov.

Shells attaining a large size, compressed, involute (the umbilicus usually forming about one-fifth of the diameter of the shell), with rounded venter and very slightly convex sides, which in the adult may be nearly or quite smooth, but in the young are marked by low, curved, branching ribs that sometimes tend to form tubercles around the umbilical margin and on either side of the venter. In the early stages the ribs cross the venter but later they are interrupted more or less distinctly there before they disappear from the flanks. The relatively narrow umbilicus is funnel-shaped, its slopes becoming smooth and somewhat concave in the later stages but the inner whorls have rounded margins on which the ends of the ribs are seen within the umbilicus.

Lobes and saddles of the suture not very complex, nor deeply incised, and characterized generally by their great breadth. The ventral lobe with

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[1] Zeitschr. deutsche geol. Gesellschaft, Bd. 44, 1892, p. 18.

its two robust branches on each side is almost as long as the first lateral lobe, which is irregularly tripartite and very broad at the base. The second lateral lobe is similar to the first, but very much smaller and more slender. There is only one well developed auxiliary lobe outside the umbilicus. (The details of the suture on the umbilical slopes have not been seen.) The siphonal saddle is oblong, rather broad, tripartite at the extremity and serrated on the sides in adult sutures. The other saddles are more or less distinctly bipartite but not symmetrically divided. The external and first lateral saddles have about the proportions of the first and second lateral lobes, respectively, and the second lateral saddle is relatively much broader and stouter than the first. The internal, or dorsal, portion of the suture has not been studied in the type species, but in *H. argentinense* the antisiphonal, or dorsal, lobe is slender, pointed and dentate and there are two rather simple, paired dorsal saddles of which the outer one is the broader.

The type is *Hatchericeras patagonense* sp. nov., described below.

The few ammonites collected by Mr. Hatcher in Patagonia have proved to be very interesting, and at the same time troublesome, in that they show features suggesting relationship with several described generic groups, while they do not possess all the essential characteristics of any one of them. It seems necessary, therefore, to state the facts, so far as they are determined, and to propose a new generic name for them. The forms thus grouped together, vary considerably in sculpture and general appearance, but in at least two of them, the type and *H. argentinense*, these differences are superficial only, and there is general agreement in all essential features. The other two forms, each represented by a single small specimen, are placed here with some doubt, for reasons that will be given in connection with the specific descriptions. In the generic comparisons that follow, the data for Hatchericeras are taken from *H. patagonense*, unless otherwise stated.

The adult in general form and surface has some resemblance to Haploceras, but the sutures are very different in all their details. In its smooth adult whorls, the amount of involution, the form of the umbilicus and, to a less extent, the character of the suture, it suggests *Ammonites cleon* d'Orbigny, which has been made the type of Cleoniceras by Parona and Bonarelli,[1] but is referred with the other members of the group to Desmo-

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[1] Palæontographia Italica, Vol. II, 1896, p. 83.

ceras by Sarasin,[1] who has thoroughly studied them more recently. The entire absence of periodic constrictions, and the reduced number and different form of the auxiliary lobes, in the species now referred to Hatchericeras, prevent their reference to Desmoceras.

Another group that suggests comparison, both in general form and in sutures, is that typified by the South Indian *Ammonites telinga* Stoliczka, for which Kossmat[2] proposed the name Neoptychites, but this is somewhat more involute than Hatchericeras, the whorls are more inflated, the aperture is greatly contracted laterally, and the sutures show many differences in details, especially in the proportions of the dorsal and external saddles, and the first lateral lobe and the form and posture of the accessory lobes and saddles. It is true that no examples showing the complete aperture of Hatchericeras have been seen, but one showing a small part of the body chamber gives no evidence of lateral contraction.

The suture of *Ammonites leopoldinus* d'Orbigny, which is generally referred to Hoplites, closely resembles that of *H. patagonense* and the general form of the adult shell is somewhat similar, though the sides are less convex, the umbilicus is broader and has not the funnel shape characteristic of Hatchericeras. Young shells show much greater differences in both form and sculpture, *Amm. leopoldinus* having a row of distinct elongated tubercles on either side of the somewhat flattened venter, obscure ribs that are not developed on the middle of the flanks ending abruptly at these tubercles, and another row of tubercles around the umbilical margin. The young of our new genus, which have been studied only in *H. argentinense*, do not have the venter distinctly flattened, nor bordered by well-developed tubercles elongated parallel with the venter. As to the similarity of the sutures, Sarasin, in the paper above cited, has called attention to the fact that similar sutures, suggesting a transition to Placenticeras, are developed in both Hoplites and Desmoceras, and that such resemblances in sutures do not necessarily mean generic identity. In this connection mention should be made of the striking general resemblance in the sutures of the Patagonian Ammonite and those of *Amm. clypeiformis* d'Orbigny, which is referred by most authors to

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[1] Quelques considérations sur les genres Hoplites, Sonneratia, Desmoceras et Puzosia. Bull. Soc. Géol. de France, 3d Sér., Vol. XXV, 1897, pp. 760–799.

[2] Untersuchungen über die südindische Kreideformation, Beiträge zur Paläont. und Geol. Österreich-Ungarns und des Orients, Bd. IX, p. 165, Wien, 1895.

Placenticeras, but is regarded by Kossmat as representing a distinct group related to his Neoptychites and also showing some affiliation with *Hoplites leopoldinus.* But, although there is also similarity in the amount of involution and in the form of the umbilicus, the differences in the general form of the shells, especially in the ventral region, and in the details of the sutures, show that the species referred to Hatchericeras are not congeneric with *Amm. clypeiformis.* The conclusion drawn from all these comparisons is that the Patagonian ammonites described herein have an assemblage of characters not found in any described group, and they are therefore assigned to a new genus, whose affinities are closest with the Hoplitidæ, though Hyatt's[1] definition of that restricted family is hardly broad enough to include it.

HATCHERICERAS PATAGONENSE sp. nov.

Pl. VIII, Figs. 1 and 2, Pl. IX, Fig. 1.

Shell large, involute, compressed, with very slightly convex sides that show an obscure flattening between the middle of the whorl and the umbilicus; venter regularly rounded; umbilicus about one fifth the diameter of the shell, funnelform, the shoulder broadly rounded and the umbilical wall of each whorl slightly impressed or concave in the middle; surface of adult whorls marked only by rather coarse irregular growth lines that are seen when the shell itself is preserved but leave no trace on the internal cast. These growth lines show slightly in the umbilicus and are most conspicuous on the middle of the flank, where they form rather coarse, slightly curved wrinkles that may indicate the position of a lateral ear or lappet, such as are frequently seen in Hoplites and other groups of ammonites. The figured type gives no indication of the sculpture of the young, as its umbilicus could be cleaned only enough to show about one and a half whorls, but the smaller specimen, showing about three whorls in the umbilicus, bears on the umbilical margin of the inner whorl the ends of rather distant prominent ribs (or a row of elongated tubercles) closely resembling those seen in the umbilicus of *H. tardense.*

The suture has been sufficiently characterized in the generic description and is figured natural size on plate IX. The other figures of the type specimen are one half natural size.

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[1] In Zittel's Text-book of Palæontology, Vol. I, pt. II, p. 584, Macmillan & Co., 1900.

There are only three specimens belonging to the species in the collection and they agree very closely except in size and state of preservation. Of the dimensions given below those under I belong to the figured type.

	I	II	III
Diameter	250 mm.	210 mm.	300 mm.
Umbilicus	53	45	± 62
Height of aperture	148	113	±175
Breadth of aperture	72	63	94

The comparisons with described species have already been suggested in the discussion of the genus. It seems remarkable that no young specimens of the species were collected and every small ammonite in the collection has been critically examined in the hope of finding the sculptured young of this form. The only one that at all suggests such an immature stage is the specimen described beyond as *H. tardense*, which shows similar sculpture in the umbilicus and even at the diameter of 74 mm. begins to show the disappearance of the ribs, especially on the venter and the umbilical wall, but the umbilicus is relatively broader and the sculpture seems too pronounced to permit its reference to this species.

Locality and position.—"Mouth of cañon four miles east of Lake Pueyrrydon; Ammonite (Belgrano) beds."

HATCHERICERAS ARGENTINENSE sp. nov.

Pl. IX, Figs. 2–5.

Shell of about the same form and proportions as *H. patagonense* but probably not attaining so great a size, the flattened band between the umbilicus and the middle of the whorl somewhat more distinct than in that species; venter regularly rounded, and smooth on mature whorls; umbilicus funnelform, nearly one-fourth the diameter of the shell, with rather narrowly rounded or subangular shoulder and smooth walls on adult whorls, but showing distinct, closely arranged ribs in the earlier stages; surface marked by rather prominent, closely arranged ribs, part of which begin in the umbilicus of young shells up to a diameter of 50 mm., but on later whorls originate on the umbilical shoulder, cross the sides in a gentle sigmoid curve and become swollen but not distinctly tuberculate near the rounded venter, where they are interrupted by a smooth band, except on young specimens of 8 to 10 mm. or less, when they continue across the venter; ribs in part simple, part branching once just before reaching the middle of the flank and part consisting of short ribs on the outer half of the whorl interpolated between the long ones.

Sutures having the same general characteristics as in the preceding species, with broad, not very deeply dissected, lobes and saddles. The forms and proportions of the several lobes and saddles are nearly the same in the two species, the principal difference being in the more complicated and deeper dissection of the suture in *H. patagonense*, but this difference is not as great as a comparison of the figures would indicate, because both the sutures of *H. argentinense* are taken from much smaller and less mature specimens than that of the other species, and the larger one is considerably weathered. There is only one auxiliary lobe visible on the flank, and the dorsal portion of the suture, as seen on a specimen about 20 mm. in diameter, shows a slender, pointed and dentate, antisiphonal lobe and two rather simple, paired dorsal saddles on either side.

Some variations in sculpture at different stages of growth have already been indicated and, as the sculpture shows a decided tendency to become less prominent on the larger specimens which are septate throughout, it is possible that the last whorls of fully adult specimens become smooth as in *H. patagonense*.

Young shells also differ greatly in form from the adult, the umbilicus being relatively larger (that is the shell less involute) and the whorls much more convex, so that in shells 10 mm. or less in diameter the breadth of the aperture is nearly or quite equal to the height, but these proportions change rapidly to those of the adult. The following measurements of four specimens indicate the normal proportions of the species and the change from youth to maturity. The measurements under I are from the largest specimen in the collection, which was too badly weathered for figuring; those under II and III from the specimens represented by figures 4 and 5 on plate IX; and those under IV from the inner whorls of a specimen that was broken down for the study of the early stages.

	I	II	III	IV
Diameter	128	122	48	10
Umbilicus	28	25	11.5	3
Height of aperture	68	65	23	4.8
Breadth of aperture	37	35	14	4.2

The close agreement in the sutures and in general form and proportion of the shell indicates rather near relationship with *Hatchericeras patagonense*, while the more pronounced and more persistent sculpture of this form serves to distinguish it specifically. Even if additional collections should prove that large old specimens become smooth, such specimens can be at once distinguished from *H. patagonense* by the finer, more closely arranged ribs on the earlier whorls, as shown in the umbilicus.

This species, especially in its immature stages, has many features in common with Hoplites and should probably be included in that genus as broadly defined in Zittel's Handbuch to include several diverse groups, but these resemblances are believed to indicate family relationship and the probable immediate ancestry of the new genus here proposed.

Localities and position.—One specimen (the largest collected) with the preceding species from the "mouth of cañon, four miles east of Lake Pueyrrydon" and about twelve more or less fragmentary specimens, mostly young, from "ten miles east of Lake Pueyrrydon," all from the Ammonite (Belgrano) beds.

HATCHERICERAS? TARDENSE sp. nov.

Pl. X, Figs. 3–5.

Shell rather small, compressed, moderately involute, the umbilicus measuring about one fourth the diameter of the shell; sides of the whorls slightly convex, venter regularly rounded, becoming smooth on mature whorls; surface marked by rather prominent and distant, slightly sinuous ribs, that mostly spring in twos and threes from well-marked tubercles on the rounded umbilical shoulder, with occasionally one or two shorter interpolated ribs between the groups of longer ones; ribs more prominent on the earlier whorls, where they cross the venter without interruption and tend to form tubercles on either side of it. The outer half of the last whorl of the type specimen shows a gradual weakening of the ribs and tubercles, the sculpture disappearing entirely from the venter and the umbilical slope near the aperture.

The suture drawn from the middle of the last volution is of the same type as in the two preceding species but somewhat less complex in its details, probably on account of immaturity of the specimen, which is small and septate throughout. (In the figure the inner part of the suture beyond the second lateral lobe is out of its normal position, on account of the fact that the draughtsman accidentally passed from the suture he was drawing to the succeeding one at that point.) The single type specimen measures 75 mm. in diameter; umbilicus, 19 mm.; height of aperture, 36 mm.; breadth of aperture, 22 mm.

The species is doubtfully referred to Hatchericeras on account of the general agreement in form and suture with the type of the genus, and the belief that the young of the type species may have had similar sculpture, as indicated by the fact that the tubercles or ends of ribs visible in the umbilicus of *H. patagonense* are very similar in appearance to the umbilical tubercles on the earlier whorls of the present form. The type of sculpture does not differ greatly from that of *H. argentinense* and the changes in the different stages of growth are in the same directions. The relative size of the umbilicus seems too large and the sculpture too pronounced to permit the identification of this specimen as a young individual of *H. patagonense*.

Like the preceding species, this form could probably be referred to Hoplites, in the broad sense in which that term has generally been used. It has some superficial resemblance to *H. desori* Pictet and Campiche, which Behrendsen has reported from the lower Cretaceous of the Argentine Republic, but it is more involute than that species, has a more rounded venter, the ribs are relatively coarser and more distant and the umbilical tubercles are not so pronounced.

Locality and position.—From the Ammonite (Belgrano) beds at mouth of cañon, four miles east of Lake Pueyrrydon.

HATCHERICERAS? PUEYRRYDONENSE sp. nov.

Pl. X, Figs. 1 and 2.

Shell small, of the general aspect of *H.? tardense*, but more involute, the umbilicus measuring not quite one fifth the diameter of the shell; venter rounded, but showing a tendency to be flattened in earlier stages; umbilicus with subangular shoulder bearing incipient tubercles that are visible on the inner whorls, the umbilical slope of the last whorl steep and smooth; surface marked by prominent, slightly sinuous ribs that branch near the middle of the flank and usually either branch again, or have interpolated between adjacent pairs a shorter branching rib, so that the number is about four times as great at the periphery as on the umbilical shoulder; ribs swollen on each side of the venter, which they cross without interruption in the early stages, but on part of the last whorl of the type specimen they broaden and become less conspicuous; surface also marked by numerous growth lines that curve strongly forward on the middle of the whorls; suture not visible.

Diameter, 53 mm.; umbilicus, 10 mm.; height of aperture, 28 mm.; breadth of aperture, 16 mm.

The species is based on a single small specimen which is evidently related to *H.? tardense*, but easily separable from it by its more involute form and the differences in the sculpture.

Locality and position.—Ammonite (Belgrano) beds at mouth of cañon, four miles east of Lake Pueyrrydon.

PRINCETON UNIVERSITY,
E. M. MUSEUM OF ARCHÆOLOGY AND GEOLOGY.
PRINCETON, N. J., March 1, 1901.

Sir:

I have the honor to transmit herewith the Report upon the Tertiary Invertebrates collected by the Princeton expeditions to Patagonia, under Mr. J. B. Hatcher.

The collection, being the largest ever made in Patagonia, is valuable not only from a palæontological, but also from a geological and zoögeographical point of view, and it has been possible to determine satisfactorily the age of these Tertiary beds, and to compare them with other deposits of the southern as well as the northern hemisphere.

This refers especially to what is called, in this report, the Patagonian formation, and we may say that we now possess in this marine series a standard for correlating any other marine Tertiary beds of the southern hemisphere.

Very respectfully, your obedient servant,
ARNOLD E. ORTMANN, PH.D.
Curator of Invertebrate Palæontology.

DR. W. B. SCOTT,
Professor of Geology,
Princeton University.

TERTIARY INVERTEBRATES.

BY

A. E. ORTMANN, Ph.D.

CONTENTS.

INTRODUCTION.

THE Tertiary Invertebrates collected by Mr. J. B. Hatcher in Patagonia come chiefly from the so-called Patagonian beds (including the Suprapatagonian beds of Ameghino), and from what should be regarded as the type-localities of these beds: the mouth of the Santa Cruz River, and the neighborhood of San Julian. Besides, there are smaller collections from deposits both below and above the Patagonian beds, especially from marine horizons first discovered by Mr. Hatcher, which have been called "Magellanian" and "Cape Fairweather" beds respectively.

In order to give the most accurate indication of the localities that have yielded the fossils I shall point out here the position of the different places mentioned in the text, and shall refer the reader to the map of southern Patagonia published by Hatcher (1900 a, pl. 1), where most of the localities are indicated.[1]

1. *Mouth of Santa Cruz River;* situated at about 50° S. L. on the eastern coast of Patagonia; bluffs on the south side of the river, from water's edge to about 250′ above high tide. (See description of locality by Hatcher, 1900 b, p. 264.)
2. *Pescadores;* a little below Las Salinas (see below), on the Santa Cruz River; ca. 50′ above high tide.
3. *Paso del Rio Santa Cruz;* 2 miles above Las Salinas, at about high tide level.
4. *Las Salinas;* 30 miles above the mouth of the Santa Cruz River; ca. 200′ above high tide.
5. *Mount of Observation;* ca. 50 miles S. W. of Santa Cruz, on the eastern coast of Patagonia.
6. *San Julian, Oven Point;* ca. 50 miles N. E. of Santa Cruz.
7. *San Julian, Darwin Station;* ca. 10 miles to the south of the latter locality.

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[1] The geographical location of "Jegua quemada," "La Cueva," and "Jack Harvey," given frequently by v. Ihering (according to Ameghino) for Patagonian fossils is unknown. Mr. Hatcher has tried to ascertain their situation, but failed to do so.

8. *Port of Deseado* (Port Desire); on the eastern coast of Patagonia at about 48° S. L.

9. *Port Madryn;* New Bay, on the coast of the territory of Chubut.

10. *Shore of Salt Lake;* 10 miles north of the mouth of the Rio Chico (northern tributary of Rio Santa Cruz).

11. *Upper Rio Chalia;* foothills of the Cordilleras; Rio Chalia = Rio Shehuen, South branch of Rio Chico.

12. *30 miles north of Rio Chalia;* with reference to locality 11.

13. *Cañon near Sierra Oveja;* on the Rio Chico, at about 70° W. L.

14. *Shell Gap;* on upper Rio Chico, foothills of the Cordilleras.

15. *Mayer Basin;* west of latter locality, in the Cordilleras.

16. *Arroyo Gio;* called "Basalt Cañon" in Hatcher's map; near Lake Gio (east of Lake Pueyrredon).

17. *Lake Pueyrredon;* in the Cordilleras, west of latter locality. Most of the fossils are from the "Rio Tarde Section" described by Hatcher (1900 a, p. 89, 100).

18. *Punta Arenas;* on the banks of the Rio de las Minas at Punta Arenas, Straits of Magellan; section described by the present writer (1898, p. 478 ff.).

All these localities display Patagonian beds; the last one is also the type-locality for the Magellanian beds.

The Cape Fairweather beds were first observed by Mr. Hatcher at *Cape Fairweather*, Port Gallegos, at ca. 51½° S. L. on the eastern coast of Patagonia (see Hatcher, 1897, a). Apparently contemporaneous deposits have been found at *San Julian*, *Darwin Station*, and at *Lake Pueyrredon.*

In the following pages I shall give first a systematic account of all the fossil species represented in Mr. Hatcher's collections. As will be seen, these collections—although not all of the species previously recorded from Patagonia are represented—are by far the largest ever made in that region. The richness of the material has enabled the writer to study some of the forms more closely, and thus it is not surprising that in some cases his systematic views do not fully agree with those of previous authors. But I trust that all changes introduced here are well supported: in most of the cases referred to, formerly distinct species have been united, and such cases are most apt to be found when a large material for comparison is at hand.

The systematic part is followed by chapters on the Patagonian, Magellanian, and Cape Fairweather faunas in general, discussing their palæontological characters, their geological age, correlations, physical features, and conditions under which the respective beds were deposited, as far as the material permits any conclusions in these respects. In this general part, several stratigraphical observations of Mr. Hatcher have been anticipated, which properly belong in the geological part of this work. But since the stratigraphical evidence is absolutely necessary for the correct understanding of the palæontological facts, Mr. Hatcher has kindly furnished all the pertinent data, and permitted their use by the writer. It is hardly necessary to say that the credit for all stratigraphical observations is to be given to Mr. Hatcher, and the writer is satisfied that they are entirely trustworthy, since they agree admirably with the palæontological facts, and sufficiently explain them.

In regard to the identification of species, I am greatly indebted to Dr. H. von Ihering of São Paulo, Brazil. He not only gave his opinion in doubtful cases submitted to him, but sent to the Princeton Museum a collection of Patagonian as well as Entrerios fossils, which aided me materially in the correct identification of our material. It is only proper to express also in this place my thanks for this valuable assistance.

In the systematic arrangement, I shall follow Zittel's Palæontology (1880 and 1885), but for the Mollusca I shall use the English edition of this work (Dall and Pilsbry, 1900). I regret very much that the latter did not come into my hands before the figures for the plates were drawn and sent to the printer, and this explains the fact that the arrangement of the species on the plates is different from that in the text. But I think this will prove to be only a slight inconvenience, and will certainly be counterbalanced by the improvement in the systematic part of the text.

SYSTEMATIC PART.

ECHINODERMATA.

ECHINOIDEA.

Fam. *CIDARIDÆ* Wright.

Gen. CIDARIS Klein.

1. CIDARIS ANTARCTICA Ortmann.

Pl. XI, Fig. 1^{a-d}.

1900 *Cidaris antarctica* Ortmann, in: Amer. Journ. Sci., v. 10, p. 369.

Only isolated interambulacral plates and spines.

Plates with a moderately large, perforated central tubercle, the neck of which is slightly and indistinctly crenulated. Scrobicule large, surrounded by a circle of small tubercles, between which there are, irregularly scattered, still smaller ones. *Spines* subcylindrical, mostly slightly compressed, so as to render the cross section elliptic; neck somewhat constricted. For the rest, the different fragments are of about the same thickness throughout their length. Articular surface conical, finely striated, with a deep articular groove. Surface of spines closely covered with fine, rounded granules, forming irregular longitudinal rows. The granules are evenly developed all around the spine: but there are four spines from Lake Pueyrredon, which show larger, irregular, conical, subspiniform tubercles; in two of them these tubercles are found only on one side of the spine.

Record of specimens: Mouth of Santa Cruz River, 8 spines; San Julian, Oven Point, 1 spine, 1 plate; San Julian, Darwin Station, 3 spines; 30 miles north of Rio Chalia, 4 spines, 5 plates; Lake Pueyrredon, base of Tertiary, 17 spines, 3 plates.

Affinities: Similar spines are known in *Cid. avenionensis* Desm. (Miocene of France and Switzerland, see: Loriol, 1875, p. 15, pl. 1, f. 8–13, especially Figs. 10, 11, 13), but these differ in the necks not being constricted, and in the granules being less developed on one side of the spine. In none of our specimens is a cup-like expansion of the distal end of the spine to be seen.

Spines of *Cidaris* from the upper Cretaceous (*C. dissimilis* Forb., *sceptrifera* Mant., *perornata* Forb.) show some resemblance to our species, but they differ in the granules being larger, more remote, and forming more distinct rows. Also the general form is different, the cross section being round, and the spines being not regularly cylindrical, but more or less swollen near the base.

Fam. *ECHINIDÆ* Wright.

Gen. HYPECHINUS Des.

2. Hypechinus patagonensis (d'Orbigny).

Pl. XI, Fig. 2.

1842 *Echinus patagonensis* d'Orbigny, Voy. Amer. merid., v. 3, part 4, p. 135, pl. 6, f. 14–16.
1846 *E. p.* Agassiz and Desor, in: Ann. Sci. nat. ser. 3, v. 6, p. 370.
1858 *Hypechinus pat.* Desor, Synops. Ech. foss., p. 130, pl. 18, f. 4.

Test suborbicular, slightly subpentagonal, rather elevated. Interambulacral space with two vertical rows of primary tubercles, which are very prominent and distinct, differing considerably in size from the other tubercles. The latter (the secondaries) are small, numerous and unequal, irregularly scattered over each plate. Ambulacral spaces also with two vertical rows of tubercles, which, on the abactinal side of the test, are much smaller than those of the interambulacra, while, on the actinal side, they are about as large as those of the interambulacra. Poriferous zone of ambulacra narrow, pores arranged in arcs of three pairs on each plate; plates very high, and pores quite remote from each other. On the abactinal system the madreporic plate is a little larger than the genital plates. Genital openings large, near the triangular point of the plate. Genital plates and madreporic plate with small secondary tubercles near the anal edge. All ocular plates separated from the anal system by the genital plates.

Diameter of our specimen: 30 mm.

Remarks: Our single specimen is very badly crushed on the under side, but fortunately there are preserved a number of spines: these are short, thin and sharply acuminate, with fine longitudinal striations. The form of the actinostome is unknown.

Hyp. patagonicus (sic!) mentioned by v. Ihering (1897 a, p. 336) apparently does not belong to this species, since he says that individuals from the Bay of San Jorge in his possession differ in the number of tubercles in the interambulacra. Possibly they belong to the next species.

Record of specimens: San Julian, Darwin Station, 1 sp.

Distribution:[1] So far only known from San Julian (d'Orb.).

Affinities: The chief character of this genus is found (according to Desor) in the primary tubercles of the ambulacra, which are, on the actinal side, about as large as those of the interambulacra, but decrease rapidly in size toward the abactinal system, becoming much smaller than the latter. Although this character does not seem to warrant the generic separation of this species from *Echinus*, it is not observed in any other species, and so it is impossible to point out any particular relations to any known species of *Echinus*.

Gen. TOXOPNEUSTES Ag.

3. TOXOPNEUSTES PRÆCURSOR Ortmann.

Pl. XI, Fig. $3^{a,\,b}$.

? 1897 *Hypechinus patagonicus* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 336 (non *H. patagonensis* d'Orb.).

1900 *Toxopneustes præcursor* Ortmann, in: Amer. Journ. Sci., v. 10, p. 369.

Test suborbicular, slightly subpentagonal, subconical. Ambulacral and interambulacral spaces with 4–8 vertical rows of tubercles, of subequal size, those of the ambulacral spaces being a little smaller. Poriferous zone moderately broad, about half as broad as the median part of the ambulacrum. The latter with 4 vertical rows of tubercles, the two outermost the largest, and only these extending to the abactinal system. Pores in three pairs, the two outer vertical rows of pores placed slightly closer together, and separated from the inner row by a small tubercle, these

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[1] Under this head I shall give the data of distribution *previously* reported.

tubercles forming a vertical row of secondaries outside of the main row of the ambulacrum. Interambulacral space with 6 vertical rows of subequal tubercles, to which are added, on the ambitus, two irregular vertical median rows of smaller tubercles. Of these six rows the outer and inner ones disappear toward the abactinal system. All the tubercles, in both the ambulacra and interambulacra, are surrounded by small secondaries and miliaries. The median space of the interambulacra appears comparatively smooth toward the abactinal system (as is the case in the recent species of the genus). Abactinal system unknown. Actinostome sunken, and lower surface concave; the actinal cuts are comparatively slight.

Diameter, 48; height, 25 mm.
Diameter, 17; height, 9 mm.

Remarks: The large number of vertical rows of tubercles in the interambulacral spaces places this species with the genus *Toxopneustes.* The cuts of the actinostome are but slightly developed, but these vary considerably even in the recent species (see: Agassiz, 1873, p. 498).

Record of specimens: San Julian, Oven Poin, 3 sp.; Shell Gap, lower horizon, 3 sp.

Distribution: v. Ihering's specimens from the bay of S. Jorge, recorded by him under the name of *Hypechinus patagonicus*, may perhaps belong to this species.

Affinities: This genus has not been recorded previously as a fossil one, except from subrecent deposits. The present species differs from the recent species in the larger number of vertical rows of tubercles in the ambulacra, which are much more crowded, and in the shallower cuts of the actinostome. The most closely allied species seems to be *T. pileolus* (Lmck.) from the tropical Pacific (see: Agassiz, 1873, p. 497, pl. 8b, f. 1, 2).

I have compared two young individuals of a *Toxopneustes*, without locality, in the Princeton Museum: they seem to belong to *T. pileolus.* These, being of about the same size as the best preserved individual of our fossil material, differ only in having 6 vertical rows of tubercles in the interambulacra, and in the tubercles being a little smaller and not so much crowded. The cuts of the actinostome are only slightly narrower and deeper in these recent specimens than in our fossil species.

Fam. *CLYPEASTRIDÆ* Ag.

Gen. SCUTELLA Lmck.

4. Scutella patagonensis Desor.

Pl. XI, Fig. 4^{a-e}.

1846 *Scutella patagonensis* Desor, in: Bull. Soc. geol. France, ser. 2, v. 4, 287.
1846 *Echinarachnius juliensis* Desor, ibid.
1847 *Scut. pat.* and *Ech. jul.* Agassiz and Desor, in: Ann. Sci. nat. ser. 3, v. 6, p. 135 and 134.
1858 *Scut. pat.* and *Ech. jul.* Desor, Synops. Ech. foss., p. 234 and 231.
1897 *Scut. pat.* and *Ech. jul.* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 337 and 336.
1898 *Iheringia patagonensis* Lahille, in: Rev. Mus. La Plata, v. 8, p. 437, pl. 1 and 2.

Test depressed, margin thin. Outline circular, oval, subpentagonal, or more or less transversely dilated (alate), sometimes almost semi-circular, with the posterior margin truncated. Margins often undulated and the posterior one with a more or less distinct median incision. Apex subcentral. Ambulacral petals of uniform size, lanceolate, more or less open, sometimes lyrate, with a few scattered pores diverging from the extremity of the petals. Interambulacral plates of upper side increasing in width from the apical system to near the end of the petals; then they decrease suddenly in width, so that the interambulacral space narrows considerably toward the periphery. On the periphery the interambulacral space is considerably less broad than the ambulacral space. Ambulacral furrows of lower side dividing into two branches at a short distance from the mouth, each branch subdividing again near the periphery of the test into 2 to 4 branchlets. Anus submarginal, distant from the posterior edge of the test about 1–2 times its diameter (in young individuals it is marginal, with a slight inclination toward the lower surface).

Diameter of largest complete individual of rounded form: 62 mm; of a fragment: 70 mm; alate form: longitudinal diameter: 76, transverse diameter, 94 mm.

Remarks: The two forms of Scutellids, described as two different species belonging to the genera *Echinarachnius* and *Scutella* respectively, have been united by Lahille in his monograph on these forms into one species, for which he creates the new genus *Iheringia*. This generic name, being preoccupied by Keyserling in 1891, has been changed by Berg (1898, p. 16) into *Iheringiella* (non *Iheringella* Pilsbry, 1893), and again into *Iheringiana* (Berg, 1898, p. 41), and finally Lahille himself (1899, p. 5 of separate copy) has changed it into *Iheringina*.

After a careful study of our rich material I am prepared to accept Lahille's view as to the identity of these supposed two species, as well as his views on the respective value of the genera *Echinarachnius* and *Scutella*, but I do not think that the Patagonian fossil ought to be placed in a separate genus (*Iheringia* = *Iheringiana* Berg); I prefer to leave it with the genus *Scutella*.

In discussing the differences of *Echinarachnius* and *Scutella*, Lahille has overlooked the fact that A. Agassiz (1872, p. 315) has given a character, by which the *subgenus Echinarachnius* may be distinguished from the true *Scutella*, viz., the arrangement of the pillars in the interior of the test. In *Echinarachnius* (as well as in *Dendraster* and *Scaphechinus*) the pillars are more or less concentric with the edge of the test, while in *Scutella* they recall more the stellate arrangement of *Mellita*. This is said to be the *only* ground on which *Echinarachnius* might be separated from *Scutella*. I have tried to verify this character, but did not meet with much success. Failing to find any good figures representing the interior of the test of *Scutella*, I have compared that of *Mellita* as given by Agassiz (1872, pl. 12a, f. 1–4) with those of the interior of *Echinarachinus* (Agassiz, pl. 13a and 11d, f. 45) and of *Iheringia* (Lahille, 1898, pl. 2, f. 11, 12), and do not find any essential differences, except that in *Mellita* this system of pillars is more complex, but it shows nevertheless distinctly a concentric arrangement near the edge (especially fig. 4 on pl. 12a of Agassiz). As to *Scutella*, I have chiefly compared the account and figures of *Scut. subrotunda* given by Quenstedt (1875, p. 544, pl. 83, f. 2, 4), and also do not find any differences from *Echinarachnius;* indeed, the different sections given by Quenstedt in fig. 4 render it beyond doubt that the concentric arrangement of the pillars in *Scutella* agrees with that of *Echinarachnius*.

Thus it appears that even this character does not permit a separation of *Echinarachnius* from *Scutella*, both genera (or subgenera) being practically identical; all the characters given as distinctive (outline, ambulacral furrows of lower side, position of anus, shape of ambulacral petals) are only of specific value.

As to the genus *Iheringia* = *Iheringiana*, there remains only a single character, by which it may be recognized: the considerable narrowing of the interambulacral spaces toward the margin of the test (see Lahille's generic diagnosis on p. 14). It is true, this character distinguishes the Patagonian fossil from all the known forms of *Echinarachnius* as well as *Scutella*. Nevertheless I do not believe that it is of generic value, since this narrowing of the interambulacra is exhibited by several other species, only in a less pronounced way. Especially this is true of *Echinarachnius parma* of the Atlantic coast of the United States, of which I have several hundred individuals at my disposal. Since this decrease of width of the interambulacra is brought about by an increase of width of the ambulacra, and the latter is shown in *all* species of *Scutella* and *Echinarachnius*, we may put it this way, that in *Scutella* the ambulacral plates increase suddenly in width from the end of the petals toward the margin, and in the Patagonian form this increase is most pronounced, so as to render the interambulacra very narrow on the margin, while in other species this increase goes only so far as to keep the interambulacra at the same width from the end of the petals to the margin. Sometimes it causes even a slight decrease in width: I have found a slight narrowing of the interambulacra in *Ech. parma*, *Ech. excentricus* (California), and very slightly in specimens of *Scut. interlineata* Stps. (Gabb, 1869, p. 110) from the Pliocene beds of California.

Lahille compares in this respect *Iheringia* with *Monophora*, and says (p. 6 of separate copy) that in both this star-like form of the five interambulacra, with five sharp points of the pentagram, is very striking. But comparing his figures of *Monophora* (Lahille, 1896, pl. 1–4, especially pl. 3, f. 36), there is no such close resemblance, *Monophora* being like *Ech. parma* in this respect. I was able to confirm this fact by comparison of an individual of *Monophora darwini* from the Territory of Chubut, sent to us by v. Ihering.

As Lahille points out, there can be distinguished, in *Scutella patagonica*, two series of forms, one more regularly circular in outline ("mode rotundatus"), the other more dilated and transverse ("mode alatus"). Our material also shows these two series, and I should like to make a few remarks on them.

We possess altogether 87 individuals, in which the outline is distinctly recognizable. Out of this number only about 16 may be said to belong to the "alate" form, and of these only the six largest (over 55 mm long) show this character distinctly developed. In the young ones the alate form is brought about chiefly by a comparative narrowing of the anterior end, not by an increase of the width as compared with the longitudinal diameter, although such forms are always a few millimeters broader than long. Thus, in very young individuals, the alate and rotundate forms are not so very strikingly different from each other, and, indeed, in some cases it is hard to say whether a particular individual should be classed with the one or the other. With increasing age this difference becomes more striking, and at an average length of about 50–55 mm both forms may be easily distinguished at a glance. The form "rotundatus" in young specimens is distinctly pentagonal, and also the young of "alatus" are irregularly pentagonal. But the pentagonal shape disappears with age, becoming sometimes "cordiform," when there is a posterior median emargination.

The rotundate form never attains the size of the alate. Lahille's largest rotundatus is 65 mm long, 67 mm broad. We have a fragment, apparently belonging to the rotundate form, that has a diameter of 70 mm, while the largest complete individual is only 62 mm in diameter. Some of our alate specimens are very much larger than Lahille's (his largest is 66 by 72). I give here the measurements of our six largest individuals:

Long Diameter.	Transverse Diameter.	Locality.
56	68	Lake Pueyrredon
59	65	Shell Gap
62	75	Salt Lake
64	ca. 71	Salt Lake
76	94	Salt Lake
81	89	Lake Pueyrredon

These measurements show that the relation between length and width is extremely variable, some of our specimens being much more alate than any of Lahille's.

As to the meaning of the existence of two such forms (rotundatus and alatus) within this species, I can only refer to Lahille's opinion: he compares this fact with the analogous case in *Monophora*, in which he believes (1896, p. 10), that these forms represent the *female* (rotundatus) and the *male* (alatus) of the same species. I cannot offer any further evidence for this theory, with only the exception, that the fact that the alate or male form is more frequent and most pronounced in the largest individuals, seems to furnish some support for this assumption. On the other hand, the comparatively much rarer occurrence of the alate form does not favor this view, since it is hard to believe that males were so very much less in number than females, that even in some localities they have not been found at all. The actually small number of the alate individuals in our collection is not accidental, since Mr. Hatcher informs me that he has picked up every single one that he found, and that it is really very rare as compared with the rotundate form. The final settlement of this question depends on the demonstration, that in other Scutellids the male and female sexes show analogous differences in form. In this respect I may point out here a case I have noticed: Bazin (1884, p. 38, pl. 2, f. 1–5) describes from the Miocene beds of Saint Juvat, Bretagne, two species of *Scutella*, *S. faujasi* Defr. and *S. circularis* Baz. The latter differs from the former just in these two characters, more circular form and smaller size, and perhaps *S. circularis* is nothing but the female of *S. faujasi*. The same may be the case in *S. subtetragona* Grat. and *S. striatula* M. de S. (see Agassiz and Desor).

Our young individuals show a position of the anus that has not been observed before. It is distinctly marginal. Although lying on the lower side of the test, its posterior margin coincides with the posterior margin of the test. This condition prevails in all (seven) of our specimens of less than 27 mm length; the first two that show the anus a little distant from the margin (¼ or ½ its diameter) are 28 mm in length, but again in 4 specimens of 29, 29, 32, and 34 mm in length the same marginal position is to be seen. From 35 mm in length upward the anus is always removed from the margin, and the distance increases slightly with age, although there are variations. The smallest specimen in which it is distant its own diameter is 36 mm long, the smallest in which it is distant twice its diameter is 57 mm. In the largest the distance varies from one-half to twice its diameter.

Record of specimens: San Julian, Oven Point; 20 sp., 9 of which are young, 1 of them showing traces of the alate form, the rest are rotundate. Shore of Salt Lake; 9 sp., 5 young ones show traces of the alate form, of the rest 1 is rotundatus, the rest alatus. Upper Rio Chalia; 18 more or less complete specimens, numerous fragments. 1 of medium size is slightly alate, the rest rotundate. Thirty miles north of Rio Chalia; 6 sp., all rotundate. Shell Gap, upper horizon; 7 sp., 3 small, 1 large, are alate, the rest rotundate. Lake Pueyrredon, base; 27 sp., 3 of them (1 medium, 2 large) are alate, the rest is rotundate.

Distribution: San Julian (Des., v. Ih., Lah.); Port Desire, coll. by Darwin (Des.). Darwin (1846) does not mention a *Scutella* from Port Desire, but mentions two forms (p. 110 and 112) from New Bay and San Julian. But the occurrence of this species at Port Desire is confirmed by Lahille. Jegua quemada (v. Ih.); Lake Buenos Aires (Lah.).

v. Ihering gives for *Echinarachnius* the Patagonian formation, for *Scutella* the Suprapatagonian; but, according to our material, both are found associated in the same beds.

Affinities: The most closely allied form among the recent species is *Echinarachnius mirabilis* (Barn.) from Japan (Agassiz, 1873, p. 526, pl. 13a, f. 5, 6); it resembles closely the rotundate form, but the anus is marginal, and the interambulacra are broader. The alate form resembles much the Miocene *Scutellæ* of Europe, especially *S. subrotunda* Lmck. from the lower Miocene of Bordeaux (Agassiz, 1841, p. 76, pl. 17).

The presence of this *Scutella* in the Patagonian beds points strongly to their Neogene age.

Fam. *CASSIDULIDÆ* Ag.

Gen. CYRTOMA McCl.

5. Cyrtoma posthumum Ortmann.

Pl. XII, Fig. $1^{a,b}$.

1900 *Cyrtoma posthumum* Ortmann, in: Amer. Journ. Sci., v. 10, p. 369.

Test subcircular-elliptic. Apex central. Upper side much depressed, only slightly convex, covered with very fine and crowded tubercles. Ambulacra petaloid, open, lanceolate, subequal, extending about two-thirds from the apex toward the periphery, the two posterior ones are closer together than the others. Pores jugate. Anus situated on the upper surface, in a deep depression, which commences about half way between the apex and the posterior extremity by a narrow slit, widening suddenly toward the margin and giving the anal depression a pyriform shape. Lower surface of the test concave, covered with larger, more distant and somewhat irregular tubercles, a comparatively smooth band running from the mouth toward the posterior periphery. Mouth opening subcentral, surrounded by a floscelle.

Diameter about 110 mm. Height about 28 mm.

Remarks: All three specimens are imbedded in a hard, reddish, coarse grained sandstone, and are poorly preserved, which refers especially to the apical system, the details of the ambulacra, and the mouth. The anal depression, however, is seen in all three individuals, and forms the most striking character of the genus *Cyrtoma* of McClelland (1840, p. 185), although the original diagnosis of the genus does not bring out this character sufficiently. It runs thus: "Disc oval and thin, arched to the apex; ambulacra petaloid, and either broad and flat, or more elevated, and placed on narrow ridges radiating from the apex to the disc. The two posterior ambulacra are closer together than the others, with an intermediate dorsal ridge leading to a dentate anus, and a depression or hollow between the latter and the disc. Inferior surface flat, mouth small and central, with five clavate ambulacra prolonged to margin."

It would be impossible to recognize the genus from this diagnosis; but the figures given by McClelland clearly establish its position with reference to the genera *Echinobrissus*, *Cassidulus*, etc., and there is no doubt, that it is identical (see Zittel, 1880, p. 529) with *Stigmatopygus* of d'Orbigny (1860, p. 331). According to d'Orbigny this genus comes near *Cassidulus*, and differs chiefly in the peculiar shape of the anal depression. Desor (1858, p. 296) compares it with *Echinanthus*. Of the floscelle surrounding the mouth a few traces are preserved in one of our specimens.

Record of specimens: Lake Pueyrredon, base; 3 sp.

Affinities: The genus *Cyrtoma* (= *Stigmatopygus*) is known from the Cherra Poonji beds of British India (Assam Range), which are evidently of the age of the Arialur group (Senonian) of southern India, where the genus has also been found (see: Medlicott and Blanford, 1879, part 1, p. 280, ff., and part 2, p. 688, f., and Stoliczka, 1873, p. 27). It has also been found (*Stigmatopygus*) in the upper Cretaceous (Senonian) of France (Angoulême). Our species from the Tertiary beds of Patagonia extends considerably the range of this genus in time. It differs at the first glance from all the known species in the much more depressed test, and in the lack of a ridge between the apex and the anal depression. The discovery of this genus, so far belonging exclusively to the upper Cretaceous, is one of the most important palæontological results of Mr. Hatcher's explorations in Patagonia.

Fam. *SPATANGIDÆ* Ag.

Gen. SCHIZASTER Ag.

2. Schizaster ameghinoi v. Ihering.

Pl. XIII, Fig. $1^{a,b}$.

1897 *Schizaster ameghinoi* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 338.

Test moderately depressed (our specimens have suffered from pressure and are distorted in different directions), highest in the posterior part, back of the apical system, where it is raised to a distinct longitudinal carina between the posterior ambulacra. Outline cordiform, with a deep notch anteriorly. Apex situated back of the middle of the upper surface. Anus in the upper part of the truncated and vertical posterior extremity. The anterior ambulacrum in a deep groove, the margins of which are quite distinct, but rounded, and run almost parallel toward the anterior edge of the test. The sides of the groove are oblique and concave. Pores of the anterior ambulacrum regular, those of each pair separated by tubercles, which form two rows in the groove. Anterior and posterior lateral ambulacra distinctly sunken; the two anterior curved, first running close to the anterior ambulacrum, then diverging. Posterior lateral ambulacra very short, hardly one-third as long as the anterior lateral ones. Peripetalous fasciole forming a sharp, almost rectangular, re-entering angle in the posterior lateral interambulacral space, and forming also a re-entering angle in the anterior lateral interambulacral space.

Length, 56 mm; width, 51 mm; height, 29 mm; but growing much larger as indicated by fragments.

Remarks: The description given by v. Ihering is entirely insufficient to recognize this species; but since no other species of the genus is known from Patagonia, it is perfectly safe to assume that we have to deal with this species.

Record of specimens: Mouth of Santa Cruz River, 2 sp.; Paso del Rio Santa Cruz, 3 sp.; San Julian, Oven Point, fragments of 2 specimens, imbedded in matrix.

Distribution: Gulf of San Jorge (v. Ih.).

Affinities: Micraster atacamensis and *valdivianus* of Philippi (1887, p. 231, pl. 52, f. 2, 3), the first from the Pliocene Coquimbo beds of Chile, the second from the Navidad beds, belong apparently to *Schizaster*. *S.*

atacamensis is very much higher than our species, and the vertex is produced over the anus. *S. valdivianus* comes nearer to our species, but the anterior ambulacrum is said to be in a *shallow* groove, it is more narrowed anteriorly, and the outline of the test is broader. It is hard to say whether there is any closer relation to other fossil species.

VERMES.

CHAETOPODA.

TUBICOLÆ (SEDENTARIA).

Gen. SERPULA L.

7. SERPULA PATAGONICA Ortmann.

Pl. XIII, Fig. 2.

1900 *Serpula patagonica* Ortmann, in: Amer. Journ. Sci., v. 10, p. 369.

Tubes solid, calcareous, cylindrical, irregularly contorted and vermiculate, growing upon shells, stones, etc. Outer surface transversely rugose. Diameter: up to 3 mm.

Remarks: I did not try to compare this species with any of the known forms, since the characteristic features of these tubes are so very few, that it is impossible to say whether it is a good species or not. It agrees well with the short diagnosis given by Philippi (1887, p. 217) for *S. colchaguensis* from Navidad, but without material for comparison it is hard to tell whether it is identical or not. It has been mentioned here only for the sake of completeness.

Record of specimens: San Julian, Oven Point; 5 large colonies, chiefly on *Pecten geminatus*. San Julian, Darwin Station; 1 colony, on a stone.

Gen. TEREBELLA Cuv.

8. TEREBELLA MAGNA Ortmann.

Pl. XI, Fig. $5^{a, b}$.

1900 *Terebella magna* Ortmann, in: Amer. Journ. Sci., v. 10, p. 370.

Large, cylindrical tubes, isolated or growing in groups of two or three, straight or slightly and irregularly curved. Walls composed of large and irregular fragments of shells, Balanids, etc. Inner surface of tubes smooth, outer surface very rough. Length of largest fragment, 145 mm, diameter of inner tube (without wall), 12–13 mm.

Remarks: We may safely assume that these large and curious tubes have been built by a worm, but we do not have the slightest indication as to its systematic position. I place our species with the genus *Terebella*, because this is the only fossil one known that builds its tubes by gluing together fragments of shells, sand, etc. (see Zittel, 1880, p. 564). The chief characteristics of these tubes are their large size and the large size of the shell-fragments used for their make-up. They will be easily recognized from the description and figure given here.

Record of specimens: San Julian, Oven Point; 14 fragments.

BRYOZOA.

CHILOSTOMATA.

Fam. *CELLARIIDÆ* Hcks.

Gen. CELLARIA Lamx.

9. CELLARIA FISTULOSA (Linnæus).

Pl. XI, Fig. $6^{a,b}$.

1964 *Salicornaria marginata* Stoliczka, in: Novara Exp. Geol., v. 1, p. 150, pl. 20, f. 11–13.

1880 *Cellaria fistulosa* Hincks, Hist. Brit. mar. Polyz., p. 106, pl. 13, f. 1–4 (et synonyma).

1900 *Cell. fist.* Ortmann, in: Amer. Journ. Sci., v. 10, p. 378.

Zoarium dichotomously branched, articulate, internodes of moderate length, slender, subcylindrical. Zoœcia lozenge-shaped, a little longer than broad, contiguous in the same longitudinal row. Orifice arched above, lower lip curved inward, subcentral (situated about in the middle of the zoœcium). Ovarian opening (special pore) subcircular, situated in the upper part of the zoœcium, in the upper angle of the rhombus.

Remarks: I follow Hincks in the identification of this species, although there is some doubt whether the fossil form described by Stoliczka from New Zealand is really identical with this cosmopolitan recent species.

Our Patagonian specimens agree very well with the New Zealandian fossil, but they differ—as well as the latter—from the recent *C. fistulosa* in the absence of avicularia on the top of the cells. The ankylosis of the joints found sometimes in the recent form, and described by Stoliczka in the fossil form, is also exhibited in a few fragments of the Patagonian fossil.

Our material is comparatively poor, consisting of a mass of fragments found in a small piece of rock. The structure of the surface is much obscured, only a few fragments showing the form of the cells with sufficient clearness. The form of the ovarian opening (which has sometimes a small tooth, according to Stoliczka) cannot be made out satisfactorily.

Record of specimens: Shell Gap, lower horizon; numerous fragments.

Distribution: Living, almost cosmopolitan (see Hincks). Fossil: Oligocene, Miocene, and Pliocene of Europe (see Stoliczka and Hincks); Miocene of the Orakei Bay, New Zealand (Stoliczka and Hutton, 1885 a, p. 209).

Affinities: If this is really the living species *C. fistulosa*, its range in time is from the Oligocene to the Recent times. But, as has been said above, our Patagonian form resembles more the New Zealandian Miocene form called by Stoliczka *Salicornaria marginata* Münster.

Gen. MELICERITA M.-E.

10. Melicerita triforis Ortmann.

Pl. XIII, Fig. $3^{a,b}$.

1900 *Melicerita triforis* Ortmann, in: Amer. Journ. Sci., v. 10, p. 370.

Zoarium foliaceous, lobate. Zoœcia hexagonal, with a raised border, disposed quincuncially on both surfaces of the zoarium. Each zoœcium about as long as broad. Orifice transverse, crescentic, large, situated about in the middle of the cell. Ovicells immersed, inconspicuous, indicated only by an opening (special pore) in the summit of the cell. Besides, there are two openings in each cell, near the summit on each side of the mouth, which probably represent avicularia. No other avicularia dispersed among the other cells.

Remarks: The zoœcia of *Melicerita* have the characteristic shape of the family *Cellariidæ* (genus *Cellaria* Lamx., 1812 = *Salicornaria* Cuv., 1817), but the genus differs from *Cellaria* in the foliaceous and compressed zoarium, carrying zoœcia on both sides (see Busk, 1859, p. 69, and 1884, p. 95).

Record of specimens: Upper Rio Chalia; 3 fragments.

Affinities: This species has some resemblance, in the form of the zoarium and the general shape of the cells, to the type-species of the genus, *M. charlesworthi* M.-E. (Busk, 1859, p. 70, pl. 10, f. 4) from the English Crag (Pliocene), but it differs in the absence of avicularian cells among the other cells, in the absence of the raised lines on each side of the mouth, and in the presence of the accessory (avicularian ?) openings on each side of the mouth, and, further, in much larger mouth openings. Of the two recent species described by Busk (1884), *M. dubia* is quite different, and probably does not belong to this genus at all. *M. atlantica*, however (l. c., pl. 14, f. 1), from off Monte Video, 600 fath., is closely allied in the form of the zoarium and position of the mouth, but here also the lateral pores are wanting, and the zoarium is narrower.

Fossil species of the genus have been found—aside from the English Crag—in New Zealand and Australia. *M. angustiloba* Busk (see *Cellaria ang.* Waters, 1882, p. 260, pl. 9, f. 28–30, and Stoliczka, 1864, p. 155, pl. 20, f. 15–18) is found in the Miocene of Mt. Gambier, S. Australia, and of Victoria (Busk, Waters), and in the Miocene of New Zealand (Stol.), Pareora system of Hutton (1885 a, p. 209). But in this species the zoarium is much narrower, the cells are longer, the mouth is situated in the anterior part of the cell, and the lateral pores are wanting.

Busk (1859, p. 70) says that besides the type-species, he was able to find only a single other one, that he refers to this genus: *Eschara acaste* of d'Orbigny (1852, pl. 662, f. 7–9); but these figures represent *Esch. achates.* And, when he refers this species (*achates*) to *Melicerita*, also *Esch. acis*, *acmon*, and perhaps *actæa* would also belong to it. All these Upper Cretaceous species named differ from that Tertiary species under discussion in the much narrower branches of the zoarium and the absence of all traces of "special pores," and I doubt seriously that they belong to *Melicerita.*

The established range in time of *Melicerita* would thus embrace—aside from the Patagonian beds—the Miocene of Australia and New Zealand, the Pliocene of England, and the recent South Atlantic.

Fam. *ESCHARIDÆ* Johnst.

Gen. ASPIDOSTOMA Hcks.

11. ASPIDOSTOMA GIGANTEUM (Busk).

Pl. XIII, Fig. 4.

1854 *Eschara gigantea* Busk, Cat. mar. Polyz., Brit. Mus., v. 2, p. 91, pl. 119, f. 3.
1881 *Aspidostoma crassum* Hincks, in: Ann. Mag. Nat. Hist., ser. 5, v. 7, p. 160, pl. 10, f. 6.
1884 *Aspid. giganteum* Busk, Challenger Polyz., 1, p. 161, pl. 33, f. 3.
1891 *Eschara (Aspidostoma) gig.* Jullien, in: Miss. Cap Horn, v. 6, p. 77, pl. 6, f. 5–6.
1900 *Asp. gig.* Ortmann, in: Amer. Journ. Sci., v. 10, p. 378.

Zoarium erect, compressed, bilaminate, contorted, divided and coalescent frequently. Zoœcia arranged quincuncially, thick-walled, broadly pyriform or hexagonal, divided by deep sutures, tumid in front, but depressed in the center. Mouth at the summit of the depressed area, upper lip arched, with an elevated hood rising into two prominent processes. Lower lip with a broad plate covering the mouth; margin of this plate thickened, squarely truncated in front. Oœcia rounded or oval (Hincks says, elongated), depressed in the older parts of the colony, more prominent in the younger parts.

Remarks: There is no doubt that this fossil form corresponds to the living species. The most characteristic features are the hood-like (penthouse-like, Busk), bifid projection of the upper lip of the mouth, the broad plate of the lower lip, and the central depression of the cells. All these characters are well exhibited in our specimens. The figures of Hincks and Busk do not bring out these features very distinctly; they are, however, better represented in Jullien's figures.

Record of specimens: Mouth of Santa Cruz River; many fragments. San Julian, Oven Point; 2 basal parts of colonies.

Distribution: Aspidostoma giganteum has been found so far only *living* in southern Patagonia: Straits of Magellan, between Patagonia and the Falkland Islands, and at Tristan da Cunha (110–150 fath.).

CYCLOSTOMATA.

Fam. *LICHENOPORIDÆ* Sm.

Gen. RETICULIPORA d'Orb. em. Wat.

12. RETICULIPORA PATAGONICA Ortmann.

Pl. XII, Fig. 2^{a-c}.

1900 *Reticulipora patagonica* Ortmann, in: Amer. Journ. Sci., v. 10, p. 370.

Zoarium reticulate, fenestræ of the reticulations 2–4 mm long, and 1–2 mm broad, irregular. Branches much compressed in section, about 2 mm deep. Broad lateral surfaces of the branches with slightly exserted, tubular zoœcia, which are rather crowded and form irregular transverse rows. Besides the zoœcial openings there are smaller, non-tubular ones at the sides of the branches. On the front of the branches a median lamina rises as a distinct narrow median ridge. On the back part, the branches are rounded, and show very small openings.

Remarks: In the possession of intermediate pores this species does not correspond to the original diagnosis of the genus given by d'Orbigny (1859, p. 903), but it agrees with Waters' conception of *Reticulipora*. For the same reason the present species and the genus *Reticulipora* of Waters cannot be united with *Idmonea*, as Zittel does (1880, p. 599). I leave our species in the genus *Reticulipora*, since it comes extremely near to *Ret. transennata* Waters.

Record of specimens: Mouth of Santa Cruz River; fragments of about 10 colonies.

Affinities: This species is very closely allied to *Reticulipora transennata* Waters (1884, p. 689, pl. 30, f. 2, 3, 6, 7), from Aldinga, South Australia, which locality is regarded as Eocene. Indeed, it resembles this one so much that I entertain some doubt as to the specific difference of both. The only differences I am able to point out are: the branches of the zoarium seem to be stronger in our species (compare fig. 3 of Waters), and the zoœcial openings appear to be more crowded (see fig. 7, l. c.).

Gen. TENNYSONIA Bsk.

13. TENNYSONIA SUBCYLINDRICA Ortmann.

Pl. XIII, Fig. $5^{a, b}$.

1900 *Tennysonia subcylindrica* Ortmann, in: Amer. Journ. Sci., v. 10, p. 370.

Zoarium stipitate, irregularly branched, branches coalescent and lobate, subcylindrical. Orifices of cells slightly raised above the surface, arranged in straight, uniserial lines, placed only on one side of the branches, and beginning at an imaginary median line on this side. Interspaces between cells and back side of branches with pores (cancelli).

Remarks: This fossil resembles so much the living and only known species of the genus, *T. stellata* Busk (1875, p. 34, pl. 31, f. 6) from the Cape of Good Hope, that it is possibly identical with it. The only differences are: the branches are a little thinner in the fossil form, and subcylindrical, with hardly any indication of a triangular cross section, so that there is no trace of a median ridge on the front part of the branches, and further, the orifices of the cells are slightly raised above the surface, while they are even with it in *T. stellata.*

Record of specimens: Mouth of Santa Cruz River; 1 colony.

Gen. HETEROPORA Blv.

14. HETEROPORA PELLICULATA Waters.

Pl. XIII, Fig. 6.

1879 *Heteropora pelliculata* Waters, in: Journ. Roy. Micr. Soc., v. 2, p. 390, pl. 15.

1879 *H. neozelanica* Busk, in: Journ. Linn. Soc., v. 14, p. 725, pl. 15, f. 1–4.

1880 *H. n.*, Nicholson, in: Ann. Mag. Nat. Hist., ser. 5, v. 6, p. 333, textf. 1 A, B, C.

1900 *H. pell.* Ortmann, in: Amer. Journ. Sci., v. 10, p. 378.

Zoarium erect, arising from an incrusting base, with short, subcylindrical, diverging, dichotomous branches, terminating in blunt, rounded extremities, and sometimes coalescing. Surface with two kinds of orifices, though scarcely distinguishable in size. The larger ones are subcircular, the others (cancelli), disposed more or less regularly around these, are more or less angular.

Diameter of branches 5–10 mm, rarely more.

Remarks: Heteropora neozelanica is considered identical with *H. pelliculata*, by Waters (see: Nicholson, 1880, p. 329); according to Busk it differs from the latter, (1) in the shorter branches, which are never connected with each other, (2) in the absence of the calcareous pellicle or epitheca. Our specimens are, as regards the first character, in some degree intermediate: the branches, although comparatively shorter and stouter, coalesce frequently. The "pellicle" is not present in them, but this may be due to fossilization. The surface structure is in some places quite well preserved; it corresponds to Busk's fig. 4, and still better to Nicholson's fig. 1 B, and differs in this respect from Waters' figure (copied by Nicholson in fig. 1 D).

Record of specimens: San Julian, Oven Point; 2 colonies. San Julian, Darwin Station; 1 colony. Arroyo Gio; 3 fragments.

Distribution: Living in New Zealand and Japan (Busk, Wat.); fossil at Napier, New Zealand (fide Waters, 1884, p. 696), which beds belong to the Ahuriri series of the Pareora System, Miocene (see Hutton, 1885 a, p. 194, 209).

BRACHIOPODA.

Fam. *RHYNCHONELLIDÆ* d'Orb.

Gen. RHYNCHONELLA Fischer.

15. Rhynchonella plicigera v. Ihering.

Pl. XII, Fig. 3^{a-d}.

1897 *Rhynchonella plicigera* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 270, textf. 7.

Shell variable in shape, mostly wider than long, irregularly tetrahedral or more or less triangular. Beak more or less acute and slightly recurved; foramen moderately large, the lower part of it formed by the deltidial plates. Beak-ridges well defined. Smaller valve with a more or less elevated fold, corresponding to a mesial sinus in the larger valve. Surface ornamented by sharp plaits, about 25 in number, 4 to 7 of which are in the fold and sinus; these plaits become indistinct and disappear in the upper part of the shell.

Measurements: Length 15, 16, 18, 20, 20, 22, 24, 21, 21 mm.
Width 14, 20, 18, 21, 23, 20, 24, 24, 28 mm.

Remarks: This species comes very near to *R. nigricans* (Sow.) (see: Davidson, 1852, p. 81, pl. 14, f. 30, 31; Suess, 1864, p. 60, pl. 14, f. 5; Hutton, 1873, p. 37; Davidson, 1887, p. 169, pl. 24, f. 16–19). The only difference of our fossil Patagonian form from the New Zealandian is the tendency of the plaits to disappear toward the umbo of both valves.

V. Ihering compares this species with *R. nigricans*, and says that it differs in the following particulars: (1) In the more triangular and less transverse shape; (2) in the straighter and more pointed beak; (3) in the smaller foramen. That the first character has no value is shown by our material, in which the outer form varies considerably, as is seen by a glance at our figures and the measurements given above; and the same is true of the second character. As to the foramen, the figure of v. Ihering does not show a smaller foramen than those of Davidson and Suess, and (although our specimens show, as a rule, a foramen a little smaller than in the figures quoted) this difference is very slight. In a letter, v. Ihering again calls my attention to the difference in the foramen, and compares that of *R. plicigera* to that of *R. psittacea*. In the latter species (judging from specimens collected by myself in Inglefield Gulf, North Greenland) the foramen is narrow, elongated, and the deltidial pieces on each side of it are elongated-triangular, while in *R. nigricans* (according to Davidson) the foramen is more rounded and the deltidial pieces are broadly and almost equilaterally triangular. Examining our fossil form in this respect, it agrees with *R. nigricans*, and not with *R. psittacea*. But there seem to be variations even in *R. nigricans*, as is seen in Davidson's figures, and confirmed by Suess's figures, which have a distinctly elongated foramen.

Record of specimens: Las Salinas, 1 sp.; Shell Gap, upper horizon, 1 sp.; east end of Lake Pueyrredon, 1 sp.; high bluffs, S. W. of Lake Pueyrredon, 2 sp.; Lake Pueyrredon (Rio Tarde section), base, 35 sp.

Distribution: Gulf of San Jorge, Patagonian beds (v. Ih.). Specimens sent by v. Ihering to the U. S. Museum and examined by the writer were labelled: Santa Cruz.

Affinities: The most closely allied species, *R. nigricans*, has been found living at New Zealand, and fossil in the Oamaru, Pareora and Wanganui beds of New Zealand, and thus it ranges from the Oligocene upward to Recent times.

16. RHYNCHONELLA SQUAMOSA Hutton.

Pl. XII, Fig. 4$^{a, b}$.

1873 *Rhynchonella squamosa* Hutton, Cat. Tert. Moll. Echin., New Zealand, p. 37.

1878 *R. cœlata* Tenison-Woods, Journ. Proc. Roy. Soc. N. S. Wales, v. 11, p. 77.

1880 *R. squamosa* Tate, in: Trans. Proc. Roy. Soc. S. Australia, v. 3, p. 166, pl. 9, f. 9.

1880 *R. nigricans var. pixydata* Davidson, Challenger Brach., p. 59, pl. 4, f. 14.

1887 *R. nigricans var. pixydata* Davidson, in: Trans. Linn. Soc., ser. 2, v. 4, p. 170, pl. 24, f. 10.

1896 *R. squamosa* Pritchard, in: Proc. Roy. Soc. Victoria, v. 8, p. 143.

1900 *R. squamosa* Ortmann, in: Amer. Journ. Sci., v. 10, p. 378.

Shell more or less transversely circular; beak acute and incurved. Foramen small. Dorsal (small) valve convex, mesial fold scarcely distinguishable. Ventral valve flatter, with a broad, well-defined mesial sinus. Surface of both valves with about 40–50 radiating ribs, 10–15 of them in the sinus; closely intersected by squamose, concentric lines of growth, giving an imbricated appearance to the surface.

Length 24, 25, 25 mm.
Width 26, 28, 26 mm.

Remarks: Davidson confirms the identity of *R. cœlata* with his *R. pixydata*, and—as Tate points out—*R. cœlata* is distinguished from *R. nigricans* by the same characters that distinguish *R. squamosa*, being accordingly the same as the latter.

Our individuals agree well with the figures of *R. squamosa*, as well as of *R. pixydata*, especially in the squamose surface markings. The only difference is the larger size and the more circular outline, which is not so distinctly transversely-oval.

Records of specimens: High bluffs S. W. of Lake Pueyrredon, 1 sp.; Lake Pueyrredon, base, 10 sp.

Distribution: Miocene of South Australia (Tate) and Tasmania (Pritch.); Oligocene (Oamaru system) of New Zealand (Hutt.); and recent, Kerguelen Islands, 150 fath. (Dav.).

Fam. *TEREBRATULIDÆ* King.

Gen. MAGELLANIA Chemn.

17. Magellania lenticularis (Deshayes).

Pl. XII, Fig. 5^{a-e}.

1864 *Waldheimia lenticularis* Suess, in: Novara Exp. Geol., v. 1, p. 56, pl. 10, f. 3, 4.
1873 *W. l.* Hutton, Cat. Tert. Moll. Ech., New Zealand, p. 35.
1886 *W. l.* Davidson, in: Trans. Linn. Soc., ser. 2, v. 4, p. 52, pl. 9, f. 2–13.
1897 *Magellania globosa* v. Ihering, in: Rev. Mus. Paul, v. 2, p. 268.
1900 *Magellania lenticularis* Ortmann, in: Amer. Journ. Sci., v. 10, p. 379.

Shell regularly oval or subcircular in outline, lenticuliform or more or less globose. Beak prominent, subacute, incurved; beak ridges well defined, forming a slightly excavated area. Foramen small. Valves uniformly convex, without a distinct sinus (a slight indication of a sinus is said to be present in the recent form: in a few of our specimens there is just a suggestion of it, but in most of them there is no trace).

Length, 36, 35, 32, 29, 25 mm.
Width, 31, 32, 31, 29, 23 mm.

Remarks: This species, which is found still living in New Zealand, is characterized chiefly by the regular outline and the very small foramen. *Terebratula fontainiana* d'Orb. from the coast of Chili seems to be its American representative; it is certainly not a synonym of *M. venosa*, as Davidson (1886, p. 50, 51, pl. 8, f. 6) believes. *T. fontainiana* differs from *T. lenticularis* in the more elongated form.

I have seen four specimens of v. Ihering's *M. globosa*, sent by him to the U. S. Nat. Mus., and they agree completely with our species. *M.*

globosa is made by Davidson a synonym of *M. venosa* (Sol.). (Recent, Falkland Islands and Tierra del Fuego.) Our specimens differ from *M. venosa* in the *small foramen*, which is one of the characters in which *M. lenticularis* is said to differ from *M. venosa.* The other characters given by Davidson are: beak more incurved, dorsal valve uniformly convex, and size smaller. They are, however, hardly of any value. And further, he mentions a difference in the deltidium, but the latter is described in *M. venosa* in almost the identical terms. Therefore, judging from the foramen, which is the only reliable character, the Patagonian fossil belongs to *M. lenticularis,* and it agrees surprisingly well with the account of that species given by Suess.

Record of specimens: High bluffs, S. W. of Lake Pueyrredon, 9 sp.; Lake Pueyrredon, base; 34 sp.

Distribution: Recent, New Zealand (Dav.); fossil: Gulf of San Jorge, Patagonian formation (v. Ih.); Oligocene (Oamaru), Miocene (Pareora), and Pleistocene of New Zealand (Suess, Hutt.); Oligocene and Miocene of Chatham Islands (Hutt.).

Gen. TEREBRATELLA d'Orb.

18. Terebratella dorsata (Gmelin).

Pl. XIII, Fig. 7^{a-d}.

1864 *Terebratella dorsata* Suess, in: Novara Exp. Geol., v. 1, p. 57, pl. 14, f. 6.
1873 *T. d.* Hutton, Cat. Tert. Moll. Ech., New Zealand, p. 36.
1880 *T. d.* Davidson, Challenger Brach., p. 44, pl. 4, f. 4.
1887 *T. d.* Davidson, in: Trans. Linn. Soc., ser. 2, v. 4, p. 75, pl. 14, f. 9–19.
1900 *T. d.* Ortmann, in: Amer. Journ. Sci., v. 10, p. 378.

Shell very variable in shape, but mostly transversely-oval, wider than long. Valves moderately convex, ribbed or (rarely) smooth. Dorsal valve with a median sinus, ventral valve with a corresponding fold. Beak produced, slightly incurved and truncated by a rather large, circular foramen. Beak ridges sharply defined.

Length, 44, 43, 38, 31, 31, 28 mm.
Width, 36, 45, 40, 26, 29, 22 mm.

Remarks: The radiating ribs are very variable; in some cases they extend almost over the whole shell, in others (and this is the most common form) they begin at about the middle of the shell and run to the margins, and again in other cases they are visible only near the margins. In very few specimens (about half a dozen out of 81 individuals) the ribs are lacking altogether.

The external form of the shell varies also. It is generally wider than long, often distorted (as figured by Suess), and sometimes elongated, longer than wide. In the latter case it approaches closely the following species (*T. patagonica*), but differs in the presence of ribs. This is seen in a few individuals from Lake Pueyrredon and in the specimen from the mouth of the Santa Cruz River (L. 26, W .19). This same form has been sent by v. Ihering to the U. S. National Museum, labelled: Gulf of San Jorge. Since *T. patagonica* assumes sometimes a broader form, and since the ribs of *T. dorsata* sometimes disappear completely, it is evident that both species may pass into each other, and, indeed, we possess specimens in which it is very hard to say, to which one they belong. In my opinion, both species are intimately related to each other.

There is hardly any difference between our fossil material and the recent form now living on the coast of Patagonia, of which Mr. Hatcher has collected numerous individuals. Among the fossil forms, however, there are much larger shells. The fossil New Zealand form, figured by Suess, has the fold and sinus more sharply defined than any of our specimens, but since there is much variation among them, as well as among the recent ones (the sinus and fold being in some cases quite indistinct), there is no reason for separating the New Zealandian shell from *T. dorsata.*

Record of specimens: Mouth of Santa Cruz River, 1 sp. (Var.); Shell Gap, upper horizon, 4 sp.; East end of Lake Pueyrredon, 1 sp.; Lake Pueyrredon, base, 81 sp.; Lake Pueyrredon, 600′ above base, 4 sp.

Distribution: Gulf of San Jorge (2 specimens sent by v. Ihering to the U. S. Nat. Mus.); Miocene (Pareora) of New Zealand (Suess, Hutt.); Recent, S. America (Patagonia, Straits of Magellan, Chili) and Kerguelen Islands (Dav.).

19. TEREBRATELLA PATAGONICA (Sowerby).

Pl. XIII, Fig. $8^{a, b}$ and Pl. XIV, Fig. $1^{a, b}$.

1846 *Terebratula patagonica* Sowerby, in: Darwin, Geol. Obs. S. Amer., p. 252, pl. 2, f. 26, 27.

1873 *Waldheimia p.* Hutton, Cat. Tert. Moll. Ech. New Zealand, p. 36.
1885 *W. p.* Hutton, in: Quart. Journ. Geol. Soc., v. 41, p. 553.
1887 *Terebratula p.* Philippi, Tert. Quart. Verst. Chil., p. 217, pl. 49, f. 2 (after Sowerby).
1897 *Magellania p.* v. Ihering, in: Rev. Mus. Paul, v. 2, p. 267.
1899 *Terebratella p.* Lahille, in: Rev. Mus. La Plata, v. 9, p. 289, ff., pl. 1, 2.

Shell oval, more or less elongate, rarely almost as broad as long. Both valves nearly equally convex. Beak incurved, with a large foramen; beak ridges blunt. No sinus on the dorsal (smaller) valve. Surface smooth, without ribs.

Measurements: Length, 59, 40, 30, 25, 34, 31, 27 mm.
Width, 51, 32, 28, 19, 25, 21, 25 mm.

Remarks: This species is a *Terebratella* as has been shown by Lahille, who figures the complete brachial apparatus (pl. 1, f. 53, 54, 55). Although I do not possess any specimens showing this apparatus complete, the median septum of many of my specimens shows distinctly a cruciform appearance, *i. e.*, it possesses, near the lower end, processes, which apparently were connected with the descending part of the loop. The latter, in numerous individuals, shows an angular projection just where we are to expect this connection, so that there is every reason to believe that a bridge extended between the descending branch of the loop and the median septum. And further, the close affinity of *T. patagonica* with the following species (*T. gigantea*)—from which it is hardly distinguishable specifically—supports this view, the latter being a true *Terebratella*.

Lahille has written a separate paper on the variability of this species. Although we must appreciate the value of such studies, they never can be satisfactory, if the author does not pay due attention to the stratigraphical position of the forms in question. I am very much afraid that Lahille in his paper confused the present form and the next one; at any rate, I doubt very seriously that his statement, that *T. patagonica* is found associated (p. 5 of separate copy; "dans la même couche") with *Monophora darwini*, is correct. The latter species, according to v. Ihering (1899, p. 42), belongs to the Entrerios formation, which is younger than the Patagonian, and I am fully prepared to accept this opinion, since among our collections from Patagonian beds not a single individual of *Monophora* is found, while *T. patagonica* is very abundantly represented. If Lahille states further that he has found at San José, in beds immediately overlying those containing *T. patagonica* and *Monophora*, some specimens of *Iheringia (Scutella patagonensis)*, we must distrust his stratigraphical observations entirely; this observation, if really true, would amount to nothing less than to turn the whole stratigraphy of these beds upside down. Such observations must be confirmed and supported by a detailed account of the stratigraphical conditions, and are worthless if given incidentally in a few words. It would really be more advantageous for science, if Lahille would stop sneering at and making fun of systematists and descriptive zoölogy and palæontology, and would pay more attention to the really vital questions of the stratigraphy of the Patagonian fossils.

Lahille's material was collected at three different localities: San José, Pyramides, and Madryn (Terr. Chubut), but he did not keep these three lots separate. While there is no doubt that he had the true *T. patagonica*, some of his figures suggest that also the following species was represented among his material, and especially his figures 56, 57, 58 on plate 1 resemble the latter. But since he has mixed all three localities, there is no telling whether this is really the case.

In palæontological investigation it is not the question to find out whether any allied forms from different horizons may be connected by intermediate forms, and thus be united into one single variable species, but it is to be investigated whether allied forms from different horizons show a change in the average characters which demonstrates them to be mutations in time of one and the same stock. In the present case the latter seems to be true: I have been able to find some constant—although very slight—differences between the *Terebratella* from the Patagonian beds and that of the Cape Fairweather beds, a fact that shows clearly that the Cape Fairweather form is to be regarded as a "mutation" of the Patagonian form. If we mingle indiscriminately specimens from both horizons, there is no doubt that we should arrive at the same conclusions as Lahille did, that they belong to *one* species. This result, however, misrepresents the true condition in nature.

Record of specimens: Mouth of Santa Cruz River, 28 sp.; Paso del Rio Santa Cruz, 1 sp.; Mt. of Observation, upper horizon, 1 sp.; San Julian, Oven Point, 37 sp. and many fragments; San Julian, Darwin Station, 4 sp.; Shore of Salt Lake, 1 sp.; Upper Rio Chalia, 5 sp.; 30 miles N. of upper Rio Chalia, ca. 25 sp., mostly broken; Cañon near Sierra Oveja, Rio Chico, 5 single valves; Shell Gap, upper horizon, 1 sp.; High Bluffs, S. W. of Lake Pueyrredon, 8 sp.; Lake Pueyrredon, base of Tertiary, 25 sp.; Lake Pueyrredon, 600′ above base, 26 sp.

Distribution: San Josef and San Julian (Sow.); Gulf of San Jorge (specimens sent by v. Ihering to the U. S. Nat. Mus.); Santa Cruz (specimens sent by v. Ihering to the Princeton Mus.); of Lahille's localities: S. José, Pyramides, Madryn, only the first is supported by other authors. In New Zealand, this species is recorded by Hutton from the Oamaru and Pareora beds (Oligocene and Miocene).

20. TEREBRATELLA GIGANTEA spec. nov.

Pl. XIV, Fig. 2^{a-f}.

1897 *Magellania venosa* Pilsbry, in: P. Ac. Philad., p. 330.

Shell oval or elliptical, on the average a little broader than in the preceding species; dorsal (small) valve slightly convex, ventral valve strongly convex; beak incurved, with a large foramen; beak ridges blunt. Sinus indicated only by a flattening of the dorsal valve and a slight curve of the margin, but in many cases not at all visible. Surface smooth. Hinge and septum considerably thickened in old age.

Measurements: Length, 67, 66, 64, 61, 59, 52, 48, 45, 37, 26, 14 mm.
Width, 54, 51, 56, 50, 54, 41, 45, 43, 38, 24, 13 mm.

An isolated smaller valve is 58 mm broad, which would indicate an individual measuring over 70 mm in length.

Remarks: This is the largest species of the genus hitherto known. The generic position is beyond doubt, since I have succeeded in isolating the brachial apparatus, which is represented in fig. 2^d on plate XIV.

The external shape is somewhat variable: younger individuals are broader in comparison with older ones, but I have only one case in which the width exceeds the length of the whole shell (see above). This broad shape passes gradually with age into a more elongated one, as the lines of growth indicate. The more elongated form is attained at different ages (see measurements above), so that sometimes larger individuals still retain the broad outline. Both valves are convex, but the smaller one distinctly less so. In old individuals the median septum, hinge plate and hinge processes are extremely thickened and swollen (figs. $2^{e,f}$, pl. XIV.).

Record of specimens: Cape Fairweather; 26 complete specimens and a large number of isolated or broken valves.

Distribution: As has been mentioned above, some of the specimens recorded by Lahille from the territory of Chubut (Pyramides, Madryn) may belong to this species. A fragment of a large individual, with the characteristic thickening of hinge and septum, has been sent by v. Ihering to the U. S. Museum, and said to come from the "Tehuelche formation" of Ameghino. Other younger individuals of the typical *T. gigantea* were in the same lot, labelled (according to Ameghino) "Patagonian formation." But since Ameghino's views on the latter formation are very confused, and since all his stratigraphical observations are second hand, it is better to disregard the statement that these specimens are from the Patagonian formation.

Affinities: The comparative flatness of the dorsal valve, the generally a little broader outline, and the very large size are the only characters that distinguish this species from *T. patagonia*, and there is no doubt that it is the descendant of the latter, representing it in the Cape Fairweather beds: it is a "mutation" of *T. patagonica.* In this respect it is interesting to note that the broader variety of *T. patagonica* prevails at the localities near the upper Rio Chalia, which beds form the very top of the Patagonian series.

Terebratula macrostoma of Philippi (1887, p. 217, pl. 49, f. 3 and Moericke, 1896, p. 587) from the Pliocene beds of Coquimbo and Caldera, Chili, seems to be closely allied, but differs in the larger foramen and the equally convex valves. Moericke regards this form as the ancestor of the living *Magellania venosa.* The brachial apparatus of the Chilian fossil is said to be that of a *Magellania*, but it is imperfectly known. Pilsbry (1897), without knowing the brachial apparatus, has united our Cape Fairweather species with *Magellania venosa*, but since I succeeded afterward in working out the brachial apparatus, we must separate it from this genus altogether.

Genus: BOUCHARDIA Davids.

21. BOUCHARDIA ZITTELI v. Ihering.

Pl. XIII, Fig. $9^{a, b}$.

1897 *Bouch. zitt.* v. Ihering, in: Rev. Mus. Paul, v. 2, p. 268, textfig. 6.

Shell ovate, smooth. Beak short, triangular, nearly straight, foramen small and terminal; deltidium obsolete (fused with the shell); area slightly excavated in the middle. Ventral (larger) valve more convex than the dorsal, obtusely carinated.

Measurements: (according to v. Ihering) Length, 19 mm.
Width, 15 mm.

Remarks: All our individuals are smaller than v. Ihering's and less elongated, which is apparently due to the younger age: the lines of growth in v. Ihering's figure indicate that the younger shell was comparatively broader.

Record of specimens: Lake Pueyrredon, base of Tertiary, 12 sp.

Distribution: v. Ihering does not give a locality, but simply states that this species comes from the Patagonian formation. Two individuals, sent by him to the Princeton Museum, are labelled: Santa Cruz.

Affinities: the genus *Bouchardia* is represented so far only in the recent seas, and the typical species, *B. tulipa* (Blv.) is found on the coast of Brazil.

MOLLUSCA.

PELECYPODA.

Fam. *NUCULIDÆ* Ad.

Gen. NUCULA Lamck.

22. NUCULA PATAGONICA Philippi.

Plate XXV, Fig. 7^{ab}.

1887 *N. pat.* Philippi, Tert. & Quart. Verstein. Chiles, p. 198, pl. 41, f. 8.
1897 *N. tricesima* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 243, pl. 4, f. 21, pl. 5, f. 27.
1899 *N. pat.* v. Ihering, in: N. Jahrb. Min. Geol. Pal., p. 15.
1900 *N. pat.* Ortmann, in: Amer. Journ. Sci., v. 10, p. 379.

Shell thick, very convex, almost triangular, oblique, apex forming almost a right angle. Posterior dorsal margin slightly convex, forming with the lower margin a strongly curved posterior angle. Anterior dorsal margin slightly concave, anterior end a little produced, and sharply curved. Surface smooth, with concentric lines of growth. Hinge teeth in two rows meeting at a right or slightly obtuse angle, anterior row consisting of ca. 8, posterior of ca. 11–13 teeth. No crenulations on inner side of ventral margin.

Remarks: V. Ihering says (in *N. tricesima*): "posterior" margin with 8, "dorsal" margin with 15–17 teeth, a statement that certainly contains an error. But it is impossible to find out what is meant, since his figure 27 is quite insufficient; but so far as can be seen, the number of hinge teeth does not materially differ from that observed in our specimens.

N. tricesima is apparently the same species as *N. patagonica.* The external form in our individuals is variable: some are a little more elongated, others higher. Philippi figures only the *cast,* which is, of course, more elongated, since the shell, and especially the swollen apex, is gone, which detracts considerably from the height of the shell. V. Ihering figures, in figure 21, a very high individual (Alt. 14, Long. 15), while his figure 27, which seems to represent another individual, is less high (12 by 14). In our specimens I have measured the following dimensions:

Height	Length	Diameter	
13	16.5	10	(of both valves)
15	16.5	5.5	(one valve)
12.5	15	8	(both valves)

For *N. patagonica* v. Ihering gives in 1899: 14, 17, 11, respectively.

Our second individual corresponds very closely to *N. tricesima* of v. Ihering, while the other two approach more or less the dimensions of *N. patagonica.* Moreover, there are numerous intermediate specimens.

Record of specimens: Mouth of Santa Cruz River, 20 sp.; Lake Pueyrredon, 600′ above base, 1 cast.

Distribution: Santa Cruz (Phil.), Patagonian formation (v. Ih.). Suprapatagonian beds of La Cueva (*N. tricesima* v. Ih.).

Affinities: *N. araucana* Phil. (1887, p. 198, pl. 41, f. 7) from Lebu and Navidad is closely allied, and perhaps not specifically distinct; but it is too imperfectly known to decide this question.

European Eocene species, which may be compared with *N. patagonica* in size and outline, are: *N. parisiensis* Desh., *bronni* Desh., *mixta* Desh., *greppini* Desh.; but they have all crenulations on the ventral margin, and the number of hinge teeth is larger. The same is true of *N. magnifica* Conr. from the Eocene of Alabama, and of *N. nucleus* L. and *mayeri* Hoern. from the Miocene and Pliocene beds of Europe. The character of the lack of crenulations, however, is shown in an *Oligocene* species of Europe, *N. peregrina* Desh. (see Speyer, 1866, p. 42, pl. 5, f. 3–5), and this species seems to be the species most closely allied to *N.*

patagonica, although the outline is more elongate, and the number of hinge teeth appears to be smaller. In outline, as well as the lack of crenulations, the *Pliocene* and *Recent N. tenuis* (Mont.) (see Wood, 1856, p. 84, pl. 10, f. 5) still more resembles our species, but *N. tenuis* is much thinner, and has distinctly a convex anterior dorsal margin. Thus we may say that, if there are any relations of the Patagonian shell to known forms, they are with Oligocene and Pliocene species.

In so-called "Eocene" (or Miocene?) beds of Victoria, South Australia, and Tasmania, we have *N. tumida* Ten.-Wood (Tate, 1886, p. 127, pl. 6, f. 6) as a representative of *N. patagonica*.

23. NUCULA RETICULARIS Ortmann.

Pl. XXV, Fig. $8^{a, b}$.

1900 *R. ret.* Ortmann, in: Amer. Journ. Sci., v. 10, p. 371.

Shell small, moderately convex and moderately thick, subovate, oblique; posterior and anterior dorsal margins slightly convex, ventral margin strongly arcuate. Surface with very fine concentric ribs, which are, especially near the posterior extremity, irregular and bifurcate. These ribs are crossed by still finer radial striæ, which give a beautifully reticulated appearance to the shell. Ventral margin finely crenulated on inner side. Hinge teeth fine, both parts of the series forming an obtuse angle; anterior part with ca. 9, posterior with ca. 18 teeth.

Measurements: Length, 7.5 mm; height, 6 mm.

Remarks: The radial striæ are sometimes obliterated by fossilization and indistinct, but are recognizable in almost all individuals on closer inspection.

Record of specimens: Mouth of Santa Cruz River, 1 valve; Mt. of Observation, upper horizon, 16 valves.

Affinities: The small size and sculpture characterizes this species sufficiently. This peculiar sculpture, however, brings our species very near to the *Oligocene N. chasteli* Nyst (see Sandberger, 1863, p. 342, pl. 28, f. 7), from Germany. In *N. chasteli* the same dichotomy of the concentric ribs is present, but much more strongly pronounced, and the external form is different: it is triangular or hatchet-shaped.

Fam. *LEDIDÆ* Ad.

Gen. LEDA Schum.

24. LEDA OXYRHYNCHA (Philippi).

Pl. XXVI, Fig. $2^{a, b}$.

1887 *Nucula ox.* Philippi, Tert. Quart. Verstein. Chiles, p. 197, pl. 41, f. 21.
1900 *Leda ox.* Ortmann, in: Amer. Journ. Sci., v. 10, p. 378.

Shell elongate, anterior end shorter, rounded, posterior produced and acutely rostrate. Posterior dorsal margin slightly concave, ventral margin evenly arcuate. An angular ridge runs from the apex to the posterior end, and, below this ridge, there is a slight depression. Surface of shell with concentric ribs, between which fine radiating striæ are present, which do not cross the ribs. The part of the shell between the posterior dorsal margin and the radial ridge running to the posterior end (escutcheon) has more numerous and finer concentric ribs. Anterior hinge teeth ca. 12, posterior ca. 19.

Length, 10 mm; height, 6 mm.

Remarks: The individuals from Santa Cruz are a little shorter than the figure given by Philippi, and the apex is a little more anterior. Of the casts from Arroyo Gio only one is large (length, 12 mm; height, 6 mm), and here the form and situation of the apex agree with Philippi's figure. An external cast from the same locality shows the characteristic sculpture of this species.

The radial striæ, between the concentric ribs, are distinct only near the ventral margin; toward the apex they are indistinct or even wanting. The original discription of Philippi does not give the details of sculpture mentioned above, so that there remains some doubt as to the identity of our form with the Chilian; I have made the identification chiefly on the ground of the agreement in the general appearance, and because none of the characters given by Philippi contradicts it.

Record of specimens: Mouth of Santa Cruz River, 2 right, 2 left valves; Arroyo Gio, 6 casts.

Distribution: Navidad beds of Chili; Lota, Lebu, Navidad (Phil.).

Affinities: An allied form is known from New Zealand ("juengere Abteilung" = Pareora or Miocene), and figured but not named by Zittel

(1864, p. 47, pl. 15, f. 12). But here the posterior end is blunt, and the sculpture consists only of concentric ribs, and above the posterior ridge there are no ribs.

I cannot find any other species that might be compared with this one; there are numerous species in Tertiary deposits which resemble this one in external shape, but the character of the sculpture is here very peculiar, especially the coexistence of concentric and radial sculpture, and the presence of a larger number of concentric ribs on the escutcheon.

25. LEDA ERRAZURIZI (Philippi).

Pl. XXVI, Fig. $3^{a, b}$.

1887 *Nucula err.*, Philippi, Tert. Quart. Verst. Chiles, p. 196, pl. 41, f. 11.
1900 *Leda err.* Ortmann, in: Amer. Journ. Sci., v. 10, p. 378.

Shell elongate-ovate, apex situated almost in the middle of the dorsal margin. Anterior end rounded, posterior acute, but hardly produced (about as long as anterior). Posterior dorsal margin straight. Ventral margin arcuate. A ridge runs from the apex to the posterior end; just below this ridge is a broad and sharply defined depression. Surface of shell with fine concentric ribs, the ribs terminating, near the apex, abruptly on the ridge, leaving the escutheon smooth (except for growth-lines; toward the ventral margin, the concentric ribs disappear when reaching the depression below the ridge, so that this depression is crossed only by fine growth-lines. Anterior hinge teeth ca. 21, posterior ca. 16.

Length, 13 mm; height, 7 mm.

Remarks: The specimen from Santa Cruz is the largest, and shows all the characters given above. Specimens from Lake Pueyrredon are smaller, and are mostly casts, with only fragments of the shell remaining. One individual however, shows distinctly the characters of the sculpture: the disappearance of the concentric ribs on the depression below the escutcheon, and therefore there is no doubt that they belong to this species. The outer cast from Arroyo Gio shows distinctly the sculpture of this species. The cast from Sierra Oveja is doubtful, as it does not exhibit any surface characters; but the outline agrees well with this species.

In Philippi's description of this species the surface sculpture is described as "concentrice et tenuiter striata; striis ante marginem dorsalem abrupte terminatis," which—taken together with his figure—applies well to our species.

Record of specimens: Mouth of Santa Cruz River, 1 left valve; Cañon near Sierra Oveja, Rio Chico, 100–150′ below the rest, 1 cast; Arroyo Gio, 1 external cast; Lake Pueyrredon, 600′ above base, 15 sp.

Distribution: Navidad beds of Chili, Lebu (Philippi).

Affinities: Leda hyposoma Dall (1898, p. 589, pl. 32, f. 2) from the *Miocene* of North Carolina much resembles our species in the character of the sculpture, the concentric lines disappearing on the rostrum and leaving a smooth space below the ridge. Also the general form is similar. This species is to be regarded as the most closely allied form.

Species of *Leda* coming near *L. oxyrhyncha* and *errazurizi* are found in the Australian Tertiary (Tate, 1886), but they require further examination owing to the poor figures.

Gen. MALLETIA Desm.

26. Malletia ornata (Sowerby).

Pl. XXVI, Fig. 4.

1846 *Nucula orn.* Sowerby, in: Darwin, Geol. Obs. S. Amer., p. 251, pl. 2, f. 19.
1854 *Solenella orn.* Woodward, Man. Mollusc., vol. 2, p. 270, pl. 17, f. 23.
1899 *Neilo orn.* v. Ihering, in: N. Jahrb. Min. Geol. Palaeont., vol. 2, p. 14.

Shell large, elongate, ovate or subtrapeziform; apex only slightly prominent, at about two-thirds of the length of the shell. Anterior end rounded, posterior obliquely truncate and emarginate, upper angle produced, lower angle rounded. A blunt angulation running from the apex to the lower angle, and a very indistinct angulation from the apex almost parallel to the posterior dorsal margin. Surface with strong, lamelliform, concentric ribs. Anterior hinge teeth ca. 15, number of posterior teeth a little larger (the exact number cannot be ascertained in our specimens).

Length, 45 mm; height, 25 mm.

Remarks: Ligament external in a longitudinal groove, and pallial line with a distinct sinus, thus belonging to the genus *Malletia* of Desmoulins (= *Solenella* Sow. = *Neilo* Ad.).

Record of specimens: Mouth of Santa Cruz River, 1 double valve, 2 right, and 2 external casts; Paso del Rio Santa Cruz, 1 left, 3 right valves.

Distribution: Port Desire (Sow.); Santa Cruz, Patagonian formation (v. Ih.).

Affinities: *Nucula volckmanni* Philippi (1887, p. 194, pl. 41, f. 9) from the Navidad beds (Tubul and Lebu) has more crowded concentric ribs and the posterior margin is more obliquely truncate: otherwise it is *very* closely allied.

The New Zealandian *living* species *Solenella australis* Quoy & Gaim. (see: Reeve, 1873, pl. 1, f. 4) is found, according to Zittel (1864, p. 47, pl. 13, f. 2) and Hutton (1873, p. 29 and 1886, p. 364) also in the fossil state in New Zealand, in the Pareora and Wanganui beds (Miocene and Pliocene). This species is also closely allied to the Patagonian form, although differing a little more in outline. From the older Tertiary deposits this type of shell is not known.

Fam. *PARALLELODONTIDÆ* Dall.

Gen. CUCULLÆA Lamck.

27. Cucullæa alta Sowerby.

Pl. XXV, Fig. 4^{a-c}.

1846 *C. a.* Sowerby, in: Darwin, Geol. Observ. S. Amer., p. 252, pl. 2, f. 22, 23.
1873 *C. a.* Hutton, Cat. Tert. Moll. Echin. N. Zealand, p. 27.
1885 *C. a.* Hutton, in: Quart. Journ. Geol. Soc., vol. 41, p. 551.
1897 *C. multicostata* v. Ihering, in: Rev. Mus. Paul, v. 2, p. 240, pl. 4, f. 20, pl. 5, f. 29.
1897 *C. dalli* v. Ihering, ibid., p. 241, pl. 7, f. 47, pl. 8, f. 51.
1899 *C. dalli* v. Ihering, in: N. Jahrb. Min. Geol. Pal., vol. 2, p. 12.
1899 *C. alta* v. Ihering, Ibid., p. 13.
1900 *C. alta* Ortmann, in: Amer. Journ. Sci., v. 10, p. 379.

Shell variable in outline, elongated-rhomboidal, shorter or longer, thick and inflated. Surface finely radially striated, and with fine, undulating, concentric lines of growth. Anterior end short, rounded, posterior narrowed, and a little produced to an obtuse angle. Apex high and incurved, a very indistinct and rounded angulation running down from the apex to the posterior end. Area large, according to age with 1–9 rhombiform sulci.

Remarks: v. Ihering distinguishes two species, *C. alta* and *dalli*, which I believe to be identical: in order to support my opinion, I give here detailed measurements of 14 good specimens out of our material (Nos. 1, 2, 4, 9–14 from Santa Cruz, Nos. 3, 5–8 from Mt. of Observation).

Number.	Length.	Height.	Distance of Apex from Ant. End.	Width of Area.	Number of Sulci.
1	22	18	9 rel. 1 : 2.4	?	1
2	50	41	19 “ 1 : 2.6	5	3
3	64	58	24 “ 1 : 2.6	8	4
4	65	56	26 “ 1 : 2.5	7	5 anter., 4 poster.
5	65	58	24 “ 1 : 2.6	9	4
6	67	58	27 “ 1 : 2.5	8	3
7	69	59	25 “ 1 : 2.7	8	3
8	71	62	27 “ 1 : 2.6	8	5
9	72	62	33 “ 1 : 2.2	11	7 anter., 6 poster.
10	79	67	35 “ 1 : 2.2	10	5
11	80	66	31 “ 1 : 2.6	9	6
12	83	73	40 “ 1 : 2.1	15	7 anter., 8 poster.
13	85	73	29 “ 1 : 2.9	14	7
14	88	73	33 “ 1 : 2.6	12	6 anter., 5 poster.

In 1897, v. Ihering mentioned as distinctive characters betwen *C. multicostata* and *dalli* the following: (1) External form, (2) sculpture of shell, (3) number of sulci of the area, (4) size. In 1899 he modified his statements as to the third character: he says that a shell of *C. alta* (which he unites with *C. multicostata*) of 45 mm length has an area 7 mm broad, with 9 sulci, while *C. dalli* at a length of 50 mm has an area 5 mm broad, and only two sulci. This looks certainly like a striking difference. His *C. multicostata* (= alta) of 1897 is 38 mm. long, and has only two sulci.

Among our specimens, one (No. 2), of the same size (50 mm) as the individual of *C. dalli* just mentioned, has only 3 sulci, and this number hardly increases in the specimens Nos. 3–8 (length from 64 to 71 mm): there are only 3 to 5 sulci, and specimens Nos. 10 and 11 (length 79 and 80 mm) continue this series regularly with from 5 to 6 sulci.

But No. 9 is outside of the series; its size is hardly larger than that of No. 8, but the sulci of the area number 6, or 7. Although this specimen must still be classed with v. Ihering's *C. dalli*, it shows clearly that sometimes in individuals of comparatively smaller size the number of sulci may be exceptionally high. On the other hand, we see in No. 14, that in comparatively large individuals the number of sulci may remain very small

(5 or 6), while even in smaller individuals (Nos. 12 and 13) a very high number (7 or 8) is present.

Thus is seems that the number of sulci is very variable: at a length of ca. 50 mm. it is about 3, increasing at ca. 70 mm. to 4 and 6, and at over 80 mm to 7 and 8, and even more; but sometimes there are specimens, in which this number does not correspond to this rule: Sowerby's figure 23 shows an individual 47 mm in length, that has 5 or 6 sulci, where we should expect only 2 or 3, and v. Ihering's individual of *C. alta*, of 45 mm length, has 9, where we should expect not more than 3. Although this latter individual seems at the first glance to differ strikingly from all our individuals, Sowerby's figure 23 and our specimen No. 9 form the transition between both extremes.

Aside from the number of sulci on the area, v. Ihering (in 1899) gives the following differences between *C. alta* and *dalli:* (1) *C. dalli* is the larger species; (2) the apex in *C. alta* is more anterior; (3) the surface ornamentation differs in both.

Characters (1) and (2) are of no value, since there is in size and shape considerable variety, as is shown in our series: indeed, one of the largest specimens (No. 13) shows the apex more anterior than any of the rest, and this one agrees in all other respects with v. Ihering's *C. dalli.* Further, it will be remarked that our No. 9, which, according to the sulci, is the one that approaches *C. alta* of v. Ihering most closely among our individuals, shows an almost central apex, a character of *C. dalli*, and the same is true of No. 12.

As to character (3), v. Ihering says that *C. alta* has in the middle of the shell ca. 30 radiating ribs, as broad as the intervals, but that these ribs are wanting on the anterior and posterior parts of the shell. In *C. dalli*, however, he says that these ribs are found all over the surface. (In 1897 he described in *C. dalli* the surface-ornaments as striæ rather than ribs.)

It seems to me that he has not seen the original surface of the shell. In our specimens (see fig. 4^a)—where the original surface is preserved—it is rugose ("subrugosa" Sowerby), *i. e.*, sculptured by very fine radiating striæ or impressed lines, which are crowded, but some of them at certain intervals (3–10 mm) are a little more distinct (deeper). The intervals between the striæ are flat and crossed by fine undulating lines of growth: thus there is nothing that might be called "ribs." But when the outer surface of the shell is destroyed by fossilization, the condition described by v. Ihering becomes apparent (see fig. 4^c): flat, radiating ribs, as broad as the intervals and hardly higher than the latter. Since this destruction of the outer layer of the shell takes place chiefly near the apex and on the middle part of the surface (see fig. 4^c), while the outer layer as a rule is still preserved on the anterior and posterior ends, we often see the condition described for *C. alta:* a number of ribs in the middle part of the shell, which are apparently lacking on the anterior and posterior ends. All our individuals from Santa Cruz show this condition of the partly exfoliated surface, while those from Mt. of Observation are in a better state in this respect (see fig. 4^a).

Thus, of the characters given by v. Ihering, only that of the number of sulci of the area deserves any attention, and it seems—as has been shown above—that even this one does not warrant the establishment of two different species. If I am mistaken in this opinion, if there are really two different but closely allied species at Santa Cruz, we possess only one of them: *C. dalli*, but not what v. Ihering calls *C. alta.* The little uncertainty that remains in this respect is chiefly due to the fact that the differences of sculpture of the surface mentioned by v. Ihering are not illustrated by any good figures: that of *C. multicostata*, given in 1897 (pl. 5, f. 29), is quite insufficient.

Record of specimens: Mouth of Santa Cruz River; 4 double, 7 right, 3 left valves. (Some of them labelled 200′ and 250′ above high tide.) Mt. of Observation, lower horizon; 2 double, 1 right, 2 left valves.

Distribution: Santa Cruz (Sow., v. Ih.); La Cueva and Jack Harvey (v. Ih.); Port Desire (Sow.). Patagonia formation (v. Ih.), Oamaru and Pareora systems (Oligocene and Miocene) of New Zealand (Hutton).

Affinities: C. chilensis Phil. (1887, p. 189, pl. 40, f. 2), from the Navidad beds of Chili comes extremely near to this species, the only difference is the less high and more elongated form. From the Oligocene and Miocene beds of New Zealand Hutton has described three more species, which are hardly distinguishable.

Sowerby compared this species with *C. decussata* Sow. (= *crassatina* Lmck.), which is found in *Eocene* beds of Europe, and a similar form is found in the *Eocene* of the eastern United States: *C. gigantea* Conr. (see: Clark, 1896, pl. 30–33). Since species of this genus have not been found in the northern hemisphere in younger Tertiary beds, we are confronted here with a pronounced relation to Eocene: but the value of this case is counterbalanced by the fact that the identical species or very closely allied forms are found in beds that are considered Oligocene, Miocene and Pliocene (Hutton, 1886, p. 365), in Chili and New Zealand, and further by the fact that the genus still exists in the recent seas.

28. CUCULLÆA (CUCULLARIA) DARWINI (Philippi).

Pl. XXV, Fig. $5^{a, b}$.

1887 *Arca darw.* Philippi, Tert. Quart. Verstein. Chiles, p. 188, pl. 36, f. 3.
1897 *Cucullaria tridentata* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 237, pl. 4, f. 22, pl. 5, f. 28.
1900 *Cucullæa darwini* Ortmann, in: Amer. Journ. Sci., v. 10, p. 379.

Shell elongate-oval, subtrapeziform, with fine radial ribs, which are flat and separated by fine but sharp sulci. Toward the lower margin the ribs appear geminate or double, through the development of a slight sulcus in the middle of each rib. The ribs are crossed by distant, distinct lines of growth. Apices swollen, closely approaching each other. Anterior end of shell short, rounded; posterior broader, with rounded angles. Area very small. Teeth of hinge (according to v. Ihering): 2–3 horizontal anterior ones, and 3 posterior. Small vertical teeth below the apex.

Our largest individual measures: length, 29 mm; height, 17 mm; but the species grows much larger, since v. Ihering gives: length, 42; height, 24.

Remarks: According to v. Ihering this species belongs to the subgenus *Cucullaria.* My specimens agree completely with his figure in outline, but they are smaller and do not show the hinge.

There cannot be the slightest doubt that this species is the same as Philippi's *Arca darwini.* Philippi's reconstruction of the anterior part of the shell is not quite correct (it being too high), and this is the only difference from v. Ihering's figures. The fact that Philippi's species is from Santa Cruz is sufficient to establish this identity.

Record of specimens: Mouth of Santa Cruz River, 1 double, 1 right valve; Las Salinas, 2 right valves.

Distribution: Santa Cruz (Phil.); Jegua quemada, Suprapatagonian beds (v. Ih.).

Affinities: The type-species of the subgenus or genus *Cucullaria* is *C. heterodonta* Desh. from the Eocene of the Paris basin (see: Deshayes, 1860, p. 906, pl. 67, f. 22–25); it differs considerably from our species in size, shape and sculpture, the latter consisting of fine, sharp and nodulose ribs. *C. aldrichi* Dall (1898, p. 630, pl. 32, f. 19), from the *Eocene* of Alabama approaches our species more closely in size and shape and also in sculpture, which consists, in *C. aldrichi*, of fine, flattish, equal, but not geminate ribs. In the sculpture of the shell, *C. tæniata* Dall (ibid., p. 631, pl. 25, f. 1), from the *Pliocene* of Florida and Carolina, is still more closely allied to our form, showing geminate, and even quadripartite ribs; the shape, however, of *C. tæniata* is different. Thus, it seems that *C. darwini* is intermediate in sculpture between the Eocene *C. aldrichi*, and the Pliocene *C. tæniata*, approaching in form more the former.

Fam. *LIMOPSIDÆ* Dall.

Gen. LIMOPSIS Sassi.

29. Limopsis insolita (Sowerby).

Pl. XXV, Fig. 6.

1846 *Trigonocœlia ins.* Sowerby, in: Darwin, Geol. Observ. S. Amer., p. 252, pl. 2, f. 20, 21.
1864 *Limopsis ins.* Zittel, in: Novara Exp., p. 48, pl. 13, f. 1.
1873 *L. i.* Hutton, Cat. Tert. Moll. Ech., New Zealand, p. 28.
1886 *L. i.* Tate, in: Tr. R. Soc., South Australia, vol. 8, p. 134.
1887 *L. araucana* Philippi, Tert. Quart. Verst. Chiles, p. 191, pl. 46, f. 4 (juv.).
1897 *L. ins.* v. Ihering, in: Rev. Mus. Paul., vol. 2, p. 234.
1899 *L. i.* v. Ihering, in: N. Jahrb. Min. Geol. Pal., vol. 2, p. 14.

Shell suboval, very oblique, thick, convex. External surface, in well preserved specimens, with very fine radiating striæ (fine grooves separated by flat intervals), and with distinct concentric lines of growth. Umbones not much prominent. Area triangular, high, with a triangular depression in the middle below the apex, bordered by sharp margins. Hinge teeth forming a curved line, anterior and posterior ones larger, median ones smaller.

Height, 26 mm; length, 25 mm.

Remarks: The external surface of the shell is finely striated, a character in which *L. araucana* is said to differ. Sowerby and Zittel, however, describe the surface of *L. insolita* as smooth, and, indeed, in most of the specimens it appears so. But this character is produced by fossilisation, the fine striæ being distinctly visible only in very well preserved individuals. This character has been ascertained already by v. Ihering. We possess young shells that agree in every respect with Philippi's *L. araucana*, they being less oblique than the older ones.

V. Ihering (1899, p. 40, footnote) doubts the identity of the New Zealandian and Patagonian form. Zittel's figure of *L. insolita* represents a very large specimen, which is very oblique, and which is smooth. That the latter character does not agree with the Patagonian fossil has been mentioned, but since the latter was described originally and erroneously as smooth, it is very probable that also in New Zealandian specimens, in well preserved individuals, a striation may be present. The external form does not warrant a specific separation, since among our Patagonian material the obliquity of the shell varies considerably in individuals of the same size, and since also—as has been said above—young individuals as a rule are less oblique. Accordingly, the very oblique shape of the figure given by Zittel may be due to age. In the configuration of the area I do not find any differences: although it is hard to understand Zittel's description in this respect ("area—traversed by a narrow, slightly depressed, very indistinct, triangular groove"), his figure corresponds to what we see in the Patagonian fossil: below the apex, there is, on the area, a broadly-triangular depression on a slightly lower level than the lateral parts of the area, and separated from the latter by a sharp, angular line. This triangular depression is slightly concave in the middle.

Record of specimens: Mouth of Santa Cruz River, 175 isolated specimens, and many more imbedded in matrix; Las Salinas, 1 sp.

Distribution: Santa Cruz (Sow.); La Cueva and Jegua quemada (v. Ih.). According to v. Ihering in both the Patagonian and Suprapatagonian beds.

Navidad beds of Llancahue, Chili (Phil.). New Zealand (Zittel), Miocene Pareora beds (Hutt.). South Australia, in so called "Eocene" (?Miocene) beds (Tate).

Affinities: By the very strongly developed obliquity, by the very broad triangular groove of the area, by the lack of crenulations of the inner margins, this shell represents a very peculiar type of the genus, that cannot be brought into closer relation to any of the known species. The more striking is the fact that this identical type is represented in the Pareora beds of New Zealand and in Australia.

Fam. *ARCIDÆ* Dall.

Gen. ARCA Lamck.

30. ARCA PATAGONICA v. Ihering.

Pl. XXV, Fig. $3^{a,b}$.

1897 *A. pat.* v. Ihering, in: Rev. Mus. Paul., Vol. 2, p. 235, pl. 4, f. 23, pl. 5, f. 30.

Shell elongate, anterior part short, rounded, posterior elongated, obliquely truncated. Ventral margin almost straight and parallel to the upper margin (hinge-line). A blunt, but distinct carina runs down from the apex to the posterior ventral angle. Apices remote from each other, area broad, concave, with a large sulciferous rhombus. Surface of shell with radiating ribs, anterior ribs stronger, median ribs finer, and on the posterior part of the shell, above the carina, again 3–5 (according to age) stronger ribs. All ribs noduloso-imbricated by concentric lines crossing them. In older parts of the shell (near the apex) the ribs are much crowded, but they become more distant on approaching the ventral margin, and finer ribs develop in the intervals. In old individuals, near the ventral margin, from 2 to 4 finer ribs are found between the stronger ones.

Our largest individual measures: Length, 28 mm; height, 20 mm; diameter, 10 (× 2) mm.

Records of specimens: Mouth of Santa Cruz River, ca. 30 sp.; Mt. of Observation, upper horizon, 1 sp.; Arroyo Gio, 1 cast.

Distribution: Jegua quemada, Suprapatagonian beds (v. Ih.).

Affinities: *A. oxytropis* Philippi (1887, p. 188, pl. 37, f. 6) from the Navidad beds of Lebu, Chili—although very incompletely known—seems to be closely allied to this species. In *A. oxytropis* the following characters agreeing with *A. patagonica* are known: (1) the elongated and narrow form, (2) the oblique truncation of the posterior end, (3) the ridge running across the valve, (4) the existence of a few (3) ribs above this ridge.

V. Ihering compares this species with *A. imbricata*, which is, according to Dall (1889, p. 40), a living species of the West Indies.

In my opinion the most closely allied forms are: *A. tetragona* Poli (= *navicularis* Desh.) from the English Crag (see Wood, 1856, p. 76, pl. 10, f. 1), and said to be also Miocene and Recent. And further, a closely allied species is *A. noæ* L. (Miocene to Recent, see Hoernes, 1870, p. 324, pl. 62, f. 4).

Specimens of the same size of *A. tetragona* from the *Pliocene* of Mt. Mario, Rome, differ only in the more anterior position of the apex, finer ribs, and sharper carina.

Although the type of *A. noæ* is represented also in Eocene deposits by different species, none of these approach our species so closely as the two forms named (*A. tetragona* and *noæ*), so that we have here a distinctly *Neogene* relation.

Similar forms, for instance *A. occidentalis* Phil. and *A. paratina* Dall (Philippi, 1851, p. 15, pl. 4, f. 4, and Dall, 1898, p. 621, pl. 33, f. 14), closely allied to the European *A. noæ*, are found in Oligocene, Miocene, Pliocene, and Recent beds in Florida and the West Indies.

Also *A. pseudonavicularis* Tate (1886, p. 139, pl. 11, f. 8) from so-called "Eocene" beds of South Australia and Tasmania belongs into this group.

Gen. GLYCIMERIS Da Costa.

(= *Pectunculus* Lamck.)

31. Glycimeris ibari (Philippi).

Pl. XXVI, Fig. 1^{a-c}.

1887 *Pectunculus ib.* Philippi, Tert. Quart. Verst. Chiles, p. 190, pl. 40, f. 3.
1887 *Pectunculus magellanicus* Philippi, ibid., p. 190, pl. 41, f. 1.
? 1887 *P. araucanus* Philippi, ibid., p. 191, pl. 36, f. 2.
1897 *P. pulvinatus cuevensis* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 238, pl. 7, f. 46, pl. 8, f. 50.
1899 *P. pulv. cuev.* v. Ihering, in: N. Jahrb. Min. Geol. Pal., v. 2, p. 14.
1900 *P. ibari* Ortmann, in: Amer. Journ. Sci., v. 10, p. 379.

Shell large and thick, suborbicular or more or less oblique. Surface with radial striæ, the striæ are fine, but sharp furrows, separated by rather broad, flat intervals; they are crossed by fine concentric lines of growth. Area triangular, increasing in width with age, with rhombiform sulci up to 6 or 7. Hinge teeth up to 11 on each side; the median ones, in old individuals, covered by the dilated area, so that only 4 to 5 on each side are visible. Only the median teeth slightly geniculate, the lateral ones oblique to horizontal, but straight.

Remarks: As v. Ihering has already pointed out, the external form of this species is extremely variable. Sometimes it is perfectly circular, but often more or less oblique, or even transversely elongate; the latter extreme is represented by Philippi's *P. magellanicus.* We possess from Punta Arenas all intermediate conditions in shape. Also the thickness of the shell is variable. (As to variations in shape and thickness in this genus, compare Wood, 1856, p. 68, under *P. glycimeris.*)

Philippi's *P. ibari* represents an extremely thick and high individual, while his *P. magellanicus* is extremely transverse. Both are large, and possess accordingly a very broad area, which leaves only the 4–5 lateral hinge teeth exposed. The same number of teeth is present in our largest individuals (see below, No. 11 and 12). We have a smaller individual (No. 3) that corresponds in shape exactly to *P. magellanicus*, but has a larger number of hinge teeth. V. Ihering figures a very large individual of subcircular outline, in which the median hinge teeth are not completely covered.

I give here the measurements of some of our specimens, compared with those of Philippi and v. Ihering.

No.	Height.	Length.	Diameter.	Anterior hinge teeth.	Sulci.	Shape.
1	48	50	18	11	1	almost circular (left).
2	50	54	20	9	?	oblique (left).
3	66	80	27	9	?	very oblique, transverse (left).
4	70	ca. 70	25	8	?	almost circular (left).
5	70	72	30	12	?	subcircular (left).
6	72	71	26	10	3	almost circular (right).
7	74	77	32	12	?	moderately oblique (left).
8	76	77	31	8	?	almost circular (right).
9	82	92	33	8	4	oblique (left).
10	87	ca. 95	35	6	?	moderately oblique (right).
11	90	85	33	5	5	moderately oblique, high (left).
12	92	100	38	5	6	oblique (right).
13	90	116	37	5	7	very oblique, transverse.
14	98	92	ca. 40	5	?	moderately oblique, high.
15	99	106	38	ca. 8	4 or 5	subcircular.

Of these individuals Nos. 1–12 are in our collection from Punta Arenas; No. 13 is Philippi's *P. magellanicus*, and No. 14 is Philippi's *P. ibari*. No. 15 gives the measurements of v. Ihering's *P. pulvinatus cuevensis*.

The following are the corresponding measurements of our smaller individuals from Santa Cruz:

16	28	29	9	10	1	very slightly oblique (left).
17	25	25	8	9	?	circular (right).
18	19	19	6	8	0	circular (right).

Finally, we have here the measurements of an individual from Lake Pueyrredon, base of Tertiary:

19	93	90	ca. 34	?	?	slightly oblique, high (left).

Individuals from other localities are too poorly preserved to be measured.

It may be, that *P. colchaguensis* Phil. (1887, p. 191, pl. 37, f. 8) from the Navidad beds of Chili is identical with our species; it is of medium size, and the measurements fit well into the series, but Philippi says that the surface shows only lines of growth, and hardly any radial striae; and further, the sulci of the area seem to be—according to the figure—more numerous and more crowded.

P. araucanus Phil. is a very young form; Philippi says that it differs from other species in the rectilinear hinge line. The same character is present in a few of our smallest and medium sized specimens from Santa Cruz, but it disappears with age. Although these young specimens from Santa Cruz resemble completely Philippi's figure of *P. araucanus*, it does not seem quite safe to put this species in the synonymy of *P. ibari*, without having compared authentic specimens of the Navidad form.

The failure on the part of v. Ihering to recognize the identity of his species with *P. magellanicus* and *ibari* of Philippi, is apparently due to the fact that Philippi has figured two extremes of this form; an exceptionally transverse one, and an exceptionally high one; but we possess from the type-locality (Punta Arenas) not only these two extremes, but also the intermediate forms. The latter prevail, are more circular in outline, and agree well with v. Ihering's species (so especially our Nos. 4, 5, and 8).

The large specimens in our collection from Rio Chalia are all casts, but agree well—as far as can be ascertained—with the specimens from Punta

Arenas. Large specimens from Arroyo Gio and Lake Pueyrredon possess at least part of the valves and are completely identical with those from Punta Arenas.

Record of specimens: Mouth of Santa Cruz River, 14 valves (young and medium); Upper Rio Chalia, 8 casts (large); 30 miles north of upper Rio Chalia, 4 casts; Arroyo Gio, 2 valves (large and small); Lake Pueyrredon, base of Tertiary, 2 sp. (large and small); Lake Pueyrredon, 600′ above base, 11 casts (small and medium); Punta Arenas, horizon V, 12 valves (medium and large).

Distribution: Punta Arenas (Phil.); Patagonian beds of Santa Cruz (v. Ih.), and Suprapatagonian beds of Jegua quemada and La Cueva (v. Ih.); Perhaps in the Navidad beds (Lebu) of Chili (*P. araucanus* Phil.).

Affinities: V. Ihering considers this form a variety of *P. pulvinatus* Lmck., and compares it with the form described by Hœrnes as *P. pilosus* L. from the *Miocene* of the Vienna basin. This is quite right, especially as far as it relates to the sulci of the area. The larger Eocene species of the genus (*P. obovatus* Lmck., *pulvinatus* Lmck., *polymorphus* Desh.) differ at a glance in the more crowded, and accordingly more numerous sulci, while in the Miocene, Pliocene and Recent form, that has been called by the Linnean name *P. pilosus*, the number of sulci, in individuals of corresponding size, agrees closely with that of *P. ibari*. In *P. pilosus*, however (see Hœrnes, 1870, p. 316, pl. 40, 41), these sulci are very indistinct, while in *P. ibari* they are well developed and sharp, and further, *P. pilosus* differs from our species in the teeth of the hinge being more distinctly geniculate, and in the radial striæ of the surface being less distinct and more obscured toward the lower margin by the lines of growth. Thus *P. ibari* has a distinctly Neogene appearance.

Fam. *PERNIDÆ* Zitt.

Gen. PERNA Brug.

32. PERNA QUADRISULCATA v. Ihering.

Pl. XXIV, Fig. $2^{a,b}$.

1897 *P. qu.* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 231, pl. 9, f. 54.

Shell thick, upper margin straight, anteriorly sharply angulated, posteriorly alate, angularly produced and sinuate. Hinge broad, with four distant, very broad grooves.

Remarks: Our fragments from Santa Cruz do not show the external form of the shell. According to v. Ihering it is subquadrate, a little broader than high. The specimens from Lake Pueyrredon are chiefly casts; one of them shows clearly the impressions of the lower margin of three of the cardinal grooves (see pl. XXIV., fig. 2^b), agreeing with the specimens from Santa Cruz in being very broad and distant, which is the most prominent character of this species. Only part of the shell remains here. The casts indicate apparently a higher shell, but taking into consideration the great thickness of the shell at the anterior end, and the missing part at the posterior, which has been lost by fossilization, the outline of the Pueyrredon specimens would come near to that given by v. Ihering. I do not hesitate to refer them to v. Ihering's species, since the characteristic feature of *P. quadrisulcata* is exhibited in one of them.

Record of specimens: Mouth of Santa Cruz River, 9 fragments; Lake Pueyrredon, base of Tertiary, 2 sp.; Lake Pueyrredon, 600′ above base, 4 sp. (2 of them young).

Distribution: La Cueva, upper part of Patagonian formation (v. Ih.).

Affinities: No known species of *Perna* can be compared with this one; but there is some resemblance to *Crenatula aviculiformis* Philippi (Navidad beds of Chili), but the latter is too incompletely known to permit any opinion in this respect.

Fam. *OSTREIDÆ* Lamck.

Gen. OSTREA L.

33. OSTREA TORRESI Philippi.

Pl. XIV, Fig. $3^{a,b}$.

1887 *O. torr.* Philippi, Tert. Quart. Verst. Chiles, p. 215, pl. 48, f. 8.
1899 *O. torr.* Ortmann, in: Amer. Journ. Sci., v. 8, p. 427.

Shell in outline broader or narrower oval, rarely suborbicular; moderately thick. Lower valve deeply excavated, upper valve flat. Area moderately large, triangular. Muscular impression about in the middle of the inner surface, only slightly lateral. Both valves with numerous, strong radial plaits, but on the upper valve these are less distinct and sometimes missing.

Measurements:					An upper valve:
Length,	104,	117,	125,	131.	129 mm.
Width,	74,	106,	74,	95.	102 mm.

Remarks: Characterized by the well developed radial plaits, and by the deeply and regularly excavated lower valve, which has a spoon-like shape. All our individuals are much worn, but in spite of this fact the radial plaits are distinct. This character, as well as the comparatively thinner shell, are the only differences from the following species, of which it is no doubt the representative in the Magellanian beds. I am not quite satisfied that it is really a distinct *species.*

Record of specimens: Punta Arenas, Magellanian beds, upper horizon (III), 21 lower, 14 upper valves (5 upper valves from the lower horizon (II) of the Magellanian beds may belong to this species, but since they do not show any plaits, and lower valves are absent, I am not prepared to say that they really belong here).

Distribution: Straits of Magellan (Phil.). Our specimens are apparently from the type-locality of this species, since most of the fossils described by Philippi from the Straits of Magellan (1887, p. 251) are from Punta Arenas.

Affinities: A similar species is *O. bellovacina* Lmck. (see Wood, 1861, p. 17, pl. 3, f. 1, pl. 7, f. 3) from the Lower Eocene of France and England, but in the latter the radial plaits are stronger, and the outline is broader.

34. OSTREA INGENS Zittel.

Pl. XV, XVI, XVII, XVIII, and XIX, Fig. 1^{a-c}.

1864 *O. ingens* Zittel, in: Novara Exped., p. 54, pl. 13, f. 3.
1864 *O. nelsoniana* Zittel, ibid., p. 55, pl. 11, f. 7.
1873 *O. nelson. & ing.* Hutton, Cat. Tert. Moll. Echin., N. Zealand, p. 34.
1887 *O. patagonica* Philippi (non d'Orbigny), Tert. Quart. Verst. Chiles, p. 213 (pro parte, *not* fig. 2 on pl. 48).
1887 *O. ferrarisi* Philippi (non d'Orbigny), ibid., p. 214 (*not* fig. 5 on pl. 48).
1887 *O. bourgeoisi* Philippi (non Rémond), ibid., p. 215, pl. 48, f. 3.
1896 *O. beneckei* Moericke, in: N. Jahrb. Min. Geol. Pal. Beil., Bd. 10, p. 574, pl. 13, f. 1.
1897 *O. ferraresi* Pilsbry (non d'Orbigny), in: Pr. Acad. Philad., p. 330.
1897 (Nov.) *O. hatcheri* Ortmann, in: Amer. Journ. Sci., v. 4, p. 355, pl. 11, f. 1.
1897 *O. philippii* Ortmann, ibid., p. 356, pl. 11, f. 2.

1897 (Dec.) *O. percrassa* v. Ihering (non Conrad), in: Rev. Mus. Paul., v. 2, p. 221, pl. 9, f. 53, textfig. 1.

1897 *O. patagonica* v. Ihering (non d'Orbigny), ibid., p. 222, pl. 9, f. 2 (*O. orbignyi* in tab.) (*non O. patagonica*, ibid., p. 326).

1899 *O. hatcheri* v. Ihering, in: N. Jahrb. Min. Geol. Pal., v. 2, p. 8.

1900 *O. ingens* Ortmann, in: Amer. Journ. Sci., v. 10, p. 379.

Shell very variable in shape, circular, ovate, triangular, or elongated, becoming very large and thick with age. Lower (left) valve more or less convex, concave on inner side. Outer surface with concentric lines of growth, forming lamellæ, which are sometimes very far apart from each other, giving thus a graduated appearance, but in other cases the lamellæ are much crowded. Radial plaits in many cases completely absent, in others slightly and irregularly developed, but always less than in *O. torresi.* Upper (right) valve flat or slightly concave on the inner side, externally with lines of growth, forming lamellæ, very rarely with traces of radial plaits. Beak of lower valve longer or shorter, often very much elongated, sometimes incurved or distorted. Area triangular, generally longer than broad, often very long, rarely broader than long. Ligament-groove deeper or shallower, broader or narrower. Beak and area of upper valve shorter than in the lower valve. Muscular impression large, situated generally a little below the middle of the shell and a little posteriorly (laterally). Margins of upper valve, close to the area, sometimes for a short distance with small crenulations (wrinkles or nodes) corresponding to small grooves in the other valve, but in most cases no traces of these crenulations are present.

Largest specimen: Length, 255 mm; width, 162 mm.

Remarks: The chief characters of this species are:

1. The large size, and extremely thick shell.
2. The situation of the muscular scar.
3. The smooth margin of the inner side of the valves.
4. The slight development of the radial folds.

But even these characters are variable in a certain degree. Greater variations are shown in: (1) the outline, (2) the shape of area and beak, (3) the convexity of the valves, (4) size, and development of the surface-sculpture, especially of the lines of growth.

Since there is an almost unparalleled confusion as to the identification and synonymy of the large oyster of the Patagonian beds, it seems necessary to support the position taken by the writer by a detailed account of the history of this form, and the results furnished by the examination of our material.

It is exceedingly difficult to clear up the synonymy of the large oysters of Patagonia.

The oyster described by d'Orbigny as *O. patagonica* has been frequently and almost generally confused with the present species, but—as will be demonstrated below—the original *O. patagonica* is not found at all in the Patagonian formation, that is to say, *below* the Santa-Cruz beds containing mammalian remains.

It is to be borne in mind, that *O. patagonica* is not recorded by d'Orbigny himself from any locality south of San Julian; and since our collections show, that the true *O. patagonica* is really present at San Julian, but in a higher horizon, it is very probable, that d'Orbigny did not possess the species from the true Patagonian formation at all.

The latter was first mentioned by Darwin (1846, p. 111 and passim), but without being distinguished from *O. patagonica*.

Philippi (1887) possessed typical specimens of the Patagonian oyster from Punta Arenas, and called them by the name of *O. bourgeoisi* Rémond, which was a mistake, as *O. bourgeoisi* is from the Californian Miocene. At the same time he confounds the true *O. patagonica* with the species found at Santa Cruz, and introduces two more species: *O. ferrarisi* d'Orb. and *remondi* from the Pliocene Coquimbo-beds of Chili. What he calls *O. ferrarisi* is not the *O. ferrarisi* of d'Orbigny (=*patagonica*), since he distinctly states, that crenulations of the margins are *not* present in his specimens. These crenulations are the only character by which *O. patagonica* can be distinguished from *O. ingens* in every case, and accordingly, Philippi's *O. ferrarisi* must belong to *O. ingens*. *O. remondi*, on the other hand, seems to belong to the true *O. patagonica* (see below).

Mœricke, in 1896, mentions from the Pliocene Coquimbo-beds: *O. remondi* and *transitoria* Hup., both apparently the same species as Philippi's of the same names, and adds a new species: *O. beneckei*. The latter is nothing but a very old and large, typical individual of *O. ingens*. Its chief characters, the extreme thickness of the shell, the incurved beak, and the elongated and large area are exhibited in many of our larger individuals. Incidentally Mœricke (p. 575) mentions *O. patagonica* from Santa Cruz, and it seems, he understands by this name the more circular form found at this locality.

The present writer, in 1897, recognized first the difference of this oyster of the Patagonian formation from the true *O. patagonica* of d'Orbigny, but he made the mistake of regarding the more elongated form from the upper Rio Chalia and the more circular form of Santa Cruz as different species, and described them under the names of *O. philippi* (substituting this name for the preoccupied *bourgeoisi* of Philippi) and *O. hatcheri* respectively. In the same year, a few weeks later, v. Ihering called the more rounded form of Santa Cruz by the name of *O. percrassa* (preoccupied by Conrad for a Miocene species of N. America, see: Whitfield, 1894, p. 29, pl. 3, f. 1–4), giving as its chief characters the widely remote lamellæ formed by the lines of growth, which gives a terraced or graduated appearance to the external surface. This same character is found in the type-specimen of my *O. hatcheri;* but I do not regard it as of specific value. Some individuals show it very distinctly developed, but in others we have all transitional conditions to the crowded lines of growth of what I have called *O. philippi*, and, indeed, both characters—the distant and the crowded lamellæ—may be present in *one and the same* individual at different stages of age (see pl. XV). Moreover, this percrassa-stage—which is apparently due to very vigorous growth of the shell—is not restricted to the locality of Santa Cruz or to the particular horizon of the Patagonian beds represented there.

Very recently (1899, p. 8), v. Ihering has again discussed the oyster of Santa Cruz, adopting the specific name of *hatcheri.* Here he does not consider the graduated appearance of the shell as of specific value, but still he maintains its specific difference from "*patagonica*" = *philippii* Ortm. The chief characters given are:

1. Very thick shell and rounded outline.
2. Short and broad area.
3. Ligamental fossa of upper valve concave or flat, not prominent on the lower margin of the area, or only slightly so.
4. Muscular impression far distant from the margin.

Characters (1) and (2) have been discussed above, and are of no specific value: we have at the type-locality elongate shells as well as rounded ones, and individuals with an elongated area. These characters change sometimes in the same individual with age (see pl. XV). In fact, the typical *O. hatcheri* (or *percrassa*) is not the only form found at Santa Cruz, and it is not even the prevailing form (see: No. 1 under record of specimens). As to the situation of the muscular scar (character 4), it may be remarked, that the more central position is found in more rounded individuals, and is without doubt directly dependent on the outline of the shell.

As to the third character introduced by v. Ihering, taken from the ligamental groove of the upper valve, I fail to see any constancy in it. Indeed, there is considerable variation, it being sometimes concave, sometimes flat, sometimes slightly convex, and the lower margin is more or less prominent. The convex character, however, of the surface of the groove, is exhibited in comparatively few individuals, and the prominence of the lower margin is not always connected with a convexity of the surface. My type-specimen of *O. philippii* does not differ at all in this respect from *O. hatcheri*, and my specimens of the true *O. patagonica* from Entrerios (sent by v. Ihering to the Princeton Museum) do not show a remarkable convexity, and also among my specimens of the true *O. patagonica* from S. Julian the fossa is sometimes flat and sometimes slightly convex. On the other hand, I have specimens of the typical *O. hatcheri* with the lower margin of the ligamental fossa *very* prominent, although its surface is flat, and many individuals from Cape Fairweather (see pl. XVIII) show a distinctly concave fossa. I possess even a few individuals with circular outline, which have a slightly convex and strongly prominent fossa: on the whole, this latter development is *rare* among our material, and shows all possible transitions to a concave fossa. Therefore, it is evident, that this character is of no use for distinguishing *O. hatcheri* and *philippii*, and also cannot be used for the distinction of the Patagonian oyster from *O. patagonica*.

The form with the crowded lamellæ from the Patagonian beds (v. Ihering following Ameghino, alleges that it is restricted to the so-called Suprapatagonian beds), has also been confounded by v. Ihering with the true *O. patagonica*, although he confirms the presence of the characteristic crenulations of the upper valve in specimens from Parana (Entrerios). In 1899 (p. 10), he emphasizes this character, but he says that crenulations are not always missing in the oyster of the Patagonian beds and not always present in the Entrerios oyster. But—according to my experience—the first is the case in a very limited degree: the crenulations in Patagonian shells—if present at all—are found only for a very short distance near the area (see pl. XVIII, fig. 1^b), while, on the other hand, the lack of crenulations in the true *O. patagonica* is always due to an incomplete state of preservation, the crenulations being worn off or having disappeared by the breaking off of the margin (see below under *O. patagonica*).

O. pyrotheriorum of v. Ihering (1897, p. 315, textfig. 21, numbered 20 by mistake) seems to be a different species. It has a short, triangular outline, with crenulations of the upper valve. The figure is very poor, but since v. Ihering has kindly sent a specimen of this species to Princeton, I have verified his statement that the triangular form is very striking, and furthermore—as v. Ihering has already pointed out—the muscular impression is very peculiar, being very narrow and transversely elongated. The stratigraphical position of this form is said to be in the Pyrotherium beds, but since at present nobody knows what these beds really are, and since—as Ameghino himself admits (1899, p. 13)—different horizons have been mixed up under this designation, I cannot venture to express an opinion on this subject. But at any rate, a Cretaceous age of these beds is out of question (see Hatcher, 1900, p. 96). I may, however, call attention to the following facts: (1) *O. pyrotheriorum* possesses, according to v. Ihering, crenulations on the margin of the upper valve, and (2) I have figured on pl. XX, fig. 1^d, an upper valve of *O. patagonica*, from San Julian, belonging to the lot described below, which has a muscular scar that corresponds exactly to that of *O. pyrotheriorum*. Thus two of the chief characters of *O. pyrotheriorum* are also found in *O. patagonica*, and it may be, that *O. pyrotheriorum* is only a form of *O. patagonica*, and that the two individuals, upon which this species is based, have been picked up just for this peculiarity in external form. If this should prove to be correct, its stratigraphical position would be in much younger beds (Pliocene), and this would support Mr. Hatcher's opinion, that a *part* at least of the Pyrotherium-beds of Ameghino belongs in the Pliocene.

To sum up, we have the following results:

1. The large oyster of the Patagonian formation is different from the true *Ostrea patagonica* of d'Orbigny, and the only, but constant difference, is the presence of crenulations all around the margin of the upper valve in the latter. Such crenulations are sometimes present near the hinge in the Patagonian oyster, but they are very much smaller, and found only for a short distance, *never* all around the margin.

2. There is only *one* species of large oyster in the Patagonian formation. From our material, I may pick out individuals corresponding to

every single one of the figures of the different supposed species. And, in addition, we possess numerous intermediate forms, and individuals combining characters of these so-called species.

3. This large species of oyster continues its existence all through the (Miocene) Patagonian formation, as well as upward into the Pliocene Coquimbo beds of Chili.

Now, the same is true in Patagonia. The identical form reappears in the Cape Fairweather beds, which are separated from the Patagonian beds by the whole of the Santa Cruz formation. (At the cañon near Sierra Oveja, No. 11, *O. ingens* has been found in beds interstratified with the lower Santa Cruz beds.) I cannot find any specific difference between the Patagonian and the Cape Fairweather forms, although there are some slight and almost insensible differences in the general features: the Cape Fairweather form does not grow quite as large, the shell—although still very thick—is not quite so gigantic in mass, the outline is more distinctly and more frequently of a triangular shape; the crenulations of the margin of the upper valve near the hinge occur more frequently, but still there are many specimens which show no traces of them.

An oyster closely resembling in these characters the Cape Fairweather form is found in the uppermost oyster bed at Punta Arenas (No. 22), and in the uppermost beds at Lake Pueyrredon (No. 19).

As to the identification of the Patagonian oyster with the New Zealandian form, I would make the following remarks:

O. ingens and *nelsoniana* of Zittel are apparently identical. The latter is smaller, and accordingly younger, but Zittel mentions the character of the extraordinary thickness of the shell. *O. ingens* is a large individual, of elongated shape, and with a very long and broad area. Zittel says, that the area is limited on each side by a groove (sulcus), a character that is seen in some of our specimens. I do not find a single character by which it is possible to distinguish our species from the New Zealand-form, and, indeed, I can pick out individuals agreeing closely with the figures given by Zittel of *O. ingens* as well as of *O. nelsoniana*.

A very closely allied, if not identical, form is *O. sturtiana* Tate (1886, p. 97, pl. 6, f. 1), from the Miocene River Murray Cliffs, Australia.

Ostrea rostrata of Hupé (see Philippi, 1887, p. 213), from Coquimbo, of which no figure is known, seems to agree, according to the descriptions, with the form called by Moericke *O. beneckei*. If that should prove to be correct, the name of *O. rostrata* of Hupé antedates *O. ingens* of Zittel, and should be used accordingly.

O. transitoria of Hupé (Philippi, p. 213, pl. 49, f. 9), from Coquimbo, Caldera and Navidad (Pliocene and Miocene of Chili) may also belong here. It is very broad, but agrees in this character with many individuals from Patagonia. *O. transitoria* of Moericke (1896, p. 576, pl. 12, f. 1), however, seems to belong to *O. patagonica* (see below).

Lately, several species of *Ostrea* have been described by Grzybowski (1899, pp. 629–631) from the lower Miocene and Pliocene of northern Peru (Payta and Tumbez), of which *O. latiareata* (Miocene) and *O. oculata* and *lunaris* possibly also belong here. At any rate, they are closely allied to *O. ingens*, but the material described and figured is too poor to form an opinion upon.

I shall now proceed to give a record of our specimens, adding under each locality the necessary notes, which would serve to support the views set forth above.

Record of specimens:

1. Mouth of Santa Cruz River; 12 double, 7 lower valves.

One of them is my type of *O. hatcheri.* 2 more of the double valves agree completely: they are broad, with distant lamellæ. In 2 more the lamellæ are more crowded near the lower margin; 1 other is a little elongated, with crowded lamellæ in the posterior third of the shell, otherwise like *O. hatcheri.* 5 are very large, greatly elongated (one of them figured on pl. XV and XVI), with the beak and area more elongated; one of them with distinct lateral furrows as in *O. ingens* from New Zealand; the lamellæ are much crowded in the posterior part of the shell. 1 further specimen is of medium size and elongated; the lamellæ are crowded, except near the beak; the area is long. Of the single valves 5 small or medium sized are the typical *O. hatcheri;* form circular or broadly oval. 2 others are larger and more elongated, one of them very large, is very elongate, with the lamellæ crowded in the posterior half; area long and broad, with distinct lateral furrows. The other is a little smaller than this one, ovate, the area triangular, the lamellæ crowded posteriorly.

In all specimens from this locality the radial ribs of the surface are only slightly or not at all developed.

As will be noticed, the typical *O. hatcheri* is represented, among these 19 individuals, by only 8. The rest are transitions to *O. philippii*, and a few may be called *O. philippii.*

2. Pescadores, Rio Santa Cruz; 1 lower, 1 small upper valve.

3. Paso del Rio Santa Cruz; 1 double valve.

These are typical, broad *O. hatcheri.*

4. Mt. of Observation, lower horizon; 12 double, 3 lower, 1 upper valve.

Four of them are large, rounded, with short and broad area, but the lamellæ, although a little distant, are more crowded than in the typical *O. hatcheri.* Only slight traces of radial ribs are present. 1 individual of medium size has the lamellæ as in *O. hatcheri*, but its form is elongate, with long, triangular area. 3 of medium size have the lamellæ more or less crowded, the form elongate, and the area long. The rest are young individuals of very irregular shape.

5. Mt. of Observation, upper horizon; 2 double valves.

One is of medium size, the lamellæ distant, the outline elongated-triangular; area very long and narrow. Slight traces of plaits. This is the first individual that shows traces of crenulations near the area on the upper valve. The other is young, ovate-triangular, with a long area. No characters of *O. hatcheri.*

6. San Julian, Oven Point; 2 double, 1 lower valves.

Both double valves are the typical *O. hatcheri*, and in one of them—a very rare case—the upper valve has radial ribs. The single valve is of a more ovate form. All three lower valves have distinct radial ribs; in no other set of specimens are these radial plaits so strongly developed as in this one.

7. Port Madryn, New Bay, Terr. of Chubut; 2 lower valves from between tides, 2 lower and 3 upper valves from ca. 25′ above high tide.

One lower valve of the lower horizon is the typical *O. hatcheri;* the others have the lamellæ more crowded; their outline is ovate or elongate. Area broadly triangular.

8. Shore of Salt Lake, 10 miles north of mouth of Rio Chico; 1 double, 4 lower, 5 upper valves.

Double valve, and 1 lower, typical *O. hatcheri*, with distant lamellæ. The rest is more ovate or irregular. 2 isolated upper valves show distinct traces of crenulations, in the larger of them the lamellæ are remote.

9. Upper Rio Chalia; 1 double, 5 lower, 9 upper valves.

The double valve agrees absolutely with *O. bourgeoisi* Phil. One upper valve is the typical *O. hatcheri*, with rounded outline and remote lamellæ. Another upper valve is the typical *O. philippii* (= *O. bourgeoisi*, but with very long area). The rest are young individuals, of various shapes; one upper valve shows crenulations on the margin; a very young lower one (pl. XIX, fig. 1^c) shows the corresponding grooves.

10. 30 miles north of upper Rio Chalia; 2 double, 6 lower, 2 upper valves.

One of the double valves is the type of my *O. philippii;* the lamellæ are on ⅔ of the shell remote, as in *O. hatcheri.* The other double valve, and one of the lower ones agree with this in the elongate form and long area, but the lamellæ are crowded. Another lower valve is very broad, almost circular, area short and broad, and it agrees in these respects with *O. hatcheri;* but the lamellæ are very crowded. The type of *O. philippii* has distinct crenulations near the area of the upper valve.

11. Cañon near Sierra Oveja, Rio Chico (interstratified with Santa-Cruz beds); 1 double, 2 lower, 2 upper valves.

The double valve is the typical *O. philippii*, but the area is a little shorter (= *O. bourgeoisi*). Outline of the others irregularly oval, lamellæ not much crowded, but less distant than in *O. hatcheri.* Area triangular. In one of the upper valves the lamellæ are very distant for half its length.

12. Shell Gap, Rio Chico, lower horizon; 1 double, 1 lower, 1 upper valve.

The double valve corresponds to *O. hatcheri.* The lower valve (pl. XVII) is elongated, area *very* long, lamellæ crowded, only near the beak more distant. The upper valve is broadly ovate, the lamellæ more crowded than in the typical *O. hatcheri.*

13. Mayer Basin, upper lignites; 2 lower valves.

Elongate, with long area, corresponding to *O. philippii.*

14. Arroyo Gio; 2 double, 16 lower, 1 upper valves.

One of the double valves is very large, round; the other one small, circular; the latter with remote lamellæ, and distinct crenulations in the upper valve near the area; it is a typical *O. hatcheri*, while in the larger one the lamellæ are more crowded. One of the lower valves is very large, round, with lamellæ like *O. hatcheri*, but the area is elongated. The upper valve is an ovate, typical *O. bourgeoisi*, with crenulations. The rest (15 lower valves) grow in clusters, of very irregular shape; no characters of *O. hatcheri* are present; area mostly triangular, in a few very long; 4 of them show grooves corresponding to crenulations near the area; they correspond to *O. bourgeoisi* and *philippii.*

15. East end of Lake Pueyrredon; 1 lower valve.

Young, oval.

16. Lake Pueyrredon, base of Tertiary; 1 lower valve.

Form of *O. hatcheri*, but lamellæ in posterior half more crowded.

A fragment found washed out just below these beds, in the same matrix and of the same color, indicates a more elongated shell, with long area and crowded lamellæ.

17. Lake Pueyrredon, 600′ above base; 2 double valves.

The smaller one is a typical *O. hatcheri;* the larger one is more ovate, with crowded lamellæ.

18. Lake Pueyrredon, extreme top of Patagonian beds; 2 double valves.

Both broadly oval, like *O. hatcheri*, and with broad area, but lamellæ more crowded.

19. Lake Pueyrredon, marine beds overlying Santa-Cruz beds; 8 double valves.

No characters of *O. hatcheri;* outline irregularly oval or triangular. Area triangular, shorter or longer. Size medium or small. Ribs indistinct or none. Crenulations in smaller valve in 3 specimens. Approaches distinctly the Cape Fairweather form.

20. Punta Arenas, horizon V, lower layer ("below V"); 2 double, 3 upper valves.

Both double valves are the typical *O. philippii:* long-ovate, area very long, in one of them incurved; lamellæ in the latter quite distant. 2 of the upper valves agree with this form, but the third is subcircular, with a broad area, and distant lamellæ, except near the margin, and it would thus correspond to *O. hatcheri.*

21. Punta Arenas, horizon V proper; 1 double, 8 lower, 2 upper valves,

Lower valves all much elongated, long-oval, beak much produced, narrowed toward the tip, area very long (see pl. XIX, fig. 1^b); corresponding to *O. philippii.* Lamellæ not very distant, crowded near the margins. One upper valve is oval, with distinct crenulations near the area. The area of these specimens corresponds to Philippi's figure of the area of *O. bourgeoisi.*

22. Punta Arenas, "above horizon V"; 2 double, 2 lower valves.

Outline ovate or subtriangular. Area triangular, not very long. In one of the isolated lower valves the lamellæ are very distant, as in *O.*

hatcheri. The more oval specimens are fully identical with Philippi's main figure of *O. bourgeoisi.* These specimens approach closely the Cape Fairweather form in the triangular outline, moderate area, and medium size and thickness of the shell.

23. Cape Fairweather; 23 double, 12 lower, 5 upper valves.

The characters of this form are given above. Crenulations of the margin, close to the area (see pl. XVIII, fig. 1^b), are shown in 14 upper valves (out of 28).

Thus we possess from these 23 different localities 77 double, 76 isolated lower, and 35 isolated upper valves. Altogether, 153 lower, and 112 upper valves are represented in our collection.

Distribution: Darwin mentions this species from southern Patagonia generally, Philippi from Punta Arenas, v. Ihering from Santa Cruz and La Cueva (upper part of Patagonian formation and Suprapatagonian respectively); it has been found in the Pliocene Coquimbo beds of Chile (Moer.), and further in New Zealand, in the Oamaru and Pareora beds (Oligocene and Miocene) (Zitt., Hutt.).

Affinities: Moericke has already compared this oyster with *O. crassissima* Lamck. from the Miocene of Europe, and there is no doubt a striking resemblance between them in general appearance. Still closer appears the relation to that form called *O. gingensis* (Schloth.), especially when we compare the account and figures given of it by Hoernes (1870, p. 452, pl. 76–80). Hoernes (p. 455) points out the close resemblance of *O. gingensis* and *ingens.*

This type of oyster (*crassissima*-type)—although not exclusively found in the Miocene—is a very characteristic feature of *Miocene* deposits. In older Tertiary beds this giant type is not found.

35. OSTREA PATAGONICA d'Orbigny.

Pl. XX, Fig. 1^{a-d}.

1842 *O. patagonica* d'Orbigny, Voy. Amer. merid., v. 3, p. 33, pl. 7, f. 14–16.
1842 *O. ferrarisi* d'Orbigny, ibid.
1887 *O. patagonica* Philippi, Tert. Quart. Verst. Chiles, p. 215 (part.), pl. 48, f. 2 (after d'Orbigny).
1887 *O. ferrar.* Philippi, ibid., pl. 48, f. 5 (after d'Orbigny) (non text, p. 214).

1887 *O. remondi* Philippi, ibid., p. 214, pl. 48, f. 4.
1896 *O. rem.* Moericke, in: N. Jahrb. Min. Geol. Pal. Beil., Bd. 10, p. 575, pl. 12, f. 2.
1896 *O. transitoria* Moericke, ibid., p. 576, pl. 12, f. 1.
1897 *O. patagonica* Ortmann, in: Amer. Journ. Sci., v. 4, pl. 11, f. 4 (after d'Orbigny).
1897 *O. patagonica* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 326 (non p. 222, nec pl. 9, f. 52).

V. Ihering quotes as synonyms the following species of Philippi: *O. burmeisteri*, *O. bravardi*, *O. longa*, *O. agglutinans*, *O. adsociata* (Anales Mus. Nac. Chile, 1893): I cannot verify these, since I have no access to that paper.

Differs from *O. ingens* in the presence of distinct crenulations all around the margin of the upper valve.

In addition, we may mention, that there are sometimes folds on the lower valve, which are irregular, and comparatively larger than these of *O. ingens* (see the figure of *O. remondi* given by Philippi and our figure 1^b on plate XX).

Remarks: These crenulations or wrinkles are the only distinctive character, but it is a very good one. They are shown in one of the original figures of d'Orbigny, which represents an upper valve. V. Ihering mentions them, and the two upper valves among the material sent by him to the Princeton Museum show them well developed.

Among our material, all of the 33 upper valves show these crenulations, and they pass all around the margin in 26 of them. In the 7 remaining the lower margin is either broken away, or so much worn, that the crenulations have been obscured, but they are always seen at least in certain parts of the margin. In the 103 upper valves of *O. ingens* in our collection in which the inner side is exposed, crenulations are *never* seen all around the margin, and only in 13 valves from the Patagonian beds, and in 14 from the Cape Fairweather beds they are present for a short distance near the area.

We cannot wish any better specific character in an oyster!

To the crenulations of the upper valve correspond, in the lower valve, little grooves. But these are in most cases obliterated, or have been destroyed by the mutilation of the margins. So it is difficult, in many cases, to identify isolated lower valves, unless radial ribs are present.

Out of 14 lower valves in our material, about 10 show these radial ribs of the outer surface distinctly, the rest indistinctly or not at all. The 4 lower valves sent by v. Ihering do not show them.

Our individuals are small or of medium size. The largest lower valve measures: Length, 135 mm; width, 79 mm; the largest upper valve: Length, 142 mm; width, 91 mm.

O. ferrarisi is nothing but the young of this species. *O. remondi* of Philippi is certainly this species; the lower valve figured by him shows radial folds of a character that is never found in *O. ingens*, but frequently in *O. patagonica*, and Philippi expressly states, that the margin of the upper valve possesses crenulations ("margine interno exquisite denticulato"). These crenulations are wanting in Philippi's *O. ferrarisi*, and therefore I consider his specimens of this species to belong to *O. ingens*, while his *figure* is a copy of d'Orbigny's *O. ferrarisi* = *patagonica*.

O. remondi of Moericke is apparently the same as *O. remondi* Phil. *O. transitoria* of Hupé and Philippi is doubtful (see above). But *O. transitoria* of Moericke is certainly identical with *O. patagonica*, since it has crenulations ("deutliche Kerbung am Schalenrande").

O. patagonica seems to be the descendant of *O. ingens*. The crenulations of the margin begin to develop in *O. ingens*, but are rare there, only in the Cape Fairweather form they are more frequent. But they never extend all around the margin. In the true *O. patagonica* this character is fully developed, and—as it seems—is always present, unless obscured or destroyed by the process of fossilization.

Record of specimens: San Julian, Darwin Station, above Patagonian beds; 14 lower, 33 upper valves. (V. Ihering has sent to Princeton from Parana, Entrerios: 1 double, 3 lower, 1 upper valves.)

Distribution: Entrerios; Punta Gorda (mouth of Uruguay); Rio Negro; San Julian (d'Orb.). Santa Rosa (or Punta Raza?, see under discussion of Cape Fairweather beds below), between Santa Cruz and San Julian, Tehuelche Formation (v. Ihering, p. 225); Parana, Entrerios (v. Ih.).

Pliocene of Chili: Coquimbo (Phil.), Caldera (Moer.).

Gen. GRYPHÆA Lamck.

36. Gryphæa cf. tarda Hutton.

Pl. XIV, Fig. 4$^{a, b}$.

1873 *G. tard.* Hutton, Catal. Tert. Moll. Ech. New Zealand, p. 35.
1886 *G. tard.* Tate, in: Tr. R. Soc. S. Australia, v. 8, p. 98, pl. 6, f. 2.

Lower (left) valve ovate-triangular in outline, tumid, with incurved umbo. Exterior smooth, with concentric lines of growth; posterior margin produced into a distinct lobe.

Height, 59 mm; width, 58 mm (but posterior lobe-like expansion damaged).

Remarks: According to Tate, *G. tarda* is very close to the European and North American upper Cretaceous *G. vesicularis* (Lamck.), and differs chiefly in the more triangular outline and larger lobation. Especially the first character would apply to our specimen, which agrees well also in the side view with Tate's figure. Our specimen, however, does not possess the upper valve, the inner side of the lower is filled with hard matrix and not exposed, and further, the lobe-like expansion of the posterior margin is much damaged. Thus it is hard to say, whether our Patagonian fossil is really identical with the Australian species or not. The close resemblance to *O. vesicularis* is quite striking, and there is hardly any doubt that we have to deal with a species of the genus *Gryphæa.*

Record of specimens: High bluffs, S. W. of Lake Pueyrredon, ca. 1000′ below Santacruzian beds, 1 sp.

Distribution: G. tarda has been mentioned first by Hutton from the Chatham Islands, from beds, which belong probably to the Oamaru and Pareora series (Oligocene and Miocene). Tate records this species from South Australia (Aldinga Bay and Bunda Cliffs) from supposed Eocene beds (lowest beds of marine series of older Tertiary).

The genus *Gryphæa* is generally supposed to have disappeared at the close of the Cretaceous period, but we must bear in mind that already Whitfield (1885, p. 224) has recorded *G. vesicularis* from the Eocene marls of New Jersey, and according to Zittel (1885, p. 20) it continues to Recent times. The stratigraphical position of our specimen is not very well ascertained, but it has been found associated with a number of

Brachiopods, which are characteristic for the lower part of the Lake Pueyrredon (Rio Tarde) section, and belong undoubtedly in the Patagonian series: thus the Tertiary age of our fossil, and its association with Patagonian fossils seems to be well established.

Fam. *PECTINIDÆ* Lamck.

Gen. PECTEN Mueller.

37. Pecten proximus v. Ihering.

Pl. XXI, and Pl. XXII, Fig. 1ᵃ⁻ᶜ.

1897 *P. centralis* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 229, pl. 8, f. 48, 49 (non *P. centralis* Sow.).
1897 *P. proximus* v. Ihering, ibid. in tabula.
1900 *P. prox.* Ortmann, in: Amer. Journ. Sci., v. 10, p. 379.

Valves equilateral, unequal, the left one flat, the right one convex. Outline suborbicular. Ears large, subequal, the anterior one a little larger; byssal sinus wanting. Sculpture of the convex (right) valve: about 6 large, rounded principal folds, the 2–4 median ones distinct, the lateral ones indistinct. Each fold with 4–8 strong, radial ribs. Intervals between the folds concave, a little narrower than the folds, near the apex of the shell without ribs, and finely squamulate. Toward the lower margin strong ribs begin to develop in the intervals (from 1 to 5), and, on the margin, the whole surface of the shell, folds as well as intervals, are covered with strong radial ribs. The finely squamulate sculpture is found on the ribs also, but toward the margin it disappears through obliteration by transverse larger squamæ, which develop on the ribs. The ribless intervals are different in extent in different individuals: sometimes they begin to show ribs at an earlier age than in other cases. Flat (left) valve of a similar sculpture: 5–7 principal folds, but intervals broader than the folds, ribs more strongly squamate, the squamæ beginning nearer to the apex. Ears in both valves with radiating ribs, which are less strong than those of the valves, subequal, and squamose.

Largest valve: Height, 21 cm; width, 22.5 cm (but not quite complete).

Remarks: Young individuals, which have the intervals between the large folds smooth (except for minute squamulæ) exhibit quite a different aspect from large individuals, where the lower half of the valve is covered completely with strong radial ribs. V. Ihering's figure 48 (right valve, *proximus*) represents an individual in which the intermediate ribs have not begun to develop. This species cannot be the *P. centralis* of Sowerby, as will be seen below.

Record of specimens: Mouth of Santa Cruz River; 5 double, 9 right, 4 left valves.

Distribution: Jegua quemada, Suprapatagonian beds (v. Ih.).

Affinities: A most closely allied form is *P. caracolensis* Steinmann (1881, p. 254, pl. 14, f. 10) = *P. simpsoni* Philippi (1887, p. 210, pl. 46, f. 1) from the Navidad beds of Chili, but in *P. caracolensis* (according to Philippi's figure) the principal folds are more numerous and narrower, and the ribs are less numerous.

P. athleta Zittel (1864, p. 49, pl. 10, f. 1) from the Oligocene (Oamaru, Hutton, 1873, p. 32) of New Zealand is also closely allied. It differs in the same characters and seems hardly distinct from *P. caracolensis.*

As to the relation to *P. caloosaënsis* Dall see below (under next species).

38. PECTEN PRÆNUNCIUS v. Ihering.

Pl. XIX, Fig. $2^{a, b}$.

1897 *P. præn.* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 230.

Similar to *P. proximus* in the unequal valves, and the large folds (5–7). The differences are: Right valve with a slight byssal sinus. No radial ribs, but only fine radial striæ.

Our specimens are smaller than *P. proximus:* Height, 63 mm; width, 54 mm.

Remarks: The characters given above seem to agree with v. Ihering's species, and moreover, through the kindness of Dr. v. Ihering, I possess a lead-pencil sketch of *P. prænuncius*, which removes all doubt as to the identity of our specimens with this species.

In the two left valves from San Julian the radial folds are quite strong, especially in the one figured (pl. XIX, fig. 2^b). The right valve is small, and the folds are of medium size. Of the specimens of Santa Cruz, one of the right valves agrees completely with that from San Julian; in the other one the radial folds are very slight (pl. XIX, fig. 2^a). The left valve from Santa Cruz shows hardly any traces of folds, and is almost perfectly flat.

Record of specimens: Mouth of Santa Cruz River; 2 right, 1 left valves; San Julian, Darwin Station; 1 right, 2 left valves.

Distribution: Gulf of S. Jorge, Patagonian formation (v. Ih.).

Affinities: There is a strong resemblance to *P. caloosaënsis* Dall (1898, p. 731, pl. 29, f. 12) from the Pliocene of Florida, but in the latter the striæ are stronger, more rib-like, and *P. caloosaënsis* approaches in this respect more the younger individuals of *P. proximus.*

The Australian representative of this species is: *Pecten palmipes* Tate (1886, p. 105, pl. 5, f. 4, pl. 7, f. 4); it has been found in so called (?) Eocene beds of Edithburgh, Yorke Peninsula, and of Aldinga Bay (South Australia).

39. PECTEN CF. CENTRALIS Sowerby.

Pl. XXIII, Fig. 1^{a-b}.

1846 *P. centr.* Sowerby, in: Darwin, Geol. Observ. S. Amer., p. 253, pl. 2, f. 31.

Sowerby figures a left valve. It is characterized by 5 (text, the figure shows 6) radial ribs, which are thin and sharp, and separated by broad, concave intervals. This character is exhibited in our left valve, but the intervals are finely squamulose, without striæ, while Sowerby describes "numerous rough radial lines."

Sowerby did not possess right valves. Our right valve, which was found in connection with the left, agrees completely with that of the foregoing species (*P. prænuncius*). Anterior ear without sinus.

Both valves are much broken, very delicate, and have been put in a bed of plaster, some fragments of the left valve, however, are not in the proper place; I give the figures, as is the present condition of the shell.

Measurements of left valve: Height, ca. 63 mm; width, ?

There remains some doubt whether this is really Sowerby's species; but since it comes from one of his type-localities, it may be that it is this species.

Record of specimens: Port Desire, N. E. side, 1 right and 1 left valve, belonging together.

Distribution: San Julian and Port Desire, one fragment from the first locality, two of the latter (Sow.). Sowerby and Darwin (1846, p. 113) mention this species also from Santa Cruz.

40. PECTEN GEMINATUS Sowerby.

Pl. XXIII, Fig. 2^{a-e}.

1846 *P. gem.* Sowerby, in: Darwin, Geol. Observ. S. Amer., p. 252, pl. 2, f. 24.
1897 *P. quemadensis* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 228, pl. 6, f. 38.
1899 *P. fissicostalis* v. Ihering, in: N. Jahrb. Min. Geol. Pal., v. 2, p. ,11 pl. 1, f. 1.
1900 *P. geminatus* Ortmann, in: Amer. Journ. Sci., v. 10, p. 379.

Both valves almost equally convex, the right one a little less so. Outline suborbicular in old individuals, subtriangular in younger ones. Anterior ears considerably larger than the posterior, that of the right valve with a deep byssal sinus. Outer surface of right valve with from 20–30 strong ribs, arranged somewhat irregularly in pairs. All the principal ribs distinct down to the lower margin, but on the lateral parts of the shell they become less distinguishable from the smaller (secondary) ribs. Intervals between the principal ribs a little broader than the ribs, occupied by from 1 to 5 secondary ribs or striæ. All ribs covered with squamæ. In very old individuals the number of the intermediate ribs increases to 7, and those adjoining the principal ribs grow larger, giving a fasciculate appearance to the principal ribs. The median secondary rib in each interval is usually a little stronger than the rest. In the left valve the character of the ornamentation is practically the same, but the geminate character of the principal ribs is altogether lacking.

Measurements: Height, 105, 85, 35 mm.
Width, 107, 80, 28 mm.

Remarks: The character of the geminate ribs is present only in the *right* valve, and distinct only on the median part of it; near the lateral margins principal and secondary ribs are hardly distinguishable. Young individuals, of about the size of Sowerby's figure, ca. 30 mm, show only the principal ribs and a few single striæ in the intervals, so that the total number of ribs is only about 20 to 24. In larger individuals, of the size of v. Ihering's figure of *P. quemadensis*, ca. 35–40 mm, the intermediate ribs become more numerous, and especially the ribs near the lateral margins increase in number, so that we may count 24–30 ribs. In still larger individuals the number of the principal ribs does not increase materially with age, but that of the secondary ribs does considerably, so that we may count, in very large ones, 90–100 ribs of different size.

Furthermore, this species varies in the development of the larger ribs. In some cases (so chiefly in large individuals from Santa Cruz) the principal ribs are very distinct and much larger than the secondary. A few individuals from Oven Point and Darwin Station show the same character, but in the larger number from Oven Point this difference is not so strongly pronounced, although the principal ribs are still well marked. A third variety is found, to which belongs the larger number from Darwin Station; here the fasciculate appearance of the ribs, shown in old individuals of the typical form, begins at an earlier stage: the intermediate ribs closest to the principal ones become stronger, while the principal rib itself is not so strongly contrasted to them in size, and we have in shells of medium size, already an appearance of the principal ribs being composed of from two to four smaller ones. In these specimens the ribs appear to be more numerous, a little finer on the average, and more crowded, and they represent completely the form described by v. Ihering as *P. quemadensis.*

There is no sharp line to be drawn between these different forms, and the form *quemadensis*, although not found among the larger specimens from Santa Cruz, is exhibited in a few younger individuals from this locality, and in a few larger ones from Oven Point. As has been stated, it is the prevailing form at Darwin Station. There are all possible transitions between the different forms in the development of ribs.

The outline of the shell changes with age. Young shells appear more elongate, subtriangular, while larger shells are broader and more rounded (see measurements).

V. Ihering's *P. fissicostalis* is nothing but the cast of a larger individual of this species. We have received from v. Ihering one cast under this name, from Santa Cruz: it agrees completely with casts of *P. geminatus* represented in our collection, and still connected with the shell.

Record of specimens: Mouth of Santa Cruz River, 7 right, 11 left valves; San Julian, Oven Point, 3 double, 17 right, 17 left valves; San Julian, Darwin Station, 6 double, 12 right, 7 left valves; Cañon near Sierra Oveja, 1 left valve; Shell Gap, lower horizon, 3 single shells (imbedded in matrix); Arroyo Gio, 1 right valve; East end of Lake

Pueyrredon, 2 casts; Lake Pueyrredon, base of Tertiary, 4 casts; Lake Pueyrredon, 600′ above base, 4 casts; Lake Pueyrredon, marine beds overlying Santa Cruz beds, 9 casts.

Distribution: San Julian (Sow.); Santa Cruz, La Cueva, Jegua quemada (v. Ih.). According to v. Ihering, *P. fissicostalis* is from the Patagonian, *P. quemadensis* from the Suprapatagonian beds.

Affinities: A very closely allied form is *P. coquimbensis* Moericke (1896, p. 577, pl. 13, f. 7–10) from the Pliocene Coquimbo beds of Chili, but in *P. coquimbensis* both valves are said to be almost flat, and the intermediate ribs are less numerous; primary ribs 26–28.

The following species (*P. actinodes*) is also closely related, see below.

41. PECTEN ACTINODES Sowerby.

Pl. XXIV, Fig. $1^{a,b}$.

1846 *P. act.* Sowerby, in: Darwin, Geol. Observ. S. Amer., p. 253, pl. 3, f. 33.
1897 *P. act.* Pilsbry, in: Pr. Acad. Philad., p. 330.
1897 *P. act.* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 227.

Shell suborbicular. Right valve very slightly convex, almost flat; left valve convex. Anterior ear much larger, that of the right valve with a deep byssal sinus. Sculpture of both valves consisting of 30–40 principal ribs, which are only slightly elevated, and not very different from the intermediate ribs, of which 3–7 exist in each interval. Sometimes the intermediate ribs closest to the principal ribs are a little stronger, giving a subfasciculate appearance to the principal ribs. All ribs covered with squamæ.

Height, 112 mm; width, 104 mm.

Remarks: This species differs from *P. geminatus* in the complete absence of geminate ribs on both valves, in the larger number and smaller size of the principal ribs, and the flattened right valve. It will be remarked, that the form *quemadensis* of *P. geminatus* makes in some degree a transition toward this species.

Record of specimens: Cape Fairweather; 15 right, 11 left valves, and a number of fragments.

Distribution: San Josef (Sow.); Bay de la Pava, north of Desire, and Punta Rosa (or Raza ?, see under discussion of Cape Fairweather beds below), between Santa Cruz and San Julian, Tehuelche formation (v. Ih.).

Affinities: There is no doubt that this species is the descendant of *P. geminatus.* Closely allied is: *P. tenuicostatus* Hup. (Philippi, 1887, p. 210, pl. 47, f. 1, and Moericke, 1896, p. 580, pl. 12, f. 13–16) from the Navidad beds of Tubul, Chili, but in *P. tenuicostatus* the byssal sinus is less developed, and the ears are not so unequal.

P. vidali Phil. (1887, p. 212, pl. 47, f. 5) from the Pliocene of Coquimbo has stronger, more distinctly fasciculate, and less numerous ribs; the right valve is not so flat.

Fam. *MYTILIDÆ* Flem.

Gen. MYTILUS L.

42. Mytilus cf. chorus Molina.

Pl. XXV, Fig. $1^{a, b}$.

1843 *M. ch.* d'Orbigny, Voy. Amer. mer., v. 5, p. 647.
1858 *M. ungulatus* Reeve, Conch. icon., v. 10, pl. 2, f. 4.
1887 *M. chorus* Philippi, Tart. Quart. Verst. Chiles, p. 202.
1889 *M. ch.* Clessin, in: Martini & Chemnitz, Syst. Conch. Cab., v. 8, p. 65, pl. 5, f. 1, pl. 9, f. 1, 2.
1897 *M. cf. ch.* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 232, pl. 9, f. 55.

Shell elongated-oval, thick, smooth, except for the growth lines; apex acute; dorsal margin slightly curved, about half as long as the total length of the shell, forming a very obtuse angle with the posterior margin. Ventral margin almost straight.

Measurements (of Cape Fairweather specimen); Length, 111 mm; height, 63 mm.

Remarks: Our specimens from Rio Chalia are very poor; they are incomplete casts, with a few fragments of the shell remaining. As far as can be made out, they agree in shape well with *M. chorus,* and since this species is also mentioned by v. Ihering from the Patagonian beds, it seems quite probable, that we have to deal with this species. One of the casts from Cape Fairweather shows well the external form, and is indistinguishable from the rest.

Record of specimens: Upper Rio Chalia, remains of 6 valves; Cape Fairweather, 2 casts.

Distribution: Living: Chili. *Fossil:* Santa Cruz, Patagonian beds (v. Ih.); Quaternary of Chili, and doubtfully in the Navidad beds (Phil.).

43. MYTILUS MAGELLANICUS Chemnitz.

Pl. XXIV, Fig. 3.

1785 *M. mag.* Chemnitz, N. syst. Conch. Cab., v. 8, p. 162, pl. 83, f. 742, 743.
1843 *M. mag.* d'Orbigny, Voy. Amer. mer., v. 5, p. 647.
1858 *M. mag.* Reeve, Conch. icon., v. 10, pl. 6, f. 22.
1873 *M. mag.* Hutton, Cat. Tert. Moll. Ech., N. Zealand, p. 25.
1886 *M. mag.* Hutton, in: Trans. N. Zealand Inst., v. 18, p. 365.
1900 *M. mag.* Ortmann, in: Amer. Journ. Sci., v. 10, p. 378.

Shell elongated-triangular, apex subacute; dorsal margin slightly convex, forming an obtuse and indistinct angle with the posterior margin; ventral margin straight or slightly concave, forming a rounded angle with the posterior margin. Surface of shell sculptured by radiating, wrinkled, dichotomous ribs.

Length, 50 mm; height, 23 mm.

Remarks: I have compared our specimens with recent specimens of *M. magellanicus* collected by Mr. Hatcher at various localities on the Patagonian coast, and find that they agree completely.

Record of specimens: San Julian, Oven Point; internal and external casts of about 10 specimens.

Distribution: Living: coast of Patagonia and Straits of Magellan. *Fossil:* Philippi (1887, p. 249) mentions *M. magellanicus* from Lota, Chili, "probably quarternary," but does not give it in the text, pp. 200–202. Hutton records it from the Miocene (Pareora), Pliocene (Wanganui) and Pleistocene beds of New Zealand.

Gen. MODIOLA Lamck.

44. MODIOLA AMEGHINOI v. Ihering.

Pl. XXV, Fig. 2.

1897 *M. am.* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 233, pl. 6, f. 43.

Shell oblong, elongate, subtrapeziform, smooth. Cardinal part of dorsal margin very slightly convex, posterior part slightly concave; these two parts meeting at an obtuse angle; posterior part passing in a regular curve into the posterior margin. Ventral margin slightly concave. Apex situated a very short distance from the anterior end.

Remarks: Our specimens differ from the original description in the more ventricose valves and apex, but the general form agrees well with v. Ihering's species, so that I do not think they are different.

Record of specimens: Mouth of Santa Cruz River, 1 right valve; Mt. of Observation, upper horizon, 1 left valve.

Distribution: Jegua quemada, Suprapatagonian beds (v. Ih.).

Affinities: Our specimens come very near to *M. coquimbana* of Philippi (1887, p. 203), especially to the variety figured in Philippi's pl. 44, f. 7, from the Pliocene of Coquimbo, Chili. In *M. coquimbana*, however, the apex is more anterior.

45. MODIOLA ANDINA Ortmann.

Pl. XXIV, Fig. 4.

1900 *M. and.* Ortmann, in: Amer. Journ. Sci., v. 10, p. 370.

Shell small, elongate, about 2½ times as long as high. Apex near anterior end. Both valves convex, with a blunt ridge running down from the apex to the posterior and inferior end. This ridge is curved, the concave side of the curve directed toward the lower margin. Upper margin almost straight in its anterior (cardinal) part, forming a blunt angle with the posterior part, which is almost straight, and passes by a regular curve into the rounded posterior margin of the shell. Ventral margin distinctly concave, and forming with the posterior margin a right, but blunt angle. Surface of shell finely radially striated in the upper part, *i. e.*, above the oblique ridge crossing the valve; the striæ most distinct near the posterior half of upper and near posterior margin. Lower part of shell, below the ridge, smooth, only with few lines of growth. Anterior end of shell, below and in front of the apex, with a few (5–7) fine striæ, which are often very indistinct.

Measurements:	
Length,	24, 23 mm.
Height,	9, 10.5 mm.

Remarks: No *Modiolæ* are known from South American deposits that might be compared with this one. In *M. rugulosa* and *læviuscula* of Philippi (both from Lebu, Chili), radial striæ are present, but they are not distributed in the particular manner as in this species, and, furthermore, the outline of the shell is quite different.

Record of specimens: Lake Pueyrredon, base of Tertiary, 1 sp.; Lake Pueyrredon, 400′ above base, ca. 35 sp.; Lake Pueyrredon, 600′ above base, ca. 8 sp.

Fam. *CRASSATELLITIDÆ* Dall.

Gen. CRASSATELLITES Krueger.

46. CRASSATELLITES LYELLI (Sowerby).

Pl. XXVI, Fig. 9$^{a, b}$.

1846 *Crassatella l.* Sowerby, in: Darwin, Geol. Observ. S. Amer., p. 249, pl. 2, f. 10.

1897 *C. l.* v. Ihering, in: Rev. Mus. Paul, v. 2, p. 246.

Shell obovate, comparatively thin and flat, rounded anteriorly, angulated posteriorly; posterior dorsal margin oblique, straight or slightly concave near the apex; anterior dorsal margin straight near the apex, hardly concave. Surface with broad concentric grooves, which are separated by blunt ridges.

Length, 44 mm; height, 33.5 mm; diameter, 5.5 (×2).

Remarks: V. Ihering says that the ventral margin is crenulated. I do not see any crenulations in our specimens.

Record of specimens: Mouth of Santa Cruz River, 1 double, 1 right, 3 left valves.

Distribution: Santa Cruz (Sow.), Patagonian formation (v. Ih.).

47. CRASSATELLITES KOKENI (v. Ihering).

Pl. XXVI, Fig. 10$^{a, b}$.

1899 *Crassatella k.* v. Ihering, in: N. Jahrb. Miner., etc., v. 2, p. 17, pl. 2, f. 2.

Shell ovate, subtriangular, comparatively thicker than in *C. lyelli*, and more convex; rounded anteriorly, angulated posteriorly, but not so much produced as in *C. lyelli.* Posterior dorsal margin oblique, slightly convex near apex; anterior dorsal margin distinctly concave below apex. Surface markings nearly as in *C. lyelli*, but the ridges separating the concentric grooves are a little sharper. Ventral margin sharply crenulate.

Measurements: Length, 26 mm; height, 22 mm; diameter, 6 (× 2) mm.

Remarks: Differs from *C. lyelli* in the subtriangular, shorter outline, the concave lunular margin, and the crenulations of the lower margin. As to the latter point, compare remarks above.

Record of specimens: Mouth of Santa Cruz River, 4 right, 4 left valves.

Distribution: Santa Cruz, Patagonian formation (v. Ih.).

Affinities: *C. plicatilis* Deshayes (1860, p. 745, pl. 18, f. 6, 27) from the Middle Eocene of Paris comes near this species, but *C. kokeni* is narrower posteriorly, the surface markings are much more distant from each other, and the anterior dorsal margin is concave. Still more closely allied is *C. sulcata* (Sol.) (see Wood, 1871, p. 170, pl. 23, f. 11) from the Upper Eocene of England and France, which agrees especially well in sculpture, while the outline is more like that of *C. plicatilis*, although more produced posteriorly.

48. CRASSATELLITES QUARTUS (Ortmann).

Pl. XXVII, Fig. 1.

1900 *Crassatella quarta* Ortmann, in: Amer. Journ. Sci., v. 10, p. 371.

Shell ovato-elongate, comparatively thin, less convex than in the preceding species, but more so than in *C. lyelli.* Apex only slightly prominent. Anterior end of shell rounded, posterior hardly angulated and hardly narrowed. Posterior dorsal margin straight near apex, anterior straight, only with a slight suggestion of concavity close to the apex. Surface ornaments as in *C. lyelli*, but the ridges more crowded, and a little less strongly developed. Ventral margin without crenulations.

Measurements of Santa Cruz specimen: Length, 25 + x; height, 15 mm; of Lake Pueyrredon specimen: Length, 17 mm; height, 10 mm.

Remarks: The single isolated valve from Santa Cruz is broken posteriorly, so that the complete length cannot be given. According to the lines of growth, however, we have here the following relations: Length, 16 mm; height, 9 mm, which agrees well with the Lake Pueyrredon specimen, and would bring up the total length of the shell to about 30 mm (not quite double its height).

Record of specimens: Mouth of Santa Cruz River, 1 left valve; Lake Pueyrredon, 600′ above base, 1 cast of left valve.

49. Crassatellites longior (v. Ihering).

Pl. XXVII, Fig. 2.

1897 *Crassatella l.* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 247, pl. 5, f. 34, pl. 6, f. 37.

Shell elongate-triangular, slightly convex, thick. Apex at about ⅓ of the length. Anterior end rounded, posterior produced and narrowed. Posterior dorsal margin oblique, forming a blunt angle with the posterior margin. Ventral margin curved anteriorly, almost straight posteriorly, forming a distinct acute angle with the posterior margin. An indistinct angulation runs down from the apex to the posterior angle. Surface marked with shallow concentric furrows. According to v. Ihering, the ventral margin is crenulated.

Length, 44 mm; height, 27 mm; diameter, 8 (× 2). Attains, according to v. Ihering, almost double that size.

Record of specimens: Lake Pueyrredon, base of Tertiary; 1 right valve.

Distribution: Jegua quemada, Suprapatagonian beds (v. Ih.).

Affinities: This species resembles *C. melina* Conr. (see Whitfield, 1894, p. 60, pl. 8, f. 11–13) from the *Miocene* of New Jersey, but it is more elongated and less convex, and the ventral margin is straight in the posterior part. A more remote resemblance exists with *C. ponderosa* Phil. from the Navidad beds of Chili, the latter being larger, thicker, and less elongate, with the ventral margin arcuate throughout.

Fam. *CARDITIDÆ* Gill.

Gen. CARDITA Brug.

50. Cardita elegantoides Ortmann.

Pl. XXVI, Fig. 5^{a-c}.

1899 *C. el.* Ortmann, in: Amer. Journ. Sci., v. 8, p. 428.

Shell subcircular, slightly oblique, with 18–19 radial ribs, which are convex and obtuse, about as broad as the intervening furrows, and nodulose. Lunula small, oblong.

Measurements (of type specimen): Length, 16 mm; height, 14 mm; of specimens from Santa Cruz: Length, 18.5, 15.5 mm; height, 17, 14.5 mm.

Remarks: This species was first described by the present writer in 1899 from a few poorly preserved individuals from the Magellanian beds of Punta Arenas. Later, among the last set of fossils brought home by Mr. Hatcher, I found a larger number of better preserved valves of a small *Cardita* from the Patagonian beds of Santa Cruz, which agree completely with the Punta Arenas fossil. The chief characters of this species are: the shape and the size of the shell, and the number and shape of the ribs. Young individuals of *C. inæqualis*, of the same size as this species, may be distinguished at a glance by the larger number of ribs. *C. volckmanni*, which is closely allied, differs in the smaller number of ribs.

Record of specimens: Punta Arenas, horizon III (upper Magellanian), 3 isolated right valves, 2 valves in matrix; Mouth of Santa Cruz River, 23 right, 17 left valves; Mt. of Observation, upper horizon, 1 double, 4 right, 1 left valves.

Affinities: I compared this species with *C. elegans* Lmck. of the European Eocene. But since there are so many similar species known from Tertiary deposits, it is impossible to say that just this one is the *most* closely allied form.

This is so far the only species that is common to the Magellanian and Patagonian beds.

51. CARDITA VOLCKMANNI Philippi.

Pl. XXVI, Fig. 6.

1887 *C. v.* Philippi, Tert. and Quart. Verstein. Chiles, p. 173, pl. 37, f. 4.
1900 *C. v.* Ortmann, in: Amer. Journ. Sci., v. 10, p. 378.

The only difference from the preceding species is the number of the radial ribs: there are only 15 of them. The ornamentation of the ribs is not preserved in our specimens.

Record of specimens: Lake Pueyrredon, 600′ above base of Tertiary, 6 casts.

Distribution: Navidad beds of Tubul, Chili (Phil.).

52. CARDITA INÆQUALIS Philippi.

Pl. XXVI, Fig. 7^{a-d}.

1887 *C. in.* Philippi, Tert. and Quart. Verst. Chiles, p. 173, pl. 37, f. 5.
1897 *C. in.* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 245.
1897 *C. patagonica* v. Ihering, ibid., p. 244.
1899 *C. pat.* v. Ihering, in: N. Jahrb. Miner., etc., v. 2, p. 16.
1900 *C. inæqu.* Ortmann, in: Amer. Journ. Sci., v. 10, p. 380.

Shell ovato-subquadrate, oblique. Surface with 21–26 radiating ribs, which are sharply angular and high, crossed by lines of growth, and rendered sharply nodulose by them. In old individuals the ribs become more rounded, and the nodules disappear toward the ventral margin.

Length, 43 mm; height, 40 mm.

Remarks: In outline this shell is somewhat variable: the apex is more or less inclined. Philippi's specimens had all lost the outer layer of the shell. In our specimens the latter is in most cases at least partly preserved, and the shell has, as regards the sculpture, quite a different appearance. The radial ribs are sharp, angulated, and on their upper edge is a series of sharp nodules. The valleys between the ribs are deep, but their bottom is flat. If the outer layer is gone, the ribs appear as flat, broad, and smooth elevations.

Toward the ventral margin, in some of the old individuals, the ribs become comparatively narrower with broader intervals, while the general character of the ribs remains the same; in others, however, the ribs become more rounded and broader, and lose their nodules.

Although individuals of medium and large size may be easily recognized, young ones (smaller than 15 mm) do not always exhibit distinctly the characteristic outline, and especially the apex is not so much inclined. It is sometimes difficult to distinguish these from *C. elegantoides*, but, as a rule, in *C. elegantoides* the apex is more upright, and the posterior hinge tooth of the left valve is shorter than in the present species. Furthermore, the number of ribs is different. I have 12 shells from Santa Cruz—all small—which have the ribs of *C. inæqualis* (over 20), but the shape of the shell is that of *C. elegantoides.*

In *C. inæqualis* the posterior hinge tooth in the left valve is about four times as long as the anterior, but there are considerable variations in the thickness of the hinge teeth.

V. Ihering has sent to us one right and one left valve of this species under the name of *C. patagonica;* they are from Santa Cruz, and he called this species apparently by that name *(patagonica)* in 1899. But the external shape of the true *C. patagonica* of Sowerby is entirely different, and we cannot regard it as this species, unless we assume that Sowerby's figure is all wrong. There is, however, hardly anything that could warrant this assumption, although there are discrepancies between Sowerby's diagnosis and his figure.

Record of specimens: Mouth of Santa Cruz River, 2 double, 20 right, 29 left valves; Las Salinas, 3 right, 4 left valves; Mt. of Observation, upper horizon, 2 double, 12 right, 2 left valves.

Distribution: Santa Cruz (Phil., v. Ih.); Patagonian formation (v. Ih.). Suprapatagonian beds of Jegua quemada and La Cueva (v. Ih.).

53. CARDITA PATAGONICA Sowerby.

Pl. XXVI, Fig. 8^{a-c}.

1846 *C. pat.* Sowerby, in: Darwin, Geol. Observ. S. Amer., p. 251, pl. 2, f. 17.
1897 *C. pat. var.* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 245.
1899 *C. pseudopatagonica* v. Ihering, in: N. Jahrb. Miner., etc., v. 2, p. 16.
1900 *C. pat.* Ortmann, in: Amer. Journ. Sci., v. 10, p. 380.

Shell ovate, subtriangular, hardly oblique, as high as long, or higher; apex very slightly inclined. Surface with 23–25 radial ribs, which are rounded, not angular, and slightly squamuloso-nodose near the apex, but toward the ventral margin they are crossed only by lines of growth.

Measurements: Length, 20, 19 mm; height, 20, 20 mm.

Remarks: In the external form our specimens agree with Sowerby's figure, especially the almost upright apex is very striking. Sowerby, in the diagnosis, calls the ribs narrow, angular and squamoso-serrate, characters which are not supported by the figure, where the ribs appear broad, rounded, and slightly nodulose. In all essential respects the figure corresponds with our specimens, with only the exception that it is almost double the size (length, 35; height, 37). Since a large form, agreeing with this figure has never been found by other collectors at Santa Cruz, it seems possible that Sowerby's figure was drawn on an enlarged scale.

V. Ihering, in 1897, mentions this smaller form from the so called Santacruzian (=Suprapatagonian) beds, and calls it in 1899 *C. pseudo-*

patagonica, and this is certainly identical with our species. Besides, v. Ihering records from the Patagonian formation a *C. patagonica*, but it seems to me that this identification is not correct. He does not give any detailed description of this supposed *C. patagonica*, but (as has been said above) he has sent to the Princeton Museum 2 specimens of *C. inæqualis* under that name, so that there is no doubt that his *C. patagonica* is really *C. inæqualis.*

If my presumption is correct that Sowerby's figure is enlarged, then it is beyond doubt that this small form represented in our collections is the typical *C. patagonica.*

Hutton (1886, p. 364) identifies his *Venericardia intermedia* (1873, p. 24) with "*C. patagonica*," but I am unable to say whether this species corresponds to our *C. patagonica.*

Record of specimens: Mouth of Santa Cruz River; 9 right, 4 left valves.

Distribution: Santa Cruz (Sow.), ibid., Patagonian formation (v. Ih.); Jegua quemada, Suprapatagonian beds (v. Ih.).

Affinities: Sowerby compares this species with the European Eocene *C. acuticostata* Lmck. (Wood, 1861, p. 142, pl. 22, f. 5), but there is hardly any close relation with it.

C. caumotiensis Deshayes (1860, p. 774, pl. 61, f. 6–8) from the Eocene of France has a similar outline, but is much smaller and has more numerous and finer ribs. *C. granulata* Say (Whitfield, 1894, p. 56, pl. 9, f. 1–4) from the Miocene of New Jersey agrees in the slightly oblique outline and the number and character of ribs, but it is more circular and the apex more incurved. The most closely allied form seems to be: *C. dunkeri* Phil. (1846, p. 50, pl. 7, f. 7) from the Lower Oligocene of Germany. It agrees well in sculpture and outline, but the latter is more circular, with hardly an indication of triangular shape, and the apex is slightly more inclined. In this species also the hinge teeth of the right valve closely correspond to *C. patagonica.*

Fam. *LUCINIDÆ* Flem.

Gen. LUCINA Brug.

54. Lucina neglecta spec. nov.

Pl. XXVII, Fig. 3.

Shell suborbicular, lentiform; posterior dorsal margin slightly convex, forming an obtuse angle with the posterior margin. Anterior dorsal margin slightly concave, forming an indistinct, rounded angle with the anterior margin. Anterior, ventral, and posterior margins forming part of a regular circle. Beak small. Surface with concentric, elevated lines, which are crowded, especially near the apex. Hinge teeth not visible.

Length, ca. 22 mm; height, 21 mm; diameter, 4 mm (× 2).

Remarks: In my preliminary report on the Magellanian beds of Punta Arenas, I confounded these shells with *Dosinia magellanica* (see below), a mistake that was due to the fact, that they are imbedded in the same piece of rock with the latter species, and had not been worked out of the matrix sufficiently.

This species resembles much the following (*L. promaucana*), but is distinguished by the concentric lines, which, in *L. neglecta*, are more crowded, especially toward the apex, and which are more irregular toward the ventral margin. *L. neglecta* seems also to be a little less convex, and the lunula—as far as can be seen—is less concave and less distinct.

Record of specimens: Punta Arenas, horizon II (lower Magellanian), 1 double, 1 right, 2 left valves.

55. LUCINA PROMAUCANA Philippi.

Pl. XXVII, Fig. $4^{a,b}$.

1887 *L. prom.* Philippi, Tert. & Quart. Verst. Chiles, p. 181, pl. 24, f. 6.
1897 *L. prom.* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 47, pl. 5, f. 32.

Shell suborbicular, lentiform, posterior dorsal margin almost straight, forming an obtuse angle with the posterior margin; anterior dorsal margin slightly concave, forming an indistinct, rounded angle with the anterior margin. Anterior, ventral, and posterior margins forming part of a regular circle. Beak small. Surface with concentric, rather widely distant, elevated lines. Hinge (of right valve) with 2 cardinal teeth, the posterior slightly divided; anterior and posterior lateral tooth small, but distinct.

Our largest specimen (Punta Arenas) measures: Length, 25 mm; height, 22 mm; diameter, 5 (× 2), another one (Paso del Rio Santa Cruz): Length, 21 mm; height, 19 mm; diameter, 5 mm (× 2). According to Philippi and v. Ihering it attains the length of 31 mm by a height of ca. 28 mm.

Record of specimens: Mouth of Santa Cruz River, 2 double valves; Paso del Rio Santa Cruz, 1 right valve; Upper Rio Chalia, 2 casts; Punta Arenas, horizon V (Patagonian beds), 2 right valves.

Distribution: Jegua quemada, Jack Harvey, La Cueva, Suprapatagonian beds; perhaps also from Santa Cruz, Patagonian beds (v. Ih.); Santa Cruz (Phil.). Navidad beds of Chili: Navidad, Matanzas, Lebu (Phil.).

Affinities: Philippi compares this species with *L. radula* Lmck. = *borealis* (L.) (see: Hoernes, 1870, p. 229, pl. 33, f. 4), to which it is very closely allied indeed. *L. borealis* is Miocene to Recent in Europe, and also Miocene to Recent in California (see: Gabb, 1869, p. 100). In *L. promaucana* the lateral hinge teeth are more distinct than in the European species; I have seen, however, in the Princeton collections, individuals of *L. borealis* from the Pliocene of Italy, which also have distinct lateral teeth. *L. praecedens* v. Koenen (1868, p. 246, pl. 28, f. 8) from the Middle and Upper Oligocene of Germany is hardly distinguishable from *L. borealis.*

56. LUCINA ORTMANNI v. Ihering.

Pl. XXVII, Fig. 5.

1899 *L. o.* v. Ihering, in: N. Jahrb. Miner., etc., v. 2, p. 18, pl. 2, f. 3.

Shell suborbicular, convex; posterior dorsal margin straight, forming an obtuse angle with the posterior margin. Anterior dorsal margin straight, forming an obtuse angle with the anterior margin. No lunula. Beak small. Anterior, ventral, and posterior margins forming part of a circle. Two very blunt ridges running from the apex toward the middle and lower part of the posterior margin (according to v. Ihering): these ridges are not shown in his figure. In our specimen an indistinct depression runs toward the lower posterior margin, which would correspond to the space between the ridges mentioned by v. Ihering. Surface almost smooth, very finely concentrically striated, and with concentric growth-lines, but no elevated lines are present as in the two preceding species.

Length, 22 mm; height, 20 mm; diameter, 6 (× 2) mm.

Record of specimens: Mouth of Santa Cruz River; 1 right valve.

Distribution: Santa Cruz, Patagonian beds (v. Ih.).

Affinities: v. Ihering compares this species with *L. globosa* Ad. We know several Tertiary species, which resemble this one in form and sculpture, but until we know the interior of the shell and the hinge, it is impossible to say whether there are closer relations to any of them.

Fam. *CARDIIDÆ* Fisch.

Gen. CARDIUM L.

57. CARDIUM PHILIPPII v. Ihering.

Pl. XXVII, Fig. 6.

1887 *C. multiradiatum* Philippi, Tert. & Quart. Verst. Chiles, p. 178 (pro parte, non *C. multiradiatum* Sowerby).
1897 *C. philippii* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 49, pl. 6, f. 40.
1899 *C. ph.* var. *pauciradiata* v. Ihering, in: N. Jahrb. Miner., etc., v. 2, p. 15.

Shell large, subglobular, with about 45 radiating ribs, of which 1 or 2 near the anterior end are large and geminate. The other ribs are high and smooth, those of the posterior end finer and tuberculate.

Remarks: Our specimens are all badly preserved, but they agree, especially those from Santa Cruz, with v. Ihering's species, which is, according to v. Ihering, different from *C. multiradiatum* of Sowerby. They seem to correspond to the variety *pauciradiata.* Our best individual shows only *one* geminate rib anteriorly.

Two casts from Lake Pueyrredon, 600′ above base, show distinctly 2 larger geminate ribs. One of them is very small (about as large as the following species), but it is distinguished at once by the smaller number of ribs.

The casts from Arroyo Gio are doubtful: only traces of the ribs are seen, which seem to correspond to this species.

Record of specimens: Mouth of Santa Cruz River, 2 right valves, and several fragments; Arroyo Gio, 2 casts; east end of Lake Pueyrredon, 1 cast; Lake Pueyrredon, base of Tertiary, 1 cast; Lake Pueyrredon, 600′ above base, 6 casts.

Distribution: Suprapatagonian beds of Jegua quemada, and Patagonian beds of Santa Cruz (v. Ih.); Santa Cruz (Phil.).

58. CARDIUM PUELCHUM Sowerby.

Pl. XXVII, Fig. 7.

1846 *C. p.* Sowerby, in: Darwin, Geol. Observ. S. Amer., p. 251, pl. 2, f. 15.
1899 *C. p.* v. Ihering, in: N. Jahrb. Miner., etc., v. 2, p. 15.

Shell subglobular, posterior end with an indistinct angulation running down from the apex toward the posterior margin. Surface of shell with very numerous (60–80) radiating ribs, which are about as broad as the intervals. On the posterior part of the shell these ribs are a little higher and sharper. In all our specimens (as in Sowerby's) the outer layer of the shell is gone: only in that from Las Salinas remains of it are still present; here the ribs are flat, and appear to be separated by narrow, impressed lines.

Length, 30 mm; height, 30 mm; diameter (double shell), 20 mm.

Record of specimens: Mouth of Santa Cruz River, 2 double, 7 single valves; Las Salinas, 1 double valve; Mt. of Observation, upper horizon, 1 double valve; Cañon near Sierra Oveja, 2 casts.

Distribution: Santa Cruz (Sow.), ibid., Patagonian beds (v. Ih.)

Affinities: C. comatulum Bronn (see: Speyer, 1864, p. 301, pl. 41, f. 10, and v. Koenen, 1868, p. 244, pl. 29, f. 1, 2) from the Middle and Upper Oligocene of Germany, and the Miocene of the Azores, seems to be closely allied. It has the same general form, but is smaller, and the radiating ribs are less strongly developed. The same type of Cardium is continued from the Miocene to the Recent time in Europe by *C. fragile* Brocchi (see: Hoernes, 1870, p. 173, pl. 30, f. 6).

An Eocene representative of these species is *C. difficile* Deshayes (1860, p. 572, pl. 55, f. 6, 7), but it is distinguished by the distinctly broader form and more distinct posterior angulation.

C. puelchum is clearly more closely allied to the Oligocene and Neogene species mentioned.

59. CARDIUM PISUM Philippi.

Pl. XXVII, Fig. 8.

1887 *C. p.* Philippi, Tert. & Quart. Verst. Chiles, p. 179, pl. 9, f. 9.

Shell small, ovate, subglobular, scarcely oblique. Surface with 25–30 radiating ribs, which are rounded and crossed by concentric lines of growth.

Length, 9.5 mm; height, 10.5 mm; diameter, 4.5 (× 2) mm. The specimen from Las Salinas: height, 11 mm.

Remarks: v. Ihering (1897, p. 251) hints that this may be only a variety of *C. pulchrum:* but the very much smaller number of ribs does not support this view. Philippi says that the radiating ribs are indistinct near the anterior and posterior margins: this is true in our specimen from Santa Cruz, but this feature is due to the exfoliation of the upper layer of the shell. In the specimens from Lake Pueyrredon the shell is partly preserved, and the ribs are distinct also near the anterior and posterior margins, although a little finer and less high than in the middle.

Record of specimens: Mouth of Santa Cruz River, 1 sp.; Las Salinas, 1 sp.; Arroyo Gio, 1 cast; Lake Pueyrredon, base of tertiary, 11 sp.

Distribution: Santa Cruz (Phil.).

Affinities: A closely allied species is *C. sphæridium* Phil. from Lebu (Navidad beds), but in the latter species the ribs are finer and more numerous.

Gen. AMATHUSIA Phil.

60. AMATHUSIA ANGULATA Philippi.

Pl. XXVII, Fig. $9^{a, b}$.

1887 *A. ang.* Philippi, Tert. & Quart. Verst. Chiles, p. 135, pl. 23, f. 1, pl. 25, f. 1.

1897 *A. ang.* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 257, textf. 2.

Shell large, smooth, subcordate, oblique, with irregular concentric lines of growth. Apex at ⅓ of the length of the shell. Anterior dorsal margin straight, posterior first straight and horizontal, then oblique, forming with the posterior margin a rostrum.

Length, ca. 190 mm; height, ca. 150 mm.

Remarks: There cannot be any doubt that the proper position of the genus *Amathusia* is near *Cardium*, and in the family *Cardiidæ.* Philippi points out the resemblance of the hinge to that of *Cardium*, but relying on the external form of the shell he prefers to place it with *Venus.* V. Ihering (1899, p. 38) believes that *Amathusia* is related to *Glycimeris* (*Panopæa*), but I cannot see on what grounds. Indeed, there are no characters at all, which would warrant the position of this genus with either the *Veneridæ* or the *Saxicavidæ* (*Glycimeridæ*). On the other hand, the hinge, with the exception of the anterior part, agrees so closely with that of the *Cardiidæ*, that, comparing large species of *Cardium*, for instance *C. discrepans* Bast., *C. laqueatum* Conr., *C. sulcatum* Lmck., one is at once struck by the close resemblance. Indeed, the hinge is identical, but for the complete lack of the anterior lateral tooth in *Amathusia*.

The hinge has two cardinal teeth in each valve, and one posterior lateral tooth; the lack of the anterior lateral tooth cannot be regarded as a serious reason for separating this shell from the *Cardiidæ*, since in this family the lateral teeth are obsolete in other genera.

The ligamental plates (nymphæ) are very high in *Amathusia*, and separated from the umbones by a very deep furrow, a condition that is often seen in species of *Cardium* (for instance *C. discrepans*, see: Hoernes, 1870, pl. 24, f. 1, 2), where it is developed almost in the same degree as in *Amathusia*.

The pallial impression in *Amathusia* possesses an almost rectangular upward curve posteriorly, which can hardly be called a sinus. The same character, and even a distinct sinus is found in some *Cardiidæ*, so that this character also does not argue against the position with the *Cardiidæ*.

The most striking characters that distinguish *Amathusia* from *Cardium* are: (1) the lack of the anterior lateral tooth, of which no trace is present; (2) the complete absence of radial sculpture of the shell, and the lack of crenulations of the lower margin.

Record of specimens: Mouth of Santa Cruz River (just above high tide); 2 double, 2 left valves.

Distribution: Navidad, Chili (Phil.); Jegua quemada, Suprapatagonian beds (v. Ih.) (p. 257; on p. 258, v. Ihering says that his specimens are from Santa Cruz).

Fam. *VENERIDÆ* Leach.

Gen. VENUS L.

61. Venus difficillis Ortmann.

Pl. XXVIII, Fig. 1^{a-c}.

1899 *V. d.* Ortmann, in: Amer. Journ. Sci., v. 8, p. 428.

Shell thick, oblique, inflated, posteriorly a little narrowed; apex situated in advance of or at ¼ of the length. Area long, occupying almost the whole of the posterior dorsal margin of the shell. Lunula oval, flat. Surface with close and regular concentric furrows, and with some concentric lines of growth, the latter more crowded near the lower margin and irregular. Concentric furrows sharp, not interrupted, ½ to 1 mm distant from each other. Margin of shell not crenulated within.

Length, 75 mm; height, 64 mm; diameter, 18 (× 2) mm; apex at 16 mm from anterior end.

Remarks: Surface more or less well preserved in specimens from the lower horizon, but in those from the upper horizon obscured by adhering coarse matrix, although still recognizable.

Record of specimens: Punta Arenas, horizon II (lower Magellanian); 2 double, 2 left valves. Punta Arenas, horizon III (upper Magellanian); 2 right, 1 left valves, and several fragments.

Affinities: I have compared, in my preliminary report, this species with *V. subsulcata* Phil. (1887, p. 115, pl. 17, f. 7) from the Cretaceous beds of Chile. And indeed, this seems to be the most closely allied form.

62. VENUS ARENOSA Ortmann.

Pl. XXVIII, Fig. $2^{a, b}$.

1899 *V. a.* Ortmann, in: Amer. Journ. Sci., v. 8, p. 428.

Shell transversely elliptical, moderately swollen. Posterior end hardly narrower than the anterior. Apex situated at about ⅓ of the length. Area indistinct, shorter than the posterior part of the dorsal margin. Nymphæ ⅔–¾ as long as the area. Lunula indistinct. Exterior surface with strong concentric lines of growth, which have between them finer concentric striæ. Hinge that of a true *Venus*.

Length, 60 mm; height, 44 mm; diameter, 15 (× 2) mm.

Remarks: The surface markings are obliterated on account of the closely adhering matrix.

Record of specimens: Punta Arenas, horizon III (upper Magellanian), 3 right valves.

Affinities: This species possesses a very characteristic, elongated outline, and resembles in this character—as I have pointed out in my preliminary report—*V. landbecki* Phil. (1887, p. 116, pl. 20, f. 8) from the Cretaceous of Chili. *V. landbecki*, however, differs in the position of the apex, more inflated valves, and more distinct area.

63. VENUS CHILOËNSIS Philippi.

Pl. XXVII, Fig. 10.

1887 *V. ch.* Philippi, Tert. and Quart. Verst. Chiles, p. 121, pl. 15, f. 6.
1900 *V. ch.* Ortmann, in: Amer. Journ. Sci., v. 10, p. 378.

Shell ovato-elliptical, moderately swollen, both ends well rounded; apex at about one-fifth of the length. Area indistinct, nymphæ immersed. Lunula ovate, flat. Surface with widely distant, elevated lines, and sharp radiating striations.

Measurements: Length, 44 mm; height, 37 mm; diameter, 12 (× 2) mm; according to Philippi: Length, 62 mm; height, 52 mm; diameter (double), 32 mm.

Remarks: We possess only a single right valve, which is much smaller than Philippi's figure, but agrees in all essential respects very well with it. Since Philippi mentions this species from the Straits of Magellan, we may safely assume that our individual comes from one of the type-localities, as most of the fossils recorded by Philippi from "Magellanes" are from Punta Arenas.

Record of specimens: Punta Arenas, horizon V (Patagonian), 1 right valve.

Distribution: Ancud, Chile, and Straits of Magellan (Phil.).

Affinities: This species comes near *V. meridionalis* in sculpture, but differs in size and outline. Other relations see under *V. meridionalis.*

64. VENUS MERIDIONALIS Sowerby.

Pl. XXVII, Fig. 11$^{a, b}$.

1846 *V. mer.* Sowerby, in: Darwin, Geol. Observ. S. Amer., p. 250, pl. 2, f. 13.
1887 *V. mer.* Philippi, Tert. and Quart. Verst. Chiles, p. 120, pl. 14, f. 8.
1897 *V. mer.* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 251.
1899 *V. mer.* v. Ihering, in: N. Jahrb. Miner., etc., v. 2, p. 19.

Shell ovate, convex, both ends rounded. Apex between ⅓ and ¼ of the length. Area indistinct, nymphæ immersed. Lunula well marked, broadly lanceolate, a little convex and prominent. Surface with rather widely distant, elevated and sharp concentric lines, which are, toward the ventral margin, more crowded; besides, there are distinct radiating striæ. Margin of shell very finely crenulated.

Length, 33 mm; height, 27 mm; another individual: Length, 31 mm; height, 24 mm; diameter (double), 15 mm.

Remarks: This species differs from *V. chiloënsis* chiefly in the outline; it is more elongated (rel. H.: L. = 1 : more than 1.2, while in *V. chiloënsis* it is = 1 : less than 1.2). Further, the position of the apex is different, and the lunula is convex and distinctly elevated in the middle in *V. meridionalis.* Young individuals, however, have a more circular outline.

Record of specimens: Mouth of Santa Cruz River, 14 double, 57 isolated valves; Las Salinas, 3 isolated valves; Mt. of Observation, upper horizon, 2 isolated valves; Shell Gap, Rio Chico, upper horizon, 2 casts; Lake Pueyrredon, 600′ above base, 17 casts.

Distribution: Patagonian beds of Santa Cruz (Sow., v. Ih.); Suprapatagonian beds of Jegua quemada (v. Ih.); Navidad beds of Chili: Navidad (Sow., Phil.), Ranquil near Ancud (Phil.).

Affinities: A species similar in outline and sculpture is *Mercenaria cancellata* Gabb (see: Whitfield, 1884, p. 68, pl. 12, f. 2, 3), from the *Miocene* of New Jersey. It is intermediate in outline between *V. meridionalis* and *chiloënsis.* In *V. clathrata* Duj. (see Hoernes, 1870, p. 125, pl. 13, f. 3), from the *Miocene* of Europe the same type of surface ornamentation is seen, but much more strongly developed. Moreover, *V. clathrata* is much higher and more rounded than even *V. chiloënsis.*

This type of ornamentation in the genus *Venus* (cancellated surface) is characteristic for species from *Miocene* to *Recent* deposits. It is represented in Australia and Tasmania by *V. multitæniata* Tate (= *multilamellata* Tate, 1887, p. 154, pl. 15, f. 6), and *V. hormophora* Tate (ibid., p. 155, pl. 15, f. 1), said to be *Eocene,* but being probably *Miocene.*

According to Hutton (1886, p. 362), *Chione vellicata* Hutt. (1873, p. 21), is identical with *V. meridionalis,* and thus this species would also belong to the Pareora and Wanganui beds of New Zealand.

65. VENUS VOLCKMANNI Philippi.

Pl. XXVIII, Fig. $3^{a,b}$.

1887 *V. v.* Philippi, Tert. & Quart. Verst. Chiles, p. 121, pl. 14, f. 9.
1897 *V. v.* var. *argentina* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 252, pl. 7, f. 45.
1899 *V. v.* v. Ihering, in: N. Jahrb. Miner., etc., v. 2, p. 20.

Shell suborbicular, very convex; posterior dorsal margin slightly convex, forming an obtuse angle with the posterior margin, which forms, with the ventral margin, part of an almost regular circle. Apex between ⅓ and ¼ of the length. Area indistinct, nymphæ immersed. Lunula cordate, elevated in the middle. Surface with rather widely distant, elevated lines, and distinct radiating striæ.

Measurements: Length, ca. 73 mm; height, 70 mm; diameter, 27 (× 2). Another individual: length, 55 mm; height, 51 mm; diameter (double), 35 mm. In the latter, the apex is 15 mm from the anterior end.

Remarks: Philippi gives the position of the apex as $\frac{41}{200}$ = ca. $\frac{2}{5}$ of the length, v. Ihering as $\frac{30}{100}$ = ca. ⅓. This difference is apparently in part due to the different position given to the shell, as the regular outline of the shell renders it difficult to give a uniform position to different specimens.

The form from Santa Cruz is hardly distinguishable as a variety from that from Chili (in 1899 v. Ihering mentions typical individuals from Santa Cruz). The convexity of the dorsal margin is variable, and the anterior end (below the lunula) is more or less produced in different individuals: There are specimens from Santa Cruz completely agreeing with Philippi's figure in this respect.

The cast from Shell Gap does not show any surface markings, but agrees in form. The casts from Lake Pueyrredon, however, show distinct remains of the cancellations. The cast from the mouth of Santa Cruz River shows the impression of the cardinal teeth: they are those of a true *Venus*.

Record of specimens: Mouth of Santa Cruz River, 1 double cast (near high water mark), 1 double valve, 2 isolated valves (250′ above high tide). Shell Gap, Rio Chico, upper horizon; 1 cast. Lake Pueyrredon, base of Tertiary; 3 casts. Lake Pueyrredon, 600′ above base; 2 casts.

Distribution: Patagonian beds of Santa Cruz (v. Ih.); Navidad beds of Chili: Navidad, Tubul, Millanejo and Lebu (Phil.).

Affinities: In sculpture, this species is closely related to the two foregoing. It is represented in the recent seas of Chili and Patagonia by *V. antiqua* Kg. (see: v. Ihering, 1897, p. 253).

66. VENUS DARWINI Philippi.

Pl. XXVIII, Fig. 4.

1887 *V. d.* Philippi, Tert. & Quart. Verst. Chiles, p. 122, pl. 17, f. 2.
1899 *V. d.* v. Ihering, in: N. Jahrb. Miner., etc., v. 2, p. 19.

Shell ovato-orbicular, subquadrate, convex. Posterior dorsal margin convex, forming an indistinct angle with the posterior margin. Anterior extremity distinctly narrower than posterior. Apex at about one-fifth of the length. Area indistinct, nymphæ immersed. Lunula lanceolate, depressed in the middle. Surface with regular, rather widely distant, elevated concentric lines, and very slight indications of radiating striæ. Inner margins crenulate.

Length, 73 mm; height, 65 mm; diameter, 17 (× 2) mm. Apex at 15 mm from anterior end.

Remarks: Radiating striæ are not shown in Philippi's figure, and, indeed, there are hardly any traces of them in our specimens.

This species corresponds in size to *V. volckmanni*, but is more elongated, and the concentric lines are a little more widely distant in *V. volckmanni.* There is also a slight resemblance to *V. difficilis* (see above), but in the latter the posterior end of the shell is narrower, and the surface ornaments are quite different.

Record of specimens: Mouth of Santa Cruz River, 2 right, 4 left valves (in matrix).

Distribution: Patagonian formation of Santa Cruz (Phil., v. Ih.).

Affinities: Closely allied in form and sculpture is *V. burdigalensis* Mayer (see: Hoernes, 1870, p. 129, pl. 15, f. 1) from the *Miocene* of Europe, but the latter differs in the more closely set, and more distinctly lamellar concentric lines, and further, in *V. burdigalensis*, the hinge makes a transition to the genus *Meretrix*, while *V. darwini* seems to be a true *Venus.* Philippi and v. Ihering do not describe the hinge; in our specimens only part of it is seen, and seems to possess, in the left valve, only three teeth: at any rate, I do not see any trace of a fourth (lunular) tooth; this part of the hinge, however, is incompletely exposed.

67. VENUS NAVIDADIS Philippi.

Pl. XXVII, Fig. $12^{a,b}$.

1887 *V. nav.* Philippi, Tert. & Quart. Verst. Chiles, p. 126, pl. 14, f. 4.
1897 *V. striatolamellata* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 253, pl. 7, f. 44.
1900 *V. nav.* Ortmann, in: Amer. Journ. Sci., v. 10, p. 380.

Shell ovate, slightly convex, anterior and posterior ends rounded. Apex at about ¼ of the length. Area indistinct, nymphæ immersed. Lunula lanceolate, concave. Surface with concentric lamellæ, between the lamellæ fine concentric striæ. Margin on inner side not crenulate.

Length, 63, 39 mm; height, 50, 31 mm; ½ diameter, 10, 7 mm.

Remarks: As v. Ihering has already mentioned, the external form is a little variable. His type specimen measures: L. 79, H. 68 (ratio H.: L. = 1 : 1.16), while another one is only 64 high by 79 long (ratio = 1 : 1.23). Philippi gives: L. 47, H. 38 (ratio = 1 : 1.23). The ratio of our specimens given above is = 1 : 1.25, and 1 : 1.26; they are, accordingly, a little more elongated than even v. Ihering's second individual, while that figured by v. Ihering appears exceptionally high. In all other respects our specimens agree well with v. Ihering's description of *V. striato-lamellata*, and I cannot discover any difference between this species and *V. navidadis.* V. Ihering believes them to be closely allied, but points to a difference in the lunula, which he takes from the *figure* of *V. navidadis.* In the discription of both forms, however, Philippi and v. Ihering use the identical words: "lunula profundata," so that it is impossible for me to see the difference.

In the description Philippi gives the position of the apex at ⅓ of the length; but his figure shows it distinctly at ¼.

The casts from Upper Rio Chalia possess the outline of this species, but no traces of the shell are preserved.

Record of specimens: Mouth of Santa Cruz River; 2 left, 5 right valves. Upper Rio Chalia, 4 casts.

Distribution: Suprapatagonian beds of Jegua quemada (v. Ih.); Navidad (Phil.).

Affinities: This species comes near *V. arenosa* described above, but *V. arenosa* is still more elongated (ratio = 1 : 1.36 to 1 : 1.5), and further, the apex is, in *V. navidadis*, distinctly more anterior, and the sculpture seems to be different.

According to v. Ihering, this species is closely allied to the living species *V. exalbida* Ch. from S. America.

Gen. MERETRIX Lam.

68. Meretrix (?) pseudocrassa (Ortmann).

Pl. XXIX, Fig. $1^{a,b}$.

1899 *Cytherea ps.* Ortmann, in: Amer. Journ. Sci., v. 8, p. 429.

Shell very thick and solid, very convex. Outline almost circular, posterior end rounded. Apex at two-sevenths of the length. Lunula and area indistinct, nymphæ deeply immersed. Exterior surface concentrically striated, but the adhering matrix obscures the details of sculpture. Ventral margin of shell not crenulated. Hinge with two strongly developed teeth, and a smaller anterior one. Posterior tooth distinctly divided by a groove, the middle one also divided on upper side.

Length, 62 mm; height, 60 mm; diameter, 25 (× 2) mm.

Remarks: I am unable to decide whether this species belongs really to *Meretrix* or not. The division of the posterior hinge teeth is in favor of this view, but I cannot make out whether there was a fourth (lunular) tooth; we have only the right valve, and that part of it, where we should look for the groove that receives this tooth, is broken out. Perhaps it would be better to leave this species with *Venus.*

Record of specimens: Punta Arenas, horizon III (upper Magellanian); 1 right valve.

Affinities: I have compared this species with the Pliocene *V. crassa* Phil., and the Cretaceous *V. alta* Phil., both from Chili.

69. Meretrix iheringi Cossmann.

Pl. XXVIII, Fig. $5^{a,b}$.

1897 *Cytherea splendida* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 255, pl. 6, f. 42 (non *C. splendida* Merian).

1898 *Meretrix iheringi* Cossmann, in: Rev. crit. Paleozool., v. 2, No. 3, p. 109.

1899 *Cytherea ih.* Ameghino, in: Segundo Censo Arg. Supl., p. 4.

Shell large, swollen, with concentric sulci. Apex slightly prominent, at ⅓ of the length of shell. Anterior dorsal margin straight, posterior slightly arcuate. Anterior end of shell shorter, rounded; posterior subrostrate. Lunula circumscribed by a slightly impressed line. Three cardinal teeth; the anterior and middle one diverging from the apex. Lateral (lunular) tooth of left valve strong, lamelliform, and parallel to the lunula.

Remarks: We possess only an incomplete left valve, but it agrees—according to the lines of growth—with this species in form. The hinge is well preserved, and corresponds well to the description given by v. Ihering: especially the large lunular tooth is very striking.

Record of specimens: Punta Arenas, horizon V (Patagonian); 1 left valve.

Distribution: Jegua quemada and La Cueva, Suprapatagonian beds (v. Ih.).

70. MERETRIX ROSTRATA (Koch).

Pl. XXVIII, Fig. 6.

1845 *Cytherea rostr.* Koch, in: Philippi, Abbild. neu. Conchyl., v. 1, p. 150, pl. 1, f. 3.

Shell cordate-ovate, oblique, swollen; surface with concentric lines of growth. Apex much produced and strongly incurved. Anterior end of shell short, rounded; posterior longer, rounded and a little produced. Lunula very large, cordate, almost flat, circumscribed by a distinct impressed line. Pallial sinus triangular.

Height, 34, 39 mm; length, 38, ca. 42 mm; ½ diameter (of first specimen), ca. 14 mm.

Remarks: Our material consists chiefly of casts, but some show large portions of the shell preserved. The agreement with the recent form is complete. The outline of the shell is a little variable, the apex being more or less produced.

Record of specimens: Cape Fairweather; remains of 14 valves.

Distribution: So far known only Recent from Brazil (Koch); I have seen, in the collections of the Academy of Philadelphia, specimens from Maldonado Bay, Uruguay.

Gen. DOSINIA Scop.

71. Dosinia magellanica spec. nov.

Pl. XXVII, Fig. 13.

1899 *D. complanata* Ortmann, in: Am. Journ. Sci., v. 8, p. 429 (non *D. complanata* Phil.).

Shell orbicular, compressed. Posterior dorsal margin forming, with the posterior margin, a regular, circular curve. Lunula ovate, concave, but elevated in the middle. Surface with regular concentric impressed lines, which are not very crowded (½ to ¾ mm distant from each other), distinct all over the shell; intervals between these lines perfectly flat, but near the anterior and posterior margins a little elevated.

Length, 28 mm; height, 26.5 mm; diameter, about 4 (×2) mm.

Remarks: In my first publication I made a mistake: I believed some fragments of *Lucina neglecta* (see above, p. 130) imbedded in the same piece of rock to belong to this species. But now, after succeeding in working them out of the matrix more satisfactorily, I see that we really have to deal with two different forms, and that the characters of the surface markings and of the curve of the posterior and dorsal margins, on which I founded the identification with Philippi's *D. complanata*, are taken from individuals of the new *Lucina*.

D. magellanica differs from *D. complanata* in the shell's being a little more convex, in the posterior dorsal margin's forming no angle with the posterior margin, and in the surface ornaments, which consist of impressed lines, not of elevated striæ.

In the following species *(D. meridionalis)*, the curve between posterior dorsal and posterior margins is not regularly circular, but there is a suggestion of a blunt angle; the lunula is not elevated in the middle, the concentric ornaments are more irregular, and the intervals between the impressed lines are more or less convex; the shell itself is much larger.

Record of specimens: Punta Arenas, horizon II (lower Magellanian), 2 right, 1 left valves.

Affinities: The most closely allied form seems to be: *D. semilævis (Artemis s.*, Philippi, 1887, p. 113, pl. 13, f. 22) from Navidad, especially as regards the concentric lines, which are said to be "remote" from each other. But in *D. semilævis* they appear still more widely distant than in *D. magellanica*, and the outline of the shell is different.

72. DOSINIA MERIDIONALIS v. Ihering.

Pl. XXIX, Fig. 2^{a-c}.

1897 *D. m.* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 256, pl. 6, f. 41.

Shell circular, compressed; posterior dorsal margin forming, with the posterior margin, a strong curve, giving the appearance of a blunt and indistinct angle. Lunula concave, oblongo-cordate, its margin obtuse and indistinct. Surface with concentric impressed lines, which are somewhat irregular (more or less deep, and more or less widely distant), on the whole quite crowded; the intervals between these lines are distinctly convex, but not much so.

Measurements: Length, 55 mm; height, 51 mm; diameter (double), 23 mm. V. Ihering gives the following measurements: Length, 83 mm; height, 74 mm; diameter, 21 (× 2) mm, but his figure is much smaller.

Remarks: V. Ihering says that the concentric sculpture tends to become obsolete in the middle of the shell: in his figure it is quite distinct everywhere, and is also in our specimens well developed in the middle. Toward the margins the sculpture becomes more strongly pronounced.

Young individuals, about as large as *D. magellanica*, differ at once from the latter in the concentric lines' being more crowded, and the intervals' being distinctly convex.

The casts from upper Rio Chalia do not show any details of sculpture, but agree—at least two of them—completely in outline. The internal cast from Cape Fairweather is very poor, but the cast of the surface sculpture, as well as the size and form of the pallial sinus agree with this species.

Record of specimens: Mouth of Santa Cruz River, 2 double, 7 right, 5 left valves; Upper Rio Chalia, 6 casts; Arroyo Gio, 1 double valve; Cape Fairweather, 1 inner cast of right valve, and part of external cast of right valve.

Distribution: Jegua quemada, Suprapatagonian beds (v. Ih.).

According to v. Ihering (1897, p. 331) this species is also found in the "Paranense" formation of Parana, Entrerios. As only casts have been found there, v. Ihering says himself (1899, p. 43) that this identification is doubtful. But the presence of this species in the Cape Fairweather beds affords some support to v. Ihering's original opinion.

Affinities: As v. Ihering points out, this species is very closely allied to *Artemis ponderosa* Gray (see: Philippi, 1887, p. 113, pl. 14, f. 5, and Moericke, 1896, p. 585), which is found in the Pliocene Coquimbo beds of Chili, and living on the western coast of Mexico. The latter form, however, is larger, and the concentric sculpture is less marked in the middle of the shell. The hinge agrees closely in both species, and even the lunula, although there is a slight difference as v. Ihering points out, is almost the same, and differs from other species of *Dosinia.*

D. ponderosa is represented in the *Miocene* deposits of California by *D. mathewsoni* Gabb (1869, p. 57, pl. 15, f. 16), which differs from *D. meridionalis* in the more swollen form, but agrees well in size.

A very close resemblance exists also to *D. acetabulum* (Conr.). Although, in comparing the figure given by Whitfield (1894, pl. 13, f. 2), and copied from Conrad, this resemblance is not so very striking as regards the sculpture, I have compared specimens from Virginia, in which the sculpture is essentially identical. The only difference is the large size, and the less excavated lunular margin of *D. acetabulum.* *D. acetabulum* is from the *Miocene* of the Atlantic coast of N. America.

D. denselineata Pritchard (1896, p. 135, pl. 4, f. 5–7) seems to be closely allied to *D. meridionalis,* especially in sculpture, but the outline is different: the posterior dorsal margin appears longer, and forms a more distinct angle posteriorly. It is from Table Cape, Tasmania and Spring Creek, Victoria.

Thus the presence of this comparatively large and typical *Dosinia* in the Patagonian beds points clearly to a *Neogene* age, and this view is still more supported by the fact, that *D. meridionalis* is apparently closely related to, and perhaps the ancestral form of a species that is still found living on the western coast of America. Probably all the forms mentioned above are connected genetically.

73. Dosinia læviuscula (Philippi).

Pl. XXVIII, Fig. 7.

1887 *Artemis læv.* Philippi, Tert. & Quart. Verst. Chiles, p. 115, pl. 19, f. 1.
1899 *Dosinia læv.* v. Ihering, in: N. Jahrb. Miner., etc., v. 2, p. 20.

Shell circular, not much compressed, but comparatively swollen. Posterior dorsal margin convex, hardly forming an angle with the posterior margin. Lunula ovate, slightly concave, indistinct. Surface almost smooth, only with very fine and crowded concentric lines.

Length, 22 mm; height, 20 mm; diameter, 5 (× 2) mm.

Remarks: Although much smaller than Philippi's and v. Ihering's specimens, and more circular in outline, I believe our individuals to belong here, since the characters of the surface agree completely. Philippi gives: L. 50, H. 43, D. 25 mm, and v. Ihering: L. 75, and perhaps up to 85 mm, while our largest is only: L. 24, H. 21.5 mm.

Our specimens retain the original shell in many places, and show only very fine, concentric, impressed lines, which are quite different from the distinct impressed lines with more or less prominent intervals in *D. meridionalis.* And further, the character mentioned by Philippi, that the shell is comparatively more swollen than in other species, is also shown in our individuals: a young one, L. 17.5, H. 17, has a diameter of both valves of 9 mm.

I think the more circular form of our specimens is due to their young age.

Record of specimens: Mouth of Santa Cruz River, ca. 30 internal and external casts in hard matrix, with remains of the shell adhering.

Distribution: Patagonian beds of Santa Cruz (Phil., v. Ih.).

Fam. *TELLINIDÆ* Desh.

Gen. TELLINA L.

74. Tellina tehuelcha v. Ihering.

Pl. XXIX, Fig. 3.

1899 *T. t.* v. Ihering, in: N. Jahrb. Miner., etc., v. 2, p. 21, pl. 2, f. 4.

Shell oblong-oval, subequilateral, inequivalve; left valve convex, right one flat (according to v. Ihering). Apex at about the middle of the length. Anterior end rounded, posterior indistinctly biangulate. Pallial sinus linguiform, reaching hardly to the middle of the shell.

Length, 28.5 mm; height, 20 mm; another: length, 27 mm; height, 18 mm.

Remarks: Our casts of the left valve agree completely with v. Ihering's figure, and one of them shows also the pallial sinus. The external cast of a right valve, however, is convex, and perhaps it does not belong here. In the largest individual, near the ventral margin, faint indications of radiating striæ are seen.

Of this species, so far only the cast is known.

Record of specimens: Shell Gap, Rio Chico, upper horizon, 2 internal casts of left valve, 1 external cast of right valve.

Distribution: Santa Cruz, Patagonian formation (v. Ih.).

75. TELLINA JEGUAËNSIS v. Ihering.

Pl. XXVIII, Fig. 8.

1897 *T. j.* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 260, pl. 5, f. 33.

Shell thin, subpyriform, smooth. Anterior end longer, rounded, posterior narrowed and acuminate, near the posterior dorsal margin a radiating angulation.

Length, 20 mm; height, 14 mm (according to v. Ihering: length, 25 mm; height, 16 mm; diameter, 4 mm).

Remarks: Our individuals from Santa Cruz are smaller, but otherwise agree well with v. Ihering's figure. The specimens from Arroyo Gio are a little higher comparatively, and the anterior end is less elongated.

Record of specimens: Mouth of Santa Cruz River, 2 valves; Arroyo Gio, 5 casts.

Distribution: Jegua quemada, Suprapatagonian beds (v. Ih.).

Affinities: *T. promaucana* Phil. (1887, p. 141, pl. 26, f. 9) from Navidad comes near this species, but it is equilateral (anterior end not longer than posterior), and higher (L., 26; H., 19; rel. = 1.26:1). Our individuals from Arroyo Gio are intermediate in form between *T. promaucana* and *jeguaënsis:* rel. = 1.42:1, while in the typical form, according to v. Ihering, the rel. is = 1.56:1. The anterior end in the Arroyo Gio specimens is less elongated than in the typical form, thus approaching *T. promaucana* in this character also.

T. capillifera Conr. (see: Whitfield, 1894, p. 76, pl. 14, f. 8–10) from the *Miocene* of New Jersey is hardly distinguishable from this species.

Fam. *PSAMMOBIIDÆ* Dall.

Gen. PSAMMOBIA Lam.

76. Psammobia patagonica Philippi.

Pl. XXIX, Fig. 4.

1887 *P. pat.* Philippi, Tert. and Quart. Verst. Chiles, p. 143, pl. 26, f. 17.[1]
1899 *P. pat.* v. Ihering, in: N. Jahrb. Miner., etc., v. 2, p. 21.

Shell elongated-elliptical, compressed, smooth, almost equilateral, the posterior end a little shorter, both ends evenly rounded. Anterior and posterior dorsal margins straight, forming an obtuse angle. Ventral margin very slightly curved.

Length, 28 mm; height, 16 mm; diameter, 3 (× 2) mm.

Record of specimens: Mouth of Santa Cruz River, 10 valves; Las Salinas, 6 valves; 30 miles north of upper Rio Chalia, 1 double cast; Arroyo Gio, 3 casts.

Distribution: Patagonian beds of Santa Cruz (Phil., v. Ih.).

Affinities: This species has a distinct *Eocene* appearance, and resembles much the forms described by Deshayes (1860, p. 370, ff.) under the names of *P. nitida* (pl. 24, f. 1, 2), and *P. tenera* (pl. 24, f. 6–8), especially the first, with which it also agrees in size.

A very closely allied species is *P. hamiltonensis* Tate (1887, p. 167, pl. 16, f. 13) from Muddy Creek, Victoria, and Table Cape, Tasmania, from so-called "Eocene," but probably Miocene beds.

Fam. *MACTRIDÆ* Gray.

Gen. MACTRA L.

77. Mactra (?) darwini Sowerby.

Pl. XXIX, Fig. 8.

1846 *M. d.* Sowerby, in: Darwin Geol. Observ. S. Amer., p. 249, pl. 2, f. 9.

Shell triangularly subovate, almost equilateral, compressed, but convex toward the apex. Surface smooth, with concentric lines of growth.

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[1] There are two figures numbered 17 on Philippi's plate, but only the smaller one represents this species, the larger one is *Tellina subfalcata*.

Anterior and posterior ends rounded, posterior very little more produced than anterior.

Length, 48 mm; height, 36 mm; diameter, 9 (× 2) mm.

Remarks: Sowerby calls the posterior end "subquadrate," but his figure does not show this character, nor is it seen in our specimens.

The generic position is doubtful: I do not see the hinge in any of our individuals. The external form agrees completely with Sowerby's figure, but most of the specimens are larger.

Record of specimens: Mouth of Santa Cruz River, 19 double, 9 single valves; Mt. of Observation, upper horizon, 4 fragments; Shell Gap, Rio Chico, upper horizon, 1 double cast.

Distribution: Santa Cruz (Sow.).

78. MACTRA GARRETTI spec. nov.

Pl. XXIX, Fig. 9^{a-d}.

Shell thin, triangularly-subovate, compressed, a little inequilateral, smooth, with concentric lines of growth. Anterior end a little longer, rounded, posterior subtruncate, with an indistinct keel running down from the apex to the posterior ventral angle.

Length, 19 mm; height, 15 mm; diameter (double), 7 mm.

Remarks: At first I believed that this is *M. indistincta* of v. Ihering; but having sent some specimens to the author, he informs me that it is *not* his *M. indistincta,* but probably new, and so I describe it as new, connecting with it the name of Mr. J. W. Garrett.

This species is a true *Mactra* (see: Dall., 1898, p. 874), as shown by the hinge-teeth (pl. XXIX, Fig. $9^{c,d}$).

Record of specimens: Mt. of Observation, upper horizon, ca. 40 well-preserved shells, and many fragments; Lake Pueyrredon, 600′ above base, 1 cast of right valve.

Affinities: Among the numerous species of *Mactra* described by Philippi from Chili, there is one that might be compared with *M. garretti: M. truncatula* (Phil., 1887, p. 154, pl. 27, f. 15) from Navidad. It agrees in the truncation of the posterior end, which is shorter than the anterior: but it is smaller, the anterior end is distinctly narrower than the posterior, and longer comparatively than in *M. garretti.*

There are some species in the Eocene beds of France, which resemble this one in outline, although they differ in other respects: *M. levesquei* Desh., *M. lamberti* Desh., and *M. contortula* Desh. (Deshayes, 1860, p. 289, ff. pl. 18).

Another closely allied form is *M. trinacria* Semp. (Speyer, 1866, p. 34, pl. 3, f. 4) from the Oligocene of northern Germany, but it is smaller and a little higher.

Gen. LUTRARIA Lam.

79. Lutraria (?) undatoides Ortmann.

Pl. XXX, Fig. 3.

1899 *L. u.* Ortmann, in: Amer. Journ. Sci., v. 8, p. 429.

Shell almost elliptic, 1½ times as long as high. Surface with strong, and somewhat irregular, undulated concentric folds. Dorsal margin almost straight, ventral margin slightly arcuate. Apex at ⅓ of the length, prominent, rather sharp, incurved. Anterior and posterior ends evenly rounded, and of the same height.

Length, 32 mm; height, 21 mm; apex at 11 mm from anterior end.

Remarks: Only the remote resemblance to *L. undata* Phil. (1887, p. 164, pl. 33, f. 8–11) induces me to place this species with the genus *Lutraria.*

Record of specimens: Punta Arenas, horizon II (lower Magellanian), 1 double valve (cast).

Fam. *CORBULIDÆ* Flem.

Gen. CORBULA Lam.

80. Corbula hatcheri Ortmann.

Pl. XXX, Fig. 4^{a-e}.

1900 *C. h.* Ortmann, in: Amer. Journ. Sci., v. 10, p. 371.

Shell small, solid and thick, subovato-triangular. Right valve very little larger than left, both moderately convex. Anterior end rounded, posterior produced, subtruncate, an angular ridge running down from the apex to the posterior angle. Ventral margin arcuate, posteriorly a little concave. Lower margin of right valve reflected toward the left valve. Surface with concentric ribs, which are rounded and rather crowded.

Length, 11 mm; height 7.5 mm; diameter (of right valve), 2.5 mm. Cast from San Julian: length, 13 mm; height, 8 mm; diameter (double), 5 mm.

Remarks: So far no *Corbula* has been known from Patagonia. In *C. birostris* Phil., from Lota, Chili (Navidad beds), the genus is very doubtful.

Record of specimens: Mouth of Santa Cruz River, 8 double, 6 right, 8 left valves; Las Salinas, 1 left valve; Mt. of Observation, upper horizon, 1 left valve; San Julian, Darwin Station, 2 double casts.

Affinities: The most closely allied form, in my opinion, is *C. subæquivalvis* Sandb. (see: Boettger, 1870, p. 41, pl. 9 (8b), f. 16), from the *Oligocene* of Germany and Switzerland. In *C. hatcheri* the posterior truncation is less distinct, the lower margin is more arcuate, and the ribs of the surface seem to be stronger (Boettger calls them "thin" in *C. subæquivalvis*).

There are also some Miocene species of Europe and North America, which might be compared with *C. hatcheri*, but they do not approach it so closely as *C. subæquivalvis*.

Fam. *SAXICAVIDÆ* Gr.

Gen. PANOPEA Men.

81. Panopea ibari Philippi.

Pl. XXIX, Fig. 5.

1887 *Panopæa ibari* Philippi, Tert. & Quart. Verst. Chiles, p. 167, pl. 35, f. 4.

1899 *Glycimeris ib.* Ortmann, in: Amer. Journ. Sci., v. 8, p. 429 (non *Glycimeris ibari* (Phil.), see above, p. 94).

Shell elongate-oval, moderately convex, with concentric undulations. Apex at two-fifths of the length, prominent. Both ends rounded, posterior distinctly narrower than anterior. Ventral margin arcuate.

Length, 84 mm; height, 45 mm; diameter, 15 mm; apex at 35 mm from anterior end. Rel. H. : L. = 1 : 1.8; in another individual: = 1 : 2.0.

Record of specimens: Punta Arenas, lower horizon, II (lower Magellanian), 1 double, 2 right, 2 left valves.

Distribution: Magellanes and Skyring Water (Phil.).

82. Panopea subsymmetrica (Ortmann).

Pl. XXIX, Fig. 6.

1899 *Glycimeris subs.* Ortmann, in: Amer. Journ. Sci., v. 8, p. 429.

Very near the preceding species *(P. ibari)*, but more swollen, not so much elongated, and posterior end not narrowed.

Length, 69 mm; height, 45 mm; diameter, 18 mm. Apex at 28 from anterior end. Rel. H. : L. = 1 : 1.6.

Remarks: Differs from the following species *(P. regularis)* in the position of the apex (nearer to the middle), and the stronger convexity, especially of the posterior part of the shell.

Record of specimens: Punta Arenas, horizon III (upper Magellanian), 1 right valve.

83. Panopea regularis (Ortmann).

Pl. XXX, Fig. $1^{a,b}$.

1900 *Glycimeris reg.* Ortmann, in: Amer. Journ. Sci., v. 10, p. 371.

Shell elongate, convex, with concentric lines of growth and undulations. Apex at one-third of the length, incurved. Anterior end rounded, posterior subtruncate, not narrower than the anterior. Ventral margin straight in the middle.

Length, 101 mm (incomplete); height, 61 mm; diameter, ca. 30 mm; apex at 40 mm (Santa Cruz).

Length, 78 mm; height, 45 mm; apex at 25 mm (San Julian).

Length, 105 mm (incomplete); height, 75 mm; apex at 31 mm (Lake Pueyrredon).

Remarks: This species differs from *P. ibari:* (1) in the anterior and posterior ends of the shell being equally high; (2) in the straight lower margin; (3) in the situation of the apex. It differs from *P. subsymmetrica:* in the more anterior apex and less convex shell; from *P. quemadensis* in the more anterior apex and higher posterior end. *P. nucleus* v. Ih. (1899, p. 23, pl. 1, f. 7), from Santa Cruz, agrees in the position of the apex, but it is considerably narrower posteriorly, and I do not see any traces of the grooves or depressions described by v. Ihering as running down from the apex (these grooves are not visible in v. Ihering's figure).

Record of specimens: Mouth of Santa Cruz River, 1 double valve: San Julian, Darwin Station, 1 double valve; Lake Pueyrredon, base of Tertiary, 1 double valve; Lake Pueyrredon, 600′ above base, 1 double valve (jun.).

84. PANOPEA QUEMADENSIS (v. Ihering).

Pl. XXX, Fig. 2.

1897 *Glycimeris qu.* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 264, textf. 4.

Differs from *P. regularis* in the apex, which is situated only a little in advance of the middle of the shell, and in the posterior end's being narrower than the anterior.

Length, 110 mm; height, 73 mm; diameter, 54 mm; apex at 46 mm (Santa Cruz).

Length, 83 mm; height, 53 mm; apex at ca. 35 mm (Lake Pueyrredon).

Record of specimens: Mouth of Santa Cruz River, 2 double valves; San Julian, Darwin Station, 1 double cast; Upper Rio Chalia, 1 cast of left valve; 30 miles north of upper Rio Chalia, 2 double casts; Lake Pueyrredon, base of Tertiary, 1 double cast; Lake Pueyrredon, 600′ above base, 5 double casts.

Distribution: Jegua quemada, Suprapatagonian beds (v. Ih.).

85. PANOPEA PILSBRYI spec. nov.

Pl. XXIX, Fig. 7.

Shell short and high, very convex, with concentric lines of growth. Apex about in the middle of the length, incurved. Anterior end rounded, posterior subtruncate, hardly narrower than the anterior. Ventral margin straight in the middle.

Length, 79 mm; height, 60 mm; diameter, 22 (× 2) mm; apex at 38 mm. from anterior end.

Remarks: In the comparatively very short and high outline of the shell, with the apex almost in the middle of the length, and the posterior and anterior ends of the shell of about the same height, this species differs from all others mentioned here.

We possess one good cast, which shows the pallial sinus well preserved. The rest are only fragments, but, as far as can be seen, possess the same characteristic features, especially the short and high outline.

Record of specimens: Cape Fairweather, 1 cast and 5 fragments of casts.

Note: I am not quite satisfied that my identifications of the species of *Panopea* are correct. As to *P. ibari* and *quemadensis* I think I have recognized them correctly, but the question remains, whether the new species are really different. I have characterized them only by the external form, since no other parts are visible, only in a few cases the shell itself being preserved. I did not find any form that corresponds to *P. nucleus* of v. Ihering.

Possibly all the Patagonian species described are really nothing but variations of one and the same form.

Fam. *PHOLADIDÆ* Fisch.

Gen. MARTESIA Leach.

86. Martesia patagonica (Philippi).

Pl. XXX, Fig. 5.

1887 *Pholas pat.* Philippi, Tert. & Quart. Verst. Chiles, p. 171, pl. 42, f. 8.
1897 *Martesia pat.* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 266.
1899 *Mart. pat.* v. Ihering, in: N. Jahrb. Miner., etc., v. 2, p. 23, pl. 2, f. 6.

Shell subovate, convex, gaping anteriorly, the anterior end forming a blunt right angle; the gap is closed by two callous plates. From the beak toward the ventral margin runs an oblique groove; posterior to this groove only concentric lines of growth, anterior to it sharp ribs, which run parallel to the (gaping) anterior margin of the shell, and bear sharp, upturned spinules, disposed, toward the anterior end, in distinct radiating lines. These spinules become smaller near the oblique furrow, and finally, close to it, are indicated only by undulations. The ribs of the anterior part of the shell form, with the lines of growth of the posterior, almost a right, or slightly obtuse angle. Anterior dorsal margin reflected. No accessory umbonal plates preserved in our specimens. On the cast, the radial groove forms a distinct impression, and the gaping anterior margin, where it joins the callous plate, forms another impression running from the lower end of the first impression obliquely upward toward the anterior margin.

Length, 22 mm; height, 14 mm; diameter, 7 mm (× 2); (Mt. of Observation).

Length, 24; height, 15; diameter, 14.5 (double); (cast from Las Salinas).

It seems, however, that this species grew much larger: specimens from Mt. of Observation and Shell Gap, only in fragments, indicate a length of about 60 mm, by about 30 mm in height.

V. Ihering says that his figured specimen measures: length, 37 mm; height, 23 mm; but the figure itself, which is said to be natural size (1/1), is only: length, 23 mm; height, 15.

Record of specimens: Mouth of Santa Cruz River, 1 right valve; Las Salinas, 1 double cast; Mt. of Observation, upper horizon, 4 double, 1 right, 1 left valve, 7 casts; Shell Gap, Rio Chico, upper horizon, 1 double cast; Lake Pueyrredon, 600′ above base, 1 cast of right valve.

Distribution: Patagonian beds of Santa Cruz (Phil., v. Ih.).

Affinities: Although this genus is not rare in Eocene deposits, none of the Eocene species agrees so well with *M. patagonica*, as *M. peroni* Cossm. & Lamb. from the *Oligocene* of Switzerland (see: Kissling, 1896, p. 45, pl. 4, f. 4, 5), especially as regards the general form and position of the impressions on the cast. *M. peroni*, however, is smaller than our species.

On the other hand, our species resembles also the Pliocene and recent type-species of the genus *Pholadidea*, *P. papyracea* (Sol.) (see: Wood, 1856, p. 298, pl. 30, f. 10, Woodward, 1854, pl. 23, f. 20, and Philippi, 1851, p. 128, pl. 2, f. 3), and it is possible that it belongs to this genus, which fact would point to a much younger age (Neogene).

87. MARTESIA PUMILA Ortmann.

Pl. XXX, Fig. $6^{a, b}$.

1900 *M. p.* Ortmann, in: Amer. Journ. Sci., v. 10, p. 371.

This form resembles *M. patagonica*, but it is much smaller, the callous plate of the anterior margin is very small, and the ribs of the anterior part of the valve form a very obtuse angle with the lines of growth of the posterior part. The radiating furrow is narrower, and runs more inclined posteriorly, so as to render the posterior part of the shell smaller in comparison with the anterior.

The ribs of the anterior part are less in number, and the gaping of the anterior margins is very slight: indeed, in the cast (and we possess only casts with slight traces of shell remaining), the anterior end seems to be closed: only the lowermost rib does not run parallel to the lower anterior margin, but cuts off a small, crescentric piece, which seems to represent the impression of the callus.

The ribs (on the cast) are simple, but near the anterior end of the shell they are crossed by three to four radiating lines, forming small nodes at the points of intersection. Anterior end of shell not rectangular, but rounded.

Length, 9 mm; height, 4 mm; diameter (double), 4 mm. Largest individual: height, 7 mm, but incomplete in length, which was probably about 16 or 18 mm.

Remarks: I was first inclined to regard this form as the young stage of *M. patagonica.* But we possess a single, fragmentary valve, coming from the same piece of rock with the rest, which is a little larger (see measurements above), and corresponds in size to our smallest individuals of *M. patagonica.* Yet this specimen shows the narrow radiating groove, the obtuse angle between the lines of growth and the concentric ribs, and the simple character of the latter, while the young specimens of *M. patagonica* (from Mt. of Observation) agree in these respects with larger individuals of that species.

Record of specimens: Mouth of Santa Cruz River, ca. 100 specimens.

SCAPHOPODA.

Fam. *DENTALIIDÆ* Gray.

Gen. DENTALIUM L.

88. DENTALUM SULCOSUM Sowerby.

Pl. XXXI, Fig. $1^{a,b}$.

1846 *D. sulc.* Sowerby, in: Darwin, Geol. Observ. S. Amer., p. 263, pl. 2, f. 2.
1846 *D. majus* Sowerby, ibid., p. 263, pl. 2, f. 3.
1887 *D. sulc.* Philippi, Tert. & Quart. Verst. Chiles, p. 106 (partim).
1887 *D. maj.* Philippi, ibid., p. 106, pl. 12, f. 11.
1887 *D. gayi* Philippi, ibid., p. 107, pl. 12, f. 19 (juv.).
1889 *D. patagonicum* Rochebrune & Mabille, in: Miss. Sci. Cape Horn, v. 6, p. 98.

1899 *D. pat.* v. Ihering, in: N. Jahrb. Miner., etc., v. 2, p. 24.
1900 *D. sulc.* Ortmann, in: Amer. Journ. Sci., v. 10, p. 380.

Shell rounded, in young stage angular and curved, almost straight when old, with longitudinal ribs. Principal ribs, in young individuals, 10 to 14, between which, in older ones, smaller ribs (1 to 3 in each interval) are intercalated, bringing up the total number to from 20 to 30; but always about 14 ribs are stronger than the rest. The ribs, which are rather sharp in the young stage, are rounded in older individuals; in young individuals the intervals are broader and flat, in older ones the ribs appear more crowded. In very old specimens the ribs are less distinct, and are sometimes crossed by distinct lines of growth.

Remarks: We possess numerous fragments, but no complete individual. This species grows very large: the largest diameter is 15 mm, while the smallest is 1 mm (upper end of the smallest fragment is 2.5 mm in diameter, by a length of 18 mm). Between these small ones and the largest we possess all transitions.

One of the smallest has only 9 ribs; another one, as small as this one, has 10. Individuals of from 3 to 5 mm in diameter have 10 to 14 ribs: in all these very young ones the ribs are angular, the intervals flat, and the shell has a polygonal cross section. A fragment, diameter 7 mm, has 15 principal ribs, and 3 very small ones intercalcated. At this diameter, from 6 to 10 mm, the characters of *D. sulcosum* Sow. are typically exhibited: about 14 ribs, with flat intervals, but sometimes a few intermediate ribs are present. An individual of from 6 to 9.5 mm diameter (on the lower and upper end respectively, length 54 mm), has on the narrow end 11 large, and 1 small rib, on the wider end 12 larger, and 11 smaller (and besides a few striæ), and represents thus, on the wider end, distinctly *D. majus* of Sowerby. In still larger fragments, more intermediate ribs are intercalated, and at a diameter of from 11 to 12 mm there are about 14 larger, and 14 to 15 smaller ribs. This intercalation of ribs is not regular: in some of the intervals there are none; in others 2 to 3. In very large fragments, the ribs often become indistinct, and further, the peculiar exfoliation of the outer layer of the shell tends in many individuals to obscure the ribs, especially the smaller ones, so that only 11–14 principal ribs are visible. Often distinct lines of growth are visible in larger fragments.

The curvature of the young shell is a little stronger than that of the rest, which in most cases is almost straight, in some cases perfectly so.

The taper of the young shell is apparently more considerable than in the old: a fragment 29 mm long is, on the one end, 3 mm in diameter, on the other, 5.5. Another one, 58 mm long, is on one end 7 mm in diameter, on the other 10 mm: this latter fragment thus increases only 3 mm, where we should expect—at the rate of the first one—about 5 mm.

In *D. giganteum* Sowerby (1846, p. 263, pl. 2, f. 1), and Philippi (1887, p. 105, pl. 12, f. 9), from Navidad, the sculpture is different, consisting of shallow and narrow grooves, separated by rounded and low intervals.

According to the figure, *D. sulcosum* of Philippi (pl. 12, f. 10), from Navidad is certainly different from *D. sulcosum* of Sowerby, and it closely resembles *D. giganteum*, but the furrows are much deeper and more distinct. The specimens, however, mentioned by Philippi from Santa Cruz as belonging to *D. sulcosum*, belong no doubt to the true *D. sulcosum*.

D. lebuense Philippi (1887, p. 106, pl. 12, f. 18), from Lebu and Llancahue resembles a young *D. sulcosum*, but it is much straighter.

D. gayi Philippi (Matanzas and Carauma), comes no doubt into the synonymy of *D. sulcosum*: the figure resembles exactly a young individual of the Santa Cruz species.

D. patagonicum of Rochebrune and Mabille, and v. Ihering, is certainly identical with our species: we have received from v. Ihering a fragment of medium size under this name, and this agrees completely with our *D. sulcosum*.

D. mantelli Zittel (1864, p. 45, pl. 13, f. 7), from New Zealand, Victoria and South Australia (Tate, 1887, b, p. 190), and Tasmania (Pritchard, 1896, p. 126), comes very near to *D. sulcosum*. The only difference (according to the figure) is the much stronger curvature of the shell. (Tate, 1887, b, p. 191, says: *D. giganteum* of which *solidum* Hutton is a synonym is distinct though conspecific with *D. mantelli*, a sentence that is not quite clear.)

Record of specimens: Mouth of Santa Cruz River, 59 fragments; San Julian, Darwin Station, 2 casts; Lake Pueyrredon, base of Tertiary, 1 broken and compressed specimen.

Distribution: Santa Cruz (Phil., Roch. & Mab., v. Ih.), Patagonian formation (v. Ih.); Navidad beds of Chili: Navidad, Huafo Island (Sow.), Ancud, Llancahue, Tubul, Matanzas, Carauma (Phil.).

Affinities: As has been pointed out above, the New Zealandian and Australian species *D. mantelli* is closely allied to this species. It is found in New Zealand, in the Pareora system of *Miocene*, according to Hutton.

A closely allied species seems to be: *D. gabbi* Pilsbry and Sharp (1897, p. 470, pl. 10, f. 6, 7, 13, pl. 11, f. 1, 2), from the *Oligocene* or *Miocene* beds of San Domingo, but it is smaller, and the number of ribs near the apex is less.

Of the European species, *D. kickxi* Nyst (see: Speyer, 1870, p. 199, pl. 21, f. 8–11) from the Middle and Upper *Oligocene* seems to be the most closely allied species.

89. DENTALIUM OCTOCOSTELLATUM Pilsbry and Sharp.

Pl. XXXI, Fig. 2.

1897 *D. octocostatum* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 266, pl. 4, f. 16 (non *D. octocostatum* Fraas, 1867).

1898 *D. octocostellatum* Pilsbry and Sharp, Man. Conch., v. 17, p. 211.

Shell small, slightly curved, with 6 to 8 longitudinal ribs, which are distant, with flat intervals, rendering the cross section polygonal.

Diameter up to 3.5 mm.

Remarks: This species differs from the foregoing: (1) in the small size; (2) in the smaller number of ribs; v. Ihering gives 8–9, but his figure shows—as far as can be made out—an individual that had certainly not more than six ribs. In our specimens, one (the largest) has only 6 distinct ribs, with two very indistinct ones (on the lateral intervals). The other individuals have 7 or 8. *D. sulcosum*, at the same size, has always at least 9 or 10 ribs.

(3) The taper in both species is different. Our largest individual of the present species is 25 mm. long, the diameter at one end is 2.3 mm, at the other 3.5 mm. An individual of *D. sulcosum*, 24 mm long, increases from 2.3 to a little over 4 mm.

The specimens from Arroyo Gio are casts, but they agree in size, curvature and taper with this species.

Records of specimens: Mt. of Observation, upper horizon, 6 fragments; Arroyo Gio, 2 casts.

Distribution: Jegua quemada, Suprapatagonian beds (v. Ih.).

GASTROPODA.

Fam. *PATELLIDÆ* Carp.

Gen. PATELLA L.

90. PATELLA PYGMÆA Ortmann.

Pl. XXX, Fig. 7^{a-c}.

1899 *P. p.* Ortmann, in: Amer. Journ. Sci., v. 8, p. 430.

Shell subconical, outline regularly oval. Apex situated in the anterior half. Surface with fine, crowded, a little unequal, radial ribs, crossed by concentric lines of growth, and very finely granulated.

Length, 7 mm; width, 5 mm; height, 4 mm.

Remarks: This may be an *Acmæa*. Pilsbry (1891, p. 7) says of *Acmæa:* the shells may generally be distinguished from *Patella* by the different texture and the marginal border of the inside. The presence or lack of this border cannot be ascertained in our specimens, since the interior is filled with matrix.

There already exists an *Acmæa heroldi forma pygmæa* Dunker (see: Pilsbry, 1891, p. 45). If our species should prove to belong to *Acmæa*, the specific name is ill chosen, but cannot be changed, unless *pygmæa* Dunker is regarded as a good species.

Record of specimens: Punta Arenas, horizon III (upper Magellanian); 1 sp.

Fam. *FISSURELLIDÆ* Riss.

Gen. FISSURELLA Brug.

91. FISSURELLA EURYTRETA Cossmann.

Pl. XXX, Fig. 8.

1899 *F. e.* Cossmann, in: Journ. Conchyliol., p. 3 (of sep. cop.), pl. 11, f. 1.

Shell depressed, elongated-elliptical; foramen subcentral, large, elliptical. Surface with radiating ribs.

Length, 21 mm; width, 12 mm; altitude, 5.5 mm.

Remarks: Surface ornaments not seen in our individual, which is a cast.

Record of specimens: Upper Rio Chalia; 1 cast.

Distribution: Jegua quemada, Suprapatagonian beds (Cossm.).

Fam. *DELPHINULIDÆ* Fisch.

Gen. LIOTIA Gray.

92. Liotia scotti Ortmann.

Pl. XXX, Fig. 10^{a-c}.

1900 *L. s.* Ortmann, in: Amer. Journ. Sci., v. 10, p. 372.

Shell small, rounded, flat above, with a large, open umbilicus below. Spire with 4 rounded whorls, increasing rapidly; suture deep. Last whorl with six revolving, equidistant keels, the keel nearest the umbilicus the smallest, and disappearing within the umbilicus; the upper whorls show only the two uppermost keels. The keels are crossed by very fine striæ, and a number (15) of strong radial ribs; at the points of intersection of these ribs and the revolving keels there are small conical tubercles. Last whorl a little deflected toward the mouth, which is circular and thickened.

Height, 4 mm; diameter, 8 mm.

Remarks: This species has been named in honor of Professor W. B. Scott, of Princeton University.

Record of specimens: Mouth of Santa Cruz River; 1 sp.

Affinities: This species is very closely allied to the recent *L. (Lippistes) acrilla* Dall (1889, pl. 32, f. 6, 11) from Florida, but the latter has only five revolving keels, and the upper side of the shell is a little concave.

Fam. *TROCHIDÆ* Ad.

Gen. LEPTOTHYRA.

93. Leptothyra philippi Cossmann.

Pl. XXX, Fig. $9^{a,b}$.

1899 *L. p.* Cossmann, in: Journ. Conchyliol., p. 4 (of sep. cop.), pl. 10, f. 10, 11.

Shell small, subgloboso-conical. Spire short. Whorls convex, suture deep. Surface of upper whorls with 6 to 9 revolving ribs, which are obtusely granulate. Last whorl about ¾ of the height of the shell. Base rounded, imperforate. Mouth contracted, circular, very oblique.

Height, 8 mm; diameter, 6.5 mm.

Record of specimens: Mouth of Santa Cruz River, 6 sp.

Distribution: Jegua quemada, Suprapatagonian beds (Cossm.).

Affinities: Cossmann compares this species with the French Eocene species *L. obtusalis* Baud. and *L. montensis* Br. & Corn., but it differs considerably from them.

Gen. SOLARIELLA Wood.

94. Solariella dautzenbergi Cossmann.

Pl. XXX, Fig. 11^{a-c}.

1899 *S. d.* Cossmann, in: Journ. Conchyliol., p. 8 (of sep. cop.), pl. 10, f. 14.

Shell small, conical; spire short, scalariform. Whorls with *two* spiral angulations, a little concave between them; upper part, above upper angulation, horizontal, lower part, below lower angulation, vertical. Whole surface (aside of these angulations) with fine revolving striæ, 3 on upper part, 4–6 on the middle (concave) part, and 3 on the lower. Angulations distinctly granulated (in well preserved specimens), and very fine and indistinct granulations are sometimes seen on the striæ, especially in the middle part of the whorls. Last whorl with an angulation on the periphery. Base plane, with 7–9 revolving striæ, and a stronger and beautifully granulated rib near the deep umbilicus. Fine revolving striæ are also present within the umbilicus, where they are finely and indistinctly granulated.

Height, 6 mm; diameter, 7 mm.

Remarks: Cossmann does not mention the granulations of the angulations of the upper whorls, and describes, within the umbilicus, only obtuse crenulations, but I think, in his specimens, these fine ornaments were worn off, as is also the case in two of ours.

Record of specimens: Mouth of Santa Cruz River, 4 sp.; Lake Pueyrredon, 600′ above base, 1 cast.

Distribution: Jegua quemada, Suprapatagonian beds (Cossm.).

Affinities: *Trochus stoliczkai* Zittel (1864, p. 40, pl. 15, f. 7), from the Miocene (Pareora, Hutton, 1873, p. 15), of New Zealand seems to represent this form in New Zealand: but the whorls are more rounded, and not so distinctly angular, and the fine revolving striæ are lacking.

Cossmann compares this species with the "Eocene *Solariellæ*" from Paris, from which it is said to differ in the lack of granulations: but as we have seen above, these granulations are present in the Patagonian fossil. On the other hand, there is a *Miocene* species, *S. turritella* Dall (1892, p. 408, pl. 23, f. 2), from Florida, and even a *Pliocene* species, *Margarita maculata* Wood (1848, p. 135, pl. 15, f. 3), which much resemble our species, so that it is impossible to say that the Patagonian shell has a distinctly Eocene appearance.

Gen. CALLIOSTOMA Swains.

95. Calliostoma philippii (Ortmann).

Pl. XXX, Fig. 12$^{a, b}$.

1899 *Trochus ph.* Ortmann, in: Amer. Journ. Sci., v. 8, p. 430.

Shell low, conical, not umbilicated. Whorls almost flat, only very slightly convex. Last whorl sharply angular on the periphery; above this angular ridge there are 4 revolving ribs. Lower surface slightly convex, with 5 strong, revolving ribs, the most exterior of them separated from the peripheral ridge by a broad groove. Ribs of lower surface with regular, strong granules; similar granules seem to have been present on the ribs of the upper part of the whorls.

Height, 7 mm; diameter, 11 mm.

Remarks: There already exists a *Trochus philippii* Koch (see: Pilsbry, 1889, p. 52), but since our species comes in the genus *Calliostoma*, no change of the specific name is necessary.

The upper surface of the whorls is not well preserved in our specimens, so that the characters of the sculpture, especially the granulations, are not plainly recognizable.

This species differs from *T. fricki* Philippi (1887, p. 101, pl. 12, f. 7), from the Navidad beds of Chili in the following details: (1) the whorls are slightly convex (in *T. fricki* perfectly flat); (2) the revolving ribs are less numerous (in *T. fricki* there are 6 on the upper part, and at least 7 on the lower part); (3) the umbilicus is absent.

C. philippii differs from *C. observationis* in the following particulars: (1) the revolving ribs are less numerous (in *C. observationis* 5–6 in the upper part, 9–10 on the base); (2) the ribs of the base are separated from the periphery by a groove; (3) there are granulations present.

Record of specimens: Punta Arenas, horizon III (upper Magellanian); 2 sp.

Affinities: In the Navidad beds of Chili we have a closely allied species, *T. fricki.* I cannot say, however, that any species of the northern hemisphere shows a marked affinity to this one, although there are many, which might be compared with it.

96. CALLIOSTOMA OBSERVATIONIS Ortmann.

Pl. XXX, Fig. $13^{a, b}$.

1900 *C. o.* Ortmann, in: Amer. Journ. Sci., v. 10, p. 372.

Shell low, conical, not umbilicated. Whorls flat, last whorl bluntly angular on the periphery. Above this angulation there are 5 distinct revolving ribs; near the mouth, between the 2d and 3d (counted from the upper part), a sixth rib begins to appear, and, in our largest individual, the peripheral angulation is divided by a fine impressed line into two ribs. On the upper whorls, near the apex, the 2d and 4th ribs disappear, so that only three ribs remain (1st, 3d, and 5th), besides the peripheral angulation, which appears as a 4th rib immediately above the suture. All the ribs, when fully developed, are subequal, flattened, smooth, about as broad as the intervals between them. The base of the shell shows 9–10 revolving ribs of the same character, which are, near the umbilicus, as broad as the intervals, but more crowded toward the periphery. The outermost of them is not separated from the peripheral angulation by a broader interval.

Height, 10.5 mm; diameter, 12 mm.

Remarks: The lack of granulations distinguishes this species at once from *C. fricki* and *philippii.* Furthermore, in *C. fricki,* the spire is more depressed, but more acute; the revolving ribs of the base are more crowded, and a small umbilical excavation is present.

Record of specimens: Mt. of Observation, upper horizon; 10 sp.

97. CALLIOSTOMA PERARATUM Cossmann.

Pl. XXXI, Fig. $3^{a, b}$.

1899 *C. p.* Cossmann, in: Journ. Conchyliol., p. 9 (of sep. cop.), pl. 10, f. 6.

Shell conical, about as high as broad, not umbilicated. Whorls flat, last whorl bluntly angulated. Upper whorls with 2 strong and 1 finer revolving keels; the lower keel is formed by the peripheral angulation;

above this is a similar one, which is strong, but not quite as broad as the first one; near the suture, on the upper part of the whorls, there is a much finer, but distinct keel. No granulations on the keels. The two larger ones broad and rounded, and, on the last whorl, near the mouth of the shell, bifid. All three keels separated by broad, smooth grooves, about as broad as the middle keel. Base of shell almost flat, with 8–10 revolving ribs, which are flat and smooth, more crowded toward the periphery, a little more widely distant toward the umbilicus; the furrows between them, however, are always narrower than the ribs.

Height, 8.5 mm; diameter, 9 mm.

Record of specimens: Mouth of Santa Cruz River; 3 sp.

Distribution: Jegua quemada, Suprapatagonian beds (Cossm.).

Affinities: Cossmann says that, among the fossil species, *C. audebardi* Bast. from the Lower *Miocene* of Bordeaux is the most closely allied form.

98. CALLIOSTOMA COSSMANNI Ortmann.

Pl. XXXI, Fig. $4^{a, b}$.

1900 *C. c.* Ortmann, in: Amer. Journ. Sci., v. 10, p. 372.

Shell conical, higher than broad, not umbilicated. Whorls flat, the last one angulated, with a keel on the periphery, which is wholly exposed on the upper whorls, being situated close to, but above the suture. Upper whorls with 5 revolving keels, the lowermost (the keel of the periphery just mentioned) the strongest and almost smooth, with hardly any traces of granulations. The uppermost (first) and the third keels stronger than the 2d and 4th; the 1st, 2d, and 3d distinctly granulated, the 4th with finer granulations. Toward the apex of the shell, the 2d and 4th keels disappear, so that only three keels are present, the two upper ones granulated, the lower one (peripheral angulation) smooth. (Perhaps it was also finely granulated, but if so, the granules are worn off.) Base of shell hardly convex, with 6 revolving keels, which are subequal, smooth, narrower than the intervals. One or two of the keels, nearest to the periphery, appear bifid toward the mouth of the shell.

Height, 8 mm; diameter, 6.5 mm.

Record of specimens: Mouth of Santa Cruz River, 4 sp.

99. CALLIOSTOMA SANTACRUZENSE Cossmann.

Pl. XXXI, Fig. $5^{a, b}$.

1899 *C. s.* Cossmann, in: Journ. Conchyliol., p. 10 (of sep. cop.), pl. 10, f. 13.

Shell conical, higher than broad, not umbilicated. Whorls slightly convex, suture shallow. Last whorl angulated, with a keel on the angulation. Above this keel, which is wholly exposed on the upper whorls, there are 2 to 3 other revolving keels, which are remote from each other, the uppermost close to the suture. They are crossed by oblique longitudinal ribs, which form, at the intersection with the revolving ribs, small tubercles or conical granulations. These longitudinal ribs are fairly remote from each other in the upper whorls, but more crowded near the mouth of the shell, resembling there lines of growth. Base of shell oblique, a little convex, with 6 spiral ribs, the outermost a little more distant from the peripheral keel than from the rest. These ribs of the base are crossed by lines of growth (or ribs) in the same way as those of the upper part of the whorls, and are also granulated at the points of intersection.

Height, 9 mm; diameter, 7 mm.

Remarks: Our specimens differ a little from the original description. Cossmann calls the whorls convex, but they are very slightly so (also in Cossmann's figure[1]). Further, Cossmann gives 4 spiral ribs on the upper whorls, with a finer one intercalated on the last whorl. In our largest individual, although a little larger than Cossmann's, I can distinguish 4 ribs only near the mouth, with no traces of intermediate ones, and the upper whorls show only three ribs.

But since the general character of sculpture: revolving ribs, crossed by longitudinal ones, with granules at the points of intersection, is well exhibited in our specimens, I have no doubt that they belong to Cossmann's species.

Record of specimens: Mouth of Santa Cruz River, 4 sp.

Distribution: Jegua quemada, Suprapatagonian beds (Cossm.).

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[1] Cossmann's figures do not help materially in the identification of the species; they give a good representation of the external form and dimensions, but in most cases the details of sculpture, etc., are obscure. The fault lies with method of reproduction.

Affinities: Cossmann compares this species with *C. podolicum* (Dub.) from the upper *Miocene* (Sarmatian) of southeast Europe, and *C. pseudoturricula* Dollf. from the middle Miocene of France. There is no doubt that the first one (*C. podolicum*, see Hoernes, 1856, p. 447, pl. 45, f. 2) represents a similar type, although the details of sculpture are different.

100. CALLIOSTOMA GARRETTI Ortmann.

Pl. XXXI, Fig. 6$^{a, b}$.

1900 *C. g.* Ortmann, in: Amer. Journ. Sci., v. 10, p. 373.

Shell conical, as high as broad, not umbilicated. Eight whorls, which are very slightly convex; suture shallow. Last whorl very bluntly angular at the periphery, without a distinct peripheral keel. Surface of whorls, above the periphery, covered with numerous fine revolving threads: there are, on the third whorl, about 7 of them, increasing to about 17 on the last whorl. The number of threads increases by intercalation, the new ones being at first smooth; with increasing size they equal the older threads, and become, like the latter, finely but distinctly granulated. These granulations, however, are developed only in the upper three quarters of the whorls: the lower 4 or 5 threads remain smooth. Intervals between the threads about as broad as these, and crossed by very fine lines of growth, giving a pitted appearance to them. The revolving threads continue over the periphery to the base of the shell, which is slightly convex; their number is about 24 on the base, and they are smooth, without granulations, resembling in all other respects those of the upper part of the whorls.

Height, 17 mm; diameter, 17 mm.

Remarks: The specific name is given in honor of Mr. J. W. Garrett.

Record of specimens: Mouth of Santa Cruz River, 6 sp.

Affinities: Trochus macsporrani Philippi (1887, p. 102, pl. 12, f. 6), from the island of Santa Maria, Chili (Navidad beds?) seems to represent this species in Chili, but in *T. macsporrani* the granulations are wanting, and the periphery is more sharply angulated.

C. garretti exhibits distinctly *Miocene* relations, with a group of species found in Miocene beds of the southern United States, described by Dall (1892, p. 390 ff., pl. 18 and 22). The most closely allied of them seem to be: *C. philanthropus* (Conr.) (see: l. c., p. 390, pl. 18, f. 9a) from the

Miocene of Virginia, which differs, however, in the more strongly angulated periphery, flatter whorls and coarser threads, and *C. metrium* Dall (p. 394, pl. 22, f. 27) from the older Miocene of Florida, which differs in the flat whorls and the finer sculpture.

101. CALLIOSTOMA IHERINGI Ortmann.

Pl. XXXI, Fig. $7^{a, b}$.

1900 *C. i.* Ortmann, in: Amer. Journ. Sci., v. 10, p. 373.

Shell conical, broader than high, scalariform, umbilicated. Six whorls, which are sharply angulated; one angulation is formed by a sharp revolving keel in the upper part of the whorls, a second one—exposed only on the last whorl—is formed by a keel on the periphery. Suture distinct, forming an obtuse angle; upper part of whorls (above upper keel) oblique, flat, with 5 to 6 revolving threads, which are slightly granulated; lower part (below that keel) vertical, slightly concave on the last whorl, with 5 to 7 fine, smooth threads. Base of shell slightly convex, depressed toward the umbilicus, which is moderately large. About 18 revolving threads on the base, which are smooth, more crowded and finer toward the periphery, a little stronger near the umbilicus, where the intervals are about as broad as the threads.

Height, 9.5 mm; diameter, 12 mm.

Remarks: The presence of an umbilicus brings this species into the subgenus *Eutrochus.*

Record of specimens: Mouth of Santa Cruz River, 1 sp.

Affinities: A species that resembles this one in the presence of two angulations on the last whorl, and belongs also to the subgenus *Eutrochus* is: *C. cyclus* Dall (1892, p. 403, pl. 23, f. 20) from the *Miocene* of North Carolina, but this one is much lower. Another species with the same double angulation and open umbilicus is *Trochus biangulatus* Eichw. (see: Hoernes, 1856, p. 460, pl. 45, f. 5) from the *Miocene* of Europe, but it is much higher. The latter species is said to be identical with *T. ditropis* Wood (1848, p. 133, pl. 14, f. 9) from the Pliocene of England. The latter, however, in external form, is more like our Patagonian fossil, being less high than the Miocene form, and it differs from *C. iheringi* in the upper angulations being more prominent, the number of revolving threads being different, especially on the base, which is said to be finely imbricated.

Gen. GIBBULA Riss.

102. GIBBULA LÆVIS (Sowerby).

Pl. XXXI, Fig. 8.

1846 *Trochus lævis* Sowerby, in: Darwin, Geol. Observ. S. Amer., p. 256, pl. 3, f. 46, 47 (adult).
1846 *T. collaris* Sowerby, ibid., p. 256, pl. 3, f. 44, 45 (junior).
1887 *T. lævis* Philippi, Tert. & Quart. Verst. Chiles, p. 101, pl. 12, f. 5.
1897 *Gibbula coll.* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 273.
1899 *G. c.* v. Ihering, in: N. Jahrb. Miner., etc., v. 2, p. 24.

Shell conical, broader than high, umbilicated. Surface smooth, whorls almost flat, only the last one slightly convex. Periphery sharply angulated. Upper whorls, close to the suture, with a series of small tubercles. Base very slightly convex, with a deep umbilicus of medium size, and a number of fine revolving striæ, which are distinct near the umbilicus, but disappear toward the periphery.

Height (not complete), 28 mm; diameter, 51 mm; according to Philippi: height, 38 mm; diameter, 50 mm.

Remarks: Philippi was the first to recognize that *T. collaris* of Sowerby is only the young stage of *T. lævis*, and he retains the specific name of the old stage. V. Ihering again uses the specific name of *collaris*, preceding that of *lævis* in Sowerby's text, but according to the rules of nomenclature, we are to follow Philippi, who was the first to make a selection between the two names available.

In some specimens the small tubercles near the suture disappear later than in others. The lower surface of the shell has spiral striæ, which in very young ones are very faint near the periphery, and disappear in old shells altogether, with the exception of 5 to 7 close to the umbilicus (see: Sowerby's figure 47).

Record of specimens: Mouth of Santa Cruz River, 12 sp.; Las Salinas, 1 sp.; San Julian, Oven Point, 2 casts; Lake Pueyrredon, base of Tertiary, 2 casts; Lake Pueyrredon, 600′ above base, 1 cast.

Distribution: Patagonian beds of Santa Cruz (Sow., v. Ih.); Navidad (Sow., Phil.), Lebu (Phil.).

Affinities: A very closely allied species is *T. veneficus* Philippi (1887, p. 101, pl. 12, f. 8), from Navidad, but the latter has a blunt, but distinct angulation near the suture, on which the tubercles are placed.

Philippi compares this species *(veneficus)* with *T. magus* L. (Pliocene and Recent, Europe), and indeed, this is the only relation with any other known form, but it is very remote. A little closer is the affinity of *T. magus* with the next species, as we shall see below.

103. GIBBULA DALLI v. Ihering.

Pl. XXXI, Fig. $9^{a, b}$.

1897 *G. dalli* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 272, pl. 3, f. 1, pl. 4, f. 13.
1897 *G. fracta* v. Ihering, ibid., p. 273, pl. 3, f. 2.
1900 *G. dalli* Ortmann, in: Amer. Journ. Sci., v. 10, p. 380.

Shell conical, broader than high, widely umbilicated. Whorls convex, especially in the upper part, near the suture. Last whorl obtusely carinated on the periphery. Surface ornamented with revolving striæ, and oblique, tubercular, radial ribs near the suture. The latter are sometimes short, and more like tubercles, in other cases they are more elongated. extending almost to the middle of the upper (exposed) part of the whorls, Revolving striæ very unequal, 5 to 6 larger ones are found in the region of the tubercles, with intermediate finer ones; the rest, toward the periphery, are fine. Very often, and especially in the young shell, between the tubercles and the peripheral angulation (which shows partly on the upper whorls above the suture), there is another revolving, blunt ridge, resembling the peripheral angulation. Base of shell slightly convex or flat, umbilicus deeply depressed, wide. Base with a number (7 to 8) of revolving ribs, and numerous fine striæ between them; 3 to 5 of the larger ribs, near the umbilicus, are distinctly granulated by fine lines radiating from the umbilicus.

Height, 17 mm; diameter, 36 mm; our largest cast measures: height, about 28 mm; diameter, 52 mm; v. Ihering gives: height, 35 mm; diameter, 63 mm.

Remarks: I regard *G. fracta* as the young stage of this species. The only difference—according to the diagnosis; the figure does not show any differences except that it is smaller—is the presence of two spiral angulations in the lower part of the upper whorls. These blunt ridges are present in almost all individuals, and even those that are large and show the typical character of *G. dalli* on the last whorl, exhibit them on the upper whorls. But the development of these ridges is very variable: sometimes, and especially in the young shell, they are very distinct, and such specimens represent v. Ihering's *G. fracta.* In a few individuals the upper ridge is completely absent, even in the young shell, and this part of the shell appears depressed between the row of tubercles and the peripheral angulation: such individuals are mentioned by v. Ihering (p. 274) as variety *cuevensis.* With increasing age these spiral ridges disappear, and on the last whorl of large shells no trace of the upper one is found, and the lower one (on the periphery) becomes indistinct. At the same time, the tubercles become less pronounced, and the upper half of the whorl appears evenly convex, without depression, representing thus the typical *G. dalli.* We possess all intermediate stages.

There is also considerable variation in the development of the revolving striæ, both of the upper side and of the base. In older shells they become more uniform and less distinct, especially the finer ones. The larger striæ are often beautifully waved in crossing the tubercles near the suture.

Record of specimens: Mouth of Santa Cruz River, 16 sp.; Upper Rio Chalia, 5 casts; Shell Gap, Rio Chico, upper horizon, 12 sp. (mostly casts); Arroyo Gio, 1 cast; Lake Pueyrredon, 600′ above base, 2 casts.

Distribution: Jack Harvey and Jegua quemada, Suprapatagonian beds (v. Ih.).

Affinities: This species has a better claim than the preceding one to be compared with *G. magus* (L.), both having radial and spiral sculpture combined; for the rest, in the details of sculpture, general form of shell, and shape of umbilicus, there are numerous differences. But we may say, if there is any relation of this species, it is with Pliocene and recent forms.

104. GIBBULA DIAMETRALIS Cossmann.

Pl. XXXI, Fig. $10^{a,b}$.

1899 *G. d.* Cossmann, in: Journ. Conchyliol., p. 5 (of sep. cop.), pl. 10, f. 1–3.

Shell conical, broader than high, umbilicated. Whorls convex, suture distinct. Upper surface of whorls with 2 strong, rounded, revolving ribs, and a similar angulation on the periphery, which is partly exposed on the upper whorls. Upper rib with very elegant crenulations or plications, formed by short, oblique ribs radiating from the suture. These crenulations are restricted to the upper part of this rib, the lower being occupied by 2 to 3 sharp revolving threads. Similar threads or keels (4 to 5) are on the second rib, and a number of very fine, but distinct striæ are on the peripheral angulation. Intervals between the ribs deep, with indistinct revolving striæ. Base of shell with about 9 revolving keels, which are strong and distinctly crenulated near the umbilicus, becoming finer toward the periphery. Umbilicus deep, of medium size.

Height, 12 mm; diameter, 15 mm.

Remarks: I am not quite satisfied that my identification of this species is correct. Cossmann mentions crenulations on the inferior part of the whorls, while my individuals show them only in the upper part: this discrepancy is not cleared up by Cossmann's figure, which shows no crenulations at all. In all other respects our individuals agree with Cossmann's figure and description, but it is to be remarked that the figure represents an individual that is apparently considerably worn. In our figured specimen the surface ornaments are in a beautiful state of preservation, and all of them are more distinct and more pronounced than in Cossmann's figure.

In another of our specimens the upper revolving rib does not show any finer keels, but is bipartite, the lower division being a little narrower and showing also traces of crenulations. The third individual is very small, while the other two are considerably larger than the measurements given by Cossmann.

Record of specimens: Mouth of Santa Cruz River, 3 sp.

Distribution: Jequa quemada, Suprapatagonian beds (Cossm.).

Fam. *PYRAMIDELLIDÆ* Gr.

Gen. ODONTOSTOMIA Jeffr.

105. ODONTOSTOMIA SUTURALIS (v. Ihering).

Pl. XXXIII, Fig. $7^{a,b}$.

1897 *Odostomia sut.* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 275, textf. 10.
1899 *Odontostomia synarthrota* Cossmann, in: Journ. Conchyliol., p. 12, (of sep. cop.), pl. 11, f. 4.
1900 *Odontostomia sut.* Ortmann, in: Amer. Journ. Sci., v. 10, p. 380.

Shell pyramidal, smooth; whorls 7 (9 according to v. Ihering), flat, angulated near the suture, last whorl rounded. Mouth oblong, inner lip with a fold below.

Height, 9 mm; diameter, 3.5 mm (v. Ihering gives: height, 19; diameter, 7; Cossmann: height, 5; diameter, 2 mm).

Remarks: One of our specimens is isolated, and it is smaller than v. Ihering's, but larger than Cossmann's. The only difference of Cossmann's species is the small size and small number of whorls (5–6). Our individual is exactly intermediate in these respects between both, and so there is no doubt that Cossmann's species is only the young stage of this species. The fold on the inner lip is well seen in our specimen. The other specimen in our collection is larger, but as it is imbedded in matrix, no exact measurements can be given.

In the use of *Odontostomia* for *Odostomia* I follow Dall (1892, p. 248).

Record of specimens: Mouth of Santa Cruz River, 2 sp.

Distribution: Jegua quemada, Suprapatagonian beds (v. Ih., Cossm.).

Affinities: According to Cossmann, this species is distinguished by the angulated whorls from the Eocene species of France. I do not know any other species in which this feature is shown, except a variety of *O. conoidea* Brocchi (Dall, 1892, p. 250). This variety is mentioned by Wood (1848, p. 86), from the Pliocene of England. He says "the angulated edge of the volution gives a subcanaliculated form of suture to another variety" (fig. 3a on pl. 9).

O. conoidea is found from Miocene to Recent times in Europe, the United States, and the West Indies.

Gen. TURBONILLA Riss.

106. TURBONILLA CUEVENSIS v. Ihering.

Pl. XXXIII, Fig. 8$^{a, b}$.

1897 *T. c.* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 276, textf. 11.

1899 *T. iheringi* Cossmann, in: Journ. Conchyliol., p. 13 (of sep. cop.), pl. 10, f. 12.

1900 *T. c.* Ortmann, in: Amer. Journ. Sci., v. 10, p. 380.

Shell elongate-pyramidal, surface with longitudinal ribs and indistinct spiral striæ. Longitudinal ribs about 20 on the last whorl, not extending to the base. Whorls flat, suture distinct and sharply canaliculate. Mouth ovate, columella with an indistinct fold.

Height, 12 mm; diameter, 3 mm (v. Ihering gives: height, 5; diameter, 1.5; Cossmann: height, 7; diameter, 1.5 mm).

Remarks: V. Ihering's figure is given as half natural size, but it is—according to the measurements given—about 8 times enlarged.

Cossmann's description differs from v. Ihering's only in that he mentions an indistinct fold on the columella, which may have been overlooked by v. Ihering. (Cossmann calls it "hardly visible.") This fold exists in our individual, but, indeed, it *is* hardly noticeable. It is situated well upward on the columella. Cossmann says it is situated in the lower part, but it is to be remarked that he turns all his shells upside down; in his figure something like a columellar fold is visible, situated exactly as in our individual, but the figure is too poor to make sure whether this is really this fold.

The spiral striæ are hardly visible in our specimen.

Record of specimens: Mt. of Observation, upper horizon, 1 sp.

Distribution: Suprapatagonian beds of La Cueva (v. Ih.) and Jegua quemada (Cossm.).

Affinities: According to Cossmann, this species differs from those of the Eocene of Paris in being much more conical, that is to say, apparently, being less slender. I can, however, hardly support this view, since many of the Eocene species do not differ at all in form from the Patagonian species (see Deshayes, 1864, pl. 20 and 21). It is hard to say to which one of the numerous Tertiary *Turbonillæ* the present species bears the closest resemblance.

Fam. *SCALARIIDÆ* Brod.

Gen. SCALARIA Lmck.

107. SCALARIA RUGULOSA Sowerby.

Pl. XXXI, Fig. 11^{a-e}.

1846 *S. rug.* Sowerby, in: Darwin, Geol. Observ. S. Amer., p. 255, pl. 3, f. 42, 43.
1864 *S. lyrata* Zittel, Novara Exp. Geol., p. 41, pl. 9, f. 8.
1864 *S. browni* Zittel, ibid., p. 42, pl. 9, f. 9.
1873 *S. browni & lyrata* Hutton, Catal. Tert. Moll. Ech. N. Zealand, p. 9.
1885 *S. browni & lyrata* Hutton, in: Quart. Journ. Geol. Soc., v. 41, p. 550.

1887 *S. rug.* Philippi, Tert. & Quart. Verst. Chiles, p. 83, pl. 9, f. 15.
1897 *S. rug.* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 277.

Shell large, solid, conical, elongate, not perforated. Whorls convex, with longitudinal ribs and spiral striæ. Suture deep. Longitudinal ribs subequal, high, variciform, moderately thick in the young shell, very thick and swollen in the old, the anterior side (directed toward the mouth) is rounded, the posterior excavated, with a sharp edge. The number of ribs varies from 8 to 16 in different individuals, and even in one and the same individual the number sometimes varies considerably (for instance from 10 to 16 in a large one from San Julian); other individuals preserve the number throughout (so a large one from San Julian with 8 ribs on all whorls). In young individuals, where the longitudinal ribs are thinner, they often show, on the upper part, near the suture, a small point or angle. Ribs and intervals crossed by revolving striæ, which are more or less distinct (when indistinct, probably worn off). Base of shell with a spiral carina interrupted by the longitudinal ribs. Mouth almost circular, lip reflected.

Measurements: Almost complete individual: height, 52 mm, diameter, 18.5 mm; almost complete individual: height, 77 mm, diameter, 25 mm; end broken off: height, 78 mm, diameter, 31 mm.

Remarks: The number of revolving striæ is very variable. The only difference from the Patagonian shell observed in the New Zealand fossil is the small number (8) of revolving ribs, but I possess from San Julian an individual of medium size that shows exactly this number, and younger ones that possess still less (only 6). In larger individuals this number of revolving striæ increases considerably in the Patagonian shell (up to about 20). *S. browni* is said to possess 16 to 18 longitudinal ribs, a number which is not supported by the figure: the last whorl, in the figure, has on the side directed toward the spectator only 6 ribs, which would bring the total number hardly over 15. Hutton says, that he does not see why *S. lyrata* should be different from *S. rugulosa*, and that *S. browni* is only a variety of *S. lyrata*, while Zittel regards *S. browni* as hardly distinguishable from *S. rugulosa.*

In my opinion, all these alleged species are forms of one and the same species, which varies in the number of longitudinal ribs, their thickness, and the development of the spiral striæ. Indeed, among our material, the young ones completely resemble the figures of *S. rugulosa*, as well as of *S. browni*, and some of the larger ones completely resemble *S. lyrata*, while others have the same form, but the rugosities of the ribs caused by the spiral striæ are less pronounced. It is impossible to distinguish, among our material, more than one species: if we wanted to do so—according to the number of ribs and the development of the striæ—we should be forced to accept about half a dozen species, with as many transitional forms.

Record of specimens: Mouth of Santa Cruz River, 5 sp.; Mt. of Observation, upper horizon, 4 sp.; San Julian, Darwin Station, 21 sp.; Upper Rio Chalia, 2 sp.; 30 miles north of Upper Rio Chalia, 1 sp.; Cañon near Sierra Oveja, Rio Chico, 1 sp.; Lake Pueyrredon, base of Tertiary, 1 sp.

Distribution: San Julian (Sow.); Santa Cruz, La Cueva, Jegua quemada, Suprapatagonian, and possibly Patagonian beds (v. Ih.); Chili: Navidad, Matanzas, Lebu (Phil.); New Zealand, Oamaru and Pareora systems, Oligocene and Miocene (Zittel, Hutton).

A variety, *obsoleta*, without spiral striæ is mentioned by v. Ihering from Santa Rosa or Punta Raza (see pp. 112 and 119), Tehuelche beds.

Affinities: Very closely allied is the *Oligocene S. inæquistriata* v. Koenen (1867, p. 107, pl. 6, f. 14), from northern Germany: the longitudinal ribs are from 14 to 20, and the spiral ribs are more numerous (30 to 40 on the last whorl in individuals, which are only as large as a medium sized *S. rugulosa*). The latter character is the only difference I can discover. On the other hand, the *Miocene S. lamellosa* (Broc.) (see: Hoernes, 1856, p. 474, pl. 46, f. 7) comes very near (as has been pointed out by Zittel under *S. lyrata*): it has ribs of the same character, but the number of spiral striæ is less (only 6), and the whorls increase (according to the figure) a little more rapidly. In Eocene deposits this type of *Scalaria* seems to be lacking.

Fam. *CAPULIDÆ* Cuv.

Gen. CRUCIBULUM Schum.

108. CRUCIBULUM DUBIUM Ortmann.

Pl. XXXII, Fig. $3^{a,b}$.

1900 *C. d.* Ortmann, in: Amer. Journ. Sci., v. 10, p. 373.

Cast subcircular, depressed-conical. Apex subcentral. On one side is seen the impression of the internal cup-shaped lamina, which was attached to the inner wall of the shell.

Diameter, 20 mm; height, 8 mm.

Record of specimens: Arroyo Gio, 1 cast.

Affinities: There are some species living on the western coast of South America; but without knowledge of the external surface our cast cannot be compared with them.

The genus *Crucibulum* is found, according to Zittel (1885, p. 215), from the Miocene to recent times in North America and the West Indies.

Gen. INFUNDIBULUM Montf.

109. Infundibulum merriami (Ortmann).

Pl. XXXII, Fig. $4^{a,b}$.

1887 *Trochita costellata* Philippi, Tert. & Quart. Verst. Chiles, p. 93, pl. 11, f. 4 (non *T. costellata* Conrad, 1855).

1899 *T. merriami* Ortmann, in: Amer. Journ. Sci., v. 8, p. 430.

Shell thin, depressed-conical; apex central. Surface with numerous, fine, radial ribs, or rather fine, radial forrows, separated by flat ribs.

Height, 12 mm; diameter, 24 mm. (The measurements given by Philippi in text and figure do not agree, although they refer to one and the same individual; the text gives: height, 9 mm; diameter, about 25; the figure shows: height, 14 mm; diameter, 18 mm.)

Remarks: The genus *Trochita* Schum. 1817, is synonym with *Infundibulum* of Montfort 1810, but not with *Infundibulum* of Klein 1753. But since Klein's genus is Pre-Linnean, *Infundibulum* Montfort is to be used as Tryon (1886, p. 103) does (as subgenus of *Calyptræa*). The chief generic character is found in the distinct *spiral* diaphragm of the interior, the columellar margin of which does *not* form a false umbilicus, that is to say: although reflected, the reflected part of the diaphragm is closely appressed, to that no opening remains.

This species differs from the following *(I. corrugatum)* in the much finer radial sculpture. This sculpture is well preserved in one specimen from the lower beds, but hardly at all in that from the upper beds, which is poor.

Record of specimens: Punta Arenas, horizon II (lower Magellanian), 2 sp.; Punta Arenas, horizon III (upper Magellanian), 1 sp.

Distribution: Lebu, Chili (Phil.).

Affinities: A similar species is *Trochita filosa* Gabb (1869, p. 15, pl. 2, f. 25) from the *Miocene* of California, but in *T. filosa* the radiating striæ are still finer, and often dichotomous.

110. INFUNDIBULUM CORRUGATUM (Reeve).

Pl. XXXII, Fig. V^{a-e}.

1859 *Trochita corr.* Reeve, Conch. Icon., v. 11, pl. 2, f. 9.
1867 *Clypeola corr.* Gray, in: Pr. Zool. Soc. London, p. 735.
1886 *Calyptræa (Infundibulum) radians* Tryon (pro parte), Man. Conch., v. 8, p. 121, pl. 35, f. 84–88.
1897 *Trochita corr.* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 279, pl. 4, f. 18, pl. 5, f. 26.
1899 *Tr. corr.* v. Ihering, in: Jahrb. Miner., etc., v. 2, p. 25.

Shell subcircular, conical, more or less elevated. Apex more or less central. Surface with distinct radial ribs; the latter rounded, about as broad as the intervals, and crossed by concentric or spiral lines, which are not parallel to the suture. Interior with a spiral diaphragm, which is a little reflected at the columellar side, but does not form a false umbilicus.

Height, 15 mm; diameter, 20 mm.
Height, 8 mm; diameter, 19 mm.

Remarks: This species is very variable in external form, higher or more depressed, and in the development of the radiating ribs. The latter are more or less distinct, sometimes quite indistinct. These ribs are sometimes visible on the cast, but in most cases they are not, which renders it impossible to distinguish casts of very depressed individuals from the following species.

Tryon identifies the living *T. corrugata* with *radians* of Lamarck, and possibly he is right: *T. radians* differs only in the much larger size (see: Reeve, pl. 1, f. 3).

From San Julian we have a very large cast (pl. XXXII, f. 5^{e}), which would correspond in size to *T. radians*, except for the higher conical form. This cast appears to be smooth, but I think I can see indistinct traces of radial ribs.

Mr. Hatcher has collected a large number of specimens of the recent *I. corrugatum* at various localities on the coast of Patagonia, and they agree completely with the common fossil form found on the mouth of the Santa Cruz River.

Record of specimens: Mouth of Santa Cruz River, 25 sp.; Mt. of Observation, upper horizon, 14 sp.; San Julian, Oven Point, 2 sp.; 30 miles north of upper Rio Chalia, 22 sp.; Shell Gap, Rio Chico, upper horizon, 2 sp.; Lake Pueyrreden, 600′ above base, 17 sp.

Distribution: Fossil: Santa Cruz and Jegua quemada, Patagonian and Suprapatagonian beds (v. Ih.).

Recent: West coast of South America (Chili, Peru, and perhaps California), and East coast of Patagonia (coll. Hatcher: Punta Arenas, Cape Fairweather, Santa Cruz).

110a. INFUNDIBULUM CORRUGATUM VAR. ELATUM var. nov.

Pl. XXXII, Fig. 5^f.

We possess three individuals, which are very high, and—although the shell is well preserved—it does not show any radiating ribs, but numerous concentric lamellæ. They agree in the latter character apparently with the following species, but are very much higher. Among the material from 30 miles north of Rio Chalia, casts are found, which agree in form with this variety, but some of them show traces of radial ribs.

To this variety may belong: *Trochita parvula* of Philippi (1887, p. 93, pl. 11, f. 2), from Navidad. Philippi had only a single small individual, which was apparently poorly preserved. And further, the var. *lævis* Gray (l. c.), recent, Falkland Island may belong here, but it is said of to be smooth (without concentric lamellæ). We possess this smooth form among the recent material collected by Mr. Hatcher at Cape Fairweather.

Record of specimens: Mouth of Santa Cruz River, 3 sp.

111. INFUNDIBULUM CLYPEOLUM (Reeve).

Pl. XXXII, Fig. $6^{a, b}$.

1859 *Trochita clypeolum* Reeve, Conch. Icon., v. 11, pl. 3, f. 14.
1867 *Clypeola magellanica* Gray, in: Pr. Zool. Soc. London, p. 735.
1897 *Trochita mag.* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 280, pl. 4, f. 17, pl. 5, f. 25.

1899 *T. m.* v. Ihering, in: N. Jahrb. Miner., etc., v. 2, p. 25.
1900 *Infundibulum clypeolum* Ortmann, in: Amer. Journ. Sci., vol. 10, p. 380.

Like *I. corrugatum*, but shell much depressed, without radial ribs, and with strong concentric striæ.

Our largest individual measures: Height, 12 mm; diameter, 30 mm; v. Ihering gives: Height, 21 mm; diameter, 54 mm.

Remarks: I hardly believe that this is a good species. We have seen that in *I. corrugatum* the radial ribs sometimes disappear, and that the external form is very variable; indeed, we possess individuals, which are much more depressed than the typical *I. clypeolum*, but have distinct ribs. But until the relations of the living *I. clypeolum* and *corrugatum* are settled, I am not prepared to make any change in the accepted nomenclature of these fossil forms.

Record of specimens: Mouth of Santa Cruz River, 2 sp.

Distribution: Fossil: Santa Cruz and Jegua quemada, Patagonian and Suprapatagonian beds (v. Ih.).

Recent: Straits of Magellan.

Gen. GALERUS Gray.

112. Galerus araucanus (Philippi).

Pl. XXXII, Fig. $7^{a,b}$.

1887 *Trochita ar.* Philippi, Tert. & Quart. Verst. Chiles, p. 92, pl. 11, f. 1.
1900 *Galerus a.* Ortmann, in: Amer. Journ. Sci., v. 10, p. 379.

Cast subcircular, conical, more or less depressed. Spiral diaphragm forming an impression on the cast running down from the apex to the periphery, and occupying not more than about one-fourth of the circumference. A second impression, very much shorter, starts also from the apex, and has been formed, apparently, by the reflected part of the diaphragm. Of the outer surface of the shell only a few traces are seen, and it was apparently smooth.

Height, 8 mm; diameter, 19 mm.

Remarks: That the second, shorter impression on the cast is formed by the reflected margin of the diaphragm, is positively shown by an individual from Lake Pueyrredon, in which the apex of the cast is broken away. This species may be recognized by the two impressed lines on the cast, and these casts are distinguishable at a glance from the casts of *Infundibulum corrugatum*—which are found associated with them—by the much shorter diaphragm, which does not form a complete revolution, but only part of it.

The generic name *Galerus* Humphreys, 1797, takes precedence over *Calyptræa* Lamarck, 1799 (see Tryon, 1886, p. 103), and this genus is distinguished from *Infundibulum* chiefly in the columellar margin of the diaphragm, which is reflected, and forms a false umbilicus.

Record of specimens: Shell Gap, Rio Chico, upper horizon, 1 cast; Lake Pueyrredon, 600′ above base, 14 casts.

Distribution: Lebu and Guayacan, Chili (Phil.).

113. GALERUS MAMILLARIS (Broderip).

Pl. XXXII, Fig. $8^{a, b}$.

1859 *Trochita m.* Reeve, Conch. Icon., v. 11, p. 3, f. 12.
1886 *Calyptræa m.* Tryon, Man. Conch., v. 8, p. 120.
1897 *Cal. aff. mam.* Pilsbry, in: Pr. Acad. Philad., p. 330.

Shell subcircular, conical, elevated or depressed. Apex central. Surface with concentric lines of growth, otherwise smooth. Interior with a spiral diaphragm, making 1 to 2 complete revolutions, the columellar margin is reflected, and forms a distinct false umbilicus.

Height, 16 mm, diameter, 20 mm; height, 10 mm, diameter, 18 mm; height, 9 mm, diameter, 24 mm.

Remarks: There is some variability as to the external form: the shell is more or less high, as shown by the measurements given above.

We possess only inner and outer casts, and, superficially, the internal casts very much resemble *Infundibulum corrugatum*. But the radial ribs of the latter are completely absent, as is shown by a number of external casts, and a closer examination reveals the fact that the columellar margin of the diaphragm was reflected, forming an umbilicus. This umbilicus is filled with matrix in the cast, and, after breaking away the upper whorls, the cast of the umbilicus is well exhibited in a number of specimens (see plate XXXII, fig. 8^{b}).

This species differs from *G. araucanus* at once in the number of revolutions of the diaphragm: while in *G. araucanus* the diaphragm does not form a complete revolution, it completes, in *G. mamillaris*, the circle at least once (in small individuals), and 1½ to 2 times in larger individuals.

Record of specimens: Cape Fairweather, 31 casts.

Distribution: This species is found living on the western coast of South America, from Chili to California (see Tryon, l. c., p. 120).

Gen. SIGAPATELLA Less.

114. SIGAPATELLA AMERICANA Ortmann.

Pl. XXXII, Fig. $9^{a,b}$.

1900 *S. a.* Ortmann, in: Amer. Journ. Sci., v. 10, p. 373.

Shell subcircular or subelliptical, depressed. Apex distinctly excentric. Surface with irregular, concentric, slightly lamellate striæ, crossed by very fine radial rugosities. Internal diaphragm spiral, columella excentric, margin of diaphragm slightly concave and slightly reflected at the columella.

Measurements of a specimen from Punta Arenas: Height, 3 mm, diameter, 17 mm; of a specimen from Santa Cruz: Height, 16 mm, diameter, 49 mm; of another from Santa Cruz: Height, 5 mm, diameter, 27 mm.

Remarks: As to the generic name *Sigapatella* see Tryon, 1886, p. 104.

The radial plications or rugosities are very fine and sometimes indistinct. In our smaller individual from Santa Cruz, which is a little worn, there are no traces of them left.

Record of specimens: Mouth of Santa Cruz River, 2 sp.; Punta Arenas, above horizon V (Patagonian), 4 sp., found inside of *Ostrea ingens.*

Affinities: Trochita colchaguensis Philippi (1887, p. 93, pl. 11, f. 5) from La Cueva, Colchagua, Chili (age doubtful), may be identical, as well as the recent species *S. calyptræiformis* Lmck. (= *tomentosa* and *maculata*, Qu. & Gaim.), from Australia and New Zealand (see Tryon, 1886, p. 122, pl. 35, f. 96–99): but these forms do not show the sculpture of our species.

A species has been mentioned under the name of *Trochita dilatata* Sow. = *maculata* Qu. & Gaim., by Zittel (1864, p. 43, pl. 15, f. 8), from the New Zealand Miocene, but it seems doubtful whether this is a *Sigapatella* at all. *Calyptræa maculata* Qu. & Gaim., is given by Hutton (1873, p. 13) from the Oamaru, Pareora, and Wanganui beds of New Zealand, and thus it would pass from the Oligocene upward to Recent times.

No other fossil *Sigapatella* being known, our species would point most distinctly to *Neogene* age.

Gen. CREPIDULA Lmck.

115. CREPIDULA GREGARIA Sowerby.

Pl. XXXII, Fig. 10^{a-e}.

1846 *C. g.* Sowerby, in: Darwin, Geol. Observ. S. Amer., p. 254, pl. 3, f. 34.
1864 *C. incurva* Zittel, in: Novara Exp. Geol., p. 44, pl. 15, f. 9.
1873 *Crypta i.* Hutton, Catal. Tert. Moll. Echin. New Zealand, p. 14.
1887 *Crepidula uncinata* Philippi, Tert. & Quart. Verst. Chiles, p. 94, pl. 11, f. 6.
1887 *C. gregaria* Philippi, ibid., p. 94, pl. 12, f. 1 (after Sowerby).
1887 *Haliotis imperforata* Philippi, ibid., p. 102, pl. 12, f. 2.
1897 *Crepidula gregaria* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 278.

Shell oblong, thick, smooth, except for growth-lines, very convex. Apex incurved, marginal, sometimes a little produced; apical margin of mouth thickened. Diaphragm concave or plane, reaching about to the middle of the shell or slightly beyond, its margin concave.

Measurements of largest individual from Punta Arenas: Length, 92 mm, width, 44 mm, height, 34 mm.

Remarks: This shell is very variable in shape, broader or narrower. The apex, in smaller individuals, is produced and prominent beyond the line of the curvature of the margin of the shell, and simply incurved; in very old and large individuals it is subspiral, and raised a little upon the upper surface.

C. incurva of Zittel is no doubt this species: the figure agrees perfectly with our complete specimen of small size from Santa Cruz.

C. uncinata of Philippi is also a small individual of this species.

Haliotis imperforata Phil. comes from Skyring Water: there is no doubt that our giant specimens from Punta Arenas represent this form, and they are nothing but very large *C. gregaria.*

Record of specimens: Mouth of Santa Cruz River, 6 sp. (one of them almost complete); Upper Rio Chalia, 31 casts; Arroyo Gio, 3 sp.; Punta Arenas, horizon V (Patagonian), 6 sp.; (5 of them very large).

Distribution: Santa Cruz (Sow.); Jegua quemada and La Cueva, Patagonian and Suprapatagonian beds (v. Ih.); Navidad beds of Chili: Lebu, Matanzas, Guayacan, La Cueva (Phil.).

New Zealand: Pareora beds = Miocene (Zitt., Hutt.).

Affinities: The living *C. fornicata* L. (see Dall, 1889, pl. 50, f. 23, 24) from the Atlantic coast of North America and the West Indies is very closely allied, and its range in time begins in the *Miocene*. The Patagonian fossil, however, is much larger, generally more elongate, more solid and thicker, and especially the apical margin is more thickened.

I cannot distinguish the Patagonian fossil from *C. prærupta* Conrad (1849, p. 727, pl. 19, f. 9, 10) from the Miocene of Astoria, Oregon, which, according to Gabb (1869, p. 81) is identical with *C. princeps* Conrad (1856, p. 326, pl. 6, f. 52) from Subrecent beds of St. Barbara, California (also living). And, further, Gabb identifies this species with *Crypta grandis* Middendorf (1849, p. 101, pl. 11, f. 8–10) from Bering Sea. If all these should really prove to be forms of one and the same species, the range would be—in the northern Pacific—also from *Miocene* to *Recent* times, and give to the Patagonian beds a distinctly *Neogene* age.

116. CREPIDULA DILATATA Lamarck.

Pl. XXXII, Fig. 11.

1843 *C. d.* d'Orbigny, in: Voy. Amer. Merid., v. 5, p. 465, pl. 58, f. 6.
1859 *C. d.* Reeve, Conch. Icon., v. 11, pl. 1, f. 3.
1886 *C. d.* Tryon (pro parte), Man. Conch., v. 8, p. 127, pl. 37, f. 31, 32.

Shell rather thick, broadly ovate or irregularly circular, depressed; surface smooth except for growth-lines. Apex obliquely curved, marginal. Diaphragm slightly concave, hardly reaching to the middle of the shell, its margin sinuate.

Measurements (of a cast): Length, 20 mm; width, 18 mm; height, 6.5 mm.

Remarks: This species differs at once from the foregoing in the broader and almost circular outline. All our individuals are casts and comparatively small, and it seems that the shell was not as thick as that of *C. gregaria*. Tryon (l. c., p. 127) unites with this species the *C. grandis* of Middendorf (see above) from the North Pacific, but all the figures published of the latter are more elongate, so that I believe it comes nearer to *C. gregaria*.

Record of specimens: Cape Fairweather; 5 casts.

Distribution: This species has not been found previously in the fossil state, but is known living from the Falkland Islands and the Straits of Magellan along the western coast of South America.

Fam. *NATICIDÆ* Forb.

Gen. NATICA Lmck.

117. NATICA CHILOËNSIS Philippi.

Pl. XXXIII, Fig. $1^{a, b}$.

1887 *N. c.* Philippi, Tert. & Quart. Verst. Chiles, p. 89, pl. 10, f. 12.
1899 *N. c.* Ortmann, in: Amer. Journ. Sci., v. 8, p. 431.

Shell ovate, thick, smooth, except for lines of growth. Spire conical, about ¼ of the height of the shell. Umbilicus small. Callus very thick, covering most of the umbilicus. Mouth ovate, not dilated.

Measurements of a very large specimen: Height, 34 mm, diameter, 25 mm, height of mouth, 21 mm; of a smaller one: height, 24 mm, diameter, 19, height of mouth, 15 mm.

Remarks: This species is recognized by the oval outline (which is, however, a little variable), by the thick and solid shell, and the thick callus. The callus leaves only a narrow slit open at the umbilicus.

N. ganæ of Philippi (Cretaceous of Quiriquina) is allied, but has a higher spire (one-third of the height of the shell), while in *N. chiloënsis* it is between one-fourth and one-fifth, rarely more than one-fourth. The external form is a little variable in our species, some individuals being more rounded. The callus of the inner lip is very thick, suddenly narrowed near the umbilical region, leaving a narrow, oval or crescentic opening at the umbilicus. The suture is not impressed: in larger individuals, however, where the outer layer of the shell is exfoliated, the suture appears as a deep groove giving a scalariform appearance to the spire, a feature which reminds one of *N. chilina* and *auca* d'Orb. from Puerto de Hambre.

One individual from horizon III (upper) has the callus in the umbilical region broader, with the slit hardly visible, and approaches thus (as also in the more globular form) *N. pachystoma* Hupé from the Navidad beds (see Philippi, 1887, pl. 10, f. 1a), to which also *N. barroisi* Phil. seems to belong. The specimen figured by Philippi in fig. 1c is probably a different species from *N. pachystoma (N. oyarzuni* Phil.).

Record of specimens: Punta Arenas, horizon II (lower Magellanian), 25 sp.; Punta Arenas, horizon III (upper Magellanian), 2 sp.

Distribution: Chiloë: Cueva de Cucao (Phil.).

Affinities: In the ovate form, thickness of shell and callus, and the small umbilicus, this species resembles some Eocene species from the Paris basin, especially *N. venusta* Deshayes (1866, p. 38, pl. 68, f. 78), but the latter has a much more distinct suture, and the callus is not quite so thick as in our species; there are other slight differences, but on the whole, *N. venusta* is the only species that I was able to compare with our Punta Arenas fossil.

118. NATICA OVOIDEA Philippi.

Pl. XXXIII, Fig. 2.

1887 *N. o.* Philippi, Tert. & Quart. Verst. Chiles, p. 89, pl. 10, f. 10, a, b (and perhaps fig. 18, as *N. solida*).
1887 *N. famula* Philippi, ibid., p. 89, pl. 10, f. 13, a, b.
1897 *N. f.* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 285.
1899 *N. f.* v. Ihering, in: N. Jahrb. Miner., etc., v. 2, p. 28.
1900 *N. ovoidea* Ortmann, in: Amer. Journ. Sci., v. 10, p. 380.

Shell ovate, moderately thick, smooth. Spire conical, about one-fourth to one-fifth as high as the shell. Umbilicus open, only partly covered by a comparatively thin callus. Mouth ovate, slightly dilated.

Height,	27	29	24	20	12	mm.
Diameter,	21	24	16.5	16	9	mm.
Mouth:	21	23	18	16	9	mm.

Remarks: N. famula is distinguished from *N. ovoidea* (and its allies), according to Philippi, by its smaller size (height, 15 to 18 mm) and thicker callus. Of our individuals, one is only 12 mm high, the rest are larger, and approach *N. ovoidea* (height 30 to 31 mm, according to Philippi). The callus may be called thick or thin, according to the species selected for comparison, but at any rate, in Philippi's figure of *N. famula*, it is not thicker than that of *N. ovoidea*. Our large individuals agree completely with *N. ovoidea*, and since it is thus shown that this form is also found at Santa Cruz, it seems very likely that *N. famula* is only the young state of this species.

V. Ihering believes (1897, p. 281) that Philippi's figure 18, which is given as *N. solida*, belongs to *N. ovoidea:* if so, this species must grow to a much more considerable size.

N. ovoidea comes near *N. chiloënsis*, but is distinguished by the thinner shell and much thinner callus, which leaves a larger portion of the umbilicus open; and further, the mouth is wider.

Record of specimens: Mouth of Santa Cruz River, 5 sp.; San Julian, Darwin Station, 1 cast.

Distribution: Santa Cruz, Patagonian beds (Phil., v. Ih.); Navidad beds of Chili: Navidad, Tubul, Llancahue (and perhaps Lebu, of fig. 18 belongs here). (Phil.)

119. NATICA SECUNDA Rochebrune & Mabille.

Pl. XXXIII, Fig. $3^{a,b}$.

1885 *N. secunda* Rochebrune & Mabille, in: Bull. Soc. Philom. Paris, ser. 7, v. 9, p. 103.
1887 *N. obtecta* Philippi, Tert. & Quart. Verst. Chiles, p. 88, pl. 10, f. 2, a, b.
1887 *N. vidali* Philippi, ibid., p. 91, pl. 10, f. 17.
1889 *N. secunda* Rochebrune & Mabille, in: Miss. Sci. Cape Horn, v. 6, p. 39.
1897 *N. obtecta* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 282.
1899 *N. o.* v. Ihering, in: N. Jahrb. Miner., etc., v. 2, p. 27.
1900 *N. secunda* Ortmann, in: Amer. Journ. Sci., v. 10, p. 180.

Shell semi-ovato-globular, thick, smooth. Spire short, suture inconspicuous. Umbilicus large, covered in part by a thick callus, which is divided by a groove.

Height, 40 mm, diameter, 42 mm; another individual: Height, 32 mm, diameter, 33 mm.

Remarks: As v. Ihering (1899, p. 6) has pointed out, *N. secunda* of Rochebrune and Mabille is identical with *N. obtecta* of Philippi; since the specific name of *secunda* was already published in 1885 in a preliminary note, this name has precedence over that given by Philippi.

N. obtecta of Moericke (1896) is different; v. Ihering calls it (1897, p. 283) *N. pachystoma* var. *moerickei.*

Record of specimens: Mouth of Santa Cruz River, 16 sp.

Distribution: Santa Cruz (Phil., v. Ih.), Jegua quemada and La Cueva (v. Ih.), Patagonian and Suprapatagonian beds (v. Ih.); Navided beds of Chili: Navidad, Matanzas, Chiloë (Phil.).

Affinities: This species, as well as the closely allied *N. moerickei* v. Ih. (=*N. obtecta* Moer.) from the Navidad beds, is characterized by the umbilical callus, which is divided by a groove. Moericke has pointed out that the most closely allied European form is the *Oligocene N. hantoniensis* Sow. (see v. Koenen, 1867, p. 148, pl. 12, f. 9), and that other related species are found in Cretaceous and Miocene beds of California. The Californian Miocene species (*N. callosa* Gabb, 1869, p. 10, pl. 2, f. 17) more resembles Moericke's form, while the European *N. hantoniensis* is more like the Patagonian *N. secunda.* Since the California Cretaceous species, *N. secta* and *globosa*, are a little more different in external form, the closest relation of our species is with one of *Oligocene* age (*N. hantoniensis*).

120. NATICA DARWINI Hutton.

Pl. XXXIII, Fig. 4.

1846 *N. solida* Sowerby, in: Darwin, Geol. Observ. S. Amer., p. 255, pl. 3, f. 40, 41 (non *N. solida* Blainville).
1864 *N. sol.* Zittel, in: Novara Exp. Geol., p. 42, pl. 15, f. 6.
1873 *N. sol.* Hutton, Cat. Tert. Moll. Echin. N. Zealand, p. 9.
1885 *N. sol.* Hutton, in: Quart. Journ. Geol. Soc., v. 41, p. 550.
1886 *N. darwini* Hutton, in: Tr. N. Zealand Instit., v. 18, p. 334.
1887 *N. sol.* Philippi, Tert. & Quart. Verst. Chiles., p. 91, pl. 10, f. 10 (nec. fig. 18).
1889 *N. sol.* Rochebrune & Mabille, in: Miss. Sci. Cap Horn, v. 6, p. 29.
1896 *N. sol.* Moericke, in: N. Jahrb. Miner, etc., Beil. Bd. 10, p. 558.
1897 *N. sol.* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 280.
1899 *N. darwini* v. Ihering, in: N. Jahrb. Miner., etc., v. 2, p. 29.
1900 *N. darw.* Ortmann, in: Amer. Journ. Sci., v. 10, p. 380.

Shell subglobular, thick, smooth. Spire short, suture inconspicuous. Umbilicus large, open, not covered by the callus; labial callus thick in the upper part, truncated at the umbilicus. Mouth ovate, large.

Measurements: Height, 35 mm, diameter, 34 mm (but it grows larger).

Remarks: I cannot find any difference between the Patagonian fossil and Zittel's figure of the New Zealandian form, except that in the latter the callus is not truncated at the umbilicus.

In weathering, in this species as well as in *N. secunda*, a comparatively larger amount of shell substance is removed at the suture, so that the latter appears to be situated in a groove or channel.

Record of specimens: Mouth of Santa Cruz River, 4 sp.; 30 miles north of upper Rio Chalia, 1 good specimen, 3 doubtful casts.

Distribution: Santa Cruz (doubtful casts, according to Sowerby) (Roch. & Mab.); La Cueva and Jegua quemada, Suprapatagonian, but *not* Patagonian beds (v. Ih.); Navidad beds of Chili; Navidad (Sow., Phil., Moer.), Lebu (Phil.).

New Zealand (Zitt.), Pareora beds (Miocene, Hutt.); Chatham Isl. (Hutt.).

Affinities: This species comes near those which have been called by the collective name of *Natica heros*, and are found from *Miocene* to *Recent* times on the Atlantic coast of North America, and which are divided by Dall (1892, pp. 372, 373) into three species. One of them, *N. interna* Say, resembles our Patagonian fossil in the thick callus, but the callus is not suddenly truncated at the umbilicus, the umbilicus is narrower, and has a spiral rib inside, and further, the suture is more distinct. (I have compared 4 specimens from the Miocene of St. Mary's River, Maryland, one of which seems to be a true *N. heros*, the others belonging to *N. interna*). In *N. perspectiva* the suture is more like that of our species, but it has a sharp umbilical rib, while in the true *N. heros* this rib is wanting, but the callus is less developed, and the suture deeper. Thus it is hard to say, to which of these forms *N. darwini* shows the closest affinity, but at any rate, it is closely allied to this *Neogene* group of species.

121. NATICA SUBTENUIS v. Ihering.

Pl. XXXIII, Fig. 5.

1897 *N. s.* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 284, textfig. 13.

Shell ovato-subglobose, comparatively thin, smooth. Spire short, suture inconspicuous. Umbilicus small. Inner lip with thin callus. No callus on the columellar lip. Mouth large.

Height, 40 mm; diameter, 35 mm, another individual: height, 29 mm, diameter, 24 mm.

Remarks: This species is closely allied to the foregoing, but the shell is thinner, the callus is less developed, the umbilicus narrower, the suture a little more depressed, and the external form a little higher.

Record of specimens: Mouth of Santa Cruz River, 2 sp.

Distribution: Jegua quemada, Suprapatagonian beds (v. Ih.).

Affinities: This species approaches more nearly the typical form of *N. heros* Say (see Dall, 1889, pl. 51, f. 11) from *Miocene* to *Recent*, but the latter has the suture more depressed.

122. NATICA CONSIMILIS v. Ihering.

Pl. XXXIII, Fig. 6.

1897 *N. c.* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 283, textfig. 12.
1899 *N. c.* v. Ihering, in: N. Jahrb. Miner., etc., v. 2, p. 28.

Shell subglobular, rather thick, smooth. Spire obtusely conical, about ¼ of the height of the shell; whorls convex, indistinctly angulated near the distinct and deep suture. Umbilicus small, open, without callus. Columellar lip thin, the free part at the umbilicus slightly reflected and thickened. Mouth large.

Height, 28 mm; diameter, 26 mm.

Remarks: The distinct and sharply depressed suture distinguishes this species from all other Patagonian species of the genus. In partly exfoliated individuals the suture is very deep.

It seems doubtful whether *N. omoia* Rochebrune & Mabille (1885, p. 138, and 1889, p. 31), belongs to this species. According to the description, the union seems hardly warranted; but since no figure of *N. omoia* is given, this question is to remain open.

There seems to be a slip of the pen in v. Ihering's description of this species in 1899. After describing *N. consimilis*, he says: It seems probable that also *N. consimilis* belongs here as a synonym. *N. subtenuis* cannot be the species intended, since it is quite different, and thus this sentence remains unintelligible.

Record of specimens: Mouth of Santa Cruz River, 16 sp.

Distribution: Santa Cruz and La Cueva, Patagonian and Suprapatagonian beds (v. Ih.).

Affinities: There is quite a number of species in Eocene and Miocene deposits of the northern hemisphere, which resemble this one in external form, but I cannot point any particular one, that agrees with this one more closely than others.

Note: The Australian species of *Natica* (Tate, 1893, p. 318, ff.) require closer inspection: there are many forms similar to the Patagonian.

Fam. *TURRITELLIDÆ* Gray.

Gen. TURRITELLA Lmck.

123. TURRITELLA EXIGUA Ortmann.

Pl. XXXI, Fig. $12^{a,b}$.

1899 *T. e.* Ortmann, in: Amer. Journ. Sci., v. 8, p. 430.

Shell small, with 10 whorls, about 4 times as high as broad at the base. Suture deep, whorls convex, with 5 to 7 spiral ribs, which are rather crowded, and often alternately stronger and weaker. The stronger ribs sometimes appear to be slightly granulated.

Height, 15 mm; diameter, about 4 mm.

Remarks: In the small size of the shell this species differs from all other Patagonian *Turritellæ*, and agrees with the two dwarf forms described by Philippi from the Navidad beds of Chili: *T. trilirata* and *parvula*. But the latter can easily be distinguished by their flat whorls and smaller number of ribs.

Record of specimens: Punta Arenas, horizon II (lower Magellanian), over 100 sp.

Affinities: As regards the sculpture and the convex whorls, this species finds many analogous forms in Eocene, Miocene and Pliocene beds, as the type of which we may take the Oligocene and Miocene *T. turris* Bast. of Europe. But taking into consideration the small size of the present form, we find that the species younger than Eocene are very much larger, and only in Eocene beds do we find a few that might be compared with our species in this respect also. One of the most closely allied forms seems to be: *T. granulosa* Deshayes, from the Eocene of France, but this one is still considerably larger than *T. exigua* and the whorls increase more rapidly.

124. TURRITELLA AMBULACRUM Sowerby.

Pl. XXXI, Fig. $13^{a,b}$.

1846 *T. ambulacrum* Sowerby, in: Darwin, Geol. Observ. S. Amer., p. 257, pl. 3, f. 49.

1846 *T. suturalis* Sowerby, ibid., p. 257, pl. 3, f. 50.

1873 *T. ambulacrum* Hutton, Cat. Tert. Moll. Ech. New Zealand, p. 12.
1887 *T. sowerbyana* (= *suturalis* Sow.) Philippi, Tert. & Quart. Verst. Chiles, p. 76, pl. 9, f. 2 (after Sowerby).
1887 *T. ambulacrum* Philippi, ibid., p. 76, pl. 9, f. 1a (after Sowerby).
1889 *T. ambulacrum* and *suturalis* Rochebrune & Mabille, Miss. Cape Horn, v. 6, p. 43.
1896 *T. affinis* Moericke, in: N. Jahrb. Miner., etc., Beil Bd. 10, p. 555, pl. 11, f. 3 (nec *T. affinis* Hupé, Philippi, Gray, see: Dall, 1892, p. 308).
1897 *T. ambulacrum* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 286.
1897 *T. argentina* v. Ihering, ibid., p. 286.
1897 *T. steinmanni* v. Ihering, ibid., p. 289.
1899 *T. ambulacrum* and *argentina* v. Ihering, in: N. Jahrb. Miner., etc., v. 2, p. 25.

Shell elongated, forming an angle of about 16 to 21°. Suture in a deep furrow, whorls flat or slightly concave, with 3 principal revolving ribs, the upper and lower one the strongest, the middle one a little weaker. The upper rib forms a distinct angulation. Between the principal ribs, 3 to 5 finer striæ, and below the lower principal rib, 1 to 3 fine striæ. Principal ribs, especially the uppermost, sometimes indistinctly crenulated by the lines of growth, but in no case with granulations.

Height, 56 mm; diameter, 15 mm.

Remarks: This species is on the one hand very variable, and on the other it assumes a different aspect according to the state of preservation. In young specimens the suture is not so deep as in older ones, and if the spiral striæ are well preserved, they represent v. Ihering's *T. argentina*. Large individuals show a very deep suture, and, as a rule, the surface ornamentation is destroyed to a great degree, so that the finer striæ are in most cases completely obliterated, and only the three principal ribs remain. In many cases, only the upper and lower principal ribs are preserved, and such individuals correspond to Sowerby's type of *T. ambulacrum*. Individuals, in which the difference between the stronger and finer ribs is less pronounced, form v. Ihering's *T. steinmanni*. In some cases the lower principal rib is indistinct, and such individuals are Sowerby's *T. suturalis* (*sowerbyana* of Philippi). *T. affinis* of Moericke is a typical young *T. ambulacrum* (= *argentina* v. Ih.). One must bear in mind that Moericke's figure is 4 times natural size.

I do not think that *T. argentina* is a distinct variety, but it is only the younger, and better preserved state of the larger, and partly worn *T. ambulacrum*. All our individuals of the typical *T. ambulacrum* show in the upper part of the shell the sutural furrow less deep. The external sculpture is essentially the same in both, only in old shells it is much worn, and shows the striæ less plainly, or not at all.

V. Ihering, in 1899, hinted at the identity of *T. ambulacrum*, *argentina* and *steinmanni*.

Record of specimens: Mouth of Santa Cruz River, about 250 specimens, and many fragments; Paso del Rio Santa Cruz, 3 sp.; Las Salinas, 10 sp., and 6 doubtful chalcedony casts; Mt. of Observation, lower horizon, 11 sp.; Upper Rio Chalia, about 20 sp. (mostly casts); 30 miles north of Upper Rio Chalia, about 40 sp. (mostly casts); Arroyo Gio, 18 sp.; Lake Pueyrredon, base of Tertiary, 2 fragments; Lake Pueyrredon, 600′ above base, about 22 sp., and numerous fragments.

Note: Some of the casts from 30 miles north of upper Rio Chalia may belong to *T. patagonica*, since this species is also represented at this locality.

Distribution: San Julian (Sow.); Santa Cruz (Sow., Roch. & Mab., v. Ih.); La Cueva and Jegua quemada (v. Ih.); Patagonian and Suprapatagonian beds (v. Ih.).—Navidad beds: Navidad (Sow., Phil., Moer.); Ypun Isl., Chonos Arch. (Sow.); Matanzas, Lota, Chiloë (Phil.).—New Zealand: Pareora beds (Miocene, Hutt.) and Wanganui beds (Pliocene Hutt.; Chatham Isl. (Hutt.).

Affinities: This *Turritella* is a characteristic type of the Patagonian and Chilian Tertiary, and continues, in Chili—through the Pliocene *T. cingulatiformis* Moer.—into Recent times, where it is represented by *T. cingulata* (see Moericke). In Tertiary deposits of the northern hemisphere this type of *Turritella* is quite rare, but it is represented nevertheless. There is one species in the Miocene beds of Europe, which has some resemblance to it: *T. bicarinata* Eichw. (Hoernes, 1856, p. 426, pl. 43, f. 8–12). Especially what Hoernes calls the first and second varieties (fig. 10, 11, 12) much resemble our form in the deep suture and the two strong spiral ribs. In this species, however, these two ribs are situated closer together (the upper one being more remote from the suture), and there is no trace of an intermediate third principal rib. On the other hand, the young shell of *T. bicarinata* is quite different from the young *T. ambulacrum*, having only one principal rib. But then again, *T. bicarinata* agrees in the lack of granulations on the ribs.

In the American Tertiary we have one species that is apparently very closely allied to ours: *T. apicalis* Heilprin from the Pliocene beds of Florida. Especially in what Dall (1892, p. 316, pl. 16, f. 10) calls the typical form of *T. apicalis*, there are two principal ribs, on the upper and lower part of each whorl, with a third and smaller intermediate one, and besides, a number of fine spiral striæ: a type of ornamentation that agrees completely with that of *T. ambulacrum*. (I have compared and verified this character in 6 specimens of this form from the Caloosahatchie beds in the Princeton Museum). In *T. apicalis*, however, the principal ribs are distinctly and regularly granulated, and the suture is less deep. Thus *T. apicalis* corresponds very closely to *T. cingulatiformis* of Moericke (Pliocene of Chili), which is, according to Moericke, the Pliocene descendant of *T. affinis* = *ambulacrum* of the Navidad beds.

This comparison of the morphological characters of *T. ambulacrum* with those of *T. apicalis* would accordingly, for *T. ambulacrum*, point to an age a little older than that of the Pliocene *T. apicalis*, *i. e.*, to *Miocene*.

T. aldingæ Tate (1893, p. 336, pl. 8, f. 1) from the so-called "Eocene" of South Australia (Aldinga Bay) comes very near to *T. ambulacrum*, but the suture is not so deep.

125. TURRITELLA BREANTIANA d'Orbigny.

Pl. XXXI, Fig. $14^{a, b}$.

1847 *T. breantiana* d'Orbigny, in: Voy. Astrolabe et Zélée, Geol. Atlas, pl. 5 (Paleont., pl. 2), f. 36, 37.
1887 *T. breantiana* Philippi, Tert. & Quart. Verst. Chiles, p. 77, pl. 9, f. 1b.
1889 *T. couteaudi* Rochebrune & Mabille, in: Miss. Cap Horn, v. 6, p. 44 (no locality).
1897 *T. tricincta* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 287, pl. 3, f. 3 (non *T. tricincta* Hutton, 1873, p. 13).
1898 *T. iheringi* Cossmann, in: Rev. crit. Paleozool., v. 2, p. 109.
1899 *T. iheringi* Ameghino, in: Seg. Cens. Nac. Rep. Argent. Supl., p. 4.
1899 *T. breantiana* var. *indecussata* v. Ihering, in: N. Jahrb. Miner., etc., v. 2, p. 26.

Shell large, very elongate, forming an angle of about 12 to 16°. Suture not very deep, whorls flat with 3 thick principal revolving ribs, the uppermost the strongest. Ribs, especially the uppermost, crossed by lines of growth, and appearing distinctly crenulated, but not granulated. Between the principal ribs are 1 to 3 fine striæ, becoming more numerous with age.

Measurements of largest fragment: Height, 58 mm; diameter, 14 mm.

Remarks: Of the principal ribs, the uppermost is always the strongest, forming a distinct angulation. In most of the cases, the lowermost rib is the second in thickness, and the middle one is the finest. But in some cases the lowermost is finer than the middle one, and such individuals represent v. Ihering's *T. tricincta.* In young individuals the suture is very shallow.

Large individuals of this species are easily recognizable by the more elongated and more slender form, and by the thick revolving ribs. But young individuals and fragments, especially if a little worn, are almost indistinguishable from *T. ambulacrum*, since the slender form is not so evident. It is possible that some of the individuals recorded under *T. ambulacrum* belong really to this species.

Record of specimens: Mouth of Santa Cruz River, 7 sp.; Paso del Rio Santa Cruz, 1 sp.; Las Salinas, 3 sp. (one of them a cast); Mt. of Observation, lower horizon, 2 sp. (one of them a typical *T. tricincta*).

Distribution: Chiloë (Phil.); Santa Cruz (Phil., v. Ih.); Jegua quemada (v. Ih.): Patagonian and Suprapatagonian beds (v. Ih.).

Affinities: *T. perattenuata* Heilprin (see: Dall, 1892, p. 316, pl. 16, f. 5, 9), from the Pliocene of Florida has a general resemblance, but seems to be more slender. There are (according to Dall) Miocene species, which resemble *T. perattenuata*, especially *T. terebriformis* Dall (p. 311), but since there is no figure published, I cannot say what are the relations to *T. breantiana*. At any rate, we must take *T. breantiana* as a species of *Neogene* relations.

126. TURRITELLA PATAGONICA Sowerby.

Pl. XXXI, Fig. 15^{a,b}.

(?) 1846 *T. pat.* Sowerby, in: Darwin, Geol. Observ. South America, p. 256, pl. 3, f. 48.

1887 *T. darwini* Philippi, Tert. & Quart. Verst. Chiles, p. 75, pl. 9, f. 7.

1887 *T. patagonica* Philippi, ibid., p. 76 (after Sowerby).

1889 *T. patag.* Rochebrune & Mabille, in: Miss. Cap Horn, v. 6, p. 43.

1897 *T. patag.* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 287 (after Sowerby),
1899 *T. patag.* v. Ihering, in: N. Jahrb. Miner., etc., v. 2, p. 26.

Shell elongated, forming an angle of about 17 to 24°. Suture simple, not in a furrow. Whorls flat, with a number of finer or stronger striæ, three of which are usually stronger and granulate.

Height, 28 mm (not complete); diameter, 11 mm; height, 38 mm (not complete); diameter, 14 mm.

Remarks: This species resembles *T. ambulacrum* in its more rapidly increasing whorls, but is distinguished at once by the lack of a sutural depression. The three larger revolving ribs are less pronounced, and in well preserved individuals they show distinct granulations, which are independent of the lines of growth.

There is no doubt that the form mentioned by v. Ihering in 1899 under the name of *T. patagonica* agrees with our individuals; but there is some doubt whether it is really *T. patagonica* of Sowerby, since the figure given by the latter shows a distinct sutural furrow. But in this respect the figure does not correspond to Sowerby's diagnosis, which says: "sutura indistincta." Perhaps—as v. Ihering suggests—this figure is not accurate.

I have not the slightest doubt that Philippi's *T. darwini* belongs here, since diagnosis as well as figure correspond closely, with the exception that granulations are not mentioned: but their apparent lack may be due to fossilization, as is the case in most of our specimens.

Young fragments are hard to distinguish from *T. ambulacrum*, since in young ones of the latter species the suture is much less deep than in older ones.

Record of specimens: Mouth of Santa Cruz River, 6 sp.; Paso del Rio Santa Cruz, 1 sp.; San Julian, Oven Point, 11 sp.; 30 miles north of upper Rio Chalia, 2 sp.

Distribution: Port Desire (Sow.), Santa Cruz (Roch. & Mab., v. Ih.), Navidad beds of Chili: Navidad (Sow., Phil.), Lota, Tubul, Lebu (Phil.).

Philippi erroneously says that Darwin found this species at Puerto del Hambre (Port Famine).

Affinities: T. chipolana Dall (1892, p. 312, pl. 22, f. 24), from the *Miocene* of Florida seems to be closely allied in form and sculpture, but the sculpture seems to be more complex and more strongly developed.

127. TURRITELLA INNOTABILIS Pilsbry.

Pl. XXXI, Fig. $16^{a,b}$.

1897 *T. i.* Pilsbry, in: Pr. Acad. Philad., p. 330.

"Shell long-conic, of about a dozen slowly increasing whorls, which are but slightly convex, but become decidedly so below, the latter two or three being well rounded. Sculpture on the lower whorls of 5 rounded and subequal spiral cords separated by intervals of about the same width, traversed by one to three (generally two) sharp threads. Earlier whorls have three primary spirals parted by intervals bearing a single strong thread, and still earlier the threads disappear from the intervals." (Pilsbry)

Remarks: This species is closely allied to the foregoing (*T. patagonica*): the external form, the suture, and the ornaments are essentially the same. The only difference I can discover is found in the more rounded lower whorls, which produce a more distinct suture, and in the increase of the spiral ribs to 5 on the last whorl. Whether there were any granulations on the principal spiral cords, is hard to say; the external casts are too imperfect to render it certain, but sometimes there is the appearance of granulations.

T. cingulatiformis of Moericke (1896, p. 556, pl. 11, f. 4) from the Pliocene Coquimbo beds of Chili seems to be closely allied, but it has only 3 principal cords, and the suture is more depressed.

Record of specimens: Cape Fairweather, numerous internal and external casts.

Fam. *VERMETIDÆ* Ad.

Gen. VERMETUS Adams.

128. VERMETUS cf. INTORTUS (Lamarck).

Pl. XXXII, Fig. 1.

1848 *V. i.* Wood, Crag Moll., v. 1, Univ. p. 113, pl. 12, f. 8.
1856 *V. i.* Hoernes, in: Abh. K. K. geol. Reichsanst., v. 3, p. 484, pl. 46, f. 16.
1861 *V. i.* Moerch, in: Pr. Zool. Soc. London, p. 353.

1885 *V. i.* Zittel, Handb. Palæont., v. 2, p. 212, textf. 285.
1900 *V. cf. i.* Ortmann, in: Amer. Journ. Sci., v. 10, p. 379.

Shell generally gregarious, tubular, subquadrate, closely and regularly spiral in the young state, with the whorls in close contact. The extremity suddenly reflected, straightened and free. Aperture subcircular. Surface transversely rugose and often with longitudinal ribs.

Diameter of tubes in our specimens: 2 mm.

Remarks: Our specimens are not well preserved and only fragmentary, but they agree in general form closely with the figure given by Hoernes. Longitudinal ribs are present at the suture, where the whorls touch each other, and further, there seems to be a single rib in the middle of the whorls, but this rib is visible only on the uppermost whorl of the figured specimen. In size (diameter), our specimens agree best with Wood's figure 8a, and differ considerably from that of the Italian Pliocene form figured by Zittel.

Record of specimens: Shell Gap, Rio Chico, upper horizon: 1 sp.; Lake Pueyrredon, 600′ above base: 1 sp.

Distribution: *V. intortus* is found in Oligocene, Miocene, and Pliocene deposits of Europe.

Affinities: Our specimens agree best in the surface characters with the Central-European Miocene form figured by Hoernes, in size with the English Pliocene form figured by Wood, while the Italian Pliocene form is larger, and has more, and more distinct longitudinal ribs. According to Moerch's diagnoses, it would correspond best to the French Miocene form of this species. There remains, however, some doubt, whether we really have to deal here with this European species, but the material at hand is too incomplete to decide this question.

129. VERMETUS (?) INCERTUS sp. nov.

Pl. XXXII, Fig. 2.

Tubes fragmentary, elongate-cylindrical, very slightly and irregularly curved, almost straight. Walls thick. Outer surface transversely rugose, in one specimen indistinctly flattened on one side.

Diameter of tube: 5–8 mm.

Remarks: There is considerable doubt whether these tubes belong at all to *Vermetus*, and I cannot find any described species, with which to compare them. But I describe and figure them in order that they may be recognized if found again.

Record of specimens: Mouth of Santa Cruz River: 3 fragments; San Julian, Darwin Station: 2 fragments.

Fam. *APORRHAIDÆ* Phil.

Gen. APORRHAIS da Costa.

130. APORRHAIS ARAUCANA (Philippi).

Pl. XXXIII, Fig. 9.

1887 *Chenopus a.* Philippi, Tert. & Quart. Verst. Chiles, p. 35, pl. 1, f. 1,
1900 *Aporrhais a.* Ortmann, in: Amer. Journ. Sci., v. 10, p. 379.

Shell fusiform, smooth. Upper whorls carinato-angulated, last whorl bicarinate; upper keel indistinctly nodulose or merely waved. Outer lip dilated, produced into two fingers, and a short process appressed to the spire and directed toward the apex.

Height of fragment: 17 mm; diameter, 10 mm.

Remarks: I have at my disposal only one single incomplete individual; the lower digit of the outer lip is broken away, as well as the lower canal. Otherwise it agrees completely with Philippi's species, with the exception that the upper carina is slightly waved, thus giving a suggestion of granulations or tuberculations.

Record of specimens: Mouth of Santa Cruz River, 1 sp.

Distribution: Navidad beds of Chili: Lebu (?) (Phil.).

Affinities: Species of *Aporrhais* with carinated whorls (type: *A. pes pelecani* L., Miocene-Recent, see Hoernes, 1856, p. 194, pl. 18, f. 2–4) begin in the *Oligocene* beds (*A. speciosa* Schloth., see Speyer, 1864 a. p. 166, pl. 31, f. 1–5) of Europe, and continue up to recent times, and it is to this group that *A. araucana* bears the closest resemblance, as has already been pointed out by Philippi. In the lack of distinctly developed nodules, and in the lack of a third (lower) carina on the last whorl, our species differs strikingly from these.

Fam. *STROMBIDÆ* d'Orb.

Gen. STRUTHIOLARIA Lmck.

131. Struthiolaria hatcheri Ortmann.

Pl. XXXIII, Fig. $10^{a, b}$.

1899 *S. h.* Ortmann, in: Amer. Journ. Sci., v. 8, p. 431.

Shell ovato-pyramidal, spire scalariform. Whorls with revolving ribs, which number 20 to 22 on the last whorl, and are all equal in size and distance from each other. Upper part of the whorls oblique, not canaliculate, rendered subangular by a series of 10–11 blunt, conical, subcostiform nodes. Of the spiral ribs, about 5 or 6 are in the region of the nodes, the rest (14–15) are below the nodes, on the lower part of the whorls.

Measurements: Height, 22 mm, diameter, 13 mm; another: height, 21 mm, diameter, 14 mm. But it grows a little larger, as is shown by a fragment that is 16 mm in diameter.

Remarks: This species differs from all the other South American species of the genus in the spiral ribs, which are of uniform size, in the upper part as well as in the lower part of the whorls. In all the following species there are at least a few ribs on the lower part of the last whorl, which are distinctly and considerably stronger than those on the upper part. Also the small number of nodes, and the suture, which is not canaliculate, serve to distinguish this species.

Record of specimens: Punta Arenas, horizon II (lower Magellanian), 8 sp.

132. Struthiolaria ameghinoi v. Ihering.

Pl. XXXIII, Fig. 11^{a}.

1897 *S. ameghinoi* v. Ihering, in: Rev. Mus. Paul, v. 2, p. 289, textf. 14.

1900 *S. chilensis* Ortmann, in: Amer. Journ. Sci., v. 10, p. 380 (non *S. chilensis* Phil., 1887).

Shell ovato-pyramidal, spire scalariform. Whorls spirally ribbed, on the last whorl about 20 to 25 ribs, which are very unequal. Upper part of whorls oblique near the suture, not canaliculated, angulated, angulation formed by a series of 12 to 16, rarely up to 18, costiform, conical, blunt or subacute nodes. In the upper part of the whorls, in the region of the nodes, the spiral ribs (8 to 10 of them) are fine and subequal; in the lower part, below the nodes, are, on the last whorl, 5 to 6 stronger ribs, alternating with finer ones, followed by about 5 finer ones in the lowermost part of this whorl.

Height of largest complete individual: 56 mm, diameter, 35 mm; a fragment has a diameter of 40 mm.

Remarks: V. Ihering does not mention the finer ribs on the lowermost part of the last whorl, which are not shown in casts. Well-preserved specimens of medium size agree completely with Philippi's figure of *S. chilensis*, having the nodes more conical and subacute, and thus I was led to believe that *S. ameghinoi* and *chilensis* are identical. But v. Ihering writes to me, that the true *S. chilensis* has 19 very fine spiral threads in the region of the nodes. If that is the case, it is impossible to unite these two species.

Record of specimens: Mouth of Santa Cruz River, 43 sp.; San Julian, Oven Point, 1 sp.; 30 miles north of Upper Rio Chalia, 4 sp.; Lake Pueyrredon, base of Tertiary, 5 sp.; Lake Pueyrredon, 600′ above base, 1 sp.

Distribution: La Cueva and Santa Cruz, Suprapatagonian and Patagonian beds (v. Ih.). In 1899 (p. 37) v. Ihering doubts the occurrence of this species in the "Patagonian" beds.

Affinities: S. chilensis Phil. is the representative of this species in the Navidad beds of Chili (Matanzas and Navidad).

132a. STRUTHIOLARIA AMEGHINOI VAR. MULTINODOSA var. nov.

Pl. XXXIII, Fig. 11^b.

Not so high, more globular. Whorls convex, hardly angulated, nodes 18–19, more elongated and distinctly costiform. Only 4 to 5 stronger ribs on the lower part of the last whorl, without intermediate finer ones, followed by about 5 finer ribs on the lowermost part of this whorl.

Height, 32 mm, diameter, 21 mm; another: height, 41 mm, diameter, 27 mm.

Remarks: I first believed that this was v. Ihering's *S. ornata* var. *densestriata* (1897, p. 291, textfig. 15); but after having sent a specimen to v. Ihering he informs me that it is *not* his *S. densestriata*, the latter being merely a *S. ornata* without the two larger spiral ribs.

I think this form is only a *variety* of *S. ameghinoi*, since we possess individuals, which are in some degree intermediate, and especially the number of nodes sometimes increases in *S. ameghinoi* to 17 and 18. The other differences, number of spiral ribs, smaller size and more costiform appearance of the nodes, smaller size and more globular form of the shell, are only differences in degree of development; but at any rate, this form is a very distinct variety.

Record of specimens: Mouth of Santa Cruz River, 5 sp.; San Julian, Oven Point, 24 sp. (most of them poor); San Julian, Darwin Station, 2 sp. (poor); Shell Gap, Rio Chico, upper horizon, 1 sp.

133. STRUTHIOLARIA ORNATA Sowerby.

Pl. XXXIII, Fig. 12$^{a, b}$.

1846 *S. o.* Sowerby, in: Darwin, Geol. Observ. S. Amer., p. 260, pl. 4, f. 62.
1887 *S. o.* Philippi, Tert. & Quart. Verst. Chiles, pl. 1, f. 5 (after Sowerby).
1889 *S. o.* Rochebrune & Mabille, in: Miss. Cap Horn., v. 6, p. 40.
1897 *S. o.* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 291.
1897 *S. o.* var. *densestriata* v. Ihering, ibid., p. 291, textfig. 15.
1899 *S. o.* v. Ihering, in: N. Jahrb. Miner., etc., v. 2, p. 27.

Shell ovate, apex acuminate. Whorls convex, with unequal revolving ribs to the number of about 20 on the last whorl. Upper part of whorls deeply canaliculate at the suture, not angulated, with a series of about 15 costiform, elongated nodes. In the region of these nodes are about 12–13 fine, subequal spiral ribs, in the lower part, just below the nodes, are 2 very strong ribs, followed by about 5–6 finer ones; the uppermost of the latter is sometimes a little stronger than the rest, and sometimes a fine rib is intercalated between the two large ones.

Height, 25 mm; diameter, 16 mm.

Remarks: The canaliculate suture, and the two strong ribs just below the nodes serve to distinguish this species at once. But it is to be remarked, that in rare cases only one of the larger spiral ribs is developed, and even none at all. The latter form has been called by v. Ihering var. *densestriata.*

Sowerby's figure is very poor; it represents a cast, and does not bring out the most characteristic features of the shell.

Record of specimens: Mouth of Santa Cruz River, about 270 sp.; Paso del Rio Santa Cruz, 1 sp.; Las Salinas, 4 sp.

Distribution: Santa Cruz (Sow., Roch. & Mab., v. Ih.), La Cueva (v. Ih.), Patagonian beds (v. Ih.).

Sowerby mentions casts of a large variety from San Julian; our collections show (see above) that these casts belong to *S. ameghinoi*, and chiefly to the variety *multinodosa.*

Affinities of the genus Struthiolaria: The genus *Struthiolaria* is restricted to the southern hemisphere, and is found—aside from the Patagonian, Navidad and Magellanian beds—only in the Tertiary beds of New Zealand, and living in New Zealand and Australia, and, further, it has been discovered in the lower Miocene of northern Peru (Zorritos, see: Grzybowski, 1899, p. 647). It begins in New Zealand, according to Hutton (1873, p. x), in the lower Miocene, but it is *not* represented in the Oamaru or Oligocene beds. The New Zealandian species differ considerably in sculpture from the South American forms, only the form described by Zittel (1864, p. 35, pl. 15, f. 3) without specific name resembles slightly the Patagonian type of this genus.

Fam. *DOLIIDÆ* Ad.

Gen. DOLIUM Lmck.

134. Dolium ovulum Ortmann.

Pl. XXXIII, Fig. $13^{a, b}$.

1900 *D. o.* Ortmann, in: Amer. Journ. Sci., v. 10, p. 374.

Shell ovato-globular, spire short, conical, acute, last whorl large. Surface with fine and crowded revolving striæ, which are subequal, but in the lower part of the shell finer striæ are intercalated. Mouth large, elongated-oval, canal very short, truncated, straight and comparatively narrow. Inner lip without callus, tubercles or folds. Outer lip slightly thickened.

Height, 34 mm; diameter, 25 mm.

Remarks: I do not see any crenulations on the inside of the outer lip, but the latter is partly broken away or obscured by hard matrix.

Record of specimens: Mouth of Santa Cruz River, 2 sp.

Affinities: The genus *Dolium* is preëminently recent and tropical. Fossil representatives—aside from a doubtful Upper Cretaceous species—have been found from Miocene beds upward, so that the presence of this species in the Patagonian beds points distinctly to *Neogene* age.

Gen. PYRULA Lmck. (= *Ficula* Sw.).

135. PYRULA CAROLINA d'Orbigny.

Pl. XXXIII, Fig. $14^{a, b}$.

1847 *P. c.* d'Orbigny, in: Voy. Astrolabe & Zélée, Geol. Atlas, pl. 5 (Paléontol., pl. 2), f. 34, 35.
1887 *Ficula c.* Philippi, Tert. & Quart. Verst. Chiles, p. 52, pl. 4, f. 2.
1897 *F. c.* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 293, pl. 4, f. 19.
1899 *F. c.* v. Ihering, in: N. Jahrb. Miner., etc., v. 2, p. 30.

Shell fusiform, elongated, slender. Spire very short, apex acute. Surface with about 22–25 revolving ribs, which are equidistant from each other and equal, crossed by fine, crowded, longitudinal striæ. In old shells the revolving ribs become more distant from each other, and at two or three places a single finer one is intercalated. Mouth elongated, canal long and slender.

Measurements of a complete individual: Height, 52 mm; diameter, 31 mm.

Record of specimens: Mouth of Santa Cruz River, 19 sp.; San Julian, Darwin Station, 1 sp.; Lake Pueyrredon, 600′ above base, 1 sp.

Distribution: Santa Cruz (Phil., v. Ih.), Jegua quemada (v. Ih.); Patagonian and Suprapatagonian beds (v. Ih.). Navidad, Chili (Phil.).

Affinities: This species is closely allied to a Neogene or recent group of species which are closely connected with one another, and differ chiefly in the development of the spiral sculpture. *Ficus pyriformis* of Gabb (1869, p. 48, pl. 14, f. 4) from the *Miocene* of California is very near in external form and sculpture (smaller ribs intercalated between the larger ones, are rare), but the number of the spiral ribs is much larger (about 40), and they are, accordingly, more crowded.

F. concinna Beyr. (see Speyer, 1864, p. 184, pl. 33, f. 15, especially fig. 15c), from the Oligocene of Germany is also closely allied: the secondary spiral ribs are wanting, exactly as in *P. carolina*, but the ribs are more numerous (in a much smaller specimen figured by Speyer 30 are present), and the longitudinal striæ are less crowded.

All other species differ more considerably, especially those forms designated under the name of *P. condita* Brongn. (Hoernes, 1856, p. 270, pl. 28, f. 4–6), from Miocene to Recent, and *P. reticulata* Lmck. (Hoernes, ibid., p. 268, pl. 28, f. 1–3, and Speyer, 1864, p. 185, pl. 33, f. 12), from Oligocene to Recent, in which between the principal spiral ribs one or more secondary ones are regularly intercalated, and in which the longitudinal striæ are rib-like, stronger, and more distant from each other.

It is extremely significant, that the present species compares better with the *Miocene P. pyriformis* from California, than with any other species, and especially that it does not exhibit the characters of those forms (*P. condita, reticulata*) which continue to the Recent time.

Fam. *TRITONIDÆ* Ad.

Gen. TRITONIUM Lmck.

136. Tritonium bicegoi v. Ihering.

Pl. XXXIII, Fig. 15.

1899 *T. b.* v. Ihering, in: N. Jahrb. Miner., etc., v. 2, p. 29, pl. 1, f. 8.

Shell ovato-conical, swollen below, with three varices. Whorls with fine spiral striæ, and large tubercles, the latter, on the last whorl, in three spiral rows, those of the upper row larger (6–7 between two varices), those of the lower rows smaller, situated on two indistinct spiral ribs. Columella smooth, canal short, a little twisted and oblique. Outer lip subdentate, near the upper end with a distinct canaliform emargination, opposite to which, on the upper part of the inner lip, there is a dentiform fold.

Height of incomplete individual: 76 mm; diameter, 49 mm.

Remarks: In our individuals the canal appears to be long, but the last whorl is almost completely gone.

Record of specimens: Mouth of Santa Cruz River, 2 sp.

Distribution: Santa Cruz, Patagonian formation (v. Ih.).

Affinities: The type of ornamentation is essentially the same as in the following species (*T. morgani*), but the external form is quite different, being much broader and comparatively shorter, and less elongated.

137. TRITONIUM MORGANI Ortmann.

Pl. XXXIII, Fig. 16.

1900 *T. m.* Ortmann, in: Amer. Journ. Sci., v. 10, p. 374.

Shell subfusiform, elongated, with three varices. Whorls with fine, unequal, spiral striæ and large tubercles, the latter, on the last whorl, in three spiral rows, those of the upper row large, about 7 between two varices; those of the middle row (5–6) small, and those of the lower row (3–4) very indistinct, and indicated only by a slight spiral rib. Columella smooth, with a few indistinct crenulations in the lower part (on the canal). Canal comparatively long, narrow. Outer lip distinctly crenulato-dentate within in the lower part, with an indistinct canaliform emargination in the upper part, opposite to which, on the upper part of the inner lip, there is a distinct dentiform fold.

Height, 63 mm; diameter, 28 mm.

Remarks: The specific name is given in honor of Mr. J. Pierpont Morgan.

Record of specimens: Mouth of Santa Cruz River, 1 sp.

Affinities: This species comes very near *T. verruculosum* (Sow.) (1846, p. 260, pl. 4, f. 63, and Philippi, 1887, p. 57, pl. 4, f. 10) from Navidad, but it differs in the much more slender form, and more numerous tubercles (in *T. verruculosum* there are only 2–4 between two varices).

The two species of *Tritonium* known from Patagonia offer a distinctly *Neogene* feature. The genus is found from Eocene up to Recent times, but the Eocene and Oligocene species differ considerably in sculpture from our species, and it is in Miocene deposits where we first find this type of sculpture. In external form as well as in ornamentation, *T. morgani*—as regards the number of spiral rows or tubercles on the last whorl—comes nearest to *T. tarbellianum* (Grat.) (see Hoernes, 1856, p. 203, pl. 20, f. 7–12), and especially to the more nodulose variety of this species from the *Miocene* of Europe. It differs, however, in the more slender form, the longer canal, and the slighter development of the spiral ribs.

Species of *Tritonium* offering a similar structure to these two Patagonian species are found in the so-called "older" Tertiary beds of Australia (see Tate, 1888, p. 116, ff.), but they require further investigation.

Fam. *BUCCINIDÆ* Trosch.

Gen. BUCCINUM L.

138. Buccinum (Cominella) annæ Ortmann.

Pl. XXXIII, Fig. 17.

1900 *B. a.* Ortmann, in: Amer. Journ. Sci., v. 10, p. 374.

Shell subfusiform, elongated-oval. Spire long. Whorls 7–8, angulated, the angulation with a series of tubercles, 12–14 on the last whorl which are continued downward as irregular longitudinal ribs. Upper part of whorls (above angulation) slightly concave, appressed toward the suture. Exposed part of upper whorls, below angulation, subcylindrical. Whole surface of shell covered with numerous revolving striæ, which are somewhat unequal. Last whorl large. Mouth ovate, elongate, upper end subcanaliculate, lower end truncate, and with a short, reflected canal, forming a varix on the columella. Inner lip a little expanded, thin. Outer lip thin, smooth within.

Height, 66 mm; diameter, 30 mm.

Remarks: The tubercles of the angulation become somewhat irregular on the last whorl, and indistinct near the mouth. The longitudinal ribs are irregular on the last whorl, sometimes two of them starting from one tubercle, sometimes being quite indistinct. This species belongs to the subgenus *Cominella.*

The specific name is given in honor of Mrs. Anna Ortmann.

Record of specimens: Mouth of Santa Cruz River, 4 sp.

Affinities: This species comes near *B. veneris* Basterot (1825, p. 47, pl. 2, f. 15) from the *Miocene* of Southern and Western Europe. The general form is essentially the same, only the canal is a little longer, and the ornaments of the shell are slightly different: in *B. veneris* the angulation has more numerous and more closely set tubercles, and the longitudinal ribs are indistinct or wanting. There is no other *Buccinum,* to my knowledge, that resembles our species so much as this one.

139. BUCCINUM (COMINELLA) OBESUM VAR. MINOR (Philippi).

Pl. XXXIII, Fig. 18.

1887 *Fusus obesus* var. *minor* Philippi, Tert. & Quart. Verst. Chiles, p. 48, pl. 3, f. 4b.

1900 *Buccinum obesum* Ortmann, in: Amer. Journ. Sci., v. 10, p. 379.

Shell broadly oval, swollen. Spire short, conical. Whorls 5, convex, slightly depressed in the upper part, near the suture, with about 14–15 longitudinal ribs, which disappear suddenly on the upper part of the whorls, some distance from the suture, and run down, on the last whorl, almost to the canal. Surface of shell with numerous revolving striæ, which are somewhat unequal. Last whorl large. Mouth ovate, upper end slightly canaliculate, lower end truncate, with a broad and very short, reflected canal, forming a varix on the columella. Inner lip thin, outer lip smooth within.

Height, 19 mm; diameter, 14 mm.

Remarks: This is also a *Cominella*, and I have no doubt that it is congeneric with the foregoing. The short reflected canal forming a varix is quite unlike the long canal of *Fusus*, and agrees well with that of *B. annæ*, and the genus *Buccinum* in general.

It may be remarked that—if belonging to *Fusus*—the specific name would be preoccupied by *Fusus obesus* Michelin (subgenus *Euthria*, see Zittel, 1885, p. 272).

Record of specimens: Mouth of Santa Cruz River, 3 sp.

Distribution: Chili: Matanzas and Cucao (Phil.). The typical form of *B. obesum* is found at Navidad.

Gen. CHRYSODOMUS Sw.

140. CHRYSODOMUS CANCELLATUS (Ortmann).

Pl. XXXIV, Fig. $2^{a,b}$.

1900 *Fusus c.* Ortmann, in: Amer. Journ. Sci., v. 10, p. 375 (non *F. c.* Sowerby).

1901 *F. ortmanni* Cossmann, in: Rev. crit. Paléozool., v. 5, July, 1901, p. 151, footnote (3).

Shell small, fusiform, elongate. Spire a little shorter than the last whorl. Whorls convex, surface ornamented by revolving and longitudinal ribs, cancellated. Besides, there are distinct and regular lines of growth. Spiral ribs, on the upper whorls, to the number of 4–5, 12–13 on the last whorl. They are sharp, but flat, equidistant, narrower in the intervening spaces between the longitudinal ribs, but on the points of intersection with the latter, they are slightly broadened, giving the appearance of low tubercles. Longitudinal ribs 12–13 on each whorl, rounded (not sharp), but distinct, running from suture to suture, but disappearing on the canal. The lines of growth are very distinct, fine and sharp, and very numerous. Mouth elliptical, canal comparatively short. Outer lip crenulated within.

Height, 16 mm; diameter, 6.5 mm.

Record of specimens: Mouth of Santa Cruz River, 5 sp.

Affinities: This species seems to be very closely allied to the European *Miocene Fusus glomus* Géné (Hoernes, 1856, p. 279, pl. 31, f. 2), but the latter is less slender, larger, and the longitudinal ribs are less developed. The character of the spiral sculpture is essentially the same.

Another closely allied form is *F. nexilis* Dall. (1890, p. 128, pl. 8, f. 4) from the *Miocene* Silex-beds of Florida, but it is less slender, and the outer lip has no crenulations. Another similar form, *Chrysodomus glyptus* Verr., is found living in the West Indies, but this one has a larger mouth and longer canal (see Dall, 1889, pl. 61, f. 82).

141. CHRYSODOMUS PILSBRYI (Ortmann).

Pl. XXXIV, Fig. 3.

1900 *Fusus p.* Ortmann, in: Amer. Journ. Sci., v. 10, p. 375.

Shell thick, elongated, fusiform; spire a little shorter than the last whorl. Whorls 7–8, convex, slightly appressed in the upper part near the suture, ornamented with 8–9 strong, rounded, longitudinal ribs, which are slightly oblique and curved. On the upper whorls these ribs reach from suture to suture, on the last whorl they disappear at a short distance below the middle. All of the surface of the shell is covered by very fine, numerous, but distinct and subequal spiral striæ. Lines of growth fine and indistinct. Mouth comparatively small, continued into a comparatively short canal. Inner lip expanded, smooth; outer lip thick and apparently without crenulations.

Height, 36.5 mm (not quite complete at upper end); diameter, 12 mm.

Remarks: There are slight variations in the external form; some specimens are less slender: Height, 30 mm (not complete, but damaged to about the same extent as the specimen given above); diameter, 12.5 mm. The number of longitudinal ribs is 11 in one individual, in all others 8–9. I am not quite satisfied as to the generic position of this shell.

The specific name has been given in honor of Mr. H. A. Pilsbry, of Philadelphia.

Record of specimens: Mouth of Santa Cruz River, 5 sp.

Gen. SIPHONALIA Ad.

142. SIPHONALIA DOMEYKOANA (Philippi).

Pl. XXXIV, Fig. 4.

1887 *Fusus domeykoanus* Philippi, Tert. & Quart. Verst. Chiles, p. 45, pl. 2, f. 10.

1896 *F. d.* Moericke, in: N. Jahrb. Miner., etc., Beil. Bd. 10, p. 569.

1899 *Siphonalia dilatata* var. *subrecta* v. Ihering, in: N. Jahrb. Miner., etc., v. 2, p. 30.

1900 *Fusus domeykoanus* Ortmann, in: Amer. Journ. Sci., v. 10, p. 380.

Shell large, biconically-fusiform, with 7–8 whorls; whorls angulated, last whorl large. Angulation with a spiral series of large tubercles, 10–11 in one volution, tubercles blunt, conical, situated, on the upper whorls, at a little distance over the suture, continued downward, on the last whorl, as short longitudinal ribs. Upper part of whorls (above the tubercles) oblique, flat. Whole surface with numerous, crowded, strong spiral striæ. Mouth ovate, angulated on the outer lip, and slightly canaliculate at the upper end. Canal about as long as the mouth, open, slightly curved.

Measurements of a complete individual: Height, 98 mm, diameter, 48 mm; of another: height, 94 mm, diameter, 53 mm; of an individual with an upper and lower end incomplete: height, 114 mm, diameter, 63 mm.

Remarks: V. Ihering refers this form to the New Zealandian living and fossil (Miocene upward) species *Fusus dilatatus* Quoy & Gaimard (1832, p. 498, pl. 34, f. 15, 16), and this species is, no doubt, closely related, but, according to the original figure, the living form is broader and less elongated. *F. domeykoanus*, of Philippi, is mentioned by v. Ihering as resembling the Patagonian species, but he says that Philippi's sentence: "apertura superius subcanaliculata" does not apply to it. But this canaliculation is well shown in our specimens, and agrees perfectly with Philippi's figure. On the other hand, I do not think that *F. subreflexus* of Sowerby (1846, p. 259, pl. 4, f. 57), from Navidad belongs here. The latter has the upper part of the whorls concave, and the general outline, especially of the last whorl, and the ornaments are a little different. Since Philippi does not give any comment on Sowerby's figure or diagnosis (1887, p. 45, pl. 2, f. 8), but simply copies the former, we are to suppose that really another species agreeing with Sowerby's *F. subreflexus* exists at Navidad.

Our specimens, on the average, differ from Philippi's figure of *F. domeykoanus* only in being a little more slender, but there is variation in this respect among our material, as is shown by the measurements given above. Philippi's figure still more approaches, in this respect, the living *F. dilatatus* than our specimens do.

F. oncodes Philippi (p. 45, pl. 2, f. 11), also from Navidad, seems to be only a variety, and agrees in outline better with our individuals.

F. steinmanni Moericke (1896, p. 570, pl. 11, f. 18, 19), from the Pliocene Coquimbo-beds of Caldera, Chili, is very closely allied, but the tubercles are less developed. Partly exfoliated individuals of our species, where the tubercles are more or less gone, resemble *F. steinmanni* very closely, so that I was inclined at first, when I had only such poor material, to take it for that species.

Record of specimens: Mouth of Santa Cruz River, 24 sp.; Las Salinas, 1 cast.

Distribution: Santa Cruz, Patagonian beds (v. Ih.); Navidad, Chili (Phil., Moer.).

Affinities: As has been demonstrated above, *S. domeykoana* is represented in the Pliocene beds of Chili by *S. steinmanni*, and in New Zealand by *S. dilatata*, which has been found in Miocene and Pliocene beds (see Hutton, 1873, p. 3, and 1886, p. 348), and still lives there.

Among the European species the Miocene *F. virgineus* Grat. (Hoernes, 1856, p. 286, pl. 31, f. 10–12) might be compared with this one, but it is more slender, and the sculpture, although of the same type, is a little different. There are no species of this type in Eocene deposits of the northern hemisphere.

143. SIPHONALIA NOACHINA (Sowerby).

Pl. XXXIV, Fig. 5.

1846 *Fusus noach.* Sowerby, in: Darwin, Geol. Observ. S. Amer., p. 259, pl. 4, f. 58, 59.
1897 *Siphonalia noach.* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 298.
? 1899 *S. n.* Cossmann, in: Journ. Conchyliol., p. 19 (of sep. cop.), pl. 11, fig. 2, 3 (perhaps jun.?).

Shell ovato-fusiform, spire much shorter than the last whorl, subconical. Whorls 5–6, convex, last whorl very large and swollen. Surface ornaments consisting of spiral grooves, which are deep and quite distant from each other, separated by low and rounded ribs, which are about twice as broad as the sulci. The bottom of the sulci is finely pitted (by lines of growth). Upper whorls with very indistinct longitudinal ribs (8 or 9). Mouth oval, large. Canal of medium length, broad, open, slightly curved.

Measurements of an almost complete individual: Height, 61 mm, diameter, 35 mm; another one, slightly damaged, measures: height, 97 mm, diameter, 55 mm.

Remarks: This species grew to a considerable size: an individual, with the larger part of the spire broken away, measures: Height, 93 mm; diameter, 59 mm. In large specimens the spiral sculpture of the last whorl becomes very strong, consisting of a number of strong, rounded, subequal ribs, separated by narrower, deep and flat grooves, the pitted appearance of which is not so strongly exhibited.

It seems doubtful whether the small specimen described by Cossmann really belongs here.

Record of specimens: Mt. of Observation, upper horizon, 2 sp.; San Julian, Oven Point, 7 sp.; San Julian, Darwin Station, 1 sp.; Cañon near Sierra Oveja, Rio Chico, 1 sp.; Lake Pueyrredon, 600′ above base, 1 sp.

Distribution: San Julian (Sow.); ? Jegua quemada, Suprapatagonian beds (Cossm.).

Fam. *MURICIDÆ* Tryon.

Gen. MUREX L.

144. Murex hatcheri Ortmann.

Pl. XXXIV, Fig. 6.

1900 *M. h.* Ortmann, in: Amer. Journ. Sci., v. 10, p. 375.

Shell ovato-subfusiform. Whorls 5–6, rapidly increasing. Spire short, conical. Upper whorls angulated by a prominent, but blunt carina, which is situated below the middle of the whorls; this carina also forms an angulation on the last whorl, and, below it, there are 4–5 other carinæ, of which the first, or the first and second, are strong, resembling the upper carina, while the others are smaller, becoming indistinct toward the canal. Upper part of whorls, above the upper carina, flat and obliquely descending from the suture, with a few revolving striæ becoming indistinct on the last whorl. Varices 5–6, lamelliform, strong and thick, at the points of crossing with the spiral carinæ produced into short leaf- or ear-like lobes, strongest on the uppermost carina, and decreasing in size toward the canal. On the upper whorls only the upper row of lobes is visible, which become indistinct toward the apex. Mouth large, ovate, prolonged into an open canal of medium length, hardly as long as the mouth. Outer lip ornamented with 5–6 ear-like lobes, identical with the lobes of the varices.

Height, 63 mm; diameter, 44 mm.

Remarks: The development of the spiral carinæ differs in the two individuals at hand. The larger one has only two of them strongly developed, the others are small and indistinct, and indicated chiefly by the lobes of the varices, which are quite large. In the other individual, these two larger carinæ are also developed, but below them are about four distinct ribs decreasing in size downward. The lobes of the varices are indistinct and small in this individual (partly worn off on the whorls), but very distinct, although smaller than in the first one, on the margin of the mouth.

As to the resemblance of this species to *Urosalpinx pyriformis* (v. Ih.) see below.

Record of specimens: San Julian, Darwin Station, 2 sp.

Affinities: This is the first true *Murex* known from the Patagonian beds, and, indeed, the first that is referable without doubt to this genus from any South American Tertiary deposits, and it belongs in the subgenus *Phyllonotus* Montf. Species of this type are hardly found before Miocene times, but are quite abundant in Miocene, Pliocene, and Recent beds. I cannot compare it with any known form, none having a particularly close affinity to it, but on the whole it has a *Neogene* character.

Gen. TROPHON Montf.

145. TROPHON PATAGONICUS (Sowerby).

Pl. XXXIV, Fig. 7^{a-d}.

1846 *Fusus patagonicus* Sowerby, in: Darwin, Geol. Observ. S. Amer., p. 259, pl. 4, f. 60.
1897 *Trophon laciniatus* var. *santacruzensis* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 294, pl. 3, f. 4.
1897 *T. patag.* v. Ihering, ibid., p. 296.
1899 *T. p.* v. Ihering, in: N. Jahrb. Miner., etc., v. 2, p. 31.
1900 *T. p.* Ortmann, in: Amer. Journ. Sci., v. 10, p. 380.

Shell ovato-oblong, with lamelliform varices. Whorls angulated, upper part, near the suture, flat, varices not extending upon this flat part, or only represented by growth-lines. Number of varices from 8–16, on the last whorl sometimes quite crowded, on the upper whorls more or less distant, elevated, and produced, on the angulation, into acuminate, often recurved lobes. Mouth subcircular or subovate, canal about as long as the mouth or a little shorter, umbilicus larger or smaller. Whole surface of shell, except upper flat part, with spiral striæ, which are more or less distinct, often entirely obliterated.

Measurements (not quite complete individual): Height, 72 mm, diameter (varices included) 60 mm; another one, with the upper end gone: Height, 82 mm, diameter, 75 mm; of a complete individual: Height, 63 mm, diameter, 38 mm.

Remarks: v. Ihering's *T. laciniatus* var. *santacruzensis* differs, at the first glance, considerably from Sowerby's *T. patagonicus:* nevertheless, both are connected by numerous intermediate forms, so that it is impossible to draw a line between them. According to v. Ihering, the chief characteristics of *T. santacruzensis* are:

1. It has only 8 varices. 2. The flat part of the whorls is slightly ascending toward the suture (in *T. patagonicus* it is said to be descending or excavated). 3. The form of the shell is more elongated and the canal longer.

I would make the following remarks on these three points:

1. The number of varices increases with age, but it is already variable in the young shell. Indeed, we have specimens of the same size as v. Ihering's figure, which have only 8 varices; but many others have more at the same size, 9–11. The average number, in individuals a little larger than v. Ihering's, is between 10 and 12, but sometimes, on the last whorl, the number increases rapidly, reaching 16. Our largest individual, from Darwin Station, however, has only 12. Sowerby's figure represents an individual of a little more than medium size (height, 69 mm), possessing very numerous varices.

2. There is a slight variation as to the flat upper part of the whorls, it being more or less ascending toward the suture, but in most cases it is almost horizontal. In no case, even in individuals corresponding closely to Sowerby's figure, it is descending toward the suture. The excavated appearance is due to the strongly elevated varices.

3. The external form is very variable. As a rule, younger individuals are more slender, older ones comparatively broader, but there are many exceptions to this rule in young ones. Our largest individuals, however, are all short and broad.

With the external form the length of the canal varies, and there is considerable variation as to the size of the umbilicus and the development of the spiral striæ, which in many individuals are entirely absent, and in a few very strongly developed. They are best developed in comparatively young specimens.

This species differs from *T. laciniatus* in the following points: 1. The upper flat part of the whorls is not crossed by the varices, and this flat part is broader. 2. The lobe formed by each varix on the angulation is more strongly developed, more acuminate and recurved.

In the occasional presence of spiral striæ this species approaches also the recent *T. geversianus* (Pall.) (see: Kuester & Kobelt, 1878, p. 275, pl. 72, f. 1–3, pl. 73, f. 1), which is probably nothing but a variety of *T. laciniatus.*

Record of specimens : Mouth of Santa Cruz River, 13 sp.; San Julian, Oven Point, 21 sp.; San Julian, Darwin Station, 5 sp.; 30 miles north of upper Rio Chalia, 1 sp.; Lake Pueyrredon, base of Tertiary, 4 sp.; Lake Pueyrredon, 600′ above base, 1 sp.

Distribution : San Julian (Sow., see Darwin, 1846, p. 112); Santa Cruz, La Cueva, and Jegua quemada, Patagonian beds (v. Ih.).

Affinities : This species is apparently the ancestral form of both, *T. laciniatus*, which is found in the Cape Fairweather beds, and is also recent, and *T. geversianus*, which is recent.

The genus *Trophon*, according to Zittel (1885, p. 278) is a characteristic Tertiary genus, and hardly found before Oligocene times. The present species has no closely allied forms in deposits of the northern hemisphere.

146. TROPHON LACINIATUS Martyn.

Pl. XXXIV, Fig. $8^{a, b}$.

1847 *Fusus l.* Reeve, Conch. Icon., v. 4, pl. 4, f. 14.
1878 *Trophon l.* Kuester & Kobelt, in : Martini & Chemnitz, System. Conch.-Cabin., v. 3, pars 2, p. 280, pl. 72, f. 6, 7.
1880 *T. l.* Tryon, Man. Conch., v. 2, p. 143, pl. 31, f. 330.
1897 *T. l.* Pilsbry, in : Pr. Acad. Philad., p. 329.

Shell ovato-oblong, with lamelliform varices; whorls more or less angulated, upper part, near the suture, flat, narrow, crossed by the varices. Varices quite numerous, elevated into ear-like lobes on the angulation. Mouth suboval, canal moderately long, umbilicus larger or smaller. Surface of shell, between the varices, without spiral sculpture.

Height (not quite complete), 62 mm, diameter, 36 (varices included); height (not quite complete), 72 mm, diameter, 38 mm.

Remarks : The ear-like lobes in this Cape Fairweather fossil are larger, but less acuminate than in the recent form, but I do not think that this warrants the creation of a new species, especially if we take into consideration the enormous variability of the recent form.

Record of specimens : Cape Fairweather, 16 sp.

Distribution : Known living from the Straits of Magellan and Patagonia.

146a. TROPHON LACINIATUS VAR. INORATUS (Pilsbry).

Pl. XXXIV, Fig. 8^c.

1897 *T. varians* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 296.
1897 *T. inornatus* Pilsbry, in: Pr. Acad. Philad., p. 330, textfig.

This form, found—at Cape Fairweather—associated with the typical form of *T. laciniatus*, is hardly anything more than a variety of the latter. Its external form is more or less slender, sometimes quite swollen. Surface without lamellose varices, or only with slight traces of them, smooth except for lines of growth.

Height, 60 mm, diameter, 37 mm.

Remarks: We possess individuals that show slightly developed varices, in some parts of the shell, which fact makes it the more certain that it is only a variety of *T. laciniatus*. The upper part of the whorls has sometimes a distinct angulation and a distinct, but narrow, flattened space near the suture (var. *gradata* v. Ih.); in other cases no trace of this angulation is seen, the whorls being evenly convex.

This variety much resembles some of the varieties generally classed with *T. geversianus*, especially: *T. geversianus* var. *calva* (Kuester & Kobelt, 1878, p. 305, pl. 75, f. 1, and Tryon, 1880, pl. 32, f. 338), and *T. geversianus* var. *varians* (Tryon, pl. 32, f. 346). Some of our specimens, for instance, that figured by Pilsbry, which are more obese and have no angulation, are indistinguishable from *T. varians* as figured by Tryon. On the other hand, we have specimens that are more elongate, and the complete lack of spiral sculptures, as well as the fact that this form is found associated with *T. laciniatus*, is in favor of the course adopted, to leave it with *T. laciniatus*.

The fact that *T. laciniatus* offers the same variations as *T. geversianus* is very interesting, and would bring these two supposed species still closer together.

Record of specimens: Cape Fairweather, 11 sp.; San Julian, Darwin Station, above Patagonian beds, 3 sp.

Distribution: T. varians, mentioned by v. Ihering from Santa Rosa (or Punta Raza, see pp. 112, 119 and 177), between Santa Cruz and San Julian, and from between San Jorge and Deseado, from the Tehuelche beds, is no doubt this form.

Gen. UROSALPINX Stps.

147. UROSALPINX ELEGANS Ortmann.

Pl. XXXIV, Fig. 9.

1900 *U. e.* Ortmann, in : Amer. Journ. Sci., v. 10, p. 376.

Shell ovato-fusiform ; whorls 5–6, convex, with spiral striæ and 7–8 longitudinal variciform costæ, which are rounded. Mouth oval, elongated into an open, but narrow canal, which is about as long as the mouth. Outer lip distinctly crenulated within.

Height, 16.5 mm ; diameter, 8 mm.

Remarks: This species closely resembles *Triton leucostomoides* of Sowerby (1846, p. 260, pl. 4, f. 64 = *Fusus sowerbyanus* Philippi, 1887, p. 48, pl. 3, f. 16), but appears to be more slender than the latter, and the number of ribs is smaller (8 against 12 in *T. leucostomoides*, according to Philippi), and the ribs are accordingly more distant from one another.

As to the genus *Urosalpinx* see: Dall, 1890, p. 147, v. Ihering, 1897, p. 297, and Cossmann, 1899, p. 18.

U. leucostomoides Cossmann is different from Sowerby's species.

Record of specimens: Mouth of Santa Cruz River, 3 sp.

Affinities: U. leucostomoides (Sow.) is closely allied ; it is found, according to Sowerby and Philippi, in the Navidad beds of Chili, and according to v. Ihering (1897, p. 321), in the Suprapatagonian beds. V. Ihering does not give any particular locality, nor does he give any additional description or figure, so that it is impossible to control his identification.

Murex lamellifer of Philippi (1887, p. 56, pl. 3, f. 22) from the Navidad beds of Matanzas, Chili, also resembles this species, but it has spiral striæ only in the upper part of the whorls, and the external form is a little different.

148. UROSALPINX COSSMANNI Ortmann.

Pl. XXXIV, Fig. 10^{a-c}.

1899 *U.* cf. *leucostomoides* Cossmann, in: Journ. Conchyl., p. 17 (of sep. cop.), pl. 10, f. 7.

1900 *U. cossmanni* Ortmann, in: Amer. Journ. Sci., v. 10, p. 380.

Shell small, fusiform. Whorls 6, convex, suture deep; surface ornamented with spiral cords, 5 of which are exposed on the upper whorls;

they are crossed by numerous longitudinal, sometimes variciform, ribs. Mouth ovate, elongated into an open, slightly curved canal of medium length, a little shorter than the mouth. Outer lip thickened and crenulated on inner side.

Height, 10 mm, diameter, 4.5 mm; a larger, but incomplete, individual has a diameter of 6.5 mm; Cossmann gives: height, 13 mm, diameter, 6 mm.

Remarks: This species differs from *T. leucostomoides* in the more numerous (30 and more), and finer longitudinal ribs, and further, in the more slender form.

Record of specimens: Mouth of Santa Cruz River, 14 sp.

Distribution: Jegua quemada, Suprapatagonian beds (Cossm.).

149. UROSALPINX PYRIFORMIS (v. Ihering).

Pl. XXXIV, Fig. 11.

1897 *Trophon p.* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 295, pl. 3, f. 5.

Shell ovato-pyriform, spire short. Whorls with spiral ribs, 2–3 of which are stronger, the uppermost of them forming an angulation on the whorls. Varices lamellar, 7–9. Mouth ovate, canal short, straight.

Height, 14 mm; diameter, 9.5 mm.

Remarks: Our specimen is smaller than that figured by v. Ihering, and poorly preserved. v. Ihering's figure is very indistinct, and shows only the external form, which agrees completely with our individual. v. Ihering mentions 3 stronger spiral ribs, which are not seen in his figure. Our individual has only 2 stronger ribs; and further, he gives 9 varices, while I see only 7.

There is a very striking resemblance to *Murex hatcheri*: the chief difference is, that *M. hatcheri* has only 5 or 6 varices, which are distinctly lobate. In our individuals of *M. hatcheri*, the varices on the upper whorls are so much obscured, that it is impossible to count them correctly, but they seem to be more numerous there. Possibly, *T. pyriformis* is only the young stage of *M. hatcheri*, but the lack of more material prevents me from determining this question.

Record of specimens: Lake Pueyrredon, base of Tertiary, 1 sp.

Distribution: Jegua quemada, Suprapatagonian beds (v. Ih.).

Fam. *FUSIDÆ* Tryon.

Gen. FUSUS Lmck.

150. Fusus subspiralis spec. nov.

Pl. XXXIII, Fig. 19.

Shell fusiform, elongated and slender. Eight whorls are preserved, but the shell is defective below. Whorls very sharply angulated, suture deep. Angulation forming a sharp and simple (not nodulose) carina on the upper 6 whorls; on the 7th and 8th whorl there are small, remote, but distinct tubercles, not continued as ribs below or above the angulation. Upper surface of whorls, above the carina, and lower surface slightly concave, receding toward the suture. Surface of shell apparently smooth on the upper whorls, but with fine revolving striæ on the lowermost whorl in its upper as well as in its lower part, continued downward as far as can be seen. Striæ not much crowded, crossed by very fine and indistinct lines of growth. Columella straight, slender, elongate, indicating a long and straight canal.

Height, 31 mm; diameter, 12 mm.

Remarks: Only one incomplete individual, imbedded in hard, refractory matrix—apparently the upper part of a rather large species—is present. Last whorl not preserved, but the elongated columella indicates a species of the genus *Fusus*.

The number of nodes of the carina cannot be ascertained, since only part of the lower volutions is exposed, and this part lacks most of the shell. I have, however, no doubt that it is possible to recognize this species, if better material should be found.

Record of specimens: Punta Arenas, horizon II (lower Magellanian); 1 sp.

Affinities: F. subspiralis resembles *F. oxytropis* Philippi from the Navidad beds of Chili (see under *F. archimedis*), but differs in the larger size and much more slender spire; also the form of the upper whorls is different, the carina being situated, in *F. oxytropis*, nearer to the lower suture, in *F. subspiralis*, nearer to the upper one, although only very slightly above the middle.

151. FUSUS ARCHIMEDIS Ortmann.

Pl. XXXIII, Fig. $20^{a, b}$.

1900 *F. a.* Ortmann, in: Amer. Journ. Sci., v. 10, p. 374.

Shell fusiform; spire shorter than the last whorl, scalariform. Whorls over 5 (upper part of spire missing), very prominently angulated, suture very deep. Upper part of whorls, above angulation, flat, obliquely descending from the suture, lower part of upper whorls (below angulation) very slightly convex, obliquely receding toward the lower suture. Angulation blunt, with a number (10–13) of blunt, often indistinct tubercles. Sometimes these tubercles resemble indistinct longitudinal ribs, running for a short distance downward. Surface of shell with fine revolving ribs on the lower part of the whorls and on the angulation, but these ribs disappear on the upper part of the whorls at a short distance from the angulation. Whole surface with distinct lines of growth, which have a squamulose appearance where they cross the revolving ribs. Last whorl large. Mouth triangular, continued into a long and straight canal. The revolving ribs of the last whorl become indistinct on the canal.

Height, 50 mm (but defective at upper end), diameter, 25 mm; diameter of a fragment, 31 mm.

Remarks: Characterized by the strongly angulated whorls and deeply receding suture. The larger part of the upper flat portion of the whorls is quite smooth, except for growth-lines. Only near the angulation 3 to 4 revolving ribs begin to appear, and these ribs continue downward over the angulation toward the canal, where they become indistinct.

Record of specimens: San Julian, Darwin Station, 3 sp.

Affinities: Only one species of this characteristic, strongly angulated form is known from the South American Tertiary: *F. oxytropis* Philippi (1887, p. 50, pl. 3, f. 15) from Navidad and Tubul, but this one is much smaller, and the angulation much sharper, cariniform.

I know only one other species that may be compared with ours: *F. hector* Whitfield (1892, p. 199, pl. 25, f. 3–6) from the *Eocene* Marls of New Jersey. But the latter is distinguished at once by the spiral sculpture: the upper part of the whorls, above the angulation, does not possess any spiral lines, and those below the angulation are much more distant from each other and fewer in number. But, on the whole, the type of sculpture is very similar in both species.

152. FUSUS TOROSUS Ortmann.

Pl. XXXIV, Fig. 1.

1900 *F. t.* Ortmann, in: Amer. Journ. Sci., v. 10, p. 375.

Shell subturbinate-fusiform. Spire short, rather depressed. Whorls 4, last whorl very large. Surface with numerous fine spiral ribs, which are rather crowded and somewhat unequal, crossed by very fine, squamiform lines of growth. Whorls strongly convex, swollen, with about 7 strong, variciform, longitudinal ribs, which begin at the suture, and become thick and swollen in the middle of the last whorl, attenuating again toward the lower end of the shell. Mouth ovate, continued into a canal of moderate length, which is slightly curved.

Height, 31 mm; diameter, 20 mm.

Remarks: In external form this species closely resembles *F. pyruliformis* of Sowerby (1846, p. 258, pl. 4, f. 56) from Navidad. I should not hesitate to identify my individual with Sowerby's species, if it was not for the account of the Navidad form given by Philippi (1887, p. 43, pl. 2, f. 1) and Moericke (1896, p. 569, pl. 11, f. 1, 2). According to these authors, Sowerby's figure is very poor, and both give better figures of the Navidad species (Philippi in an unnumbered figure in the upper right hand corner of plate 2).

According to these figures, the Navidad species differs from ours in the following particulars: (1) The upper part of the last whorl, as well as the upper whorls, is smooth, the longitudinal ribs not being continued upward to the suture: in our species these ribs continue to the suture, being very distinct on the spire. (2) The last whorl, from the middle downward, is occupied by swollen longitudinal ribs, which are cut up into a number of tubercles, which form spiral rows: in our species these ribs are crossed by fine spiral cords, but are not cut up by them into tubercles. (3) The canal is perfectly straight, while it is slightly curved in our individual.

I entertain some doubt, whether Philippi's and Moericke's species is really the *F. pyruliformis* of Sowerby. Sowerby's figure, no doubt, is poor, but his diagnosis applies perfectly to our individual, since he calls the spire "rudis," by which expression he may have intended the rough, tuberculated appearance given to the spire by the upper continuations of the ribs toward the suture, and, further, since he describes the sculpture of the last whorl as tubercles continuing downward as ribs, crossed by furrows ("anfractibus . . . medio tuberculatis, tuberculis transversim sulcatis, in costas subdecurrentibus"), which agrees better with our species than with Philippi's and Moericke's species. If our species should prove to belong really to Sowerby's species, the specific name of *pyruliformis* is to be retained, and that of Philippi's species is to be changed.

Record of specimens: Mouth of Santa Cruz River, 1 sp.

Affinities: According to the considerations given above, there is no doubt that the Navidad form *F. pyruliformis* is very closely allied. The latter has been compared by Moericke with *F. burdigalensis* Bast. from the Miocene of Europe (see Hoernes, 1856, p. 296, pl. 32, f. 13, 14). This species is remarkable for the *Pyrula*-like form of the shell, and this character is still more strongly expressed in *F. pyruliformis* as well as in *F. torosus.* The sculpture, however, is different, *F. burdigalensis* having only a row of small tubercles, but no costiform tubercles, and no accessory rows of tubercles as *F. pyruliformis.*

Fam. *VOLUTIDÆ* Gray.

Gen. MARGINELLA Lmck.

153. Marginella gracilior v. Ihering.

Pl. XXXV, Fig. 1.

1897 *M. g.* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 308, textfig. 18.

Shell ovato-oblong, subcylindrical, solid, smooth. Spire short, mucronate. Upper whorls with a series of indistinct tubercles, wanting completely on the last whorl. Columella with 4 folds.

Height, 20 mm; diameter, 10.5 mm.

Remarks: The obtuse tubercles mentioned in v. Ihering's diagnosis are not visible in his figure, and in our individual only very slight traces of them are discernible. This species differs from *M. quemadensis* and *confinis* v. Ih. in the more slender form.

Record of specimens: Mouth of Santa Cruz River, 1 sp.

Distribution: Jegua quemada, Suprapatagonian beds (v. Ih.).

Affinities: This species, in its external form, recalls *M. bella* (Conr.) and *M. faunula* Dall (1890, p. 53, pl. 4, f. 8, 9), the former from the Miocene, Pliocene and Recent of the southern states of North America, the other from the Miocene of Florida, but *M. gracilior* is very much larger, more than double their size, and the nodules of the upper whorls are not present in the North American species.

154. MARGINELLA PLICIFERA v. Ihering.

Pl. XXXV, Fig. 2.

1897 *M. p.* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 308, textfig. 19.

Shell ovato-elongate, solid. Spire more elongated than in any other Patagonian species, conical. Whorls with rib-like, longitudinal folds, above, near the suture, slightly concave and with spiral striæ. Columella with 4 folds.

Height, 22 mm, diameter, 11 mm, length of mouth, 15 mm; v. Ihering gives: height, 31 mm, diameter, 16 mm, mouth, 20 mm.

Remarks: v. Ihering, in the diagnosis, calls the spire "breviuscula," but says farther on that it is more elongated in this species. His specimens were badly preserved and partly damaged. In our complete individual the spire is almost intact, and accordingly, the form appears more slender than in v. Ihering's figure.

v. Ihering further says, in his diagnosis and description, that an impressed line accompanies the suture. Nothing of this kind is seen in his figure. In our specimens there is a slight depression of the upper part of the whorls near the suture, and in one of them there are distinct revolving striæ (5–6) on this part of the shell.

Record of specimens: Mouth of Santa Cruz River, 6 sp. (most of them greatly damaged).

Distribution: Jegua quemada, Suprapatagonian beds (v. Ih.).

Affinities: The sculpture of this species is very remarkable, and I cannot find any other species that might be compared with it in this respect.

155. MARGINELLA OLIVELLA nom. nov.

Pl. XXXV, Fig. 3^{a,b}.

1900 *M. oliviformis* Ortmann, in: Amer. Journ. Sci., v. 10, p. 376 (non *M. oliviformis* Tuomey & Holmes, 1857).

Shell elongate, subcylindrically-fusiform. Spire conical. Surface of shell smooth and shining. Suture quite indistinct. Mouth long and narrow, canal very short, represented only by a rounded sinus. Columella with 4 subequal folds. Outer lip thickened, smooth within.

Height, 11 mm; diameter, 5 mm; length of mouth, 6.5 mm.

Remarks: This species differs from the other Patagonian species in the perfectly smooth surface and very elongated form.

Record of specimens: Mouth of Santa Cruz River, 5 sp.

Affinities: The Pliocene and recent *M. styria* Dall (1890, p. 54, pl. 5, f. 1) resembles this species in form, but it is smaller, still more slender, and the spire is longer.

Gen. VOLUTA L.

156. VOLUTA TRIPLICATA Sowerby.

Pl. XXXV, Fig. 4^{a-e}.

1846 *V. t.* Sowerby, in: Darwin, Geol. Observ. S. America, p. 262, pl. 4, f. 74.

1887 *V. t.* Philippi, Tert. & Quart. Verst. Chiles, p. 70, pl. 7, f. 8–12.

1897 *V. dorbignyana* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 303 (teste v. Ihering).

1899 *V. triplicata* v. Ihering, in: N. Jahrb. Miner., etc., v. 2, p. 33.

Shell moderately elongated, subfusiform. Whorls 6, surface with numerous, distinct, and rather crowded spiral cords, and a number of longitudinal ribs (8–16), which are rather prominent; their upper end terminates abruptly some distance from the suture, being often tuberculiform; the uppermost part of the whorls, near the suture, is more or less distinctly concave. Last whorl moderately inflated, mouth (including canal) about half as long as the whole shell. Columella mostly with 3 plaits, which are sometimes subequal, and sometimes the uppermost is weaker than the others and may disappear; in one case there are 4 distinct plaits, the uppermost the smallest.

Measurements: Height, 106 mm; diameter, 46 mm (large part of canal gone). Height, 92 mm; diameter, 41 mm (large part of upper end gone). Height, 87 mm; diameter, 34 mm (almost complete, only apex wanting). Height, 44 mm; diameter 21 mm (complete, young).

Remarks: The most important characters of this species have already been pointed out by v. Ihering, and are found in the relation of the length of the mouth to the whole shell, and in the longitudinal sculpture. The longitudinal ribs end abruptly before reaching the suture, forming a distinct shoulder, and sometimes this shoulder is marked by a distinct tuberculiform development of the ribs. In all other characters this species is extremely variable. The external form is more or less slender: there are some individuals, which are as slender as the following species (*V. gracilior*); the upper whorls are sometimes about half as high as broad, sometimes almost as high as broad; the spiral cords are more or less developed; the number of longitudinal ribs is very variable, between 8 and 16, and, further, the number of columellar plaits varies from 2 to 4.

Even the character of the longitudinal ribs is not quite constant; sometimes their upper termination is less sudden, and, indeed, there are individuals which approach the following species also in this respect.

v. Ihering says (under *V. alta*), that the transition from the mouth into the canal is well marked by an obtuse angulation: I cannot see anything like that in any of our specimens: the outer lip of the mouth passes in a regular curve into the canal.

I possess two young individuals, which show the nucleus of the shell. It corresponds closely to what Dall (1890, p. 68) calls the *Caricella-nucleus* (see plate XXXV, Fig. $4^{d,e}$), with a distinct small point or apical spur. This species is, accordingly, not to be classed with the *Volutoid-series*, as Dall (p. 69) does, but with the *Scaphelloid-series* (ibid., p. 70). I may mention here that we have the same nucleus in *V. dorbignyana*, and it is quite probable that the other Patagonian species also belong to the same type, which fact would bring them into closer relation with the living *Volutæ* (Gen. *Scaphella*) of Patagonia (*V. ancilla*, *magellanica*, etc.).

Record of specimens: Mouth of Santa Cruz, 13 sp.

Distribution: Santa Cruz, Patagonian beds (v. Ih.); Navidad beds of Chili: Navidad (Sow., Phil.), Matanzas (Phil.).

157. VOLUTA GRACILIOR v. Ihering.

Pl. XXXV, Fig. 5^{a-c}.

1887 *V. gracilis* Philippi, Tert. & Quart. Verst. Chiles, p. 70, pl. 7, f. 13 (non *V. gracilis* Lea, 1833).
1896 *V. gracilior* v. Ihering, in: Nachr. deutsch. malakozool. Ges., p. 96.
1896 *V. quemadensis* v. Ihering, ibid., p. 97.

1897 *V. quemadensis* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 304, pl. 3, f. 7.
1897 *V. philippiana* v. Ihering, ibid., p. 305 (non *V. philippiana* Dall., 1890).
1899 *V. philippiana* v. Ihering, in: N. Jahrb. Miner., etc., v. 2, p. 34.
1899 *V. quemadensis* v. Ihering, ibid., p. 34.
1900 *V. gracilior* Ortmann, in: Amer. Journ. Sci., v. 10, p. 381.

This species is extremely near the preceding, and it may be only a variety of it. According to our material it differs in the following points:

1. The shell is more elongated, and the whorls are higher.
2. The longitudinal ribs are more numerous (about 18–20), and do not end abruptly before reaching the suture; they disappear gradually, and traces of them are continued to the suture. They do not form a series of tuberculiform prominences.
3. The whorls are more evenly convex, with hardly a trace of a shoulder. The upper part of the whorls is only slightly depressed.
4. There are, as a rule, only two columellar plaits, although traces of a third (upper) one are sometimes developed.

Measurements: Height, 135 mm; diameter, 66 mm (large part of spire missing). Height, 119 mm; diameter, 46 mm (not quite complete). Height, 88 mm; diameter, ca. 36 mm (only uppermost part of spire missing, but last whorl damaged).

Remarks: I unite the two species called by v. Ihering *V. philippiana* and *V. quemadensis*, respectively. *V. philippiana* is said to possess a longer spire, and longitudinal ribs, which do not terminate in tubercles, and the whorls are said to be evenly convex: in all other respects it resembles *V. triplicata*. *V. quemadensis* is said to differ from *V. philippiana* in the still more elongated spire, with higher whorls, the larger number of ribs, and the presence of only two plaits on the columella.

Among our material, I find that the external form is very variable. Although all specimens registered under this form are more slender than the average of *V. triplicata*, there are, among the latter, individuals which approach this form closely. Those with the most slender spire, and with the highest whorls (almost as high as broad), which would correspond, in this respect, to *V. quemadensis*, possess a distinct third columellar plait, thus uniting characters of *V. quemadensis* and *philippiana;* as to the number of longitudinal ribs, there is so much variability, that it is impossible to draw any line. Indeed, in the more elongated individuals, the number of these ribs is larger than in the typical *V. triplicata*, but some individuals, belonging undoubtedly to *V. triplicata*, possess 16 or even 17 ribs, while sometimes in the elongate form only 17 or 18 are present. As to the height of the upper whorls, there is no less variability: some specimens correspond to the proportions given by v. Ihering for *V. quemadensis*, while others correspond to those of *V. philippiana*, but many intermediate individuals are found.

Even the development of the longitudinal ribs is not quite uniform, some specimens showing traces of an angulation near the suture, giving a suggestion of the series of tubercles found usually in *V. triplicata*.

Thus, I can separate only a more slender form from *V. triplicata*, but I doubt very much that it is really a good species. Dall (1890, a, p. 314) and v. Ihering (1897, p. 305, and 1899, p. 32) have already suggested that all these forms may belong as varieties to one and the same species (*V. triplicata*).

The recent *Volutilithes philippiana* Dall (1890, a, p. 303, pl. 9, f. 4) from the coast of Chili (677 fath.) is quite different from this fossil species, as is seen at once by the fact that it already has 6 whorls at a size of only 36 mm, while in the fossil form of the same size hardly more than 3 whorls are present. And, further, this recent form is a *Volutilithes*, while our fossil—in analogy with *V. triplicata*—seems to belong to *Scaphella*. Accordingly, the specific name of *philippiana* cannot be used for this fossil, and since *gracilis* of Philippi is preoccupied, we must adopt the name *gracilior* proposed by v. Ihering in 1896.

A cast of this species has been sent to us by v. Ihering under the name of *V. triplicata*.

Record of specimens: Mouth of Santa Cruz River, 7 sp.; San Julian, Oven Point, 1 sp.; San Julian, Darwin Station, 2 casts; Upper Rio Chalia, 1 cast; Arroyo Gio, 1 cast.

Distribution: Santa Cruz (Phil., v. Ih.), Patagonian beds (v. Ih.); Jegua quemada, Suprapatagonian beds (v. Ih.).

158. VOLUTA PETERSONI Ortmann.

Pl. XXXV, Fig. 6.

1900 *V. p.* Ortmann, in: Amer. Journ. Sci., v. 10, p. 376.

Shell elongate, fusiform. Whorls 5 (aside from the apex, which is broken off). Spire slender, conical, mouth apparently not much longer than half of the shell (lower end of shell damaged). Upper whorls quite high, about two-thirds as high as broad (the measurements are: height of penultimate whorl, 24 mm; width, 38 mm). Whorls almost evenly convex, only slightly appressed and concave toward the suture, without a distinct angulation. Surface beautifully cancellated by spiral and longitudinal ribs. Spiral ribs strongly developed, equidistant, sharp, a little more crowded on the upper whorls than on the last one. Longitudinal ribs a little stronger than the spiral ribs, sharp, running from suture to suture, about 30 on the last whorl. Cancellations rectangular, about twice as broad as high on the last whorl, and about three or four times as broad on the upper whorls, traversed by fine lines of growth. Mouth elongated (lower end not preserved). Columellar plaits not clearly visible, but there are at least two which seem to be quite weak.

Height, 148 mm (not complete); diameter, 65 mm.

Remarks: The sculpture of this species is quite unique, and characterizes it sufficiently. Although the sculpture can be compared with that of *V. triplicata* and *gracilior* to which this species is apparently related, the large number of longitudinal ribs, which are developed as sharp and narrow carinæ, and the cancellations produced by the stronger development of the spiral ribs are quite unlike what we see in the other species named.

The specific name is given in honor of Mr. O. A. Peterson, Mr. Hatcher's assistant, who collected this species.

Record of specimens: Mouth of Santa Cruz River, 1 sp.

159. VOLUTA DORBIGNYANA Philippi.[1]

Pl. XXXVI, Fig. 1 $^{a-e}$.

1887 *V. d.* Philippi, Tert. & Quart. Verst. Chiles, p. 70, pl. 7, f. 7.
1899 *V. d.* v. Ihering, in: N. Jahrb. Miner., etc., v. 2, p. 33.

Shell fusiform. Whorls 6 (and two apical whorls). Spire conical, moderately long. Mouth distinctly longer than half of the shell, almost two-thirds of it. Whorls convex, with a more or less distinct shoulder, above which the upper part of the whorls is depressed or slightly concave (more distinctly so on the last whorl), and appressed to the suture. Sur-

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[1] It is to be remarked, that there already exists a *Voluta orbignyana* Mueller (Mon. Aachen. Kreideverst., v. 2, 1851, p. 50). The latter species, however, is brought by Holzapfel (Palæontograph., 34, 1868, p. 97) into the genus *Volutolithes.*

face with spiral striæ and longitudinal ribs, this sculpture becoming quite indistinct on the last whorl. In large individuals the last whorl is often quite smooth except for growth-lines. Spiral sculpture very variable, sometimes strongly developed, in other cases weak, or entirely disappearing. Longitudinal ribs also variable; in most cases distinct on the upper whorls, but not reaching the upper suture. On the lower whorls these ribs disappear, being represented, in many cases, by slight and indistinct swellings on the shoulder, and disappearing in very large shells entirely on the last whorl. Mouth elongate. Columella with three plaits, the uppermost sometimes very slightly developed.

Measurements: Height, 186 mm; diameter, 79 mm (complete, except for apex). Height, 70 mm; diameter, 27 mm (complete, young).

Remarks: As v. Ihering points out, this species is well characterized by the elongated mouth, which is comparatively much longer than that of *V. triplicata* and allied forms, and, further, by the tendency of the longitudinal ribs to disappear on the lower whorls, the last whorl, in large individuals, being quite destitute of ribs.

V. Ihering has sent us the lower half of a large specimen of this species, which agrees well with our large individuals.

We possess a number of small individuals, which agree in form. Two of them show the apex: it is distinctly of the *Caricella-type* of the *Scaphelloid-series* (Dall, 1890, b, p. 70). (See our plate XXXVI, fig. $1^{b, c}$.)

One individual (plate XXXVI, fig. 1^{c}) shows the spiral striæ very strongly developed, even on the beginning of the last whorl. Specimens like this, when only parts of the surface of the lower whorls are preserved, which do not possess any longitudinal ribs, may have been taken by v. Ihering for *V. alta*. V. Ihering himself says that his *V. alta* and *dorbignyana* are similar in form (which is really not correct, the true *V. alta* of Sowerby from the Navidad beds having a much shorter mouth), and that he had only very poor material of his *V. alta* (only one individual showing remains of the shell). Since the absence of longitudinal ribs in *V. alta* is the only difference between v. Ihering's *V. alta* and *V. dorbignyana*, and since these ribs also tend to disappear on the lower part in *V. dorbignyana*, and, indeed, do so completely on the last whorl, it is quite possible that v. Ihering's *V. alta* corresponds to such specimens of *V. dorbignyana* as is represented in our figure.

It is probable that the doubtful casts from Santa Cruz referred to *V. alta* by Sowerby also belong to this species. We do not possess the true *V. alta* from Santa Cruz.

Record of specimens: Mouth of Santa Cruz River, 17 sp.; Upper Rio Chalia, 1 cast.

Distribution: Santa Cruz, Patagonian formation (Phil., v. Ih.).

Affinities: In general form and size this species corresponds closely to the living *V. ancilla* Sol. (Reeve, 1851, pl. 17, f. 39; Tryon, 1882, p. 97, pl. 29, f. 110; Lahille, 1895, p. 21, especially pl. 1, f. 9, pl. 8 and 11), but it differs chiefly in the presence of longitudinal ribs on the upper whorls. It is quite possible that this is the ancestral form of *V. ancilla.*

In Australia, this species is represented by *V. halli* Pritchard (1896, p. 101, pl. 2, f. 1–3) from supposed Eocene, but probably Miocene beds of Tasmania and Victoria. This species has the same mamillate (Scapheloid-) apex, but seems to possess a shorter mouth and longer spire.

160. VOLUTA DOMEYKOANA Philippi.

Pl. XXXVII, Fig. $1^{a,b}$.

1887 *V. d.* Philippi, Tert. & Quart. Verst. Chiles, p. 70, pl. 8, f. 4.
1899 *V. pilsbryi* v. Ihering, in: N. Jahrb. Miner., etc., v. 2, p. 34, pl. 2, f. 9.
1900 *V. domeykoana* Ortmann, in: Amer. Jour. Sci., v. 10, p. 381.

Shell ventricoso-fusiform; whorls 5 (besides the apex). Spire short, conical. Mouth considerably longer than half of the shell, about as long as three-fifths of it. Whorls convex, with a distinct shoulder, upper part concave, and appressed toward the suture. Surface with spiral striæ, which become indistinct on the last whorl, and with longitudinal ribs, which form distinct nodes on the shoulder. Last whorl inflated, large. Mouth wide, elongated. Columella with two plaits, and sometimes with a suggestion of a third (upper) one.

Height, 149 mm; diameter, 72 mm (almost complete individual, only apex gone).

Remarks: V. Ihering figures the lower part of a very large individual, and has sent to us the same part of another, large one, which both agree well with our specimens, two of which are almost of the same size. On the other hand, our fine individual figured on pl. XXXVII, fig. 1^a, agrees so closely with the description and figure of Philippi's *V. domeykoana*, except for its larger size, that I do not entertain any doubt as to their specific identity. In a letter, v. Ihering maintains the difference of both, saying that the mouth is much wider in *V. pilsbryi.* But according to our material, the width of the mouth increases with age, and since our individuals are smaller than v. Ihering's, and agree better with *V. domeykoana* in the size of the mouth, I believe this supposed character of *V. pilsbryi* is only a character of age.

The development of the nodes is variable, especially on the last whorl. In one of our specimens these nodes are much less distinct (see fig. 1^b). In all other respects our four specimens much resemble one another, and may be recognized at once by the characteristic shape of the shell, which is, in some degree, intermediate between *V. dorbignyana* and *V. ameghinoi.*

Record of specimens: Mouth of Santa Cruz River, 4 sp.

Distribution: Santa Cruz, Patagonian beds (v. Ih.); Chiloë, Navidad, and Quiriquina, Chili (Phil.). As to the occurrence of this species in the Cretaceous beds of the island of Quiriquina, compare Philippi, l. c., and Steinmann, 1895, p. 24.

Affinities: As v. Ihering points out, this species is closely related to the following species, *V. ameghinoi,* and to the living *V. magellanica* Lmck. (see Reeve, 1851, pl. 14, f. 33; Tryon, 1882, p. 98, pl. 29, f. 107, 108; Lahille, 1895, p. 25, especially pl. 1, f. 11, pl. 8), and it seems to be especially close to the variety figured by Reeve in fig. 33a, which has nodes on the shoulder, and which seems to be included in Lahille's *V. tuberculata* Wood (Lahille, 1895, pl. 1, f. 12, 13 and pl. 7, f. 140–145); we may take it for the ancestral form of *V. tuberculata* and *magellanica,* and the latter would represent the same relation to *V. domeykoana,* as *V. ancilla* does to *V. dorbignyana.*

161. VOLUTA AMEGHINOI v. Ihering.

Pl. XXXVI, Fig. 2.

1896 *V. a.* v. Ihering, in: Nachr. deutsch. malakozool. Ges., p. 97.
1897 *V. a.* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 302, textfig. 17.

Shell globoso-ovate. Whorls about 3–4 (besides the apical part). Spire very short, conical. Mouth very large, over ⅔ of the length of the shell. Whorls convex, with a distinct shoulder, which is ornamented by a series of strong tubercles. Upper part of whorls oblique, appressed toward the suture, and covering the tubercles of the preceding whorls. Surface smooth, only with lines of growth. Last whorl large and inflated. Mouth wide. Columella with three plaits, the uppermost of which is very indistinct.

Height, 74 mm (apex damaged); diameter, 56 mm.

Remarks: This is distinguished from the other Patagonian species by the very short spire and the strong nodes on the last whorl. Our individuals are considerably smaller than v. Ihering's (height, 156 mm; diameter, 100 mm), hardly half as large, and the slight differences that may be noticed between our figure and that of v. Ihering are, no doubt, differences of age.

The cast from Lake Pueyrredon is very poor, but the general form agrees, and there are also indications of the nodes. It cannot be united with any other species, but compares well with this one.

Record of specimens: Mt. of Observation, upper horizon, 2 sp. (one of them very small); Lake Pueyrredon, 600′ above base, 1 cast.

Distribution: La Cueva, Suprapatagonian beds (v. Ih.).

Affinities: *V. brasiliana* Sol. (Reeve, 1851, pl. 5, f. 34; Tryon, 1882, p. 98, pl. 29, f. 113; = *V. colocynthis* Chemn., Lahille, 1895, p. 10, pl. 1, f. 3, 4, pl. 5) seems to be the descendant of *V. ameghinoi*, as has been pointed out already by v. Ihering.

V. pacifica Sol. (Zittel, 1864, p. 38, pl. 15, f. 4, and Hutton, 1873, p. 7) also resembles this species, but is more slender. It has been found from the Oamaru (Oligocene) beds to Recent times in New Zealand, and apparently *V. atkinsoni* Pritchard (1896, p. 100, pl. 3, f. 1) comes very near to the latter. It is from the Table Cape beds of Tasmania.

NOTE.—It is an extremely interesting fact that the three types of fossil Patagonian *Volutæ*, *V. dorbignyana*, *V. domeykoana*, and *V. ameghinoi* are still represented on the Patagonian coast by very closely allied forms, namely: *V. ancilla*, *V. magellanica*, and *V. brasiliana*. This brings the fauna of the Patagonian beds into close relationship with the present Patagonian fauna, and makes it probable that the interval of time is not very great.

The type of *V. triplicata* is no longer represented in the Recent South American waters, at least not by very closely allied forms. But we have seen that *V. triplicata* is linked to this recent group through *V. dorbignyana*, so that we may say that all the known Tertiary and living Volutas from Patagonia belong to one and the same stock.

In Australian Tertiary deposits we have representatives of the group of *V. triplicata* in *V. serissa* Tate and *V. tateana* Johnst. (see Tate, 1889, p. 129, pl. 2, f. 1, and p. 132, pl. 2, f. 5), the first from the Miocene beds of the River Murray Cliffs, the second from the supposed Eocene (?) beds of Tasmania.

Fam. CANCELLARIIDÆ Ad.

Gen. CANCELLARIA Lmck.

162. CANCELLARIA GRACILIS v. Ihering.

Pl. XXXVI, Fig. 3^{a-b}.

1897 *C. g.* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 310, pl. 3, f. 11.
1899 *C. g.* var. *major* v. Ihering, in: N. Jahrb. Miner., etc., v. 2, p. 35, pl. 2, f. 10.

Shell ovato-fusiform, elongate, not umbilicated. Whorls 4½ to 8. Spire acuminate. Whorls convex, near the suture, in the upper part, indistinctly angulated, suture deep. Surface with 10 or 11 longitudinal ribs, crossed by spiral cords. Mouth oval. Outer lip crenulated within. Columella with two subequal plaits. Canal short, slightly curved.

Height, 12 mm; diameter, 6 mm.

Remarks: Our complete specimen is a little smaller than the original one described by v. Ihering in 1897, but agrees with it completely, with the exception that it has only 4½ whorls (5½ in v. Ihering's specimen).

But it seems that this species attains a very much larger size; the individual described by v. Ihering in 1899 as var. *major* has 8 whorls, and is 43 mm high, but otherwise it much resembles this species, with the exception that there are 4–5 smaller plaits on the columella in addition to the two larger ones; but this may be due to age.

This species is very closely allied to the following, but differs in the more elongate form, less distinctly angulated whorls, and number of longitudinal ribs.

Record of specimens: Mt. of Observation, upper horizon, 1 sp.; San Julian, Darwin Station, 1 cast.

Distribution: Patagonian beds of Santa Cruz, and Suprapatagonian beds of La Cueva (v. Ih.).

163. CANCELLARIA cf. MEDINÆ Philippi.

Pl. XXXVI, Fig. $4^{a,b}$.

1887 *C. m.* Philippi, Tert. & Quart. Verst. Chiles, p. 68, pl. 7, f. 1.
1900 *C. cf. m.* Ortmann, in: Amer. Journ. Sci., v. 10, p. 379.

Very closely allied to *C. gracilis*, but differing in the following particulars: Shell broader and shorter, whorls distinctly angulated near the deep suture; number of longitudinal ribs 14–15. Plaits of columella less strongly developed.

Measurements: of specimen from Mt. Observation: height, 10.5 mm, diameter, 6 mm; specimen from Santa Cruz: height, 12 mm, diameter, 7.5 mm.

Remarks: If our individuals really belong to *C. medinæ*, they are very young. Philippi gives: Height, 44 mm; diameter, 29 mm. But since in all other respects they agree with Philippi's description and figure, I identify them, although with some doubt, with this species. They cannot belong to Philippi's *C. vidali* and the other allied form mentioned by him but not described, both from Santa Cruz, since both possess an open umbilicus, which is not seen in our individuals.

Record of specimens: Mouth of Santa Cruz River, 3 sp.; Mt. of Observation, upper horizon, 1 sp.

Affinities: There are many species of the genus *Cancellaria* known from Tertiary deposits of the northern hemisphere that may be compared with those mentioned here, but I am unable to point out any close affinities to any particular one.

Fam. *TEREBRIDÆ* Ad.

Gen. TEREBRA Lmck.

164. TEREBRA COSTELLATA Sowerby.

Pl. XXXVI, Fig. 5.

1846 *T. c.* Sowerby, in: Darwin, Geol. Observ. S. Amer., p. 262, pl. 4, f. 70, 71.

1887 *T. c.* Philippi, Tert. & Quart. Verst. Chiles, p. 67, pl. 7, f. 3 (after Sowerby).

1897 *T. c.* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 311.

Shell turrite, elongate. Whorls numerous, convex in the middle, in the upper part depressed, with an indistinct, depressed line running parallel to the suture. 11–15 longitudinal ribs on each whorl; these ribs are slightly curved, and extend from suture to suture, although less distinct in the upper, depressed part. Mouth elongate, with a short canal. Columella smooth.

Height (of fragment), 29 mm; diameter, 10 mm.

Remarks: V. Ihering distinguishes two varieties: var. *quemadensis*, with the ribs extending from suture to suture, and more elongate mouth, and var. *santacruzensis*, with the ribs indistinct just below the suture, and shorter mouth. Our specimens seem to belong to the first variety, since the ribs, although less strongly pronounced on the upper part, still are distinctly discernible, and since the mouth is a little more elongate than in Sowerby's figure.

Recently, v. Ihering has informed me, that the Chilian *T. costellata* is different from both Patagonian forms, but does not say in what characters.

Record of specimens: Mouth of Santa Cruz River, 3 sp.; Lake Pueyrredon, 600′ above base, 1 sp. (jun.).

Distribution: La Cueva and Jegua quemada, Suprapatagonian beds (v. Ih.); Navidad, Chili (Sow., Phil.).

Affinities: The genus *Terebra* is rare in Eocene deposits, but the number of species increases rapidly from the Miocene upward. It is a characteristic tropical genus.

Hoernes (1856, p. 134, pl. 11, f. 30) records this species (*T. costellata*) from the *Miocene* of the Vienna basin; comparing his figure and description with our individuals, I do not believe that they are identical; in our species the ribs are much stronger, less numerous, and the whorls are more distinctly convex. Nevertheless, there is a close resemblance to this *Miocene* species.

(The second Navidad species of Sowerby, *T. undulifera*, has been identified by Hoernes, p. 130, with *T. acuminata* of Borson from the Miocene and Pliocene, of Europe and, indeed, I cannot see any differences between them.)

Fam. *PLEUROTOMIDÆ* Stol.

Gen. PLEUROTOMA Lmck.

165. Pleurotoma subæqualis Sowerby.

Pl. XXXVI, Fig. 6.

1846 *P. s.* Sowerby, in: Darwin, Geol. Observ. S. Amer., p. 257, pl. 4, f. 52.

1887 *P. s.* Philippi, Tert. & Quart. Verst. Chiles, p. 38, pl. 1, f. 9.

1899 *P. discors* v. Ihering, in: N. Jahrb. Miner., etc., v. 2, p. 35 (non *P. discors* Sowerby).

1900 *P. subæqualis* Ortmann, in: Amer. Journ. Sci., v. 10, p. 381.

Shell turrite, elongate, subfusiform. Whorls seven, convex, upper part (above carina) slightly concave. Upper whorls with a tuberculiferous carina in the middle and a number of spiral threads. Number of tubercles on the carina, in the last whorl, about 12. Last whorl large, about as long as the spire, or a little longer, with 3 prominent ribs below the carina, which are slightly and indistinctly nodulose and finer spiral threads on the canal. Mouth large, canal of medium length. Sinus of outer lip situated on the upper tuberculiferous carina.

Height, 23 mm (not complete); diameter 10 mm.

Remarks: Our individual is larger than Sowerby's and Philippi's figures, but agrees well with them and with the descriptions, although Sowerby mentions 5 ribs on the last whorl, which is, according to Philippi, probably a mistake. Our specimen has, below the upper tuberculiferous carina, two strong ribs, followed by a very weak one, but the latter is still stronger than the fine threads of the canal.

I have no doubt that v. Ihering has made a mistake in the identification of his *P. discors.* What he describes, in 1897, as *P. discors* var. *unifascialis* is the following species, and what he mentions, in 1899, under the name of *P. discors* is apparently the present one. For he states expressly that the latter possesses *three* stronger ribs below the carina, a character that belongs to *P. subæqualis*, while in the diagnosis of *P. discors* (Sowerby, 1846, p. 258), nothing of this kind is mentioned and no traces of it are seen in the figure (l. c., pl. 4, f. 54). And further, Philippi expressly states that *P. discors* is a *Fusus*, having no sinus on the outer lip, while v. Ihering's *P. discors* has a sinus.

In addition we should consider the fact that we do not possess in our collection any form that might be taken for *Fusus discors* and so it is quite probable that this Navidad species is *not* found at Santa Cruz, and that the specimen referred to it by v. Ihering, although his description is very meagre, really belongs to our species, the *P. subæqualis.*

This species grows much larger. Philippi gives: Height, 33 mm, diameter, 11 mm, and v. Ihering: Height, 45 to 50 mm.

Record of specimens: Mouth of Santa Cruz River, 1 sp.

Distribution: Patagonian beds of Santa Cruz (v. Ih.); Navidad beds of Chili: Huafo Island (Sow.), Lebu, Matanzas, Navidad (Phil.).

Affinities: Sowerby compares this species with an undescribed living species from South America, but the identification of the latter is impossible and the differences he mentions do not make the relation appear to be a very close one.

Among fossil forms there is one that much resembles our species: the *Miocene P. monilis* Br. of Europe (see Hoernes, 1856, p. 353, pl. 38, f. 14–16): especially the presence of a tuberculiferous carina, and a few stronger ribs below this on the last whorl are significant.

166. PLEUROTOMA UNIFASCIALIS v. Ihering.

Pl. XXXVI, Fig. $7^{a, b}$.

1897 *P. discors* var. *unifascialis* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 312.

1900 *P. unifascialis* Ortmann, in: Am. Journ. Sci., v. 10, p. 381.

Shell turrite, subfusiform. Whorls seven. Upper whorls covered with a number of fine spiral threads and with a tuberculiferous carina below the middle; tubercles on this carina about 20 on the last whorl. Upper part of whorls slightly concave. Last whorl large, longer than the spire, sculptured as the upper whorls, but in addition there is, some distance below the carina, a single, rib-like angulation. Canal moderately long, sinus of outer lip situated on the tuberculiferous carina.

Height, 17 mm; diameter, 7 mm.

Remarks: The single, more strongly developed rib below the carina on the last whorl, seems to be characteristic. V. Ihering says that this is the first of the striæ on the lower part of the shell, and this is apparently the case in our specimen also. But a closer investigation reveals the fact that this stronger rib is not the first below the carina, but is preceded by a number of very fine striæ, which are easily overlooked, and, indeed, in some parts of our specimen there seems to be a smooth space in their place.

V. Ihering regards his specimen as a variety of *P. discors*. But, as has been demonstrated above, his *P. discors* is really the *P. subæqualis* of Sowerby, and, further, according to our specimens, there are other differences between both, that make it advisable to separate *P. unifascialis* from *P. subæqualis* as a distinct species. The chief differences are: (1) The existence of only one spiral rib below the carina. (2) The position of the tuberculiform carina on the upper whorls, which, in the present species, is considerably below the middle, nearer to the lower suture, which gives to the whole shell a different appearance. (3) The number of tubercles on the carina, which is, in *P. unifascialis*, about 20 in the last whorl, against only 12 in *P. subæqualis*.

Record of specimens: Mouth of Santa Cruz River, 1 sp.

Distribution: Jegua quemada, Suprapatagonian beds (v. Ih.).

Gen. GENOTA Ad.

167. GENOTA CUEVENSIS v. Ihering.

Pl. XXXVII, Fig. 2.

1897 *G. c.* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 313, pl. 3, f. 10.

Shell subfusiform, biconical. Whorls seven, in the upper part concave, with longitudinal ribs and spiral cords. Last whorl large, higher than the spire. Longitudinal ribs about 12–16, terminating in small nodes above, these nodes forming an angulation on the last whorl; on the upper whorls the nodes are close to the lower suture. Spiral cords unequal on the lower part of the last whorl (below the angulation), the larger ones are slightly nodulose, the nodes situated at the points of crossing with the longitudinal ribs. Mouth narrow, elongate, canal short, slightly recurved. Sinus of outer lip very slight, situated on the concave part of the whorl, near the suture.

Measurements: Height, 16 mm; diameter, 8 mm (complete individual). Height, 22 mm; diameter, 10 mm (apex gone). V. Ihering gives: Height, 32; diameter, 14 mm.

Remarks: There are slight variations in sculpture. The number of longitudinal ribs varies between 12 and 17 in our individuals; v. Ihering gives 18 for the last whorl, but his specimen is larger than any of ours. The nodulose appearance of the upper end of the ribs is more or less distinct: sometimes the ribs only end suddenly without forming a node. The spiral cords are unequal, with from 1 to 4 smaller cords between the stronger ones. The nodulose appearance of these cords is sometimes quite distinct, sometimes hardly indicated.

Record of specimens: Mouth of Santa Cruz River, 6 sp.

Distribution: Santa Cruz and La Cueva, Suprapatagonian beds (v. Ih.).

Affinities: The European *Miocene* species *P. intorta* Brocchi (Hoernes, 1856, p. 331, pl. 36, f. 1, 2, especially fig. 1) resembles the Patagonian form so closely that it is difficult to point out the difference; but it seems that in *P. intorta* the longitudinal ribs are less distinct, and their upper noduliferous termination is more strongly developed. The Pliocene form of *P. intorta* (Wood, 1848, p. 53, pl. 6, f. 4) differs more from our species.

Gen. DRILLIA Gray.

168. Drillia santacruzensis Ortmann.

Pl. XXXVII, Fig. $3^{a, b}$.

1900 *D. s.* Ortmann, in: Amer. Journ. Sci., v. 10, p. 376.

Shell turrite, subfusiform. Last whorl hardly half as long as the shell. Whorls 8, convex, but depressed and slightly concave in the upper part, near the suture. This depression forms a shallow groove, following the suture, and is sharply separated from the rest of the whorl, which is ornamented by oblique longitudinal ribs, which end abruptly at the sutural depression. The number of these ribs is from 12 to 15. Besides, there are very fine lines of growth, but no trace of spiral sculpture. Mouth elongate, canal short. Sinus of outer lip semicircular, situated in the sutural depression, close to the suture; at the point of junction of the outer lip with the columella (in the upper angle of the mouth) there is a distinct nodulose, callous swelling.

Height, 13 mm; diameter, 4.5 mm.

Remarks: The most characteristic features of this species are: (1) The callosity of the upper end of the inner lip. (2) The sharply defined sutural depression. (3) The complete lack of spiral sculpture.

Record of specimens: Mouth of Santa Cruz River, 3 sp.

Affinities: Within the genus *Drillia* we know a few species in which a collosity of the inner lip is combined with the character of slight development of spiral sculpture, but in most of them spiral lines are present at least in the lowermost part of the shell (on the canal). A complete lack of this sculpture is given for *D. perpolita* Dall (1890, p. 36, pl. 2, f. 2), Pliocene and Recent, West Indies and southern United States, but the latter has no callosity. Species, which have a callosity, but have traces of spiral ribs, are, for instance, *D. kœneni* Speyer (1867, p. 203, pl. 22, f. 6, 7), Oligocene, Germany, *D. sigmoidea* Bronn, Pliocene, Europe. The most closely allied species seems to be *D. limatula* Conrad. In the Princeton Museum there are 7 specimens of this species from the *Miocene* of St. Mary's River, Maryland, which agree in the complete lack of spiral sculpture and the presence of a callosity, as well as in the presence of a sutural depression with our Patagonian fossil. The differences, however, are: (1) the number of longitudinal ribs is less (9–11); (2) the sutural depression is less distinct, the ribs not ending so abruptly; (3) the shape of the shell is less elongate.

Gen. BORSONIA Bellardi.

169. Borsonia patagonica Ortmann.

Pl. XXXVII, Fig. 4^{a-c}.

1900 *B. p.* Ortmann, in Amer. Journ. Sci., v. 10, p. 377.

Shell subfusiform, biconical; whorls, about 6; last whorl a little larger than half of the shell, Whorls convex, depressed in the upper part, with a slight swelling just below the suture; depressed part smooth (except for lines of growth), the rest ornamented by 10–12 longitudinal, rib-like swellings, which are slightly tuberculiform on the upper whorls; on the last whorls they are rib-like, but less distinct, and tend to disappear toward the mouth. Besides the ribs, there are spiral cords on the lower part of the whorls, which are wanting on the depressed part, but continue on the last whorl upon the canal. Mouth elongate, canal of medium length. Outer lip with a moderately developed sinus, which is situated in the sutural depression. Columella with two plaits, of which the lower one is sometimes quite indistinct.

Height, 19 mm; diameter, ca. 9 mm (apex gone). Height, 17 mm; diameter, ca. 9 mm (larger part of apex gone).

Remarks: The spiral sculpture is in most of our specimens quite indistinct, worn off, only in one of them, a small one, it is well preserved. It consists of a number of spiral cords, which, toward the canal, become finer. The upper plait of the columella is stronger and longer than the lower one, the latter being in one case so indistinct as to be hardly perceptible.

Record of specimens: Mouth of the Santa Cruz River, 4 sp.

Affinities: The genus *Borsonia* is quite characteristic of *Eocene* deposits, being very rare in the Neogene. Our species agrees in shape, size, and sculpture very closely with the European *Oligocene* species: *B. delucii* Nyst (see Speyer, 1867, p. 205, pl. 23, f. 34). This agreement is so close that it is hard to point out a difference; but it seems that the spiral sculpture in *B. delucii* is a little different, the cords being finer, with smaller ones intercalated. Among the Eocene species of the Paris basin, there is none that comes so near our species, although the differences between the species are not very marked.

Fam. *ACTÆONIDÆ* d'Orb.

Gen. ACTÆON Montf.

170. ACTÆON CHILENSIS Philippi.

Pl. XXXVII, Fig. $5^{a, b}$.

1887 *A. c.* Philippi, Tert. & Quart. Verst. Chiles, p. 111, pl. 13, f. 16.
1899 *A. c.* Ortmann, in: Amer. Jour. Sci., v. 8, p. 431.

Shell ovate, rather broad; spire short, conical, about ¼ of the length of the shell; whorls 5½, convex, the upper ones much broader than high (3 to 4 times as broad as high); suture distinct. Whole surface covered with fine spiral furrows, which are punctate, subequal, and separated by broad, flat intervals, crossed by extremely fine lines of growth. Mouth elongate-ovate, columella with a fold below.

Height, 8.5 mm; diameter, 5 mm; Philippi gives: Height, 10 mm; diameter, 6.5 mm.

Remarks: Philippi's enlarged figure appears more swollen than the outline sketch in natural size; the latter corresponds completely to our individual. In all other respects there is no difference between Philippi's figure and description, and our specimen, so that I am entirely satisfied that we have to deal with this species.

Record of specimens: Punta Arenas, horizon II (lower Magellanian), 1 sp.

Distribution: Navidad and Matanzas, Chili (Phil.).

Affinities: Philippi and Moericke (1896, p. 596) compare this species with *A. tornatilis* (L.), Neogene and Recent, Europe (see Hoernes, 1856, p. 508, pl. 46, f. 24), but in my opinion, there is no closer relation to this species, *A. tornatilis* being much more slender and differing in sculpture.

Among the *Eocene* species of the Paris basin there is *A. turgidus* (Deshayes) (Deshayes, 1864, p. 594, pl. 37, f. 14–16), which agrees very closely with our species in form and sculpture, and, indeed, there is hardly any difference, except the much more considerable size (15 mm) of *A. turgidus.*

Cossmann (1897, p. 2, pl. 1, f. 6, 9) has lately described another, but much smaller (height, 4.5 mm; diameter, 3 mm) species from supposed Eocene beds of South Australia, *A. subscalatus*, which is also closely allied to our species in form and sculpture.

171. ACTÆON SEMILÆVIS Ortmann.

Pl. XXXVII, Fig. $6^{a,b}$.

1900 *A. s.* Ortmann, in: Amer. Journ. Sci., v. 10, p. 377.

Shell elongate-oval, rather slender; spire short, conical, about one-fourth of the length of the shell. Whorls 4, convex, the upper ones 2–3 times as broad as high. Suture distinct, a slight carina running close to the suture and parallel to it on the uppermost part of the whorls. Below this carina, there is an indistinct spiral groove. Below the latter, the surface of the shell is smooth; but in the lower third of the last whorl there are 5–7 spiral furrows, which are rather broad, almost as broad as the flat intervals. Mouth elongate, wider below, columella with a distinct fold below.

Height, 7 mm; diameter, 3.5 mm.

Remarks: The smooth part of the whorls exhibits in one specimen very slight traces of spiral structure, but only close to the edge of the mouth. The furrow running close to the upper sutures appears sometimes bifid toward the mouth.

Record of specimens: Mt. of Observation, upper horizon, 3 sp.

Affinities: In general form and sculpture this species is closely allied to *A. semistriatus* (Fer.) (Hoernes, 1856, p. 507, pl. 46, f. 22, 23), *Miocene*, Europe.

Fam. *BULLIDÆ* Pilsbry.

Gen. BULLA Klein.

172. Bulla remondi Philippi.

Pl. XXXVII, Fig. $7^{a, b}$.

1887 *B. r.* Philippi, Tert. & Quart. Verst. Chiles, p. 109, pl. 13, f. 7.
1899 *B. r.* Ortmann, in: Amer. Journ. Sci., v. 8, p. 431.

Shell subcylindrical. Apex deeply umbilicated, funnel-shaped, with blunt edge, whorls hidden. Whole surface covered with fine, spiral, impressed lines. Mouth elongate, narrow above, not produced upward, dilated below the middle.

Height, 13 mm; diameter, 5 mm.

Remarks: The measurements given by Philippi in the text (p. 109) do not agree with his figure, but would indicate a much thicker shell (height, 19 mm; diameter, 9 mm; rel. 2.1:1), while his figure is: Height, 21 mm; diameter, 8 mm; rel. 2.6:1, which agrees well with our specimens, although the latter are much smaller.

Philippi says that there is a fold on the columella; I do not see it, but the preservation of our specimens (filled with and imbedded in hard matrix) does not permit a closer investigation. Philippi figures no fold.

B. chilensis d'Orb. (Philippi, 1887, p. 109, pl. 13, f. 23), from Port Famine (supposedly Cretaceous) somewhat resembles this species, but it is broader and shorter and the spiral lines are wanting in the lower part of the shell.

B. patagonica v. Ih. comes very near in form, but the spiral lines are distinct in the lowor part of the shell and indistinct or wanting in the upper part.

B. triticum Philippi (1887, p. 110, pl. 13, f. 9) from Navidad has also a similar outline, but is distinguished at once by the sharp angulation on the apical part, the latter being only slightly concave, not funnel-like.

Record of specimens: Punta Arenas, horizon II (lower Magellanian); 6 sp.

Distribution: Navidad, Matanzas, Tubul and Lebu, associated with *Pyrula hombroniana*, said to be from the Navidad beds (Phil.). Recorded also from the Cretaceous of Tumbez. Moericke (1896, p. 394) questions this fact.

Affinities: Among the numerous Tertiary species of *Bulla*, it is hard to point out a particular one to which this one shows the closest affinities. It seems to me that *B. striatissima* Deshayes (1864, p. 636, pl. 38, f. 20–22), from the *Eocene* of the Paris basin might be compared with *B. remondi*, although the form of *B. striatissima* is slightly shorter, the mouth a little more produced upward and the spiral sculpture much finer. Another species that might be compared is *B. conoidea* (Deshayes, p. 622, pl. 39, f. 24–26), from the *Oligocene* of Europe, but the latter is a little more inflated and less cylindrical and the apex is less distinctly excavated.

173. BULLA PATAGONICA v. Ihering.

Pl. XXXVII, Fig. 8^{a-c}.

1897 *B. p.* v. Ihering, in: Rev. Mus. Paul., v. 2, p. 271, textfig. 8.

Shell subcylindrical, a little narrowed above. Apex deeply umbilicated, funnel-shaped with a blunt edge; whorls hidden. Surface with spiral striæ in the lower part of the shell; the striæ are wanting in the upper part. Mouth elongate, narrow above, very slightly produced upward, dilated below the middle. No fold on the columella.

Height, 12 mm, diameter, 6 mm; another one: Height 10 mm, diameter, 4.5 mm. V. Ihering gives: Height, 11 mm, diameter, 5.5 mm.

Remarks: This species is closely allied to the preceding in general form, although it seems to be a little shorter (rel. of H.: D. = 2 : 1 or 2.2 : 1). The chief difference is the development of the spiral lines, which are distinct only in the lower half or one-third of the last whorl. In most individuals there is no trace of the spiral lines in the upper part, but in some of them, especially young ones, there is a slight indication of these lines, but they are always much less distinct than in the lower part.

Sometimes there are a few of these lines (1–3), more distinct from one another, near the upper extremity. The striæ (impressed lines) are more remote from one another than in *B. remondi.*

Record of specimens: Mouth of Santa Cruz River, 109 sp; Arroyo Gio, 2 casts.

Distribution: Jegua quemada, Suprapatagonian beds (v. Ih.).

Affinities: In external form, this species might be compared with the same as the foregoing species. In the peculiar development of the spiral sculpture it differs, however, and in the latter respect it recalls the European *Eocene B. glaphyra* Deshayes (1864, p. 639, pl. 39, f. 6–18). The external form of the latter is less cylindrical, and more ovoid.

CRUSTACEA.

CIRRIPEDIA.

Fam. *LEPADIDÆ* Darw.

Gen. SCALPELLUM Leach.

174. SCALPELLUM JULIENSE Ortmann.

Pl. XXXVII, Fig. 9^{a-c}.

1900 *S. j.* Ortmann, in: Amer. Journ. Sci., v. 10, p. 377.

Only the carina known.

Carina narrow, elongate, strong and solid, curved; basal margin bluntly pointed; surface smooth, but with lines of growth. Tectum strongly arched in its upper part, only slightly so in its lower; upper part solid, its cross section almost quadrangular; this form is brought about by the presence of a prominent ridge on the concave side, formed by the junction of the inflected parietes on each side. Parietes very narrow, separated from the tectum by distinct, but blunt ridges.

Length, 40 mm; width, 8 mm.

Remarks: The only carina at hand resembles so closely that of *S. solidulum* Steenstrup (see Darwin, 1851, p. 42, pl. 1, f. 8) from the Upper Cretaceous of Scania, that I have no doubt that it belongs to the genus *Scalpellum* as well as that species. *S. solidulum* differs from all other species of the genus in the solid, almost quadrangular, section of the upper part of the carina, brought about by the peculiar conformation of the "parietes," and this very character is exhibited in our fossil, as may be seen at once on comparing our figure 9^c on plate XXXVII with Darwin's figure 8^c. Our species differs from *S. solidulum* in the absence of radial ribs on the tectum, and the distinct separation of the parietes from the tectum by a blunt ridge.

Record of specimens: San Julian, Darwin Station, 1 carina.

Affinities: The affinities to the *upper Cretaceous S. solidulum* have been explained above.

Fam. *VERRUCIDÆ* Darw.

Gen. VERRUCA Schum.

175. VERRUCA LÆVIGATA Sowerby.

Pl. XXXVIII, Fig. 1^{a-c}.

1854 *V. l.* Darwin, Mon. Cirrip. Balan., p. 520, pl. 21, f. 3.
1900 *V. l.* Ortmann, in: Amer. Journ. Sci., v. 10, p. 379.

Walls of the shell smooth. Movable scutum with the lower articular ridge broader than the short upper articular ridge; movable tergum broader than high, with the upper articular ridge produced into a point.

Diameter of largest individual, 5.5 mm.

Remarks: I cannot find any difference between our fossil form and the living *V. lævigata.* The walls of the shell are smooth, with concentric lines of growth, without radiating ribs. The movable scutum has the lower articular ridge broad (decidedly broader than in *V. strœmia*), and the upper articular ridge short. The movable tergum (*T*) is broad. In our figure 1^c on plate XXXVIII, the scutum appears to be narrower than in fig. 3 of Darwin, but one must bear in mind, that our figure represents only the exposed parts of scutum and tergum; of the occludent margin (the convex one) a part is covered by the occludent margin of the fixed scutum, and is not shown. The same is the case with the basi-carinal angle of the tergum.

Of the three complete specimens, two have the left hand scutum and tergum fixed, and the third is reversed, *i. e.*, with the right hand scutum and tergum fixed (compare Darwin's figure 1^a and 1^d on pl. 21). Darwin says that the latter case (left opercular valves movable) appears to be more common in the recent form.

The reversed specimen is the largest. The figure 1^b was drawn from a combination of the two others, each 4 mm in diameter. The fourth individual, with the movable opercular valves missing, is still smaller.

Record of specimens: Upper Rio Chalia, 4 sp. (on a specimen of *Turritella ambulacrum*).

Distribution: Recent: Tierra del Fuego, Eastern Patagonian, Chili, Peru (Darw.).

Fam. *BALANIDÆ* Darw.

Gen. BALANUS List.

176. Balanus cf. psittacus (Molina).

Pl. XXXVIII, Fig. 2.

1854 *B. p.* Darwin, Mon. Cirrip. Balan., p. 206, pl. 2, f. 3.
1887 *B. p.* var. *minor* Philippi, Tert. Quart. Verst. Chiles, p. 223, pl. 51, f. 4, 5.
1896 *B. p.* var. *minor* Moericke, in: N. Jahrb. Miner., etc., Beil. Bd. 10, p. 591.
1897 *B. p.* Weltner, in: Arch. f. Naturg., v. 1, p. 261.

". . . Orifice hexagonal. Scutum with the articular ridge very small, confluent with the very prominent adductor ridge, forming a tubular cavity, which extends up to the apex of the valve. Tergum with apex produced, needle-like, purple; spur placed at less than its own width from the basi-scutal angle." (Darwin.)

Remarks: From the base of the Patagonian beds at Lake Pueyrredon we possess two specimens of a large *Balanus*, which seems to be distinct from *B. varians.* The one measures: Height, 52 mm, diameter, at base, 40 mm; the other: height, 48 mm, diameter, 51 mm. Both are poorly preserved, and do not possess opercular valves. The parietes are porous, and the orifice is subhexagonal, which would correspond, together with the large size, to *B. psittacus.* This view is supported in some degree by the fact that this species has been recorded and figured by Philippi from the Navidad beds of Chili, and our specimens agree closely with the figure 4 of Philippi. Philippi figures also (fig. 5) the scutum, which corresponds to that of this species (Darwin, pl. 2, f. 3*a*), and so it seems probable that this large *Balanus* really belongs to the recent *B. psittacus*, although this assumption needs further confirmation through the discovery in the fossil form of the very characteristic tergum.

From Cape Fairweather we possess two specimens, one upon the other, of a *Balanus* that is considerably larger than the common form, although smaller than those from Lake Pueyrredon; the measurements of the larger are: Height, 27 mm, diameter, 29 mm. In general shape they agree with the Lake Pueyrredon specimens, and it could be ascertained that the base and parietes are porous, and the orifice is also large and subhexagonal. But since scuta and terga are wanting, we can unite this form only with doubt with this species, although it would not be strange—if this form really exists in the Patagonian beds—that it is also found in the Cape Fairweather beds.

Record of specimens: Lake Pueyrredon, base of Tertiary, 2 sp. Cape Fairweather, 2 sp.

Distribution: Recent: Peru, Chili, Patagonia (Darw. Weltn.). According to Darwin, fossil in a superficial, recent bed at San Josef, Patagonia. According to Darwin, Philippi, and Moericke, fossil in the Pliocene Coquimbo beds of Coquimbo and Caldera, Chili, and according to Philippi, also in the Navidad beds of Guayacan, La Cueva, and Navidad, Chili.

177. BALANUS VARIANS Sowerby.

Pl. XXXVIII, Fig. 3^{a-e}.

1846 *B. v.* Sowerby, in: Darwin, Geol. Observ. S. America, p. 264, pl. 2, f. 4–6.

1854 *R. v.* Darwin, Mon. Cirrip. Balan., p. 298, pl. 8, f. 9.

1887 *R. v.* Philippi, Tert. & Quart. Verst. Chiles, p. 224, pl. 51, f. 1, 6 (after Sowerby).

1887 *Chthamalus antiquus* Philippi, ibid., pl. 51, f. 7 (after Sowerby).

Shell very variable in shape, conical or tubular, often inverted conical and much elongate. Orifice moderately toothed, large, subtrigonal or subrhomboidal. Walls either smooth or longitudinally folded, the elongated specimens are most apt to be smooth. Parietes moderately thick, imperforate or (rarely) with traces of pores. Radii narrow and oblique, their upper margins more or less oblique and rather smooth. Basis flat or (in elongate specimens) deeply cup-shaped, calcareous, porose. Scutum elongate-triangular, outer surface with fine lines of growth, without radiating sculpture. Inner surfaces with a very prominent articular ridge; adductor ridge absent. Tergum with the longitudinal furrow indistinct, spur short, bluntly pointed, narrow, about one-fifth or one-sixth the width of the valve, placed at more than its own width from the basi-scutal angle; the basal margin, on each side close to the spur, curves toward it; articular ridge of inner side very prominent.

Diameter of largest conical individual at base, 30 mm; height of largest elongate individual, 43 mm.

Remarks: Among the many *Balani* from the Patagonian beds at hand, the external form is very variable, but there may be distinguished three chief forms: (1) short, conical, with distinct folds on the parietes; (2) short, conical, with smooth parietes; (3) elongate, with smooth parietes. There are, however, intermediate forms. The first two forms generally grow isolated, the last crowded in colonies. I possess a large colony that shows a number of elongated individuals of form 3, but the marginal ones are shorter, and represent form 1. This disposes of Philippi's opinion, that the folded form (fig. 6, of Sowerby) is different. Moreover, all the folded individuals are true *Balani*, and do not belong in the genus *Chthamalus*, as Philippi believes, since the rostrum possesses radii, not alæ, as is the case in *Chthamalus*.

In most of my specimens the parietes are imperforate, as Darwin states, but sometimes pores are visible: these pores are most distinctly seen in a small colony from 30 miles north of Rio Chalia.

Darwin describes the scutum, and describes and figures the tergum. I possess one scutum and 2 terga taken from the interior of a specimen of form 3, and 7 scuta and 1 (broken) tergum obtained by washing the matrix from the exterior and interior of the colonies (all from San Julian, Oven Point). Upon a lower valve of *Ostrea ingens* from the same locality there are 21 individuals of the varieties 1 and 2, of which no less than 5 show the opercular valves in situ: most of them are firmly imbedded, but in one individual of var. 1, I have extracted one scutum and tergum. Both agree with those taken from var. 3, although the spur of the tergum is broken off.

The most prominent features of the opercular valves are, that in both, scutum and tergum, the articular ridge is very prominent, that the scutum is comparatively narrow, and has no radial sculpture, and that the spur of the tergum is narrow and short. In these characters, *R. varians* strikingly differs from the externally similar species of the Cape Fairweather beds.

Whether the specimens recorded by Philippi (p. 225) under the name of *Chthamalus antiquus* from Punta Arenas (from *Ostrea torresi*, and accordingly from the Magellanian beds) really belong to this species remains to be shown. The *figure* is a copy of Sowerby's and belongs thus to *B. varians.*

Record of specimens: Mt. of Observation, upper horizon, 2 sp. (var. 2) (on *Voluta ameghinoi*); San Julian, Oven Point, ca. 50 sp. (all three var.'s); San Julian, Darwin Station, 2 sp. (var. 2 and 3); Upper Rio Chalia, 5 sp., and a large colony of ca. 40 sp. (all three var.'s); 30 miles north of upper Rio Chalia, 7 sp. (6 forming a small colony) (var. 2 and 3); Shell Gap, Rio Chico, upper horizon, 8 sp. (var. 1); Lake Pueyrredon, base of Tertiary, 13 sp. (var. 1, 2 and transition to 3).

Distribution: San Julian (Sow., Darw.). Darwin gives with a ?: Eastern plain of Tierra del Fuego. Philippi gives: Ancud and Tubul, Chili (Navidad beds), but he did not know the opercula. V. Ihering (1897, p. 339) records *B. varians* from the Patagonian formation, without locality, and *B. lævis* (according to Weltner) from the Suprapatagonian beds. According to our material, *B. lævis* is not found in these beds, but appears first in the Cape Fairweather beds (see below).

Affinities: The genus *Balanus* is extremely rare, and even doubtful in Eocene deposits (see Zittel, 1885, p. 543 and 545). It becomes more abundant from the Oligocene upward.

Darwin compares our species with *B. unguiformis* Sowerby from the Upper Eocene and Lower Oligocene beds of England and Belgium (1854, a, p. 29, pl. 2, f. 4; 1854 b, p. 296, pl. 8, f. 8). The fact that in *B. varians* the parietes are sometimes perforated, brings it still closer to *R. unguiformis*, but in both the form of the scutum and tergum is different, especially the tergum has a broader and longer spur in *B. unguiformis*, and, further, the basis in the latter has no pores.

178. BALANUS cf. TRIGONUS Darwin.

Pl. XXXVIII, Fig. 4^{a-e}.

1854 *B. t.* Darwin, Mon. Cirrip. Balan., p. 223, pl. 3, f. 7.
1897 *B. t.* Weltner, in: Arch. f. Naturg., v. 1, p. 262.

Parietes and basis with pores. Parietes ribbed (very rarely smooth). Orifice broad, subtrigonal. Scutum thick, with from one to six longitudinal rows of little pits (rarely wanting); articular ridge ending in a small point below; adductor ridge short; a narrow, deep pit or cleft for the lateral depressor muscle. Tergum with blunt apex and scarcely a trace of a longitudinal furrow; spur broad, with the end truncated, situated very near or quite close to the basi-scutal angle.

Remarks: There is no doubt that our fossil species belongs in the neighborhood of *B. trigonus* and *spongicola* Darwin (ibid., p. 225, pl. 4, f. 1), but it is hard to say with which one of these it is to be classed. I possess 4 sets, of which I have procured scuta and terga, the latter corresponding closely to the figures given by Darwin (especially fig. 7^a on pl. 3). The scuta also agrees in general form, especially two taken from a colony of young ones (on *Terebratella gigantea*): in these the rows of pits are quite distinct and numerous (about 6). In other scuta (3 taken from colonies upon *Ostrea ingens*), these pits are hardly or not at all visible, and the adductor ridge is more prominent, so that I am not quite satisfied that they really belong to this species. A character that would speak against the union of our specimens with *B. trigonus* is the complete lack of ribs on the parietes: but, according to Darwin, such a variety is known in *B. trigonus*.

B. spongicola is characterized by the lack of these ribs, and, further, the existence of numerous (6) rows of pits on the scutum, giving rather a radially striated appearance to it, would tend to approximate our specimens to *B. spongicola*. In this species, however, the apex of the tergum is sharply pointed or beaked, which is not the case in *B. trigonus*, nor in any of our terga.

Thus, it seems that our fossil form is in some degree intermediate between *B. trigonus* and *spongicola*, which is not astonishing at all, since Darwin points out the close resemblance of both.

It is not certain that all the specimens recorded here really belong to this species; the outer form of the shell is indistinguishable from that of the following species. The single individuals, however, are distinctly larger, with the exception of those of a colony on *Terebratella gigantea*, which are of about the same size as those of the colony of *B. lævis* described below. Height of largest individual, 16 mm, diameter at base, 27 mm.

Record of specimens: Cape Fairweather, ca. 12 more or less isolated specimens; three colonies, one on *Terebratella gigantea*, two on *Ostrea ingens*. 6 scuta, 3 terga.

Distribution: Recent, almost cosmopolitan; at any rate, circumtropical (Weltn.). It has been found on both sides of South America:

Brazil, Peru, but not in Patagonia and Chili. In fossil state hitherto unknown.

179. BALANUS LÆVIS Bruguière.

Pl. XXXVIII, Fig. 5^{a-e}.

1846 *B. coquimbensis* Sowerby, in: Darwin, Geol. Observ. S. Amer., p. 264, pl. 2, f. 7.
1854 *B. lævis* Darwin, Mon. Cirrip. Balan., p. 227, pl. 4, f. 2.
1887 *B. coquimbensis* Philippi, Tert. & Quart. Verst. Chiles, p. 224, pl. 51, f. 3 (after Sowerby).
1897 *B. lævis* Weltner, in: Arch. f. Naturg., v. 1, p. 263.

Parietes and basis with pores; parietes smooth. Orifice small. Scutum with one or two longitudinal furrows, rarely with one inconspicuous furrow; articular ridge with its lower point produced into a free style; adductor ridge sharp or blunt; pit for lateral depressor muscle minute, but deep. Tergum with a longitudinal furrow; spur of moderate length and breadth, with its lower end obliquely truncated and rounded, situated at some distance, but less than its width, from the basi-scutal angle.

Remarks: A large colony upon a stone has yielded a number of scuta and terga, which are to be identified with this species. The terga agree completely with those of this species; the scuta, however, do not represent the typical form, but rather the form designated by Darwin as var. *nitidus* (fig. 2^e and 2^f). The longitudinal furrow, in our specimens, is quite shallow, sometimes appearing double. This fact is interesting in so far as only the typical variety of *B. lævis* is found at present on the coast of southern Patagonia and Tierra del Fuego, while the var. *nitidus* is the common form farther north in Chili and Peru.

According to Darwin, *B. coquimbensis* is only a variety of *B. lævis*, a fact that has been overlooked entirely by Philippi and Moericke. The central individuals of our colony approach the *coquimbensis*-form.

It seems that the *Balani* recorded by Philippi under the names of *B. apertus* and by Moericke under *B. apertus* and *coquimbensis* belong here; but since no opercular valves have been found, this remains doubtful.

Record of specimens: Cape Fairweather, 1 colony of ca. 100 sp.; 12 scuta, 8 terga. (Two other, small colonies resemble this one, but have not yielded any opercula.)

Distribution: Living from Tierra del Fuego along the western coast of America to California, and along the eastern coast to Brazil (Darw., Weltn.). Fossil in the Pliocene Coquimbo beds of Chili (Sow., Darw., Phil.), and subrecent in Peru (Darw.).

DECAPODA.

Fam. *CARCINOPLACIDÆ* Ortm.

Gen. GERYON Kröy.

180. GERYON (?) PERUVIANUS (d'Orbigny).

Pl. XXXVIII, Fig. 6$^{a, b}$.

1842 *Portunus peruvianus* d'Orbigny, in: Voy. Amer. merid., v. 3, p. 107, pl. 6, f. 17.

1860 *Carcinus p.* A. Milne-Edwards, in: Annal. Sci. natur., ser. 4, v. 14, p. 69, pl. 8.

1887 *Cancer patagonicus* Philippi, Tert. & Quart. Verst. Chiles, p. 220, pl. 50, f. 1.

1900 *Geryon (?) peruvianus* Ortmann, in: Amer. Journ. Sci., v. 10, p. 381.

Carapace with the regions hardly distinguishable, subpentagonal, surface finely granulated. Front with four tooth-like lobes. Orbits transverse, each a little broader than the front, with a closed fissure in the upper margin. Antero-lateral margin curved, a little shorter than the straight postero-lateral margin, with 5 teeth, the first of which is the extra-orbital tooth; teeth conical, pointed, separated by broad, concave intervals. Sternum broadly oval. Abdomen of the male triangular, that of the female ovate. Third maxilliped of the usual Brachyuran type, with an almost quadrate meropodite, at the anterior inner angle of which the carpopodite is inserted, and with a well-developed exopodite. First pair of pereiopods strong, a little unequal; meropodite triangular, stout; carpopodite short and stout, with a tooth on the inner side; hand elongate-oval, fingers strong, a little shorter than the palm, with inner edges strongly dentate. Meropodite of the 4 posterior pairs of pereiopods strong and rather elongate, compressed, with a blunt edge on the upper margin.

Length of carapace: 66 mm; width, 91 mm.

Remarks: There is not the slightest doubt that *Cancer patagonicus* is identical with *Portunus peruvianus* of d'Orbigny, which has been placed by A. Milne-Edwards in the genus *Carcinus.* Our specimens agree completely with the description given by Philippi and A. Milne-Edwards, with the exception that the front possesses distinctly four, not three teeth.

The systematic position of this crab is very doubtful. A. Milne-Edwards places it with the genus *Carcinus* Leach (= *Carcinides* Rathbun, Proc. Biol. Soc. Washington, v. 11, 1897, p. 164), and, indeed, there is some general resemblance to *Carcinides mænas* of the European seas; but the fact that the front has four teeth is strongly opposed to this classification. In my opinion there is a very striking resemblance to the living genus *Geryon* (see for comparison the figure of *G. quinquedens* Smith, in: Trans. Connect. Acad., v. 5, 1897, pl. 9, f. 1).

Geryon, however, is no Cyclometope, but a Catometope, and belongs to the most primitive group of the latter division, which is intimately connected with the former. But since the position of the male sexual opening has not been ascertained in our fossil, this opinion remains to be confirmed, although the writer personally is strongly in favor of it.

Record of specimens: Mouth of Santa Cruz River, 4 sp.; Mt. of Observation, lower horizon, 2 sp.; San Julian, Darwin Station, 2 dactylopodites of first pereiopod; Lake Pueyrredon, 600′ above base, 1 sp.

Distribution: The provenience of d'Orbigny's and Milne-Edwards' specimen is unknown. Philippi records his species from Monte Leon, Patagonia (near the mouth of the Santa Cruz River).

Note: Other species of Decapods existed in the Patagonian beds, as is shown by a number of fragments of chelæ from San Julian, Darwin Station, which are different from those of *G. peruvianus.* But it is impossible to classify them.

LIST OF FOSSILS DESCRIBED.

MAGELLANIAN BEDS.

1. Ostrea torresi Phil.
2. Cardita elegantoides Ortm.
3. Lucina neglecta Ortm.
4. Venus difficilis Ortm.
5. Venus arenosa Ortm.
6. Meretrix (?) pseudocrassa (Ortm.).
7. Dosinia magellanica Ortm.
8. Lutraria (?) undatoides Ortm.
9. Panopea ibari Phil.
10. Panopea subsymmetrica (Ortm.).

11. Patella pygmæa Ortm.
12. Callistoma philippi (Ortm.).
13. Infundibulum merriami (Ortm.).
14. Natica chiloënsis Phil.
15. Turritella exigua Ortm.
16. Struthiolaria hatcheri Ortm.
17. Fusus spiralis Ortm.
18. Actæon chilensis Phil.
19. Bulla remondi Phil.

PATAGONIAN BEDS.

1. Cidaris antarctica Ortm.
2. Hypechinus patagonensis (d'Orb.).
3. Toxopneustes præcursor Ortm.
4. Scutella patagonensis Des.
5. Cyrtoma posthumum Ortm.
6. Schizaster ameghinoi v. Ih.
7. Serpula patagonica Ortm.
8. Terebella magna Ortm.
9. Cellaria fistulosa (L.).
10. Melicerita triforis Ortm.
11. Aspidostoma giganteum (Bsk.).
12. Reticulipora patagonica Ortm.
13. Tennysonia subcylindrica Ortm.
14. Heteropora pelliculata Wat.
15. Rhynchonella plicigera v. Ih.
16. Rhynchonella squamosa Hutt.
17. Magellania lenticularis (Desh.).
18. Terebratella dorsata (Gm.).
19. Terebratella patagonica (Sow.).
20. Buchardia zitteli v. Ih.
21. Nucula patagonica Phil.
22. Nucula reticularis Ortm.
23. Leda oxyrhyncha (Phil.).
24. Leda errazurizi (Phil.).
25. Malletia ornata (Sow.).
26. Cucullæa alta Sow.
27. Cucullæa (Cucullaria) darwini (Phil.).
28. Limopsis insolita (Sow.).
29. Arca patagonica v. Ih.
30. Glycimeris ibari (Phil.).
31. Perna quadrisulcata v. Ih.
32. Ostrea ingens Zitt.
33. Gryphæa cf. tarda Hutt.
34. Pecten proximus v. Ih.
35. Pecten prænuncius v. Ih.
36. Pecten cf. centralis Sow.
37. Pecten geminatus Sow.
38. Mytilus cf. chorus Mol.
39. Mytilus magellanicus Chemn.
40. Modiola ameghinoi v. Ih.
41. Modiola andina Ortm.
42. Crassatellites lyelli (Sow.).
43. Crassatellites kokeni (v. Ih.).
44. Crassatellites quartus (Ortm.).
45. Crassatellites longior (v. Ih.).
46. Cardita elegantoides Ortm.
47. Cardita volckmanni Phil.
48. Cardita inæqualis Phil.
49. Cardita patagonica Sow.
50. Lucina promaucana Phil.
51. Lucina ortmanni v. Ih.
52. Cardium philippii v. Ih.
53. Cardium puelchum Sow.
54. Cardium pisum Phil.
55. Amathusia angulata Phil.
56. Venus chiloënsis Phil.
57. Venus meridionalis Sow.
58. Venus volckmanni Phil.
59. Venus darwini Phil.
60. Venus navidadis Phil.
61. Meretrix iheringi Cossm.
62. Dosinia meridionalis v. Ih.
63. Dosinia læviuscula (Phil.).
64. Tellina tehuelcha v. Ih.
65. Tellina jeguaënsis v. Ih.
66. Psammobia patagonica Phil.
67. Mactra (?) darwini Sow.
68. Mactra garretti Ortm.
69. Corbula hatcheri Ortm.
70. Panopea regularis (Ortm.).
71. Panopea quemadensis (v. Ih.).
72. Martesia patagonica (Phil.).
73. Martesia pumila Ortm.
74. Dentalium sulcosum Sow.
75. Dentalium octocostellatum Plsb. & Sh.
76. Fissurella eurytreta Cossm.

77. Liotia scotti Ortm.
78. Leptothyra philippii Cossm.
79. Solariella dautzenbergi Cossm.
80. Calliostoma observationis Ortm.
81. Calliostoma peraratum Cossm.
82. Calliostoma cossmanni Ortm.
83. Calliostoma santacruzense Cossm.
84. Calliostoma garretti Ortm.
85. Calliostoma iheringi Ortm.
86. Gibbula lævis (Sow.).
87. Gibbula dalli v. Ih.
88. Gibbula diametralis Cossm.
89. Odontostomia suturalis (v. Ih.).
90. Turbonilla cuevensis v. Ih.
91. Scalaria rugulosa Sow.
92. Crucibulum dubium Ortm.
93. Infundibulum corrugatum (Rv.).
94. Infundibulum clypeolum (Rv.).
95. Galerus araucanus (Phil.).
96. Sigapatella americana Ortm.
97. Crepidula gregaria Sow.
98. Natica ovoidea Phil.
99. Natica secunda Roch. & Mab.
100. Natica darwini Hutt.
101. Natica subtenuis v. Ih.
102. Natica consimilis v. Ih.
103. Turritella ambulacrum Sow.
104. Turritella breantiana d'Orb.
105. Turritella patagonica Sow.
106. Vermetus cf. intortus (Lmck.).
107. Vermetus (?) incertus Ortm.
108. Aporrhais araucana (Phil.).
109. Struthiolaria ameghinoi v. Ih.
110. Struthiolaria ornata Sow.
111. Dolium ovulum Ortm.
112. Pyrula carolina d'Orb.
113. Tritonium bicegoi v. Ih.
114. Tritonium morgani Ortm.
115. Buccinum (Cominella) annæ Ortm.
116. Buccinum (Cominella) obesum var. minor (Phil.).
117. Chrysodomus cancellatus (Ortm.).
118. Chrysodomus pilsbryi (Ortm.).
119. Siphonalia domeykoana (Phil.).
120. Siphonalia noachina (Sow.).
121. Murex hatcheri Ortm.
122. Trophon patagonicus (Sow.).
123. Urosalpinx elegans Ortm.
124. Urosalpinx cossmanni Ortm.
125. Urosalpinx pyriformis (v. Ih.).
126. Fusus archimedis Ortm.
127. Fusus torosus Ortm.
128. Marginella gracilior v. Ih.
129. Marginella plicifera v. Ih.
130. Marginella olivella Ortm.
131. Voluta triplicata Sow.
132. Voluta gracilior v. Ih.
133. Voluta petersoni Ortm.
134. Voluta dorbignyana Phil.
135. Voluta domeykoana Phil.
136. Voluta ameghinoi v. Ih.
137. Cancellaria gracilis v. Ih.
138. Cancellaria cf. medinæ Phil.
139. Terebra costellata Sow.
140. Pleurotoma subæqualis Sow.
141. Pleurotoma unifascialis v. Ih.
142. Genota cuevensis v. Ih.
143. Drillia santacruzensis Ortm.
144. Borsonia patagonica Ortm.
145. Actæon semilævis Ortm.
146. Bulla patagonica v. Ih.
147. Scalpellum juliense Ortm.
148. Verruca lævigata Sow.
149. Balanus cf. psittacus (Mol.).
150. Balanus varians Sow.
151. Geryon (?) peruvianus (d'Orb.).

CAPE FAIRWEATHER BEDS (and probably contemporaneous deposits).

1. Terebratella gigantea Ortm.
2. Ostrea ingens Zitt.
3. Ostrea patagonica d'Orb.
4. Pecten actinodes Sow.
5. Mytilus cf. chorus Mol.
6. Meretrix rostrata (Koch).
7. Dosinia meridionalis v. Ih.
8. Panopea pilsbryi Ortm.

9. Galerus mamillaris (Brod.).
10. Crepidula dilatata Lmck.
11. Turritella innotabilis Plsbr.
12. Trophon laciniatus Mart.
13. Balanus cf. psittacus (Mol.).
14. Balanus cf. trigonus Darw.
15. Balanus lævis Brug.

GENERAL CONSIDERATIONS.

The Patagonian Beds.

History of Our Knowledge of the Patagonian Fauna.

The first species of Invertebrates described from what is now known under the designation "Patagonian beds" is: *Hypechinus patagonensis* d'Orbigny (1842). Indeed, *d'Orbigny* has described, in the same publication, other species from Patagonia, but most of them came from the northern parts of the country, and, as far as has been ascertained, do not belong to the true Patagonian beds.

Darwin mentions in 1846 from the Patagonian beds a large oyster under the name of *Ostrea patagonica*, which is a mistake, this species being different (*O. ingens*). In the same work, *Sowerby* (1846) gives descriptions and figures of 24 species from Santa Cruz, San Julian, and other localities, which undoubtedly belong to the Patagonian deposits. They are the following (corrected names in brackets):

1. *Terebratula patagonica* (*Terebractella p.*).
2. *Nucula glabra* (*Leda g.*).
3. *Nucula ornata* (*Malletia o.*).
4. *Cucullæa alta.*
5. *Trigonocœlia insolita* (*Limopsis i.*).
6. *Pecten geminatus.*
7. *Pecten centralis.*
8. *Crassatella lyelli* (*Crassatellites l.*).
9. *Cardita patagonica.*
10. *Cardium puelchum.*
11. *Venus meridionalis.*
12. *Mactra* (?) *darwini.*
13. *Mactra rugata.*
14. *Trochus collaris* (*Gibbula lævis*).
15. *Scalaria rugulosa.*
16. *Crepidula gregaria.*
17. *Natica solida* (*N. darwini*).
18. *Turritella ambulacrum.*
19. *Turritella patagonica.*
20. *Struthiolaria ornata.*
21. *Fusus noachinus* (*Siphonalia n.*).
22. *Fusus patagonicus* (*Trophon p.*).
23. *Voluta alta* (?).
24. *Balanus varians.*

Including the large oyster mentioned by Darwin, these are 25 species, of which 22 are represented in our collection, and belong undoubtedly to the Patagonian beds. Of the remaining three, *Leda glabra* belongs here according to v. Ihering; *Mactra rugata* is very doubtful, and, although recorded from the typical locality at Santa Cruz, has never been found again; and *Voluta alta* was probably wrongly identified (see p. 232). Thus we may say, that Sowerby and Darwin have added to the only known species (*Hypechinus patagonensis*), 23 new species, bringing up the number of species to *24*.

In 1846, *Desor* adds *Scutella patagonensis* and *Echinarachnius juliensis*, which are now regarded as identical, giving *25* as the total number of Patagonian species.

No additions to our knowledge of the Patagonian fauna were made till 1885, when *Rochebrune* and *Mabille* described the following new species: *Photinula detecta*, *Natica secunda* and *Natica omoia*.

Only *N. secunda* has been recognized subsequently, and, owing to the poor descriptions and lack of figures, we can add only this one to the well established species of the Patagonian fauna, giving the number *26*.

In 1887 *Philippi* described the following new species from Santa Cruz:

1. *Nucula patagonica.*
2. *Arca darwini* (*Cucullæa d.*).
3. *Cardita inæqualis.*
4. *Lucina promaucana.*
5. *Fimbria* (?) *patagonica.*
6. *Cardium multiradiatum* (*C. philippii*).
7. *Cardium pisum.*
8. *Venus darwini.*
9. *Venus patagonica.*
10. *Venus læviuscula* (*Dosinia l.*).
11. *Psammobia patagonica.*
12. *Pholas patagonica* (*Martesia p.*).
13. *Trochita* sp. (? *Infundibulum corrugatum*).
14. *Natica famula* (*N. ovoidea*).
15. *Ficula carolina* (*Pyrula c.*).
16. *Voluta gracilis* (*V. gracilior*).
17. *Voluta dorbignyana.*
18. *Cancellaria vidali.*
19. *Cancer patagonicus* (*Geryon peruvianus*).

Of these 19 species, 16 are represented in our collection; of the rest *Venus patagonica* and *Cancellaria vidali* are well characterized forms, while *Fimbria patagonica* needs confirmation. Thus we may add safely 18 species to the Patagonian fauna, which brings the total number up to *44*.

Rochebrune and *Mabille* in 1889 added the following species:

Dentalium patagonicum (*D. sulcosum*).
Photinula resurrecta.
Turritella couteaudi (*T. breantiana*).
Turritella elachista.
Terebra undulifera (probably *T. costellata*).

Only two of these species, *Dentalium patagonicum* and *Turritella couteaudi*, and the existence of the genus *Terebra* have been verified, the other species must be regarded as doubtful, owing to the unsatisfactory descriptions. Thus the number of well established Patagonian species would be *47*.

The most important contribution to the Patagonian fauna was made in 1897 by *v. Ihering.* Following Ameghino, who furnished the material, v. Ihering distinguishes two marine horizons, the Patagonian and Suprapatagonian (or marine Santacruzian) beds, a division, which is not accepted by us. For the present, however, we shall give the list of species added to these faunas, as v. Ihering has given it.

The following are the so-called Patagonian species added by him:

1. *Rhynchonella plicigera.*
2. *Magellania globosa* (*M. lenticularis*).
3. *Bouchardia zitteli.*
4. *Perna quadrisulcata.*
5. *Pecten prænuncius.*
6. *Mytilus cf. chorus.*
7. *Venus volckmanni.*
8. *Struthiolaria ameghinoi.*

All these 8 species are represented in our collections. A few more species given by v. Ihering are to be dropped as synonyms (so *Cucullæa dalli* and *multicostata* = *C. alta; Turritella argentina* and *steinmanni* = *T. ambulacrum; Trophon laciniatus* var. *santacruzensis* = *T. patagonicus*). *Pecten patagonensis* and *Siphonalia* cf. *nodosa* are very doubtful, and *Trophon varians* has been dropped by v. Ihering himself in 1899.

The following are the new Suprapatagonian species:

1. *Schizaster ameghinoi.*
2. *Arca patagonica.*
3. *Pectunculus pulvinatus cuevensis* (*Glycimeris ibari*).
4. *Pecten centralis* (*P. proximus*).
5. *Modiola ameghinoi.*
6. *Crassatella longior* (*Crassatellites l.*).
7. *Amathusia angulata.*
8. *Venus striatolamellata* (*V. navidadis*).
9. *Cytherea splendida* (*Meretrix iheringi*).
10. *Dosinia meridionalis.*
11. *Tellina perplana.*
12. *Tellina patagonica.*
13. *Tellina jeguaënsis.*
14. *Mactra indistincta.*
15. *Solen elytron.*
16. *Glycimeris quemadensis* (*Panopea q.*).
17. *Pholas paucispina.*
18. *Dentalium octocostatum* (*D. octocostellum*).
19. *Fissurella* sp.
20. *Gibbula dalli.*
21. *Eulima subventricosa.*
22. *Odostomia suturalis* (*Odontostomia s.*).
23. *Turbonilla cuevensis.*
24. *Trochita magellanica* (*Infundibulum clypeolum*).
25. *Natica consimilis.*
26. *Natica subtenuis.*
27. *Triton dautzenbergi.*
28. *Trophon pyriformis* (*Urosalpinx p.*).
29. *Trophon leucostomoides* (*Urosalpinx l.*).
30. *Marginella quemadensis.*
31. *Marginella confinis.*
32. *Marginella gracilior.*
33. *Marginella plicifera.*
34. *Voluta ameghinoi.*
35. *Voluta patagonica.*
36. *Cancellaria ameghinoi.*
37. *Cancellaria gracilis.*
38. *Pleurotoma discors* (*P. unifascialis*).
39. *enota Gcuevensis.*
40. *Bulla patagonica.*

The *Trochita* mentioned by Philippi is identified as *T. corrugata*, and the *Terebra*, given as *undulifera* by Rochebrune and Mabille, as *T. costellata*.

Other species mentioned by v. Ihering as new, have been recognized as synonyms of known forms; they are: *Pecten quemadensis*, *Cucullaria tridentata*, *Nucula tricesima*, *Gibbula fracta*, *Turritella tricincta*, *Voluta philippiana* and *quemadensis*.

Thus v. Ihering adds to what he calls Patagonian and Suprapatagonian fauna: 48 species, which brings up the total number of species known from these beds to *95*.

Of the 48 species, 36 are represented in our collection.

In a second contribution, in 1899, *v. Ihering* added the following species, all from the typical Patagonian beds:

1. *Pinna semicostalis* var. *magellanica*.
2. *Crassatella kokeni* (*Crassatellites k.*).
3. *Lucina ortmanni*.
4. *Tellina santacruzensis*.
5. *Tellina tehuelcha*.
6. *Glycimeris nucleus* (*Panopea n.*).
7. *Tritonium bicegoi*.
8. *Siphonalia dilatata* (*S. domeykoana*).
9. *Voluta triplicata*.
10. *Voluta pilsbryi* (*V. domeykoana*).
11. *Pleurotoma discors* (*P. subæqualis*).

Of these 11 species, 8 are found in our collection. *Venus* cf. *uncinata*, *Pyrula hombroniana* are extremely doubtful, while *Pecten fissicostalis* is a synonym of *P. geminatus*.

This contribution brings up the number of well-known Patagonian species to *106*.

Finally *Cossmann*, in 1899, describes the following "Suprapatagonian" species:

1. *Leptothyra philippii*.
2. *Solariella dautzenbergi*.
3. *Calliostoma pararatum*.
4. *Calliostoma santacruzense*.
5. *Gibbula diametralis*.
6. *Gibbula iheringi*.
7. *Gibbula margaritoides*.
8. *Trichotropis patagonica*.
9. *Fossarus pillula*.
10. *Odontostomia euryope*.
11. *Triton obliteratus*.
12. *Urosalpinx leucostomoides* (*U. cossmanni*).
13. *Peratotoma iheringi*.

He gives to the *Fissurella* already mentioned by v. Ihering the name of *F. eurytreta*. *Odontostomia synarthrota* and *Turbonilla iheringi* are synonyms.

Of these 13 species, only 6 are represented in our collection.

This adds 13 species, giving the total number of the Patagonian fossils known up to this date as *119*.

Comparing our list of species (see pp. 257, 258) with that of the species reported previously from the Patagonian beds, we see that of the 119 species known, 95 are represented in our collection, while 56 are added, our list containing altogether 151 species. The following is the list of 24 species, reported previously, which are more or less well established, but not represented in our collection:

1. *Leda glabra* (Sow.), 1846, and v. Ih., 1897.
2. *Pinna semicostata* var. *magellanica* v. Ih., 1899.
3. *Venus patagonica* Phil., 1887, and v. Ih., 1899.
4. *Tellina perplana* v. Ih., 1897.
5. *Tellina patagonica* v. Ih., 1897.
6. *Tellina santacruzensis* v. Ih., 1899.
7. *Solen elytron* Phil., v. Ih., 1897.
8. *Mactra indistincta* v. Ih., 1897.
9. *Panopea nucleus* (v. Ih.), 1899.
10. *Pholas paucispina* v. Ih., 1897.
11. *Gibbula iheringi* Cossm., 1899.
12. *Gibbula margaritoides* Cossm., 1899.
13. *Eulima subventricosa* v. Ih., 1897.
14. *Odontostomia euryope* Cossm., 1899.
15. *Fossarus pillula* Cossm., 1899.
16. *Trichotropis patagonica* Cossm., 1899.
17. *Tritonium dautzenbergi* v. Ih., 1897.
18. *Tritonium obliteratum* Cossm., 1899.
19. *Marginella quemadensis* v. Ih., 1897.
20. *Marginella confinis* v. Ih., 1897.
21. *Voluta patagonica* v. Ih., 1897.
22. *Cancellaria vidali* Phil., 1887.
23. *Cancellaria ameghinoi* v. Ih., 1897.
24. *Peratotoma iheringi* Cossm., 1899.

This would bring up the total number of well established Patagonian species to *175*, to which we have to add the following doubtful forms:

1. *Pecten nodosoplicatus* v. Ih., 1897.—Too incompletely known.
2. *Fimbria* (?) *patagonica* Phil., 1887.—Too incompletely known.
3. *Venus cf. uncinata* Phil., v. Ih., 1899.—Casts only known.
4. *Mactra* (?) *rugata* Sow., 1846.—Too incompletely known, and never found again.
5. *Photinula detecta* Roch. & Mab., 1885.—Description unsatisfactory.
6. *Photinula resurrecta* Roch. & Mab., 1889.—Description unsatisfactory.
7. *Natica omoia* Roch. and Mab., 1885.—Perhaps identical with one of the other *Naticæ*.
8. *Turritella elachista* Roch. & Mab., 1889.—Description unsatisfactory.
9. *Pyrula cf. hombroniana* Phil., v. Ih., 1899.—Material very poor.
10. *Fusus cf. nodosus* Mart., v. Ih., 1897.—Cast only.
11. *Trophon leucostomoides* Sow., v. Ih., 1897.—Identification beyond control.
12. *Voluta alta* Sow., 1846, and v. Ih., 1899.—Identification probably incorrect.
13. *Terebra undulifera* Roch. & Mab., 1899.—Perhaps = *T. costellata*.

Other species, especially some of those given by d'Orbigny, Sowerby, and in Philippi's list (1887, p. 251) do not belong to the Patagonian formation, but to much younger deposits. I mention here the following, in which this fact has been demonstrated:

1. *Arca bonplandiana* d'Orb. Parana formation, see v. Ih., 1897, p. 329.
2. *Ostrea patagonica* d'Orb. (and Phil.). Tehuelche formation, see v. Ih., p. 329, and our collections, p. 112.
3. *Ostrea ferrarisi* d'Orb. Synonym of *O. patagonica*.
4. *Pecten darwinianus* d'Orb. (and Sow.). Parana formation, see v. Ihering, p. 329.
5. *Pecten paranensis* d'Orb. (and Sow.). Tehuelche and Parana formations, see v. Ihering, pp. 226 and 328.
6. *Pecten actinodes* Sow. Tehuelche formation, v. Ih., and our collection, p. 119.
7. *Cardium platense* d'Orb. Parana formation, see v. Ihering, p. 330.
8. *Venus muensteri* d'Orb. (and Phil.). Tehuelche and Parana formation, see v. Ihering, pp. 328 and 330.

THE IDENTITY OF PATAGONIAN AND SUPRA-PATAGONIAN BEDS.[1]

1. THE TYPE-LOCALITY AT SANTA CRUZ.

Ameghino (1898 and 1899), and, following him, v. Ihering distinguish two marine deposits underlying the non-marine Santacruzian beds (containing Mammalian remains): the lower division is called by the term

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[1] The general results to which the following detailed investigations lead have been published by Mr. Hatcher and the present writer in preliminary notes (J. B. Hatcher, 1900 a, Ortmann, 1900). Although it was distinctly stated that the observed facts which furnish the base for our conclusions would be given in the present final report, F. Ameghino did not deem it necessary to wait for its publication, but, from the start, rejected them altogether as having no value at all (see, for instance, F. Ameghino, Notices préliminaires sur des Ongulés nouveaux des terrains Crétacés de Patagonie, in: Boletin de la Academia Nacional de Ciencias de Cordoba, vol. 16, 1901, p. 349).

This is the more astonishing and throws a very peculiar light upon the character of Ameghino's work, since he must have been aware of the fact that Mr. Hatcher, as well as the present writer, tried faithfully, at the beginning, to verify his views on the geology of Patagonia, and that it was during the progress of their studies that they ventured to express opinions contrary to those of Ameghino (compare Hatcher, 1897, pp. 334–338, and 1900 a, p. 99 ff.; Ortmann, 1898, p. 482, and 1899, p. 432). Of course, then it was impossible to give the bulk of the evidence supporting our views, but the mere fact that we arrived at our conclusions by slow steps ought to have been sufficient proof to Ameghino that they were not hastily formed, and in this connection it is well to remember that Ameghino himself has never published any geological or stratigraphical facts in the form of sections or the like.

"Patagonian *formation*," and Ameghino subdivides this into a lower part, "Piso Juliense," and an upper part, "Piso Leonense." The upper division he calls by the name of "Suprapatagonian" beds, and separates it from the Patagonian formation, making it a subdivision, "Piso Suprapatagonico," of the Santacruzian *formation*. V. Ihering follows him in this arrangement, and gives "Santacruzian formation" as the horizon for all marine "Suprapatagonian" fossils. (It is well to bear in mind that v. Ihering's "Santacruzian" means the same as Ameghino's "Suprapatagonian.")

As Hatcher (1900 a, p. 99, ff., and 1900 b, p. 263, ff.) has repeatedly indicated in his preliminary publications, he has failed entirely to verify these subdivisions of the marine beds underlying the typical (non-marine) Santacruzian beds, and he was unable to find any stratigraphical evidence for them, and I shall endeavor here to show *that the palæontological material collected also fails to warrant any subdivisions of this marine series.*

In order to demonstrate this, we must choose the type-locality at the mouth of the Santa Cruz river and its fauna as a starting point. According to Hatcher (1900 b), the deposits at this locality consist of several hundred feet of soft sand and clays, often filled with hard concretions, and interrupted occasionally by a stratum of hard sandstone. The fossils are found both in the loose material and in the harder concretions.

The following is the list of all fossils recorded from this locality:

1. *Cidaris antarctica.*
2. *Schizaster ameghinoi.*
3. *Aspidostoma giganteum.*
4. *Reticulipora patagonica.*
5. *Tennysonia subcylindrica.*
6. *Rhynchonella plicigera* (v. Ih.).
7. *Terebratella dorsata* var.
8. *Terebratella patagonica.*
9. *Nucula patagonica.*
10. *Nucula reticularis.*
11. *Leda glabra* (Sow., v. Ih.).
12. *Leda oxyrhyncha.*
13. *Leda errazurizi.*
14. *Malletia ornata.*
15. *Cucullæa alta.*
16. *Cucullæa darwini.*
17. *Limopsis insolita.*
18. *Arca patagonica.*
19. *Glycimeris ibari.*
20. *Perna quadrisulcata.*
21. *Ostrea ingens.*
22. *Pecten proximus.*
23. *Pecten prænuncius.*
24. *Pecten geminatus.*
25. *Pinna semicostata* (v. Ih.).
26. *Mytilus cf. chorus* (v. Ih.).
27. *Crassatellites lyelli.*
28. *Crassatellites kokeni.*
29. *Crassatellites quartus.*
30. *Cardita elegantoides.*
31. *Cardita inæqualis.*
32. *Cardita patagonica.*
33. *Lucina promaucana.*
34. *Lucina ortmanni.*
35. *Cardium philippii.*
36. *Cardium puelchum.*
37. *Cardium pisum.*
38. *Amathusia angulata.*

39. *Venus meridionalis.*
40. *Venus volckmanni.*
41. *Venus patagonica* (Phil., v. Ih.).
42. *Venus darwini.*
43. *Venus navidadis.*
44. *Dosinia meridionalis.*
45. *Dosinia læviuscula.*
46. *Tellina tehuelcha* (v. Ih.).
47. *Tellina jeguaënsis.*
48. *Tellina santacruzensis* (v. Ih.).
49. *Psammobia patagonica.*
50. *Mactra darwini.*
51. *Corbula hatcheri.*
52. *Panopea regularis.*
53. *Panopea quemadensis.*
54. *Panopea nucleus* (v. Ih.).
55. *Martesia patagonica.*
56. *Martesia pumila.*
57. *Dentalium sulcosum.*
58. *Liotia scotti.*
59. *Leptothyra philippii.*
60. *Solariella dautzenbergi.*
61. *Calliostoma peraratum.*
62. *Calliostoma cossmanni.*
63. *Calliostoma santacruzense.*
64. *Calliostoma garretti.*
65. *Calliostoma iheringi.*
66. *Gibbula lævis.*
67. *Gibbula dalli.*
68. *Gibbula diametralis.*
69. *Odontostomia suturalis.*
70. *Scalaria rugulosa.*
71. *Infundibulum corrugatum.*
72. *Infundibulum clypeolum.*
73. *Sigapatella americana.*
74. *Crepidula gregaria.*
75. *Natica ovoidea.*
76. *Natica secunda.*
77. *Natica darwini.*
78. *Natica subtenuis.*
79. *Natica consimilis.*
80. *Turritella ambulacrum.*
81. *Turritella breantiana.*
82. *Turritella patagonica.*
83. *Aporrhais araucana.*
84. *Struthiolaria ameghinoi.*
85. *Struthiolaria ornata.*
86. *Dolium ovulum.*
87. *Pyrola carolina.*
88. *Tritonium bicegoi.*
89. *Tritonium morgani.*
90. *Buccinum annæ.*
91. *Buccinum obesum.*
92. *Chrysodomus cancellatus.*
93. *Chrysodomus pilsbryi.*
94. *Siphonalia domeykoana.*
95. *Trophon patagonicus.*
96. *Urosalpinx elegans.*
97. *Urosalpinx cossmanni.*
98. *Fusus torosus.*
99. *Marginella gracilior.*
100. *Marginella plicifera.*
101. *Marginella olivella.*
102. *Voluta triplicata.*
103. *Voluta gracilior.*
104. *Voluta petersoni.*
105. *Voluta dorbignyana.*
106. *Voluta domeykoana.*
107. *Cancellaria gracilis.*
108. *Cancellaria cf. medinæ.*
109. *Cancellaria vidali* (Phil.).
110. *Terebra costellata.*
111. *Pleurotoma subæqualis.*
112. *Pleurotoma unifascialis.*
113. *Genota cuevensis.*
114. *Drillia santacruzensis.*
115. *Borsonia patagonica.*
116. *Bulla patagonica.*
117. *Geryon peruvianus.*

The question arises, which one of Ameghino's subdivisions is represented in this fauna. According to Mr. Hatcher, this fauna is a unit stratigraphically, and no subdivisions are possible; he tried at first, in collecting, to distinguish different horizons, but soon found that this was impossible. That this is not due to defective observation, will be shown further on, and it will be demonstrated, that the palæontological characters given by Ameghino do not hold good in the face of a careful comparison with our material.

Ameghino (1899) gives the following characteristic fossils for his subdivisions.

Piso Juliense:

Hypechinus patagonensis.
Echinarachnius juliensis (= *Scutella patagonensis*).
Schizaster ameghinoi.
Terebratula patagonica (= *Terebratella p.*).
Rhynchonella plicigera.
Bouchardia zitteli.
Pecten geminatus.
Pecten prænuncius.
Siphonalia noachina.

Piso Leonense:

Ostrea percrassa (= *O. ingens*).
Perna quadrisulcata.
Cucullæa alta.
Turritella argentina (= *T. ambulacrum*).
Struthiolaria ornata.

Piso Suprapatagonico:

Ostrea patagonica (= *O. ingens*).
Pecten quemadensis (= *P. geminatus*).
Cytherea splendida (= *Meretrix iheringi*).
Amathusia angulata.
Dentalium octocostatum (= *D. octocostellatum*).
Voluta ameghinoi.

It is most important to know, where we are to look for the type-localities of these divisions. In this respect Ameghino is remarkably careless; indeed, he does not say in any case, what we are to take for typical representations of his divisions, and thus we have to guess, or rather to infer from the names given, which one is the locality intended in each case. The *Piso Juliense* is apparently called after *San Julian*, and this we must take for the type-locality of it (see below). The *Piso Leonense* has been named apparently from *Mt. Leon* at the mouth of the Santa Cruz River, and thus those beds, of which the list of fossils is given above, are to be taken as representation of this division. And indeed, all five species, mentioned by Ameghino as characteristic of this subdivision, have been found at the mouth of the Santa Cruz River, and further, since two of them, *Cucullæa alta* and *Struthiolaria ornata*, have been found nowhere else, it is beyond doubt *that we must take the mouth of the Santa Cruz River as the type-locality for the Leonense beds.*[1]

As regards the *Suprapatagonian beds*, Ameghino does not take the trouble to give the slightest hint as to a type-locality. Species coming from this subdivision are given by v. Ihering chiefly from two places called "La Cueva" and "Jegua quemada." The geographical position of these places is not given, and Mr. Hatcher—although trying to do so—was not able to locate them, when he was at Santa Cruz. Thus the only way left is to try to identify the Suprapatagonian beds according to the characteristic fossils given, but—as we shall see below—this has proved to be a complete failure.

V. Ihering recognized the importance of the establishment of a type-locality, and the careful registering of the fossils found there. He sent his collector, Mr. Bicego, to Santa Cruz, and tried to get as many fossils as possible from this old type-locality of Patagonian beds. The result of these investigations was published in the paper of 1899. V. Ihering here gives a list of the fossils found at Santa Cruz, and by comparing them with those recorded by him—on the authority of Ameghino—from the Suprapatagonian beds, gives (l. c., p. 38) a list of the characteristic fossils from both the Patagonian and Suprapatagonian beds.

According to him, the following species found at Santa Cruz must be taken as characteristic of the *Patagonian formation*, since they never have been found in what Ameghino calls Suprapatagonian beds):[2]

Cucullæa alta.
Pecten fissicostalis (= *P. geminatus*).
Cardita patagonica (= *C. inæqualis*).
Lucina ortmanni.
Cardium puelchum.
Venus patagonica.
Dosinia læviuscula.
Struthiolaria ornata.
Siphonalia dilatata (= *S. domeykoana*).

For the *Suprapatagonian beds* he gives the following characteristic fossils, which—according to him—have never been found at Santa Cruz:

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[1] The manner in which Ameghino distorts facts in order to suit his preconceived theories is simply astonishing. In 1899 (p. 12) he says—in discussing the section of Punta Arenas discovered by Hatcher and described by the present writer—that the fauna of his Piso Leonense is known only in small part, while, as has been demonstrated above, this fauna must be identical with that of the type-locality of the whole of the Patagonian beds at Santa Cruz, and this fauna, indeed, is the *best known* part of the Patagonian fauna.

[2] I omit *Siphonalia noachina*, since this has never been found at Santa Cruz, and also *Voluta alta*, since this species is altogether doubtful (see p. 231).

Cucullaria tridentata (= *Cucullæa darwini*).
Arca patagonica.
Pecten centralis (= *P. proximus*).
Lucina promaucana.
Amathusia angulata.
Dosinia meridionalis.
Scalaria rugulosa.
Natica solida (= *N. darwini*).
Struthiolaris ameghinoi.
Marginella quemadensis.
Marginella confinis.
Marginella gracilior.
Marginella plicifera.
Voluta ameghinoi.

Of the 117 species found at the type-locality of Santa Cruz (see our list, p. 266 f.) the following are mentioned in v. Ihering's list of characteristic Patagonian fossils:

Cucullæa alta.
Pecten geminatus.
Cardita inæqualis.
Lucina ortmanni.
Cardium puelchum.
Venus patagonica.
Dosinia læviuscula.
Struthiolaria ornata.
Siphonalia domeykoana.

These are nine species (all of those mentioned by v. Ihering), eight of which also occur in our collections, only *Venus patagonica* not being represented.

On the other hand, of v. Ihering's characteristic Suprapatagonian fossils the following have been found at Santa Cruz, according to our collection:

Cucullæa darwini.
Arca patagonica.
Pecten proximus.
Lucina promaucana.
Amathusia angulata.
Dosinia meridionalis.
Scalaria rugulosa.
Natica darwini.
Struthiolaria ameghinoi.
Marginella gracilior.
Marginella plicifera.

That is to say, all the characteristic Suprapatagonian species, with only three exceptions (*Marginella quemadensis* and *confinis*, *Voluta ameghinoi*) have been found here.

This result shows at a glance, that v. Ihering's list of characteristic fossils for both supposed formations does not hold good.

Comparing Ameghino's characteristic fossils with our list of the Santa Cruz fauna we find the following species represented there:

Juliense species:

Schizaster ameghinoi.
Terebratella patagonica.
Pecten prænuncius.
Pecten geminatus.
4 out of 9.

Leonense species:

Ostrea ingens.	all of them.
Perna quadrisulcata.	
Cucullæa alta.	
Turritella ambulacrum.	
Struthiolaria ornata.	

Suprapatagonian species:

Ostrea ingens.	3 out of 6.
Pecten geminatus.	
Amathusia angulata.	

This gives about the same result, although the fact is remarkable that of the Leonense species (5) all are found at Santa Cruz, of the others only a part.

Thus we see, that—taking together all the forms mentioned by both, Ameghino and v. Ihering—there are, at the type-locality of the Patagonian beds, *15 Patagonian species*, namely:

Schizaster ameghinoi.
Terebratella patagonica.
Cucullæa alta.
Perna quadrisulcata.
Ostrea ingens.
Pecten prænuncius.
Pecten geminatus.
Cardita inæqualis.
Lucina ortmanni.
Cardium puelchum.
Venus patagonica.
Dosinia læviuscula.
Turritella ambulacrum.
Struthiolaria ornata.
Siphonalia domeykoana.

At the same time, *13 Suprapatagonian species* are found there, namely

Cucullæa darwini.
Arca patagonica.
Ostrea ingens.
Pecten proximus.
Pecten geminatus.
Lucina promaucana.
Amathusia angulata.
Dosinia meridionalis.
Scalaria rugulosa.
Natica darwini.
Struthiolaria ameghinoi.
Marginella gracilis.
Marginella plicifera.

These facts would make the locality at Santa Cruz as well Patagonian as Suprapatagonian, and *suggests strongly the identity of both.*

On the other hand, we have seen that the so-called "Leonense" species of Ameghino are all (5) found at Santa Cruz, while only a part of the "Juliense" (4 out of 9) have been found there. Of the remaining 5 Juliense species, however, 3 have been found at San Julian (*Hypechinus patagonensis, Scutella patagonica, Siphonalia noachina*) by Mr. Hatcher. We shall discuss this fact later.

2. Comparison of Other Localities with the Type Fauna at Santa Cruz.

(In the following *P* means characteristic Patagonian, according to v. Ihering; *S* means characteristic Suprapatagonian, according to Ameghino or v. Ihering; *J* means characteristic Juliense, according to Ameghino; *L* means characteristic Leonense, according to Ameghino.)

Pescadores, Rio Santa Cruz; ca. 50′ above high tide.

Only *Ostrea ingens* has been found here.

Paso del Rio Santa Cruz: 2 miles above Las Salinas (see below), at about high tide level.

J Schizaster ameghinoi.
J Terebratella patagonica.
Malletia ornata.
L & S Ostrea ingens.
S Lucina promaucana.
L Turritella ambulacrum.
Turritella breantiana.
Turritella patagonica.
L Struthiolaria ornata.

All of these 9 species are found at Santa Cruz, and 5 of them are Patagonian, 2 of which are Juliense, and 3 Leonense, while 2 are Suprapatagonian. Since this locality represents a very low horizon, close to the water's edge of the Santa Cruz River and the sea, the presence of Leonense and Suprapatagonian species is very significant.

Las Salinas; 30 miles above mouth of Santa Cruz River, ca. 200′ above high tide.

J Rhynchonella plicigera.
S Cucullæa darwini.
Limopsis insolita.
P Cardita inæqualis.
P Cardium puelchum.
Venus meridionalis.
Psammobia patagonica.
Martesia patagonica.
L Turritella ambulacrum.
Turritella breantiana.
L Struthiolaria ornata.
P Siphonalia domeykoana.

All of these 12 species were found at Santa Cruz. This locality is at a much higher level than Paso del Rio Santa Cruz, but has 3 fossils in common with it (*Turritella ambulacrum* and *breantiana*, *Struthiolaria ornata*), two of which are Leonense according to Ameghino. 6 specimens are Patagonian, 1 of which is Juliense, while 2 are Leonense. *Cucullæa darwini* is a Suprapatagonian fossil according to v. Ihering. Thus we have here a mixture of fossils from all three subdivisions.

Mount of Observation, lower horizon; from between tides to 25′ above tides.

L & S *Ostrea ingens.*
L *Cucullæa alta.*
L *Turritella ambulacrum.*
Turritella breantiana.
Geryon peruvianus.

The prevalence of Leonense species is opposed to the low level to which this locality belongs, especially when we come to compare it with the upper horizon at the same locality. All 5 species are found at Santa Cruz.

Mount of Observation, upper horizon; 25–150′ above tides.

J * *Terebratella patagonica.*
* *Nucula reticularis.*
S * *Arca patagonica.*
L & S * *Ostrea ingens.*
Modiola ameghinoi.
* *Cardita elegantoides.*
P * *Cardita inæqualis.*
P * *Cardium puelchum.*
* *Venus meridionalis.*
* *Mactra darwini.*
Mactra garretti.
* *Corbula hatcheri.*
* *Martesia patagonica.*
S *Dentalium octocostellatum.*
Calliostoma observationis.
Turbonilla cuevensis.
S * *Scalaria rugulosa.*
* *Infundibulum corrugatum.*
J *Siphonalia noachina.*
S *Voluta ameghinoi.*
* *Cancellaria gracilis.*
* *Cancellaria cf. medinæ.*
Actæon semilævis.
Balanus varians.

Of these 24 species, 15 are found at Santa Cruz (those marked *). This horizon would correspond to about the middle of the series at Santa Cruz; nevertheless it contains 2 distinctly Juliense, and no less than 5 Suprapatagonian species, while Leonense species are hardly represented.

On the other hand, 9 species are found here, which have not been found at Santa Cruz. These, however, cannot be taken as representing a "Suprapatagonian" fauna. 6 of them are either new species, or have not been found elsewhere; of the rest 2 are found at San Julian (see below) at a much lower level (*Siphonalia noachina* and *Balanus varians*), and *V. ameghinoi* has been found at Lake Pueyrredon, 600′ above base of Tertiary. That this latter locality cannot be regarded as Suprapatagonian will be demonstrated below.

According to stratigraphical evidence, we are to expect that this locality should belong to the upper Juliense or Leonense division of the Patagonian beds: instead of that, Suprapatagonian species prevail, while a few Juliense are intermingled with them. Thus it is impossible to say, to which of Ameghino's and v. Ihering's subdivisions the beds of this locality are referable.

All the foregoing localities resemble more or less in the state of preservation of the fossils and in the matrix the type-locality at Santa Cruz, and, indeed, geographically, they are not far distant from it. The first locality that differs in the character of the deposits is the next, near San Julian.

San Julian, Oven Point; near the water's edge, not over 10′ above high tide. This horizon is distinctly lower than any of the beds at Santa Cruz. Facies: sandy, with shell-fragments.

*Cidaris antarctica.
Toxopneustes præcursor.
J Scutella patagonica.
J *Schizaster ameghinoi.
Serpula patagonica.
Terebella magna.
*Aspidostoma giganteum.
Heteropora pelliculata.
J *Terebratella patagonica.
L & S *Ostrea ingens.
J & S Pecten geminatus.
Mytilus magellanicus.
*Gibbula lævis.
*Infundibulum corrugatum.
*Turritella patagonica.
S *Struthiolaria ameghinoi.
J Siphonalia noachina.
*Trophon patagonicus.
*Voluta gracilior.
Balanus varians.

Although this locality represents the lowermost horizon of the whole series known on the coast of Patagonia; we have here no less than 3 species, which are Suprapatagonian, according to Ameghino and v. Ihering. For the rest, Juliense species prevail. Of the 20 species, 12 (marked *) have been found at Santa Cruz.

San Julian, Darwin Station; at a higher horizon than Oven Point. Matrix resembling that of Santa Cruz. This horizon seems to be about the same as the lowermost part of the Santa Cruz section.

*Cidaris antarctica.
J Hypechinus patagonensis.
Serpula patagonica.
J *Terebratella patagonica.
Heteropora pelliculata.
J *Pecten prænuncius.
J & S *Pecten geminatus.
*Corbula hatcheri.
*Panopea regularis.
*Panopea quemadensis.
*Dentalium sulcosum.
S *Scalaria rugulosa.
*Natica ovoidea.
*Turritella sp.
Vermetus incertus.
S *Struthiolaria ameghinoi.
*Pyrula carolina.
J Siphonalia noachina.
Murex hatcheri.
*Trophon patagonicus.
Fusus archimedis.
*Voluta gracilior.
*Cancellaria gracilis.
Scalpellum juliense.
Balanus varians.
*Geryon peruvianus.

Of these 26 species, 17 are also found at Santa Cruz (marked *). Again here, Juliense species prevail; typical Leonense species are wanting, but 3 characteristic Suprapatagonian species are present.

It is impossible to decide which one of these two localities near San Julian is to be regarded as the type-locality of Ameghino's "Piso Juliense." Both contain a number of Juliense fossils (each 5), of which 3 (_Terebratella patagonica, Pecten geminatus, Siphonalia noachina_) have been found at both. The fact that the matrix at Darwin Station approaches more that of the mouth of the Santa Cruz River, is expressed in the higher percentage of species that are also found at Santa Cruz, although this difference from Oven Point is very slight.

Both San Julian localities have 9 species in common, but the abundance of the respective species at each locality is very different. Taking together these two localities, we may regard them as the type of the Juliense beds, since 7 of the 9 species mentioned by Ameghino have been found here. But the fact, that 1 Leonense (*Ostrea ingens*), and 4 Suprapatagonian species (*Ostrea ingens*, *Pecten geminatus*, *Scalaria rugulosa*, *Struthiolaria ameghinoi*) have been found here, strongly points to the conclusion, that these beds also represent what Ameghino calls "Suprapatagonian."

Two more localities on the coast are: *Port of Deseado* (Port Desire), which has yielded only *Pecten cf. centralis*, and *Port Madryn* (New Bay, Terr. Chubut), which has yielded *Ostrea ingens* from two horizons: between tides, and 25′ above high tide.

The following localities are situated more or less inland: they all have a sandy facies, and often the matrix is composed of fragments of shells.

Shore of Salt Lake, 10 miles north of the mouth of Rio Chico; near the base of the series, within 50′ above barren Cretaceous sandstones.

J *Scutella patagonensis.*
J **Terebratella patagonica.*
L & S **Ostrea ingens.*

Even among this small number of species, a Leonense and Suprapatagonian is associated with two Juliense.

Upper Rio Chalia; beds immediately underlying the Santacruzian beds, containing mammals. Top of marine series.

J *Scutella patagonensis.*
Melicerita triforis.
J **Terebratella patagonica.*
**Glycimeris ibari.*
L & S **Ostrea ingens.*
**Mytilus cf. chorus.*
S **Lucina promaucana.*
**Venus navidadis* (?).
S **Dosinia meridionalis* (?).
**Panopea quemadensis.*
Fissurella eurytreta.
**Gibbula dalli.*
S **Scalaria rugulosa.*
**Crepidula gregaria.*
L **Turritella ambulacrum.*
**Voluta gracilior.*
**Voluta dorbignyana.*
Verruca lævigata.
Balanus varians.

These beds which are undoubtedly near the extreme top of the marine series, and which ought to be, according to stratigraphical evidence, Suprapatagonian, contain—among 19—no less than 14 species, which have been found also at Santa Cruz (marked *). 4 of the species are characteristic Suprapatagonian, while 4 are Patagonian (2 Juliense and 2 Leonense). The presence of 7 species in these beds (*Scutella patagonensis*, *Terebratella patagonica*, *Ostrea ingens*, *Panopea quemadensis*, *Scalaria rugulosa*, *Voluta gracilior*, *Balanus varians*) is most significant, since these have been found also in the lowermost beds of the whole series at San Julian.

Thus the palæontological evidence—if we follow Ameghino's divisions—is in conflict with the stratigraphical.

30 miles north of upper Rio Chalia; beds corresponding to the last locality: immediately below Santacruzian beds, top of marine series.

* *Cidaris anatarctica.*
J *Scutella patagonensis.*
J * *Terebratella patagonica.*
* *Glycimeris ibari.*
L & S * *Ostrea ingens.*
* *Psammobia patagonica.*
* *Panopea quemadensis.*
S * *Scalaria rugulosa.*
* *Infundibulum corrugatum.*
S * *Natica darwini.*
L * *Turritella ambulacrum.*
* *Turritella patagonica.*
S * *Struthiolaria ameghinoi.*
* *Trophon patagonicus.*
Balanus varians.

Although this list differs a little from that of the last locality (8 species in common), there is much resemblance between both as regards matrix, etc., indeed, both belong apparently to about the same level in the marine series.

Of these 15 species, 13 have been found at Santa Cruz (marked *); 4 are characteristic Suprapatagonian, while 4 are Patagonian (2 Juliense and 2 Leonense). The conclusions are identical with those drawn from the last locality.

Cañon near Sierra Oveja, Rio Chico; extreme top of the series: these beds are interstratified with Santacruzian beds containing Mammalian remains.

J * *Terebratella patagonica.*
L & S * *Ostrea ingens.*
J & S * *Pecten geminatus.*
P * *Cardium puelchum* (?).
S * *Scalaria rugulosa.*
J *Siphonalia noachina.*

These beds, which ought to be, by all means, Suprapatagonian, contain only a single form that is characteristic of the Suprapatagonian beds, while 2 species are found in both Patagonian and Suprapatagonian, and 2, *Terebratella patagonica* and *Siphonalia noachina*, at the base of the series, in the "Piso Juliense" of Ameghino. The presence of these two species at this locality is entirely opposed to Ameghino's conception of Patagonian and Suprapatagonian beds.

At the same locality 100-150′ below the fossils mentioned above, have been found Mammalian bones associated with _Leda errazurizi_ (?).

Shell Gap, Rio Chico, lower horizon.

Toxopneustes praecursor.
Cellaria fistulosa.
_L & S_ *_Ostrea ingens._
_J & S_ *_Pecten geminatus._

The list is too small to permit any conclusions. _Toxopneustes præcursor_ is also from the lowermost beds of the marine series at San Julian.

Shell Gap, Rio Chico, upper horizon; 150–200′ above lower horizon.

J Scutella patagonensis.
_J_ *_Rhynchonella plicigera._
*_Terebratella dorsata._
_J_ *_Terebratella patagonica._
_P_ *_Cardium puelchum_ (?).
*_Venus meridionalis_ (?).
*_Venus volckmanni_ (?).
*_Tellina tehuelcha._
*_Mactra darwini._
*_Martesia patagonica._
*_Gibbula dalli._
*_Infundibulum corrugatum._
Galerus araucanus.
Vermetus cf. intortus.
_S_ *_Struthiolaria ameghinoi._
Balanus varians.

Of these 16 species, 12 have been found at Santa Cruz. 4 are characteristic Patagonian (mostly Juliense) fossils, while one is Suprapatagonian. This locality offers in matrix, etc., a striking resemblance to that of the upper Rio Chalia and 30 miles north of it, and 6 of the species have also been found there. Petrographically and stratigraphically, these beds would belong near the top of the series, while palæontological evidence points partly to the identity with the beds of the upper Rio Chalia, partly to a lower position, near the base of the series.

Mayer basin; upper Lignites, below Patagonian beds.

Ostrea ingens has been found here, and indeterminable remains of other Bivalves, possibly of a _Mytilus._

Arroyo Gio; ca. 100 feet marine beds, between barren Cretaceous sandstones and Santacruzian beds; sandy facies.

Heteropora pelliculata.
*_Leda oxyrhyncha._
*_Leda errazurizi._
_S_ *_Arca patagonica._
*_Glycimeris ibari._
_L & S_ *_Ostrea ingens._
_J & S_ *_Pecten geminatus._
*_Cardium philippii_ (?).
*_Cardium pisum._
_S_ *_Dosinia meridionalis._
*_Tellina jeguaënsis._
*_Psammobia patagonica._
S Dentalium octocostellatum.
*_Gibbula dalli._
Crucibulum dubium.
*_Crepidula gregaria._
_L_ *_Turritella ambulacrum._
*_Voluta gracilior._
*_Bulla patagonica._

Casts of indeterminable species of _Natica, Marginella_ and _Bivalves._

Of these 19 species, 16 (marked *) are found at Santa Cruz, which would make these beds identical with those of the type-locality. The fact, that Juliense, Leonense, and Suprapatagonian species—although only a few of each category—are associated here, is in so far interesting, as it shows that these three supposed different divisions are condensed here into only 100 feet.

LAKE PUEYRREDON.

East end of Lake Pueyrredon; horizon not ascertained.

J *Rhynchonella plicigera.
*Terebratella dorsata.
L & S *Ostrea ingens.
J & S *Pecten geminatus.
*Cardium philippii.

All of these 5 species have been recorded from Santa Cruz, and, although the number of species is very small, we have a mixture of Patagonian and Suprapatagonian forms. According to the matrix and the species found, this horizon seems to correspond to the lowermost of the Rio Tarde section (see below).

High bluffs, S. W. of Lake Pueyrredon; horizon not ascertained, but about 1000′ below Santacruzian beds.

J *Rhynchonella plicigera.
Rhynchonella squamosa.
Magellania lenticularis.
J *Terebratella patagonica.
Gryphæa cf. tarda.

This horizon also seems to correspond to the lowermost of the Rio Tarde section.

LAKE PUEYRREDON, RIO TARDE SECTION, 700′ thick (see Hatcher, 1900 a, p. 100).

Base of marine Tertiary: The lowermost beds of the Rio Tarde section, immediately overlying a basaltic deposit that lies on top of the barren Cretaceous sandstones.

*Cidaris antarctica.
J Scutella patagonensis.
Cyrtoma posthumum.
J *Rhynchonella plicigera.
Rhynchonella squamosa.
Magellania lenticularis.
*Terebratella dorsata.
J *Terebratella patagonica.
J Bouchardia zitteli.
*Glycimeris ibari.
L *Perna quadrisulcata.
L & S *Ostrea ingens.
J & S *Pecten geminatus.
Modiola andina.
Crassatellites longior.
*Cardium philippii.
*Cardium pisum.
*Venus volckmanni.
*Panopea regularis.
*Panopea quemadensis.
*Dentalium sulcosum.
*Gibbula lævis.
S *Scalaria rugulosa.
L *Turritella ambulacrum.
S *Struthiolaria ameghinoi.
*Trophon patagonicus.
Urosalpinx pyriformis.
Balanus cf. psittacus.
Balanus varians.

Of these 29 species, 19 have been found at Santa Cruz. This horizon, the lowermost in this section, ought to be Juliense, and, indeed, it contains 5 Juliense species; but this conclusion is entirely upset by the fact that 3 Leonense and 4 Suprapatagonian species are also represented here.

400′ above base.

Only *Modiola andina* has been collected here.

600′ above base (or 100′ below top of marine series).

*Terebratella dorsata.
J *Terebratella patagonica.
*Nucula patagonica.
*Leda errazurizi.
*Glycimeris ibari.
L *Perna quadrisulcata.
L & S *Ostrea ingens.
J & S *Pecten geminatus.
Modiola andina.
*Crassatellites quartus.
Cardita volckmanni.
*Cardium philippii.
*Venus meridionalis.
*Venus volckmanni.
Mactra garretti.
*Panopea regularis.
*Panopea quemadensis.
*Martesia patagonica.
*Solariella dautzenbergi.
*Gibbula lævis.
*Gibbula dalli.
*Infundibulum corrugatum.
Galerus araucanus.
L *Turritella ambulacrum.
Vermetus cf. intortus.
S *Struthiolaria ameghinoi.
*Pyrula carolina.
J Siphonalis noachina.
*Trophon patagonicus.
S Voluta ameghinoi.
*Terebra costellata.
*Geryon peruvianus.

The comparison of this locality with others is very important and interesting. About half (15) of the number of species are identical with those of the lowermost horizon of this section, although both are separated from each other by almost 600 feet of deposit. In this locality, out of 32 species, 25 are common to the type-locality at Santa Cruz, and this shows conclusively that the three (Santa Cruz, lower and upper horizon of Rio Tarde section) cannot be separated, and further, it shows that at Santa Cruz no two or more horizons can be represented, since the latter section comprises only about 250 feet, while here, at 600 feet above the base, still an unmistakable Patagonian fauna (as found at Santa Cruz) is present. Comparing our list with the subdivisions of Ameghino and v. Ihering, we see that we have here again, at 600′ above the base, and 100′ below the top, where we should expect a characteristic Suprapatagonian fauna, a mixture of 3 Juliense, 3 Leonense, and 4 Suprapatagonian elements, a relation that has hardly changed from that found at the base of the Rio Tarde section.

Extreme top of marine series (Rio Tarde section).

Ostrea ingens has been found here in a form (see p. 109) that corresponds to *O. hatcheri*, which is found, according to v. Ihering and Ameghino, exclusively in the Leonense beds.

Punta Arenas, horizon V (uppermost). See the description of the Punta Arenas section, given by the writer, according to Hatcher's observations, 1898, p. 481.

Ameghino (1899, p. 13) has completely misunderstood, and arbitrarily changed the account the writer has given of this horizon. Hatcher labelled some oysters collected here: "below" and "above" V. This means only that this horizon begins, at the base, with an almost solid layer of oysters, then follows a layer of dark-greenish sand that contains the other fossils, which ends again, at the top, in a similar layer of oyster-shells. This whole horizon, including both oyster beds, is a *unit*, and there is no break at all. Nevertheless, Ameghino constructs an hiatus between the upper oyster layer and the rest, and correlates the former with his Tehuelche formation, the latter with the Suprapatagonian part of the Santacruzian formation. This assumption of an hiatus within our horizon V is entirely unwarranted, and characterizes Ameghino's manner of trimming facts to suit his theories, even without having seen the original locality.

We must take together all the fossils found here, and may mention only that *Ostrea ingens* occurs everywhere in this horizon (also in the sand between the two oyster beds), and that *Sigapatella* has been found only inside of oyster shells of the upper oyster bed. The latter consists of a form of *Ostrea ingens*, that resembles much the Cape Fairweather variety:

*_Glycimeris ibaria._
L & S *_Ostrea ingens._
S *_Lucina promaucana._
Venus chiloënsis.
S _Meretrix iheringi._
*_Crepidula gregaria._
*_Sigapatella americana._

Although very small, this list contains 5 species that are found at the type-locality at Santa Cruz (marked *). For the rest, so-called "Suprapatagonian" species prevail. *Ostrea ingens* is a Patagonian (Leonense) and Suprapatagonian species, and it is to be remarked, that the form *hatcheri*, which is said to be characteristic of the Leonense beds, has also been found here.

In conclusion, I add here a list of those species which have been ascertained to be present both near the base and near the top of the Patagonian series (as understood by us).

1. *Cidaris antarctica.* { base: San Julian.
top: 30 miles north of Rio Chalia.

2. *Scutella patagonensis.*	base: San Julian; Salt Lake; Lake Pueyrredon. top: Rio Chalia; 30 miles north of Rio Chalia.
3. *Rhynchonella plicigera.*	base: Lake Pueyrredon. top: Las Salinas; Shell Gap.
4. *Terebratella dorsata.*	base: Lake Pueyrredon. top: Shell Gap.
5. *Terebratella patagonica.*	base: San Julian; Salt Lake; Lake Pueyrredon. top: Rio Chalia; Lake Pueyrredon.
6. *Glycimeris ibari.*	base: Lake Pueyrredon. top: Rio Chalia; Lake Pueyrredon.
7. *Perna quadrisulcata.*	base: Lake Pueyrredon. top: Lake Pueyrredon.
8. *Ostrea ingens.*	base: San Julian; Salt Lake; Lake Pueyrredon. top: Rio Chalia; Sierro Oveja; Lake Pueyrredon.
9. *Pecten geminatus.*	base: San Julian; Lake Pueyrredon. top: Sierra Oveja; Lake Pueyrredon.
10. *Modiola andina.*	base: Lake Pueyrredon. top: Lake Pueyrredon.
11. *Lucina promaucana.*	base: Paso del Rio Santa Cruz. top: Rio Chalia.
12. *Cardium philippii.*	base: Lake Pueyrredon. top: Lake Pueyrredon.
13. *Cardium puelchum.*	base: Santa Cruz. top: Sierra Oveja.
14. *Venus volckmanni.*	base: Santa Cruz; Lake Pueyrredon. top: Lake Pueyrredon.
15. *Panopea regularis.*	base: San Julian; Lake Pueyrredon. top: Lake Pueyrredon.
16. *Panopea quemadensis.*	base: San Julian; Lake Pueyrredon. top: Rio Chalia; Lake Pueyrredon.
17. *Gibbula lævis.*	base: San Julian; Lake Pueyrredon. top: Lake Pueyrredon.
18. *Scalaria rugulosa.*	base: San Julian; Lake Pueyrredon. top: Rio Chalia; Sierra Oveja.
19. *Infundibulum corrugatum.*	base: San Julian. top: Rio Chalia; Lake Pueyrredon.
20. *Turritella ambulacrum.*	base: Santa Cruz; Lake Pueyrredon. top: Rio Chalia; Lake Pueyrredon.
21. *Turritella patagonica.*	base: Santa Cruz; San Julian. top: Rio Chalia.
22. *Struthiolaria ameghinoi.*	base: San Julian; Lake Pueyrredon. top: Rio Chalia; Lake Pueyrredon.

23. *Pyrula carolina.*	base: San Julian. top: Lake Pueyrredon.
24. *Siphonalia noachina.*	base: San Julian. top: Sierra Oveja; Lake Pueyrredon.
25. *Trophon patagonicus.*	base: San Julian; Lake Pueyrredon. top: Rio Chalia; Lake Pueyrredon.
26. *Voluta gracilior.*	base: San Julian. top: Rio Chalia.
27. *Balanus varians.*	base: San Julian; Lake Pueyrredon. top: Rio Chalia; Shell Gap.
28. *Geryon peruvianus.*	base: San Julian; Santa Cruz. top: Lake Pueyrredon.

We add the following species, which are either given as Suprapatagonian by v. Ihering, Cossmann or Ameghino, but found in our collection only near the base, or are given as Juliense by Ameghino or Patagonian by v. Ihering, but found in our collection at the top.

Suprapatagonian species, found at the base:

29. *Crassatellites longior*, Lake Pueyrredon, base.
30. *Amathusia angulata*, Santa Cruz, at water's edge.
31. *Urosalpinx pyriformis*, Lake Pueyrredon, base.

Patagonian species, found at the top:

32. *Mytilus cf. chorus*, Rio Chalia.
33. *Tellina tehuelcha*, Shell Gap.
34. *Psammobia patagonica*. Rio Chalia.
35. *Martesia patagonica*, Shell Gap, Lake Pueyrredon.
36. *Voluta dorbignyana*, Rio Chalia.

Finally, I give here the species which are recorded by v. Ihering as Patagonian *and* Suprapatagonian.

37. *Nucula patagonica.*
38. *Limopsis insolita.*
39. *Cardita inæqualis.*
40. *Cardita patagonica.*
41. *Venus meridionalis.*
42. *Infundibulum clypeolum.*
43. *Crepidula gregaria.*
44. *Natica secunda.*
45. *Natica consimilis.*
46. *Turritella breantiana.*
47. *Cancellaria gracilis.*

Of these 47 species, for which a *distribution from top to bottom of the series* is very probable, the following belong to Ameghino's or v. Ihering's characteristic fossils of their different subdivisions.

1. *J x Scutella patagonensis.*
2. *J Rhynchonella plicigera.*
3. *J x Terebratella patagonica.*
4. *L Perna quadrisulcata.*
5. *L & S x Ostrea ingens.*
6. *J & S x Pecten geminatus.*
7. *S Lucina promaucana.*
8. *P Cardium puelchum.*
9. *S Amathusia angulata.*
10. *S x Scalaria rugulosa.*
11. *L x Turritella ambulacrum.*
12. *S x Struthiolaria ameghinoi.*
13. *J Siphonalia noachina.*

This fact is the more important since just these species belong to the most striking and characteristic features of this series, especially those marked *x*.

Finally, I offer here a list of the so-called characteristic species of Juliense, Leonense, and Suprapatagonian beds, which have been found *associated in one and the same block:*

Darwin Station, San Julian:

J & S Pecten geminatus *J Pecten prænuncius.*

Mouth of Santa Cruz River:

Block 1:	*S Arca patagonica.*	*L Turritella ambulacrum.*	*L Struthiolaria ornata.*
Block 2:	*J Pecten prænuncius.*	*S Dosinia meridionalis.*	*S Struthiolaria ameghinoi.*
Block 3:	*J Terebratella patagonica.*	*S Amathusia angulata.*	*S Marginella plicifera.*
	S Arca patagonica.	*L Struthiolaria ornata.*	
Block 4:	*P Cardita inæqualis.*	*S Dosinia meridionalis.*	*S Struthiolaria ameghinoi.*
Block 5:	*S Cucullæa darwini.*	*L Turritella ambulacrum.*	
Block 6a:	*S Arca patagonica.*	*L Turritella ambulacrum.*	
Block 6b:	*S Arca patagonica.*	*P Cardita inæqualis.*	

Other instances, where Suprapatagonian species not recorded under the characteristic forms are found (at Santa Cruz) associated in the same block with Patagonian, are the following:

Block 7:	*S Leptothyra philippii* (Cossm.).	*L Turritella ambulacrum.*	*L Struthiolaria ornata.*
Block 8:	*S Leptothyra philippii.*	*L Turritella ambulacrum.*	
Block 9:	*S Bulla patagonica* (v. Ih.).	*J. Terebratella patagonica.*	

Leptothyra philippii is also found in block 5, *Bulla patagonica* in block 1, 2 and 4. *Nucula patagonica* (P) is in block 6b.

Mt. of Observation:

Block 10: *S Modiola ameghinoi.* *P Cardita inæqualis.*

Arroyo Gio:

Block 11: *J & S Pecten geminatus.* *S Dosinia meridionalis.* *L Turritella ambulacrum.*

Of the Santa Cruz blocks, all except 1 and 3 are still intact. 1 has been broken up completely, while of 3 a part remains intact.

This line of evidence demonstrates clearly that of the 36 characteristic species introduced by Ameghino and v. Ihering, at least 20 are to be dropped; of 13 of them it has been shown (see list, p. 283) that they are found anywhere within the marine series underlying the Santacruzian beds, and 7 more (aside from 5 that are included in these 13) have been found associated with each other in such a way in the matrix that they are to be looked for at any horizon within this series.

Of the remaining 16 species, 13 belong to the rarer forms, and, on that account, are unfit to be used as characteristic fossils; the remaining 3 are *Cucullæa alta*, *Dosinia læviuscula* and *Siphonalia dilatata*. These are said to be Patagonian (Leonense) species, and have been found exclusively in the neighborhood of the mouth of the Santa Cruz River. This fact—considering the close relations of the fauna of Santa Cruz to those of other localities—does not permit them to be used as characteristic fossils for any definite horizon, but rather demonstrates that they should be regarded as local elements of this particular locality (see p. 285).

Taking together all the foregoing considerations, we arrive at the following conclusions.

It is impossible to assign—according to the palæontological evidence—any of our Patagonian localities to any of the subdivisions distinguished by Ameghino. Not only are we unable to separate the Juliense and Leonense subdivisions of the "Patagonian formation," but also we are at a loss to draw a line between the "Patagonian formation," and the lower, marine part of the "Santacruzian formation," which has been called by Ameghino "Piso Suprapatagonico." This conclusion is fully supported by the stratigraphical observations made by Mr. Hatcher, who will elsewhere discuss this question from the point of view of stratigraphy.

The palæontological characters of the different subdivisions given by Ameghino and (following him) by v. Ihering are, accordingly, of no use, and have no significance at all. Patagonian and Suprapatagonian beds form a palæontological unit, with one and the same fauna going through from top to bottom, without any remarkable change.[1] *The terms "Supra-*

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[1] But slight traces of a change in the fossils have been noticed; see under *Ostrea ingens* and *Terrebratella patagonica*.

patagonian," "Juliense" and "Leonense" are consequently to be dropped, and the whole series should retain the old name: Patagonian beds.[1]

The contention of Ameghino that there is an hiatus in time between Patagonian and Suprapatagonian beds, is completely erroneous. (See Hatcher, 1900 a, p. 100.)

Nevertheless, differences in the fauna are recognizable in different localities. This refers especially to the fauna of the typical beds at Santa Cruz. Some of the most characteristic species (for instance *Cucullæa alta*, *Struthiolaria ornata*, *Siphonalia domeykoana*) have been found nowhere else in Patagonia, while they are abundant at Santa Cruz (including Mt. of Observation, Las Salinas, etc.). This fact, in my opinion, is due to the different development of the *facies*. The region around the mouth of the Santa Cruz River is distinguished from the rest by its facies. (See Hatcher, 1900 b, p. 264.) All other localities have a more or less sandy facies, often changing into a shell breccia, and these deposits apparently were laid down in very shallow water, close to the shore, at any rate, in shallower water than the deposits at the mouth of the Santa Cruz River. This would sufficiently explain the slight differences of the respective faunas.

Geographically, the sandy facies seems to extend over all the country from the coast of San Julian to the Cordilleras, and southward to Punta Arenas. The clay deposits with concretions have only a local development, near the mouth of the Santa Cruz River.

Ameghino's "Piso Juliense" represents the local fauna of San Julian; his "Piso Leonense" that of the mouth of the Santa Cruz River.

The Patagonian beds, as understood here, were deposited in many localities (observed at: Salt Lake, Arroyo Gio, Lake Pueyrredon) on the eroded surface of the barren sandstones of the Guaranitic beds (see Hatcher, 1900 a, pp. 93 and 108; at Lake Pueyrredon there is a basaltic layer between both). In other places they overly other Tertiary beds, but there are only two localities where this has been observed: Mayer Basin, where the Upper Lignites are below them, and especially Punta Arenas, where the Magellanian series precedes them in time, consist-

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[1] The question remains whether we ought to call these beds by that name at all. The older writers, especially d'Orbigny, understood under "Patagonian beds" deposits of a different age, and the fact is, that most of d'Orbigny's Patagonian fossils do not belong to what is now called by that name; they come chiefly from Entrerios and the region of the Rio Negro.

ing of the marine Magellanian beds and the Upper Lignites (see Ortmann, 1898, p. 481 and 1899, p. 457, and Hatcher, 1900 a, p. 97). At the top, the Patagonian beds pass gradually into the typical Santacruzian beds containing Mammalian remains, which, at their base, are sometimes interstratified with the uppermost Patagonian beds (Hatcher, 1900 a, p. 105). The contact of both has been observed: in the region of the upper Rio Chalia, Arroyo Gio, Lake Pueyrredon; interstratification has been observed in the Cañon near Sierra Oveja, Rio Chico.

THE AGE OF THE PATAGONIAN BEDS.

1. COMPARISON OF THE PATAGONIAN FAUNA WITH FAUNAS OF THE NORTHERN HEMISPHERE.

The conflicting opinions as to the age of the Patagonian beds have been shortly mentioned by Mr. Hatcher (1900 a, p. 103). For the sake of completeness we give here the different opinions of the various writers.

Darwin (1846, pp. 118 and 134) believes them to be *older Tertiary*, probably Eocene.

D'Orbigny (Cours élémentaire de Paléontologie et de Géologie, v. 2, 1852, p. 750) puts them in his Falunien stage (*Miocene*), but it should be remembered that D'Orbigny's material came chiefly from the northern parts of Argentina (Entrerios, Rio Negro), and it seems that these beds are much younger.

The position in the *older Tertiary*, without reference to any particulars, has been the accepted one afterward.

Doering (1882) was the next to take up this question, but he was much handicapped by a serious mistake as to the proper succession and correlation of the different deposits of Patagonia. He uses the term "Patagonian formation" for a series of marine and freshwater beds, which he places in the *Oligocene* and *Upper Eocene*. It is hard to say which of his three subdivisions (Piso Paranense, Mesopotamico, and Patagonico) corresponds to actual deposits, since in all three of them apparently different faunas are confused, but, as far as can be made out, the *Piso Paranense* has for its type what is now called by the same name (Entrerios), the *Piso Patagonico* includes the classic locality for the marine Patagonian beds at Santa Cruz, and the *Piso Mesopotamico* is a mixture of fresh-water beds of the northern and southern parts of Argentina. In the latter he places the beds containing *Astrapotherium*, and thus we may say that the sequence (beginning at the base): *Paranense, Mesopotamico, Patagonico,* is exactly the opposite of the actual conditions, and that Doering in the first line is responsible for the inversion of the true succession of the respective beds.

Ameghino (1889) closely follows Doering, and although he introduces a few changes, he perpetuates the fundamental mistake of Doering in leaving the Patagonian beds at the top of the series; and further, he adds considerably to the confusion in creating, below Doering's "Patagonian formation," a new formation called "Santacruzian," consisting of an upper, fresh water, deposit (Piso Santacruzeno), and a lower, marine, deposit (Piso Subpatagonico), to which he assigns the respective ages of *Lower Eocene* and "*Paleocene.*" The former is undoubtedly identical with our Santacruzian beds, while the latter (characterized according to Ameghino, by the presence of the genus *Baculites*) is very doubtful; later, however, he changes the *Subpatagonian* beds into the *Suprapatagonian*, but it is impossible to tell what then becomes of their characteristic fossil, *Baculites*.

Ameghino clings very tenaciously to this division and to this determination of the respective ages, and it was not until *Mercerat* (1893) indicated the true sequence of the respective beds, that he did his "remarkable bit of stratigraphic juggling" (Hatcher, 1900 a, p. 103). The result was the following sequence (see Ameghino, 1894, p. 5) (beginning at the base): *Patagonian, Suprapatagonian, Santacruzian beds* (see below).

Moericke (1896, pp. 593 and 597) believes that the Patagonian formation is of the same age as the "Navidad Stufe" of Steinmann, *i. e., Miocene.*

Mercerat (1896–97) places the Patagonian formation partly in the "Laramie," *i. e., Upper Cretaceous*, partly in the *Eocene;* the Suprapatagonian in the *Upper Eocene.*[1]

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[1] Mercerat, 1896–97, p. 119. Since we shall not have occasion to refer to this article, it may be well to remark that Mercerat's observations are far from clearing up the real state of things in Patagonia, although he was the first to correct the principal error of Doering and Ameghino. He takes considerable pains to give detailed profiles; but these profiles, which fill six plates, are entirely unintelligible, at any rate, I have not the slightest idea of what is meant by the dotted lines appearing so frequently in them and resembling anticlines.

The characteristic oysters mentioned by Mercerat on pages 106 and 119 for the different

Von Ihering (1897, p. 346) makes the "Patagonian formation" *Upper Eocene*, the "Suprapatagonian" *Oligocene* or *Lower Miocene*, while *Cossmann* (1898, p. 110) in reviewing v. Ihering's paper says that the "Santacruzian" formation has rather a *Miocene* than an *Oligocene* character.

Dall (1898 b, p. 342) having received "Santa Cruz" fossils from v. Ihering, says that these beds, if not *Miocene*, can hardly be referred to a horizon older than *Oligocene*.

Ameghino finally (1898–1899) places the Patagonian and Suprapatagonian beds in the *Upper Cretaceous* and *Lower Eocene*.

Our own studies have convinced us, that the age assigned to these beds by Ameghino and Mercerat is certainly too great. In his first publication (1897) *Mr. Hatcher* was still under the influence of Ameghino's views, but he already tried to move up the series in the scale, making the Patagonian beds *Eocene*, and the Suprapatagonian beds *Miocene*. In the later publication (1900) he unites both, and makes them—according to the evidence furnished by the present writer—*Miocene*.

In the following I shall try to prove in detail my opinion that these beds are of *Miocene* age.

I wish first to say a few words on the method employed. In very many cases the age of Tertiary deposits is determined by the percentage of living species found in them. In my opinion this line of evidence is entirely inadmissible in our case, and I hardly need to say anything to support this view: this method may be safely used in Europe, but in the southern hemisphere it is out of the question.

For the sake of completeness, however, we shall state here the percentage of living forms in the Patagonian beds.

Von Ihering gives (1899, p. 38) 6 species out of 70, that is to say, 8–9 per cent.

1. *Trochita corrugata* (*Infundibulum c.*).
2. *Trochita magellanica* (*Infundibulum clypeolum*).
3. *Siphonalia dilatata* (*S. domeykoana*).
4. *Siphonalis cf. nodosa.*
5. *Trophon laciniatus* (*T. patagonicus*).
6. *Magellania globosa* (*M. lenticularis*).

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divisions are certainly all wrongly identified; in fact, the succession of the forms has been almost inverted. *Ostrea patagonica* is not found at all in the Patagonian beds; *O. ferrarisi* (which is only the young of *O. patagonica*) has never been found in Santacruzian beds, and *O. torresi* has never been found in the Tehuelche beds. The exact stratigraphical position of these oysters is given above. The idea of characterizing five horizons exclusively by the oysters found in them, shows that Mercerat seems to be very innocent of Palæontology.

The identification of Nos. 3 and 5 has changed, No. 4 is entirely doubtful, so there would remain only *three* species.[1]

Our list of living forms is the following:

Cellaria fistulosa.
°°*Aspidostoma giganteum.*
Heteropora pelliculata.
Rhynchonella squamosa.
°*Magellania lenticularis.*
°°*Terebratella dorsata.*
Mytilus cf. chorus.
°°*Mytilus magellanicus.*
°°*Infundibulum corrugatum.*
°*Infundibulum clypeolum.*
°*Verruca lævigata.*
Balanus cf. psittacus.

This is 12 species out of 151, or about 8 per cent., which would agree fairly well with v. Ihering's percentage. But is to be remarked that I am positive of the identity of only 7 species (marked °° and °), and that I have compared only 4 (marked °°) with living individuals.

A slight change in the systematic views of the author would change this percentage considerably: for it is only a matter of taste whether we consider the following as distinct species or as forms of living ones:

Tennysonia subcylindrica and *T. stellata.*
Rhynchonella plicigera and *R. nigricans.*
Crepidula gregaria and *C. grandis.*
Siphonalia domeykoana and *S. dilatata.*
Trophon patagonicus and *T. laciniatus* or *geversianus.*

We even might extend this to the different species of *Voluta.*

Thus, disregarding this line of evidence, the safest way to determine the age of any deposit is to compare its fossils directly with those of other localities, the age of which has been ascertained. In trying to use this method we meet with extraordinary difficulties in the Patagonian beds; the Patagonian fauna is very peculiar, and there are hardly any species that have been found elsewhere in well-known deposits. At any rate—as we shall see below—the only clearly marked relations are with fossils of the southern hemisphere, and as it happens, all these southern localities (Chili, New Zealand, Australia) are of doubtful age: the same discussion as to their age exists as in the case of the Patagonian beds. When we turn to well-known deposits of the northern hemisphere, we find that no species at all (perhaps with a few insignificant exceptions, *Cellaria fistulosa*, *Heteropora pelliculata*, *Vermetus intortus*) are identical

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[1] This is a remarkable instance of how the different opinions of different writers may change the conclusions drawn by this method, and demonstrates clearly the chief dangers of it.

with Patagonian species, and thus it seems impossible to compare directly the Patagonian beds with any deposit of the northern hemisphere.

Nevertheless, the comparison with northern faunas proves to be very valuable. As we shall see below, although we hardly find an identical species, quite a number of forms show close affinities to northern species. This method was used by Moericke (1896) for the Navidad beds of Chili, and he concluded that these beds are possibly Miocene, since a number of species show distinct relationship to Miocene species of the northern hemisphere, and since these relations are the prevalent ones.

Although it might be objectionable to draw a conclusion like this, when only a few species are known, it is quite another thing when the bulk of the species available for comparison points the same way. Indeed, it is quite possible that closely allied species are found in deposits of different age, and it is not admissible to rely on single instances of this kind. But when—as is the case in our material—a large percentage of the whole fauna, and a still larger one of those species which may be compared at all with known ones, shows the identical relations to northern forms, it is safe to say that this is a possible way to ascertain the age of any deposit, and, as it happens, this is the only way left in our case.

Therefore I have used this method in the first place, and have found that the affinities of most of the Patagonian species point to a *Miocene* age of these deposits. This conclusion will be strengthened by other considerations to be made below.

First I shall give here a table containing only those species which permit a comparison with species of the northern hemisphere.

	CRETACEOUS.	EOCENE.	OLIGOCENE.	MIOCENE.	PLIOCENE.	RECENT.
1. Cidaris antarctica				C. avenionensis, Europe		
2. Toxopneustes præcursor						Genus Toxopneustes
3. Scutella patagonensis				S. subrotunda, Europe		Echinarachnius mirabilis, Japan
4. Cyrtoma posthumum	Cyrtoma India, Europe					

	CRETACEOUS.	EOCENE.	OLIGOCENE.	MIOCENE.	PLIOCENE.	RECENT.
5. Cellaria fistulosa			Oligocene . . .	Miocene . . . . Europe		Recent
6. Melicerita triforis					M. charlesworthi, England	
7. Heteropora pelliculata						Japan
8. Nucula patagonica			N. peregrina, Europe			
9. Nucula reticularis			N. chasteli, Europe			
10. Leda errazurizi				L. hyposoma, N. America		
11. Cucullæa alta		C. decussata, Europe, C. gigantea, N. America				
12. Cucullæa darwini		C. aldrichi, N. America			C. tæniata, N. America	
13. Arca patagonica				A. tetragona and A. noæ Miocene . . .	Pliocene . . . Europe	Recent
14. Glycimeris ibari				G. pilosus and pulvinatus Miocene . . .	Pliocene . . . Europe	Recent
15. Ostrea ingens				O. gingensis, Europe		
16. Gryphæa cf. tarda	G. vesicularis, Europe N. America					
17. Pecten prænuncius					P. caloosaënsis, Florida	
18. Crassatellites kokeni		C. sulcatus, Europe				
19. Crassatellites longior				C. melina, N. Jersey		
20. Cardita patagonica			C. dunkeri, Europe			
21. Lucina promaucana				Miocene . . .	Lucina borealis Pliocene . . . Europe and California	Recent
22. Cardium puelchum			Cardium comatulum, Oligocene and Miocene, Europe, Azores			

	Cretaceous.	Eocene.	Oligocene.	Micocene.	Pliocene.	Recent.
				Cardium fragile, Miocene . . . Pliocene . . . Recent Europe		
23. Venus chiloënsis				V. cancellata, N. Jersey		
24. Venus meridionalis				V. cancellata, N. Jersey		
25. Venus darwini				V. burdigalensis, Europe		
26. Dosinia meridionalis				D. matthewsoni, California D. acetabulum, Virginia	D. ponderosa, Pliocene . . . . . Recent Mexico	
27. Tellina jeguaënsis				T. capillifera, N. Jersey		
28. Psammobia patagonica		P. nitida, P. tenera, Europe				
29. Mactra garretti			M. trinacria, Europe			
30. Corbula hatcheri			C. subæquivalvis, Europe			
31. Martesia patagonica			M. peroni, Europe			
32. Dentalium sulcosum			Dentalium gabbi, Oligocene . . . . Micocene, West Indies D. kickxi, Europe			
33. Liotia scotti						L. acrilla, Florida
34. Calliostoma peraratum				C. audebardi, Europe		
35. Calliostoma santacruzense				C. podolicum, Europe		
36. Calliostoma garretti				C. philanthropus, N. America C. metrium, Florida		
37. Calliostoma iheringi				C. cyclus, Florida C. biangulatum, Europe	C. ditropis, Europe	

	CRETACEOUS.	EOCENE.	OLIGOCENE.	MIOCENE.	PLIOCENE.	RECENT.
38. Gibbula dalli					Gibbula magus, Pliocene . . . . Recent Europe	
39. Odontostomia suturalis				Odontostomia conoidea, Miocene . . . . Pliocene . . . . Recent Europe, N. America, West Indies		
40. Scalaria rugulosa			S. inæquistriata, Germany	S. lamellosa, Europe		
41. Crucibulum dubium				Genus: Crucibulum Miocene . . . . . Pliocene . . . . . Recent West Indies		
42. Crepidula gregaria				Crepidula prærupta and allied forms Miocene . . . . . Pliocene . . . . . Recent North Pacific		
43. Natica secunda			N. hantoniensis, Europe	N. callosa, California		
44. Natica darwini				Group of Natica heros Miocene . . . . . Pliocene . . . . . Recent North America		
45. Natica subtenuis				Natica heros Miocene . . . . . Pliocene . . . . . Recent North America		
46. Turritella ambulacrum					T. apicalis, Florida	
47. Turritella breantiana					T. perattenuata, Florida	
48. Turritella patagonica				T. chipolana, Florida		
49. Vermetus intortus			Oligocene . . . . Miocene . . . . . Pliocene Europe			
50. Aporrhais araucana			Genus: Aporrhais Oligocene . . . . Miocene . . . . . Pliocene . . . Recent Europe			
51. Dolium ovulum				Genus: Dolium Miocene . . . . . Pliocene . . . . . Recent Europe		
52. Pyrula carolina				P. pyriformis, California		
53. Tritonium morgani				T. tarbellianum, Europe		
54. Buccinum annæ				B. veneris, Europe		
55. Chrysodomus cancellatus				C. glomus, Europe		

	CRETACEOUS.	EOCENE.	OLIGOCENE.	MIOCENE.	PLIOCENE.	RECENT.
56. Murex hatcheri				Subgenus: Phyllonotus Miocene..... Pliocene..... Recent Tropical seas		
57. Fusus archimedis		F. hector, N. Jersey				
58. Fusus torosus				F. burdigalensis, Europe		
59. Marginella gracilior				M. faunula, Florida Marginella bella Miocene..... Pliocene..... Recent North America		
60. Marginella olivella					Marginella styria Pliocene...... Recent North America	
61. Terebra costellata				Terebra sp. (costellata) Europe		
62. Pleurotoma subæqualis				P. monilis, Europe		
63. Genota cuevensis				G. intorta, Europe		
64. Drillia santacruzensis				D. limatula, N. America		
65. Borsonia patagonica			B. delucii, Europe			
66. Actæon semilævis				A. semistriatus, Europe		
67. Bulla patagonica		B. glaphyra, Europe				
68. Scalpellum juliense	S. solidulum, Europe					
69. Balanus varians		Bal. unguiformis, Eocene...... Oligocene Europe				

Among these 69 species available for comparison, we have the following relations:

Cretaceous relations: 3 species = 4 per cent.

Cyrtoma posthumum. *Gryphæa cf. tarda.* *Scalpellum juliense.*

Eocene relations: 5 species = 7 per cent.

Cucullæa alta.
Crassatella kokeni.
Psammobia patagonica.
Fusus archimedis.
Bulla patagonica.

Eocene and Oligocene relations: 1 species = 1.5 per cent.

Balanus varians.

Oligocene relations: 7 species = 10 per cent.

Nucula patagonica.
Nucula reticularis.
Cardita patagonica.
Mactra garretti.
Corbula hatcheri.
Martesia patagonica.
Borsonia patagonica.

This gives the sum of all *Eogene* relations (Eocene and Oligocene, but not passing up into the Neogene) as 13 species = *18.5* per cent.

Intermediate (Eogene as well as Neogene) species: 8 = 12 per cent.

Cellaria fistulosa (Olig.-Rec.).
Cucullæa darwini (Eoc. & Plioc.).
Cardium puelchum (Olig.-Rec.).
Dentalium sulcosum (Olig., Mioc.).
Scalaria rugulosa (Olig., Mioc.).
Natica secunda (Olig., Mioc.).
Vermetus intortus (Olig.-Plioc.).
Aporrhais araucana (Olig.-Rec.).

Miocene relations: 22 species = 32 per cent.

Cidaris antarctica.
Leda errazurizi.
Ostrea ingens.
Crassatellites longior.
Venus chiloënsis.
Venus meridionalis.
Venus darwini.
Tellina jeguaënsis.
Calliostoma pararatum.
Calliostoma santacruzense.
Calliostoma garretti.
Turritella patagonica.
Pyrula carolina.
Tritonium morgani.
Buccinum annæ.
Chrysodomus cancellatus.
Fusus torosus.
Terebra costellata.
Pleurotoma subæqualis.
Genota cuevensis.
Drillia santacruzensis.
Actæon semilævis.

Pliocene relations: 4 species = 6 per cent.

Melicerita triforis.
Pecten prænuncius.
Turritella ambulacrum.
Turritella breantiana.

Recent relations: 3 species = 4 per cent.

Toxopneustes præcursor.
Heteropora pelliculata.
Liotia scotti.

Neogene relations (Miocene–Recent): 13 species = 19 per cent.

Scutella patagonensis.
Arca patagonica.
Odontostomia suturalis.
Crucibulum dubium.
Natica subtenuis.
Dolium ovulum.

Glycimeris ibari.
Lucina promaucana.
Dosinia meridionalis.
Crepidula gregaria.
Natica darwini.
Murex hatcheri.
Marginella gracilior.

Miocene and Pliocene relations: 1 species = 1.5 per cent.

Calliostoma iheringi.

Pliocene and Recent relations: 2 species = 3 per cent.

Gibbula dalli.
Marginella olivella.

To sum up, among the species which may be compared with known ones, the percentage of the relations with particular beds is the following:

Cretaceous	4%	*4 %*
Eocene	7	
Oligocene	10	
Eoc. and Olig.	1.5	
Eogene	18.5	*18.5 %*
Intermediate	12	*12 %*
Miocene	32	
Pliocene	6	
Recent	4	
Mioc.-Rec	19	
Mioc. and Plioc	1.5	
Plioc. and Rec	3	
Neogene	65.5	*65.5 %*
		100 %

The above figures speak for themselves. We see a constant increase of the percentage from the Cretaceous to the Miocene, and then again quite a sudden decrease from Miocene to Recent. The percentage of all Neogene forms is 65.5, considerably more than half of the number, while that of the Eogene and Cretaceous together is only 22.5; the rest (12 per cent.) is intermediate between Eogene and Neogene.

These facts bring the Patagonian beds undoubtedly into the *Neogene*, and when we consider the fact that after the Miocene there is a marked decrease in the percentage, we must put these beds in the beginning of the Neogene times, that is to say, in the *Miocene*. This course is rendered the only possible one by the fact that 32 per cent. of the whole number of species shows Miocene relations. No other group has a percentage like this. Taking together all species that *might possibly be Miocene*, we would have:

Miocene species	22
Mioc.-Rec. species	13
Mioc. & Plioc. species	1
Eogene & Mioc. species	8
	44 = 64 %.

Directly opposed to Miocene age are:

Older than Miocene.

Cretaceous species	3
Eocene species	5
Oligocene species	7
Eogene species	1
	16 = 23 %.

Younger than Miocene.

Pliocene species	4
Recent species	3
Plioc. & Rec. species	2
	9 = 13 %.

Thus 64 per cent. of the whole number may be taken safely as Miocene specimens, while 23 per cent. point to an older age, and only 13 per cent. to a younger age. This latter fact has apparently the following meaning: there are, in these Miocene beds, more relations with the underlying than with the overlying beds, and, accordingly, we are to consider this fact by *placing the Patagonian beds in the Lower Miocene.*[1]

2. Comparison of the Patagonian Beds with Tertiary Deposits of the Southern Hemisphere.

This result, that the Patagonian beds are *Lower Miocene*, has been obtained by comparing them exclusively with deposits of the northern hemisphere. Now it will be very interesting to compare them with other beds of the southern hemisphere, and we shall see that there are extremely significant connections.

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[1] According to Dall (1898b) some of the North American and West Indian beds classed here with the Miocene are really Oligocene; this would, however, affect our conclusions only in so far as it would increase slightly the relations with the older Tertiary, and would thus place the Patagonian beds more decidedly in the *lower* Miocene.

The *Navidad beds of Chili* are undoubtedly the best known Tertiary deposits of the southern hemisphere, at least as regards their Palæontology, and Darwin, d'Orbigny, Philippi, and Moericke held the opinion that they are about contemporaneous with the Patagonian beds.

According to our collections, the following Navidad fossils have been found in the Patagonian beds:

A. *Identical species:*

Leda oxyrhyncha.
Leda errazurizi.
Limopsis insolita.
Glycimeris ibari (?).
Mytilus cf. chorus (?).
Cardita volckmanni.
Lucina promaucana.
Amathusia angulata.
Venus chiloënsis.
Venus meridionalis.
Venus volckmanni.
Venus navidadis.
Dentalium sulcosum.
Gibbula lævis.
Scalaria rugulosa.
Galerus araucanus.
Crepidula gregaria.
Natica ovoidea.
Natica secunda.
Natica darwini.
Turritella ambulacrum.
Turritella breantiana.
Turritella patagonica.
Aporrhais araucana.
Pyrula carolina.
Buccinum obesum minor.
Siphonalia domeykoana.
Voluta triplicata.
Voluta domeykoana.
Cancellaria medinæ (?).
Terebra costellata.
Pleurotoma subæqualis.
Balanus cf. psittacus (?).
Balanus varians.

B. *Closely allied species are the following:*

Schizaster ameghinoi	*S. valdivianus.*
Nucula patagonica	*N. araucana.*
Malletia ornata	*M. volckmanni.*
Cucullæa alta	*C. chilensis.*
Arca patagonica	*A. oxytropis.*
Pecten proximus	*P. caracolensis.*
Cardium philippii	*C. multiradiatum.*
Cardium pisum.	*C. sphæridium.*
Tellina jeguaënsis	*T. promaucana.*
Mactra garretti	*M. truncatula.*
Sigapatella americana	*S. colchaguensis.*
Struthiolaria ameghinoi	*S. chilensis.*
Tritonium morgani	*T. verruculosum.*
Urosalpinx elegans	*U. leucostomoides.*
Fusus torosus	*F. pyruliformis.*

Thus, out of 151 species, 34 are identical with species found in the Navidad beds, that is to say, 22 per cent. or almost one quarter. This is certainly to be regarded as a high percentage, considering the considerably more northern situation of the Navidad beds, and undoubtedly establishes the identity at least of a part of the Navidad series with the Patagonian beds. Whether of all of it, remains doubtful, since we do not possess any stratigraphical observations on the Navidad beds, and we shall become acquainted, further on, with facts, which point to the possibility that these Chilian beds are not a unit, but contain horizons of different age.

Moericke (1896, p. 593), following Steinmann, included the Patagonian beds of Santa Cruz in the "Navidad stage," and makes (p. 597) it *Miocene, with a suggestion of Oligocene*, which agrees well with our results, which make the Patagonian beds *Lower Miocene*.

Relations to New Zealand were discovered first by Zittel (1864): he directly identifies some New Zealand species with Patagonian. According to the list of New Zealand fossils published in 1873 by Hutton, and his subsequent writings on this fauna (1885), I have been able to compile the following list of identical and closely allied species.

(In the following *O* means Oamaru (Oligocene); *P* means Pareora (Miocene); *W* means Wanganui (Pliocene); *R* means Recent.

A. *Identical species:*

Cellaria fistulosa.	*P*
Heteropora pelliculata.	*P*
Rhynchonella squamosa.	*O*
°*Magellania lenticularis.*	*O, P, R*
°*Terebratella dorsata.*	*P*
Terebratella patagonica.	*O, P*
°*Cucullæa alta.*	*O, P*
°*Limopsis insolita.*	*P*
°*Ostrea ingens.*	*O, P*
Gryphæa tarda.	*O, P* (Chatham Isl.).
Mytilus magellanicus.	*P, W*
°*Scalaria rugulosa.*	*O, P*
°*Crepidula gregaria.*	*P*
°*Natica darwini.*	*P*
Turritella ambulacrum.	*P, W*

B. *Closely allied species:*

Melicerita triforis	*M. angustiloba.*	*P*
Rhynchonella plicigera	*R. nigricans.*	*O, P, W, R*
Leda oxyrhyncha	*L. sp.* (Zittel).	*P*
Malletia ornata	*M. australis.*	*P, W, R*
Pecten proximus	*P. athleta.*	*O*
Dentalium sulcosum	*D. mantelli.*	*P*
Solariella dautzenbergi	*S stoliczkai.*	*O*
Sigapatella americana	*S. maculata.*	*O, P, W, R*
Genus *Struthiolaria*	Genus *Struthiolaria.*	*P, W, R*
Siphonalia domeykoana	*S. dilatata.*	*P, W, R*
Voluta ameghinoi	*V. pacifica.*	*O, P, W, R*

Thus, out of 151 species, 15, or 10 per cent., are identical with New Zealandian Tertiary fossils, while 11 more are closely allied, making the total number of relations between Patagonian and New Zealandian Tertiary 17 per cent. This is indeed a large percentage, considering the wide separation of the two localities.

Of these New Zealand species, 4 go through from the Oamaru beds to Recent times, and 3 from the Pareora to Recent. Five are found in both the Oamaru and Pareora, and 2 in the Pareora and Wanganui. Of the rest (12), 3 belong to the Oamaru, and 9 to the Pareora beds. Thus the bulk of the affinities points directly to a comparison with the New Zealandian *Pareora beds*, which are, according to Hutton (1885a), *Miocene*, and this result again corroborates our identification of the Patagonian beds as *Miocene*.[1]

We cannot, however, disregard the fact that there is considerable discussion as to the age of these New Zealandian beds, especially Hector, in opposition to Hutton, considers them to be much older (Cretaceous-Tertiary). But in this respect I should say that our investigations tend to confirm Hutton's opinion, which makes these beds Oligocene and Miocene (Oamaru and Pareora).

On the other hand, v. Ihering (1899, p. 40, footnote) tries to minimize the evidence furnished by the comparison of Patagonian and New Zealandian fossils, and thinks that a closer inspection of the New Zealand species will prove their specific difference in many cases. In my opinion, the question of specific identity is of secondary value, although I firmly believe that in those cases marked ° in the list it is well established. But even if there should be no identical species, the fact remains that a number of Patagonian fossils very closely resemble New Zealandian species, and this fact is the more important, since some of these forms are extremely characteristic, for instance: *Cucullæa*, *Limopsis insolita*, *Scalaria rugulosa*, *Malletia*, *Sigapatella*, *Struthiolaria*, *Siphonalia domeykoana*, which types are hardly represented elsewhere. Indeed, it is the association of forms like these which gives to the Patagonian and New Zealandian faunas their striking similarity, not the fact that a few species are really identical.

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[1] I have disregarded *Cardita patagonica* and *Venus meridionalis*, which are found, according to Hutton (1886, p. 362 and 364) in the Pareora and Wanganui beds, since I have no means of deciding their identity with the respective New Zealand species (*C. intermedia* and *V. vellicata*).

I have further tried to *compare our Patagonian fossils with those of the Tertiary beds of Tasmania and southern Australia*, and am able to give the following list of relations:

Melicerita triforis	*M. angustiloba*, S. Australia (? Miocene).
Reticulipora patagonica	*R. transennata*, S. Australia (? Eocene).
Rhynchonella squamosa	same species in Tasmania (? Miocene).
Nucula patagonica	*N. tumida*, Australia, Tasmania (? Eocene).
Leda oxyrhyncha and *errazurizi*	similar species in Australia.
Limopsis insolita	same species, S. Australia (? Eocene).
Arca patagonica	*A. pseudonavicularis*, Australia (? Eocene).
Ostrea ingens	*O. sturtiana*, River Murray Cliffs (? Miocene).
Gryphæa cf. tarda	*G. tarda*, S. Australia (? Eocene).
Pecten prænuncius	*P. palmipes*, Australia (? Miocene).
Venus meridionalis	*V. multitæniata* and *hormophora*, Australia, Tasmania (? Eocene).
Dosinia meridionalis	*D. denselineata*, Tasmania, Victoria (? Miocene).
Psammobia patagonica	*P. hamiltonensis*, Victoria, Tasmania (? Eocene).
Dentalium sulcosum	*D. mantelli*, Australia, Tasmania (? Eocene).
Turritella ambulacrum	*T. aldingæ*, S. Australia (? Eocene).
Voluta triplicata	*V. sarissa* and *tateana*, Australia (? Miocene, Eocene).
Voluta ameghinoi	*V. atkinsoni*, Tasmania.

No attempt has been made to correct or to control the age given for these Australian species. This list is very defective, since it was impossible for me to make a closer comparison, especially because the figures of Australian species given by Tate (1886–1893) are in most cases very poor. Nevertheless the fact is apparent that a few identical species are found, which are in part also recorded from New Zealand, and that a larger number of species show close affinities with Patagonian forms. The latter number will undoubtedly be increased considerably, after a careful examination of the Australian fossils has been made. For the present, it is sufficient to call attention to the fact that not only in New Zealand, but also in Australia and Tasmania, Tertiary deposits are found, which yield a fauna that shows unmistakable affinity to the Patagonian fauna.[1]

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[1] According to Harris (1897), whose Australasian Tertiary Mollusca were not consulted until the above was written, I can add the following striking cases:

Liotia scotti .... *L. roblini* Johnst. (Harris, p. 284, pl. 8, f. 4) "Eocene," Muddy Creek.

Fissurella eurytreta .... *Fissurellidea malleata* Tate (ibid., p. 287, pl. 8, f. 5) "Eocene," Muddy Creek.

Unfortunately our information on Australian stratigraphy is very defective, and especially as to their age we are again confronted with the same contradictory opinions that have been expressed in the case of New Zealand and Patagonia. Most of the Australian Tertiary deposits belong, according to Tate (see Tate, Correlation of the marine Tertiaries of Australia in Trans. Roy. Soc. S. Australia, vol. 17, 1893, vol. 19, 1895, vol. 20, 1896), to the *Eocene*, and the same opinion is held by others. On the other hand, most of these beds have been classed with the *Miocene* by the Geological Survey of Victoria, while Harris (1897, p. 15), although following Tate, expresses doubts as to the correct correlation of his "Eocene."

Tate's determination of the age of these beds relies exclusively on the percentage of recent forms found in them.[1] As has been said above, we consider this line of evidence as entirely inadmissible, and since Tate has not tried to introduce any other proofs, we may safely say that there is no evidence at all warranting the reference of these beds to the *Eocene*. And, indeed, the writer is of the opinion that these Australian and Tasmanian beds are also to be regarded as *Miocene*, simply because, in that case, we would not have any discrepancies in the stratigraphical position of these species, which have been found both in Australia and New Zealand. If we regard—as we actually do—the New Zealandian Pareora beds as Miocene, the Australian beds containing Pareora species (for instance *Limopsis insolita*, *Dentalium mantelli*) must be correlated with them, unless other evidence points to a contrary conclusion; but no proof of the latter kind has been offered so far.

Of course, we do not claim that all of the Australian Tertiary is Miocene, but we should expect to find that other deposits are also represented there. All we wish to say is that beds corresponding in age to the Miocene Patagonian beds must be present in Australia and Tasmania, and that there are apparently faunistic relations between both continents. It is left for future investigation to ascertain how far this parallelism extends, and we entertain no doubt that the faunal relations between Patagonia and Australia, as well as New Zealand, will prove a very fruitful and interesting subject for research.

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[1] The same is true of the determination of the Eocene age of these beds by other writers; for instance, Hall and Pritchard (see: Proc. R. Soc. Victoria, v. 7, 1894, p. 180, ff. and v. 8, 1895; p. 151, ff.) do not use any other method than that used by Tate.

The result of the foregoing considerations is: *We regard the Patagonian beds as of Lower Miocene age; contemporaneous deposits are found, in the southern hemisphere, not only in Chili (within the Navidad series), but also in New Zealand (Pareora beds of Hutton) and Australia, and the faunas of these three localities (South America, New Zealand, and Australia) show unmistakable affinities with each other.* We shall return to this fact below.

THE MAGELLANIAN BEDS.

The "*Magellanian beds,*" discovered by Mr. Hatcher near Punta Arenas, were first described by the present writer in 1898, and the term "Magellanian beds" was introduced by him in 1899, and accepted by Hatcher (1900 a, p. 97). The stratigraphical position of these beds has been ascertained positively by Hatcher: they are several hundred feet below the Patagonian beds, and separated from them by the Punta Arenas coal (Upper Lignites of Hatcher, l. c., p. 99).

Ameghino (1899, p. 12) has referred to this Punta Arenas section, and has attempted to correlate it with his subdivisions of the Patagonian formation, and, indeed, practically identifies our Magellanian beds with his "Patagonian formation."

It is hardly necessary to pay any attention to this entirely unwarranted opinion (see: Ortmann, 1899, p. 427, first footnote). In what Ameghino calls his Piso Juliense in the Punta Arenas section (our horizon I), not a single Juliense species is present, but only plant remains have been found. What he calls Piso Leonense (our horizon II) does not contain a single Leonense fossil; what he calls transitional beds between Patagonian and Suprapatagonian formation (our horizon III) contains only a single Patagonian species (*Cardita elegantoides* spec. nov.), but no other Patagonian or Suprapatagonian fossils. Such correlations are simply ridiculous, not to mention the fact that Ameghino's subdivisions, as has been demonstrated above, have no reality at all.

The following is the fauna of the Magellanian beds. (II = lower horizon, III = upper horizon.)

	RELATIONS.
x Ostrea torresi (III)	*O. bellovacina*, Low. Eocene, Europe.
Cardita elegantoides (III).....	identical species in the Patagonian beds.
x Lucina neglecta (II)	*L. promaucana*, Patagonian beds.

x *Venus difficilis* (II & III)	*V. subsulcata*, Cretaceous, Chili.
x *Venus arenosa* (III)	*V. landbecki*, Cretaceous, Chili.
x *Meretrix pseudocrassa* (III)	*M. alta*, Cretaceous, Chili; *M. crassa*, Pliocene, Chili.
x *Dosinia magellanica* (II)	*D. semilævis*, Navidad.
x *Lutraria undatoides* (II)	*L. undata*, Chili (Navidad beds ?).
x *Panopea ibaria* (II).	
x *Panopea subsymmetrica* (III).	
x *Patella pygmæa* (III).	
x *Calliostoma philippii* (III)	*C. fricki*, Navidad; *C. observationis*, Patagonian beds.
Infundibulum merriami (II and III)	identical species (*I. costellatum* Phil.) in the Navidad beds; *I. filosum*, Miocene, California.
Natica chiloënsis (II and III)	identical species in Chiloë; *N. venusta*, Eocene, Europe.
x *Turritella exigua* (II)	*T. granulosa*, Eocene, Europe.
x *Struthiolaria hatcheri* (II)	possibly ancestral form of the Patagonian species of the genus.
x *Fusus subspiralis* (II)	*F. oxytropis*, Navidad.
Actæon chilensis (II)	identical species in the Navidad beds; *A. turgidus*, Eocene, Europe.
Bulla remondi (II)	identical species in the Navidad beds; *B. striatissima*, Eocene, Europe.

Of these 19 species, 3 have been found in both horizons. One is found in the Patagonian beds of Santa Cruz, 4 have been found in the "Navidad beds" of Chili, while the rest (14, marked *x*) are restricted to this locality. Of these, 4 show relations to Navidad species, 2 relations to Patagonian species. One of the Navidad species (*Infundibulum merriami*) shows affinities to a Miocene California species, 5 species show relations to European Eocene species, and even Cretaceous affinities are not wanting (3 species).

Although the number of species known from these deposits is quite small, the comparatively more numerous affinities to deposits of older age (Eocene and even Cretaceous) agree well with what we know of the stratigraphical conditions; the Magellanian beds are older than the Patagonian, and further, one fact needs special mention: while the lithological character of the deposit, especially of horizon II, agrees strikingly with that of the type locality of the Patagonian beds at Santa Cruz (hard concretions, filled with shells, imbedded in looser material), some genera found in both localities (Punta Arenas and Santa Cruz) are represented by different species, for instance:

Venus difficilis	*V. darwini* (Santa Cruz).
Dosinia magellanica	*D. meridionalis*.
Infundibulum merriami	*I. corrugatum*.

Natica chiloënsis	*N. ovoidea.*
Turritella exigua	*T. ambulacrum.*
Struthiolaria hatcheri	*S. ameghinoi* (and *ornata*).
Bulla remondi	*B. patagonica.*

Since these genera belong to the most characteristic forms of these deposits, it is very significant that they are represented by different species, and this fact affirms the difference in age of both series indicated by the stratigraphical evidence.

The fact that 4 Navidad species have been discovered in the Magellanian beds suggests that this latter horizon is also represented within the Navidad series. In this respect it is significant that these Navidad species have never been found in Patagonia, and it is quite possible that the Navidad fauna as described by Philippi contains elements of different age, including the Magellanian beds.

As regards *the age of the Magellanian* beds we must depend in the first line on the stratigraphy, since palæontology—although suggestive of a slightly older age than Patagonian—is altogether insufficent to permit any definite opinion. The Magellanian beds are several hundred feet below the Patagonian, and are separated from them by a coal deposit; since the Patagonian beds are Lower Miocene, this would bring the Magellanian beds into the *Oligocene*, or perhaps—taking into consideration the changed conditions under which the Upper Lignites were deposited—into the *Upper Eocene.*

It would be very interesting and important to get more material from the Magellanian beds. This first indication of this fauna was given by Philippi (1887), who described a number of fossils from Punta Arenas and Skyring Water. From his list of 16 species (leaving out *Turritella patagonica*, which has been inserted by mistake) the following are represented in our collection:

Haliotis imperforata = *Crepidula gregaria.*
Venus chiloënsis.
Panopea ibari.
Pectunculus ibari and *magellanicus* (both identical and = *Glycimeris ibari*).
Ostrea bourgeoisi and *patagonica* (both identical and = *O. ingens*).
Ostrea torresi.

Two of these belong in the Magellanian beds (*Panopea ibari* and *Ostrea torresi*), while the rest has been found in horizon V, which represents the Patagonian beds.

The Punta Arenas section (Ortmann, 1898, p. 481) has been mentioned twice before in literature. First Mallard and Fuchs (1873, p. 67, ff.) have given a profile taken at 6–7 kilometers from Punta Arenas on the left bank of the river (Rio de las Minas). There does not seem to be any agreement with Mr. Hatcher's observations, but the fact that these writers mention at the base of their section, a glauconitic sand, which contains "*Ostrea patagonica*" and a large *Pectunculus* (= *Glycimeris*), renders it beyond doubt that this bed corresponds to Hatcher's horizon V, which consists of a dark green sand containing a large oyster (*O. ingens*) associated with a large *Pectunculus* (*Glycimeris ibari*). Thus Mallard and Fuchs' section begins just where Hatcher's section ends.

A second time this section has been mentioned by Nordenskjoeld (1898, p. 24, footnote). His account agrees fairly well with Hatcher's, and the comparison is as follows (beginning at the top):

Sand, Sandstein und Geroell in maechtigen Schichten, unten mit etwas Lignit	includes probably horizon V (Patagonian).
Schieferthon mit Lignit und Pflanzenresten (*Araucaria*)	undoubtedly = horizon IV (Upper Lignites).
Sandstein mit einer muschelfuehrenden Bank: reichliche Schalen von *Ostrea bourgeoisi* und *torresi*.	= horizon III (*Ostrea torresi*).
Sand mit kalkigen Einlagerungen (mit Steinkernen schlecht erhaltener Mollusken)	probably beds separating horizons II and III.
Muschelfuehrende Bank (*Ostrea* fehlt; *Turritella* und andere Gasteropoden vorhanden)	= horizon II (*Turritella exigua*).
Sand und Sandsteine mit kalkigen Konkretionen, die schlecht erhaltene Pflanzenversteinerungen enthalten (*Fagus*)	= horizon I.
Lignitische Schicht.	

The plant remains of our horizons I and IV have been described by Dusén from the collections made by the Swedish expedition (Dusén, 1899). He provisionally refers the upper Lignites (horizon IV; *Araucaria*-beds) to the *Miocene*, and the horizon I (*Fagus*-beds)[1] to the *Oligocene* (p. 93), although it may be *Eocene* (p. 91).

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[1] I have been able to identify some of the plant remains collected by Hatcher in horizon I, namely, *Fagus subferruginea* Dus. (p. 94), *Nothofagus variabilis forma microphylla* Dus. (p. 97), and others, which are identical with forms mentioned by Dusén from the *Fagus* beds of Punta Arenas. This establishes beyond doubt the identity of our horizon I and the "*Fagus* beds" of Dusén.

This would make the Magellanian beds Oligocene in age.

THE CAPE FAIRWEATHER BEDS (? MARINE TEHUELCHE BEDS).

The *Cape Fairweather beds* were first described by Hatcher (1897 a, p. 342). They are of marine origin, and their stratigraphical position is unconformably on top of the Santacruzian beds (see section, l. c., p. 344): this separates them at once stratigraphically from the Patagonian beds, which are *below* the Santacruzian beds.

A first, preliminary account of the fauna of these beds has been given by Pilsbry (1897 a). Further investigations have increased the number of species, and have made necessary a few corrections, so that the list of species known from the Cape Fairweather beds stands at present as follows:

		RELATIONS AND DISTRIBUTION.
1.	*Terebratella gigantea*	Mutation of *T. patagonica*, Patagonian beds.
2.	*Ostrea ingens*	Patagonian beds.
3.	*Pecten actinodes*	Mutation of *P. geminatus*, Patagonian beds; distribution northward from San Julian, in the Tehuelche beds (v. Ih.).
4.	*Mytilus cf. chorus*	Patagonian beds and Recent (Chili).
5.	*Meretrix rostrata*	Recent (Brazil and Uruguay).
6.	*Dosinia meridionalis*	Patagonian beds and Entrerios beds (v. Ih.).
7.	*Panopea pilsbryi.*	
8.	*Galerus mamillaris*	Recent, Chili to California.
9.	*Crepidula dilatata*	Recent, southern Patagonia.
10.	*Turritella innotabilis*	Mutation of *T. patagonica*, Patagonian beds; closely allied to *T. cingulatiformis*, Pliocene, Chili.
11.	*Trophon laciniatus*	Mutation of *T. patagonicus*, Patagonian beds; Recent, Patagonia.
	T. l. var. inornatus	also at Darwin Station; Tehuelche beds (*T. varians* v. Ih.).
12.	*Balanus cf. psittacus*	Patagonian beds, and Recent, Patagonia.
13.	*Balanus cf. trigonus*	Recent, almost Cosmopolitan (Patagonia).
14.	*Balanus lævis*	Pliocene, Chili; recent, Patagonia, Chili to California.

Indeterminable remains of *Pinna*, *Arca*, *Lucina* (or *Diplodonta* ?), *Cardita.*

Of these 14 species, 4 (*Ostrea ingens, Mytilus chorus, Dosinia meridionalis, Balanus psittacus*) are also represented in the Patagonian beds, while we may consider 4 others (*Terebratella gigantea, Pecten actinodes, Turritella innotabilis, Trophon laciniatus*) as mutations of Patagonian forms. On the other hand, we have in 5 species (*Meretrix rostrata, Galerus mamillaris, Crepidula dilatata, Balanus trigonus, Balanus lævis*) new elements in this fauna, and it is very significant that these are all still living species. This introduction of new, recent elements into the Cape Fairweather fauna, as compared with the Patagonian, is the most important character, agreeing completely with the stratigraphical position.

Altogether, the Cape Fairweather fauna contains 8 living species (57 per cent.), 5 of which are still found in Patagonia (*Crepidula dilatata, Trophon laciniatus, Balanus psittacus, Balanus trigonus, Balanus lævis*), while 2 are found in Chili (*Mytilus chorus* and *Galerus mamillaris*), and 1 in Uruguay (*Meretrix rostrata*). This fact approximates this fauna so closely to the recent one, that we may safely regard the Cape Fairweather beds as *Pliocene.*

Only a few members of this fauna have been found elsewhere. *Pecten actinodes* was recorded long ago from various localities in Patagonia (chiefly the northern part), and has been given by v. Ihering (according to Ameghino's material) for the *Tehuelche formation.* The same is true in the case of *Trophon laciniatus* var. *inornatus*, which is mentioned by v. Ihering (as *Trophon varians*) from the Tehuelche beds (see below). *Dosinia meridionalis* has been recorded (aside from the Patagonian beds) from the *Entrerios beds*, and *Turritella innotabilis* finds a closely allied form in the *Pliocene T. cigulatiformis* of Chili. Thus it would seem, that the Pliocene Coquimbo beds of Chili, the Entrerios beds of Parana, and the "Tehuelche" beds are in some degree correlated with the Cape Fairweather beds.. But since a large number of Coquimbo- and Entrerios-species are known (Philippi, Mœricke, v. Ihering), the above relations are not satisfactory, and if these beds are really contemporaneous, we should expect a larger number of affinities.

On the other hand, we must take into account the much more southern location of the Cape Fairweather beds than any of the other beds, and if they all really belong to the Pliocene, we should expect considerable climatic differences in their fauna.

For the present it is impossible to say, whether the few relations on the one side, and the differences on the other, indicate a difference in age, or a difference in geographical position. The solution of this question may be obtained by a closer examination of corresponding beds in the northern parts of Patagonia (from San Julian northward to Entrerios): we have numerous indications that such beds really exist there.

Mr. Hatcher's observations indicate the existence of such beds near San Julian. He discovered marine beds *unconformably overlying* the Patagonian beds at Darwin Station (Hatcher, 1900 a, p. 108). Here he collected only two species: *Ostrea patagonica* and *Trophon laciniatus* var. *inornatus.* The latter form most distinctly points to the Cape Fairweather beds, but the oyster is different. It is this the southernmost locality at which the true *O. patagonica* has been found, and the association of this Entrerios oyster with the Cape Fairweather *Trophon* suggests very strongly that both deposits may be identical in age, and that their difference may be due to their geographical location: then the Miocene Patagonian *Ostrea ingens* would remain the identical species in Pliocene times in the south, while it changes into *O. patagonica* in the Pliocene farther north.

It is not impossible that our locality at Darwin Station is identical with one of the type localities of Ameghino for the marine Tehuelche beds. V. Ihering (1897) mentions four species (*O. ferrarisi* = *patagonica*, *Pecten actinodes*, *Scalaria rugulosa* var. *obsoleta*, and *Trophon varians* = *laciniatus* var. *inornatus*) from a locality between Santa Cruz and San Julian, which he spells: Santa Rosa (pp. 225, 277, 296), Punta Rosa (p. 227) and Pta. or P. Rasa (pp. 322 and 323). Since the latter form is given for the same species, for which Santa or Punta Rosa is quoted, there is no doubt that the same place is intended. Mr. Hatcher informs me that he has the vague impression that the peninsula between the bay of San Julian and the sea is called "Punta Raza" by the sailors. If that is true, it is very probable that our locality at Darwin Station is not very far from, if not identical with Ameghino's Punta Rasa, since it is situated near the base of this peninsula. Punta Rasa is said to represent "Tehuelche" beds, and of the four species mentioned by v. Ihering, we possess 2 from Darwin Station (*Ostrea patagonica* and *Trophon inornatus*), and 2 from Cape Fairweather (*Pecten actinodes* and *Trophon inornatus*). This fact also is much in favor of the view that Hatcher's locality at Darwin Station as well as the Cape Fairweather beds belongs to the same horizon as v. Ihering's and Ameghino's Punta Rasa.

Another locality, which corresponds stratigraphically with the Cape Fairweather beds, has been discovered by Mr. Hatcher at Lake Pueyrredon, where marine beds again overly the Santacruzian beds, and cap the whole "Rio Tarde section" (Hatcher, 1900 a, p. 108). Only two species have been collected here; the one is *Ostrea ingens* in a form which approaches distinctly the Cape Fairweather type of this species, the other is a *Pecten*, apparently *P. geminatus*, but it is to be remarked that only casts have been found which render the identification doubtful: we may have to deal with *P. actinodes*.

While thus the correlation of the Cape Fairweather beds with other deposits still remains somewhat doubtful, we may safely say that they themselves are of *Pliocene* age. Further investigations of corresponding beds of other localities, especially of the marine "Tehuelche" formation of Ameghino are very desirable, and will probably throw much light upon the Cape Fairweather beds.[1]

ORIGIN AND DEVELOPMENT OF THE PATAGONIAN MARINE FAUNAS.

1. THEORY OF "ANTARCTICA."

We may take the marine fauna of the Miocene Patagonian beds as the standard for all fossil Patagonian faunas, since it is the only fauna that we may call "well-known." Of the Magellanian fauna only a small part is known, and the Cape Fairweather beds also contain only a comparatively small number of species.

One of the most striking characters of the Patagonian fauna is, as we have seen above (pp. 299–302), the presence of a number of species which show distinct affinities with New Zealandian and Australian fossils. This relation of Patagonia to New Zealand and Australia is no new feature: it has been observed before in land and fresh-water animals, and also in marine animals and in plants[2] by numerous authors, and we possess various theories for the explanation of this remarkable zoogeographical fact.

A very good—although not quite complete—review of the theories connected with these relations between the southern continents has been

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[1] The paper of *Borchert* (Die Molluskenfauna und das Alter der Parana-Stufe. Stuttgart, 1901) was received after the above was written. The dissimilarity of the Parana and Cape Fairweather faunas is very striking, and the relations between them are still unsettled.

[2] A partial list of animal and plant groups, in which coexistence of allied forms in Australia and South America has been observed, is given by Hedley (1895, p. 3, footnote 1).

given by *Hedley* (1895) who has formulated his own views in the following words (l. c., p. 6): "... *during the Mesozoic or older Tertiary, a strip of land with a mild climate extended across the South Pole from Tasmania to Tierra del Fuego, and ... Tertiary New Zealand then reached sufficiently near to this Antarctic land, without joining it, to receive by flight or drift many plants and animals.*"

This theory, which has been worked out more especially in its bearing upon the Australian and Pacific faunas in a later paper by the same author (Hedley, 1899), differs in important points from all theories hitherto advanced, as it demands only a minimum of land extension, and further, as he states expressly (p. 7) that this Antarctic continent ("Antarctica") was probably "an unstable area, at one time dissolving into an archipelago, at another resolving itself into a continent." He admits further the existence of certain facts that suggest a former connection of South Africa also with Antarctica.

The facts leading to this and the older theories were observed long ago, and consist of a marked similarity in the animal and plant life of the respective continents, a similarity which is also recognizable, as we have seen above, among the fossil marine animals. With the exception of the theory of *Wallace* (1876, pp. 287 and 461), who believes that the common elements of the southern faunas have been derived from a generally distributed stock, which was pushed by the competition of other animals into the southern ends of the continental masses, where it alone survived, all explanations of this zoogeographical fact have started from the fundamental idea that there must formerly have existed a connection between the respective parts by a land bridge, and opinions differ only as to the location and probable extent of it. As to the time of its existence there is a fairly complete unanimity among the writers on this subject, provided that they have given any expression at all of their opinions on this point; if they construct this bridge for any particular time, it is for the end of the Secondary or the beginning of the Tertiary. Only Forbes (1893) makes an exception by putting his Antarctica into the "Ice age."

To my knowledge,[1] *Hooker* was the first to hold the opinion that, with reference to plant life, there may have existed a connection of the different parts of Antarctic and Subantarctic continents and islands by land.

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[1] See Ortmann, "The Theories of the Origin of the Antarctic Faunas and Floras" (American Naturalist, v. 35. February, 1901).

This opinion is the more remarkable, since it was first expressed at a time (Hooker, 1847, p. 211), when Darwin's "Origin of Species" had not yet been published. Although Hooker hints at this possibility very cautiously, he returns to this point in 1853 (p. xxiii ff.) more emphatically, and again in 1859 (pp. xvii and civ), and in this case from a Darwinian point of view (he refers here to Darwin's unprinted "Origin of Species"). His general idea was, that the southern floras indicate one great vegetation, which may once have covered a larger southern area of land; but he leaves it uncertain where was the position of this southern continent, especially he does not connect it with the polar lands of the southern hemisphere. Some of his remarks even indicate that he was in favor of placing this land connection in lower latitudes (about that of Tierra del Fuego and Kerguelen Islands).

Among zoölogists this theory of former connections of the southern lands was not taken up, until *Ruetimeyer* (1867, pp. 15 and 23)—but without reference to Hooker—expressed the opinion that the Antarctic continent is to be regarded as a center of a separate development of a certain stock of animals, from which the inhabitants spread northward, and that we should regard the faunal elements common to Australia, South America and South Africa as remnants of this Antarctic fauna. He expresses no opinion on the probable extent and configuration of this southern center, but only says that the assumption of a connection of the three southern land masses with the Antarctic continent would explain many facts of present distribution.

The next to discuss this question was *Hutton* (1873 and 1874). He has practically the same idea as Ruetimeyer, and assumes a former greater extension of land in the southern hemisphere, South America, New Zealand, Australia and South Africa were connected by a continent, which in its largest extension existed at the beginning of Cretaceous times, but which was not necessarily a single, completely continuous mass at one and the same time.

Accepting Wallace's opinion (1876) mentioned above, Hutton subsequently changed this view (1884), and abandoned the connections of these regions by an extension of the Antarctic continent, especially he no longer believes that South Africa had a connection with it. But he still maintains that there was a land connection between Australia and South America, and he constructs this bridge across the middle part of the Pacific Ocean by way of a now submarine plateau (p. 433) "from Guinea and North Australia, through the Fiji and Tonga Islands to Samoa, spreading South to New Zealand and North to the Ellice, Gilbert, Marshal, Caroline and Pelew Islands;" another plateau "extends from Chili in a northwest direction to the Society Islands and Cook's Islands, including Juan Fernandez, Easter Island, the Paumotus and the Marquesas Islands." Thus these two plateaus closely approached each other, if they were not actually connected.

Shortly after Hutton's first publication, *Gill* (1875) presented another somewhat similar view, but this was given in a very vague form. Considering the distribution of fishes, he divided the land masses in two large sections, an *Eogæa*, comprising Africa, South America and Australia, and a *Cænogæa*, comprising the rest of the present continental masses. He does not introduce the Antarctic continent at all, and does not give any details of the connection, simply intending this as a zoogeographical division. But the fact that he calls these two sections "areas of derivation or gain from more or less distant geological epochs," and that he refers to them again later (*Science*, 8 June, 1900), calling them "hemispheres," makes it apparent that he understood his Eogæa as a large continental mass.

Thus we have to distinguish, practically, three different theories, aside from Wallace's: (1) The Ruetimeyer-Hutton theory of the connection through an Antarctic continent (1867, 1873); (2) Gill's Eogæa theory (1875); (3) Hutton's theory of 1884, constructing a connection across the mid-Pacific. In all these, the fundamental idea first expressed by Hooker, that there must once have been a connection by land, serves as a basis.

Gill's theory has never been taken up by anybody else, while the two other theories have been taken into consideration by subsequent writers. Among them we should mention in the first line *H. O. Forbes* (1893). He practically accepts the first and oldest theory of Ruetimeyer and Hutton, in assuming the former existence of a larger Antarctic continent; but on the other hand, he goes far beyond Ruetimeyer's and Hutton's ideas, in constructing this continent on a very large scale: his "Antarctica," in its coast line, follows nearly what is now the 2000 fathom line, and extends in broad stretches over Australia and New Zealand to the Fiji Islands, to the Mascarene Islands and South Africa, and to South

America; in other words, it is an exaggeration of Ruetimeyer's and Hutton's conception of it. As to the time of existence of this huge continental mass, Forbes differs from all previous writers in placing it in the "Ice age" of the northern hemisphere.

Von Ihering (see: 1891 and 1894) has accepted both theories of Hutton with a slight modification, assuming a connection running from South America (Archiplata, see below) by way of Antarctica to Australia, which was in turn connected with a "Pacific continent." This Pacific continent does not correspond exactly to Hutton's (1884) bridge from Australia to Chili, since v. Ihering does not assume a direct connection of it with Chili, and thus v. Ihering's theory conforms more to the Ruetimeyer-Hutton theory. This is shown principally by the fact that for Patagonia v. Ihering (1897) urges chiefly the Antarctic origin of a part of its fauna, not a Pacific origin.

It is not necessary to quote here the large number of other writers, who have pointed out—in connection with their studies in special groups of animals or plants—the allied elements in the faunas and floras of the southern continents, since none of them has materially added to or changed the existing theories; it may be sufficient to say that all of them—if they have expressed any opinion at all—hold the view that there once existed an Antarctic continental connection between the respective parts, without venturing into a closer discussion of the question as to the probable extent and location of it.

We must, however, mention especially the writings of *Hedley* (1895 and 1899). The main idea of Hedley has been reproduced above (p. 311), and it remains to point out its relation to the theories set forth above. There is no doubt that Hedley's view keeps close to the old Ruetimeyer-Hutton theory in assuming an ancient Antarctic continent. But while Forbes enlarged this continent to an incredible size, Hedley chooses the safest and most conservative way in not extending the Antarctic land beyond its present limits unless absolutely necessary. Thus he leaves the known parts of the Antarctic continent as they are, and extends them only in narrow strips so as to join Australia, South America, and (possibly) South Africa.[1]

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[1] The same opinion that we have to restrict the land connections of the southern continents was expressed again by *Lydekker* (1896, p. 134), but apparently without knowledge of Hedley's article of 1895. For the rest, Lydekker does not favor any particular theory, and even leaves it uncertain whether there was an Antarctic or a Pacific land bridge.

Finally *Osborn* (1900, p. 565 and map on p. 566) accepts fully the theory of Antarctica, and, in the main, follows Forbes, although his reconstruction of this old continent by elevation to the 3040-meter sounding line is not quite as extensive as that of Forbes. In this respect Osborn's view is intermediate between Forbes' and Hedley's, and decidedly approaches our conception.

Thus we see that of the various theories advanced for the explanation of the similarity of the southern faunas, the theories of Gill, Wallace, and also the second theory of Hutton have not been considered seriously by subsequent writers, while the oldest one, formulated by Ruetimeyer, has furnished the fundamental idea for them. One of them, Forbes, has pushed this idea to an extreme, which we cannot accept by any means, while Hedley has attempted to restrict it to reasonable proportions, and to reconcile it with the zoogeographical facts as well as with the present conditions of distribution of land and water in the southern hemisphere. In this sense, Hedley's specification of the Ruetimeyer-Hutton theory is the most conservative, especially as compared with Forbes' fancies, and it is only natural that we should accept his ideas as the most probable of all, that is to say, *we accept the first theory of Ruetimeyer and Hutton, with the restrictions put upon it by Hedley.*

For our present purpose, this acceptance of the theory of the former existence of an "Antarctica" means that we are of the opinion that the elements of the fossil Patagonian fauna resembling certain forms in New Zealand and Australia are to be regarded as an additional proof of the former connection of South America with Australia and New Zealand. Since the respective shells are all preëminently inhabitants of the littoral, of shallow water, and since it is very probable that they were unable to cross over large extents of deep sea, a region of shallow water must have formed a connection between both parts, and nothing is more natural than to assume that this shallow water accompanied the coast line of ancient "Antarctica." It does not necessarily follow that this coast line was a continuous line along the uninterrupted shores of a truly continental mass, but it may have consisted of a chain of islands, at least in part. As Hedley urges, we should not regard the Antarctica as a solid continent, but probably it was broken up at certain times into parts, which were united again in one or another direction. This assumption seems to be chiefly supported by the evidence furnished by land animals, and will be discussed elsewhere in this work.

We wish only to emphasize here the fact that the marine fossil Patagonian fauna materially strengthens the theory of "Antarctica" by giving evidence for the former existence of a coast line, at any rate of shallow water, between Australia and New Zealand on the one side, and South America on the other.

As to the connection of Africa with Antarctica, hardly any evidence is found among our material; we should, however, call attention to the fact that the Bryozoan *Tennysonia subcylindrica* of the Patagonian beds is extremely closely allied to the only known species of the genus, *T. stellata*, which is recorded from the Cape of Good Hope.

This instance would hardly have any value if it was an isolated one. But other groups of animals have furnished similar cases, and, although these are less pronounced and less frequent than the cases of relations between South America and Australia, we must take them into account, and grant a former extension of Antarctica in the direction toward South Africa.

In the map (pl. XXXIX) accompanying this report we have tried to reconstruct ancient Antarctica: it has been assumed that the Antarctic portions of land known at the present time (the region around Graham Land; Victoria and Wilke's Land; Enderby and Kemp Land) form parts of a still existing Antarctic continental mass; we have not tried to enlarge the boundaries of this continent, except only to such a degree that a connection is formed with the present southern ends of the continents of Australia, South America and South Africa. As regards Australia (and New Zealand), we have followed Hedley's idea, as expressed in his map in his second paper (1899, p. 404); as to the connection with South America we have followed chiefly the tectonic relations known to exist between Tierra del Fuego, South Georgia, South Sandwich and Graham Land, as represented by Fricker (1900, chiefly p. 140 ff.); and as to the much more doubtful connection with South Africa, we have taken into account chiefly the results of the German Valdivia Expedition, as published by Chun (1900, Lieferung 4).[1]

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[1] As to the tectonic configuration of Antarctica, and the evidence thus furnished for its former connections with Australia, New Zealand and South America, compare the article of Gregory (Gregory, T. W. The work of the National Antarctic Expedition in: Nature, vol. 63, No. 1643, 25th April, 1901, pp. 609–612), and the sketch map given by him (p. 611). Unfortunately this very important note was published after the above was written; it supports, however, in a large part the ideas set forth above.

Although in our map Antarctica has been drawn as a continental mass, we have mentioned above that it was—at certain times—possibly broken up into archipelagoes. Antarctica may have been a continent once, but it is hard to say at what time. We may safely say—and all authors except Forbes agree in this—that it existed about the close of the Cretaceous and the beginning of Tertiary time, but we do not know anything beyond that. In this respect it is interesting to see what evidence is furnished by the geological configuration of southern Patagonia. Through Mr. Hatcher and others we know that the Cretaceous ends with a series of deposits, called Guaranitic beds (see Hatcher, 1900 a, p. 93), which indicate a general upheaval of the land. After the deposits of these beds the respective parts were land, and no deposits were formed till the beginning of Oligocene times (Magellanian beds). From this time on we have a slow subsidence, which reaches its maximum in Patagonian time (lower Miocene), and then follows, in Santacruzian time (upper Miocene): another upheaval, which culminated, possibly, in the final formation of the Cordilleras at the close of the Miocene. Within these general movements, there were a number of smaller oscillations, for instance like that indicated by the Upper Lignites (Hatcher, 1900 a, p. 99). It is beyond the scope of this report to go more into detail; but we may say here that the geology of southern Patagonia points to a maximum extent of land at the end of Secondary time and during the Eocene, and to a large—if not maximum —extent of water during lower Miocene time. If it is permitted to draw any conclusions from this, we should put the largest extent of Antarctica at the end of the Cretaceous and in the Eocene, while a marked, if not final, interruption was brought about in the lower Miocene. Within this time, smaller, and more or less important oscillatory movements took place.

This refers, however, only to the history of the Antarctic continent in the first part of the Tertiary period. In Cretaceous times similar movements may have taken place, so that the connection of Antarctica with the present continents (or parts of them) may have been established and destroyed repeatedly. And indeed v. Ihering (1894, pp. 405 and 425) dates some connections of America and Australia with Antarctica far back in Mesozoic times. (Compare v. Ihering's Mesozoic "Archinotis," 1893, p. 9.)

And further, the above refers only to South America. It is not at all necessary that the connection between Antarctica and the Austral lands should have coexisted with that between Antarctica and South America; indeed, it is quite possible that the one was interrupted when the other was established. The same refers to the connection of Antarctica with South Africa.

As regards the latter point, there is no doubt that some evidence in favor of this connection has been found.[1] But this evidence is much less distinct than in the case of the other two continents. Possibly the junction of South Africa with Antarctica is to be sought for far back in Mesozoic time, or it was, in the Tertiary, only of short duration. As to the reconstruction of this bridge, we must pay due attention to the fact that great depths of the sea have been discovered by the "Valdivia" to the south of the Cape of Good Hope (see Chun, 1900, p. 180 and map by G. Schott, ibid. Lieferung 4). Although great depth of the present sea is by no means a decisive argument against the former existence of land (as for instance Chun believes), it is better, if no other evidence is forthcoming, to be as conservative as possible, and not to interfere with these great depths. In our map we have given two indications for this land bridge: the one going from Enderby, or possibly Wilke's Land, by way of the Kerguelen, Crozet and Prince Edward Islands, the other following the submarine ridge in the South Atlantic indicated by Schott in his map, and connecting southwest Africa with the Falkland Islands by way of Tristan da Cunha. Which one of these bridges, or whether either of them, is correct, we have at present no means of deciding.[2]

Although there is still much room for speculation, we wish to emphasize the fact that the fossil marine animals of Patagonia distinctly point to this old connection of South America with Antarctica at the end of Cretaceous and the beginning of Tertiary times, and that Antarctica in turn was at some time connected with Australia and possibly with New Zealand. As Hedley maintains, there was no continental connection with the latter; we cannot decide this question, since we treat only of *marine litoral* animals, and for them a close vicinity of the respective litoral waters is sufficient. The Patagonian fauna demands a theory that assumes a compara-

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[1] I should like particularly to call attention to the presence of the freshwater fish *Galaxias capensis* at the southwestern corner of Africa (see Weber, 1897, p. 197).

[2] The extremely uneven and rugged bottom of the sea between Enderby Land and the Kerguelen Islands, as described by Chun, is in favor of the first assumption; as regards the second, I refer the reader to what Weber (1897, p. 198) says about a direct communication of southwest Africa with v. Ihering's "Archiplata."

tively shallow sea, where there is now deep water, and when we make this assumption, there is no difficulty in constructing a continental connection of the same parts, as soon as other lines of evidence force us to do so.

This communication of the Patagonian seas with Antarctica through shallow water persisted through a large part of the Tertiary, probably almost up to the recent time. V. Ihering has already assumed a repeated and continuous immigration of *marine* Antarctic forms into the South American litoral (v. Ihering, especially 1897 b, pp. 532 and 533), and there is no reason to reject this theory. That during Tertiary times a direct communication was present with the nearest parts of Antarctica, is quite probable after the discovery of marine fossils on Seymour Island, Dirck Gherritz Archipelago (Graham Land). The fossils found there, especially the presence of a species of *Cucullæa*, strongly suggest Patagonian beds[1]).

2. RELATIONS OF THE PATAGONIAN DEPOSITS TO OTHER PARTS OF SOUTH AMERICA, AND TO THE REST OF THE WORLD; THEORY OF "ARCHIPLATA" AND "ARCHHELENIS."

We have seen above that the most characteristic feature of the Patagonian fauna is the dissimilarity to other faunas of about the same age, the resemblance to the Antarctic faunas of Australia and New Zealand

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[1] It may be well to state here the facts about these Tertiary fossils, since they have been repeatedly mentioned lately, but without proper quotations, so that it is difficult to keep track of the literature.

These fossils were collected in the season 1892–3 on Seymour Island, Dirck Gherritz Archipelago (northeast of Graham Land) in 64° 24′ S. Lat., by Captain Larsen of the "Jason," and given to Dr. C. W. Donald of the "Active," who brought them back to Scotland. Dr. J. Murray was the first to notice them in the Geographical Journal, vol. 3, January, 1894, p. 11, footnote, and he says that—according to Messrs. G. Sharman and E. T. Newton, of the Geological Survey,—they belong to the genera *Cucullæa*, *Cytherea*, and *Natica* (besides pieces of Coniferous wood). He points to the probable Tertiary character of them, and compares them with lower Tertiary fossils of England and Patagonia, which would especially refer to the *Cucullæa*.

Dr. Murray again refers to these fossils in the Scottish Geographical Magazine, vol. 10, April, 1894, p. 195, and they are also mentioned in Peterson's report on Captain Larsen's discoveries (Peterson, Die Reisen des "Jason" und der "Hertha," in: Mitteilungen der Geographischen Gesellschaft in Hamburg. 1891–92. 1895, p. 273). Again they have been mentioned by Hedley (1895, p. 7), by Heilprin (Science, Febr. 28, 1896, p. 306), by Ohlin (Ymer, 1898, h. 4, p. 301), and by Fricker (1900, p. 182), but with insufficient and partly incorrect quotations.

excepted. Among the contemporaneous deposits in South America, only the Navidad fauna of Chili is related to the Patagonian, and, indeed, in such a degree that we are able to draw valuable conclusions from the comparison with it.

If we come to compare the Patagonian deposits with other American deposits, the close affinity disappears. In this respect one of the most important points is the dissimilarity of the Miocene fauna of northern Peru (Payta and Tumbez), as described by Grzybowski (1899). This fauna possesses only a few features in common with the Navidad fauna, but hardly any with the Patagonian, and the most important is the presence of a species of *Struthiolaria* in these beds. For the rest, this fauna (called Ecuadorian province by Grzybowski) shows close affinities to the Caribbean province, *i. e.*, the Miocene deposits of the West Indies, and even in some respects to the European Miocene.[1]

We have seen above that it was possible to compare our Patagonian material to some extent with Miocene faunas of Europe and North America, and the latter is in a certain degree a dependency or offshoot of the West Indian fauna, but these relations are only very general, consisting in a more or less close affinity of species, but hardly in identity. (The fact that we did not find a larger number of relations to the West Indies is probably due to the chiefly Oligocene, not Miocene, age of the latter beds, according to Dall.) Thus we have on the one hand a close relation of the Patagonian beds to the Chilian, which extends to an identity of a number of species, while, on the other hand, with the Caribbean and European provinces only remote relations can be established. The deposits of northern Peru are closely connected with the Caribbean province, although a few closer relations with the Chilian beds are recognizable.

For the explanation of these facts we have a theory propounded by v. Ihering, which we may conveniently call his *Archiplata-Archhelenis-theory* (v. Ihering, 1891, pp. 434, 437, and especially: 1893; here on p. 9 a list of other publications by the same author referring to the same subject; and 1894 p. 404 ff.).

Von Ihering maintains that South America is not a genetic unit, but consists of two parts, which became united subsequently: a southern part

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[1] According to Dall (1898 b and in: Science, Novemb. 23, 1900, p. 808) the so-called Miocene of the West Indies is really Oligocene, and this would possibly affect slightly Grzybowski's determination of the age of the Peruvian beds.

which comprises what is now Chili, Argentina, and southern Brazil, and which he calls "Archiplata," and a northern part comprising chiefly northern Brazil and Guiana, which he calls "Archibrazil," resp. "Archiguyana," or "Archiamazonas." This latter part was connected—in Mesozoic times—with West Africa by way of St. Helena, and he calls this continental mass "Archhelenis."

Archiamazonas or Archhelenis were separated completely from Archiplata by a broad stretch of sea, which extended across the present continent, where is now the valley of the Amazon River, the Cordilleras not being yet formed, and thus a broad communication existed between what is now the Atlantic and Pacific Oceans.[1]

Since Archiamazonas was connected with Africa, and this in turn in a certain degree with India and Europe, the assumption of this old continent Archhelenis (which, by the way, differs only in the supposed geographical position from the "Atlantis" of previous writers) explains satisfactorily the relations of the marine faunas of the West Indies (and southern North America) with Europe. The connection of Archiplata with Antarctica explains its relations to Australia and New Zealand, and the existence of a broad connection of the Atlantic and the Pacific separating Archiplata and Archhelenis (or Archiamazonas) explains the dissimilarity of the southern and northern faunas of South America.

Nevertheless, as we have seen, there are some remote affinities between Patagonia and the West Indies, and even Europe, and apparently this is due to the fact that—confining our view to marine animals—communication was possible in a certain degree between the shores of Archiplata and Archiamazonas. This fact is most plainly seen in the presence of Navidad fossils in corresponding deposits of northern Peru: the Navidad beds were apparently deposited near the northwestern extremity of Archi-

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[1] A former connection of the Atlantic and Pacific oceans up to Miocene times has been generally accepted, but this connection was placed chiefly, where is now the Isthmus of Panama. According to Hill, however (The Geological History of the Isthmus of Panama, etc. in: Bull. Mus. Comp. Zool. Harvard Coll., vol. 28, 1898), a Central American barrier separating both oceans has existed since Jurassic times, which was only temporarily interrupted at the close of the Eocene. On the other hand, Hill admits that there must have been a broad and important connection of oceans somewhere, but not at Panama.

It seems to me that this broad connection is to be found in the sea across South America mentioned above, and, personally, I am much in favor of the theory that the communication of the Atlantic and Pacific took place, not at Panama, but farther south in the sea separating v. Ihering's Archhelensis and Archiplata (see: Science, December 14, 1900, p. 929).

plata, and the Payta-Tumbez beds near the southwestern extremity of Archiamazonas: at these places we have probably these two continents at their points of nearest approach to each other, and an exchange of marine forms may have been possible. This exchange, however, was rendered more difficult by climatic conditions, and especially, although possible in a certain degree between the Ecuadorian and the Chilian province, it was hard for the Caribbean and Ecuadorian fauna to migrate farther south, into the Patagonian region.

This leads us to investigate the probable climatic conditions of Patagonian times. There is no doubt that in Miocene time, when the Patagonian beds were deposited, a considerably warmer climate prevailed in these regions, a fact that has been recognized by all previous writers on this question (see for instance v. Ihering, 1897 b, p. 535). Of the fossils of the Patagonian beds the following point to a warm, tropical or subtropical climate: *Scutella*, *Perna*, *Cucullæa*, *Dolium*, *Ficula*, *Murex* subgen. *Phyllotonus*, *Terebra*, *Drillia*, *Borsonia*. A part of these genera has also been found in the Navidad beds. On the other hand, a number of characteristic tropical genera are missing in the Patagonian beds, which have been found in the corresponding Chilian beds, for instance: *Conus*, *Mitra*, *Oliva*, *Cypræa*, *Cassis*, *Columbella*. Of these, *Mitra*, *Oliva*, and *Columbella* are represented in the Miocene of northern Peru, and the presence of a *Strombus* in the latter beds (upper Miocene) points still more to a truly tropical character.

Thus we may say that the Patagonian beds—although still retaining a subtropical character—differ distinctly from the Navidad beds in the lack of some features, which depend probably on the climatic conditions, and that the Navidad beds approach in just these features the tropical deposits of the Caribbean province, where genera like *Conus*, *Strombus*, *Mitra*, *Oliva*, *Columbella*, *Cypræa* form a very prominent element of the fauna.

In this connection we may also mention the complete and very singular lack of the genus *Cerithium* in Patagonia. The Navidad beds contain only a single species of this genus, which is in striking contrast to the contemporaneous deposits of the northern hemisphere.

While we thus should claim for the Patagonian beds at least a subtropical climate, we have, on the other hand, in them the beginning of a differentiation of an "Antarctic" fauna, or, more properly speaking, of an *extratropical* fauna of the southern hemisphere, which is a pendant to, but entirely different from the extratropical fauna to the north of the tropics. This fauna, of course, developed as soon as the climatic differentiation of the South Pole offered the necessary conditions, and we may say that for a large part of this fauna the shores of the supposed Antarctic continent formed the center of origin. Since Miocene Patagonia was apparently a part of this center, it is only natural that we should find here indications of this Antarctic fauna.

Some elements of the latter in the Patagonian beds are no doubt the ancestors of corresponding forms still living in these regions, and a few of them have not changed at all, so that they must be regarded as identical species, for instance (compare p. 289): *Aspidostoma giganteum*, *Terebratella dorsata*, *Mytilus magellanicus*, *Infundibulum corrugatum*, *Infundibulum clypeolum*, *Verruca lævigata*, *Balanus psittacus*. One species, *Mytilus chorus*, is no longer found in southern Patagonia, but has retreated a little northward, to Chili. Other species are no longer found in South America: *Cellaria fistulosa* (otherwise almost cosmopolitan), *Heteropora pelliculata* (New Zealand and Japan), *Rhynchonella squamosa* (Kerguelen Islands), *Magellania lenticularis* (New Zealand).

In other cases, the fossil and living species are to be regarded as different, but they are apparently genetically connected. This is the case in the following genera (see v. Ihering, 1897 b, p. 532): *Voluta*, *Trophon*, *Turritella*, *Natica*, *Venus*, *Meretrix*, *Dosinia*, *Pecten*, to which we may add *Bouchardia*. This is especially remarkable in the genus *Voluta*, where three chief types of living Patagonian *Volutæ*, *V. ancilla*, *magellanica*, and *brasiliana*, have their prototypes in the following species: *V. dorbignyana*, *domeykoana* and *ameghinoi*.

While all these forms are characteristic of the American part of the Antarctica, some of them, for instance the *Volutæ*, reappear in similar types in Australia and New Zealand. The same is true of *Siphonalia domeykoana*, which does not seem to exist at present in South America, but it is still represented in the recent seas of New Zealand in *S. dilatata*, and analogous are the cases of *Struthiolaria*, *Malletia*, *Sigapatella*. *Struthiolaria* is found fossil in South America (Oligocene of Patagonia, Miocene of Patagonia, Chili, and northern Peru) and in New Zealand (Miocene upward) and still lives in New Zealand waters. *Malletia* is known fossil from the Miocene of Patagonia, Chili, and New Zealand, and living from Chili and New Zealand. *Sigapatella* is found in the Miocene of Patagonia and Chili, from the Oligocene upward in New Zealand, and lives in New Zealand waters. Perhaps we may put into this category the subgenus *Cominella* of *Buccinum*, which, although known fossil in the northern hemisphere, is at present confined to the southern, the metropolis of the typical species being New Zealand (see Tyron, 1881, p. 201).

Finally, in *Terebratella dorsata*, we have a species that in the fossil state is common to New Zealand and Patagonia, while at the present time it is extinct in New Zealand, but survives in Patagonia.

Thus we see that, in the Miocene Patagonian beds, we must distinguish *two chief faunal elements:* a *tropic-subtropical* one, which shows relations to the tropical parts of the rest of the earth (and through these with the subtropical faunas of the northern hemisphere, in Europe and North America), and an *antarctic* element, which is peculiar to the southern hemisphere, and which shows relations only to the faunas belonging to or connected with ancient Antarctica. The first element was the chief factor that enabled us to compare the Patagonian beds with deposits of the northern hemisphere, and thus to ascertain their age, while the other has given us valuable hints for the comparison with New Zealandian and Australian beds.

For the later history of the Patagonian marine fauna the Cape Fairweather beds are valuable. While their fauna shows on the one side a continuation of Patagonian types (see p. 307), we have here, on the other side, an *introduction of new forms.* These new elements are possibly in large part new immigrants from the Antarctic shores, and, as v. Ihering (1897 b) urges, this immigration from the south must have continued on a large scale almost up to the present time, at least to the Pleistocene. This later introduction of Antarctic elements is the most important change in the general character of the fauna that has taken place since the time of the deposition of the Patagonian beds, and is—in connection with the retreat of the tropical elements toward the north—the most prominent feature that distinguishes the present Patagonian, Magellanian, and Chilian faunas from the fauna that lived on the shores of ancient "Archiplata."

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PART III. MAMMALIA OF THE SANTA CRUZ BEDS. MARSUPIALIA.

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INTRODUCTION.

THE first descriptions of marsupials peculiar to the Santa Cruz formation of Patagonia appeared in a brief dissertation by Dr. Florentino Ameghino, issued at Buenos Aires in 1887. It soon became apparent from the publication of figures in later papers by the same author (Amegh., 1889, 1894) that some of these peculiar genera resembled closely the pouched wolf or thylacyne of Tasmania, while others were more or less like the smaller diprotodont marsupials of Australia, and still others appeared to be related to the opossums of North and South America. These resemblances to existing genera, so far as could be determined from the figures and descriptions available, were confined mainly to the teeth and to the shape of the jaw with its strongly inflected angle so characteristic of, although not entirely restricted to, marsupials.

A large amount of material illustrating this group was secured by Messrs. Hatcher and Peterson and we are now able, for the first time, to ascertain what these animals were like and whether or not they were related to existing forms.

It was originally planned that Mr. Hatcher should contribute this part to the series of volumes describing the magnificent collections which his energy and devotion to science have brought together in the museum of Princeton University. His untimely death necessitated a transfer of the work which was to have been his to other hands, and, at the request of Professor Scott, it was undertaken by the writer.

Before proceeding farther, the writer desires to express his indebtedness to Professor Scott for permission to study this important group and for much helpful criticism and encouragement during the progress of the work. A number of photographs of type specimens in the Ameghino collection taken by Professor Scott have proved of great value in the study of the diprotodont forms. Indeed, without their help, it would have been impossible to be at all certain regarding the determination of many of the species. The American Museum collection of Santa Cruz marsupials, especially rich in diprotodonts, was placed at the writer's disposal by Professor H. F. Osborn, who has also contributed much valuable information regarding marsupial characters in general. Several important suggestions by Dr. W. D. Matthew and Mr. Charles Knight have been incorporated in the drawings of the restored skeletons of *Prothylacynus*, *Borhyæna* and *Cladosictis* (Pl. LXI). Dr. J. A. Allen has kindly permitted the examination and illustration of a skull of *Cænolestes obscurus* in the collection of the American Museum of Natural History (Pl. LXIII, figs. 14–14*b*). To Dr. Oldfield Thomas, of the British Museum, the writer is indebted for the loan of valuable osteological material illustrating the skeleton of *Thylacynus*, without which it would have been impossible to work out in a satisfactory manner the relationships of the Santa Cruz carnivorous marsupials. Liberal use has been made of this material in the figures presented in the accompanying text and plate (Pl. LXV, figs. 1–1*b*).

CLASSIFICATION OF THE SANTA CRUZ MARSUPIALS.

As among recent marsupials, two suborders may be recognized, agreeing in every respect with the Polyprotodontia and Diprotodontia. It has seemed advisable to retain the major subdivision of the order based on dental characters rather than to follow the recent classification proposed by Bensley (1903) in which dental characters are subordinated to foot structure, because practically nothing is known of the feet in the Santa Cruz diprotodonts, and what little is known of the feet in *Cænolestes*, their nearest living ally, adds to the confusion already existing in the classification of the Marsupials by combining a non-syndactylous foot with a diprotodont dentition.

The Santa Cruz representatives of the Polyprotodontia are carnivorous, and, with the exception of *Microbiotherium*, a minute opossum, have been placed by Ameghino (1894, p. 108) in a suborder termed by him the Sparassodonta, a group which he regards as referable neither to the creodonts, the placental carnivores, nor the carnivorous marsupials. A comparison of the so-called Sparassodonta with existing carnivorous marsupials shows that they possess in common a large number of characters, either confined entirely to marsupials, or peculiar to but few additional orders. An examination of the following list will, it is believed, convince the reader that the Sparassodonta are true carnivorous marsupials and not worthy of subordinal rank.

MARSUPIAL CHARACTERS OF THE SO-CALLED SPARASSODONTA.

1. A typical marsupial dental formula, $\frac{4-3}{3}, \frac{1}{1}, \frac{3}{3}, \frac{4}{4}$.	1. The presence of three incisors above and below is exceptional among marsupials. A fourth molar occurs in *Otocyon* and *Centetes* among placentals.
2. The number of successional teeth is reduced below that characteristic of the placentals.	2. According to Ameghino, the number of teeth having deciduous predecessors is greater in the Santa Cruz forms than among existing marsupials but less than in the placental Carnivora.
3. The nasals are broad posteriorly, excluding from contact the frontals and maxillæ.	3. A posterior broadening of the nasals is characteristic of most existing marsupials. The contact between the maxillary and frontal is more or less extensive but may be reduced to zero as in some specimens of *Trichosurus vulpecula*. Certain of the Creodonta (*Harpagolestes*, *Dromocyon*, *Mesonyx*) also show the posterior expansion of the nasals.

4. Lachrymal spreading out on the face. Lachrymal duct within the orbital rim.	4. In most marsupials the perforation for the lachrymal duct is either on or external to the orbital rim. In *Thylacynus* and in some specimens of *Borhyæna* there are perforations both within and without the orbit. The facial expansion of the lachrymal is common to marsupials and also to a number of the Creodonta and Insectivora.
5. Antero-posterior shortening of basis cranii.	5. Characteristic of carnivorous marsupials.
6. The mandibular angle is strongly inflected.	6. Mandibular angle more or less strongly inflected in all marsupials except *Tarsipes*. This character is also developed in some of the Insectivora and in Creodonts of the Mesonychid phylum.
7. An alisphenoid bulla present in some genera, absent in others. Tympanic annular and unfused with the adjacent elements in genera with bulla, unknown in those without alisphenoid bulla.	7. The alisphenoid bulla is a marsupial-insectivore character.
8. Basisphenoid perforated by internal carotid artery.	8. Characteristic of the Marsupialia and Monotremata. *Acrobates pygmæus* is exceptional in lacking this perforation, the internal carotid entering the skull through a foramen between the petrosal and the basisphenoid (Weber, Die Säugetiere, p. 46).
9. Posterior extension of the malar bar to form the preglenoid process.	9. A marsupial character.

10. Optic foramen confluent with sphenoidal fissure.	10. Not exclusively marsupial, although characteristic of that order.
11. Basisphenoid and alisphenoid ridged as in existing marsupial carnivores and unlike the structure of this region in the placentals.	11. "In the marsupial *Carnivora* the basisphenoid is relatively longer than in the placental *Carnivora*, and, at its posterior part, it sends a ridge downward from that part of each lateral margin which is not overlapped or covered by the base of the alisphenoid, the suture of which long continues distinct. These ridges, with the alisphenoid, render the whole under surface of the basisphenoid canaliculate, or concave transversely; the basisphenoid is flat beneath in the placental *Carnivora*, and that part of the base of the skull is made canaliculate by the development of the ectopterygoid plate from the alisphenoid; these plates exist likewise in the marsupials, but, as they extend backwards to join the alisphenoid bullæ, they diverge from the basisphenoid ridges and are external to them." (Owen, Phil. Trans. Royal Soc. London, Vol. 149, p. 315, 1860.)
12. Posterior border of palate thickened.	12. Characteristic of the majority of existing marsupials. Present also in some of the Creodonta (Mesonychidæ).

13. Posterior border of palate perforated by a large foramen on either side of the posterior nares.	13. A marsupial character.
14. Premaxillæ excavated for reception of the tip of the lower canine.	14. The same structure occurs in *Dasyurus*, *Thylacynus* and *Didelphys*, but is not present in *Perameles* and *Sarcophilus*.
15. Palatal vacuities absent.	15. Present in the majority of living marsupials. Absent in some species of *Macropus* and *Petaurus*. Usually thought of as primitive, but more probably to be regarded as a secondary character. Found also among the Insectivora.
16. Presence of a vascular foramen (the post-zygomatic of Cope) perforating anteriorly the base of the zygoma below or within the lip of the post-glenoid foramen.	16. Confined to the Marsupialia and Monotremata. (Cope, Proc. Am. Phil. Soc., Vol. 18, p. 453, 1880.)
17. Presence of a large vascular foramen (the sub-squamosal of Cope) perforating the squamosal on or above the crest which connects the base of the zygoma with the inion.	17. Characteristic of the Marsupialia, but not confined to that order. Absent in placental carnivores.
18. Epipubic ossifications absent.	18. Cartilaginous and vestigial in *Thylacynus*.
19. Sutures of the skull and epiphysial elements of the skeleton distinct in fully adult individuals.	19. Not strictly a marsupial character, but indicative of marsupial affinities, when considered in connection with the other characters presented.
20. Transverse process of seventh cervical perforated by arterial canal.	20. Imperforate in nearly all placental carnivores and also in *Sarcophilus*. Perforate in most marsupials.

Two families are represented among the Santa Cruz marsupial carnivores. The smaller forms, comprising the genus *Microbiotherium*, are opossums comparable in size and, to a certain extent, in dental structure to existing South American representatives of the Didelphyidæ, to which, however, they are not ancestral. They have been grouped by Ameghino in a separate family, the Microbiotheridæ, but this is hardly warranted in view of their very apparent didelphid affinities, a discussion of which will be found on a later page.

The larger forms have long been known to resemble in dental structure the Tasmanian genus *Thylacynus*, and various hypotheses have been formulated to account for the observed similarity. A comparison of the dentition, skull and skeleton of *Thylacynus* and the Santa Cruz genera shows a much closer relationship between the Tasmanian and South American forms than has previously been supposed to exist, so much so that the propriety of referring them to the same family seems beyond question.

A number of families for the reception of these South American genera have been proposed, among which may be mentioned the Borhyænidæ, Acyonidæ, Amphiproviverridæ, Hathlyacynidæ, Prothylacynidæ and Sparassodontidæ. In the present paper the existing Tasmanian and extinct Santa Cruz forms are referred to the family Thylacynidæ (Bonaparte, 1838). The following is a tabulation of the characters on which this classification is based:

Family: THYLACYNIDÆ. Incisor formula $\frac{4-3}{3}$; protocone of upper molars variable, external styloid cusps vestigial; premolar dentition unreduced, posterior premolar well developed; metaconid absent; hallux opposable (arboreal adaptation), reduced or absent (cursorial modifications); non-syndactylous.

- *A.* Skull dolichocephalic.
  - (*a*) Alisphenoid bulla present.
    - 1. Dental formula $\frac{4}{3}, \frac{1}{1}, \frac{3}{3}, \frac{4}{4}$. Protocone well developed on all the upper molars. M^4 with small but distinct metacone. Posterior premolar exceeding in size the anterior and median premolars in both series. Talonid of M_4 supporting a single blunt cuspule. Palate perforate. Mandibular symphysis ligamentous. Hallux absent. Terminal phalanges blunt with slight clefts. *Thylacynus.*
      (Recent *T. cynocephalus*, Tasmania. Pleistocene, *T. spelæus*, Queensland, New South Wales.)
    - 2. Dental formula $\frac{4}{3}, \frac{1}{1}, \frac{3}{3}, \frac{4}{4}$. Protocone well developed on M^{1-3}. M^4 with small, conical protocone, large paracone and antero-external style; metacone reduced to the merest vestige, or absent. Premolars increasing regularly in size poste-

riorly in both upper and lower series. Talonid of $M_{\overline{4}}$ inclosing a small basin-shaped area with a single high point on its posterior rim. Palate imperforate. Mandibular symphysis ligamentous. Hallux reduced. Terminal phalanges uncleft, laterally compressed and pointed. *Cladosictis.*

(Miocene, Santa Cruz formation, Patagonia, *C. lustratus*, *C. petersoni.*)

3. Dental formula $\frac{4}{3}, \frac{1}{1}, \frac{3}{3}, \frac{4}{4}$. Protocone well developed on all the upper molars. $M^{\underline{4}}$ with protocone inclosing a basin-shaped area, paracone and antero-external style large, metacone vestigial or absent. Upper premolars increasing regularly in size posteriorly; median and posterior lower premolars subequal. Talonid of $M_{\overline{4}}$ large and strongly bicuspidate. Palate imperforate. Mandibular symphysis ligamentous. Hallux large and opposable. Terminal phalanges laterally compressed and pointed, without clefts. *Amphiproviverra.*

(Miocene, Santa Cruz formation, Patagonia, *A. mazaniana*, *A. minuta.*)

(*b*) Alisphenoid bulla absent.

1. Dental formula $\frac{4?}{3}, \frac{1}{1}, \frac{3}{3}, \frac{4}{4}$. Protocone well developed on $M^{\underline{1}}$, and $M^{\underline{2}}$, absent on $M^{\underline{3}}$. $M^{\underline{4}}$ with vestigial protocone and metacone. Posterior premolar not greatly enlarged, in the inferior series not exceeding the median premolar in size. Talonid of $M_{\overline{4}}$ small and basin-shaped, with a single high cusp on its posterior rim. Palate imperforate. Mandibular symphysis fused. Hallux reduced, not supporting phalanges. Terminal phalanges laterally compressed, sharply pointed, and slightly cleft at tips. *Prothylacynus.*

(Miocene, Santa Cruz formation, Patagonia, *P. patagonicus.*)

B. Skull brachycephalic.

(*a*) Alisphenoid not dilated to form a bulla.

1. Dental formula $\frac{3}{3}, \frac{1}{1}, \frac{3}{3}, \frac{4}{4}$. Protocone on upper molars reduced. $M^{\underline{4}}$ bicuspidate with paracone and antero-external style. Posterior premolars greatly enlarged. Talonid of $M_{\overline{4}}$ with single conical cusp. Palate imperforate. Mandibular symphysis fused. Hallux unknown. Terminal phalanges round, blunt, and broadly fissured at the tips. *Borhyæna.*

(Miocene, Santa Cruz formation, Patagonia, *B. tuberata*, *B. excavata.*)

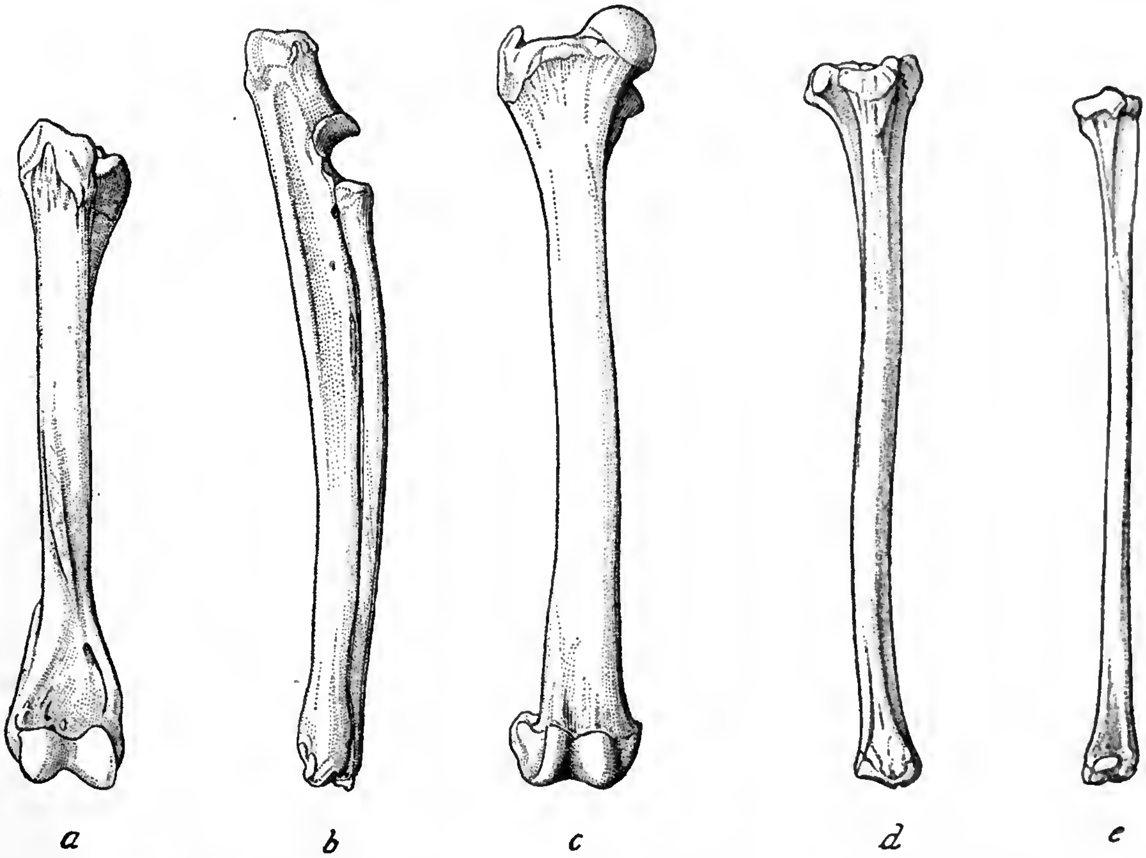
The determination of the marsupial affinities of the Santa Cruz diprotodonts rests almost entirely on their close resemblance to *Cænolestes.* The discussion of the classification adopted is more conveniently postponed to a later chapter, but it may be remarked in passing that all are referred to one family, the Cænolestidæ, so named from its best known and only surviving representative, *Cænolestes.*

POLYPROTODONTIA.

THYLACYNIDÆ.

The Santa Cruz thylacynes are short-legged animals, with large heads, long necks and heavy tails. These characters are well shown in the accompanying restorations of *Prothylacynus patagonicus* and *Cladosictis lustratus* (Pl. LXI, figs. 1, 2). In order to show clearly the points of agreement between the various Patagonian genera and *Thylacynus*, and the respects in which they differ, the following summary has been introduced:

Fig. 1.



Thylacynus cynocephalus. *a*, right humerus, front view; *b*, right radius and ulna from the outer side; *c*, right femur, front view; *d*, right tibia, front view; *e*, right fibula from the inner side. All figures × ½.

1. In all, the facial region of the skull is short in proportion to the

length of the cranium. The brain case is small in the Santa Cruz genera and greatly constricted postorbitally, and the orbits are placed much farther forward than in the *Dasyuridæ*, opossums, or *Thylacynus*. In the latter genus (Pl. LXV, fig. 1), the capacity of the brain case has increased considerably, with a corresponding expansion of the postorbital region, both of which, together with the posterior shifting of the orbit, may be regarded as progressive characters. In the extinct members of the family the palate lacks the vacuities present in all existing carnivorous marsupials, but is perforated by a number of accessory palatine foramina. Between the molars, the margin of the palate is depressed into deep hemispherical fossæ for reception of the tips of the lower teeth when the mouth is closed. The jugal arches are robust and rather broadly expanded, and the sagittal and lambdoidal crests well marked, but not very high. In the Santa Cruz forms, the occiput is semicircular in outline, in contrast with its triangular shape in the dasyures, *Sarcophilus* and *Thylacynus*. The lachrymal canal opens well within the orbital rim. In the majority of living marsupials, the opening of the lachrymal duct is placed either on or external to the orbital rim. *Thylacynus* is transitional between these two types of structure in that it possesses a double lachrymal perforation, one branch of the canal opening without and the other within the orbit.

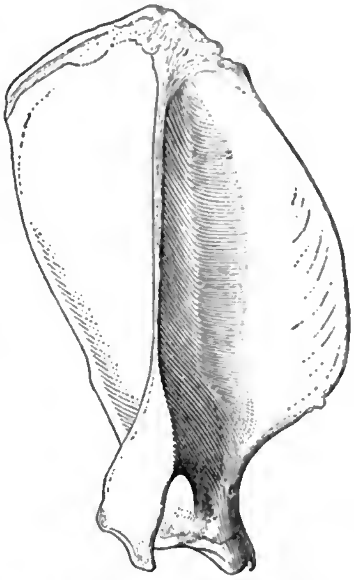
The number and position of the cranial foramina in the existing and extinct members of the family are practically the same with one important exception, namely, that in *Thylacynus* the basisphenoid is perforated by two large foramina, as in *Didelphys* (*cf.* Pl. LXV, fig. 1*a*) whereas in the Patagonian forms there is but is but a single perforation.

Borhyæna and *Prothylacynus* resemble *Sarcophilus* in the fusion of the mandibular symphysis. In the remaining genera the symphysial union is ligamentous.

2. The molars of the Santa Cruz genera are of the same type as in *Thylacynus*, differing principally in the greater reduction of $M^{\underline{4}}$, the loss of all the styloid cusps, except the antero-external, and the character of the heel of the last lower molar, which may be either small and conical, basin-shaped, or bicuspidate. The premolars are unreduced in number and usually increase in size posteriorly in both series. The canines are long, sharply pointed and slightly curved in the smaller genera. In *Borhyæna* the fang is swollen and the point short and blunt. The incisors in *Borhyæna* are reduced to $\frac{3}{3}$, an exceptional formula among marsupials

in that the number above and below is the same. In *Amphiproviverra* the median pair are conical and approximated at the tips, as in *Dasyurus* and *Didelphys*. According to Ameghino, the number of teeth having deciduous predecessors is greater in the Santa Cruz forms than among existing marsupials (see pp. 348, 378). Unfortunately it has not been possible to check this important observation by the material in the Princeton collection. It would not be surprising if Miocene marsupials retained some trace of the fuller dental replacement characteristic of the placentals. An extreme is reached in *Thylacynus*, where the deciduous predecessors of the posterior premolars are minute triangular plates displaced before birth. In the Santa Cruz forms (*cf. Cladosictis*, Pl. LIX, fig. 6) replacement does not occur until the animal is fairly mature.

FIG. 2.



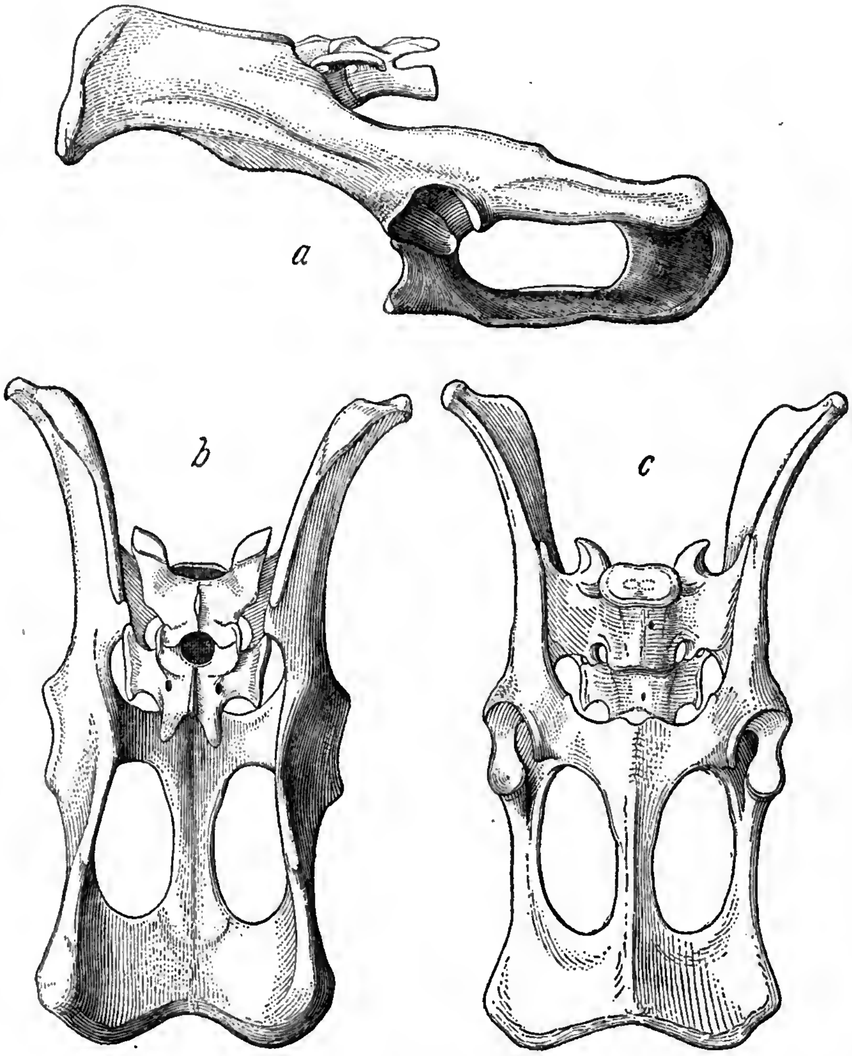
Thylacynus cynocephalus, right scapula, × ½.

3. The atlanteal intercentrum is unfused with the base of the neural arch in *Borhyæna* and *Amphiproviverra*, as it is also in *Thylacynus* (text fig. 5, *c*). In *Prothylacynus* and *Cladosictis* complete fusion has taken place, with obliteration of the sutures. An atlanteal foramen for the transmission of the spinal nerve and vertebral artery is present in all the Santa Cruz genera, except *Borhyæna*, which resembles *Phascolomys* in transmitting the nerve and artery through a groove in the anterior margin of the neural arch. The axis carries a large hatchet-shaped neural spine. The bases of the transverse processes of the second to the seventh cervicals are perforated for the transmission of the vertebral artery. The dorso-lumbar vertebral formula was probably the same as in *Thylacynus*: thirteen dorsals and six lumbars. As in that genus, the anticlinal vertebra is the tenth dorsal. Two vertebræ are coössified in the sacrum. The tail was undoubtedly long, very heavy, and greatly thickened at the base.

4. The limbs are short in proportion to the length of the body. The shortening is especially noticeable in the bones of the fore arm and fore leg, which are elongated in *Thylacynus* (text fig. 1, *b*, *d*, *e*), an adaptation to cursorial habits. In all, the radius and ulna are capable of some degree of pronation and supination. The tibia and fibula are unfused. The

inner humeral epicondyle is perforated by a large foramen in *Thylacynus*, *Prothylacynus* and *Cladosictis;* imperforate in *Amphiproviverra*. In *Prothylacynus*, the supinator ridge terminates in a hook-shaped extremity, which is wanting in *Amphiproviverra*, *Cladosictis* and *Thylacynus*. In the latter genus the distal end of the humerus is much narrower transversely than in either *Prothylacynus* or *Cladosictis*, and both supinator ridge and inner epicondyle are smaller (*cf.* text fig. 1, *a* and Pls. XLIX, figs. 1, 1*a*, 1*b*; LV, figs. 2, 2*a*).

FIG. 3.

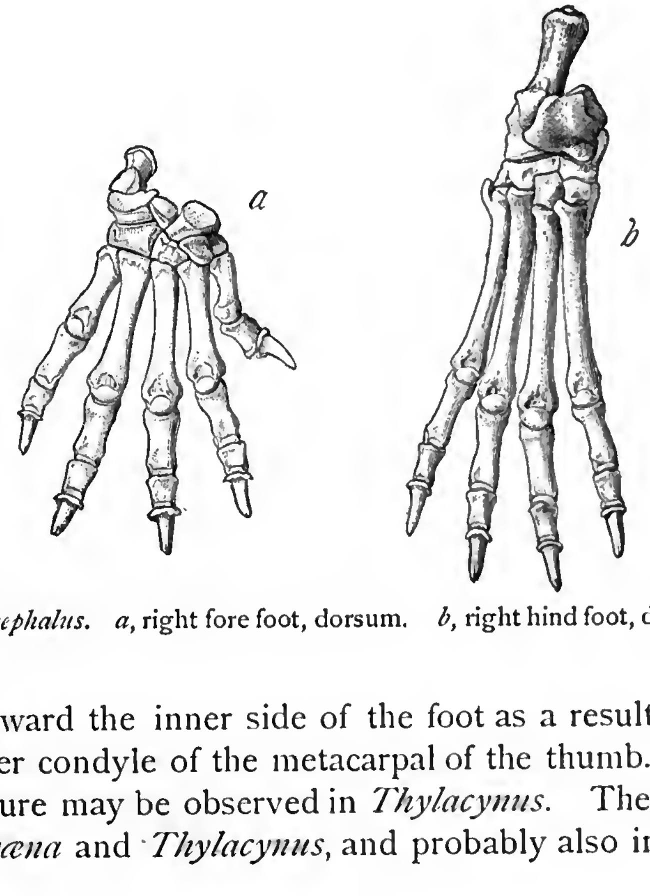


Thylacynus cynocephalus, pelvis and sacrum, × ½. *a*, from the left side; *b*, from above; *c*, from below. The epipubic cartilages are represented by the dotted outline.

5. The patella is ossified in *Amphiproviverra* and *Prothylacynus*. Among living marsupials the patella is ossified only in the Peramelidæ.

6. The feet are small, with spreading toes. The degree of reduction of the hallux is variable. In the recent genus it has been entirely obliterated (text fig. 4, *b*). In *Prothylacynus* a rudimentary metatarsal remains, while in *Amphiproviverra* the hallux is large and opposable. The loss of the hallux is a cursorial adaptation, various stages in the perfection of which are illustrated by the forms just mentioned. These genera, however, have diverged in cranial and dental development and are not a true phyletic series. A still more peculiar cursorial modification of the pes in *Thylacynus* appears in the shifting of the ectocuneiform toward the outer side of the foot until it is supported almost entirely by the cuboid (text fig. 4, *b*). In the Santa Cruz forms the shifting has progressed to about the same extent as in *Sarcophilus*. The pollex is known in *Amphiproviverra* and *Cladosictis*. In these genera, the phalanges of the pollex are deflected toward the inner side of the foot as a result of the enlargement of the outer condyle of the metacarpal of the thumb. Indications of the same structure may be observed in *Thylacynus*. The manus is pentadactyl in *Borhyæna* and *Thylacynus*, and probably also in *Prothylacynus*,

FIG. 4.



Thylacynus cynocephalus. *a*, right fore foot, dorsum. *b*, right hind foot, dorsum. Both figures × ½.

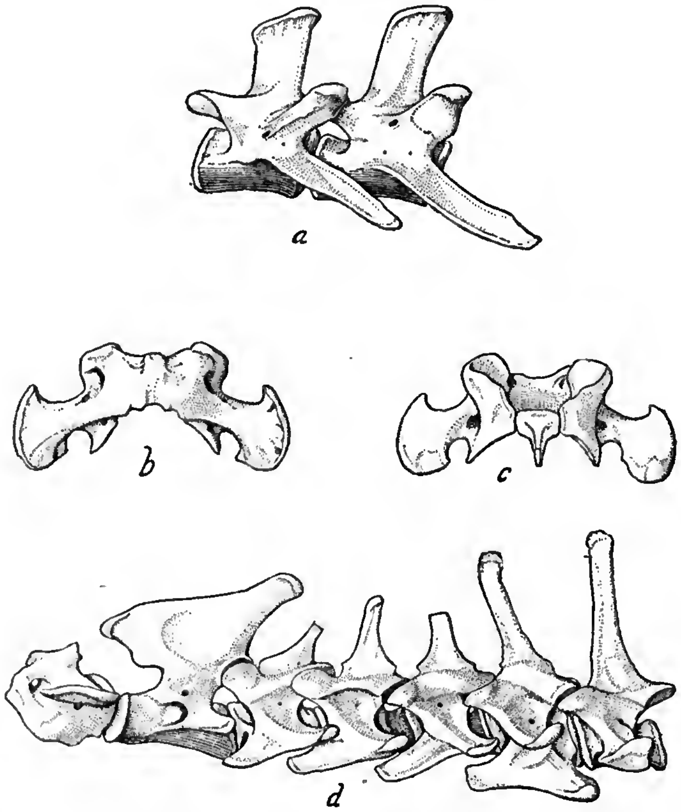
and both manus and pes are pentadactyl in *Amphiproviverra* and *Cladosictis.*

7. The trochlear surface of the astragalus in the Santa Cruz forms is short and flat with feebly differentiated facets for the tibia and fibula. This has been interpreted as indicating a plantigrade gait. In the digitigrade *Thylacynus* the astragalar trochlea is both longer antero-posteriorly and more deeply grooved.

8. There is no trace of syndactyly in either the living Tasmanian or extinct Patagonian thylacynes.

9. The pubes do not appear to have supported epipubic ossifications in *Cladosictis.* In the only specimen of *Prothylacynus* in the Princeton collection the pubes are not preserved and the entire pelvis of *Borhyæna* and *Amphiproviverra* is unknown. In *Thylacynus* the epipubic elements are mere vestigial cartilages (text fig. 3).

FIG. 5.



Thylacynus cynocephalus. *a*, fifth and sixth lumbar vertebræ from the right side; *b*, atlas from above; *c*, atlas from below; *d*, cervical series from the left side. All figures × ½.

BORHYÆNA Ameghino.

(Plates XL–XLVI; LII, Figs. 1, 2, 6; LIII, Figs. 2, *2a*, 4–*4b*, 9, *9a*;
LIV, Figs. 7, 13; LXI, Fig. 3.)

Borhyæna Amegh.; Enum. Sist. Especies Mamíf. Fós. Patagonia Austral, p. 8, Dec., 1887.

Dynamictis Amegh.; Revista Argentina Hist. Nat. I, entr. 3*a*, pp. 148–149, June, 1891.

A genus of large marsupial carnivores containing the most powerful predatory mammals in the Santa Cruz fauna. In the Princeton collection two species are represented by good skulls, with one of which a considerable portion of the skeleton is associated.

Dentition (Pls. XL; XLII; XLIV; XLV, figs. 1, 3).—In both species (*B. tuberata*, *B. excavata*), the incisors are reduced to $\frac{3}{3}$, a formula unknown among existing marsupials, with the exception of *Notoryctes*. The upper incisors here have been worn to such an extent that the pattern of the crown is entirely obliterated. The median pair are laterally compressed and show no tendency to assume a procumbent position or to become approximated at the tips, suggesting that in *Borhyæna* the reduction of the superior incisor formula has been accomplished by the suppression of the teeth homologous with the conical, procumbent, median incisors of *Didelphys* and *Dasyurus*. The upper canine is large, with swollen root and thick blunt crown. The premolars are closely crowded and increase rapidly in size posteriorly. All are double-rooted. The anterior premolar is in contact with the canine, and is placed transversely to the tooth row. The crown is slightly compressed laterally, and the heel rounded, without heel cusp. The median premolar is similar to the preceding tooth, but carries a larger heel. The posterior premolar is greatly enlarged and the heel broad, extending around the inner side of the crown. The anterior margin of the tooth is more or less abraded by contact with the similarly enlarged lower posterior premolar. The worn molars bear a superficial resemblance to the teeth of *Sarcophilus*, but their thylacyne structure is fully apparent, when it is remembered that in *Sarcophilus* the broadening of the upper molar cusps is produced by basal fusion with the outer row of styles, of which the antero-external alone is present in *Boryhæna*. The first, second and third molars increase regularly in size posteriorly. The protocone is small and ledge-like; disappearing entirely or almost entirely on worn teeth, although the inner root is still proportionately as robust as in *Thylacynus*, where the protocone is unreduced. The metacone spur is much less rotated outwardly than in the latter genus. The last molar shows greater reduction than in any other of the Santa Cruz genera. Its crown is composed of two cusps, the paracone and antero-external style, separated from each other by a sharp notch, forming a transversely placed shear. The anterior surface is greatly abraded by cutting against the postero-external margin of the protoconid of the last lower molar. M^4 is frequently single-rooted.

In the inferior dentition (Pls. XL; XLV, fig. 3), the incisors are closely crowded and the root of the second is displaced posteriorly with reference to the median and lateral teeth, as in *Thylacynus* and the Santa Cruz genera in general. The canine is large, with swollen root and slightly recurved blunt crown, bearing a broad groove on its inner side. As in the superior series, the premolars are closely crowded and the anterior tooth, situated in contact with the canine, is placed obliquely to the long axis of the tooth row. The anterior and median premolars are like those of the superior series. The posterior premolar is similarly enlarged, but has a much smaller heel. The lower molars are double-rooted and increase in size posteriorly. In the heels of the first, second and third molars the hypoconid is reduced, while the hypoconulid and entoconid are represented by a single cusp. The heel of the last molar carries a single conical cusp. The cusps of the trigonid are high and sharply separated by deep notches.

Milk Dentition. — Ameghino (1894, p. 109) states that in *Borhyæna* " the milk dentition consists of a canine and a molar; the latter has the form of a true molar and is replaced by the third tooth of the permanent dentition which follows behind the canine." The individuals in the Princeton collection are not sufficiently immature to permit of the confirmation of these important details.

Skull (Pls. XL–XLIV; XLV, fig. 1; XLVI, fig. 4). — The skull is broad and depressed, with powerful, widely expanded arches and moderately elevated sagittal and lambdoidal crests. The upper border of the facial profile has but slight inclination forward. The cranium is depressed in the parietal region and is proportionately less constricted postorbitally than in the other Santa Cruz marsupial carnivores. The brain cavity is smaller than in *Thylacynus* and the cerebral hemispheres less convoluted, judging from their impression on the cranial walls (Pl. XLII). The fossæ for lodgement of the vermis and lateral hemispheres of the cerebellum are proportionately as large as in *Thylacynus.* The olfactory sinuses are enormously developed, indicating the possession of keen powers of scent. The ascending processes of the premaxillæ are shorter than in the other Santa Cruz genera. The nasals are greatly expanded posteriorly, occupying almost the entire width of the interorbital tract and excluding from contact the frontals and maxillæ. The frontals between the orbits are plane in *B. tuberata*, slightly convex in *B. excavata.* Postorbital frontal processes are entirely wanting and the temporal ridges poorly defined. The sagittal crest is lower than in *Thylacynus;* its free border is concave in profile. The supraoccipital is not exposed on the upper surface of the skull, the parietal extending to the margin of the lambdoidal crest as in *Prothylacynus.* The orbits are smaller than in *Thylacynus* and are placed farther forward. A large lachrymal tubercle is present on the orbital rim. The lachrymal duct opens well within the orbit. A small foramen piercing the facial expanse of the lachrymal in *B. excavata* (Pl. XLV, fig. 1) may possibly be homologous with the external opening of the lachrymal duct in *Thylacynus.* The zygomatic arches are heavier and more widely expanded than in *Thylacynus.* The postorbital jugal processes are smaller and the preglenoid processes larger than in the latter genus.

The occiput (Pl. XLVI, fig. 4) is semicircular in outline and in *B. excavata* does not project posteriorly beyond the condyles, which differ from *Thylacynus* in being wider superiorly and more obliquely placed. The areal extent of the mastoid on the lateral border of the occiput is proportionately less than in the recent genus.

The base of the skull is fairly well preserved in the specimen of *B. excavata* (No. 15,120, Pl. XLIV). The basioccipital and basisphenoid are almost flat. The paroccipital processes are short, resembling *Prothylacynus* rather than *Thylacynus.* The large condyloid foramen is preceded by an accessory foramen of approximately the same size. The auditory region resembles *Prothylacynus* in the absence of alisphenoid dilatation, but the foramen ovale does not pierce the alisphenoid opposite the glenoid cavity, as in the latter genus, the posterior branches of the fifth and seventh nerves probably emerging between the alisphenoid and the tympanic. The latter element has been shed, exposing the petrous, which is smaller than in *Prothylacynus.* The palate is without vacuities, but is pierced by a number of accessory palatal foramina. The anterior palatine foramina are bisected, as in *Thylacynus*, by the premaxillo-maxillary suture. A pair of large foramina pierce the palate opposite the posterior margins of the canines. The neuro-vascular foramina at the posterior palatal border are enclosed by robust bars of bone, which are much more attenuated and often incomplete in *Thylacynus* (*cf.* Pl. LXV, fig. 1*a*). The narial border is thickened, much as in the creodont *Mesonyx*.

The mandible (Pls. XL; XLV, fig. 3) is very heavy in proportion to its length. The rami are firmly coössified at the symphysis, but traces of the suture remain. The backward inclination of the coronoid process is about the same as in *Prothylacynus*, but the width is relatively less. The masseteric fossa is broader than in *Thylacynus* and the heavy flange bordering it inferiorly is produced to the outer extremity of the condyle, while in the latter genus this structure narrows abruptly just anterior to the condyle. The condyles are very wide transversely, decreasing in width toward their outer ends, while the reverse is true in *Thylacynus*. The angle is broad and less deeply notched posteriorly than in the latter. Six mental foramina are present in *B. tuberata*, varying in position on opposite halves of the same mandible. The largest of these is situated beneath the anterior premolar.

Vertebral Column; Ribs and Sternum.—The atlas (Pl. LIII, figs. 2, 2*a*, 4–4*b*) is peculiar in lacking a foramen for the vertebral artery and first pair of spinal nerves, resembling in this respect *Phascolomys*. The nerve and artery are transmitted through a pair of deep notches in the anterior margin of the neural arch. The canal for the vertebral artery is small, entering the neural arch just above the condyles and emerging on the lower surface of the transverse process. A small foramen, possibly for a recurrent branch of the same artery, perforates the upper surface of the transverse process near its posterior border. The intercentrum (Pl. LIII, fig. 4*b*) is separately ossified and unfused with the base of the arch. Its posterior border supports a small median styloid process. The transverse processes are semicircular in outline with thickened edges.

The axis (Pl. LII, figs. 1, 2, 6) carries a large hatchet-shaped neural spine which overhangs the odontoid anteriorly. Posteriorly, the spine is extended to about the same degree as in *Thylacynus*. The odontoid tapers less than in that genus, retaining about the same width throughout. Anteriorly, it is obliquely truncated. The transverse processes are perforated by the vertebral artery. Their extremities are broken off in both specimens, but they were probably as long proportionately as in *Thylacynus.* The ventral surface of the centrum (Pl. LII, fig. 6) has a strong median keel which increases in depth posteriorly. The concavities on either side are bounded externally by the inferior edges of the transverse processes. Traces of the suture uniting the axial centrum with the anterior cotyles and odontoid are visible in both species.

The neural spine of the third cervical is proportionately larger and the median keel of the centrum stronger than in *Thylacynus.* In the fourth and fifth cervicals the diapophyses are well differentiated from the inferior lamella, unlike *Thylacynus.* The inferior lamella of the sixth cervical is less elongated antero-posteriorly than in the recent genus, but is much deeper. The transverse process of the seventh cervical is perforated by the vertebral artery. The neural spines of the cervicals increase in size and probably also in height posteriorly. The inferior keels on the centra decrease in depth on the fifth, sixth and seventh cervicals. The lateral surface of the neural arch above the canal for the vertebral artery is perforated by a small foramen in the second to the seventh cervicals.

The dorsal vertebræ associated with the skeleton of *B. tuberata* are larger than in *Thylacynus,* with heavier neural spines. The centrum of the first is keeled inferiorly, but keels are absent in the vertebræ interpreted as the seventh (Pl. XLV, fig. 6) and eighth dorsals. The dorso-lumbar vertebral formula was probably the same as in *Thylacynus* and has been so represented in the restoration (Pl. LXI, fig. 3).

Three caudals are preserved with the skeleton of *B. tuberata,* which are interpreted as the third, fourth and fifth. The fourth caudal (Pl. LIII, figs. 9, 9*a*) has been selected for illustration owing to its better state of preservation. It is considerably larger than the corresponding vertebra in *Thylacynus,* but much smaller than the fourth caudal in *Prothylacynus.* The transverse processes are broadly expanded, but are rounded at the tips, in contrast with the antero-posterior extension of the tips of the transverse processes of the proximal caudals in *Thylacynus.* The presence of chevrons on the fourth and fifth caudals is indicated by facets.

The floor of the neural canal in all the cervicals, except the atlas, and in the dorsal and anterior caudal vertebræ is subdivided by a median ridge, on either side of which a foramen pierces the centrum. A similar structure is observable in *Thylacynus* and also in various placental carnivores.

A peculiar feature noted by Ameghino (1894, pp. 112, 113) is the annular character of the vertebral epiphyses. A low round prominence from the centrum projects through the central perforation of the epiphysial ring. This structure is most typically developed in *Borhyæna*, occurring less regularly in *Prothylacynus*.

Parts of several ribs are preserved with No. 15,701, of which the two most complete specimens are figured (Pls. XLV, fig. 4; XLVI, fig. 1). The smaller of these, the second rib of the left side, is shorter than in *Thylacynus*, but slightly more robust and with thicker distal end. The larger rib (Pl. XLV, fig. 4), from the cylindrical character of its shaft, evidently belongs near the middle of the thorax. The proximal end is more robust than any of the ribs in this region in *Thylacynus*. The shaft also is more cylindrical.

Part of the sternum is preserved with the remains of both species of *Borhyæna* in the collection. The presternal segment (Pl. XLV, fig. 5) differs from the corresponding element in *Thylacynus* in having the distal portion of the posterior bar narrower and deeper. The mesosternal segments are shorter and proportionately narrower than in the recent genus.

Appendicular Skeleton. The scapula (Pl. XLVI, fig. 2), although smaller than in *Thylacynus*, has the neck of about the same length. The glenoid cavity is circular in outline and the coracoid process large, with the tip directed inwardly to about the same extent as in the Tasmanian genus. The high scapular spine divides the external surface into two unequal fossæ, of which the anterior is the larger. Its surface is almost flat. The infraspinous fossa is deeply concave with elevated axillary border. The inferior angle is more acute than in *Thylacynus*. The scapular spine terminates in a long narrow acromion, the tip of which is missing. The supraspinous fossa is perforated by a large foramen. In *Thylacynus* several foramina pierce the base of the scapular spine, opening into the infraspinous fossa. These are represented by a single large foramen in *Borhyæna*. In both genera a small foramen pierces the anterior margin of the neck near the middle of the suprascapular notch.

The radius (Pl. XLV, figs. 2, 2*a*) is of the same length as in *Prothylacynus*, but differs considerably in shape and is much less robust. The head is transversely flattened and elliptical in outline. The articular surface for the ulna is deeper than in *Thylacynus* and less confined to the posterior side, indicating somewhat greater power of pronation and supination. The bicipital tubercle is placed farther toward the outer side of the bone than in *Thylacynus*, corresponding rather with its position in *Sarcophilus*, and is much larger than in the former genus, although considerably smaller than in *Prothylacynus*. The radial shaft is slightly curved and approximately circular in median transverse section, becoming oval in cross section toward the distal end, in striking contrast with the sharply triangular section of this portion of the bone in *Prothylacynus*. The distal end is much deeper than in the latter genus, with the articular surface convex antero-posteriorly, as in *Thylacynus*, while in *Prothylacynus* it is concave. The styloid process is longer and heavier than in the last-named genus.

The ulna (Pl. XLV, figs. 2, 2*a*) is much shorter and heavier than in *Thylacynus*. The posterior border is broadly concave. In this respect *Borhyæna* differs from the other Santa Cruz thylacynes and resembles the existing genus. The olecranon is broad and heavy, comprising about one fifth the total length of the shaft. Its proximal end is greatly thickened and rugose. The greater sigmoid cavity is wider and deeper than in the recent genus and the coronoid process projects farther forward. In the lesser sigmoid cavity, the radial articular surfaces are more broadly connected proximally than in either *Thylacynus* or *Prothylacynus*. The shaft is considerably flattened and broadly grooved on the outer side. The distal end is much heavier than in *Thylacynus*, with large hemispherical styloid process and broad radial tubercle.

With the exception of the trapezoid and cuneiform, all the elements of the carpus (Pl. LIV, fig. 7) are known. The radial surface of the scaphoid is convex transversely and slightly concave in dorso-palmar section. Owing to the weathering of its palmar margin, the exact shape of the proximal articular surface cannot be determined. Distally, there is a broad contact with the magnum, sharply separated from the lunar facet. The trapezoidal facet is triangular in outline, deeply concave transversely and convex in dorso-palmar section. The facet for the trapezium is shaped like a capital B, with the invagination directed toward the inner side of the foot. It is almost plane in the dorso-palmar direction. In transverse section, the dorsal half of the facet is slightly convex and the palmar half concave. The inner posterior angle of the scaphoid supports a large hemispherical process, which is wanting in *Thylacynus*, but present in *Sarcophilus* and *Prothylacynus.* In shape, the scaphoid resembles more closely that of *Sarcophilus* than the corresponding element in *Thylacynus.*

The lunar is a wedge-shaped bone, the proximal end of which is occupied by a broad, convex facet for the radius. Distally, the lunar articulates by a concave, oval facet with the magnum, unlike *Thylacynus* (*cf.* text fig. 4, *a*). The scaphoidal facet is semilunar in outline, almost plane in dorso-palmar section and plane or slightly convex at right angles to the former diameter. The facet for the cuneiform is triangular in outline and slightly convex in all diameters. It is feebly differentiated from the semilunar facet for the unciform.

The pisiform has a concave, elliptical facet for articulation with the cuneiform and a semilunar, dorso-palmarly convex facet for contact with the styloid process of the ulna. It is slightly more robust than in *Thylacynus*, terminating distally in a large hemispherical tubercle.

The trapezium is much larger than in *Thylacynus.* It is irregularly oblong in form, with a B-shaped facet for the scaphoid, a semilunar facet for the trapezoid, convex dorsally and slightly concave toward the palmar margin, and a large, concave, oval facet for the metacarpal of the pollex.

The magnum resembles that of *Sarcophilus* rather than the corresponding element in *Thylacynus.* Proximally, it supports a heavy crest with two facets for the scaphoid and lunar respectively. The former facet is irregularly oblong with a sigmoid curvature in dorso-palmar section. Transversely, it is concave dorsally and plane or slightly convex toward the palmar margin. The lunar facet is convex, becoming slightly concave dorsally. On the median side there is an irregularly quadrilateral, almost plane facet for the trapezoid. The facet for the unciform is confined to the dorsal margin of the magnum, unlike its position in *Thylacynus.* It is quite irregular in shape, with an uneven undulating surface. Distally, there is a broad triangular, concave facet for the third metacarpal.

The unciform is partially broken and the facets for the magnum and cuneiform are incomplete. In shape it seems to have been irregularly tetrahedral. Distally this element bears a broad triangular facet for the fourth and fifth metacarpals. The surface for the fourth metacarpal is concave dorso-palmarly and plane transversely. That for the fifth metacarpal is also concave dorso-palmarly, but is convex transversely.

The metacarpal of the pollex is missing, but, judging from the size of its articular surface on the trapezium, it was larger than in *Thylacynus*. The second metacarpal overlaps proximally the third, and the fourth on the fifth. The proximal end of the third has not been preserved. The fourth is the longest element in the metacarpal series. Its proximal end is irregularly quadrangular in outline, wider dorsally than at the palmar margin. The head of metacarpal V is separated by a sharp keel into two convex facets for the overlapping metacarpal IV and the unciform respectively. Distally, the metacarpals are flattened, with well-developed keels confined to the palmar surfaces. The arrangement of the phalanges shown in the figure is arbitrary, as there was no possible way to determine the original association of these elements in the matrix. The phalanges of the proximal row are much shorter and heavier than in *Thylacynus*, with straighter shafts. Those of the second row are less flattened than in the recent genus. The distal trochleæ of the phalanges of the first and second rows have no greater dorso-palmar extension than in *Thylacynus* and there is no reason to believe that the angulation of the digital elements was any greater. The unguals are stout, resembling the claws of *Thylacynus*, but differing from that genus in the broad fissuring of the tips. The subungual processes are large. Hoods are developed to about the same extent as in *Thylacynus*. An ungual foramen is present in all the claws.

In proportion to the size of the skull, the femur (Pl. XLVI, figs. 3, 3*a*) is remarkably short. The head is of about the same size as in *Thylacynus*, but the neck is considerably longer. The great trochanter projects slightly above the level of the head, from which it is widely separated. The lesser trochanter is incompletely preserved, but was probably as large proportionately as in *Prothylacynus*. The shaft is straight. The condyles are narrower antero-posteriorly than in *Thylacynus* and are plane or slightly convex transversely. The inner condyle is considerably wider than the outer.

Restoration (Pl. LXI, fig. 3).—The disproportionately large size of the head and great length of the neck are at once apparent in the drawing of the restored skeleton. The length of the back has been determined by comparison of the lengths of the few dorsals preserved with the corresponding parts in *Thylacynus*. The lumbar vertebræ and pelvis are supplied from *Prothylacynus*. The length of the tail is largely hypothetical, but the size of the proximal caudals indicates that it was greatly thickened at the base, less so, however, than in *Prothylacynus*. Regarding the hind limb, two alternatives are possible. Either the tibia was short and the back sloped downward from the shoulders, or the hip and shoulder were equally elevated. The latter assumption seems preferable and an elongated tibia and fibula have been supplied, as in *Thylacynus*. An ossified patella has been introduced from analogy with *Prothylacynus*. The plantigrade pose is largely conjectural, as there is no certain means by which the gait of an animal may be determined from the skeleton of the fore foot alone. It is probable that *Prothylacynus*, *Cladosictis* and *Amphiproviverra* were plantigrade, and, in the absence of evidence to the contrary, the same may be assumed tentatively for *Borhyæna*. No trace of a clavicle is preserved, but one has been inserted from analogy with existing carnivorous marsupials.

Habits.—Some inference regarding the pugnacity of these animals may be drawn from the large cicatrice in the mandible of *B. tuberata* represented in fig. 3, Pl. XLV. Ability to trail by scent like the Tasmanian thylacyne may, perhaps, be inferred from the large olfactory sinuses. The blunt claws indicate adaptation to terrestrial progression. The animal undoubtedly preyed on the larger placental mammalia.

BORHYÆNA TUBERATA Ameghino.

(Plates XL–XLII; XLV, Figs. 2–6; XLVI, Figs. 1–3*a*; LII, Fig. 1; LIII, Figs. 2, 2*a*, 9, 9*a*; LIV, Figs. 7, 13; LXI, Fig. 3.)

Borhyæna tuberata Amegh.; Enum. Sist. Especies Mamíf. Fós. Patagonia Austral, p. 8, Dec., 1887.

Borhyæna zitteli Amegh.; Énum. Syn. des Espèces de Mam. Fos. des Formations Éocène de Patagonie, pp. 119–120, 1894; Bol. Acad. Cordoba, p. 375, 1894.

A nearly complete skull and mandible (No. 15,701) associated with a considerable portion of the skeleton, secured by Mr. Peterson eight miles south of Coy River, has been identified with this species, which is one of the largest of the Santa Cruz thylacynes.

Apart from characteristic measurements, *B. tuberata* may be recognized by the broad depressed skull, perfectly flat between the orbits, with robust, gradually expanding arches. The face is without antorbital constriction. The postzygomatic portion of the brain case is considerably elongated and the lambdoidal crest expanded as a broad semicircular frill. The infraorbital canal is double, neither branch being as large as the single canal in *B. excavata.* If constant, this may prove to be a good specific character. The skull is a fourth larger than in *B. excavata.*

It is not yet possible to separate generic from specific characters in the skeleton, as *B. tuberata* is the only species in which the skeleton is at all well known. Its important features have already been noted in the description of the genus.

MEASUREMENTS.

Skull, length, premaxillæ to lambdoidal crest	.230
" width across jugal arches	.160
" " between orbits	.062
Face, length to anterior orbital border	.076
Cranium, length to anterior orbital border	.141
" least width of brain case	.027
Palate, length from alveolus of median incisor to palato-narial border	.104
" width between canines	.0245
" " " posterior premolars	.037
" " " M^4	.075
Mandible, length	.186
" transverse diameter of condyle	.0423
" length of symphysis	.060
" depth below posterior premolar	.031
" " " M_4	.038
Superior dentition, length, median incisor to M^4	.113
" " " of premolar series	.0333
" " " " molar "	.045
Inferior dentition, length, base of median incisor to M_4	.1025
" " " of premolar series	.035
" " " " molar "	.0515
Median upper incisor, width of crown	.002
Lateral " " " " "	.0036
Alveolus of upper canine, length	.0165
" " " " width	.0135
Anterior superior premolar, antero-posterior diameter	.0075
" " " transverse "	.0047
Median " " antero-posterior "	.010
" " " transverse "	.0063
Posterior " " antero-posterior "	.0145
" " " transverse	.009
M^1, antero-posterior diameter	.012
" transverse "	.0082
M^2, antero-posterior "	.0126
" transverse "	.0095

$\text{M}^{\underline{3}}$, antero-posterior diameter	.015
“ transverse “	.0105
$\text{M}^{\underline{4}}$, antero-posterior “	.0055
“ transverse “	.0085
Lower canine, antero-posterior diameter at alveolar border	.0163
“ “ transverse “ “ “ “	.0112
Anterior inferior premolar, antero-posterior diameter	.009
“ “ “ transverse “	.005
Median “ “ antero-posterior “ (approximate)	.0117
“ “ “ transverse “	.006
Posterior “ “ antero-posterior “	.0143
“ “ “ transverse “	.0065
$\text{M}_{\overline{1}}$, antero-posterior diameter	.012
“ transverse “	.006
$\text{M}_{\overline{2}}$, antero-posterior “	.012
“ transverse “	.007
$\text{M}_{\overline{3}}$, antero-posterior “	.013
“ transverse “	.0075
$\text{M}_{\overline{4}}$, antero-posterior “	.016
“ transverse “	.009
Atlas, transverse breadth	.0805
“ breadth across anterior cotyles	.0498
“ width of neural arch	.022
“ “ “ intercentrum including median process	.0145
Axis, length of centrum, including odontoid	.052
“ width of posterior face of centrum	.0195
“ depth “ “ “ “ “	.015
“ length of odontoid	.011
“ width across anterior cotyles	.039
“ antero-posterior diameter of neural spine	.0745
“ height of spine above floor of neural canal	.042
Third cervical, length of centrum	.026
“ “ width across transverse processes (approximate)	.061
“ “ “ “ prezygapophyses	.0335
Fifth cervical, length of centrum	.027
“ “ width of posterior face of centrum	.0195
“ “ depth “ “ “ “ “	.0182
“ “ width across transverse processes	.053
“ “ “ “ prezygapophyses	.040
“ “ antero-posterior diameter of inferior lamina of transverse process	.0335
Sixth cervical, length of centrum	.028
“ “ width of posterior face of centrum	.0185
“ “ depth “ “ “ “ “	.0175
“ “ width across transverse processes (approximate)	.044
“ “ “ “ prezygapophyses	.0335
“ “ antero-posterior diameter of inferior lamina of transverse process	.029

Seventh cervical, length of centrum	.027
“ “ width of posterior face of centrum	.0185
“ “ depth “ “ “ “ “	.0185
“ “ width across transverse processes	.053
“ “ “ “ prezygapophyses	.034
First dorsal, length of centrum	.024
“ “ width of posterior face of centrum	.024
“ “ depth “ “ “ “ “	.0173
“ “ width across diapophyses	.054
Seventh ? dorsal, length of centrum	.023
“ “ width of posterior face of centrum	.023
“ “ depth “ “ “ “ “	.0145
“ “ width across diapophyses	.038
“ “ greatest width of neural spine	.0135
“ “ length of neural spine	.056
Eighth ? dorsal, length of centrum	.0226
“ “ width of posterior face of centrum	.025
“ “ depth “ “ “ “ “	.0145
Third ? caudal, length of centrum	.025
Fourth ? “ “ “ “	.0237
“ “ width of posterior face of centrum	.017
“ “ depth “ “ “ “ “	.013
“ “ width across transverse processes	.056
Fifth ? “ length of centrum	.0238
“ “ width of posterior face of centrum	.017
“ “ depth “ “ “ “ “	.0136
“ “ width across transverse processes (approximate)	.048
Scapula, length	.1378
“ width of neck	.025
“ antero-posterior diameter of glenoid cavity, including coracoid process	.0345
“ transverse diameter of glenoid cavity	.022
Radius, length	.1265
“ width at proximal end	.018
“ “ “ distal “	.0228
Ulna, length	.165
“ greatest width of olecranon process	.024
“ “ “ below sigmoid cavity	.0305
Femur, length	.1745
“ width at proximal end	.049
“ “ “ distal end	.036
Second rib, length	.066
Metacarpal II, width at proximal end	.012
“ III, “ “ distal “	.0115
“ IV, length	.0435
“ “ width at proximal end	.011
“ “ “ “ distal “	.012

Metacarpal V, length	.0245
" " width at proximal end	.0102
" " " " distal "	.011

BORHYÆNA EXCAVATA Ameghino.

(Plates XLIII; XLIV; XLV, Fig. 1; XLVI, Fig. 4; LII, Figs. 2, 6; LIII, Figs. 4–4*b*.)

Borhyæna excavata Amegh.; Énum. Syn. des Espèces de Mammifères Fossiles des Formations Éocènes de Patagonie, p. 121, 1894; Bol. Acad. Cordoba, p. 377, 1894.

A remarkably perfect skull (No. 15,120), five cervical vertebræ, an incomplete posterior dorsal, a fragment of the left scapula and two sternal segments are referable to *Borhyæna excavata.* This material was collected by Mr. Peterson from the Lower Santa Cruz beds ten miles south of Coy Inlet.

B. excavata may be readily identified by the strong contraction of the facial portion of the skull just anterior to the infraorbital foramen. As a result of this contraction, the shape of the tooth row is rendered strongly crescentic, with the canine and anterior premolar offset externally to a greater degree than in *B. tuberata.* The palate retains the same width from the canine to the median premolar, while in *B. tuberata* its width steadily increases posteriorly. The skull is smaller than in the latter species, the arches more abruptly expanded and the sagittal and lambdoidal crests lower. The interorbital tract is not as flat as in *B. tuberata,* the postzygomatic portion of the brain case is relatively less elongate and the infraorbital foramina are larger.

The associated skeletal parts are smaller than in *B. tuberata,* but do not differ in structure sufficiently to require separate description.

MEASUREMENTS.

Skull, length on median basal line	.187
" " occipital condyle to tips of premaxillæ	.195
" width across zygomatic arches	.140
" interorbital width	.056
Face, length	.0655
Cranium, length to anterior border of orbit	.133
" width at narrowest part of brain case	.0245
Occiput, height	.051
" width	.062

Palate, width between canines	.024
“ “ “ M$^{\underline{4}}$	.065
“ length from root of median incisor to palato-narial border	.092
Nasals, length	.061
“ width at anterior extremity	.0145
“ “ “ posterior expansion	.049
Upper dentition, length from median incisor to M$^{\underline{4}}$	.100
“ “ “ of space occupied by premolars	.027
“ “ “ “ “ “ “ molars	.043
Median incisor, width of crown	.0026
Lateral “ “ “ “	.003
Upper canine, antero-posterior diameter at alveolar border	.0145
“ “ transverse “ “ “ “	.010
“ “ length of crown	.027
Anterior premolar, antero-posterior diameter	.008
“ “ transverse “	.004
Median “ antero-posterior “	.009
“ “ transverse “ at widest part	.005
Posterior “ antero-posterior “	.0107
“ “ transverse “ at widest part	.0085
M$^{\underline{1}}$, antero-posterior diameter	.011
“ transverse “	.008
M$^{\underline{2}}$, antero-posterior “	.0125
“ transverse “	.0083
M$^{\underline{3}}$, antero-posterior “	.014
“ transverse “	.011
M$^{\underline{4}}$, antero-posterior “	.006
“ transverse “	.008
Atlas, transverse breadth across anterior cotyles	.043
“ width of neural arch	.017
“ “ “ intercentrum including median process	.0115
Axis, length of centrum including odontoid	.045
“ “ “ odontoid	.0096
“ width over anterior cotyles	.0346
“ height of neural spine above centrum	.0345
Third cervical, length of centrum	.0213
“ “ width across transverse processes	.046
“ “ height of neural spine above centrum	.0255
Fourth “ length of centrum	.0205
“ “ width across transverse processes	.044
“ “ height of neural spine above centrum	.023
Fifth “ length of centrum	.021
“ “ width across transverse processes	.043
Sternal segments, average length	.0305

PROTHYLACYNUS Ameghino.

(Plates XLVII–LI; LII, Figs. 3, 5; LIII, Figs. 5–8; LIV, Figs. 2, 2*a*, 8, 9, 14; LXI, Fig. 2.)

Prothylacynus Amegh.; Nuevos Restos. Mamíf. Fós. Patagonia Austral, p. 26, Aug. 1891; Revista Argentina Hist. Nat. I, entr. 5*a*, p. 312, Oct., 1891.

This genus, so frequently mentioned in previously published discussions of the relationships of South American and Australian marsupials, is represented in the Princeton collection by the remains of one individual referable to the species *Prothylacynus patagonicus* (No. 15,700), comprising an incomplete skull, mandible, parts of both scapulæ, humerus, both radii, ulna, pelvis, both femora, tibia, fibula, patella, part of the hind foot, the scaphoid and a few phalanges of the fore foot, six cervicals, four dorsals, three lumbars, the sacrum, five caudals and fragments of the ribs and sternum. The exceptionally perfect state of preservation of this material permits full comparison with living forms and indicates in no uncertain fashion the true relationships of the animal, a discussion of which will be found on a later page.

Dentition (Pls. XLVII; XLVIII, figs. 1, 2). — The greater part of the facial region of the skull has been weathered away, involving the incisors, canines and the anterior and median premolars. In the side view (Pl. XLVII), these have been supplied from *Borhyæna*. *Prothylacynus* differs, however, in possessing an additional upper incisor (Ameghino, 1894, p. 121). The posterior superior premolar is a stout, double-rooted tooth, with a broad heel without heel cusp. It is considerably smaller than this tooth in *Thylacynus*. The first, second and third molars increase rapidly in size posteriorly. In M^1 and M^2, the protocone is a well-developed bunoid cusp, but is absent in M^3, although the inner root supporting this part of the tooth crown is larger than in the preceding molars. The antero-external style, the only one of the outer row of styloid cusps remaining, is considerably larger than in *Thylacynus*. With this exception, the outer cingulum is entirely wanting. The fourth molar is more reduced than in *Thylacynus*. The protocone is represented by a broad smooth surface. The metacone is vestigial and the posterior root supporting it almost obliterated. The high conical paracone is connected by a sharp ridge with the antero-external style.

In the mandible, the crowns of the three incisors have been broken off, but the root of the second tooth in the series is seen to be displaced behind the median and lateral members. The tip of the canine is missing, and the crown is broadly grooved on the inner side. The premolars are closely crowded. The anterior tooth is in contact with the canine and lies obliquely to the long axis of the jaw. The crowns of all the lower premolars are laterally compressed, with large, simple heels. The median and posterior teeth are of the same size. As in the superior series, the molars increase rapidly in size posteriorly. In the first molar the protoconid, paraconid and heel are in line. In the remaining teeth, the paraconid is deflected more and more internally, forming with the protoconid a powerful shear against the inner side of the metacone spur of the upper molars. The protoconid is high and conical, with a sharp anterior edge. It is separated from the lower and more blade-like paraconid by a deep cleft. The heel of $M_{\overline{4}}$ is far more reduced than in *Thylacynus*, inclosing a shallow basin with a single high point on its posterior rim. On the anterior molars the heel is narrower and flatter than in *Thylacynus*, with a single prominent cusp at its posterior extremity. The hypoconid is greatly reduced, more so than in *Cladosictis*. The prominent cusp mentioned above occupies the position of the hypoconulid. The entoconid is smaller than in *Thylacynus* and scarcely distinguishable as a separate cusp. A small antero-external, shelf-like cingulum is developed on the second, third and fourth molars.

Skull (Pls. XLVII; XLVIII, figs. 1, 1*a*, 3).—As in all the Santa Cruz thylacynes, the skull is large in proportion to the size of the body, although relatively less so than in some of the smaller genera. The brain case is long, low and narrow, considerably depressed in the region above the tentorium and greatly constricted postorbitally. The facial region has been almost entirely destroyed by weathering, but was probably not unlike *Borhyæna* and has been so represented in the figure (Pl. XLVII). Enough is preserved to show the single, moderate-sized infraorbital foramen, situated above the posterior premolar, and the imperforate facial expansion of the lachrymal. The zygomatic arches are robust and intermediate in degree of expansion between *Borhyæna* and *Amphiproviverra*. The orbits are not placed as far forward as in the latter genus, their anterior border coinciding with a line drawn through the posterior root of the second molar.

Parietal and supraoccipital exhibit the same relationship as in *Borhyæna*.

In the posterior view (Pl. XLVIII, fig. 3), the occiput is seen to be quadrangular in outline, unlike the triangular occiput of *Thylacynus*. Its upper border projects considerably beyond the condyles. The exposure of the mastoid is relatively smaller than in *Thylacynus*. Unlike that genus, the condyles are wider dorsally, more obliquely placed and less sessile.

The base of the skull is in excellent preservation, permitting full comparison with the recent genus (*cf.* Pl. LXV, fig. 1*a*). The basioccipital is broadly keeled below. The paroccipital processes are short, blunt and massive. The condylar foramen is large. It is preceded by a very small accessory foramen. The tubercles for the origin of the *recti capitis* muscles are about as large as in *Thylacynus*. The alisphenoid is without dilatation and does not form an auditory bulla. It is perforated by the foramen ovale directly opposite the glenoid cavity. The tympanic is unfused with the elements adjacent and has not been preserved. The petrous is larger and more completely hemispherical than in *Thylacynus*, the relative position of the fenestræ remaining the same.

The basisphenoid is broadly keeled and convex in cross section in contrast with its plane, or slightly concave section in *Thylacynus*. It is perforated by a single canal, that for the internal carotid artery. The alisphenoid ridge, which is confluent with the auditory bulla in *Thylacynus*, is but slightly developed and is entirely wanting posteriorly. The postglenoid processes are proportionately shorter than in *Thylacynus*, but the preglenoid processes are much larger. The foramina of the lateral sinuses, especially the post-glenoid and sub-squamosal, are larger than in the recent genus. A small foramen pierces the jugal process of the squamosal above the glenoid cavity, as in some specimens of *Thylacynus*. The palate is without vacuities, but is pierced by several accessory palatal foramina. Its posterior margin is perforated by a double neuro-vascular canal. The narial border is slightly thickened. The margins of the palate are depressed to accommodate the tips of the lower molars, as in most carnivorous marsupials.

In proportion to its length, the mandible is much deeper than in *Thylacynus*. The anterior margin of the coronoid is convex, in contrast with its slight concavity in *Thylacynus* and is less steeply inclined posteriorly; the masseteric fossa is more broadly rounded anteriorly and the posterior margin of the angle less deeply notched. Both rami are firmly coössified in the symphysis without trace of suture, while in *Thylacynus* symphysial union is ligamentous. Three mental foramina are present, the largest of which lies beneath the anterior and median premolars. The others are situated beneath the anterior root of the first molar and posterior root of the second molar respectively. The condyles, unlike *Thylacynus*, increase in width externally.

Vertebral Column; Ribs and Sternum.—The atlas (Pl. LIII, figs. 5, 5*a*) differs from that of *Borhyæna*, *Amphiproviverra* and *Thylacynus* in having the intercentrum firmly fused with the base of the neural arch without trace of suture. The small neuro-arterial foramina are placed nearer to the anterior atlanteal margin than in the other Santa Cruz genera. The canal for the vertebral artery is small. It enters the neural arch within the spinal canal about midway between the neuro-arterial foramen and the condyles, emerging on the lower surface (Pl. LIII, fig. 5*a*) near the anterior margin of the base of the transverse process. The transverse processes are considerably thickened; their antero-posterior basal constriction is much less than in *Thylacynus*. The posterior border of the inferior arch supports a small median tubercle.

The axis (Pl. LII, figs. 3, 5) resembles closely that of *Borhyæna*, differing from *Thylacynus* in the greater width of the neural spine anteriorly, the more attenuated extremities of the transverse processes and the greater depth of the posterior inferior keel. The posterior portion of the neural spine has been broken. It was probably as long and heavy as in *Borhyæna tuberata*. The odontoid tapers slightly anteriorly, but less so than in *Thylacynus*. The anterior cotyles are extended to the same degree as the transverse processes. The lower surface of the centrum is almost the same as in *Borhyæna* (*cf.* Pl. LII, figs. 5, 6). The anterior portion of the inferior keel has been broken, which accounts for its apparently lower elevation than in *Borhyæna*.

The third, fourth and fifth cervicals differ from those of *Thylacynus* in having the diapophyses better differentiated from the inferior lamellæ. The centra are strongly keeled inferiorly. In the fifth cervical the posterior portion of the keel is bifid. The upper surface of the neural arch of the third cervical is perforated by a pair of large foramina. Of the sixth cervical, an uncharacteristic fragment remains. Small foramina pierce the lateral walls of the neural arches of the third to the sixth cervicals, as in *Thylacynus* and *Borhyæna*. The neural spines of the posterior cervicals have not been preserved.

The seventh dorsal, if the position of the vertebra represented in fig. 4, Pl. LI, has been correctly interpreted, is of about the same size as the corresponding vertebra in *Thylacynus*, but is considerably smaller than the seventh dorsal in *Borhyæna* (Pl. XLV, fig. 6). The neural spine is much wider transversely than in the former genus. The centrum is without inferior keel. The tenth dorsal, or anticlinal vertebra, (Pl. LIII, fig. 7) lacks the tip of the neural spine, the anterior margin of which slopes steeply forward, while the posterior margin descends vertically. Prominent metapophyses and anapophyses are developed on the tenth dorsal and also on the succeeding dorsals, so far as preserved (Pl. LXI, fig. 2). The centra of the tenth and eleventh dorsals are without inferior keels. The centrum of the twelfth is slightly keeled.

The dorso-lumbar formula was probably the same as in *Thylacynus*—thirteen dorsals and six lumbars. Three of the latter are preserved (Pl. LI, fig. 5). The centra are wider posteriorly than anteriorly, producing an hour-glass shape. Unlike *Thylacynus*, they are not keeled inferiorly. As in that genus, the lower surface of each centrum is perforated by one or more large foramina. The neural spines, although incompletely preserved, are seen to be much heavier than in the recent genus. Metapophyses are less strongly developed than in the posterior dorsals. The anapophyses decrease regularly in size, until, in the sixth lumbar they are mere points. The transverse processes are heavier than in *Thylacynus*, and, as in that genus, curve forward and downward. The sides of the neural arches are pierced by small foramina.

Two vertebræ are coössified in the sacrum (Pl. L, figs. 3, 3*a*) which differs from that of *Thylacynus* (*cf.* text-fig. 3, *b*, *c*) in the greater size and more complete fusion of the sacral elements. The dorsal intervertebral fenestra, present in the latter genus between the first and second sacrals, is wanting in *Prothylacynus*.

The proximal caudals (Pl. LIII, fig. 8) are much larger than in either *Thylacynus* or *Borhyæna*. The caudal centra rapidly increase in length, retaining functional postzygapophyses farther back in the series than in *Thylacynus*. The transverse processes have been more or less broken from all the caudals preserved, but were evidently very heavy (Pl. LIII, figs. 6, 8). Facets for chevrons are present on all the caudals, beginning with the third. The proximal caudals are unkeeled. The seventh, eighth and ninth are doubly keeled inferiorly. Judging from the size of the caudals, the tail of *Prothylacynus* must have been not only longer but much thicker at the base than in *Thylacynus*. It is possible that too much flexibility has been given to it in the drawing of the restored skeleton. The floor of the neural canal in the cervical, dorsal, lumbar and anterior caudal vertebræ is keeled and perforated on either side of the keel by a large foramen, as in *Thylacynus* and *Borhyæna*. The epiphyses, although more or less annular, as in *Borhyæna*, do not have such prominent bosses from the centra projecting through the median perforations. Frequently the latter are absent.

Fragments of several posterior ribs are preserved, but are too incomplete to describe. They have about the same dimensions as the posterior ribs in *Thylacynus*. The incomplete presternal segment represented in fig. 6, Pl. LI, is considerably smaller than that of either *Thylacynus* or *Borhyæna*, differing from both in possessing a strong, inferior, median keel.

Appendicular Skeleton.—The scapula (Pl. XLIX, figs. 2, 2*a*) is shorter than in *Thylacynus*, with thicker neck and longer coracoid process. The surface of the supraspinous fossa is convex, in contrast with the approximately plane surface of this region in *Thylacynus*. In part, the convexity has been accentuated by crushing. The glenoid cavity is almost circular in outline. The coracoid process projects greatly below the glenoid margin. Its anterior border is strongly inflected. The infraspinous fossa is somewhat wider than in either *Borhyæna* or *Thylacynus*. As in those genera, the axillary border is strongly deflected outwardly. The spine has been broken, destroying the acromion. The border of the suprascapular notch is perforated by a small foramen.

The humerus (Pl. XLIX, figs. 1–1*b*) is shorter than in *Thylacynus* but much heavier. The head is very broad and projects considerably beyond the posterior surface of the shaft. The greater tuberosity rises slightly above the head. The lesser tuberosity is low, not as sharply separated from the head as in *Thylacynus*. A third tuberosity rising from the inner side of the shaft below the lesser tuberosity probably marks the point of insertion of the *coraco-brachialis* muscle. The deltoid ridge is long and powerful, extending at least two thirds the length of the shaft. The distal end is exceedingly broad, with greatly enlarged supinator ridge and elongated inner epicondyle. The condylar surface is much narrower anteroposteriorly than in *Thylacynus*, but considerably wider transversely, with the trochlea and capitellum as sharply marked as in the recent genus. The supinator ridge is broad, terminating proximally in a hook-shaped process. A large entepicondylar foramen is present.

The radius (Pl. LI, figs. 1–1*b*) may be readily distinguished from that of *Borhyæna* by the great width of the distal portion of the shaft. The head is elliptical in outline and much broader antero-posteriorly than in that genus. The bicipital tubercle is much larger than in *Borhyæna* and is situated on the postero-external margin of the shaft. The shaft has a slightly greater degree of curvature than in the last-named genus. It is sharply triangular in cross section distally, closely resembling in this respect the radius of *Perameles*, but quite unlike *Thylacynus*. The styloid process is not as greatly elongated as in *Borhyæna*. The distal articular surface (Pl. LI, fig. 1*b*), unlike the condition in *Thylacynus* and *Borhyæna*, is concave.

The ulna (Pl. LI, figs. 1–1*b*) lacks the backward curvature characteristic of *Borhyæna* and *Thylacynus*. The olecranon process is slightly shorter and somewhat heavier than in the latter genus, and is broadly grooved on the inner side. The greater sigmoid cavity is deep, as in *Borhyæna*, but its proximal wall is much wider. In the lesser sigmoid cavity, the radial facets are more widely separated than in either *Thylacynus* or *Borhyæna*. Beneath the sigmoid cavity, on the inner side of the shaft, is a deep rugose pit for insertion of the *brachialis* muscle. The shaft is straight, considerably compressed laterally and broadly grooved on the outer side. The styloid process is hemispherical in shape. The radial facet is smaller than in *Thylacynus* and is supported on a distinct pedicle.

The scaphoid and a few phalanges of the fore foot are preserved. The proximal surface of the scaphoid is narrower in dorso-palmar section than is *Borhyæna;* the magnum facet is smaller and the lunar facet more deeply concave than in the latter genus. The association of the phalanges represented in fig. 9, Pl. LIV, is somewhat doubtful. That those of the first and second row were carried with respect to each other at a considerable angle (*cf.* Pl. LXI, fig. 2) is plainly indicated by the restriction of the trochlear surface of the proximal phalanx to the distal and palmar surfaces, and by the extension dorsally of the proximal articular surfaces of the phalanges of the second row. The latter are much heavier than in *Thylacynus*. The ungual (Pl. LIV, figs. 9, 14) is greatly compressed laterally, with a slight median cleft. The tip has been broken, but was probably sharp. A hood is developed to about the same extent as in *Borhyæna.* The subungual processes are large and an ungual foramen is present.

The greater part of both halves of the pelvis is preserved (Pl. XLIX, figs. 3; Pl L, fig. 1), but, unfortunately, the pubes are almost entirely missing. The peduncular portion of the ilium is considerably heavier than in *Thylacynus*, supporting a very large tubercle for the origin of the *rectus femoris* muscle. The gluteal surface is broadly expanded, but with little trace of the longitudinal grooving noticeable in the recent genus. The ilio-pectineal eminences are very large and rugose. The ischium is incomplete posteriorly, lacking the ischial tuberosity, but both acetabular and post-acetabular portions are heavier than in *Thylacynus.* The ischial spine is small. The pubis, so far as preserved, is narrower antero-posteriorly than in the recent genus. The acetabulum is large and deep. Beneath the acetabular notch, the border of the obturator foramen is exceedingly sharp. Posteriorly, it assumes the usual convex contour.

The femur (Pl. L, figs. 2, 2*a*), although of almost the same length as in *Thylacynus*, is much heavier. The large hemispherical head is supported on a long neck. The greater trochanter rises above the level of the head, from which it is separated by a broad interval. The digital fossa is long and deep and the intertrochanteric ridge high and narrow. The lesser trochanter is slightly larger than in *Thylacynus* and is separated farther from the head. The shaft is straight, circular in cross-section at the middle, but flattened antero-posteriorly at either end. Above the condyles, the distal end is semicircular in cross section. The condyles have about the same posterior extension as in *Thylacynus*, but are much flatter transversely, resembling *Borhyæna.* The intertrochanteric fossa is wider and deeper, and the rotular groove broader and shallower than in *Thylacynus.*

The patella (Pl. L, figs. 4, 4*a*) is a stout, wedge-shaped element, broad at the proximal end, but tapering distally to a thin edge. The rotular surface is irregularly pentagonal in outline, concave in vertical section and convex transversely. The anterior surface is rugose for tendinous attachment.

The tibia (Pls. XLIX, fig. 4; LI, fig. 2), unlike that of *Thylacynus,* is considerably shorter than the femur. The head supports two broad, flat surfaces for articulation with the femoral condyles. The spine is much lower than in *Thylacynus*. Unlike the latter, the distal end of the shaft is curved backward. The articular surface for the astragalar trochlea is broadly concave, that for contact with the inner side of the astragalus convex. The internal malleolus is much heavier than in *Thylacynus* and the fibular facet larger. The shaft is triangular in cross section.

The fibula (Pl. LIII, fig. 1) is much heavier than in *Thylacynus*. The proximal end is greatly thickened, supporting two approximately plane facets for articulation with the tibia and fabella respectively. The distal end carries three articular surfaces, a round tubercle for lateral contact with the tibia, a flat irregularly triangular facet for the outer margin of the astragalar trochlea, and a concave elliptical facet for the calcaneum. The peroneal groove is broader than in *Thylacynus* and less perfectly defined. The shaft is straight, with strongly marked interosseous ridge.

In contrast with the robust femur and tibia, the pes is rather feeble. The astragalar trochlea is remarkably flat, with the articular surfaces for the tibia and fibula separated by a faint groove. The tibial surface is produced distally down the dorsal aspect of the neck, as in *Amphiproviverra*, but unlike *Sarcophilus* and *Thylacynus*. The head is less obliquely placed than in the latter genus and is supported on a long heavy neck. Its distal end bears a single convex facet for the navicular. The inner side of the neck is deeply grooved for articulation with the internal tibial malleolus (Pl. LIV, fig. 2). In plantar aspect (Pl. LIV, fig. 2*a*), the semicircular ectal facet is seen to be deeply concave antero-posteriorly. The sustentacular facet is irregularly lobate in outline and strongly convex in dorso-plantar section. Several small foramina pierce the body of the astragalus at the point occupied by the astragalar foramen in certain primitive placentals. These are not visible in the dorsal view (Pl. LIV, fig. 8). The navicular has much the same shape as in *Thylacynus*, but is considerably larger and differs also in supporting all three cuneiforms, whereas in the recent genus, the outer cuneiform is supported almost entirely by the cuboid (*cf.* Pl. LIV, fig. 8, and text-fig. 4, *b*). The cuboid has the same shape as that of *Sarcophilus*, from which it differs slightly in the arrangement of some of the facets.

The cuboid in *Thylacynus* does not lend itself to comparison, owing to the outward shifting of the lateral cuneiform just mentioned. The proximal and distal surfaces of this element in *Prothylacynus* are almost the same as in *Sarcophilus*. The chief difference is in the facet for the outer cuneiform, which does not extend to the distal margin of the bone, as in the latter genus. The facet is oval in outline and slightly concave; that for the navicular, which immediately adjoins it, is triangular and convex. The cuneiforms resemble those of *Sarcophilus* rather than *Thylacynus.* The inner cuneiform is laterally flattened, supporting distally an oval, concave facet for the metatarsal of the hallux. Laterally it is in contact with the mesocuneiform by a narrow elliptical facet. The mesocuneiform is a small, oblong element, much shorter than the adjacent bones, so that the proximal end of the second metatarsal is received between them, articulating with the mesocuneiform by a concave oval facet, and with the ectocuneiform by a small plane facet confined to the dorsal margin of that bone. The outer cuneiform differs from that of *Thylacynus* and resembles *Sarcophilus* in lacking the large plantar process present in the former genus. It is in contact with the cuboid by a large triangular facet and has a very small facet for the fourth metatarsal. The facet for the mesocuneiform is narrow and sigmoid in dorso-plantar section.

The metatarsals are shorter and proportionately heavier than in *Thylacynus.* The hallux is vestigial, its distal end terminating in a rugose knob, which did not support phalanges. Proximally, the shaft bears a broad, plane facet for contact with metatarsal II. The third metatarsal is little more than half as long as the corresponding element in *Thylacynus.* The proximal end lacks the prominent plantar tubercle present in the latter and the articular surface for the ectocuneiform is more convex. The shaft is slightly curved and considerably flattened antero-posteriorly. The trochlear surface extends dorsally about as far as in *Thylacynus.* As in that genus, the keel is confined almost entirely to the plantar surface. The fourth metatarsal of the right pes is preserved. It is considerably longer than the third metatarsal. The proximal end is wider and more strongly convex in dorso-plantar section than in *Thylacynus.*

The antero-posterior shortening and especially the transverse flattening of the trochlear surface of the astragalus are believed to indicate a plantigrade gait.

Restoration (Pl. LXI, fig. 2).—The restored skeleton shows effectively the large head, long neck and short limbs characteristic of all the Santa Cruz marsupial carnivores. The lack of proportion between the femur, tibia and hind foot is at once apparent. The length of the tail is conjectural, but the error is probably in underestimating rather than in overestimating the lengths of the posterior caudals. It may have possessed less flexibility than is indicated in the drawing. No trace of a clavicle has been preserved, and it may have been rudimentary, as in *Thylacynus*, (Cunningham, p. 2, 1882) and not attached to the acromion. It has been supplied in the restoration from analogy with existing carnivorous marsupials. The length of the back has been determined by comparing the length of the dorsal series in *Thylacynus* with the lengths of the posterior lumbars in that genus and *Prothylacynus*. The depth of the chest is doubtful, as none of the longer ribs are completely preserved.

Habits. — It may be inferred from the large pointed claws that *Prothylacynus* was more active in attacking prey than *Borhyæna*. The greater degree of outward deflection of the metacone spur in the upper molars indicates a more completely carnivorous habit than in the latter genus. The reduction of the hallux is an adaptation to terrestrial progression.

PROTHYLACYNUS PATAGONICUS Ameghino.

(Plates XLVII–LI; LII, Figs. 3, 5; LIII, Figs. 5–8; LIV, Figs. 2, *2a*, 8, 9, 14; LXI, Fig. 2.)

Prothylacynus patagonicus Amegh.; Nuevos Restos Mamíf. Fós. Patagonia Austral, p. 26, Aug., 1891; Revista Argentina Hist. Nat. I, entr. 5*a*, p. 312, Oct., 1891.

The preceding account of the osteology of *Prothylacynus* is based almost entirely on the remains of a single individual of the classic species *Prothylacynus patagonicus* (No. 15,700) from the Upper Santa Cruz beds at Killik Aike. A reference to the discovery of this unique specimen will be found in Mr. Hatcher's Narrative of the expeditions (this series, Vol. I, pp. 53, 54). The American Museum collection contains a fragment of the right maxilla with the second, third and fourth molars in place (No. 9561 Am. Museum), also from Killik Aike. As a description of the anatomy of the hard parts has already been given, it remains only to tabulate the principal measurements.

MEASUREMENTS.

Cranium, length, condyles to anterior orbital border	.138
" " palato-narial border to condyles, inclusive	.109
" least width of brain case	.0175
Skull, greatest width across arches	.120
Occiput, height	.0485
" width at base	.057

Palate, width between $M^{\underline{4}}$.	.060
Mandible, length	.1655
" " $M_{\overline{4}}$ to outer end of condyle	.0755
" height of coronoid process above angle	.075
" " " condyle above angle	.033
" depth of horizontal ramus below $M_{\overline{4}}$	.030
" " " " " " posterior premolar	.024
Upper dentition, length of space occupied by molars	.042
Lower " " from anterior border of canine to $M_{\overline{4}}$ inclusive.	.090
" " " of space occupied by molars	.048
" " " " " " " premolars	.026
Posterior superior premolar, antero-posterior diameter	.010
" " " transverse	.005
$M^{\underline{1}}$, antero-posterior diameter	.0105
" transverse diameter	.008
$M^{\underline{2}}$, antero-posterior diameter	.0125
" transverse diameter	.0095
$M^{\underline{3}}$, antero-posterior diameter	.0135
" transverse diameter	.012
$M^{\underline{4}}$, antero-posterior diameter	.005
" transverse diameter	.009
Lower canine, antero-posterior diameter at base	.012
" " transverse diameter at base	.008
Anterior inferior premolar, antero-posterior diameter	.0078
" " " transverse diameter	.003
Median " " antero-posterior diameter	.0095
" " " transverse diameter	.0045
Posterior " " antero-posterior diameter	.0095
" " " transverse diameter	.0046
$M_{\overline{1}}$, antero-posterior diameter	.010
" transverse diameter	.005
$M_{\overline{2}}$, antero-posterior diameter	.011
" transverse diameter	.0055
$M_{\overline{3}}$, antero-posterior diameter	.0125
" transverse diameter	.0065
$M_{\overline{4}}$, antero-posterior diameter	.015
" transverse diameter	.008
Atlas, transverse breadth	.079
" width of neural arch	.017
" " " inferior arch	.0115
Axis, length of centrum, including odontoid process	.053
" " " odontoid process	.012
" width across anterior cotyles	.036
" depth of posterior face of centrum	.013
" width " " " " "	.020
Third cervical, length of centrum	.028

Third cervical, width across transverse processes	.050
“ “ “ “ prezygapophyses	.0315
Fourth cervical, length of centrum	.025
“ “ depth of posterior face of centrum	.014
“ “ width “ “ “ “ “	.0195
“ “ “ across prezygapophyses	.038
Fifth “ length of centrum	.025
Seventh dorsal, length of centrum	.021
“ “ depth of anterior face of centrum	.014
“ “ width “ “ “ “ “	.0165
“ “ width across diapophyses	.040
“ “ “ of neural spine	.010
Tenth dorsal, length of centrum	.0235
“ “ depth of anterior face of centrum	.014
“ “ width “ “ “ “ “	.020
Eleventh dorsal, length of centrum	.0235
“ “ depth of anterior face of centrum	.016
“ “ width “ “ “ “ “	.022
“ “ “ “ neural spine	.016
“ “ “ across anapophyses	.027
Twelfth dorsal, approximate length of centrum	.0235
“ “ depth of anterior face of centrum	.016
“ “ width “ “ “ “ “	.022
“ “ “ of neural spine	.013
“ “ “ across anapophyses	.0275
Fourth lumbar, length of centrum	.0345
“ “ depth of anterior face of centrum	.018
“ “ width “ “ “ “ “	.0225
“ “ “ “ neural spine	.0165
“ “ “ across prezygapophyses	.030
“ “ “ of transverse process at base	.015
Fifth lumbar, length of centrum	.0335
“ “ depth of anterior face of centrum	.0185
“ “ width “ “ “ “ “	.0235
“ “ “ “ neural spine	.0155
“ “ “ across prezygapophyses	.033
“ “ “ of transverse process at base	.015
Sixth lumbar, length of centrum	.033
“ “ depth of posterior face of centrum	.0185
“ “ width “ “ “ “ “	.029
“ “ “ “ neural spine	.015
“ “ “ across prezygapophyses	.034
“ “ “ of transverse process at base	.016
Sacrum, length of centra	.0505
“ width at point of greatest expansion of auricular processes	.061
“ depth of anterior face of centrum of first sacral	.018

Sacrum, depth of posterior face of centrum of second sacral	.015
“ width “ “ “ “ “ “ “ “	.022
Third caudal, approximate length of centrum	.0265
“ “ width of anterior face of centrum	.023
“ “ depth “ “ “ “ “	.015
Fourth caudal, approximate length of centrum	.0255
“ “ width of posterior face of centrum	.0225
“ “ depth “ “ “ “ “	.016
Eighth caudal, length of centrum	.041
“ “ width of posterior face of centrum	.0205
“ “ depth “ “ “ “ “	.0155
Ninth caudal, length of centrum	.044
“ “ width of posterior face of centrum	.0215
“ “ depth “ “ “ “ “	.016
Scapula, length	.132
“ width of neck	.0315
“ antero-posterior diameter of glenoid cavity	.026
“ transverse “ “ “ “	.022
Humerus, length	.155
“ width of proximal end	.037
“ depth “ “ “	.0445
“ width of distal end	.053
“ length, tip of supinator ridge to capitellum, inclusive	.063
Radius, length	.130
“ antero-posterior diameter of head	.015
“ transverse “ “ “	.0196
“ antero-posterior “ “ distal end	.015
“ transverse “ “ “ “	.0275
Ulna, length	.165
“ greatest width below sigmoid cavity	.031
“ antero-posterior diameter of distal end	.017
Pelvis, length (approximate)	.184
Ilium, width at greatest expansion	.0425
Acetabulum, antero-posterior diameter	.029
“ transverse “	.026
Femur, length from great trochanter to outer condyle	.198
“ width of proximal end	.0525
“ “ “ distal “	.042
“ depth of distal end	.031
“ diameter at middle of shaft	.017
Patella, length	.0285
“ width	.0225
“ greatest depth	.012
Tibia, length	.1725
“ width of proximal end	.0395
“ “ “ distal “	.0235

Fibula, length	.164
“ antero-posterior diameter of proximal end	.020
“ “ “ “ distal “	.0175
Astragalus, length	.026
“ width of trochlea	.019
“ “ “ neck	.009
Metatarsal I, length	.0245
“ “ width of proximal end	.008
“ “ “ “ distal “	.0065
Metatarsal III, length	.037
“ “ width of proximal end	.0075
“ “ “ “ distal “	.012

CLADOSICTIS Ameghino.

(Plates LII, Fig. 4; LIII, Figs. 3, 3*a*, 10; LIV, Figs. 1, 3, 4, 10, 12; LV–LVIII; LIX, Figs. 6–7*b*; LXI, Fig. 1.)

Cladosictis Amegh.; Enum. Sist. Especies Mamíf. Fós. Patagonia Austral, p. 7, 1887.
Hathliacynus Amegh.; Ibid., p. 7, 1887.
Anatherium Amegh.; Ibid., p. 8, 1887.
Proviverra (Rütimeyer) Amegh.; Revista Argentina, etc., I, pp. 149–150, 1891.

Dolichocephalic thylacynes intermediate in size between *Amphiproviverra* and *Prothylacynus*.

Dentition (Pls. LIV, fig. 1; LV, figs. 1, 3; LVI, figs. 1, 3; LIX, figs. 6–7*b*).

The median incisors (Pl. LV, fig. 3) are laterally compressed, unlike the corresponding teeth in *Dasyurus*, *Didelphys* and *Amphiproviverra*. The remaining incisors, so far as preserved, have laterally compressed crowns, and increase regularly in size externally. The crowns of the lateral pair are triangular in cross section. In all the specimens examined, the incisors are badly worn, reducing the crowns to irregularly truncated, flattened columns. The canines are stout, laterally compressed blades, the posterior margins of which are almost straight, while the anterior margins are moderately convex. The anterior and median upper premolars are spaced in both species. The median and posterior premolars are spaced in *C. petersoni*, unspaced in *C. lustratus*. The anterior premolar is separated by a short interval from the canine. Its crown is a simple, laterally compressed blade, with a rounded heel, but without heel cusp. The median premolar is a replica of the anterior tooth on a larger scale. The posterior premolar is enlarged, with a prominent, piercing protocone and a broad heel, with distinct heel cusp. The prominence of the latter varies with the amount of wear to which this part of the tooth crown has been subjected. The first, second and third molars have the protocone well developed. It is slightly cupped in unworn teeth. On $M^{\underline{4}}$, the protocone is reduced to a small conical cusp, while the paracone and antero-external style are enlarged, and the metacone is vestigial. In the anterior molars, the proportions of the dental cusps are much the same as in *Prothylacynus*, except that the protocone of $M^{\underline{3}}$ is well developed.

In the inferior series, the incisor crowns show considerable lateral compression, but are so badly worn in all the specimens examined that their original shape cannot be ascertained. As in many recent carnivorous marsupials, the root of the second tooth in the series is displaced posteriorly with respect to the roots of the median and lateral incisors. The canines are reniform in cross-section owing to the presence of a broad groove on the lingual side. The anterior surface of the crown is flattened (Pl. LVI, fig. 1; LIX, figs. 7, 7*a*) apparently to accomodate the tooth to the narrow groove in the premaxilla, into which its point is received when the jaws are brought into occlusion. The amount of spacing between the lower premolars varies somewhat in different individuals of the same species, the greatest amount of variation in this respect occurring in the width of the space between the median and posterior premolars. The anterior and median premolars closely resemble the corresponding teeth in the superior series. Each consists of an enlarged piercing central cusp and a round heel. In unworn teeth, the heel of the median premolar supports a small conical heel cusp. A minute anterior basal cuspule is also present. In worn teeth, the heel is reduced to a broad convex area, and the identity of the anterior cuspule is lost. The posterior premolar is enlarged like the corresponding tooth opposing it in the superior series. In unworn specimens a conical heel cusp is present. Characters of generic importance appear in the heels of the lower molars. The same rapid increase posteriorly in the size of the molar crowns is to be noted as in *Borhyæna* and *Prothylacynus.* The cusps of the trigonid are identical in shape and position with those of the latter genus. In the anterior molars, the heel supports a shallow, basin-shaped depression, bounded by a narrow rim. A notch in the posterior margin divides this bounding ridge into two portions, the hypoconid and hypoconulid-entoconid. The latter cusps are not differentiated from each other. In worn teeth, the heel consists of two rounded eminences, separated by a shallow groove. In contrast with the anterior molars, $M_{\overline{4}}$ has a much smaller heel, enclosing a small basin with a single prominent cusp on its posterior rim. An antero-external cingulum is present on the second, third and fourth tooth in the series.

Milk Dentition.—Ameghino states (1894, p. 109) that in *Cladosictis* the canine, median and posterior premolars have deciduous predecessors. The mandible represented in fig. 6, Pl. LIX, retains the deciduous tooth replaced by the posterior premolar, the germ of which is visible beneath the anterior root of the former tooth. Two large alveoli precede the deciduous tooth, evidently for the roots of the median premolar. No tooth germs were found beneath them. The region occupied by the anterior premolar has been destroyed by fracture, and in repairing this break the canine has been too closely approximated to the molars. The root of the canine is hollow, indicating, not that it is a deciduous tooth, but that it was not yet fully erupted and had not ceased its growth at the time of the animal's death. The tooth replaced by the posterior premolar differs from its permanent successor in the small size of the crown, which is greatly compressed laterally, carrying a central cusp preceded by an accessory basal cuspule. The narrow, ridge-like heel is subdivided by a shallow notch into two cuspules. The first and second molars are fully erupted and the third partly so.

Skull (Plates LIV, fig. 1; LV, fig. 1; LVI; LXI, fig. 1).—Perhaps the most striking peculiarity of this remarkable genus is the greatly elongated, narrow skull, altogether disproportionate to the size of the body. The facial portion is short and slender and the cranium elongated. The post-orbital constriction is proportionately greater than in the much smaller genus *Amphiproviverra.* The inclination of the upper border of the facial profile varies with the species. The brain (Pl. LVI, fig. 3) was less convoluted than in *Thylacynus*, and the brain case proportionately much smaller. The ascending premaxillary processes have approximately the same degree of development as in *Amphiproviverra*, and the nasals are similarly expanded posteriorly. Well defined post-orbital processes are present in *C. lustratus.* A short distance above these processes, feeble temporal ridges converge to form a long, high sagittal crest, the top of which is practically horizontal. In *C. petersoni*, only a small portion of the anterior extremity of the crest is preserved, but this rises abruptly above the interorbital tract, with decidedly convex superior border. The crest terminates posteriorly in a semicircular lambdoidal frill, which does not project beyond the condyles. The supraoccipital is broadly expanded on the upper surface of the brain case. Between the supraoccipital and the squamosal, a narrow tongue of the parietal reaches the mastoid border of the occiput. The orbits are proportionally smaller than in *Thylacynus* and are placed much farther forward, their anterior border coinciding with a line drawn through the posterior half of the first molar. A large lachrymal prominence is situated on the orbital rim above the lachrymal duct, which lies wholly within the orbit.

The occiput is semi-circular in outline, so far as can be judged from the crushed specimen (No. 15,170), in which this portion of the skull is preserved. The mastoid is exposed to about the same extent proportionately as in *Prothylacynus*.

The basioccipital and basisphenoid (Pl. LV, fig. 1) are flat, unlike *Prothylacynus*, resembling in this respect the recent genus. The paroccipital processes are broad, dome-shaped masses, lying considerably below the level of the auditory bullæ. The latter are formed entirely from the dilated alisphenoids, the petrous not entering into the posterior wall of the bulla, as in some of the dasyures. A large foramen ovale pierces the alisphenoid opposite the glenoid cavity. The palate begins to increase in width back of the posterior premolar and is without vacuities, but is pierced by several accessory palatal foramina. The anterior palatine foramina project a short distance beyond the premaxillo-maxillary suture. A pair of large foramina pierce the maxillary on either side of the median line, either opposite or a short distance anterior to the posterior border of the canine. The usual thickening is observable about the border of the posterior nares. The foramina opening into the lateral venous sinus are large, sub-squamosal, post-glenoid and post-zygomatic foramina being present. The last mentioned opens well within the lip of the post-glenoid foramen. A small foramen pierces the outer side of the squamosal bar above the glenoid cavity.

In contrast with the skull, the mandible is remarkably deep and heavy (Pls. LVI, fig. 1; LXI, fig. 1). The anterior coronoid border is straight as in *Thylacynus*, but less steeply inclined posteriorly than in that genus. The superior and posterior borders correspond in shape to the same region in *Prothylacynus*. As a whole, the coronoid is proportionately broader and higher and the masseteric fossa better defined anteriorly than in *Thylacynus*. The lower border of the horizontal ramus lacks the convexity observable in *Prothylacynus* and *Thylacynus*. The rami are united in ligamentous suture at the symphysis, which extends as far back as the anterior half of the posterior premolar (Pl. LIX, fig. 7*a*). The mental foramina vary greatly in number and position in different individuals of the same species and even on opposite sides of the same mandible (*cf.* Pls. LVI, fig. 1; LIX, fig. 7), and are of no diagnostic importance.

Vertebral Column and Ribs. — *Cladosictis* resembles *Prothylacynus* in having the atlanteal intercentrum firmly fused with the base of the neural arch (Pl. LIII, fig. 3*a*). The intercentrum retains to a slight extent only the posterior emargination observable in *Thylacynus* and *Borhyæna*. The foramina for the exit of the spinal nerves are separated from the anterior atlanteal margin by a broader osseous bar than in *Prothylacynus*, resembling rather in this respect the atlas of *Thylacynus* (text-fig. 5, *b*, *c*) and *Amphiproviverra* (Pl. LIII, fig. 1). The canals for the vertebral artery enter the neural arch within the spinal canal on a level with and a short distance anterior to the superior border of the atlanteal condyles. They emerge on the lower surface of the atlas at the bases of the transverse processes (Pl. LIII, fig. 3*a*). From this point the arteries curved dorsally, traversing a groove in the outer wall of the neural arch just anterior to the transverse process (Pl. LIII, fig. 3) and entered the neurovascular foramen. The margins of the transverse processes in the specimens studied have not been preserved. Their antero-posterior basal constriction is much less than in *Thylacynus*. The anterior margin of the neural arch supports a pair of tubercles, separated by a deep groove. In *Thylacynus* there is but a single median prominence in this region (*cf.* text-fig. 5, *b*).

The axis (Pl. LII, fig. 4) carries a powerful, hatchet-shaped neural spine, which projects anteriorly as far as the odontoid and posteriorly beyond the zygapophyses. The ventral surface of the centrum is strongly keeled posteriorly. On either side of the keel is a depressed area, bounded by the dependent edges of the transverse processes, as in *Borhyæna* and *Prothylacynus*.

In the remaining cervicals the neural spines increase regularly in robustness and probably also in height, although this can not be determined, owing to the fracturing of their extremities. The inferior lamellæ of the transverse processes are more wedge-shaped than in *Thylacynus*, resembling rather this region in *Borhyæna*, and, as in that genus, the diapophyses are fully differentiated on the fourth cervical. The transverse processes of the seventh cervical are perforated by the arterial canal. The centra are all heavily keeled inferiorly, but, owing to imperfect preservation, it can not be determined whether the keels decrease in depth in the posterior cervicals, as in *Prothylacynus* and *Thylacynus*. The upper surface of the neural arch of the third cervical is perforated on the left side by a rather large foramen. A smaller corresponding foramen occurs somewhat farther back on the right side. Small foramina may occupy similar positions in some of the other cervicals. The foramina piercing the lateral walls of the neural arches of the second to the seventh cervicals, which are so prominent in *Thylacynus* (text-fig. 5, *d*), are present in some of the cervicals of *Cladosictis* and absent in others.

The dorso-lumbar formula is apparently nineteen, although this can not be accurately determined, owing to the incomplete state of preservation of the column. The neural spines of the anterior dorsals are high and broad, but gradually decrease in both dimensions to the tenth, or anticlinal vertebra. Beyond this point, the strong backward slope of the spines changes abruptly to a forward direction. Metapophyses are developed on the tenth dorsal, and are prominent as far posteriorly as the second lumbar, beyond which they begin to decrease in height. Anapophyses also appear on the tenth dorsal and increase in size posteriorly until the fifth lumbar is reached, when they become smaller.

The lumbars (Plate LVII, fig. 6) are six in number. They have heavy neural spines strongly inclined forward, with broad tips flattened superiorly, and wide, thin transverse processes, with a forward and downward curvature. The long, keeled centra increase regularly in size posteriorly. In the first, second and third lumbars, the keels are bifid posteriorly, inclosing a more or less flattened, wedge-shaped area. The prezygapophyses overlap the outer margin of the postzygapophyses, producing an interlocking articulation. This applies also to the anterior zygapophyses of the thirteenth dorsal.

The sacrum (Pls. LVII, figs 1, 1*a*; LVIII, figs. 1, 7, 7*a*) is composed of two vertebræ more completely fused than in *Thylacynus* and lacking the dorsal intervertebral fontanelle so conspicuous in the latter genus. The spines are remarkably feeble in contrast with the heavy spine of the last lumbar. The auricular processes are confined almost entirely to the first sacral. The centra are keeled inferiorly, the first having a single low median keel and the second a pair of parallel keels.

The caudals are remarkably heavy. Those associated with No. 15,170, which have been reproduced in the figures (Pls. LVII, fig. 5; LXI, fig. 1), are interpreted as the third to the tenth. The proximal ones are short, with stout, posteriorly directed transverse processes. The centra of the more distal caudals increase in length and the transverse processes become wider and shorter. The neural canal is complete as far back as the tenth caudal. It is not possible from the material at hand to determine the length of the tail, but judging from the size of the caudals preserved, it was probably long and heavy. From analogy with *Thylacynus*, it has been restored with a vertebral formula of twenty-three. Chevrons are present between the third and fourth caudals and are represented either by the small hatchet-shaped pieces themselves, or by surfaces for their attachment, as far back as the caudal series is preserved (Pl. LXI, fig. 1).

A few ribs are associated with both specimens of *C. lustratus.* The anterior ribs (Pl. LVIII, fig. 3) have more cylindrical shafts than in *Thylacynus.* The posterior ribs are slender and sub-round in section.

Appendicular Skeleton.—The scapula (Pl. LVII, figs. 2–3) corresponds more closely with that of *Prothylacynus* than with the corresponding element in *Borhyæna* or *Thylacynus.* The neck is short, the glenoid cavity oval in outline and moderately deep and the coracoid prominent, with its anterior margin strongly inflected. In shape the scapular fossæ are much as in *Prothylacynus.* The spine is high, but its free border has been somewhat fractured in both specimens, destroying the acromion. The foramen which perforates the margin of the suprascapular notch in *Thylacynus* appears in *Cladosictis* some distance posterior to the coracoid border.

No trace of a clavicle has been found and its introduction in the restoration (Pl. LXI, fig. 1) is conjectural. It may have been rudimentary and not attached to the acromion, as in *Thylacynus.*

The humerus (Pl. LV, figs. 2, 2*a*) is short and heavy, resembling decidedly that of *Prothylacynus*, but differing in the less prominent epicondyle and the absence of a hook-shaped termination at the proximal end of the supinator ridge. In the specimen figured, this is not well shown, owing to fracturing of the extremity of the ridge, but it can be satisfactorily determined from the distal end of the humerus of *C. lustratus* (No. 15,046). The head is broad and overhangs posteriorly, as in *Prothylacynus*. Distally, the trochlear and capitellar surfaces are better defined than in the latter genus and the capitellum is separated from the anterior margin of the external condyle by a deep groove quite unlike the condition in *Thylacynus* (text-fig. 1, *a*) and *Prothylacynus* (Pl. XLIX, fig. 1). The anconeal and antecubital fossæ are deep, but the connection between them shown in the figures (Pl. LV, figs. 2, 2*a*) is due to accidental rupture of the thin lamina of bone separating them.

The radius (Pl. LVIII, figs. 4, 4*a*, 5) is intermediate in shape between that of *Borhyæna* and *Prothylacynus*. The head is oval in outline, as in the former genus. The shaft is arched, elliptical in cross section proximally, but becoming flattened and triangular in cross section toward the distal end. The large bicipital tubercle lies on the posterior surface of the shaft.

The ulna is strikingly like that of *Prothylacynus*, but the sigmoid curvature of its posterior margin is somewhat more pronounced. The short, heavy olecranon is grooved on both sides. The shaft is considerably compressed laterally and deeply grooved on the outer side. The extremity of the styloid process is hemispherical, but less sharply differentiated from the radial facet than in *Prothylacynus*.

One of the most interesting and important features in the anatomy of *Cladosictis* is the great size and decided opposability of the pollex. The feet are preserved with but one specimen (No. 15,046). Unfortunately the carpus is incomplete and the articular surfaces of the elements remaining have been partly destroyed by weathering. The arrangement shown in the figure (Pl. LIV, fig. 4) is the same as that of the carpal elements in the matrix. The metacarpals are short and stout, interlocking proximally and spreading widely distally. The metacarpal of the pollex is a robust element with a broad proximal articular surface, convex transversely. Distally, the outer condyle is greatly enlarged, deflecting the proximal phalanx toward the inner side of the foot. The tip of the ungual phalanx of the pollex (Pl. LIV, fig. 12) is incomplete, but, so far as preserved, shows no indication of a median cleft. Of the remaining metacarpals, the fourth is the longest. The shafts are more slender than that of the pollex and are slightly arched and more or less compressed in the dorso-palmar plane.

The structure of the pelvis (Pls. LVII, figs 1, 1*a*; LVIII, figs. 1, 7, 7*a*) is important from the bearing it has on the thylacyne affinities of *Cladosictis.* The anterior margin of the pubic symphysis is slightly damaged in the otherwise nearly complete pelvis of *C. lustratus* (No. 15,170). The anterior pubic border is sharp, without trace of supporting structures for epipubic bones. The pubic symphysis is closed, as in *Thylacynus,* so it seems probable that, if epipubic elements were present, they must have been vestigial cartilages, as in the latter genus (*cf.* text-fig. 3). The peduncular portion of the ilium is more attenuated than in *Prothylacynus,* supporting heavy *recti* tubercles. The gluteal surface is broad and smooth with even less trace of muscular flutings than in *Prothylacynus.* The iliopectineal eminences are large. The ischial tuberosities are less pronounced than in *Thylacynus.* The obturator foramina are large and oval in outline, with the posterior border emarginated by an anteriorly directed prominence.

The same lack of proportion between the lengths of skull and femur, which was mentioned in the discussion of the genus *Borhyæna,* is observable to even a greater extent in the case of *Cladosictis.* The femoral shaft has a gentle sigmoid curvature, expanding at either end to about the same extent and in much the same manner as in *Borhyæna.* The greater trochanter and head reach the same elevation. The lesser trochanter is prominent. As in *Borhyæna,* the inner condyle is somewhat wider than the outer one. The intercondylar notch is deep and narrow, leading anteriorly into a wide, shallow rotular groove, the margins of which are more acute than in *Thylacynus* (*cf.* text-fig. 1, *c*).

An ossified patella has not been found in association with any of the skeletal material of *Cladosictis* in the collection, and has accordingly been omitted in the restoration.

The tibia (Pl. LVIII, figs. 2, 8) resembles that of *Prothylacynus,* differing, however, in being slightly narrower distally and in having the distal fibular facet less obliquely placed. The shaft is straight, in contrast with the curvature of the tibial shaft in *Thylacynus* (text-fig. 1, *d*). The cnemial crest is poorly differentiated, as in *Prothylacynus,* extending more than half way down the shaft. Distally, the tibia exhibits a trochlear surface similar to that in *Prothylacynus* (Pl. XLIX, fig. 4). The internal malleolus is prominent.

The fibula (Pl. LVIII, fig. 9) is intermediate in shape between that of *Prothylacynus* and that of *Thylacynus*. Proximally, it is flatter than in the former genus, having the facets for the tibia and lateral sesamoid relatively longer. The shaft is curved sigmoidally, supporting a strong interosseous ridge. Distally the shaft becomes roughly circular in section. In shape, the articular surfaces for the astragalus and calcaneum are much the same as in *Prothylacynus*.

In general, the pes (Pl. LIV, fig. 3) resembles that of *Dasyurus maculatus*. The trochlear surface of the astragulus (Pl. LIV, fig. 10) is not as flat as in *Amphiproviverra* and *Prothylacynus* and is somewhat narrower proportionately than in the latter genus. The tibial portion is not produced distally on the dorsal surface of the neck, as in *Prothylacynus*. The articular surfaces on the plantar aspect are substantially the same as in the last-mentioned genus (*cf.* Pl. LIV, fig. 2*a*). The calcaneum differs from that of *Amphiproviverra* in lacking the deep groove for the accommodation of the calcaneo-cuboidal ligament. The relative position of the tarsals is the same as in *Prothylacynus*. The cuboid lacks the notch in its dorsal border between the articular surfaces of the fourth and fifth metatarsals, which is so noticeable a feature in both *Prothylacynus* and *Amphiproviverra*. The shifting of the external cuneiform toward the outer side of the foot has progressed to about the same extent as in *Prothylacynus*. The hallux is not preserved, but from the small cup-shaped character of its articular surface on the entocuneiform, it is probable that it was proportionately no larger than in *Dasyurus maculatus* or *D. viverrinus*, having lost the opposable condition retained by *Amphiproviverra*. The metatarsals interlock proximally and spread apart distally. Their distal ends have been destroyed in the right pes represented in the figure, but are well enough preserved in the left pes to show that the fourth is the longest, an arboreal character (Dollo, 1899; Bensley, 1903) retained also in the manus, where, it will be remembered, the pollex is large and opposable (*cf.* Pl. LIV, fig. 4).

Restoration of the Skeleton (Pl. LXI, fig. 1). — The lack of proportion between head and body, which has been so often referred to in the discussion of the Santa Cruz thylacynes, is nowhere more marked than in *Cladosictis*. The lengths of the few missing dorsal vertebræ were determined approximately by comparison with adjacent portions of the column. The depth of the anterior portion of the thorax is conjectural, as none of the ribs in this region are preserved. The tail was probably long and heavy, judging from the weight of its proximal portion. The legs are remarkably short and the feet probably plantigrade or semi-plantigrade.

Habits. — The elongation of the fourth digit and the opposability of the thumb point toward an arboreal habit. The loss of the opposable hallux is an adaptation toward terrestrial progression, which does not necessarily conflict with the view just stated, if we assume that these animals occupied a place in the economy of nature similar to that now filled by the dasyures and some of the smaller placental Carnivora.

CLADOSICTIS LUSTRATUS (Ameghino).

(Plates LII, Fig. 4; LIII, Fig. 10; LIV, Figs. 3, 4, 12; LV, Fig. 1; LVI; LVII, Figs. 1, 1*a*, 3, 5, 6; LVIII, Figs. 1–4*a*, 6; LIX, Figs. 7–7*b*; LXI, Fig. 1.)

Hathliacynus lustratus Amegh.; Enum. Sist. Especies Mamíf. Fós. Patagonia Austral, p. 7, 1887.

Anatherium defossum Amegh.; ibid. p. 8, 1887.

Hathliacynus defossus (Amegh.) Mercerat; Revista del Museo de La Plata, II, p. 53, 1891.

Proviverra trouessartii Amegh.; Revista Argentina, I, pp. 149–150, fig. 54, 1891.

Cladosictis trouessarti Amegh.: Énum. Syn., etc., pp. 131–132, figs. 50, 51, 1894; Bol. Acad. Cordoba, pp. 386–388, figs. 50–51, 1894.

Cladosictis lateralis Amegh.; Énum. Syn., etc., pp. 132–133, 1894; Bol. Acad. Cord., p. 388, 1894.

Judging from the number of individuals represented in the collection, this must have been the most abundant of the Santa Cruz marsupial carnivores. The two more or less complete skeletons on which the preceding account of the osteology of the genus is largely based (Nos. 15,046; 15,170) are from the Lower Santa Cruz beds, ten miles south of Coy Inlet. Three very fragmentary skulls associated with a small amount of skeletal material were collected by Mr. Hatcher at Lake Pueyrredon (see Narrative, this series, Vol. I, p. 173). Several additional specimens were obtained by Messrs. Hatcher and Peterson and Mr. Barnum Brown at Coy Inlet and along the coast to the south of the Coy (Nos. 15,015; 15,704), the Cañon de las Vacas (No. 9134, American Museum of Natural History), and North Gallegos (No. 15,703).

Cladosictis lustratus may be readily recognized by the long, narrow, depressed skull, with tapering muzzle, moderately expanded arches and low inclination forward of the facial profile. The summit line of the long sagittal crest is practically horizontal. The anterior superior premolar is separated by a short diastema from the canine and by a larger interval from the median premolar. The median and posterior premolars are almost in contact at the alveolar border. The lower premolars are separated from the canine and from each other by diastemata, which vary in width considerably in different individuals. The posterior premolar and first molar are separated in some specimens by a short interval.

With the exception of smaller size and less robust build, the skeleton, so far as it has been possible to make comparisons, is exactly the same as in *Cladosictis petersoni*, and the description already given in characterizing the genus will apply equally to both.

Within fairly well defined limits, there is considerable individual variation in size. This is probably sexual, as the difference between extremes is not greater than between the sexes in *Thylacynus* (*cf.* Thomas, 1888, p. 261). The range of this variation is well brought out in the accompanying measurements of the two individuals selected for illustration (Nos. 15,170; 15,046), which are regarded respectively as male and female.

MEASUREMENTS.

	No. 15,046.	*No. 15,170.*
Skull, extreme length, premaxillæ to lambdoidal crest	.142	.158
" width across jugal arches	.066	approximately .076
" interorbital width	.022	.0258
Face, length, premaxillæ to anterior border of orbit	.052	.0575
Cranium, length to anterior border of orbit	.090	.1005
" width at postorbital constriction	.010	.0115
Nasals, length	.052	
" width anteriorly	.008	
" " posteriorly	.024	.023
Palate, length	.069	.079
" width between posterior premolars (approximate)	.0125	.015
" " " M^4	.030	.0323
Mandible, length	.1105	.1195
" height of coronoid above angle	.039*	.051
" transverse diameter of condyle	.0152	.0162

* Slightly decreased by fracture of the angle.

	No. 15,046.	*No. 15,170.*
Mandible, length of symphysis	.0345	.036
" depth of horizontal ramus below anterior premolar	.010	.012
" depth of horizontal ramus below posterior premolar	.0146	.017
" depth of horizontal ramus below $M_{\overline{4}}$	.015	.0205
Upper dentition, length from median incisor to $M^{\underline{4}}$	.0695	.078
" " " of premolar series	.025	.025
" " " " molar "	.027	.027
Lower dentition, length from median incisor to $M_{\overline{4}}$	.0695	.072
" " " of premolar series	.024	.027
" " " " molar series	.032	.0314
Upper lateral incisor, width of crown	.002	.002
Upper canine, antero-posterior diameter at alveolar border	.0075	.009
" " transverse " " " "	.005	.0055
Anterior superior premolar, antero-posterior diameter	.0055	.005
" " " transverse "	.002	.0022
Median " " antero-posterior "	.0073	.0065
" " " transverse "	.0026	.003
Posterior " " antero-posterior "	.0085	.008
" " " transverse "	.0034	.004
$M^{\underline{1}}$, antero-posterior diameter	.0078	.007
" transverse "	.005	.005
$M^{\underline{2}}$, antero-posterior "	.0086	.008
" transverse "	.0065	.0058
$M^{\underline{3}}$, antero-posterior "	.0086	.0085
" transverse "	.0067	.0066
$M^{\underline{4}}$, antero-posterior "	.003	.003
" transverse "	.006	.007
Lower lateral incisor, width of crown	.0013	.002
" canine, antero-posterior diameter at alveolar border	.007	.008
Lower canine, transverse diameter at alveolar border	.0045	.005
Anterior inferior premolar, antero-posterior diameter	.0055	.0055
" " " transverse "	.0023	.0025
Median " " antero-posterior "	.0077	.0085
" " " transverse "	.0028	.003
Posterior " " antero-posterior "	.008	.009
" " " transverse "	.003	.0035
$M_{\overline{1}}$, antero-posterior diameter	.007	.0065
" transverse "	.003	.003
$M_{\overline{2}}$, antero-posterior "	.0075	.007
" transverse "	.0033	.0033
$M_{\overline{3}}$, antero-posterior "	.0085	.0082
" transverse "	.004	.004

	No. 15,046.	*No. 15,170.*
$M_{\overline{4}}$, antero-posterior diameter	.0095	.0096
“ transverse “	.005	.0047
Atlas, width across anterior cotyles		.0325
“ “ of neural arch		.0136
“ “ “ inferior “ (approximate)		.008
Axis, length of centrum including odontoid		.034
“ width across anterior cotyles		.0225
“ approximate length of neural spine		.044
“ “ height “ “ “ above floor of neural canal		.022
Third cervical, length of centrum		.019
“ “ width across prezygapophyses		.022
Fourth cervical, length of centrum		.017
“ “ width across prezygapophyses		.023
Fifth cervical, length of centrum		.0175
“ “ width across prezygapophyses		.024
“ “ antero-posterior diameter of inferior lamella		.017
Sixth cervical, length of centrum		.017
“ “ width across prezygapophyses		.024
“ “ antero-posterior diameter of inferior lamella		.021
Seventh “ approximate length of centrum		.0155
“ “ width across prezygapophyses		.023
Fifth dorsal, length of centrum	.011	
Sixth dorsal, “ “ “	.0118	
Tenth “ “ “ “	.013	
Eleventh dorsal, length of centrum	.014	
Twelfth “ “ “ “	.0145	
“ “ width of posterior face of centrum	.0125	
“ “ depth “ “ “ “ “	.008	
First lumbar, length of centrum		.017
“ “ width across prezygapophyses		.019
“ “ height, including spine		.023
Second lumbar, length of centrum		.020
“ “ width across prezygapophyses		.021
Third lumbar, length of centrum		.021
“ “ width across prezygapophyses		.018
Fourth lumbar, length of centrum		.022
“ “ width across prezygapophyses		.018
Fifth lumbar, length of centrum		.021
Sixth lumbar, “ “ “	.019	.021
Sacrum, total length	.027	.031
“ length of centrum of first sacral	.014	.0155
“ “ “ “ “ second sacral	.013	.0155

	No. 15,046.	*No. 15,170.*
Sacrum, greatest width across auricular processes	.025	.032
Third ? caudal, length of centrum		.0135
Fourth ? “ “ “ “		.0137
Fifth ? “ “ “ “		.0137
Sixth ? “ “ “ “		.014
Seventh ? “ “ “ “		.015
Eighth ? “ “ “ “		.0178
Ninth ? “ “ “ “		.019
Tenth ? “ “ “ “		.021
Scapula, approximate length		.078
“ width of neck		.014
“ antero-posterior diameter of glenoid cavity, including coracoid process		.0175
“ transverse diameter of glenoid cavity		.0105
Radius, length	.0646	.0666*
“ antero-posterior diameter of head	.006	.0066
“ tranverse “ “ “	.0102	.0114
“ width of distal end	.011	.011
Ulna, length	.085	.087*
“ antero-posterior diameter at lower margin of sigmoid cavity	.0136	.0166
“ antero-posterior diameter of distal end	.0088	.0085
Femur, length	.098	.1095
“ width of proximal end	.022	.026
“ “ “ distal “	.0175	.021
Tibia, length	.0965	.102
“ width of proximal end	.015	.019
“ “ “ distal end	.0095	.010
Fibula, length	.0915	
Pelvis, length	.1015	
“ width of ilium	.021	
“ “ across tubercles for origin of *rectus femoris*.	.048	
“ length of obturator foramen	.0264	
“ width of obturator foramen	.0165	
“ antero-posterior diameter of acetabulum	.013	
“ transverse “ “ “	.0125	

The following measurements of the manus and pes are from No. 15,046:

Metacarpal I, length	.0105
“ “ width of proximal end	.0066
“ “ “ “ distal end	.0055
“ II, length	.017
“ “ width of proximal end	.007

*Exclusive of distal epiphysis.

Metacarpal II, width of distal end	.006
" III, length	.021
" " width of proximal end	.0045
" " " " distal end	.0045
" IV, length	.020
" " width of distal end	.005
" V, approximate length	.013
Terminal phalanx of pollex, approximate length	.009
Length of calcaneum	.0226
Metatarsal II, approximate length	.027
" " width of proximal end (approximate)	.0036
" " " " distal end	.0062
" III, approximate length	.028
" " width of proximal end	.0047
" IV, width of proximal end	.0045
" V, " " " "	.005

CLADOSICTIS PETERSONI sp. nov.

(Plates LIII, Figs. 3, 3*a*; LIV, Figs. 1, 10; LV, Figs. 2–3*a*; LVII, Figs. 2, 2*a*, 4, 4*a*; LVIII, Figs. 5, 7–9.)

The type of this species (No. 15,702 Princeton University Museum) is the facial half of a skull associated with a large part of the skeleton, collected from the Santa Cruz beds ten miles south of Coy Inlet by Mr. Peterson, in whose honor the species is named.

The skeletal material associated with the skull includes the right scapula, humerus, radius and ulna, the left femur, tibia, fibula and astragalus, the atlas, three dorsals, six lumbars, the first sacral and the pelvis.

Cladosictis petersoni may be recognized by its large size, exceeding in this respect the largest and most robust individuals of *C. lustratus*. The face is relatively shorter, and much deeper, than in that species and the upper margin of the facial profile is inclined forward more abruptly. The sagittal crest rises high above the interorbital tract. This portion of the skull has been crushed antero-posteriorly, approximating the origin of the crest and the posterior border of the nasals to a greater extent than is normal. The arches are more abruptly expanded than in *C. lustratus*. The median and posterior premolars are spaced to a greater extent than in the latter, but otherwise there is no difference in the dentition of the two species.

The skeleton of *C. petersoni* presents no characters, apart from size, by which it may be distinguished from *C. lustratus*.

In the type skull, there are but three molars on the right side, where M$^{\underline{4}}$ is wanting. This tooth is present on the opposite side, where it is proportionately no more reduced than in *C. lustratus*.

The broad, blunt points of the upper canines are the result of fracturing, and are not characters of specific importance.

MEASUREMENTS.

Skull, width across jugal arches (approximate)	.090
Face, length, premaxillæ to anterior border of orbit	.060
Cranium, width at postorbital constriction	.011
Nasals, length (approximate)	.057
" width anteriorly	.009
" " posteriorly	.026
Palate, length	.076
" width between canines	.014
" " " posterior premolars	.020
" " " M$^{\underline{4}}$	.037
Upper dentition, length from median incisor to M$^{\underline{4}}$ (approximate)	.079
" " " of premolar series	.032
" " " " molar "	.0245
Upper median incisor, width of crown	.0012
" lateral " " " "	.0018
Upper canine, antero-posterior diameter at alveolar border	.010
" " transverse " " " "	.007
Anterior superior premolar, antero-posterior diameter.	.006
" " " transverse "	.0025
Median " " antero-posterior "	.0085
" " " transverse "	.003
Posterior " " antero-posterior "	.0085
" " " transverse "	.0038
M$^{\underline{1}}$, antero-posterior diameter	.007
" transverse "	.005
M$^{\underline{2}}$, antero-posterior "	.0078
" transverse "	.006
M$^{\underline{3}}$, antero-posterior "	.0088
" transverse "	.007
M$^{\underline{4}}$, antero-posterior "	.003
" transverse "	.007
Atlas, width across anterior cotyles	.035
" " of neural arch	.016
" " " inferior "	.009
Eleventh dorsal, length of centrum	.0175
" " width of posterior face of centrum	.0165
" " depth " " " " "	.010

Eleventh dorsal, width across prezygapophyses	.034
Twelfth " length of centrum	.019
" " width of posterior face of centrum	.0164
" " depth " " " " "	.0104
" " width across prezygapophyses	.032
" " height, including neural spine	.0275
Thirteenth " length of centrum	.020
" " width across prezygapophyses	.027
" " height, including neural spine	.0275
First lumbar, length of centrum	.021
" " width of posterior face of centrum	.016
" " depth " " " " "	.0125
" " width across prezygapophyses	.028
" " height, including neural spine	.031
Sixth lumbar, length of centrum	.022
" " width of anterior face of centrum	.017
" " depth " " " " "	.0125
" " width across prezygapophyses	.026
" " " " transverse processes	.045
First sacral, length of centrum	.018
" " greatest width across auricular processes	.038
Scapula, length	.102
" width of neck	.018
" antero-posterior diameter of glenoid cavity including coracoid process	.0228
" transverse " " " "	.0135
Humerus, length	.112
" width of distal end	.033
Radius, length exclusive of distal epiphysis	.0785
" antero-posterior diameter of head	.0087
" transverse " " "	.0135
" width of distal end	.013
Ulna, length, exclusive of distal epiphysis	.0995
" width at lower margin of sigmoid cavity	.0195
Femur, length	.1255
" width of proximal end	.030
" " " distal end	.024
Tibia, length	.116
" antero-posterior diameter of proximal end	.0215
" transverse " " distal "	.012
Fibula, length	.1095
" antero-posterior diameter of proximal end	.014
" transverse " " distal "	.0115
Pelvis, length	.123
" greatest width of ilium	.0275
" antero-posterior diameter of acetabulum	.0155
" transverse " " "	.0145

Pelvis, pubic symphysis, approximate length	.0495
Astragalus, length	.016
" greatest width of trochlea	.009
" length of trochlea	.010
" width of neck	.0055
" " " head	.0065

AMPHIPROVIVERRA Ameghino.

(Plates LIII, Figs. 1, 1*a*; LIV, Figs. 5, 6, 11; LIX, Figs. 1–5; LX).

Protoproviverra Amegh.; Nuevos Restos Mamíf. Fós. Patagonia Austral, pp. 26–27, Aug., 1891; Revista Argentina Hist. Nat., I, entr. 5*a*, pp. 312–313, Oct., 1891. Preoccupied by *Protoproviverra* Lemoine.

Amphiproviverra Amegh. Revista Argentina, etc., I, footnote p. 397, 1891.

Small, highly carnivorous marsupials, in which the protocone on the last upper molar is basin-shaped and the heels of the lower molars are broad and strongly bicuspidate.

Dentition (Pls. LIX, figs. 1–1*b*, 3*a*, 4; LX, figs. 1, 1*a*, 2–3*a*).—Dental formula $\frac{4}{3}$, $\frac{1}{1}$, $\frac{3}{3}$, $\frac{4}{4}$. The median upper incisors are styliform, and approximated at the tips, as in the opossums and dasyures. The crowns of the lateral teeth are spatulate in shape. The incisor series is placed obliquely, so that the procumbent median pair are the most anterior. Its members increase regularly in size from the first to the fourth. The canines are long and slender, projecting below the lower border of the mandible when the jaws are closed (Pl. LX, fig. 3). The anterior and median premolars are simple-crowned, double-fanged, piercing teeth, much compressed laterally. The median premolar supports a small heel cusp. The posterior premolar is enlarged, its crown projecting below the level of the molars. It is recurved to about the same degree as the tooth preceding it and also carries a small heel cusp. The anterior premolar is separated from the canine and median premolar by diastemata. The latter tooth is almost in contact with the posterior premolar in *A. manzaniana* and *A. minuta* (Pl. LX, figs. 1, 3). The anterior molars are of the characteristic thylacyne type, while the fourth resembles the last upper molar of *Dasyurus*. The first, second and third increase regularly in width, although retaining about the same antero-posterior diameter. In these teeth, the protocone is large, inclosing a basin-shaped depression, on both margins of which small intermediate cuspules may be observed in unworn teeth, as in *Microbiotherium* and *Dasyurus viverrinus.* The outer cusps are high and conical. The paracone is relatively higher than in *Thylacynus* and the metacone shear strongly developed, but less rotated outwardly on $M^{\underline{3}}$ than in the latter genus. A large antero-external style is always present. On $M^{\underline{4}}$ the protocone, paracone and antero-external style are functional. The protocone is large and basin-shaped, as in the anterior molars. The high conical paracone is connected with the antero-external style by a sharp ridge, producing a transverse shear, as in *Dasyurus*, but less perfectly so, owing to the relatively greater elevation of the paracone. In some individuals of *A. manzaniana* a small metacone is present. With decrease in size of the metacone, the root supporting it is greatly reduced and may disappear entirely, producing a double-rooted tooth. The anterior molars are triple-rooted in both species.

The lower incisors are similar to those of *Thylacynus* and *Dasyurus* with rather thick crowns divided by a transverse groove (Pl. LX, fig. 3*a*). The second tooth on either side is displaced behind the median and lateral pair. The canines are shorter and less robust than those of the upper series, with conical crowns curved to about the same extent as in *Thylacynus.* The lower premolars are simple-crowned, double-rooted, piercing teeth, of which the median and posterior are subequal in size. The heel cusp on the anterior premolar is small, becoming larger on the median and posterior pair (Pl. LX, fig. 2*a*). The anterior premolar is spaced on either side. The median and posterior premolars may be in contact or slightly spaced. The molars increase regularly, not only in size, but in the height of the external cusps. They are closely crowded, so much so that the heel of each is impressed into the anterior surface of the tooth next succeeding. In $M_{\overline{1}}$, the arrangement of the cusps is linear, but in the second, third and fourth the paraconid is more and more deflected internally, producing a shear which cuts against the metacone spur of the upper teeth. The protoconid is high and conical, becoming flattened on the posterior side by shearing against the anterior face of the trigon of the upper molars. The lobate, blade-like paraconid is separated by a narrow slit from the protoconid. The heels are broad and strongly bicuspidate, the lingual cusp corresponding to the undifferentiated hypoconulid-entoconid. A short antero-external cingulum is present on the second, third and fourth molars.

Skull (Pls. LIX, figs. 1–3*a*; LX, figs. 1–1*c*, 3).—The facial portion of the skull is short and slender, the cranial portion elongate, with low sagittal and lambdoidal crests, widely expanded arches and exceptionally long, shallow brain-case. In profile (Pl. LX, fig. 1), the upper margin is almost horizontal, becoming slightly convex back of the orbits. The ascending premaxillary processes are short, proportionately less elongated than in *Thylacynus* and *Dasyurus*. The nasals are greatly expanded posteriorly and in broad contact with the lachrymals. The lachrymals are large, spreading out on the face and excluding the maxillæ from the anterior border of the orbit. The lachrymal duct opens within the orbital rim, which is sharply defined, with a distinct lachrymal tubercle. The infraorbital canal is single, opening externally above the posterior premolar. The orbits are large and placed well forward, their anterior border lying above the middle of M^1. The postorbital processes on the frontal and jugal are small. The zygomatic arches are robust and broadly expanded, the greatest width occurring at about the middle of the arch. The jugal bar bears a well-marked ridge, situated about a third of the distance from its inferior border, for the origin of the anterior portion of the masseter. Posteriorly the jugal is continued to the glenoid cavity, of which it forms the anterior border.

The postorbital constriction of the brain case is even more marked than in the opossum. A short distance anterior to the point of greatest constriction the feeble temporal ridges unite to form a low sagittal crest. The supraoccipital, unlike its condition in *Prothylacynus* and *Borhyæna*, has considerable anterior expansion on the upper surface of the skull, rather more proportionately than in *Dasyurus maculatus* and the opossum. A broad bar of the parietal extends posteriorly between the supraoccipital and the squamosal to contact with the mastoid.

The posterior view of the skull (Pl. LX, fig. 1*c*) shows the occiput to be almost semicircular in outline, in contrast with the triangular occiput of the dasyures, *Sarcophilus* and *Thylacynus*. It does not project beyond the condyles, which are of the same general shape as in *Dasyurus*. The foramen magnum is elliptical in outline. Its upper border is notched by an irregular vacuity, resembling a similar structure in some of the Macropodidæ. Owing to the scarcity of material for comparison, it can not be determined whether this peculiar feature is normal to the genus.

The basioccipital is broad and flat. But one condyloid foramen is present, in contrast with the double condyloid foramen so common among existing marsupials. The tympanic (Pl. LIX, fig. 2) is annular and unfused with the adjacent bones of the skull. The alisphenoid is dilated to form the auditory bulla. As this region is imperfectly preserved in all the specimens examined, it can not be satisfactorily determined whether the petrous was involved in the formation of the posterior portion of the bulla, as it is in *Dasyurus* and *Microbiotherium*. The basisphenoid is ridged, as in existing carnivorous marsupials. Prominent alisphenoid ridges extend posteriorly to the confluence with the auditory bullæ. The pterygoids are not preserved in any of the specimens examined and were probably small and scale-like. The posterior nares terminate either opposite or slightly posterior to the last molar. The palato-narial border is thickened, resembling the corresponding region in the skull of *Dasyurus*, and is more or less emarginate, varying slightly in the degree of development of the median process in different individuals of the same species.

The palate is long and triangular in shape, increasing in width posteriorly. Palatal vacuities are conspicuously absent. The incisive foramina terminate a short distance posterior to the premaxillary suture. A large foramen perforates the palatal surface of the maxillary opposite either canine. Accessory palatal foramina are less numerous than in *Borhyæna*. The margins of the palate are depressed for reception of the tips of the lower molars, when the mouth is closed. The posterior border of the palate is perforated by a large foramen on either side of the nares, as in nearly all marsupials.

With a few important exceptions, the cranial foramina are the same in number and position as in existing carnivorous marsupials. As already noted, the condyloid foramen is single. The basisphenoid has but one perforation, that for the internal carotid artery. The foramina of the lateral sinuses are especially well developed. The postglenoid and sub-squamosal foramina are the largest. The postzygomatic, which opens anteriorly within the lip of the postglenoid foramen, varies in size in different individuals of the same species. A small foramen occasionally pierces the jugal process of the squamosal just above the glenoid cavity.

The mandible is slender, with moderately convex inferior border. The coronoid is less strongly inclined posteriorly than in *Thylacynus*, resembling rather the condition in *Dasyurus*. The masseteric fossa is broad, with prominent borders. The condyles have about the same degree of elevation as in *Thylacynus*, but, unlike that genus, the condylar surfaces are wider internally than externally. The angle is broad and strongly inflected. The rami are unfused at the symphysis, which extends as far back as the anterior border of the posterior premolar. Four or five mental foramina are present, varying in number and position on opposite halves of the same mandible. The most anterior and also the largest of these is situated beneath the anterior premolar.

Cervical Vertebræ.—The atlas and third cervical are associated with the skull and feet of a specimen of *A. manzaniana* (No. 15,154). The atlanteal intercentrum (Pl. LIII, figs. 1, 1*a*) is separately ossified and unfused with the neural arch. The canal for the vertebral artery pierces the inner surface of the neural arch above the condyles. A smaller foramen, possibly transmitting a recurrent branch of the same artery, penetrates the upper surface of the base of the transverse process near its posterior edge. The artery emerges on the lower surface of the atlas at the base of the transverse process. The neuro-arterial canal is large and widely separated from the upper margin of the cotyles by a broad bar of bone. The extremities of the transverse processes are lobate, and the upper surface of each is reënforced by a broad median rib.

The neural spine of the third cervical (Pl. LIX, fig. 5) is proportionately larger than in *Thylacynus*. The centrum is strongly keeled inferiorly, and the posterior bar of the costal process supports a small diapophysis.

Appendicular Skeleton.—The humerus of *A. manzaniana* (Pl. LX, fig. 4) is without internal epicondylar foramen. The supinator ridge is low and does not terminate proximally in a hook-shaped process. The deltoid crest is sharper than in *Cladosictis* or *Prothylacynus*.

With the exception of the magnum, the carpus of No. 15,154 is wanting. The magnum resembles that of *Borhyæna* in shape and in the arrangement of the facets. The metacarpals (Pl. LIV, fig. 5) interlock proximally to about the same extent as in *Sarcophilus*. The third and fourth are equal in length. The proximal articular surfaces are convex in dorso-palmar section and concave transversely. The proximal surface of the fourth is irregularly quadrangular in outline like that of the third, instead of triangular, as in *Thylacynus* and *Sarcophilus*. The distal ends are transversely flattened, with moderately developed keels on the palmar surfaces. The metacarpal of the pollex is missing, but from the size of the proximal articular surface on the first phalanx of the pollex it appears to have been proportionately larger than in *Sarcophilus* or *Thylacynus.* As in *Cladosictis*, this surface is divided by a sharp keel into a small inner and a large outer rotular groove, indicating an enlargement of the outer condyle of the metacarpal, which produced a deflection of the phalanges of the pollex toward the inner side of the foot. The remaining proximal phalanges are short and stout, with straight shafts and prominent tuberosities for the annular ligament. The distal trochleæ are without trace of the median keel-like structures observable in *Sarcophilus*, resembling in this respect *Thylacynus.* The proximal articular surfaces of the phalanges of the second row are prolonged dorsally by the development of tongue-like processes fitting between the condyles of the proximal phalanges, indicating that these two sets of elements were carried with respect to each other at a considerable angle. The unguals are laterally compressed, sharp-pointed and without terminal clefts. Hoods are developed to about the same extent as in *Sarcophilus* and *Dasyurus maculatus.*

With the exception of the claw of the second digit, the figure (Pl. LIV, fig. 5) shows the original association of the phalanges of the manus. The ungual interpreted as that of the second digit lay in the matrix above the fifth metacarpal.

In the pes (Pl. LIV, fig. 6), the trochlear surface of the astragalus is short and almost flat transversely. Distally, the tibial trochlea is produced on the upper surface of the neck. The neck is proportionately longer than in *Sarcophilus* and *Thylacynus* and the head is less obliquely placed than in those genera. The calcaneal and sustentacular facets are like those of *Prothylacynus* (Pl. LIV, fig. 2*a*) in shape and position. Two minute astragalar foramina are present. The calcaneum has the tubercle for the attachment of the calcaneo-cuboidal ligament greatly enlarged and grooved. The calcaneum carries a facet for articulation with the fibula, which is confluent with the ectal facet for the astragalus. The sustentacular facet is concave and is broadly separated from the former, unlike the condition in *Sarcophilus* and *Thylacynus.* The tuber calcis is relatively shorter than in those genera, occupying somewhat less than one half the total length of the calcaneum. The remaining tarsals agree closely in shape and in the arrangement of the articular facets with those of *Prothylacynus* and do not call for separate description.

The hallux, when brought into articulation with the entocuneiform, is strongly deflected toward the inner side of the foot (opposable). Its proximal articular surface is convex in dorso-plantar section, fitting a large concave facet in the distal end of the entocuneiform. The distal end is, unfortunately, missing. The fourth metatarsal is the longest in the pes. The proximal articular surfaces of the second, third and fourth are irregularly triangular, wider on the dorsal than on the plantar margin. Distally, these bones are flattened, with moderate keels on the plantar surfaces. The fifth metatarsal is missing.

The short, comparatively flat, astragalar trochlea, moderately interlocking metapodials and distal spreading of the toes indicate, in the writer's opinion, that *Amphiproviverra* was plantigrade. The opposable hallux and semi-opposable pollex point to arboreal habits.

The proximal and distal ends of the left fibula are associated with the pes just described. Proximally, the shaft is triangular in cross section and carries a large facet for the fabella. Distally the fibula resembles the corresponding element in *Prothylacynus.* It carries the usual three facets for the calcaneum, astragalus and tibia.

A fragment of the patella associated with the skull of *A. minuta* (No. 15,373) is hardly complete enough to describe, but is important in demonstrating the ossification of the patella in this genus as in *Prothylacynus.* Among living marsupials the patella is ossified only in the Peramelidæ.

The skull represented in figures 1, 1*a*, Plate LIX (No. 15,154), shows an interesting pathological structure, which affords some suggestions of the pugnacious habits of these animals. The right upper canine has been torn out bodily and the wound has healed, leaving an irregular cavity in the side of the face. Wounds similarly received have been noticed in the discussion of the genus *Borhyæna.*

AMPHIPROVIVERRA MANZANIANA Ameghino.

(Plates LIII, Figs. 1, 1*a*; LIV, Figs. 5, 6, 11; LIX, Figs. 1–2, 4, 5; LX, Figs. 1–2*a*, 4.)

Protoproviverra manzaniana Amegh.; Nuevos Restos Mamíf. Fós. Patagonia Austral., pp. 26–27, Aug., 1891; Revista Argentina, etc., I, entr. 5*a*, pp. 312–313, Oct., 1891.

Amphiproviverra manzaniana Amegh.; Énum. Syn., etc., p. 133, fig. 52, p. 134, 1894; Bol. Acad. Cordoba, p. 389, fig. 52, p. 390, 1894.

Apart from size, there is hardly a character which will serve to distinguish *A. manzaniana* from *A. minuta*. The species is represented in the Princeton collection by remains of three individuals:

No. 15,148, a fragment of the right maxilla retaining in place the little-worn crowns of all the teeth except the canine and median premolar, collected by Mr. O. A. Peterson from the Lower Santa Cruz beds, ten miles south of Coy Inlet.

No. 15,029, an incomplete skull and mandible obtained by Mr. Hatcher from the Lower Santa Cruz beds at the same locality as No. 15,148.

No. 15,154, a crushed skull, atlas, third cervical and portions of the right fore and left hind limbs, collected by Mr. Peterson from the Lower Santa Cruz beds, ten miles south of Coy Inlet.

The collection of the American Museum of Natural History contains a remarkably perfect skull associated with a part of the mandible (No. 9254, Pl. LX, figs. 1–1*c*) from the vicinity of Felton's estancia on the Rio Gallegos.

The accompanying table of measurements shows considerable individual variation in size. This may possibly be a sexual character.

MEASUREMENTS.

	No. 15,148.	*No. 15,029.*	*No. 15,154.*	*No. 9254 Am. Mus.*
Skull, length on median basal line .				.108
" " premaxillæ to condyles				.112
Skull, greatest width across zygomatic arches		.056	.070 *	.062
Skull, width across postorbital processes		.0204		.019
Cranium, length, condyles to anterior border of orbit				.0755
Cranium, least width of brain case .		.010	.010	.010
Face, length to anterior border of orbit		.041	.037	.039
Nasals, length		.040	.038	.039
" width at anterior extremity .		.0088	.008	.008
" " " posterior " .		.020	.020	.018
Occiput, height				.023
" width at base				.036
Mandible, length, including condyle .		.090		
Mandible, length, $M_{\overline{4}}$ to outer end of condyle		.036		
Mandible, height of condyle above angle		.0175		

* Width increased by crushing.

	No. 15,148.	*No. 15,029.*	*No. 15,154.*	*No. 9254 Am. Mus.*
Mandible, transverse diameter of condyle		.012		
Mandible, depth of horizontal ramus at $\mathrm{M}_{\overline{4}}$		.0125		.013
Mandible, depth of horizontal ramus at posterior premolar		.010		
Mandible, depth of horizontal ramus at anterior premolar		.0095		
Upper dentition, length, median incisor to $\mathrm{M}^{\underline{4}}$		.0585	.055	.0565
Upper dentition, length of space occupied by premolars		.018	.017	.0175
Upper dentition, length of space occupied by molars	.0245	.023	.020	.021
Lower dentition, length, anterior border of canine to $\mathrm{M}_{\overline{4}}$		.0525		
Lower dentition, length of space occupied by premolars		.018		
Lower dentition, length of space occupied by molars		.026		
Median upper incisor, width of crown		.001		
Lateral " " " " "		.002	.002	
Upper canine, antero-posterior diameter at alveolar border		.0058	.006	.0065
Upper canine, transverse diameter at alveolar border		.004	.0042	.004
Anterior superior premolar, antero-posterior diameter	.004	.004	.0038	.004
Anterior superior premolar, transverse diameter	.0015	.0015	.0015	.0015
Median superior premolar, antero-posterior diameter		.0055	.005	.005
Median superior premolar, transverse diameter		.002	.0018	.0018
Posterior superior premolar, antero-posterior diameter	.0063	.006	.005	.0056
Posterior superior premolar, transverse diameter	.003	.003	.0028	.0028
$\mathrm{M}^{\underline{1}}$, antero-posterior diameter	.007	.007	.006	.007
" transverse diameter	.004	.004	.004	.004
$\mathrm{M}^{\underline{2}}$, antero-posterior diameter	.0077	.0074	.006	.007
" transverse diameter	.006	.0055	.005	.0055
$\mathrm{M}^{\underline{3}}$, antero-posterior diameter	.007	.007	.006	.0064
" transverse diameter	.0078	.0068	.0055	.0058

	No. 15,148.	*No. 15,029.*	*No. 15,154.*	*No. 9254 Am. Mus.*
$\mathrm{M}^{\underline{4}}$, antero-posterior diameter . .	.0028	.0028	.0028	.0023
" transverse diameter . . .	.0072	.007	.0065	.006
Lower lateral incisor, width of crown		.0018		
Lower canine, antero-posterior diameter at alveolar border . . .		.0046		
Lower canine, transverse diameter at alveolar border		.0035		
Anterior inferior premolar, antero-posterior diameter		.0045		
Anterior inferior premolar, transverse diameter		.002		
Median inferior premolar, antero-posterior diameter		.006		
Median inferior premolar, transverse diameter		.0022		
Posterior inferior premolar, antero-posterior diameter . . .		.0065		
Posterior inferior premolar, transverse diameter		.0026		
$\mathrm{M}_{\overline{1}}$, antero-posterior diameter . .		.006		
" transverse diameter . . .		.0027		
$\mathrm{M}_{\overline{2}}$, antero-posterior diameter . .		.0068		
" transverse diameter . . .		.0035		
$\mathrm{M}_{\overline{3}}$, antero-posterior diameter . .		.0075		.0066
" transverse diameter . . .		.0038		.0033
$\mathrm{M}_{\overline{4}}$, antero-posterior diameter . .		.007		.006
" transverse diameter . . .		.004		.003
Atlas, transverse breadth . .			.043	
" width of neural arch . .			.010	
" " " intercentrum . .			.0056	
Third cervical, length of centrum .			.0155	
" " width across transverse processes			.028	

The following measurements of the manus and pes are from No. 15,154:

Metacarpal II, length	.0155
" " width of proximal end	.0045
" " " " distal "	.0055
Metacarpal III, length	.018
" " width of proximal end	.004
" " " " distal end	.005
Metacarpal IV, length	.018
" " width of proximal end	.0036

Metacarpal IV, width of distal end	.005
Metacarpal V, length	.012
“ “ width of proximal end	.004
“ “ “ “ distal “	.0055
Pollex, first phalanx, length	.009
“ ungual phalanx, length.	.0097
“ “ “ width of hood	.005
Second digit, first phalanx, length	.0085
“ “ second “ “	.0065
“ “ ungual “ “	.0098
“ “ “ “ width of hood	.005
Third digit, first phalanx, length	.0085
Fourth “ “ “ “	.0085
“ “ second “ “	.0063
“ “ ungual “ width of hood	.0036
Fifth digit, first phalanx, length.	.0075
“ “ second “ “	.0055
“ “ ungual “ “	.0085
“ “ “ “ width of hood	.0038
Astragalus, length	.0135
“ width of trochlea	.0085
“ “ “ neck	.0046
Calcaneum, length	.021
“ “ of tuber	.0097
Metatarsal I, width of proximal end	.005
Metatarsal II, length	.022
“ “ width of proximal end.	.0032
“ “ “ “ distal “	.005
Metatarsal III, length	.023
“ “ width of proximal end	.004
“ “ “ “ distal “	.005
Metatarsal IV, length	.025
“ “ width of proximal end	.004
“ “ “ “ distal “	.005

AMPHIPROVIVERRA MINUTA Ameghino.

(Plates LIX, Figs. 3, 3*a*; LX, Figs. 3, 3*a*.)

Amphiproviverra minuta Amegh.; Énum. Syn., pp. 134–135, 1894; Bol. Acad. Cordoba, p. 390, 1894.

This species may be distinguished from *A. manzaniana* by its smaller size and less robust build. It is represented in the Princeton collection by an incomplete skull and mandible (No. 15,373) associated with a fragment of the left ulna, a number of phalanges, the distal end of a metapodial and part of the patella, collected by Mr. Hatcher, from the Lower Santa Cruz beds at Killik Aike.

Although smaller than *A. manzaniana*, the length of the upper premolar-molar series is almost the same as in some individuals of that species (*cf.* Pl. LIX, figs. 1, 3*a*). In *A. minuta*, the nasals are less rounded posteriorly than in *A. manzaniana* and receive a somewhat longer tongue of the frontals between them. This, however, may be an individual rather than a specific character. In the mandible, the chin is more strongly marked than in *A. manzaniana*. The dental pattern is identical in the two species.

MEASUREMENTS.

Skull, length from ant. surface of canine to post. border of preglenoid process.	.069
" least width of brain case	.010
" width across postorbital processes	.015
" width across posterior expansion of nasals.	.015
Palate, greatest length from anterior surface of canine to palato-narial border.	.043
" width between anterior premolars	.009
" " " last molars	.020
Mandible, length, base of median incisor to condyle	.076
" " $\mathrm{M}_{\overline{4}}$ to outer end of condyle	.0295
" height of condyle above angle	.0135
" depth of horizontal ramus below $\mathrm{M}_{\overline{4}}$	.0105
" " " " " " posterior premolar . . .	.008
" " " " " " anterior premolar . . .	.0078
" transverse diameter of condyle	.009
Upper dentition, anterior border of canine to $\mathrm{M}^{\underline{4}}$ inclusive	.044
" " length of space occupied by premolars	.017
" " " " " " " molars	.020
Lower " base of median incisor to $\mathrm{M}_{\overline{4}}$ inclusive	.048
" " length of space occupied by premolars	.017
" " " " " " " molars	.0233
Upper canine, antero-posterior diameter at alveolar border	.0045
" " transverse " " " "	.003
Anterior superior premolar, antero-posterior diameter	.004
" " " transverse "	.0018
Median " " antero-posterior "	.005
" " " transverse "	.002
Posterior " " antero-posterior "	.0053
" " " transverse "	.0025
$\mathrm{M}^{\underline{1}}$, antero-posterior diameter	.0065
" transverse "	.004
$\mathrm{M}^{\underline{2}}$, antero-posterior "	.0065
" transverse "	.005

$\mathrm{M}^{\underline{3}}$, antero-posterior diameter	.006
“ transverse “	.0057
$\mathrm{M}^{\underline{4}}$, antero-posterior “	.002
“ transverse “	.0055
Median inferior incisor, width of crown	.0015
Lateral “ “ “ “ “	.002
Lower canine, antero-posterior diameter at alveolar border	.004
“ “ transverse “ “ “ “	.003
Anterior inferior premolar, antero-posterior diameter	.0045
“ “ “ transverse “	.0016
Median “ “ antero-posterior “	.0055
“ “ “ transverse “	.002
Posterior “ “ antero-posterior “	.0055
“ “ “ transverse “	.0023
$\mathrm{M}_{\overline{1}}$, antero-posterior diameter	.0058
“ transverse “	.0025
$\mathrm{M}_{\overline{2}}$, antero-posterior “	.0062
“ transverse “	.003
$\mathrm{M}_{\overline{3}}$, antero-posterior diameter	.0064
“ transverse “	.003
$\mathrm{M}_{\overline{4}}$, antero-posterior “	.0065
“ transverse “	.0035
Patella, width	.007
Terminal phalanges, average length	.0065
“ “ “ width of hoods	.003

RELATIONSHIPS OF THE THYLACYNIDÆ.

Although there is sufficient similarity in structure to warrant placing the Patagonian and Tasmanian thylacynes in the same family, it must not be inferred that the existing genus is the direct descendant of its extinct South American forerunners. The study of the group has failed to show a closer relationship than probable descent from a common pre-Santa Cruz ancestor. While retaining the fundamental family characters, both lines have diverged and in some respects the Santa Cruz forms are more advanced than the existing genus.

1. Without exception, the Santa Cruz forms, so far as known, show great reduction of the external styloid cusps in the upper molars, the antero-external style alone remaining, while in *Thylacynus*, "a small element probably equivalent to style c_2 is apparently always present in the first molar, variable in the second, and scarcely distinguishable in the

third." (Bensley, 1903, p. 108.) This style is well shown in figure 1*a* of Plate LXV.

2. The last upper molar in the Santa Cruz genera is more reduced than in *Thylacynus*, reaching an extreme in *Borhyæna*, where but two cusps remain, the paracone and antero-external style. In neither *Amphiproviverra*, *Prothylacynus*, nor *Cladosictis*, is the metacone on M^4 as strongly developed as in *Thylacynus*.

3. In the lower dentition of all the Patagonian thylacynes the hypoconulid is undifferentiated from the entoconid, and the heel of the fourth molar is not only smaller proportionately than in *Thylacynus*, but has undergone greater reduction, except in *Amphiproviverra*, in which all the lower molar heels are bifid.

4. In cranial characters *Thylacynus* is decidedly progressive, while the Santa Cruz forms are conservative. The elongation of the face and posterior shifting of the orbit, the great increase in brain capacity, the acquisition of palatal vacuities and the prenatal shedding of the milk teeth in the recent genus are all progressive characters.

5. The peculiarities in podial structure observable in *Thylacynus* are readily understood, if interpreted as adaptive modifications. The foot structure of the common ancestor of the family was probably not unlike that in *Amphiproviverra*. Adaptation to a cursorial mode of progression resulted in a reduction of the hallux, as in *Prothylacynus*. With increase in speed and the assumption of a digitigrade gait the complete loss of the hallux and the curious shifting of the tarsal elements noticed in *Thylacynus* have been produced.

In connection with the question of the descent of the Patagonian and Tasmanian thylacynes from a common ancestor, it may be interesting to notice that certain large carnivorous marsupials from the Pyrotherium beds (Amegh., 1897, pp. 97–100) named by Ameghino *Proborhyæna* and *Pharsophorus* retain the metaconid in the lower molars, while the premolar formula is unreduced. The loss of the metaconid in the Thylacynidæ separates them sharply from all other carnivorous marsupials. It is possible that the two genera mentioned, in which this cusp is retained, will be found to occupy an intermediate position between the Thylacynidæ and Dasyuridæ, but until they are better known it is unsafe to attempt generalizations of so broad a character.

Confining the discussion to the mutual relationships of the Santa Cruz thylacynes, it is surprising to notice the extent to which they have responded to adaptive specialization. No one of them is ancestral to the others, but *Amphiproviverra* is perhaps nearest to the ancestral form in foot structure and shows least reduction in the heel of $M_{\overline{4}}$. At the other extreme is *Borhyæna* which, so far as dentition goes, is a decidedly specialized animal. All the Santa Cruz genera are, apparently, divergent branches of a common pre-Santa Cruz ancestral stock, from which *Amphiproviverra* appears to have departed less in podial and dental structure than any of the others.

DIDELPHYIDÆ.

MICROBIOTHERIUM Ameghino.

(Plate LXII, Text-fig. 6.)

Microbiotherium Amegh.; Enum. Sist. Especies Mamíf. Fós. Patagonia Austral, pp. 6–7, 1887.

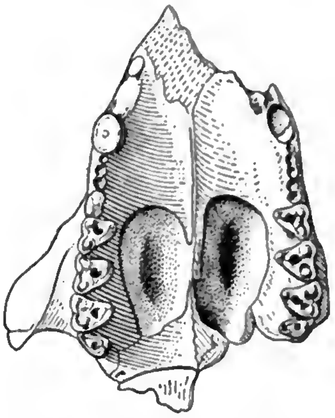
Hadrorhynchus Amegh.; Nuevos Restos Mamíf. Fós. Patagonia Austral, p. 25, Aug., 1891; Revista Argentina Hist. Nat., I, entr. 5*a*, p. 311, Oct., 1891.

Minute polyprotodonts, comparable in size to some of the smaller South American opossums. Although placed by Ameghino in a separate family, the Microbiotheridæ, this genus possesses so many important characters in common with the Didelphyidæ that the propriety of its reference to the latter family seems beyond question.

Dentition (Pl. LXII, figs. 1–6).—The dental formula is $\frac{5}{4}$, $\frac{1}{1}$, $\frac{3}{3}$, $\frac{4}{4}$, as in *Didelphys*. The upper incisors are unspaced and the lateral tooth is separated from the canine by a long diastema. The skull of *Microbiotherium tortor* in the Princeton collection (No. 15,698, Pl. LXII, fig. 1) retains in place the third incisor only. This tooth resembles the corresponding element in *Didelphys*. As in that genus, the median incisors were probably procumbent and approximated at the tips, judging from the inclination of the alveoli, but this portion of the premaxillæ has been somewhat crushed and the inference cannot be fully verified. The upper canine is a robust tooth, rather blunt, with the crown but little recurved. The premolars are three in number and closely crowded. The anterior premolar is single-rooted, the median and posterior double-rooted. The latter is the largest of the series. A photograph of a specimen in the La

Plata Museum (text-fig. 6) shows that this tooth supports a prominent central cusp, but the minuter details can not be ascertained from the photograph. The first two molars are of the same size, the third is a little narrower transversely and the fourth greatly reduced. All, except the fourth, are triangular in outline and tricuspidate, with conic cusps, a narrow external cingulum and reduced metacone spur. An antero-external style, designated by Bensley, style *ab* (Bensley, 1903, pp. 89, 183 *et seq.*), is present on all the molars as a distinct tubercle. Style *c* is well developed on the second and third molars of *Microbiotherium tehuelchum*, but is only slightly differentiated from the cingulum in *M. tortor*. On the anterior molars the metacone is decidedly larger than the paracone. The metacone spur is greatly reduced compared with its condition in *Didelphys* or *Dasyurus*, owing to the decreased width of the cingulum. M^4 has the metacone vestigial. The cusps represented on this tooth are the protocone, paracone, style *ab* and the vestigial metacone. The protocone is supported on a separate root, as in *Didelphys*. On the three anterior molars the protocone encloses a basin-shaped depression, on the margins of which two minute cuspules are developed. In shape and pattern, these teeth resemble closely the molars of some of the subspecies of *Caluromys*. All the upper molars are triple-rooted.

FIG. 6.



Microbiotherium sp., palatal view of the skull, × $\frac{3}{1}$. The representation of the molar patterns is slightly diagrammatic. Drawn from an enlarged photograph of a specimen in the La Plata Museum.

The lower incisors are spatulate in shape, resembling the incisors of *Dasyurus* rather than *Didelphys*. Unlike these genera, the root of the second tooth in the series is not displaced posteriorly with reference to the roots of the first and third. The first and second incisors only are preserved in the mandible associated with skull No. 15,698. The canine is either short, blunt, and directed anteriorly (*M. tortor*, Pl. LXII, fig. 2), or disproportionately long and pointed (*M. tehuelchum*, Pl. LXII, fig. 4). The three lower premolars are double-rooted and are either closely approximated (*M. tortor*, *M. patagonicum*), or spaced (*M. tehuelchum*). The anterior premolar is a small, simple-crowned tooth, situated close to the canine. The median and posterior premolars are provided with prominent heels. The latter tooth is the largest of the inferior premolar series and exceeded the molars in degree of elevation of the crown. In all the specimens retaining this tooth, the tip of the crown is abraded to the general level of the molars. The anterior molars are an almost exact duplication of the corresponding teeth in *Didelphys*. The first and second are of about the same size, the third is a little narrower than the preceding teeth, and the fourth is considerably reduced. On all, the three cusps of the trigonid are well developed. The talonid is identical in pattern with that of the lower molars of *Didelphys* in all except $M_{\overline{4}}$, in which it is narrower transversely than in the anterior teeth. Unfortunately, the heel of $M_{\overline{4}}$ is somewhat broken in the only specimen retaining this tooth (No. 15,698) and its pattern cannot be fully determined. It appears to have been similar to the teeth preceding it, but with the cuspules less distinct. All the lower molars are double-rooted. A narrow antero-external cingulum is present on the first and second molars of *M. tehuelchum*, but is wanting in the other species.

Skull (Pl. LXII, fig. 1 and text-fig. 6). — The skull is remarkable for the great length of the premaxillæ and the extreme posterior position of the canine. Anterior to the alveoli of the median incisors the premaxillæ develop a shelf-like extension. The orbits are large, with elevated superciliary borders and prominent postorbital processes, from which the temporal ridges converge to the sagittal crest. In No. 15,698 the greater part of the brain-case is wanting. Its narrowest part lies immediately back of the postorbital processes.

The auditory bulla and the glenoid portion of the squamosal are associated with a mandible of *M. tehuelchum* (No. 15,038). This specimen indicates that the inferior bar of the jugal extended to the anterior border of the glenoid fossa. The bulla is large, elliptical in outline, with the alisphenoid and petrous portions equally inflated and articulating in open suture, as in *Dasyurus viverrinus* (Pl. LXII, fig. 7).

The palate is well preserved in the La Plata Museum specimen (text-fig. 6). It is perforated posteriorly by two large vacuities. In No. 15,698, it is so badly crushed that the nature of the perforations cannot be ascertained. Both specimens show the thickening of the posterior palatal border and its extension beyond the last molar, as in *Didelphys*.

The infraorbital foramen is situated above the posterior half of the last premolar and outer anterior root of the first molar.

The mandible either has the angle moderately inflected and the inferior margin of the masseteric fossa widely separated from the lower mandibular border (*M. tortor*, Pl. LXII, fig. 2; *M. gallegosense*, Pl. LXII, fig. 3), or the angle is strongly inflected, with the masseteric fossa extending to the inferior border of the jaw (*M. tehuelchum*, Pl. LXII, fig. 4). The chin is either heavy, with prominent tubercle (*M. tortor*) or shallow (*M. tehuelchum*). The inferior mandibular border is much less convex than in *Didelphys*. The rami are unfused, as in that genus. The mental foramina are fairly constant in number and position. A large foramen is situated either beneath the anterior premolar, or beneath adjacent roots of the anterior and median teeth in species with unspaced premolars. A second foramen is placed below the anterior root of the first molar. Some specimens show two foramina beneath this tooth (No. 9595 American Museum). A minute foramen piercing the anterior portion of the masseteric fossa is present in *M. gallegosense*, but does not occur in the other species.

Skeleton (Pl. LXII, figs. 8–12). — Parts of the right scapula and ulna, an incomplete right humerus, and the first to the sixth cervicals, lacking the neural arches, are associated with the left half of a lower jaw and two upper molars of *M. tehuelchum*.

The body of the scapula (Pl. LXII, fig. 11) has been almost entirely destroyed. The spine is prominent, but has been broken in the region of the acromion. The neck is short. The coracoid process is large, with inflected anterior margin.

The humeral head (Pl. LXII, fig. 12) has been somewhat damaged. In general, it resembles that of *Prothylacynus* and *Cladosictis*, but does not overhang posteriorly to so great an extent. The greater tuberosity has been broken off; the lesser tuberosity is prominent and is separated from the head by a wide, shallow groove. The distal end is broad, with powerful supinator ridge and enormously developed inner epicondyle. The margin of the supinator ridge has been fractured and the character of its proximal end cannot be determined. A large internal epicondylar foramen is present.

The posterior border of the ulna (Pl. LXII, fig. 10) is strongly convex. The shaft is flattened laterally and deeply excavated on either side of the sigmoid cavity.

The atlas and axis (Pl. LXII, fig. 9) are imperfectly preserved, but the former shows distinctly the unfused intercentrum, as in *Borhyæna* and *Amphiproviverra*. The third, fourth and fifth cervicals (Pl. LXII, fig. 8) are closely applied. The tops of the neural arches have been broken, but their bases are almost in contact, obliterating the intervertebral spaces. This may indicate the beginning of a fusion comparable to that in *Didelphys*. The transverse processes resemble those of *Didelphys*, except that the anterior lamina of the transverse process of the third cervical is wanting. In this respect, *Microbiotherium* resembles *Dasyurus*. The bases of the transverse processes are pierced by a canal for the vertebral artery. These processes are imperfectly preserved on the side represented in the figure. The articular surfaces of the centra are flat. A median ventral keel is indicated on the axis. A prominent tubercle is developed on either side of the middle line on the posterior ventral border of the centrum of the fourth cervical. Corresponding swellings are faintly indicated on the lower borders of the centra of the third and fifth cervicals also.

According to Ameghino (1894, p. 105), the feet were plantigrade and probably pentadactyl.

Systematic Position and Affinities.—The affinities of *Microbiotherium* are unquestionably didelphid. Among living forms it approaches most closely some of the subspecies of *Caluromys laniger*. The genus cannot be regarded as transitional to any of the living opossums, as the degree of reduction of the outer cingulum, styloid cusps and metacone spur in the upper molars is greater. It has been suggested (Bensley, 1903, p. 208) that *Microbiotherium*, or some allied genus, is ancestral to the Cænolestidæ and the Santa Cruz thylacynes. So far as the latter are concerned, the relationship suggested is still problematic, but it is extremely probable, as will be shown later, that the Cænolestidæ have been derived from a didelphid ancestor.

MICROBIOTHERIUM TORTOR (Ameghino).

(Plate LXII, Figs. 1, 2, 2*a*.)

Hadrorhynchus tortor Amegh.; Nuevos Restos Mamíf. Fós. Patagonia Austral, p. 25, Aug., 1891; Revista Argentina Hist. Nat. I, entr. 5*a*, p. 311, Oct., 1891.

Hadrorhynchus torvus Amegh.; Ibid.

This species is represented by an imperfect cranium and mandible (No.

15,698) from the Lower Santa Cruz beds at Killik Aike. The principal cranial and dental characters have already been noted in the discussion of the genus and need not be repeated.

Microbiotherium tortor is somewhat larger than *M. tehuelchum* and may be readily distinguished by the strong mandibular symphysis, which terminates inferiorly in a prominent tubercle, by the blunt anteriorly directed lower canine, the absence of spacing between the lower premolars, the less strongly inflected angle, and the wide separation of the lower borders of the masseteric fossa and angle.

MEASUREMENTS.

Length, $I^{\underline{1}}$–$M^{\underline{4}}$ on alveolar border	.021
“ anterior border of C–$M^{\underline{4}}$	.012
“ superior premolar series	.0035
“ $M^{\underline{1}}$–$M^{\underline{4}}$	.007
“ $I_{\overline{1}}$–$M_{\overline{4}}$ on alveolar border	.0173
“ C–$M_{\overline{4}}$	.0135
“ inferior premolar series	.004
“ $M_{\overline{1}}$–$M_{\overline{4}}$ on alveolar border	.0078
Depth of mandible below anterior premolar	.004
“ “ “ “ $M_{\overline{1}}$	.0045
“ “ “ “ $M_{\overline{4}}$	.0055
Antero-posterior diameters of $M^{\underline{1}}$, $M^{\underline{2}}$ and $M^{\underline{3}}$ each	.002
Transverse diameters of $M^{\underline{1}}$ and $M^{\underline{2}}$ each	.0022
“ diameter “ $M^{\underline{3}}$	.002
Antero-posterior diameter of $M^{\underline{4}}$	.0015
“ diameters of $M_{\overline{1}}$, $M_{\overline{2}}$ and $M_{\overline{3}}$ each	.002
Transverse diameters of $M_{\overline{1}}$, $M_{\overline{2}}$ and $M_{\overline{3}}$ each	.0015
Antero-posterior diameter of $M_{\overline{4}}$	.00175
Transverse diameter of $M_{\overline{4}}$	.0012

MICROBIOTHERIUM GALLEGOSENSE sp. nov.

(Plate LXII, Figs. 3, 3*a*.)

This is the largest known species of *Microbiotherium*. The type specimen (American Museum No. 9591), collected by Mr. Barnum Brown, on the Rio Gallegos, is the right ramus of a mandible, broken at both ends. The posterior premolar and the first two molars are preserved. The remaining premolars and molars are missing.

The alveoli of the anterior and median premolars are closely crowded and the former tooth was directed obliquely to the axis of the jaw. Both are double rooted. The median and posterior premolars are slightly spaced. No trace of an external cingulum can be detected on the molars. Like *M. tortor*, the lower margin of the masseteric fossa is separated from the inferior mandibular border by a broad convex surface. The mandible is moderately convex below and increases regularly in depth posteriorly. A minute foramen, communicating presumably with the inferior dental canal, pierces the masseteric fossa anteriorly. It is not present in *M. tortor* and *M. tehuelchum*.

MEASUREMENTS.

Length, anterior premolar to $M_{\overline{4}}$ on alveolar border	.016
" of premolar series on alveolar border	.006
" " molar " " " "	.010
Antero-posterior diameters of $M_{\overline{1}}$ and $M_{\overline{2}}$ each	.0025
Transverse " " " " " "	.002
Depth of mandible below median premolar	.005
" " " " $M_{\overline{1}}$	.006
" " " " $M_{\overline{4}}$	.007

MICROBIOTHERIUM TEHUELCHUM Ameghino.

(Plate LXII, Figs. 4, 4*a*, 6–12.)

Microbiotherium tehuelchum Amegh.; Enum. Sist. Especies Mamíf. Fós. Patagonia Austral, p. 7, 1887.

The left half of a lower jaw associated with two upper molars and parts of the skull and skeleton (No. 15,038) have been identified with this species. The principal features of the skull and skeleton have already been noticed in the generic diagnosis and do not call for further comment.

The species may be recognized by its size, which is smaller than in *M. tortor*, by the less prominent chin, the long vertically-directed lower canine, the well-spaced premolars, the strongly inflected angle and the close approximation of the lower margin of the masseteric fossa to the inferior border of the jaw. The mandible differs considerably in shape from that of *M. tortor* and *M. gallegosense*, having the angle inclined obliquely inward and upward. An antero-external cingulum is developed on the lower molars. The upper teeth have the external styles rather more prominent than in *M. tortor*.

MEASUREMENTS.

Length, anterior border of canine to $M_{\overline{4}}$ inclusive	.014
" inferior premolar series	.005

Length, $M_{\overline{1}}$–$M_{\overline{4}}$ on alveolar border	.007
Antero-posterior diameters of $M_{\overline{1}}$, $M_{\overline{2}}$ and $M_{\overline{3}}$ each	.002
Transverse " " $M_{\overline{1}}$ and $M_{\overline{2}}$ each	.0015
" " " $M_{\overline{3}}$	.001
Depth of mandible below anterior premolar	.0035
" " " " $M_{\overline{1}}$	.0044
" " " " $M_{\overline{4}}$	.0048
Antero-posterior diameters of $M^{\underline{2}}$ and $M^{\underline{3}}$ each	.002
Transverse " " $M^{\underline{2}}$	.0022
" " " $M^{\underline{3}}$	.002
Antero-posterior diameter of auditory bulla	.011
Transverse " " " "	.0048
Width of humerus at distal end " "	.0075
Greatest width of radius proximally	.0023
Diameter of radial shaft	.0013
Greatest width of ulna at lower margin of sigmoid cavity	.004

MICROBIOTHERIUM PATAGONICUM Ameghino.

(Plate LXII, Figs. 5, 5*a*.)

Microbiotherium patagonicum Amegh.; Enum. Sist. Especies Mamíf. Fós. Patagonia Austral, p. 6, 1887.

A minute species, represented by the anterior portion of a right mandibular ramus, with the posterior premolar and two molars in place, collected by Mr. Barnum Brown on the Rio Gallegos (No. 9121 American Museum of Natural History). The remaining premolars, the canine and the incisors are represented by alveoles.

The premolars are closely crowded and the anterior tooth is placed obliquely to the axis of the jaw. There is no external cingulum on the molars. The remaining dental characters, so far as determinable, are of generic importance and have already been noticed. The species may be recognized by its small size.

MEASUREMENTS.

Length from anterior portion of canine alveolus to $M_{\overline{2}}$ inclusive	.007
Length of space occupied by the premolars	.003
" " " " " " first and second molars	.0028
Antero-posterior diameter of $M_{\overline{1}}$	.0016
Transverse " " "	.001
Antero-posterior " " $M_{\overline{2}}$	.0015
Transverse " " "	.001
Depth of mandible below posterior premolar	.002

DIPROTODONTIA.

CÆNOLESTIDÆ.

(Plates LXIII, LXIV; Text Figs. 7–9.)

All the Santa Cruz diprotodonts may be included in one family, of which a single survivor remains in *Cænolestes* (Pl. LXIII, figs. 14–14*b*). The species are small, possibly owing to competition with the placental herbivores acting as a check on adaptive radiation.

Before proceeding to a discussion of the group, it is desirable to offer some explanation of the classification adopted. Ameghino in his latest publication on the Diprotodontia (1903, p. 159) recognizes three families among the Santa Cruz representatives of the suborder: the Abderitidæ, Epanorthidæ and Garzonidæ. These have been referred to in a general way by other writers (Thomas, 1895; Bensley, 1903) as the Epanorthidæ. The genus *Epanorthus* was proposed by Ameghino in 1889 (1889, p. 271) as a substitute for *Palæothentes* (Moreno) Ameghino (1887, p. 5), on the assumption that the latter conflicted with *Palæoteuthis*, a genus of cephalopods. Although Moreno's *Palæothentes* (also spelled by him *Palæotenthes*) is a *nomen nudum*, the description published by Ameghino in 1887 gave this term a priority in nomenclature from which he was not at liberty to depart by the substitution of *Epanorthus*. The latter name can no longer be retained either for a genus or to designate a family. The writer prefers to group all the Santa Cruz diprotodont marsupials in a single family, which may be called the *Cænolestidæ* (Trouessart, 1898, p. 1205) from its only surviving and best known representative *Cænolestes*.

Family: *CÆNOLESTIDÆ.* — Pes, so far as known (*Cænolestes*), non-syndactylous. Sectorials, when present, restricted to the posterior premolar above and the first molar below. Superior premolars three in number (*Palæothentes*, *Cænolestes*), the anterior and median small, the posterior large and trenchant. Functional lower premolars 2–none. Vestigial teeth always present in the lower jaw. Molars rooted, brachyodont, tuberculo-sectorial or buno-lophodont, undergoing progressive complication in the superior series by the addition of a hypocone. Hypertrophied lower incisors lanceolate with cutting edges enamel layer confined to the outer face.

First Subfamily: *CÆNOLESTINÆ.*— Dental formula $\frac{4,\,1,\,3}{1,\,4\text{–}6,\,3},\ \frac{4}{4}$ (*Cænolestes*). Sectorials not developed. First and second superior molars fully quadritubercular, third and fourth tritubercular (*Cænolestes*). Lower molars tuberculo-sectorial, approaching lophodont when worn. Median and posterior lower premolars double-rooted and functional.

Genera: *Cænolestes, Halmarhiphus, Garzonia.*

Second Subfamily: *PALÆOTHENTINÆ.* — Dental formula $\frac{?,\ 1,\ 3,}{1,\ \mathit{4–3},\ 1}$, $\frac{4}{4}$. Posterior superior premolar and first lower molar sectorial in function. Sectorials unstriated. First upper molar fully quadritubercular, second with rudimentary hypocone, third and fourth tritubercular (*Palæothentes*). Lower molars lophodont. $M_{\overline{1}}$ with prominent metaconid. Posterior lower premolar double-rooted and functional or single-rooted and reduced.

Genera: *Palæothentes, Callomenus, Decastis.*

Third Subfamily: *ABDERITINÆ.* — Dental formula $\frac{?,\ ?,\ ?}{1,\ \mathit{4},\ 1}$, $\frac{?}{4}$. First lower molar with protoconoid-paraconoid blade developed into a striated sectorial shear with serrate margin, greatly elevated above the general level of the tooth row. Metaconoid absent on $M_{\overline{1}}$. Second, third and fourth lower molars buno-lophodont. Functional lower premolars wanting in known Santa Cruz forms, the posterior tooth being single-rooted and vestigial.

Genus: *Abderites.*

As many of the genera are known only from the lower jaw, it has seemed advisable to insert parenthetically in the preceding descriptions the names of those forms on which important observations regarding the upper dentition and feet are based. In writing the dental formulas, the number of lower vestigial antemolars of questionable homology is indicated in italics, while figures in roman type express the number of teeth which can be definitely homologized.

In the Cænolestinæ (Pl. LXIII, figs. 8, 9, 14) the full complement of lower premolars is retained. The antemolar formula in *Halmarhiphus* and occasionally in *Cænolestes* (Bensley, 1903, p. 124, Pl. 5, fig. 38) is the same as in *Didelphys.* In a specimen of *Garzonia* in the collection the antemolar formula is nine, but this may be tentatively regarded as an individual peculiarity, since the constancy of its occurrence has not been confirmed. In the case of the Palæothentinæ and Abderitinæ, it cannot be determined at present whether the reduction in the number of vestigial teeth is to be accounted for by the loss of incisors, canine or premolars.

The elaboration of the sectorial lower molar in the larger members of the Palæothentinæ (*Callomenus* and *Decastis*) from a tooth of the *Halmarhiphus* type is plainly indicated by the intermediate condition in *Palæothentes.* In this genus the anterior lobe of $M_{\overline{1}}$ is proportionately longer and higher than in *Halmarhiphus* or *Cænolestes*, but the paraconid is decidedly lower than the protoconid, from which it is separated by a distinct notch, as in the latter genus. In *Callomenus* and *Decastis* the notch has disappeared and the protoconid and paraconid are of the same height, forming an elevated trenchant blade.

Owing to the absence of transitional forms in the Santa Cruz fauna, so far as known, it is less easy to trace the development of the peculiar notched and fluted sectorials of *Abderites*, which are to be regarded as highly specialized structures adapted to a piercing habit, suggesting that the animal fed on the eggs of birds. The loss of the metaconid is a further adaptation toward the perfection of the piercing function. The derivation of the sectorial teeth in *Abderites* from the tuberculo-sectorial type of molar characteristic of the Cænolestinæ is indicated by the broad heel, and by the additional fact that the remaining molars, although somewhat less lophodont than in the Palæothentinæ, retain both the paraconid and metaconid as distinct cusps.

A satisfactory discussion of the derivation of the upper molar patterns in the Cænolestidæ is at present impossible, owing to a lack of material illustrating the upper dentition in many of the genera, especially in the more primitive forms.

Less uncertainty exists regarding the lower molars. In the Palæothentinæ, lophodont molars have been developed from teeth of the primitive tuberculo-sectorial type, shown in *Halmarhiphus*, by the formation of cross crests uniting the cusps of the talonid and heel. In the buno-lophodont molars of *Abderites*, all the cusps of the original tuberculo-sectorial crown have been retained, except in $M_{\overline{1}}$. The loss of cusps in this tooth has already been discussed.

So little is known of the skull in the majority of the Cænolestidæ that any attempt at a discussion would resolve itself into a repetition of Thomas's excellent description of the skull of *Cænolestes* (1895). A description of an incomplete skull of *Palæothentes* will be found on a later page, to which, and to the accompanying illustrations of the skull of *Cænolestes* (Pl. LXIII, figs. 14–14*b*) the reader is referred.

Little is known of the podial structure of the Cænolestidæ. Ameghino (1894, pp. 80, 81) describes the feet of the Santa Cruz representatives of his suborder Paucituberculata (= the Cænolestidæ) as follows: "The four limbs were almost equal in length, but the hind feet were longer than the fore. They were plantigrade, with five toes on the hind feet and probably also on the fore feet, with all the toes well developed and without the least trace of syndactyly."

Thomas (1895, p. 872) states that in *Cænolestes* both feet are pentadactyl. On the fore foot the pollex and fifth toe are provided with distinct nails and the remaining toes with well developed curved claws. The third digit is the longest; the second and fifth subequal and shorter. The hind foot is non-syndactylous and not modified into a hand, as it is in the opossums. The hallux is short, clawless and not properly opposable, developed much as in *Phascogale wallacei.* The remaining digits of the hind foot are subequal, the fourth slightly the longest, and all provided with claws.

CÆNOLESTINÆ.

HALMARHIPHUS Ameghino.

(Plate LXIII, Figs. 9, 9*a*; Text Fig. 7.)

Halmarhiphus Amegh.; Revista Argent., Hist. Nat., T. I, p. 308, 1891.

This genus is peculiar in combining characters of both marsupial suborders. The tuberculo-sectorial molars are structurally the same as in *Microbiotherium* or *Didelphys* and the antemolar formula is that of the Polyprotodontia, while in the anterior portion of the mandible Diprotodont features are apparent in the enlargement of the median incisor and the vestigial character of the remaining incisors, canine and anterior premolar. *Halmarhiphus* is of exceptional interest, not only as the direct ancestor of *Cænolestes*, but as a constructive stage in the evolution of the Diprotodontia. This will be treated at greater length in the discussion of the relationships of the Cænolestidæ.

Ameghino (1894, pp. 96–103; 1903, p. 159) places *Halmarhiphus* and *Garzonia* in the family Garzonidæ. It appears preferable, however, to group them with *Cænolestes* as a subfamily of the Cænolestidæ, to which they unquestionably belong. This subfamily has been named the Cænolestinæ after its best known representative.

Halmarhiphus is represented in the collection of the American Museum of Natural History by the right ramus of a lower jaw (No. 9593 American Museum) agreeing in size with *H. nanus* Ameghino. The tip of the median incisor has been broken off and the first two vestigial teeth shed from their alveoli. Otherwise the dentition is complete and unworn.

Nothing is known of the upper teeth. The lower dental formula may be written $\frac{}{4}$, $\frac{}{1}$, $\frac{}{3}$, $\frac{}{4}$, if definite homologies are assigned to the vestigial antemolars, instead of explaining their exceptional number as due to reduplication. This is the same dental formula as in the Didelphyidæ. It is occasionally observable in *Cænolestes*, as noted by Bensley (1903, p. 124, Pl. 5, fig. 38).

The proximal half of the median incisor is preserved. As in *Cænolestes*, the enamel layer is confined to the outer side of the crown. So far as can be judged from the part preserved, this tooth was of much the same shape as in *Cænolestes*. Following the enlarged incisor are five minute teeth closely crowded and more or less pronate, which are interpreted as three incisors, a canine and the anterior premolar. The anterior two are represented by alveoli. The first alveolus is displaced toward the inner side, lying beside instead of in front of the third incisor. The lateral incisor, the canine and the anterior premolar are identical in shape. The median and posterior premolars are double-rooted functional teeth. Both carry large heels, that on the median premolar being much larger than that on the posterior tooth. The crowns are laterally compressed, with the principal cusp high and recurved. An anterior accessory basal cuspule of microscopic proportions is observable on the inner side of the crown. The first molar is not differentiated as a sectorial and is slightly smaller than the second. The third is narrower than the second, and the fourth quite small. All display the tuberculo-sectorial pattern (text fig. 7). The trigonid is narrow, with the cusps separated by sharp notches. The talonid is broad, with the hypoconid and entoconid enlarged and the hypoconulid small, but distinct. The cusps of the trigonid and talonid are elevated to the same general level in the three anterior molars. In the fourth, the heel is depressed. The protoconid is slightly higher than the metaconid in the first molar, but of approximately the same elevation in the second, third and fourth. A prominent external cingulum is present on all the molars, as in *Cænolestes* and *Didelphys*.

Fig. 7.

Halmarhiphus nanus, right ramus, crown view, × $\frac{8}{1}$ (No. 9593 American Museum of Natural History).

The mandible is of the same depth as in *Cænolestes*, with the lower border approximately horizontal. Two conspicuous mental foramina are present, situated respectively beneath the posterior premolar and the anterior portion of the second molar.

Halmarhiphus may be distinguished from *Cænolestes* by the sharper separation of the molar cusps, which in the latter are tending toward the crescentic pattern of the Palæothentinæ. The molar crowns are less quadrangular in outline and the metaconid on $M_{\overline{1}}$ is less reduced than in *Cænolestes.* More important differences would probably appear in the upper dentition. *Garzonia* is readily separated from *Halmarhiphus* and *Cænolestes* by the single-rooted condition of $M_{\overline{1}}$.

HALMARHIPHUS NANUS Ameghino.

(Plate LXIII, Figs. 9, 9*a*; Text Fig. 7.)

Halmarhiphus nanus Amegh.; Revista Argent., T. I, p. 308, 1891; Énum. Syn., p. 101, 1894; Bol. Ac. Cord., p. 357, 1894; Segundo Censo, etc., p. 187, 1898.

The right half of a lower jaw of this little animal (No. 9593 American Museum of Natural History) was collected by Mr. Barnum Brown on the Rio Gallegos. Until a larger amount of material has been secured, the generic and specific characters cannot be separately stated. The principal measurements are as follows:

MEASUREMENTS.

Length of lower dental series from posterior border of alveolus of $I_{\overline{1}}$ to $M_{\overline{4}}$ inclusive	.008
Length of antemolar series exclusive of $I_{\overline{1}}$.	.003
" " molar series	.005
Width of base of median incisor	.0008
Depth " " " " "	.001
Median premolar, antero-posterior diameter	.0012
" " transverse "	.0005
Posterior " antero-posterior "	.001
" " transverse "	.0006
$M_{\overline{1}}$, antero-posterior diameter	.0014
" transverse "	.001
$M_{\overline{2}}$, antero-posterior "	.0016
" transverse "	.0012
$M_{\overline{3}}$, antero-posterior diameter	.0014
" transverse "	.001

$M_{\overline{4}}$, antero-posterior diameter	.001
" transverse "	.0008
Depth of mandible below median premolar	.0022
" " " " $M_{\overline{1}}$	.0023
" " " " $M_{\overline{4}}$	.0022

GARZONIA Ameghino.

(Plate LXIII, Figs. 8, 8*a*, 10–13.)

Garzonia Amegh.; Nuevos Restos Mamíf. Fós. Patagonia Austral, pp. 21–22, Aug., 1891; Revista Argentina, I, entr. 5*a*, pp. 307–308, Oct., 1891.

Phonocdromus Amegh.; Énum. Syn., pp. 99–100, 1894.

The genus *Garzonia* is represented in the Princeton collection by the left half of a lower jaw (No. 15,238), associated with parts of both fore limbs, referred provisionally to *G. patagonica.*

Dentition (Pl. LXIII, figs. 8, 8*a*). — The tip of the median incisor has been broken off, but enough remains to show that the enamel is confined almost entirely to the outer side of the crown. Six single-rooted, more or less pronate, vestigial teeth follow the enlarged incisor. Of these the first, fourth, fifth and sixth are preserved. The second and third are represented by roots retained in the alveoli. The antemolar formula of this individual is therefore nine, the highest on record among the Diprotodontia. The constancy of this character may well be doubted. The median premolar and parts of both walls of its alveolus have been broken away, but enough remains to show the double-rooted character of the tooth. The posterior premolar is a large tooth supported on heavy roots, with the crown laterally compressed and, in some species (*Garzonia typica*), elevated considerably above the molar series. In No. 15,238, the enamel has been broken from the tip of the crown, which probably had a slightly greater degree of elevation than is indicated in the figure. The rather prominent heel of the posterior premolar is overhung by the anterior portion of $M_{\overline{1}}$. The molars are greatly worn, and the crown pattern, which appears to have been similar to that in *Cænolestes*, almost obliterated (*cf.* Pl. LXIII, figs. 8*a*, 14*b*). The last molar is single-rooted, a character which distinguishes *Garzonia* from *Halmarhipus* and *Cænolestes.* The crown has been broken off. In $M_{\overline{1}}$ the trigonid is somewhat higher than the talonid, as in *Cænolestes.* This was probably true also for $M_{\overline{2}}$ and $M_{\overline{3}}$, but has been obliterated by the wear to which the teeth have been subjected. An external cingulum is present, as in *Halmarhiphus* and *Cænolestes*.

Mandible (Pl. LXIII, figs. 8, 8*a*).—In shape the mandible resembles that of *Cænolestes*, but is deeper in proportion to its length. The anterior border of the coronoid is straight, without the convex curvature seen in the latter genus (*cf.* Pl. LXIII, fig. 14), and slopes obliquely backward. The horizontal ramus is deepest beneath $\mathrm{M}_{\overline{1}}$ and $\mathrm{M}_{\overline{2}}$, becoming much shallower anterior to the masseteric fossa, which is perforated, as in *Cænolestes*, by a small foramen situated near its inferior border. The angle is strongly inflected. The condyle, which is placed far above the level of the dental series, is flat transversely, convex antero-posteriorly, and considerably wider internally than externally. The symphysial union of the jaws was ligamentous, as in all known members of the Cænolestidæ, the symphysial impression extending as far back as the posterior premolar. Two mental foramina are present, a large one beneath the posterior premolar and a smaller foramen beneath the first molar.

Appendicular Skeleton (Pl. LXIII, figs. 10–13).—Compared with the size of the mandible, the bones of the fore limb are remarkably short and slender, none of them exceeding the jaw in length.

The neck of the scapula (Pl. LXIII, fig. 10) is short and moderately constricted. The glenoid cavity is slightly oval in outline and rather shallow. The coracoid process is prominent, but incomplete at the tip.

The humeral shaft is strongly curved antero-posteriorly and greatly expanded distally. The head is strongly convex in all diameters and projects considerably beyond the shaft posteriorly. The greater tuberosity is low, not extending above the level of the head. The lesser tuberosity has been broken off. The deltoid crest is very prominent, forming a broad flattened area which extends half way down the shaft. The distal end of the humerus (Pl. LXIII, fig. 11) is broad, owing to the great development of the inner epicondyle and supinator ridge. The proximal end of the latter is without hook-shaped termination. The inner epicondyle has been broken off and is restored in outline in the figure. An entepicondylar foramen is present.

The radius (Pl. LXIII, fig. 12) is exceedingly slender. The head is oval and capable of some degree of pronation and supination. Distally, the shaft is slightly expanded and triangular in cross-section. The distal epiphysis has been lost.

GARZONIA PATAGONICA (Ameghino).

(Plate LXIII, Figs. 8, 8*a*, 10–13.)

Phonocdromus patagonicus Amegh.; Énum. Syn., etc., p. 100, 1894; Bol. Ac. Cordoba, pp. 355–356, 1894; Segundo Censo, etc., p. 186, 1898.

The left half of a lower jaw (No. 15,238) associated with the glenoid portion of the right scapula, the greater part of both humeri and the left radius and ulna, collected by Mr. Peterson from the Lower Santa Cruz beds, five miles south of Coy Inlet, is referred provisionally to this species. The correctness of the identification depends principally on the measurements, which agree fairly well with those given by Ameghino (1894, p. 100) for *Garzonia patagonica.* This species differs from *G. typica* and *G. minuta* in the less elevated condition of the posterior inferior premolar, and from *G. captiva* in size.

MEASUREMENTS.

Length of mandible from posterior border of median incisor alveolus to condyle	.0195
“ “ lower dentition exclusive of median incisor	.0105
“ “ space occupied by antemolars exclusive of median incisor	.0055
“ “ “ “ “ molars	.005
Median incisor, transverse diameter at base	.0008
“ “ depth at base	.0012
Posterior premolar, antero-posterior diameter at alveolar border	.0014
“ “ transverse “	.0005
$M_{\overline{1}}$, antero-posterior diameter	.002
“ transverse “	.0011
$M_{\overline{2}}$, antero-posterior “	.0018
“ transverse “	.0011
$M_{\overline{3}}$, antero-posterior “	.0013
“ transverse “	.001
Depth of mandible below $M_{\overline{1}}$	.0028
“ “ “ at constriction posterior to $M_{\overline{4}}$	.0023
Humerus, length (approximate)	.014
Radius, length, exclusive of distal epiphysis	.014
“ width of head	.0015
“ “ “ distal end	.002
Ulna, length, exclusive of distal epiphysis	.0175
“ greatest width above sigmoid cavity	.0028

PALÆOTHENTINÆ.

PALÆOTHENTES (Moreno) Ameghino.

(Plates LXIII, Figs. 1–7; LXIV, Figs. 1–2; Text Fig. 8.)

Palæotenthes Moreno; Patagonia, Resto de un Continente hoy sumergido, p. 22, 1882 (*nomen nudum*).

Palæothentes (Moreno) Amegh.; Enum. Sist. Especies Mamíf. Fós. Pat. Aust., p. 5, 1887.

Palæotheutes Lydekker; Zool. Record for 1887, XXIV, Mamm., 54, 1888.

Epanorthus Amegh.; Contrib. al Conoc. Mamíf. Fós. Rep. Argent., pp. 271–272, 1889.

Metaepanorthus Amegh.; Énum. Syn., p. 92, 1894.

Paraepanorthus Amegh.; Énum. Syn., pp. 93–94, 1894.

This is the most abundant and best known of the Santa Cruz diprotodonts, at least four species being represented in the collections at Princeton University and the American Museum of Natural History.

Dentition (Pls. LXIII, figs. 1–7; LXIV, figs. 1–2).—The dental formula in *Palæothentes* is $\frac{?, 1, 3}{1, 4, 1}, \frac{4}{4}$. Three upper incisors are figured by Ameghino (1895, p. 96, fig. 76; 1903, p. 141, fig. 62, p. 170, fig. 95) for *P. minutus.* The premaxillary region has been broken from the only skull in the Princeton collection (No. 15,225) and the incisor formula cannot be verified. The canine has also been broken in this specimen. From the cross-section of the root it appears to have been considerably flattened laterally. The premolar-molar series forms a crescent, tapering in width at both ends, with the convexity directed outward. The three upper premolars may be either closely crowded (*P. intermedius*, Pl. LXIV, fig. 1) or moderately spaced (*P. aratæ*, Pl. LXIII, fig. 2*a*). The anterior premolar is single-rooted in the latter species, double-rooted in *P. intermedius.* The tooth has been shed in the only specimen of *P. aratæ* in the collection (No. 9549, Am. Museum) and in the skull of *P. intermedius* has been considerably damaged. The median premolar is laterally compressed, with a central cusp and well marked anterior and posterior accessory cuspules. The posterior premolar is a smooth trenchant blade, greatly widened posteriorly and tapering to an edge in front, where a minute accessory cuspule is developed in some species. The crown terminates in a thick blunt point. The anterior root is very oblique and narrower transversely than the posterior root. The principal wear is on the postero-internal face of the crown, where the tooth shears against the anterior blade of the lower sectorial. The molars decrease rapidly in size posteriorly. Each is triple-rooted, with two roots on the buccal and one on the lingual side. The first is fully quadritubercular; the second has an incipient hypocone; the third and fourth are tritubercular. The crowns are bunodont. The protocone and hypocone are united respectively with the paracone and metacone by transverse ridges (*cf.* Pl. LXIII, fig. 7), and the latter cusps with each other by a sharp trenchant ridge, which passes over the external cusps, as in *Petaurus* (Pl. LXV, fig. 4). An external cingulum is faintly indicated in some specimens (Pl. LXIII, fig. 7), wanting in others (Pl. LXIV, fig. 1). A rather broad anterior cingulum is developed on the first molar.

The median lower incisors are procumbent and lanceolate, with the outer edge of the enamel attenuated (Pl. LXIII, figs. 4*a*, 5*a*), and occasionally notched by accidental fractures received during life. The enamel layer is restricted to the anterior face of the crown. Internally, it is reenforced by a thick rib of dentine. The enamel does not grow persistently but covers a limited area, which decreases in size as the tooth wears down (*cf.* Pl. LXIII, figs. 4 and 5). In shape the incisors resemble those of the Macropodidæ.

Following the incisor are four single-rooted vestigial teeth. The anterior two are remarkably procumbent in *P. minutus* (Pl. LXIII, fig. 4*b*), possibly less so in *P. lepidus*. The third is not retained in any of the specimens in the collection. The crown of the fourth is antero-posteriorly elongated and overhangs in front. The posterior premolar is a large double-rooted tooth elevated to about the same extent as the molars. The crown supports a prominent central cusp and more or less elevated anterior and posterior accessory cuspules. These have been used by Ameghino in defining the genera *Metaepanorthus* and *Paraepanorthus*. The former he characterizes by the presence of well-defined anterior and posterior accessory cuspules on the posterior premolar, and the latter by the occurrence of the anterior cuspule only. The presence or absence of these structures can hardly be a matter of generic importance, as they vary in size and prominence within the limits of a species (*cf.* Pl. LXIII, figs.

4 and 5). The lower molars are lophodont, the cusps of the trigonid and heel forming crescentic ridges. All the molars are double-rooted and decrease rapidly in size posteriorly.

The first is modified as a sectorial by the elongation of the protoconid-paraconid blade. Vertical ridges are not developed on the sectorial, but the enamel on the outer side is irregularly crenulated. The paraconid is lower than the protoconid, from which it is separated by a distinct notch. In this respect, *Palæothentes* is intermediate between the Cænolestinæ and the more specialized Palæothentinæ, *Callomenus* and *Decastis*. The second and third molars are similar in pattern to the first, but the paraconid is reduced and the horn of the posterior crescent, instead of uniting with the metaconid, as in the sectorial molar, is shifted farther toward the outer side, uniting with the anterior crescent between the protoconid and metaconid, as in *Callomenus* and *Decastis* (*cf.* Pl. LXIII, fig. 6*a*; Pl. LXIV, figs. 5*a*, 6*a*). The fourth molar is a small tooth similar to those preceding it, but losing early by wear the details of the crown pattern. External cingula are faintly indicated on the anterior lobes of the first and second molars.

Skull (Pl. LXIII, fig. 3; Pl. LXIV, figs. 1, 1*a*).—A skull of *P. intermedius* in the Princeton collection (No. 15,225), lacking the region anterior to the canine and posterior to the glenoid fossæ, forms the basis for the following description. In side view (Pl. LXIII, fig. 3), the skull is seen to be gently arched, the highest point lying at the junction of the temporal ridges. Back of the orbits, the brain case contracts, becoming widely expanded posteriorly. Postorbital frontal processes are wanting, but well marked temporal ridges give rise to a low sagittal crest. Between the orbits, the frontal is plane. Anteriorly, it sends a broad bar forward between the nasal and lachrymal to join the maxillary, differing in this respect from the Santa Cruz marsupial carnivores.

The nasals are very broad behind, rapidly decreasing in width anteriorly. Unlike *Cænolestes*, there is no trace of an antorbital vacuity. The premaxillæ have been largely broken away, but resemble those of *Cænolestes* in sending a narrow tongue between the maxillary and nasal (*cf.* Pl. LXIII, fig. 14; Pl. LXIV, fig. 1*a*). The lachrymal has but little facial extension. The lachrymal duct opens within the orbital rim, which supports a small but distinct lachrymal tubercle.

The anterior margin of the orbit is sharply defined. The jugal arches have been broken, but enough of the left squamosal bar remains to show that the malar extended to the glenoid fossa. The squamosal portion of the arch is not inflated, as it is in *Petaurus*, *Trichosurus* and others of the higher phalangers.

The palate is deeply concave both antero-posteriorly and transversely. The incisive foramina extend beyond the premaxillary suture to a point opposite the anterior premolars. Two antero-posteriorly elongated palatal vacuities are present, extending from a point opposite the anterior extremity of M^1 to M^4. Neuro-vascular canals perforating the posterior margin of the palate are present, as in the majority of marsupials. The palato-narial border is greatly thickened and elevated in a manner resembling *Didelphys*.

The infra-orbital foramen is large, opening above the anterior root of the upper sectorial.

Mandible (Pl. LXIII, figs. 4–6*a*; text fig. 8). — The mandible is long, slender and shallow in the smaller species, deep and probably less elongated in the larger forms. The rami are unfused. The symphysial impression extends as far back as the anterior half of the sectorial. The coronoid and angle are not preserved in any of the specimens studied. Two mental foramina are usually present, one beneath the sectorial, the other beneath or slightly anterior to the last vestigial tooth. Occasionally there are two posterior foramina somewhat variable in position.

PALÆOTHENTES ARATÆ (Moreno) Ameghino.

(Plate LXIII, Figs. 2, 2*a*; Text Fig. 8.)

Palæotenthes aratæ Moreno; Patagonia, Resto de un Continente hoy submergido, p. 22, 1882 (*nomen nudum*).

Palæothentes aratæ (Moreno) Amegh.; Enum. Sist. Especies Mamíf. Fós. Patagonia Austral, p. 5, 1887.

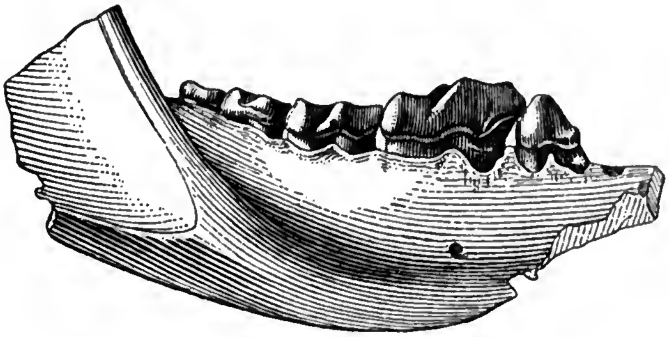
Epanorthus aratæ (Moreno) Amegh.; Contrib. al Conocimiento Mamíf. Fós. Rep. Argent., pp. 272–273, Pl. I, Figs. 10–12*b*, 1889.

Epanorthus aratæ (Moreno) Trouessart; Catalogus Mammalium, p. 1202.

Represented in the American Museum collection by a fragment of the right maxilla (No. 9549 American Museum) from Santa Cruz, retaining the median and posterior premolars and the second, third and fourth molars, as well as the alveoli of the canine, the anterior premolar and the first molar.

The species may be recognized by its size, by the presence of diastemata between the premolars, by the spacing of the canine and anterior premolar, and the single-rooted condition of the latter tooth.

Fig. 8.



Palæothentes aratæ, right ramus, × $\frac{3}{1}$. From an enlarged photograph of a specimen in the Ameghino collection.

The mandible, shown in the accompanying figure (text fig. 8), drawn from a photograph of a jaw in the Ameghino collection, is very heavy and deep, with convex lower border. The horizontal ramus increases slightly in depth posteriorly.

Measurements.

	Amegh. Coll.	*No. 9549.*
Length, posterior border of canine alveolus to $\mathrm{M}^{\underline{4}}$, inclusive		.0235
“ of space occupied by premolars		.0125
“ “ “ “ “ molars		.0115
Median premolar, antero-posterior diameter		.0025
“ “ transverse “		.0015
Posterior premolar, antero-posterior “		.006
“ “ transverse “		.0035
$\mathrm{M}^{\underline{2}}$, antero-posterior diameter		.0035
“ transverse “		.005
$\mathrm{M}^{\underline{3}}$, antero-posterior “		.0025
“ transverse “		.0035
$\mathrm{M}^{\underline{4}}$, antero-posterior diameter		.002
“ transverse “		.0025
Posterior lower premolar, antero-posterior diameter	.0035	
Length of inferior molar series on alveolar border	.015	
$\mathrm{M}_{\overline{1}}$, antero-posterior diameter	.0065	
$\mathrm{M}_{\overline{2}}$, “ “	.004	

	Amegh. Coll.
$M_{\overline{3}}$, antero-posterior diameter	.003
$M_{\overline{4}}$, " "	.002
Depth of mandible below $M_{\overline{1}}$	.0075
" " " " $M_{\overline{4}}$	.008

PALÆOTHENTES INTERMEDIUS Ameghino.

(Plates LXIII, Figs. 3, 7; LXIV, Figs, 1, 1*a*.)

Palæothentes intermedius Amegh.; Enum. Sist. Especies Mamíf. Fós. Patagonia Austral, p. 6, 1887.

Epanorthus intermedius Amegh.; Contrib. al Conocimiento Mamíf. Fós. Rep. Argentina, p. 274, Pl. I, Figs. 15–15*e*, 1889.

Metaepanorthus intermedius Amegh.; Énum. Syn., etc., p. 92, 1894; Bol. Acad. Cordoba, p. 348, 1894.

An incomplete skull (No. 15,225) collected by Mr. Peterson from the Lower Santa Cruz beds five miles south of Coy Inlet, and two maxillary fragments (No. 15,952; American Museum, No. 9550), from Killik Aike and Santa Cruz respectively, apparently belong to this species, agreeing closely with the measurement given by Ameghino (1894, p. 92) for the premolar-molar series. The important features of the skull and teeth have already been mentioned in characterizing the genus.

So far as can be judged from the small amount of material available, the size of mature individuals is fairly constant. The upper premolars are all double-rooted, without intervening diastemata. The anterior premolar is in contact with the canine. An exceedingly small anterior accessory basal tubercle is present on the upper sectorial in unworn teeth. The species is considerably larger than *P. lepidus*, occupying in point of size a position intermediate between that species and *P. aratæ*.

MEASUREMENTS.

	No. 15,225.	*No. 15,952.*	*No. 9550.*
Length of upper premolar-molar series measured as chord of arc	.015	.015	
Length of space occupied by upper premolars	.0075	.0074	
" " " " " " molars	.0085	.0085	
Anterior premolar, antero-posterior diameter	.0018		
" " transverse "	.0008		
Median " antero-posterior "	.002	.002	
" " transverse "	.001	.001	

	No. 15,225.	*No. 15,925.*	*No. 9550.*
Posterior premolar, antero-posterior diameter	.0043	.004	.004
" " transverse diameter	.0023	.0022	.0022
M^{1}, antero-posterior diameter	.004	.0038	.004
" transverse "	.0032	.003	.0033
M^{2}, antero-posterior "	.0025	.0025	.0028
" transverse "	.0032	.003	.0033
M^{3}, antero-posterior "	.0017	.0018	
" transverse "	.002	.002	
M^{4}, antero-posterior "	.001	.001	
" transverse "	.0013	.0012	
Greatest interorbital width	.0105		
Least width of brain-case	.007		
Greatest breadth of nasals	.0087		
Depth of skull to alveolar border at front of orbit	.012		
Width of palate between anterior premolars	.007		
" " " at M^{1}	.010		
" " " " M^{4}	.010		

PALÆOTHENTES LEPIDUS Ameghino.

(Plate LXII, Figs. 6, 6*a*.)

Epanorthus lepidus Amegh.; Revista Argentina, I, p. 305, 1891.

This species is known only from the mandible, of which the American Museum collection contains four incomplete specimens (Nos. 9596–9598, 9600) found by Mr. Brown on the Rio Gallegos.

In size *P. lepidus* is intermediate between *P. minutus* and *P. intermedius*. The vestigial teeth occupy a shorter space than in *P. minutus* and are more closely crowded. The alveoli of the first and second are larger than those of the third and fourth, are closely adjacent and strongly inclined forward. The alveoli of the third and fourth vestigial teeth are approximately vertical.

The mental foramina vary considerably in size and relative position and are of little diagnostic value. The principal measurements agree closely with those of a natural-size photograph of the type in the Ameghino collection, and have been depended on largely for the correctness of the specific identification.

MEASUREMENTS.

	Type.	*No. 9596.*	*No. 9597.*	*No. 9598.*	*No. 9600.*
Length, posterior border of median incisor alveolus to $M_{\overline{4}}$ inclusive	.014	.014			
Length of space occupied by vestigial teeth and posterior premolar	.005	.005			
Length of inferior molar series on alveolar border	.009	.009		.009	
Posterior premolar, antero-posterior diameter	.0014	.0015	.0015		.0015
“ “ transverse “		.001	.001		.001
$M_{\overline{1}}$, antero-posterior diameter	.0035	.0035	.0035	.0035	.0035
“ transverse “			.002	.002	.002
$M_{\overline{2}}$, antero-posterior “	.0025	.0025	.0025	.0025	.0025
“ transverse “		.002	.002	.002	.002
$M_{\overline{3}}$, antero-posterior “	.002		.002	.002	.002
“ transverse “			.0015	.0015	.0015
$M_{\overline{4}}$, antero-posterior “	.0012				
Depth of mandible below posterior premolar	.0035	.0035			
“ “ “ “ $M_{\overline{1}}$	.0035	.0035	.004	.0035	.004
“ “ “ “ $M_{\overline{4}}$				.004	

PALÆOTHENTES MINUTUS Ameghino.

(Plates LXIII, Figs. 1, 4–5*a*; LXIV, Fig. 2.)

Palæothentes minutus Amegh.; Enum. Sist. Especies Mamíf. Fós. Patagonia Austral., p. 6, 1887.

Epanorthus minutus Amegh.; Contrib. al Conocimiento Mamíf. Fós. Rep. Argent., p. 274, Pl. 1, Figs. 16–16*a*, 1889.

Paraepanorthus minutus Amegh.; Énum. Syn., etc., pp. 94–95, Fig. 40, 1894; Bol. Acad. Cordoba, p. 350, Fig. 40, 1894.

Epanorthus simplex Amegh.; Énum. Syn., pp. 91–92, 1894; Bol. Acad. Cordoba, p. 347, 1894.

Incomplete lower jaws of six individuals from Killik Aike (Nos. 15,706–15,709, 15,068, 15,624) have been identified as belonging to this little diprotodont. A maxillary fragment retaining the posterior premolar and the molars is associated with one of the mandibles (No. 15,709). Two upper molars (No. 15,999) collected by Mr. Hatcher on the south side of the Santa Cruz River, sixty miles below Lake Argentina, and part of a left mandibular ramus (No. 9122 American Museum) from a locality on the Rio Gallegos, are also referable to this species.

As characters of specific value may be mentioned the small size, shallow, slender jaws, the presence of a well-marked anterior accessory cuspule on the last upper premolar, and the great length of the space occupied by the vestigial antemolars, which are less closely crowded than in some of the larger species (*P. lepidus*). These teeth are of an exceedingly peculiar shape. The first and second of the series are widely separated from each other at the roots, but the cylindrical crowns curve forward abruptly, lying prone on the alveolar border in such a manner that the tip of the second rests on the root of the first, while the tip of the latter rests on the base of the median incisor (Pl. LXIII, fig. 4*b*). The last vestigial tooth has a small, button-shaped crown overhanging anteriorly. Minute notches in the edges of the median incisors are due to accidental fracturing of the attenuated edges of the enamel layer investing the outer surface of the crown.

Two large mental foramina are usually present, situated respectively beneath the last vestigial tooth and the first molar.

A photograph of the type specimen of *Palæothentes simplex* in the Ameghino collection, for which the writer is indebted to Professor Scott, shows no differences warranting a separation of this species from *P. minutus*.

MEASUREMENTS.

	No. 15,706.	*No. 15,707.*	*No. 15,708.*	*No. 15,709.*	*No. 15,068.*	*No. 15,624.*	*No. 15,999.*	*No. 9122.*
Length of mandible from tip of median incisor to $M_{\overline{4}}$ inclusive	.0175		.017					
Length of mandible from posterior border of median incisor alveolus to $M_{\overline{4}}$ inclusive . . .	.013		.013					
Length of space occupied by vestigial teeth and posterior premolar	.0064		.0057					
Width of base of median incisor	.0008	.0008	.0008	.001				
Depth " " " " "	.0014	.0014	.0013	.0015				
Length of superior molar series on alveolar border . . .				.006				
$M^{\underline{1}}$, antero-posterior diameter .				.0024				
" transverse " .				.002				
$M^{\underline{2}}$, antero-posterior " .				.002			.002	
" transverse " .				.0018			.002	
$M^{\underline{3}}$, antero-posterior " .				.0015			.0015	

	No. 15,706.	*No. 15,707.*	*No. 15,708.*	*No. 15,709.*	*No. 15,068.*	*No. 15,624.*	*No. 15,999.*	*No. 9,122.*
M^{3}, transverse diameter				.0015			.0018	
M^{4}, antero-posterior diameter				.0012				
“ transverse diameter				.001				
Posterior lower premolar, antero-posterior diameter	.0015	.0016	.0014	.0015	.0015	.0015		.0014
Posterior lower premolar, transverse diameter	.0008	.001	.0008	.0008	.001	.001		.0008
Length of inferior molar series on alveolar border	.007		.007		.008			
M_{1}, antero-posterior diameter	.0024	.0025			.0025			.0025
“ transverse “	.0015	.0015			.0015			.0015
M_{2}, antero-posterior “	.002	.002	.002		.002	.0022		.002
“ transverse “	.0015	.0015	.0015		.0015	.0015		.0015
M_{3}, antero-posterior “	.0017		.0016	.0018	.0018			
“ transverse “	.0012		.0012	.0014	.0014			
M_{4}, antero-posterior “	.0012		.001	.001				
“ transverse “	.0009		.0008	.0008				
Depth of mandible below posterior premolar	.0028	.003	.0025	.003	.0025			
Depth of mandible below M_{1}	.0032	.0036	.003		.0027			
“ “ “ “ M_{4}			.0032	.0035				

CALLOMENUS Ameghino.

(Plate LXIV, Figs. 5, 5*a*.)

Callomenus Amegh.; Nuevos Restos Mamíf. Fós. Patagonia Austral, p. 20, Aug., 1891; Revista Argentina, I, entr. 5*a*, p. 306, Oct., 1891.

Although known only from the mandible and inferior dentition, this genus is probably valid, having progressed farther than *Palæothentes* in the elimination of the vestigial antemolars, as the result of a progressive shortening of the lower jaw. The posterior premolar is double-rooted, but no longer reaches the general level of the molar series, as it does in *Palæothentes*. It is overlapped and partly concealed by the sectorial blade of the first molar. In view of the individual variation in the number of vestigial teeth shown by some of the phalangers, *Callomenus* may be regarded as rather doubtfully separable from *Acdestis*, which retains four of these teeth (Ameghino, 1903, p. 171, fig. 98) in addition to the double rooted premolar.

Callomenus is represented in the collection by the right half of a mandible

(No. 15,066) which retains the base of the incisor and all the inferior dentition except the vestigial antemolars. The coronoid and part of the angle have been broken off.

The median incisor is elliptical in cross-section, with the enamel confined to the outer side. Between this tooth and the posterior premolar are three closely crowded alveoles for the vestigial, single-rooted antemolars. The posterior premolar is double-rooted, compressed laterally, with an anterior principal cusp and prominent heel partly overlapped by the trenchant blade of the first molar. The molars are double-rooted and decrease in size posteriorly. The first is greatly enlarged, as in *Palæothentes.* The ridge uniting the protoconid and paraconid is functional as a sectorial blade, but is not notched as in *Palæothentes.* The prominent metaconid is united by ridges with the protoconid and cusps of the heel. These ridges form a pair of crescents, the concavity of which is directed internally. The outer side of the tooth is channelled by a deep groove which extends forward and inward toward the metaconid. The second and third molars resemble the first in pattern. In these teeth, the protoconid-paraconid blade is considerably reduced and the tooth crown more quadrangular than $M_{\overline{1}}$. The posterior crescent is deflected outwardly, joining the anterior crescent much nearer to the protoconid than the metaconid. The channel on the outer face of the tooth crown is much shallower than in $M_{\overline{1}}$. The fourth molar is a minute tooth, with button-shaped crown, which, owing to its worn condition, does not show well the lophodont pattern of the anterior molars. It is evident from the shape of the crown that this tooth was of the same general pattern as the third molar. A large mental foramen is present beneath the last vestigial tooth, and a smaller foramen beneath the sectorial molar. The masseteric fossa is imperforate. The angle is prominent and strongly inflected, and the horizontal ramus evenly convex and of about the same depth throughout beneath the molars.

CALLOMENUS LIGATUS Ameghino.

(Plate LXIV, figs. 5, 5*a*.)

Callomenus ligatus Amegh.; Énum. Syn., etc., p. 88, 1894; Bol. Acad. Cordoba, p. 344, 1894.

Three species are recognized by Ameghino (1891, p. 306; 1894, p. 88), of which but one is represented in the Princeton collection by the right half of a mandible (No. 15,066), collected by Mr. Peterson from the Upper Santa Cruz beds at Killik Aike. Owing to the small amount of material available, it has not been possible to distinguish between generic and specific characters. The principal dependence for the correctness of the identification has, consequently, been upon size. The dimensions given below agree closely with Ameghino's figures for *Callomenus ligatus*.

MEASUREMENTS.

Length, posterior border of median incisor to $M_{\overline{4}}$ inclusive	.0155
" of space occupied by vestigial teeth and posterior premolar	.0055
" " molar series on alveolar border.	.010
Width of base of incisor	.0015
Depth " " " "	.0025
Posterior premolar, antero-posterior diameter	.0015
" " transverse "	.001
$M_{\overline{1}}$, antero-posterior diameter	.0045
" transverse "	.002
$M_{\overline{2}}$, antero-posterior "	.003
" transverse "	.002
$M_{\overline{3}}$, antero-posterior "	.002
" transverse "	.0015
$M_{\overline{4}}$, antero-posterior "	.0013
" transverse "	.001
Depth of mandible below last vestigial tooth	.0043
" " " " posterior premolar	.0045
" " " " $M_{\overline{1}}$	.005
" " " " $M_{\overline{4}}$	.0055

DECASTIS Ameghino.

(Plate LXIV, Figs. 4, 4*a*, 6, 6*a*.)

Decastis Amegh.; Nuevos Restos Mamíf. Fós. Patagonia Austral, p. 19, Aug., 1891; Revista Argentina, I, entr. 5*a*, p. 305, Oct., 1891.

In *Decastis*, premolar reduction is carried one step farther than in *Callomenus*. The heel of the posterior premolar is still retained, but the whole tooth is smaller and no longer double-rooted. Between the last premolar and the median incisor are four vestigial single-rooted teeth. The base of the incisor is retained in one specimen (No. 9594 American Museum, Pl. LXIV, figs. 4, 4*a*), showing a large pulp canal, but broken off too far below the crown to indicate the distribution of the enamel. The tooth is larger than in *Callomenus*, but similar in shape at the base.

The last vestigial tooth (Pl. LXIV, fig. 6), probably representing the median premolar, has a cylindrical, blunt-pointed crown. The crown of the third intermediate (Pl. LXIV, fig. 4), overhangs anteriorly. The first two rudimentary teeth have been shed, but from the obliquity of their alveoli, it is probable that they resemble the homologous teeth in *Palæothentes*.

The molars are an exact duplication of those of *Callomenus*, but are slightly more worn in both the mandibles in the collection. The last tooth is double-rooted, but has, unfortunately, been broken off.

The number and relative position of the mental foramina is much the same as in *Callomenus*. The apparent shifting forward of the anterior foramen is due to the reduction in length of the premolar series. The masseteric fossa is imperforate and the coronoid broad and high with prominent anterior margin. The symphysial impression is wider than in *Callomenus*.

Difference in size is the only character available for the separation of the two species recognized by Ameghino (1891, p. 305), of which the larger, *D. columnaris*, is represented in the collection by two specimens.

DECASTIS COLUMNARIS Ameghino.

(Plate LXIV, Figs. 4, 4*a*, 6, 6*a*.)

Decastis columnaris Amegh.; Nuevos Restos Mamíf. Fós. Patagonia Austral, p. 19, Aug., 1891; Revista Argentina, I, entr. 5*a*, p. 305, Oct., 1891.

Like *Callomenus ligatus*, *Decastis columnaris* is known only from lower jaws, of which parts of two are in the collections at Princeton University and the American Museum. No. 15,710, collected by Mr. Peterson at Coy Inlet, is a portion of the left half of a mandible, with two premolars and three molars in place (Pl. LXIV, figs. 6, 6*a*). The second specimen (No. 9594 American Museum) from the Santa Cruz beds, on the Rio Gallegos, is the anterior half of a right mandibular ramus retaining in place two molars, the third vestigial tooth and the base of the incisor (Pl. LXIV, figs. 4, 4*a*).

MEASUREMENTS.

	No. 15,710.	*No. 9594.*
Approximate length, posterior border of median incisor to $M_{\overline{4}}$ inclusive.	.016	
Length of space occupied by vestigial teeth and posterior premolar.	.0055	

	No. 15,710.	*No. 9594.*
Length of molar series on alveolar border	.010	
Width of base of incisor		.002
Depth " " " "		.003
Posterior premolar, antero-posterior diameter	.0012	
" " transverse "	.001	
$M_{\overline{1}}$, antero-posterior diameter	.00475	.005
" transverse "	.0024	.0025
$M_{\overline{2}}$, antero-posterior "	.003	.003
" transverse "	.002	.002
$M_{\overline{3}}$, antero-posterior "	.002	
" transverse "	.0015	
Depth of mandible below first molar	.005	.005

ABDERITINÆ.

ABDERITES Ameghino.

(Plate LXIV, Figs. 3, 3*a*; Text Fig 9, *a*, *b*.)

Abderites Amegh.; Enum. Sist. Especies Mamíf. Fós. Patagonia Austral, p. 5, 1887.

Diprotodont marsupials in which the first lower molar is developed as a striated sectorial blade resembling superficially the sectorials of the Plagiaulacidæ.

Dentition (Pl. LXIV, figs. 3, 3*a*; text figs. 9, *a*, *b*).—The formula for the lower dentition is $\frac{}{1,\ 4,\ 1}, \frac{}{4}$. The median incisors are not preserved in either specimen of *Abderites crassignathus* in the Princeton collection (Nos. 15,079, 15,425), but, judging from the size of their alveoli, they were large teeth. The posterior premolar is a very small, single-rooted, cylindrical tooth closely applied to the anterior root of $M_{\overline{1}}$. Between the enlarged incisor and the posterior premolar are alveoli for four single-rooted, vestigial teeth. The molar series is placed very obliquely to the long axis of the jaw, more so than in any other member of the Cænolestidæ, the anterior blade of the first molar projecting beyond the plane of the outer surface of the mandible. The molars are double-rooted and decrease in size posteriorly, as in all the Cænolestidæ. The first has been converted into a very perfect sectorial by the complete obliteration of the metaconid, the great elevation and lateral compression of the protoconid-paraconid blade, and the development of parallel vertical ridges on both the outer and inner faces of the crown. The ridges on opposite sides meet along the edge of the sectorial blade in a series of serrations, the number of which varies with the species. The broad talon is bicuspidate. The second and third molars are quadrangular in outline and bunolophodont, with the paraconid present but reduced. The fourth molar is retained in one specimen (No. 15,425); but the crown has been abraded to a flat surface without trace of cusps or ridges.

In the fragment of the right maxillary referred by Ameghino (1898, p. 184, fig. 49, II; 1903, p. 142, fig. 64, p. 178, fig. 107) to *A. meridionalis*, the second molar is fully quadritubercular, in contrast with the incompletely quadritubercular $M^{\underline{2}}$ in *Palæothentes.*

Mandible. — The mandible is much deeper than in *Callomenus* and *Decastis.* The coronoid is high, with the anterior margin sloping backward. Its base is perforated by a branch of the alveolar canal opening externally behind the last molar (Pl. LXIV, fig. 3*a*). The masseteric fossa is broad and occasionally pierced by a small foramen situated some distance below the large irregular opening shown in the figure (Pl. LXIV, fig. 3), which is due to fracture. The symphysis is broad and heavy, extending posteriorly beneath the first molar.

ABDERITES CRASSIGNATHUS Ameghino.

(Plate LXIV, Figs. 3, 3*a*; Text Fig. 9.)

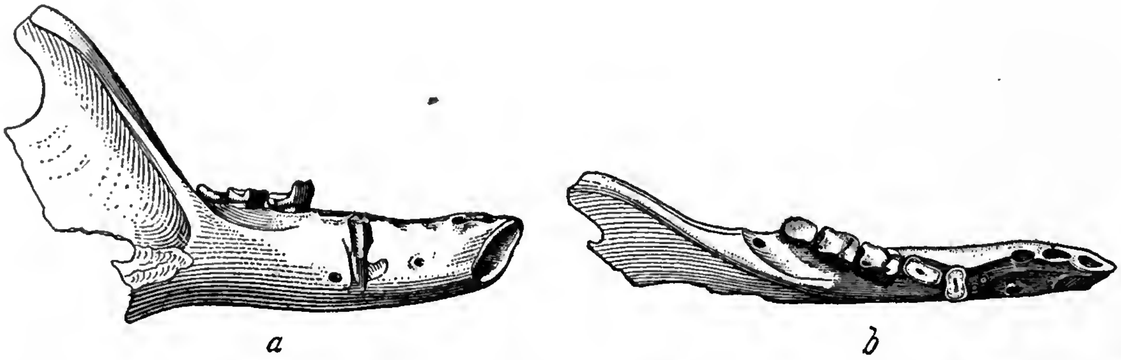
Abderites crasignathus (*sic*) Amegh.; Revista Argentina Hist. Nat., I, p. 248, 1891.

Abderites crassiramis Amegh.; Rev. Gén. des Sciences, p. 80, fig. 4, 1893.

The beautiful little specimen figured on Pl. LXIV (No. 15,079) was collected by Mr. Hatcher on the Rio Chalia, and has been mentioned by him in the Narrative of the expeditions (this series, Vol. I, p. 113). A second specimen from Killik Aike (No. 15,425) agreeing with the first in proportions, but lacking the crown of the sectorial, is referred to the same species and is represented in Fig. 9.

A. crassignathus is readily identified by the presence of five or six prominent ridges on the anterior half of $M_{\overline{1}}$. The ridges are developed on both the outer and inner sides of the tooth, producing a series of serrations on the cutting edge of the sectorial blade. A photograph of the type in the Ameghino collection obtained by Professor Scott shows five prominent ridges on the outer side of $M_{\overline{1}}$ extending to the cutting edge of the crown. In the Princeton specimen there are six ridges. On the inner side, the fourth ridge extends inferiorly but a short distance, as is well shown in the figure (Pl. LXIV, fig. 3*a*). In addition to the main anterior ridges, five short ribs are observable on the outer side of the sectorial. These probably extended farther toward the cutting edge, but have been partly obliterated by the abrasion of this part of the tooth crown from contact with the opposing tooth in the upper jaw. The photograph referred to above shows two short faint ridges back of the last prominent outer rib. These, however, do not give rise to serrations on the margin. The crowns of the vestigial antemolars have not been preserved, but in the photograph of the type specimen are seen to be antero-posteriorly elongated and to overhang in front, as in *Palæothentes minutus* (Pl. LXIII, fig. 4*b*). The fourth vestigial tooth and the posterior premolar are in contact. The third and fourth vestigial teeth are separated by a considerable diastema. The alveoli of the first and second are elongated antero-posteriorly and inclined obliquely forward, as in *Palæothentes*.

Fig. 9.



Abderites crassignathus, right ramus of mandible, × $\frac{2}{1}$ (No. 15,425). *a*, side view; *b*, crown view.

A large mental foramen pierces the mandible below the sectorial, and another is present, below or slightly posterior to the third vestigial antemolar.

MEASUREMENTS.

	No. 15,425.	*No. 15,079.*
Length, posterior border of incisor alveolus to $M_{\overline{4}}$	.022	
" of space occupied by vestigial antemolars	.0095	
" " molar series on alveolar border	.013	.013
Posterior premolar, antero-posterior diameter		.0007

	No. 15,425.	*No. 15,079.*
Posterior premolar, transverse diameter		.0008
$M_{\overline{1}}$, antero-posterior diameter		.005
" transverse "		.0023
" height of middle of crown, above alveolar border		.0045
$M_{\overline{2}}$, antero-posterior diameter	.0033	.0033
" transverse "	.0022	.0025
$M_{\overline{3}}$, antero-posterior "	.003	.003
" transverse "	.002	.002
$M_{\overline{4}}$, antero-posterior "	.002	
" transverse "	.0017	
Depth of mandible below middle of sectorial	.0065	.0065
" " " " $M_{\overline{4}}$	.006	.006

RELATIONSHIPS OF THE CÆNOLESTIDÆ.

The most primitive Santa Cruz representative of the Cænolestidæ is, undoubtedly, the genus *Halmarhiphus*, which represents, with little or no modification, a type which is not only ancestral to the Palæothentinæ, but agrees perfectly with the "minute insectivorous forms which, apart from the diprotodont modification of the antemolar teeth, possessed a full antemolar formula," indicated by Bensley's studies as the ancestors of the Phalangerinæ. In this interesting genus the dental formula and molar patterns are didelphid, affording striking evidences in favor of the theory of the didelphid origin of the Diprotodontia (see Bensley, 1903). It has already been shown (p. 417) that the lower molar patterns in the Palæothentinæ are readily derivable from the *Halmarhiphus* type by a reduction in height of the cusps and the formation of cross crests. So far as our knowledge of *Halmarhiphus* warrants an inference, there can be little objection to deriving the Palæothentinæ from a similar ancestral form. The chief objection to regarding *Halmarhiphus* as directly ancestral to the Palæothentinæ arises from the fact that the latter are represented in formations older than the Santa Cruz (*P. chubutensis* from the Pyrotherium beds, Amegh., 1897, p. 96). That *Halmarhiphus* is in the direct line of descent culminating in *Cænolestes* will, it is believed, hardly be questioned after an examination of the accompanying plates. So far as the lower dentition is concerned, no argument can be advanced to the contrary. The recent genus shows a slight tendency toward the development of crescents, while, in its Santa Cruz predecessor, the cusps are high and pointed, as in the Didelphyidæ. Unfortunately, nothing is known of the upper dentition. *Garzonia* is more specialized than the other members of the Cænolestinæ, having the last lower molar single-rooted.

Some account has already been given of the lower molars in the Palæothentinæ and an attempt has been made to show that *Palæothentes*, *Callomenus* and *Decastis* are members of a closely related series characterized by a progressive reduction in the number of antemolar teeth, reduction in the size of the posterior premolar and increasing perfection in the adaptation of the first molar to a sectorial function (see pp. 427–436). It remains to point out the striking similarity in upper molar patterns exhibited by *Palæothentes* and certain of the phalangers. Reference to the accompanying plates will at once make this clear (see Pls. LXIII, fig. 7; LXIV, fig. 1; LXV, fig, 4). Indeed, it is possible to trace in the Palæothentinæ the constructive stages in the evolution of the bunodont type of molar characteristic of the more primitive of the existing phalangers. The development of the hypocone in the upper molars of *Palæothentes* is less complete than in these phalangers, only the first molar being quadrangular and fully quadritubercular, the second retaining a triangular outline, with incipient hypocone. In the higher phalangers (*Phalanger* and *Trichosurus*, Pl. LXV, figs. 3, 3*a*), all the molars are quadritubercular, intermediate stages in molar complication occurring in *Petaurus*, with three quadritubercular molars, and *Dromicia* with two. In *Cænolestes* there exists the apparent anomaly that a genus more primitive than *Palæothentes* should have the second upper molar more complicated. This complication, however, may be a measure of the extent of dental evolution in the Cænolestinæ in post-Santa Cruz time. The condition in the Santa Cruz representatives of the family is not known, but presumably the upper molars were less advanced than in *Palæothentes*. In the highly specialized Abderitinæ, judging from Ameghino's figure of *A. meridionalis* (Amegh., 1898, p. 184, fig. 49, II; 1903, p. 142, fig. 64, p. 178, fig. 107), the second upper molar is fully quadritubercular. *Palæothentes*, then, represents an early constructive stage of a progressive complication of the upper teeth, which began with $M^{\underline{1}}$ and proceeded backward.

Abderites is near the end, if not the terminal member, of a highly specialized line, the intermediate stages of which have not been found in the Santa Cruz beds. Affinities with the Plagiaulacidæ have been commonly assumed from the striking resemblance between the first lower molar of *Abderites* and the notched and fluted sectorial teeth of the plagiaulacid Multituberculata. This resemblance is confined to the anterior half of the sectorial, the posterior portion in *Abderites* supporting a large bicuspidate heel. The posterior molars show no indication of cusp reduplication and still retain the three cusps of the trigonid, indicating their tuberculo-sectorial origin. In *Hypsiprymnodon* and *Bettongia* the posterior premolars closely resemble the sectorials of the Multituberculata. The Bettongiinæ and Abderitinæ illustrate a case of convergence, where much the same form has been assumed by totally different teeth. The homologies of the sectorials of the Plagiaulacidæ are uncertain, but they have been interpreted as posterior premolars, while in the Abderitinæ the sectorial is unquestionably the first molar.

In a former paper the writer (1905, p. 81) stated that: "the Cænolestidæ resemble the primitive phalangers in so many respects that it is impossible to escape the conclusion, that the two famlies are related and not merely convergent groups. With the exception of *Halmarhiphus*, a persistent ancestral type, the Santa Cruz diprotodonts possess specializations in dental structure which prevent their being regarded as direct ancestors' of the phalangers, but favor the idea that both groups are descended from a common ancestry." While substantially the same conclusions are still held, it is proper to point out the evidence in favor of the view that the striking similarity in dental structure displayed by the two families may be explained by convergence. So far as the foot structure of the Cænolestidæ is known (p. 418), the pes shows no trace of syndactyly, while in all the phalangers it is syndactylous. A further difference appears in the development of sectorial teeth, which, when present in the Cænolestidæ, are confined to the posterior superior premolar and first lower molar, while in the phalangers the sectorial function may be transferred to the posterior inferior premolar in some of the higher forms (*Trichosurus*, *Phalanger*). Until the upper dentition, skull and feet of the Cænolestidæ, and especially of the primitive members of the family, are fully known, this must remain an unsettled question. At present the arguments in favor of the alternatives expressed are about equally balanced.

The Cænolestidæ lend no support to the latest classification proposed for them by Ameghino (1903, pp. 153–159) in which they are grouped as the suborder Paucituberculata, order Plagiaulacoidea, superorder Diprotodonta, the latter including also the orders Hypsiprimnoidea and Rodentia. The characters which they possess are in no respect transitional to the Multituberculata. The Paucituberculata, like the Sparassodonta, are a group founded on a misconception of relationships and should be abandoned.

BEARING OF THE SANTA CRUZ MARSUPIALS ON ZOÖGEOGRAPHY.

The reality of a former land connection between the Australian region and South America is plainly indicated by several lines of evidence based on the distribution of fishes, land shells, decapod crustaceans, plants, and Tertiary marine molluscs (Ortmann, 1902). This land connection is believed to have existed not later than the close of the Cretaceous or beginning of the Tertiary, and it is only by such a connection that the distribution of the Thylacynidæ can be explained. The direction, continuity or discontinuity of this land bridge need not enter into the present discussion. So far as the Thylacynidæ are concerned, there can be little doubt of their South American origin, judging from the marked adaptive radiation which they attained during the Santa Cruz epoch, but whether the same can be said of marsupials in general is still a matter of question. It is believed, however, that the order may be properly regarded as of southern origin and that the occurrence of opossums in North America and Europe may be explained as the result of migration from the southern hemisphere.

MARSUPIALIA INCERTÆ SEDIS.

A large number of Santa Cruz marsupials have been named by Ameghino and Mercerat, which are not represented in the collections at Princeton University and the American Museum of Natural History. Many of these have never been figured and are very imperfectly known. At present, the writer is not prepared to add to what has been published regarding them. The names and full references to the literature are here given.

BORHYÆNA Ameghino.

Borhyæna fera Ameghino.

Dynamictis fera Amegh.; Revista Argentina, pp. 148–149, fig. 53, 1891.
Dinamyctis fera (*sic*) Amegh.; Ibid., p. 314.

Borhyæna fera Amegh.; Énum. Syn. des Espèces de Mamm. Foss. des Formations Éocènes de Patagonie, pp. 117–119, figs. 45, 46, 1894; Bol. Acad. Cordoba, p. 373, figs. 45, 46, 1894.

Borhyæna fera Amegh.; Segundo Censo de la República Argentina, p. 189, fig. 55, *b*, *c*, 1898.

BORHYÆNA SANGUINARIA Ameghino.

Borhyæna sanguinaria Amegh.; Énum. Syn., etc., p. 120, 1894; Bol. Acad. Cordoba, p. 376, 1894.

ACROCYON Ameghino.

ACROCYON SECTORIUS Ameghino.

Acrocyon sectorius Amegh.; Enum. Sist. Especies Mamíf. Fós. Patagonia Austral, p. 8, 1887; Contrib. al Conocimiento Mamíf. Fós. Rep. Argentina, pp. 289–290, Pl. 1, figs. 19, 19*a*, 19*b*, 1889; Énum. Syn., etc., p. 121, 1894; Bol. Acad. Cordoba, p. 377, 1894; Segundo Censo, etc., p. 189, 1898.

Acrocyon sectorius Amegh., Mercerat; Revista del Museo de La Plata, II, p. 55, 1891.

ACROCYON EQUIANUS Mercerat.

Acrocyon equianus Merc.; Revista del Museo de La Plata, II, p. 55, 1891.

ACROCYON PATAGONENSIS Mercerat.

Acrocyon patagonensis Merc.; Revista del Museo de La Plata, II, p. 55, 1891.

CONODONICTIS Ameghino.

CONODONICTIS SÆVUS Ameghino.

Conodonictis sævus Amegh.; Revista Argent., p. 314, 1891; Énum. Syn. etc., p. 121, 1894; Bol. Acad. Cordoba, p. 377, 1894; Segundo Censo, etc., p. 189, 1898.

CONODONICTIS EXTERMINATOR Ameghino.

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ERRATA.

Pp. 3–43. Throughout Part I, for Lake Pueyrrydon, Puerrydon Series, etc., *read* Lake Pueyrredon, Pueyrredon Series, etc.

P. 10, l. 2. For relatep, *read* related.

P. 54, l. 17. For Oven Poin, *read* Oven Point.

P. 79, l. 14. For *T. patagonia*, read *T. patagonica*.

P. 84, l. 19. For escutheon, *read* escutcheon.

P. 97, ll. 21, 23, 27. For *P. ibari*, read *G. ibari*.

P. 113, l. 20. For *O. vesicularis*, read *G. vesicularis*.

P. 134, l. 33. For *Panopœa*, read *Panopea*.

P. 135, heading of species 61. For *Venus difficillis*, read *V. difficilis*.

P. 153, l. 10. For cspecially, *read* especially.

P. 157, heading of species 88. For *Dentalum*, read *Dentalium*.

P. 162, " " " 93. For *Leptothyra philippi*, read *L. philippii*.

P. 180, l. 23. *Omit* of (last word of line).

P. 218, l. 1. For var. *inoratus*, read *inornatus*.

P. 230, Footnote. For *Volutolithes*, read *Volutilithes*.

P. 242, l. 3. For collosity, *read* callosity.

P. 251, l. 33. For *R. varians*, read *B. varians*.

P. 252, l. 23. For *R. unguiformis*, read *B. unguiformis*.

P. 257, l. 2. For *Callistoma philippi*, read *Calliostoma philippii*.

l. 2. For *Fusus spiralis*, read *F. subspiralis*.

P. 262, l. 37. For *D. octocostellum*, read *D. octocostellatum*.

l. 38. For *enota Gcuevensis*, read *Genota cuevensis*.

P. 263, l. 13. For *Pinna semicostalis*, read *P. semicostata*.

l. 28. For *Calliostoma pararatum*, read *C. peraratum*.

P. 266, l. 28. After No. 26, insert *Modiola ameghinoi* and change the subsequent numbers 27–117 to 28–118.

P. 270, l. 8. For 117, *read* 118.

P. 280, l. 23. For *Glycimeris ibaria*, read *G. ibari*.

P. 284, Footnote. For *Terrebratella*, read *Terebratella*.

P. 288, l. 29. For *Siphonalis* read *Siphonalia*.

P. 295, l. 3. For *Crassatella kokeni*, read *Crassatellites kokeni*.

l. 18. For *Calliostoma pararatum*, read *C. peraratum*.

P. 301, l. 19. For *V. sarissa*, read *V. serissa*.

P. 304, l. 6. For *Panopea ibaria*, read *P. ibari*.

P. 305, l. 25. For This, *read* The.

P. 317, l. 11. For deposits, *read* deposition.

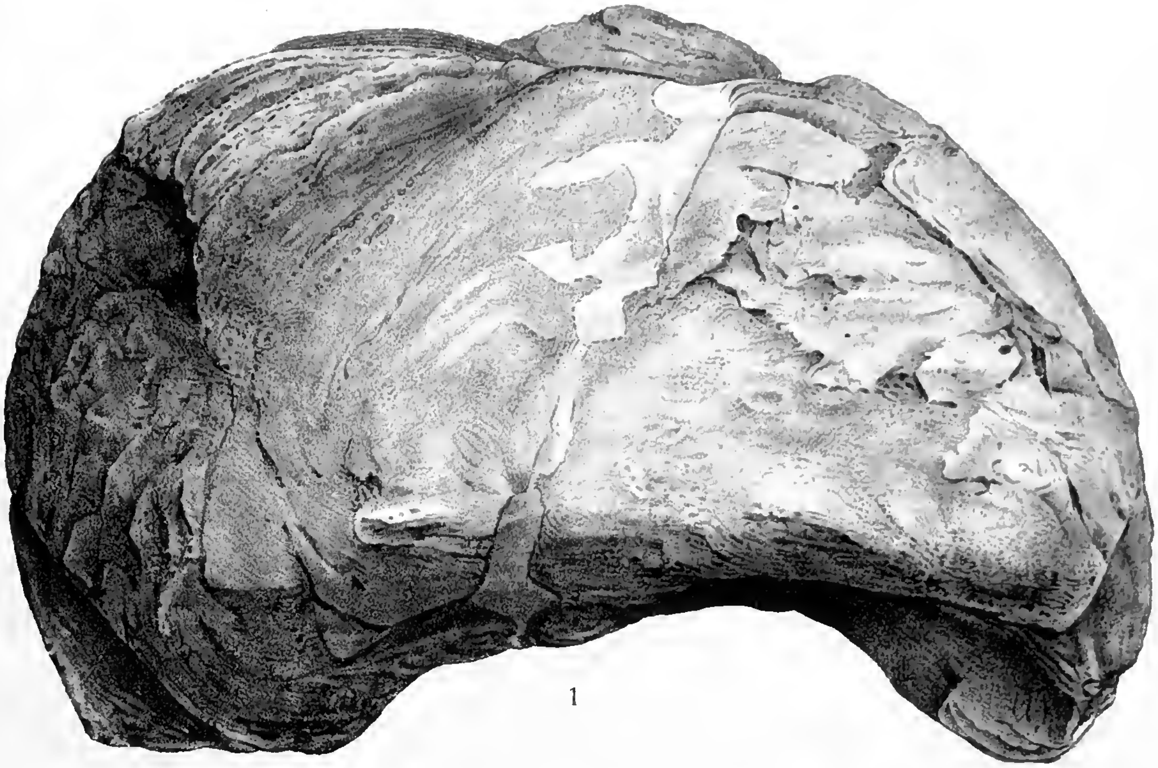
P. 324, l. 5. For Tyron, *read* Tryon.

P. 332, l. 29. For Wood, S. F., *read* Wood, S. V.

EXPLANATION OF PLATE I.

	PAGE
OSTREA TARDENSIS Stanton	11

Fig. 1. Lower valve of an average specimen. Natural size.
Fig. 2. Opposite view showing upper valve of same individual.



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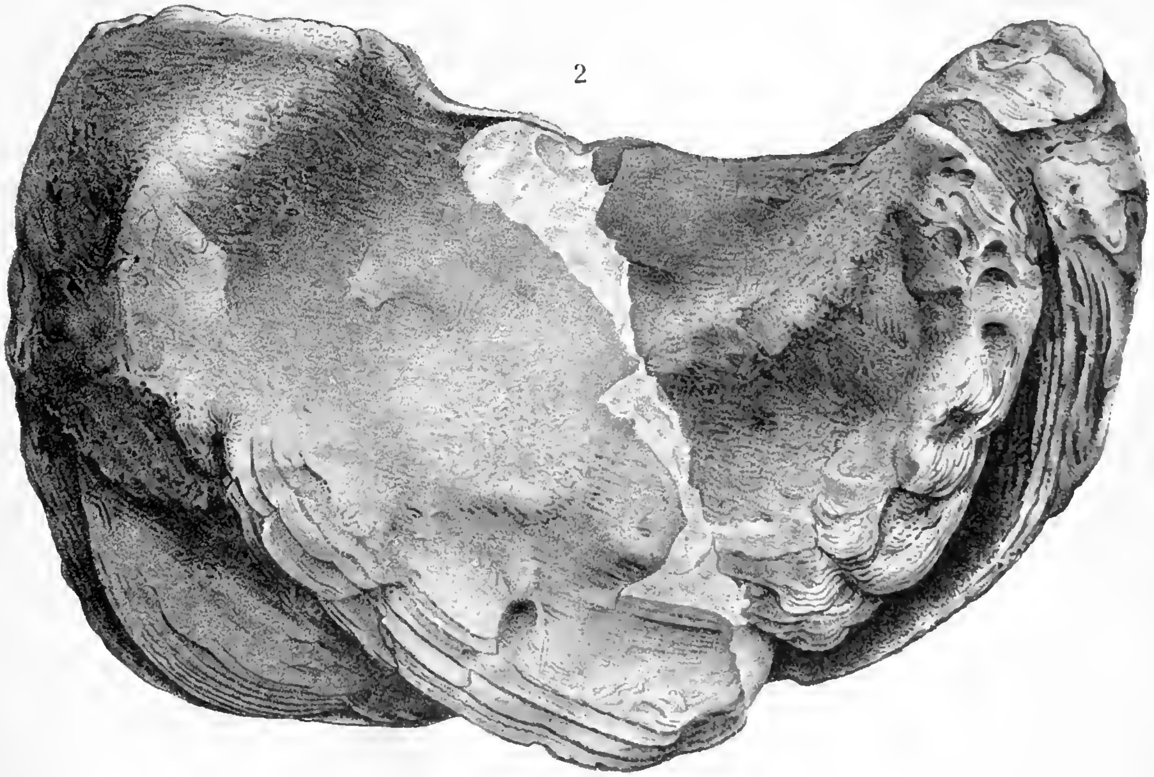

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CRETACEOUS INVERTEBRATES.

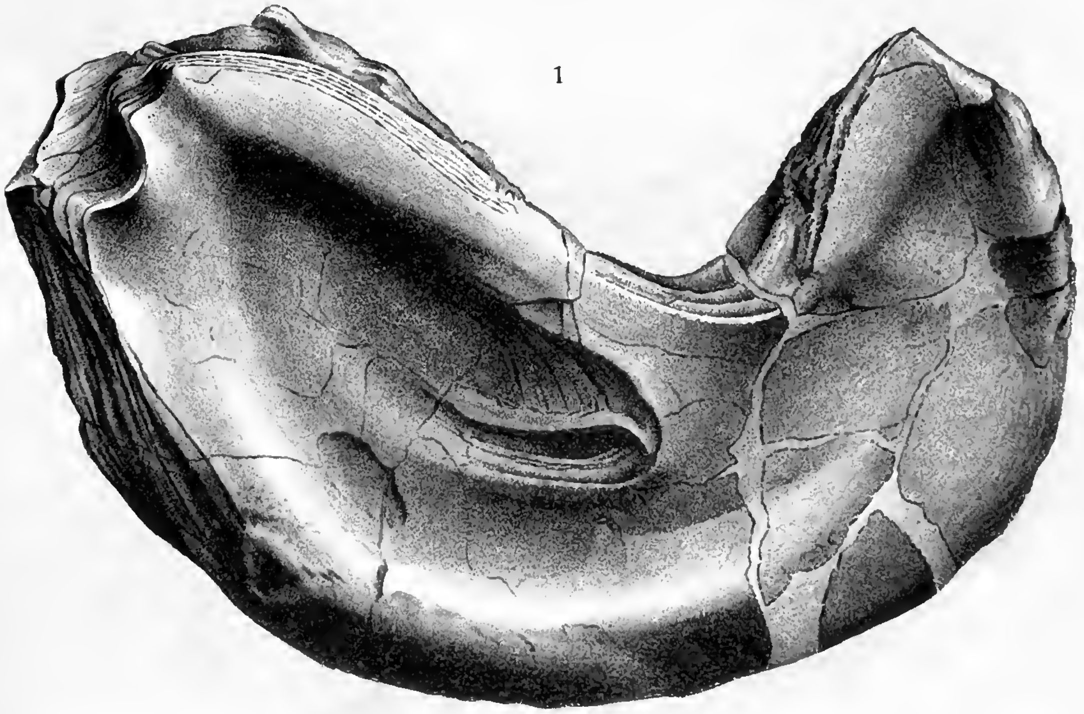
EXPLANATION OF PLATE II.

	PAGE
Ostrea tardensis Stanton	11

Fig. 1. Exterior of more strongly curved upper valve. Natural size.
Fig. 2. Interior of same.

Note.—This specimen was inadvertently posed with the beak downward.

2



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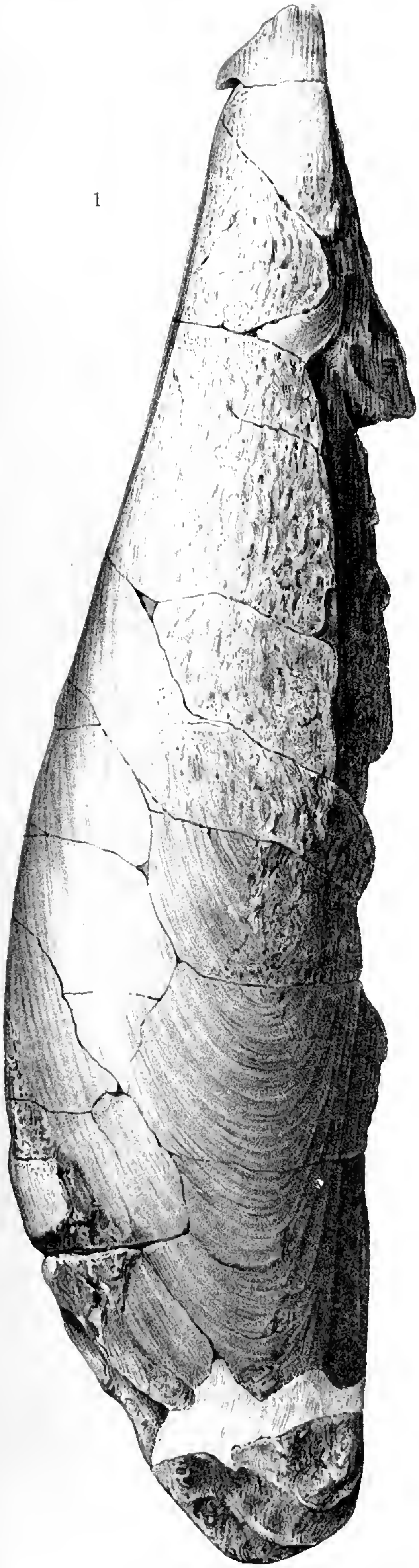
CRETACEOUS INVERTEBRATES.

EXPLANATION OF PLATE III.

	PAGE
GERVILLIA HATCHERI Stanton	15
Figs. 1, 2. Exterior and interior views of the type. Natural size.	

1



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CRETACEOUS INVERTEBRATES.

EXPLANATION OF PLATE IV.

PAGE

Pecten (Camptonectes) pueyrrydonensis Stanton 12

Fig. 1. Right valve. Natural size.

Pecten octoplicatus Stanton 14

Fig. 2. Right valve with the ears partly restored from another example. Enlarged two diameters.

Fig. 3. Left valve, similarly enlarged.

Mytilus argentinus Stanton 16

Fig. 4. Right valve. Enlarged two diameters.

Pecten argentinus Stanton 13

Fig. 5. Left valve. Natural size.

Avicula (Oxytoma) tardensis Stanton 14

Fig. 6. A small left valve enlarged three diameters to show details of sculpture. From a wax cast of a natural mold.

Fig. 7. An average left valve, natural size, with most of the shell and posterior ear removed.

Nucula pueyrrydonensis Stanton 17

Fig. 8. A small left valve from a wax cast of a natural mold.

Fig. 9. Another left valve.

Solecurtus? limatus Stanton 24

Fig. 10. Left valve.

Leda? corbuliformis Stanton 18

Fig. 11. Left valve.

Tapes? patagonica Stanton 23

Fig. 12. Dorsal view of type, enlarged two diameters.

Fig. 13. Left valve of same.

Corbula crassatelloides Stanton 26

Fig. 14. Right valve, enlarged three diameters.

Fig. 15. Left valve, enlarged three diameters.

Trigonia heterosculpta Stanton 20

Fig. 16. Young specimen showing concentric sculpture of beak and beginning of posterior series of costæ.

Fig. 17. Half-grown specimen showing further development of costæ.

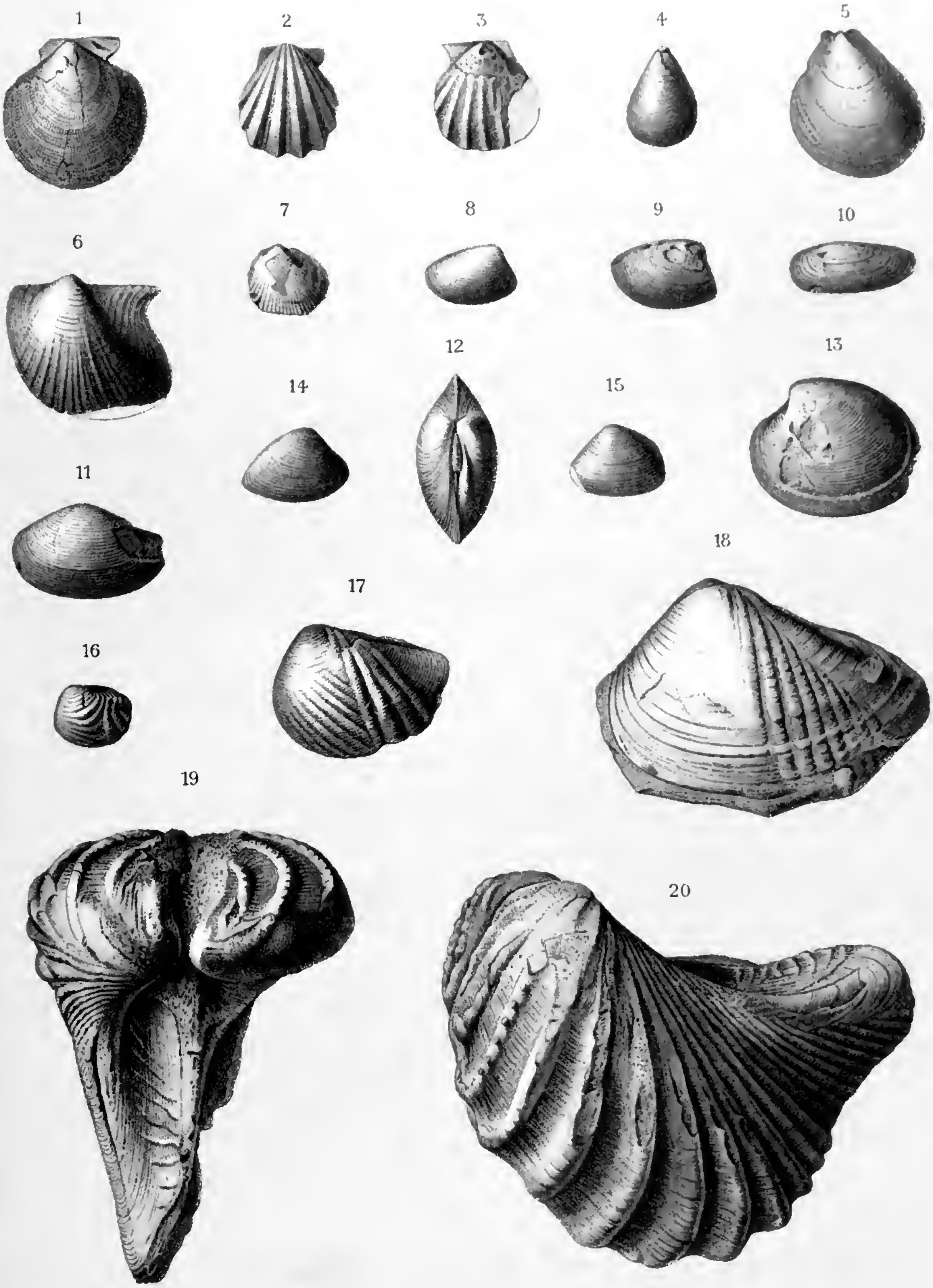
Fig. 18. Larger specimen with anterior sculpture obscured by weathering.

Trigonia subventricosa Stanton 18

Fig. 19. Dorsal view of the type.

Fig. 20. Left valve of same.

All figures of natural size unless otherwise stated.



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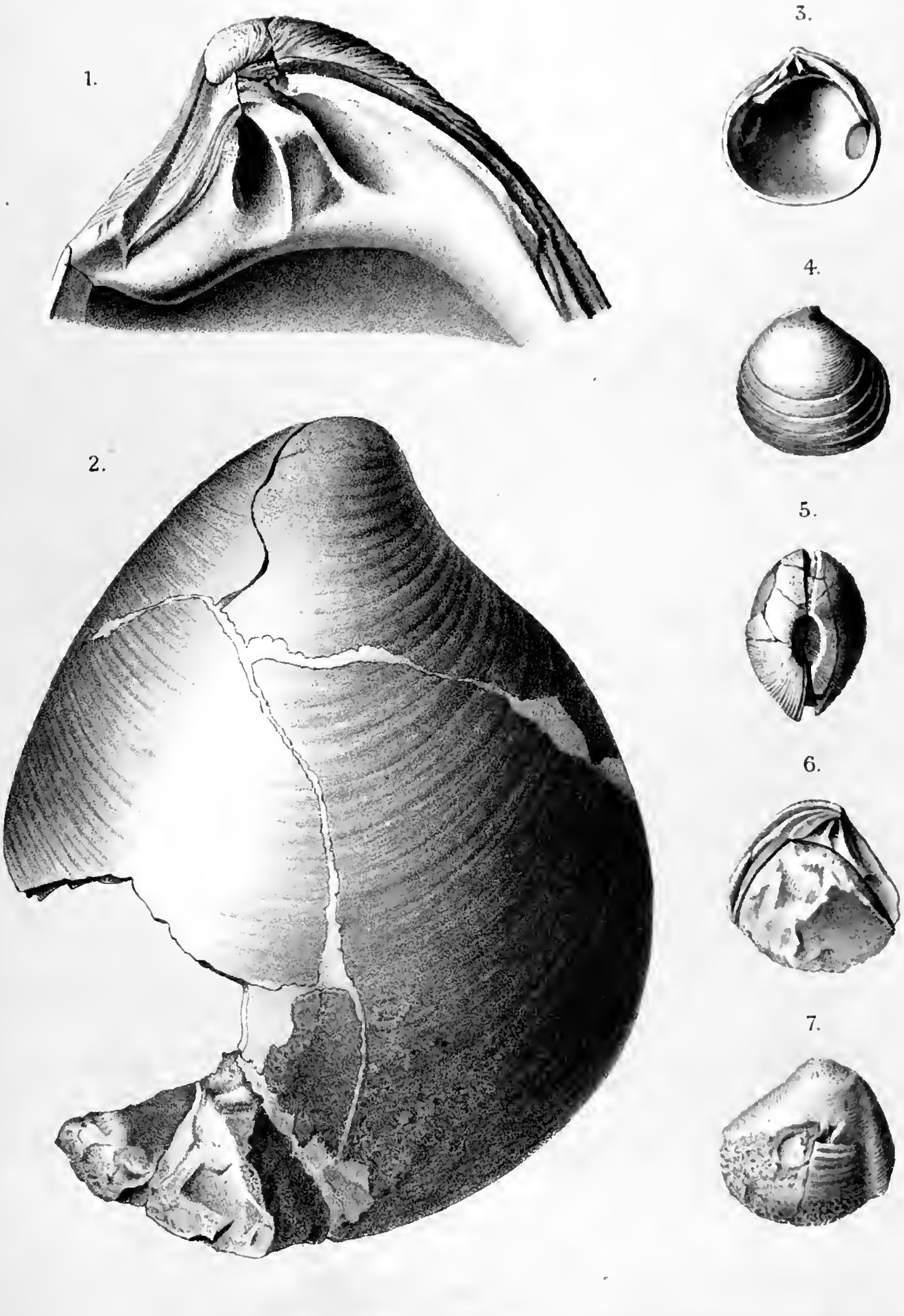
CRETACEOUS INVERTEBRATES.

EXPLANATION OF PLATE V.

	PAGE
ASTARTE PERALTA Stanton	22
Fig. 1. Hinge of right valve.	
Fig. 2. Exterior of same specimen.	
ASTARTE POSTSULCATA Stanton	23
Fig. 3. Interior of thin right valve.	
Fig. 4. Exterior of a similar valve.	
Fig. 5. Dorsal view of an example with thicker valves.	
Fig. 6. Hinge of a thick left valve.	
Fig. 7. Exterior of same specimen.	

All figures on this plate are of natural size.



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CRETACEOUS INVERTEBRATES.

EXPLANATION OF PLATE VI.

PAGE

PLEUROMYA LATISULCATA Stanton 25

Fig. 1. Right valve of the type.

Fig. 2. Dorsal view of same.

MARTESIA ARGENTINENSIS Stanton 27

Fig. 3. Dorsal view of large specimen, enlarged.

Fig. 4. Left valve of small specimen, enlarged.

TURNUS DUBIUS Stanton 27

Fig. 5. Part of a tube with shell in place, enlarged two diameters.

Fig. 6. Another view of same specimen.

Fig. 7. A left valve, enlarged two diameters.

Fig. 8. Dorsal view of another specimen, enlarged two diameters.

DENTALIUM (LÆVIDENTALIUM) LIMATUM Stanton 28

Fig. 9. A large specimen with most of the shell removed.

LUNATIA CONSTRICTA Stanton 31

Fig. 10. Aperture view of the type.

Fig. 11. Dorsal view of same.

LUNATIA PUEYRRYDONENSIS Stanton 32

Fig. 12. Dorsal view of the type.

APORRHAIS PROTUBERATUS Stanton 32

Fig. 13. Aperture view of an average specimen with part of the shell and the callus of last whorl destroyed.

Fig. 14. Aperture view of another specimen showing the callus boss and more of the sculpture.

Fig. 15. Dorsal view of same specimen.

CINULIA AUSTRALIS Stanton 34

Fig. 16. Dorsal view, enlarged two diameters.

Fig. 17. Aperture view of same specimen.

TORNATELLÆA PATAGONICA Stanton 34

Fig. 18. Dorsal view of one of the types, enlarged two diameters.

Fig. 19. Aperture view of another specimen, enlarged two diameters.

All figures are of natural size unless otherwise stated.

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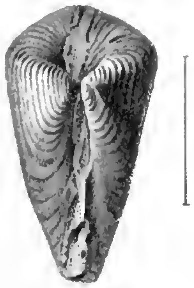

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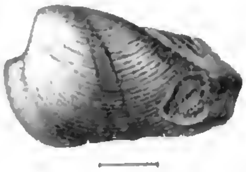

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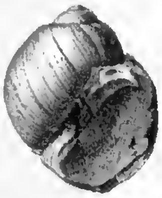

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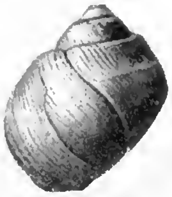

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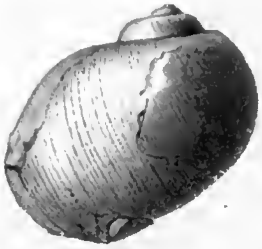

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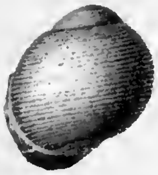

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CRETACEOUS INVERTEBRATES.

EXPLANATION OF PLATE VII.

	PAGE
PLEUROTOMARIA TARDENSIS Stanton	29

Fig. 1. Aperture view of the type.
Fig. 2. Profile view of same showing the slit.

Both figures are natural size.

PLATE VII.

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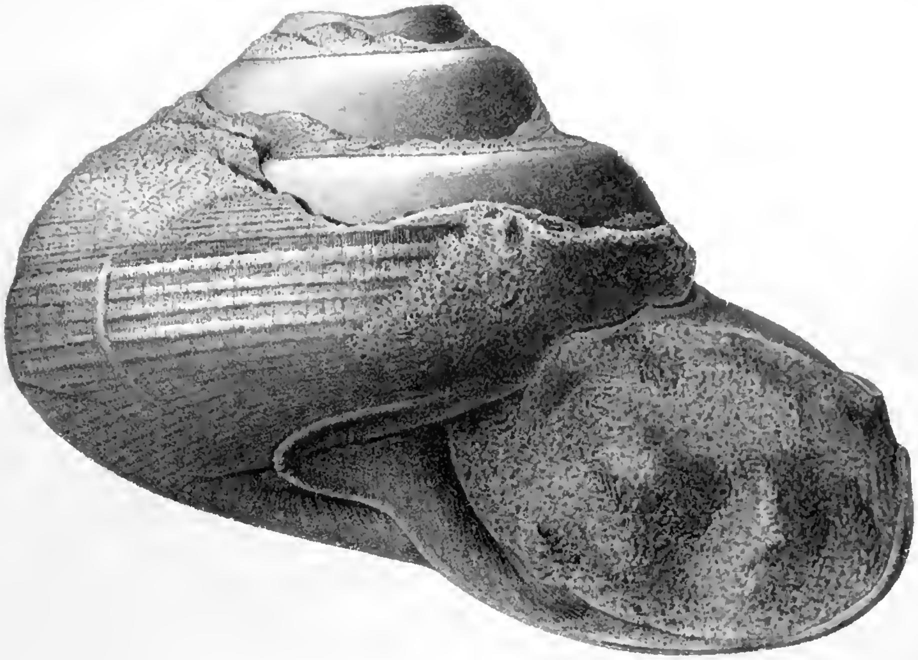

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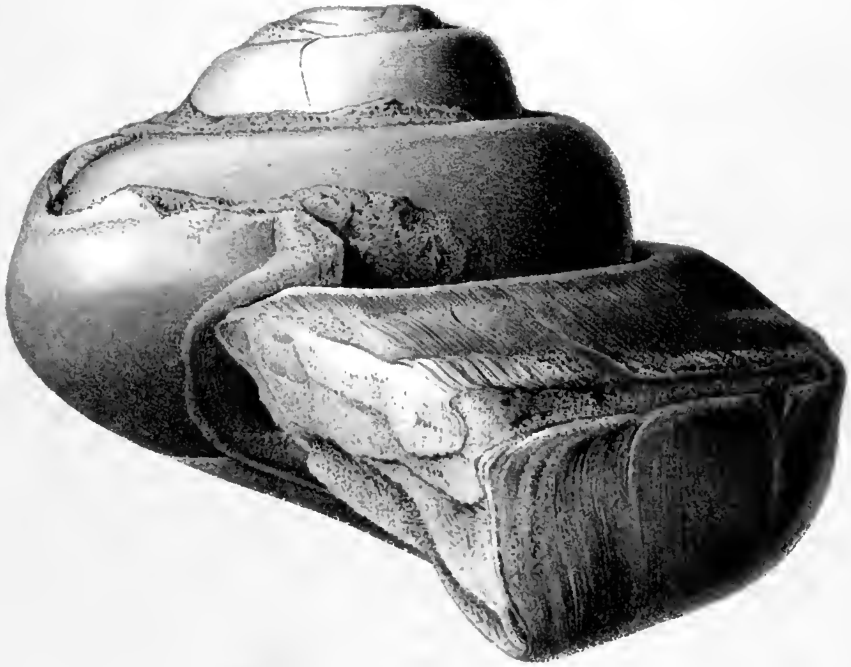

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CRETACEOUS INVERTEBRATES.

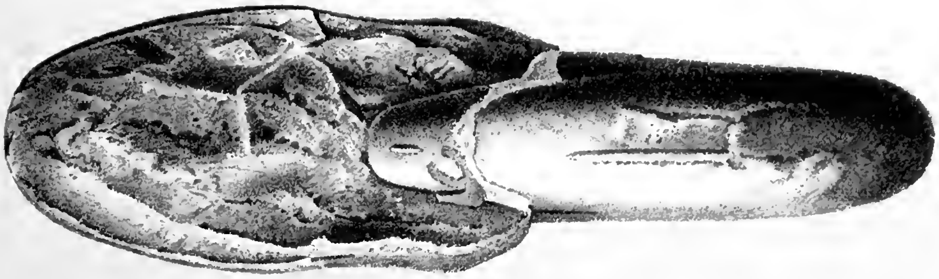
EXPLANATION OF PLATE VIII.

	PAGE
HATCHERICERAS PATAGONENSE Stanton	38

Fig. 1. Side view of type, one half natural size.
Fig. 2. Aperture view of same, one half natural size.

PLATE VIII

2.



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CRETACEOUS INVERTEBRATES.

EXPLANATION OF PLATE IX.

PAGE

HATCHERICERAS PATAGONENSE Stanton 38

Fig. 1. Suture of specimen figured on plate VIII.

HATCHERICERAS ARGENTINENSE Stanton 39

Fig. 2. Suture of large weathered specimen represented by figure 5.

Fig. 3. Suture of a young specimen.

Fig. 4. Side view of a young specimen.

Fig. 5. Side view of a larger imperfect specimen.

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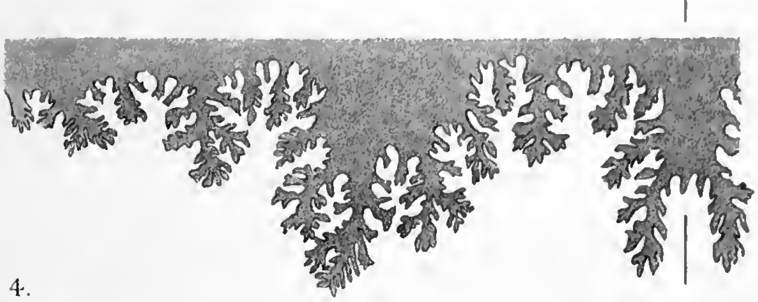

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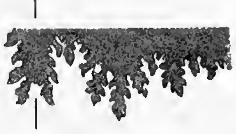

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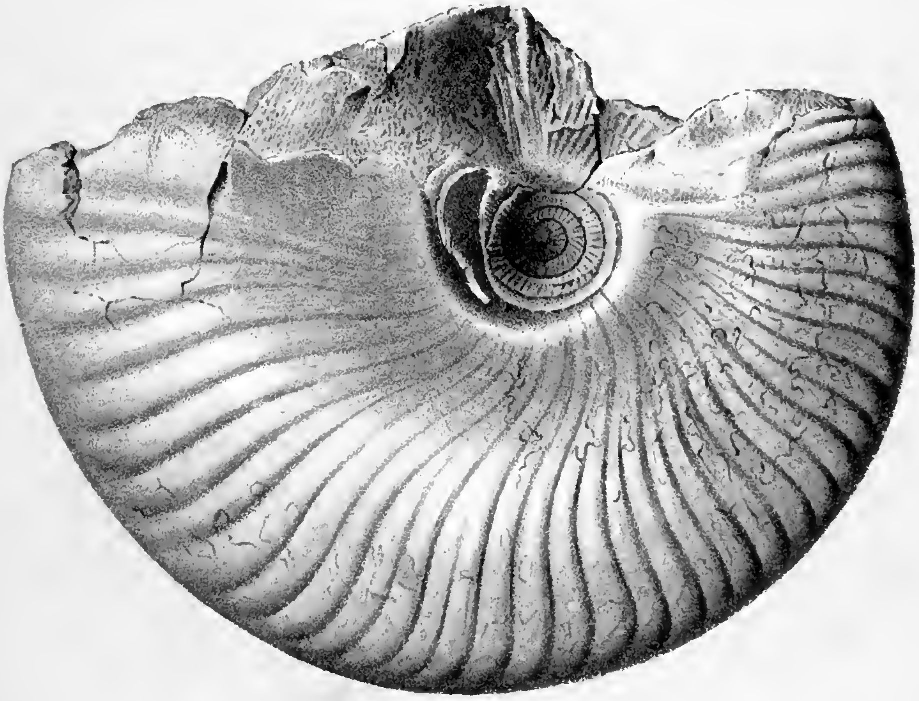

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CRETACEOUS INVERTEBRATES.

EXPLANATION OF PLATE X.

	PAGE
HATCHERICERAS? PUEYRRYDONENSE Stanton	42
Fig. 1. Side view of the type.	
Fig. 2. Aperture view of same.	
HATCHERICERAS? TARDENSE Stanton	41
Fig. 3. Suture of type specimen.	
Fig. 4. Side view of same.	
Fig. 5. Aperture view of same.	

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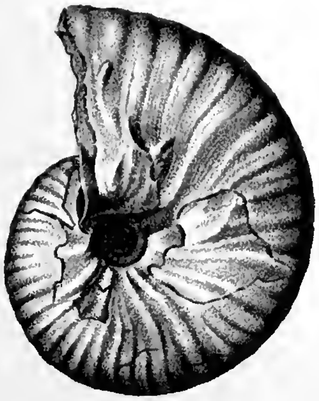

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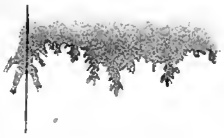

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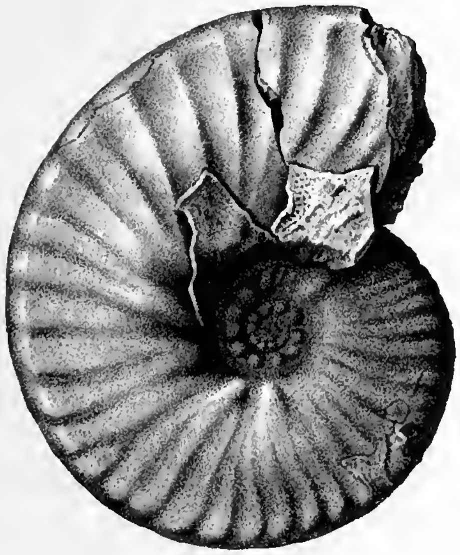

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CRETACEOUS INVERTEBRATES.

EXPLANATION OF PLATE XI.

PAGE

Fig. 1. Cidaris antarctica Ortm. 51
Patagonian beds; 30 miles north of upper Rio Chalia.
1*a*. Fragment of spine.
1*b*. Cross section of spine.
1*c*. View of articular surface of lower end of spine.
1*d*. Plate.

Fig. 2. Hypechinus patagonensis (d'Orb.). 52
Patagonian beds; Darwin Station, San Julian.
Upper view of the only specimen in the collection.

Fig. 3. Toxopneustes præcursor Ortm. 53
Patagonian beds; Oven Point, San Julian.
3*a*. Upper view of a large specimen, slightly worn.
3*b*. Side view of another specimen, 2/1.

Fig. 4. Scutella patagonensis Des. 55
Patagonian beds.
4*a*. "Alate form," adult, upper view; Salt Lake.
4*b*. "Alate form," young, lower view; Salt Lake.
4*c*. "Rotundate form," medium size, upper view; Oven Point, San Julian.
4*d*. "Rotundate form," adult, lower view; Upper Rio Chalia.
4*e*. "Rotundate form," young, lower view; Oven Point, San Julian..

Fig. 5. Terebella magna Ortm. 63
Patagonian beds; Oven Point, San Julian.
5*a*. Isolated tube (with remains of another one), side view.
5*b*. View of terminal opening.

Fig. 6. Cellaria fistulosa (L.) 64
Patagonian beds; Shell Gap, Rio Chico.
6*a*. Fragment of a branch, showing achylosis on upper end.
6*b*. A number of zoœcia, enlarged.

All of the figures, unless otherwise stated, are natural size.

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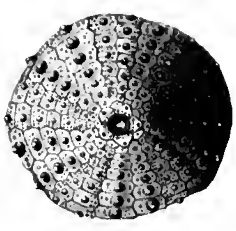

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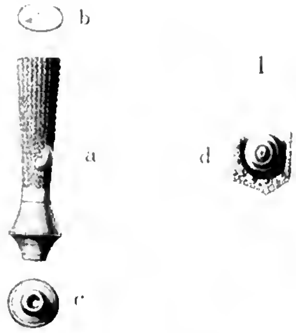

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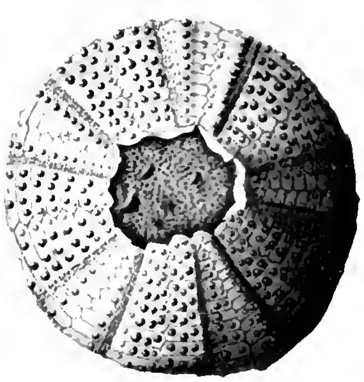

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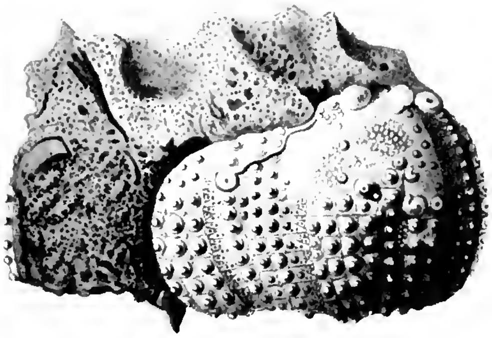

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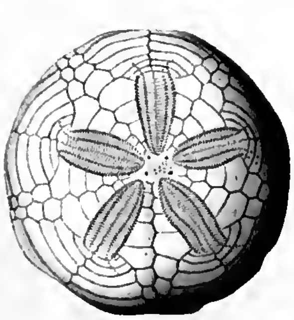

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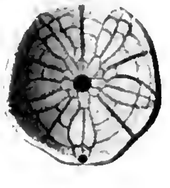

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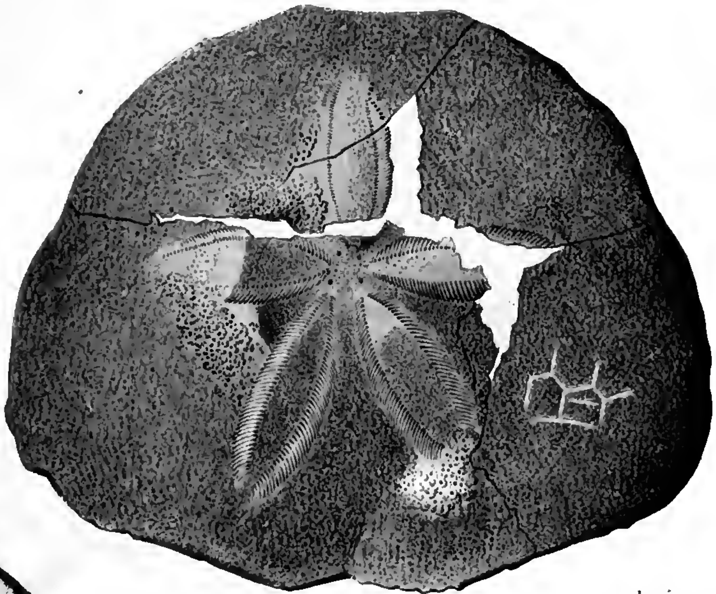

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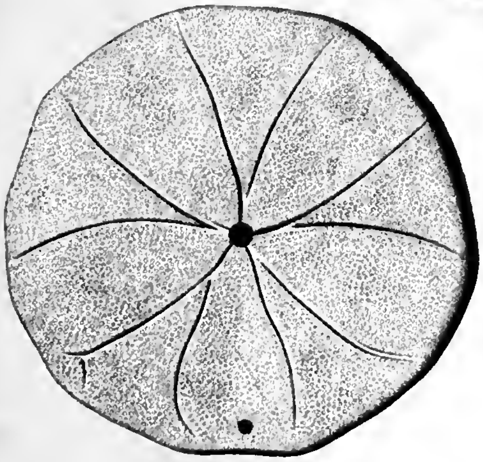
4d



6a

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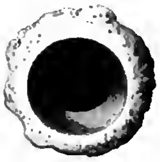
5b



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TERTIARY INVERTEBRATES.

EXPLANATION OF PLATE XII.

PAGE

Fig. 1. Cyrtoma posthumum Ortm. 60

Patagonian beds; Lake Pueyrredon, base.

1*a*. Upper view of an individual with complete outline, and well preserved anal depression.

1*b*. Upper view of a partly broken individual, with ambulacra better preserved.

Fig. 2. Reticulipora patagonica Ortm. 68

Patagonian beds; mouth of Santa Cruz River.

2*a*. View of zoarium.

2*b*. Front view of a few branches of zoarium, slightly enlarged.

2*c*. Side view of one of the branches, more strongly enlarged.

Fig. 3. Rhynchonella plicigera v. Ih. 70

Patagonian beds; Lake Pueyrredon, base.

3*a*. Anterior view of an individual of average shape.

3*b*. Front view of the same.

3*c*. Anterior view of a more elongate and triangular individual.

3*d*. Anterior view of an unusually broad individual.

Fig. 4. Rhynchonella squamosa Hutt. 72

Patagonian beds; Lake Pueyrredon, base.

4*a*. Anterior view.

4*b*. Front view of the same individual.

Fig. 5. Magellania lenticularis (Desh.). 73

Patagonian beds; Lake Pueyrredon, base.

5*a*. Anterior view of a rather large individual.

5*b*. Side view of the same.

5*c*. Anterior view of a smaller individual.

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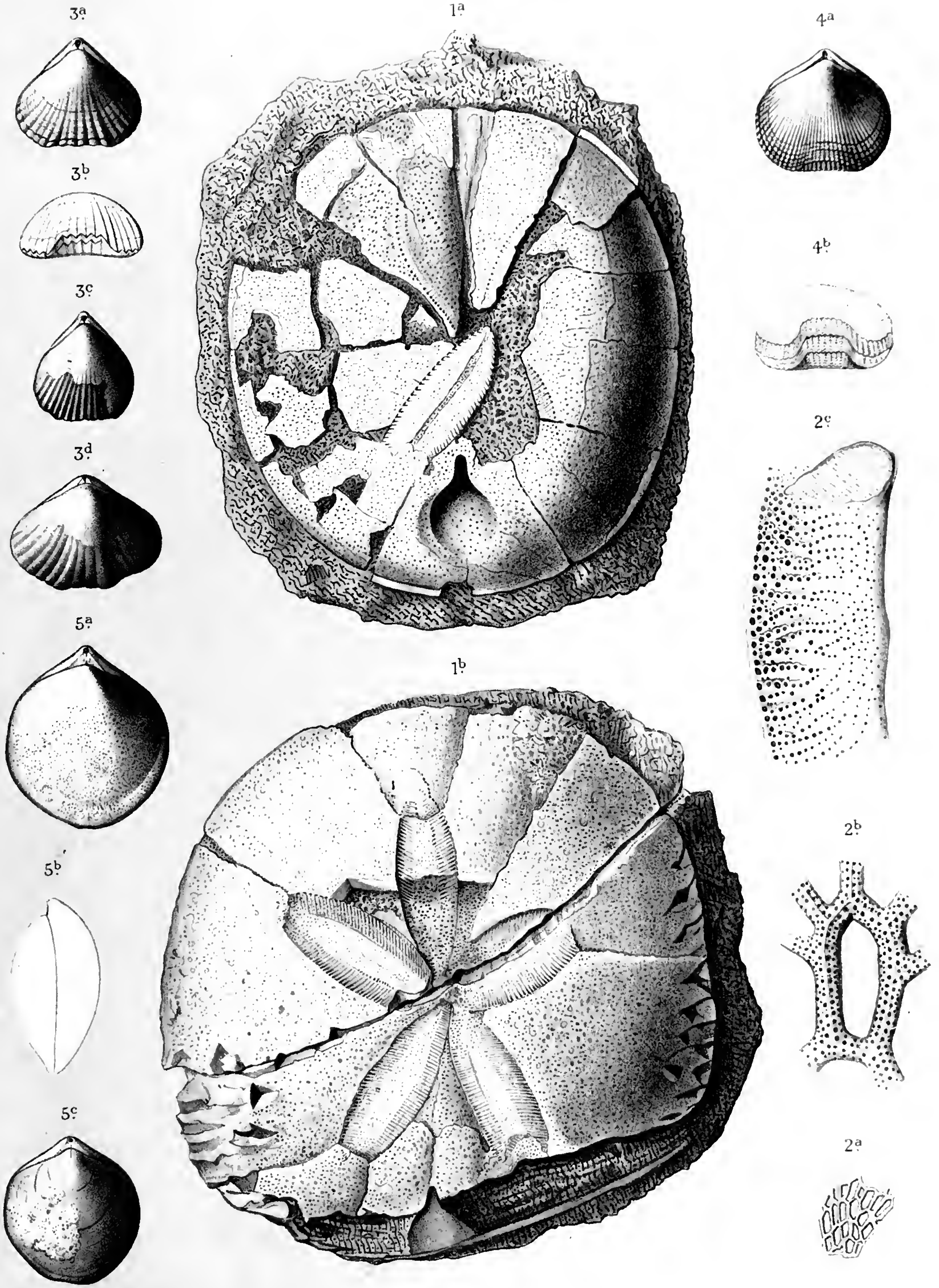

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TERTIARY INVERTEBRATES.

EXPLANATION OF PLATE XIII.

PAGE

Fig. 1. Schizaster ameghinoi v. Ih. 62

Patagonian beds.

1*a*. Upper view of an almost complete cast; Mouth of Santa Cruz River.

1*b*. Upper view of fragment of shell, showing fasciole; Oven Point, San Julian.

Fig. 2. Serpula patagonica Ortm. 63

Patagonian beds; Oven Point, San Julian. Colony on a fragment of *Pecten*.

Fig. 3. Melicerita triforis Ortm. 65

Patagonian beds; Upper Rio Chalia.

3*a*. Fragment of zoarium.

3*b*. Zoœcia, enlarged.

Fig. 4. Aspidostoma giganteum (Bsk.). 67

Patagonian beds; mouth of Santa Cruz River. Group of zoœcia, with oœcium, enlarged.

Fig. 5. Tennysonia subcylindrica Ortm. 69

Patagonian beds; mouth of Santa Cruz River.

5*a*. Zoarium.

5*b*. Fragment of branch, showing zoœcia, etc., enlarged.

Fig. 6. Heteropora pelliculata Wat. 69

Patagonian beds; Oven Point, San Julian. Zoarium.

Fig. 7. Terebratella dorsata (Gmel.). 74

Patagonian beds; Lake Pueyrredon, base.

7*a*. Anterior view of a large individual.

7*b*. Front view of the same.

7*c*. Anterior view of a smaller, oblique individual.

7*d*. Anterior view of an unusually elongate individual (transitional to *T. patagonica*).

Fig. 8. Terebratella patagonica (Sow.). 75

Patagonian beds.

8*a*. Anterior view of elongate variety; Lake Pueyrredon, base.

8*b*. Anterior view of a very large individual of usual outline; Oven Point, San Julian.

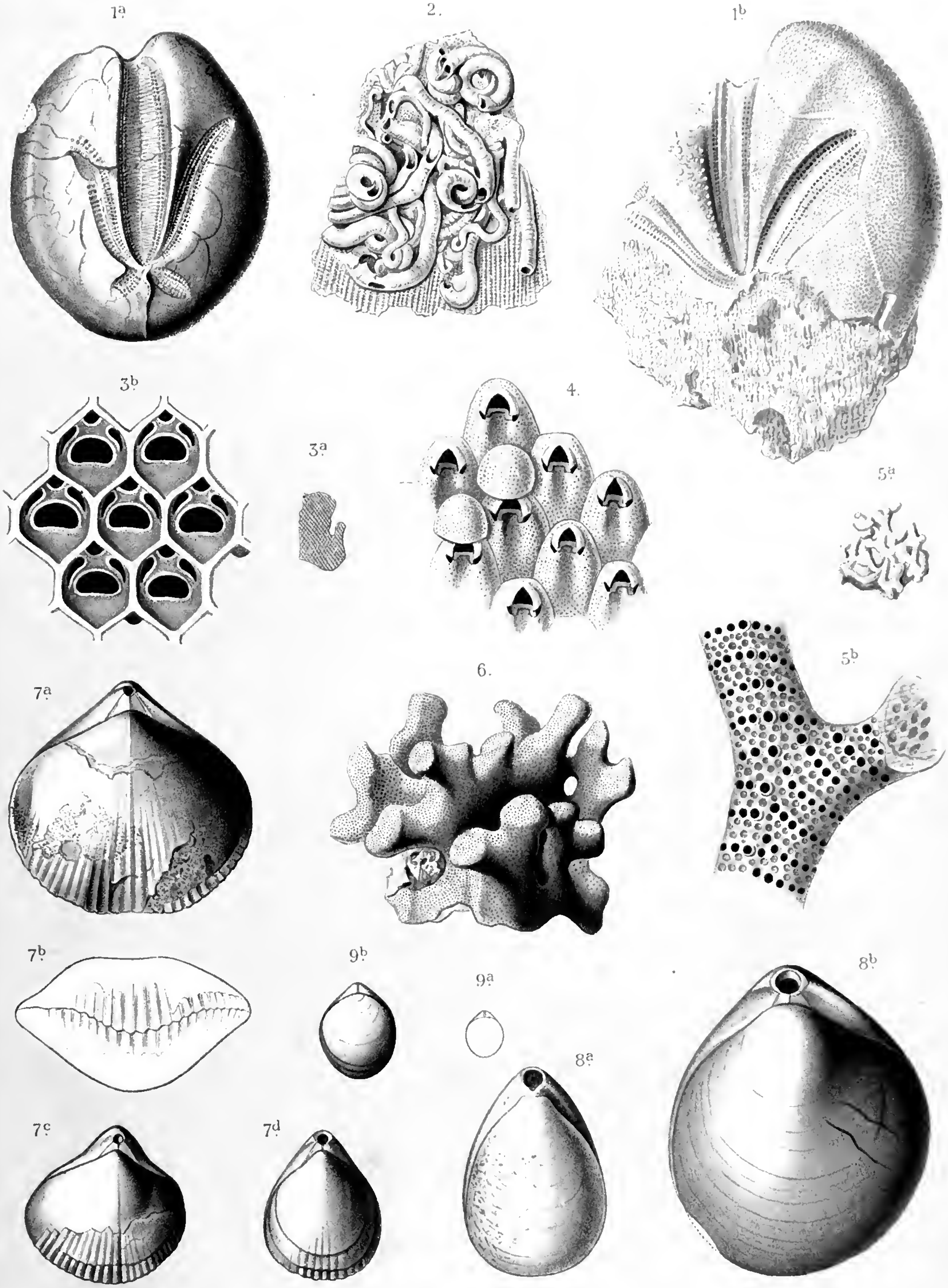
Fig. 9. Bouchardia zitteli v. Ih. 79

Patagonian beds: Lake Pueyrredon, base.

9*a*. Anterior view, natural size.

9*b*. The same, 2/1.

All of the figures, unless otherwise stated, are natural size.



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TERTIARY INVERTEBRATES.

EXPLANATION OF PLATE XIV.

PAGE

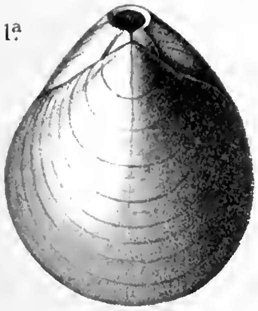
Fig. 1. Terebratella patagonica (Sow.). 75
Patagonian beds; Oven Point, San Julian.
1*a*. Anterior view of a normal individual of medium size.
1*b*. Side view of the same.

Fig. 2. Terebratella gigantea Ortm. 78
Cape Fairweather beds; Cape Fairweather.
2*a*. Anterior view of a very young individual.
2*b*. Anterior view of a normal individual of medium size.
2*c*. Side view of the same.
2*d*. Inner view of smaller valve, showing brachial apparatus.
2*e*. Inner view of smaller valve of a very old individual, showing thickening of median septum and hinge.
2*f*. Inner view of larger valve of another very old individual, showing thickening of hinge.

Fig. 3. Ostrea torresi Phil. 98
Upper Magellanian beds; Punta Arenas.
3*a*. Outer view of larger valve.
3*b*. Inner view of the same.

Fig. 4. Gryphæa cf. tarda Hutt. 113
Patagonian beds; southwest of Lake Pueyrredon.
4*a*. Inner view of larger valve.
4*b*. Side view of the same.

All figures are natural size.

1a


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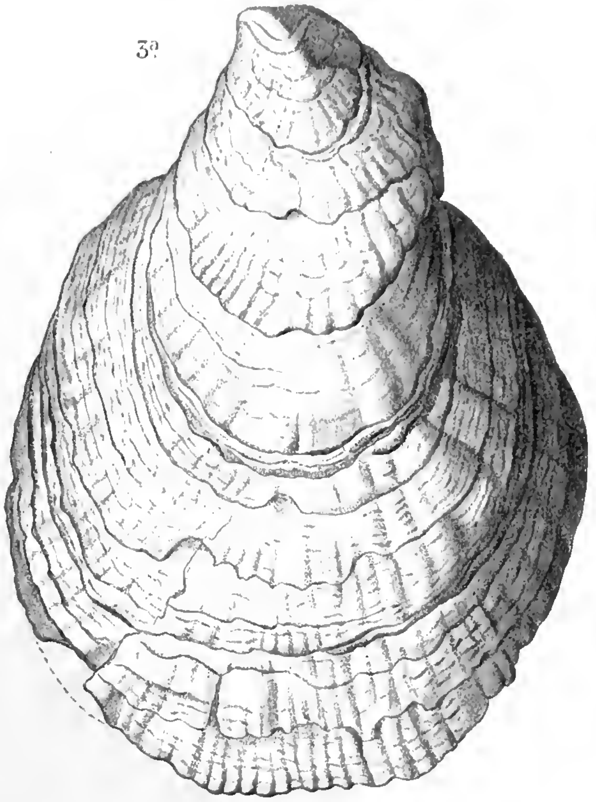

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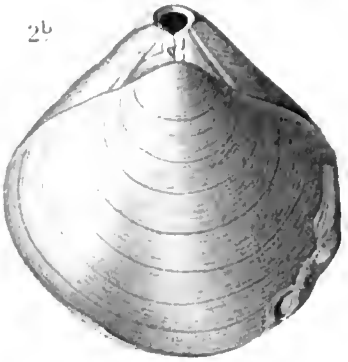
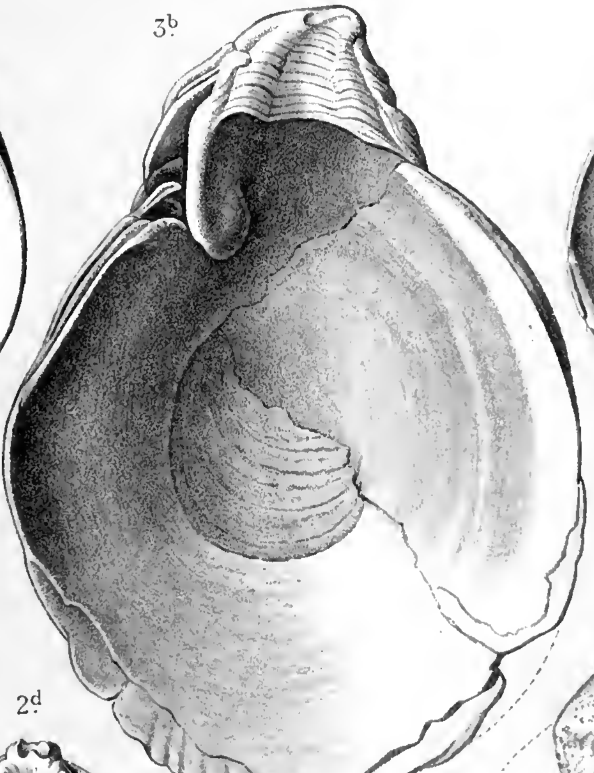


1b


2c

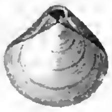

2f


3b


2e


4b


2d


2a


4a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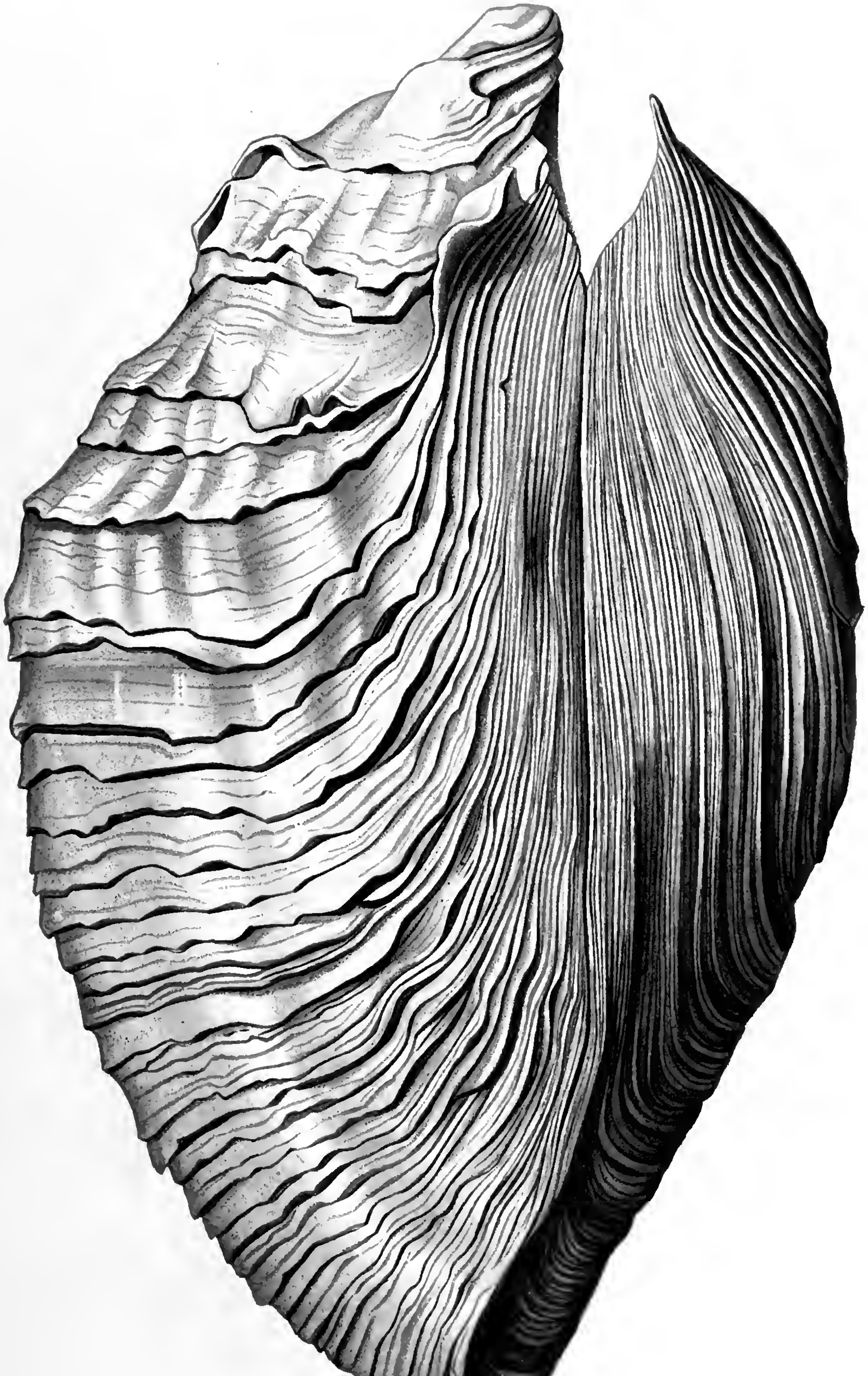
TERTIARY INVERTEBRATES.

EXPLANATION OF PLATE XV.

	PAGE
OSTREA INGENS Zitt.	99

Patagonian beds ; mouth of the Santa Cruz River.

Very large individual, side view, natural size (transitional form between var. *hatcheri* and *phillippii* Ortm.



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TERTIARY [illegible]

EXPLANATION OF PLATE XVI.

	PAGE
Fig. 1. OSTREA INGENS Zitt.	99

Patagonian beds; mouth of Santa Cruz River. (The same individual as that figured on plate XV.)

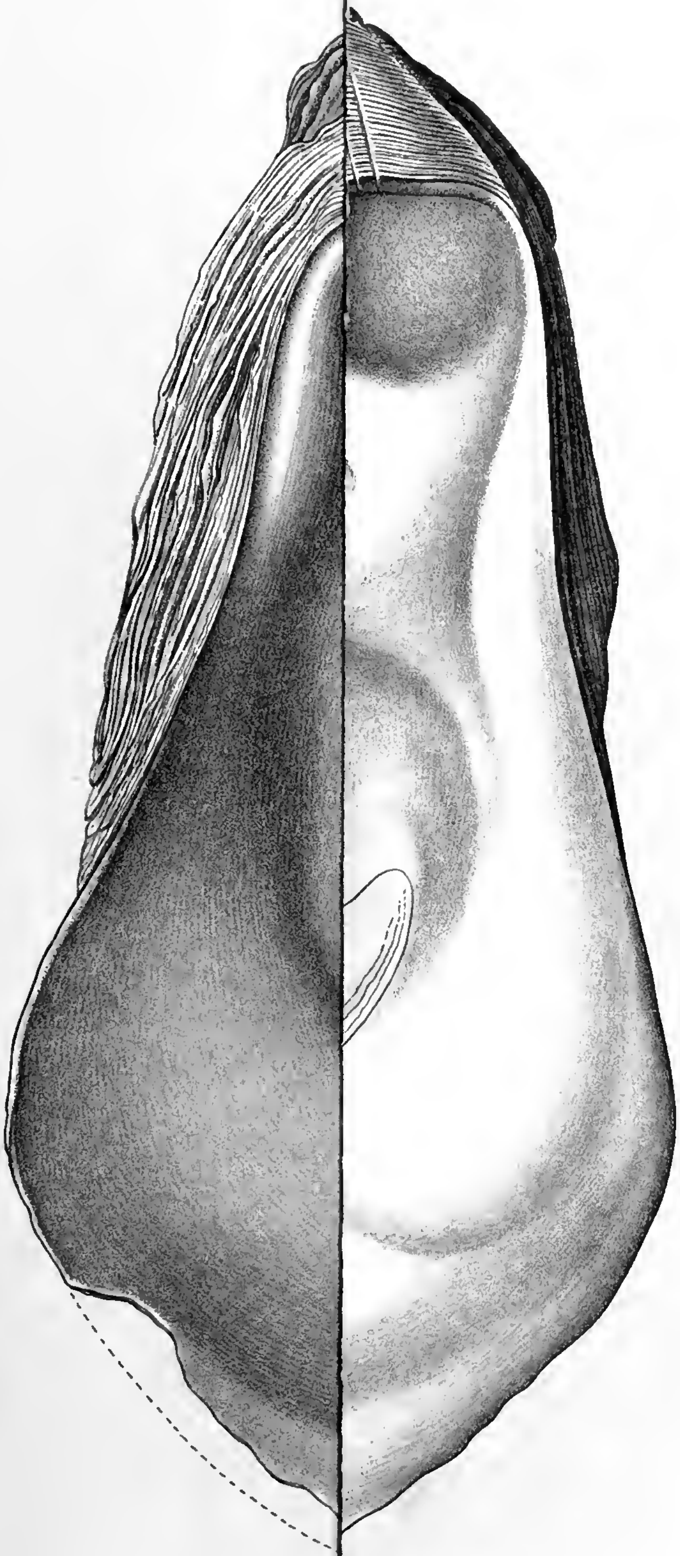
1*a*. Inner view of lower valve.

1*b*. Inner view of upper valve.

Both figures natural size.

PATAGONIAN EXPEDITIONS VOL. IV.

PLATE XII



F. v. Iterson del.

Werner & Winter Frankfort a/M. lith.

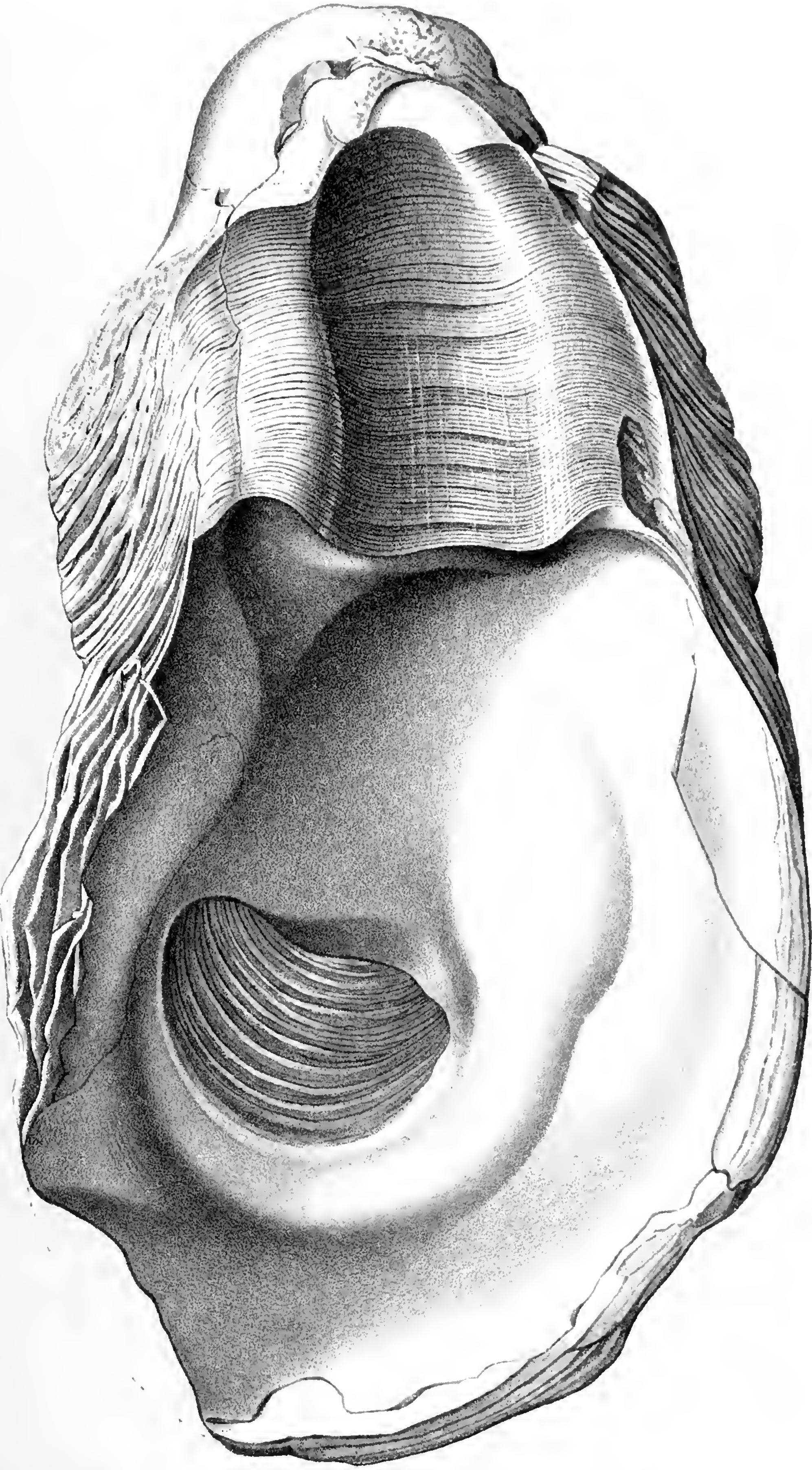
EXPLANATION OF PLATE XVII.

	PAGE
OSTREA INGENS Zitt.	99

Patagonian beds; Shell Gap, lower horizon.

Inner view of a lower valve of a very large individual, with very much elongate area (= *phillippii* Ortm.), corresponding closely to Zittel's type of *O. ingens*.

Natural size.



F. v. Iterson del.

Werner & Winter Frankfort a/M. [illegible]

TERTIARY INVERTEBRATES.

EXPLANATION OF PLATE XVIII.

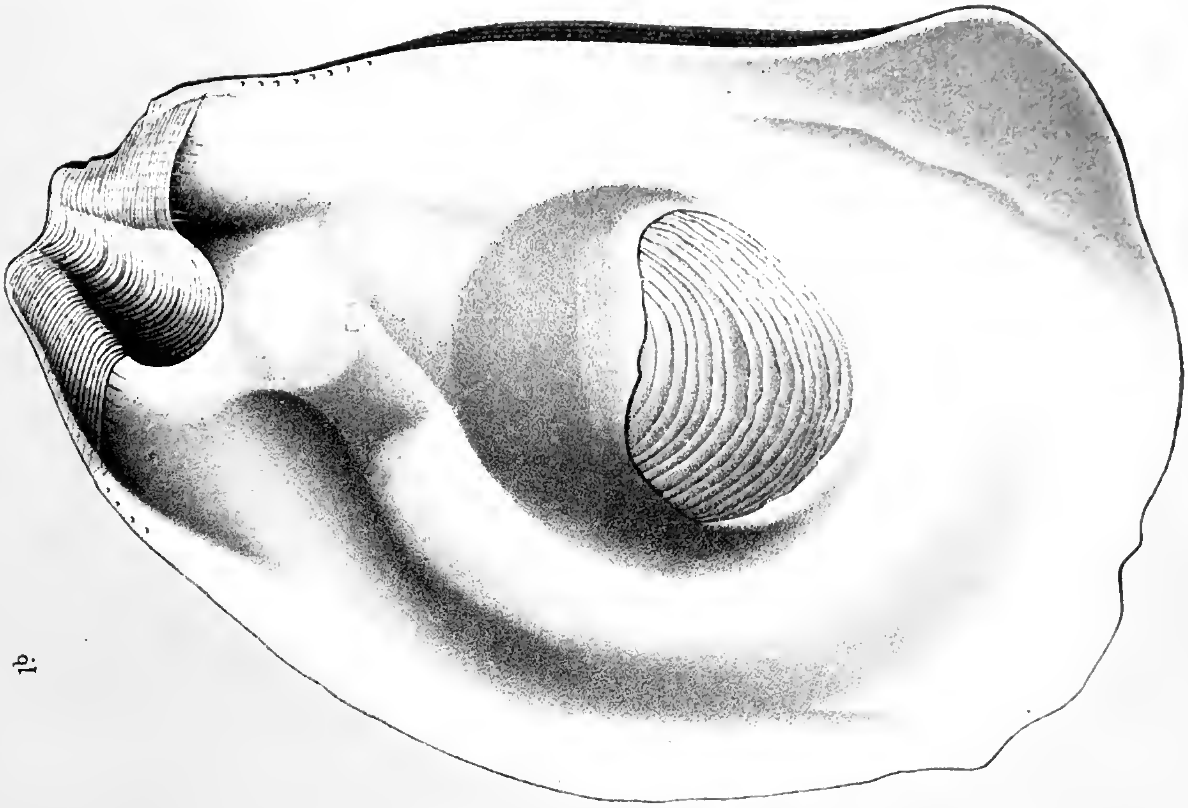
	PAGE
Fig. 1. OSTREA INGENS Zitt.	99

Cape Fairweather beds; Cape Fairweather.

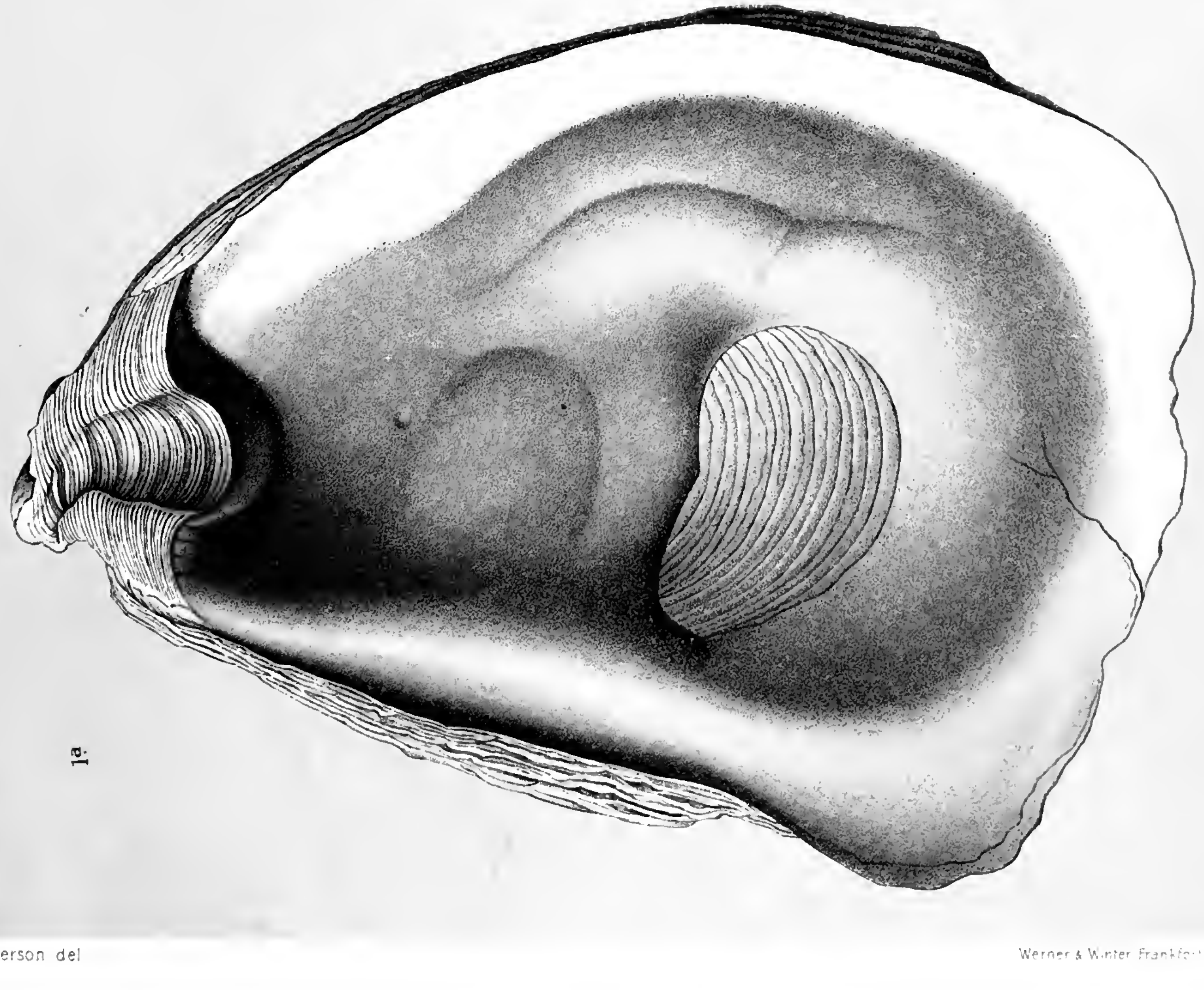
1a. Inner view of lower valve.

1b. Inner view of upper valve of same individual (showing crenulations near the area).

Both figures natural size.



1b.



1a.

F. v. Iterson del.

Werner & Winter Frankfort a/M.

TERTIARY INVERTEBRATES.

EXPLANATION OF PLATE XIX.

	PAGE
Fig. 1. OSTREA INGENS Zitt.	99

Patagonian beds.

1*a*. Outer view of lower valve of a specimen of medium size, representing the form *O. hatcheri* Ortm.; mouth of Santa Cruz River.

1*b*. Inner view of lower valve of a very elongate individual (form *O. bourgeoisi* Phil. or *philippii* Ortm.); Punta Arenas.

1*c*. Inner view of lower valve of a very young individual; Upper Rio Chalia.

Fig. 2. PECTEN PRÆNUNCIUS v. Ih.	115

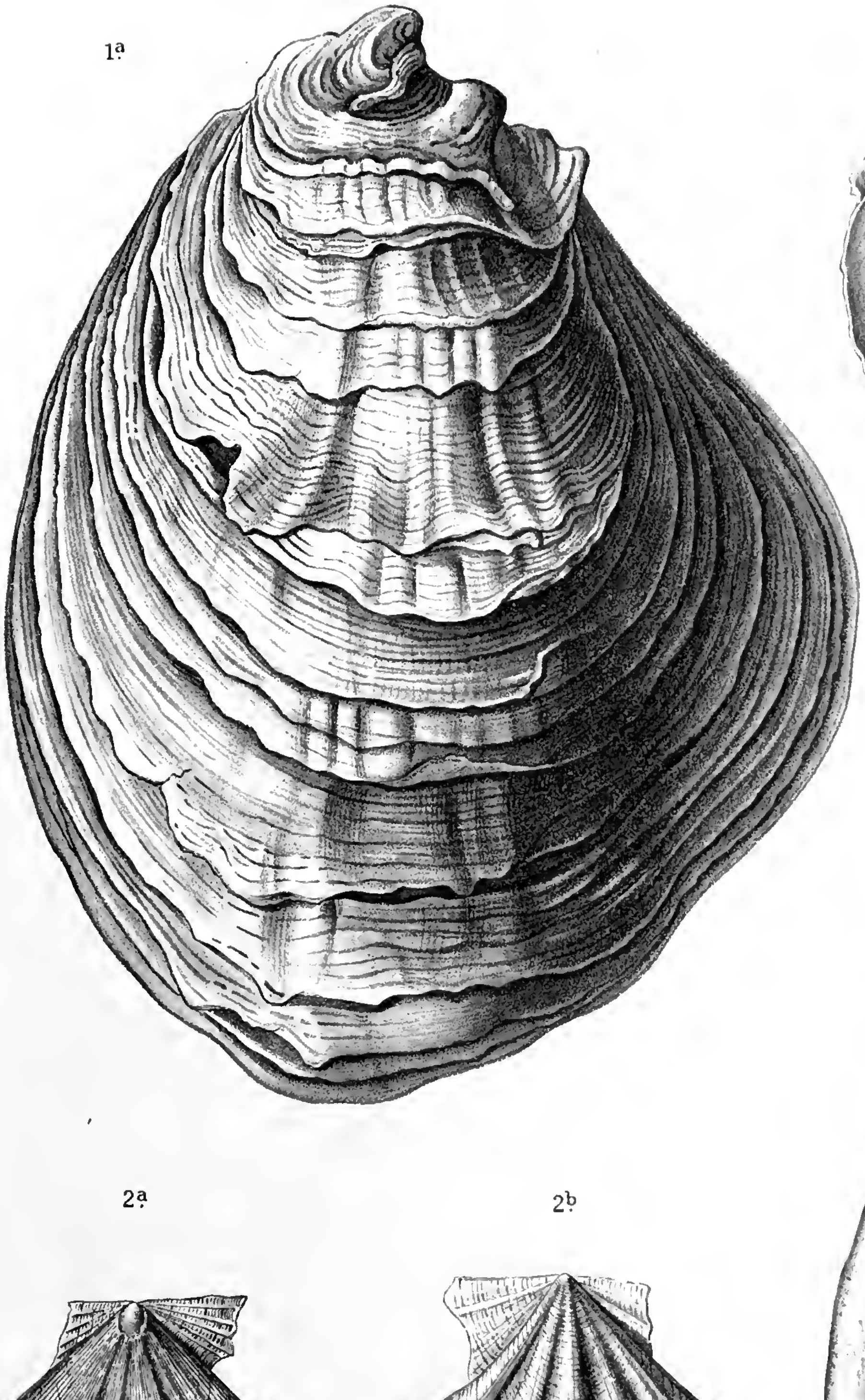
Patagonian beds.

2*a*. Outer view of a right valve; Mouth of Santa Cruz River.

2*b*. Outer view of a left valve; Darwin Station, San Julian.

All the figures are natural size.

1a



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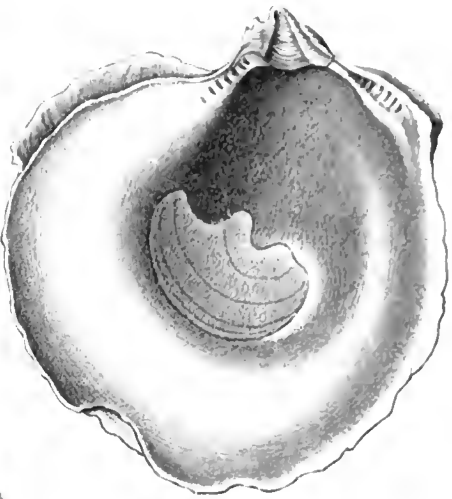

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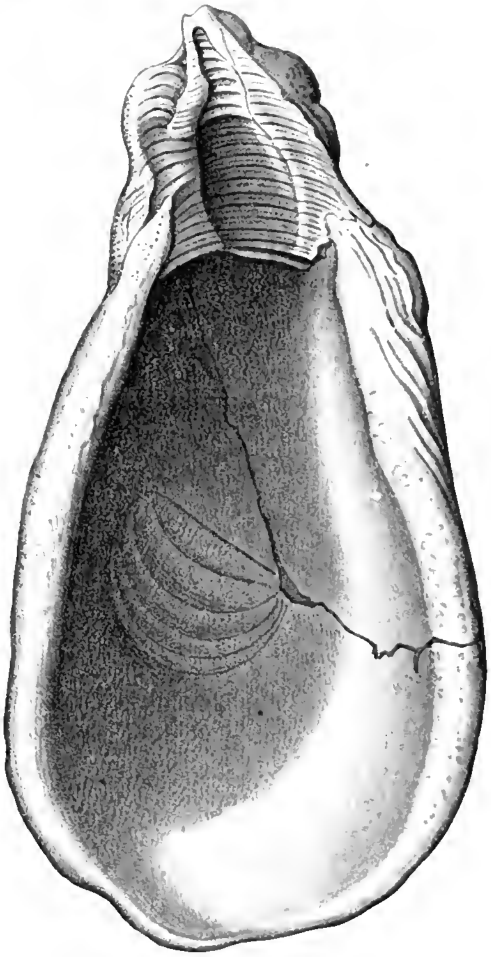
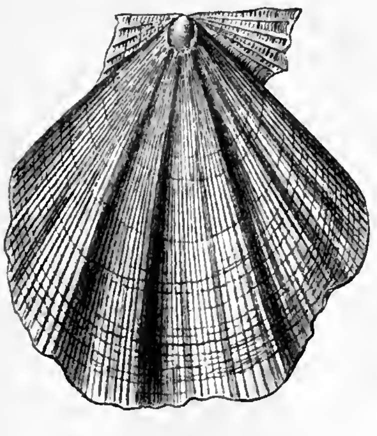


2a



2b

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TERTIARY INVERTEBRATES.

EXPLANATION OF PLATE XX.

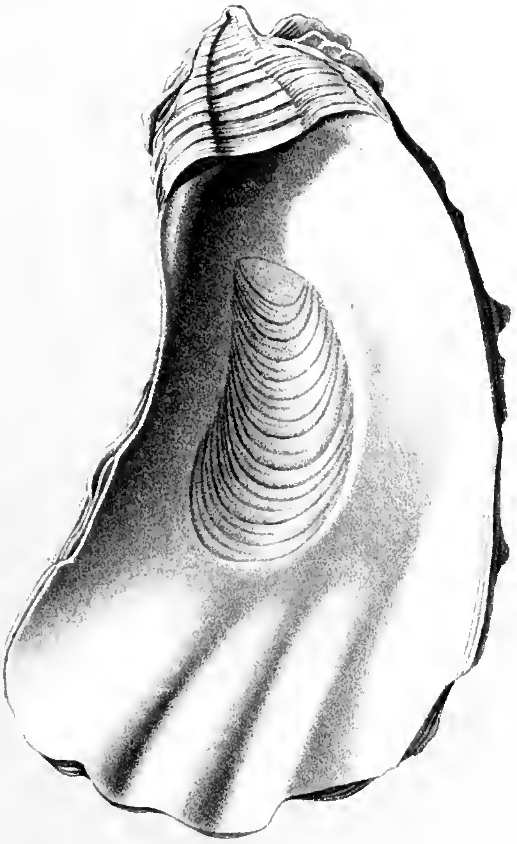
	PAGE
Fig. 1. OSTREA PATAGONICA d'Orb.	110

From beds, unconformably overlying Patagonian beds (? Tehuelche formation); Darwin Station, San Julian.

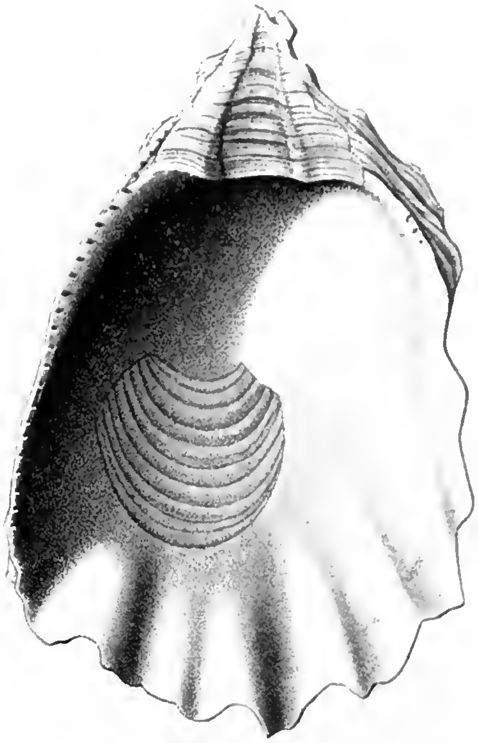
- 1*a*. Lower valve of an elongated individual.
- 1*b*. Lower valve of a more elongate individual, showing distinct folds.
- 1*c*. Upper valve of another elongate individual.
- 1*d*. Upper valve of a very broad individual, showing a muscular scar of the character of that of *O. pyrotheriorum* v. Ih.

All the figures are natural size.

1^{a}



1^{b}



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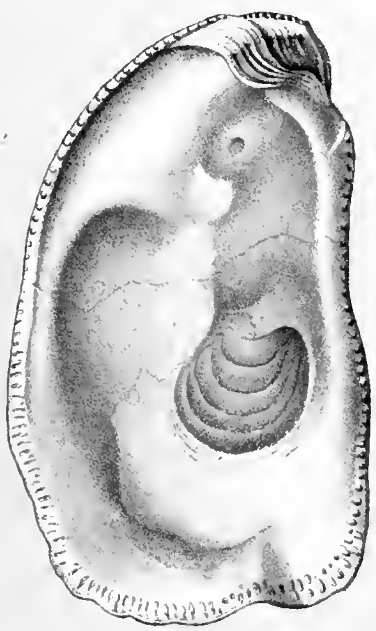
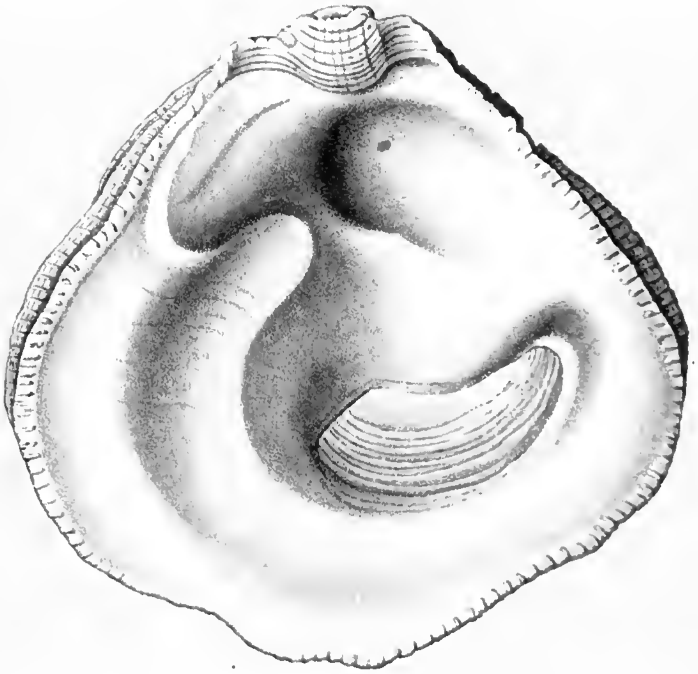


1^{d}



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Werner & Winter Frankfort a/M. lith.

TERTIARY INVERTEBRATES.

EXPLANATION OF PLATE XXI.

	PAGE
PECTEN PROXIMUS v. Ih.	114

Patagonian beds ; mouth of Santa Cruz River.
Right valve of a very large individual.

Natural size.

F. v. Iterson del.

TERTIARY [illegible]

EXPLANATION OF PLATE XXII.

	PAGE
Fig. 1. PECTEN PROXIMUS v. Ih.	114

Patagonian beds; mouth of Santa Cruz River.

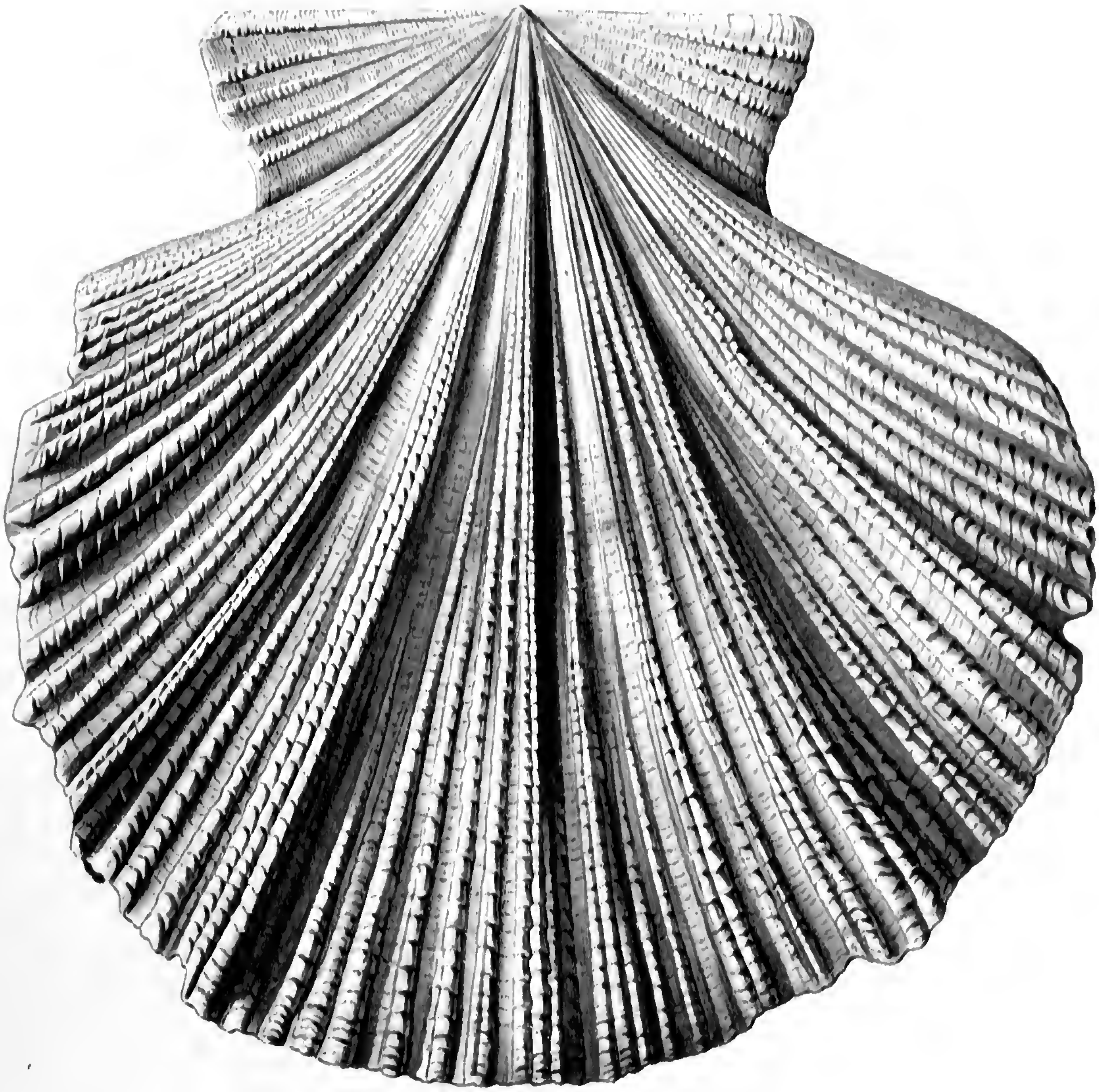
1a. Left valve belonging to the same individual as that figured on plate XXI.

1b. Right valve of a young individual.

1c. Left valve of the same.

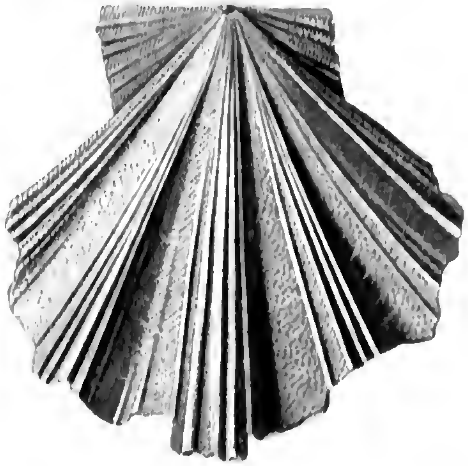
All the figures are natural size.

1ᵃ



1ᵇ

1ᶜ



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TERTIARY INVERTEBRATES

EXPLANATION OF PLATE XXIII.

	PAGE
Fig. 1. PECTEN cf. CENTRALIS Sow.	116

Patagonian beds; Port Desire.

1*a*. Right valve.

1*b*. Left valve of the same individual.

Note. Both valves in fragments; in fig. 1*b* the fragments have not been imbedded quite correctly in the plaster.

Fig. 2. PECTEN GEMINATUS Sow.	117

Patagonian beds.

2*a*. Small right valve, agreeing with Sowerby's type; Oven Point, San Julian.

2*b*. Small left valve of another individual; Oven Point, San Julian.

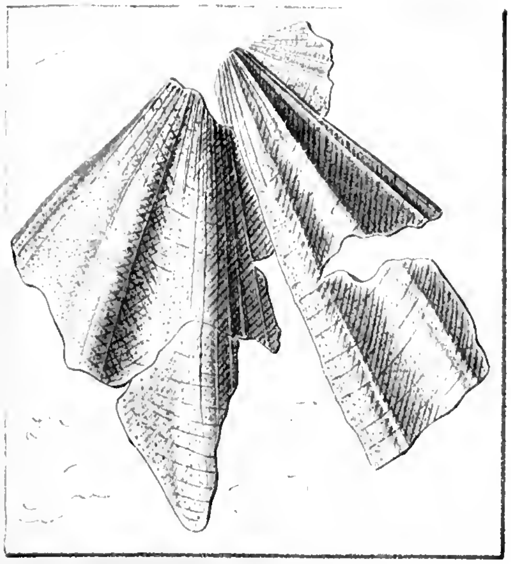
2*c*. Larger right valve; Oven Point, San Julian.

2*d*. Right valve of var. *quemadensis* v. Ih.; Darwin Station, San Julian.

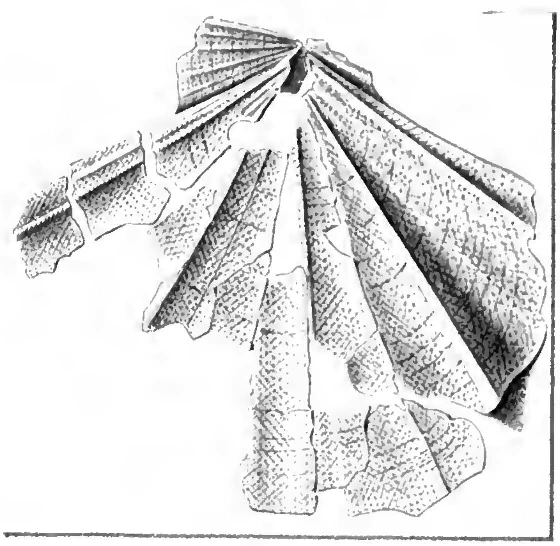
2*e*. Lateral view of both valves, the same individual as fig. 2*d*.

All the figures are natural size.

1a.



1b.



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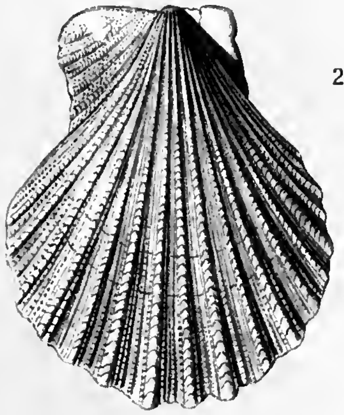

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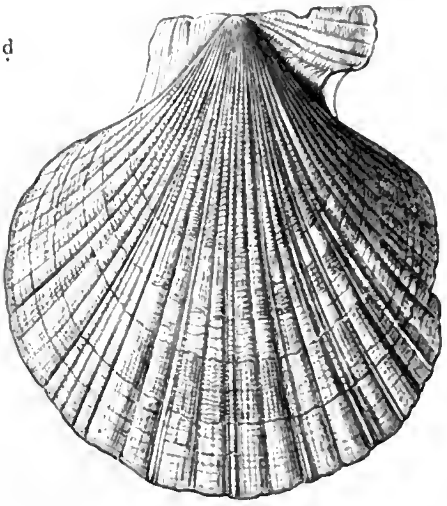

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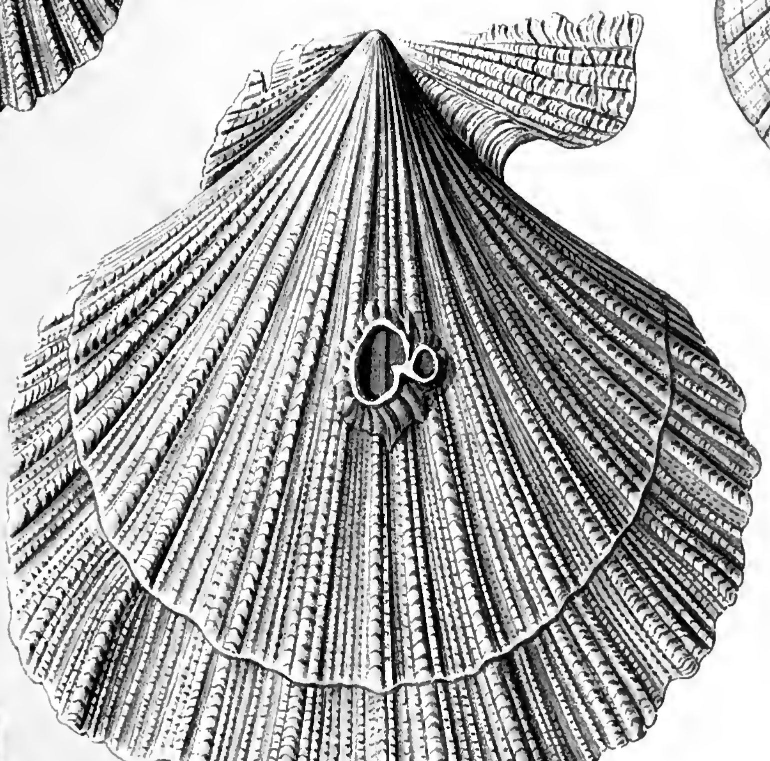


2e.

2a.

F v. Iterson del.
Werner & Winter Frankfort a/M lith.

TERTIARY INVERTEBRATES.

EXPLANATION OF PLATE XXIV.

PAGE

Fig. 1. Pecten actinodes Sow. 119
Cape Fairweather beds; Cape Fairweather.
1a. Right valve.
1b. Left valve of another individual.

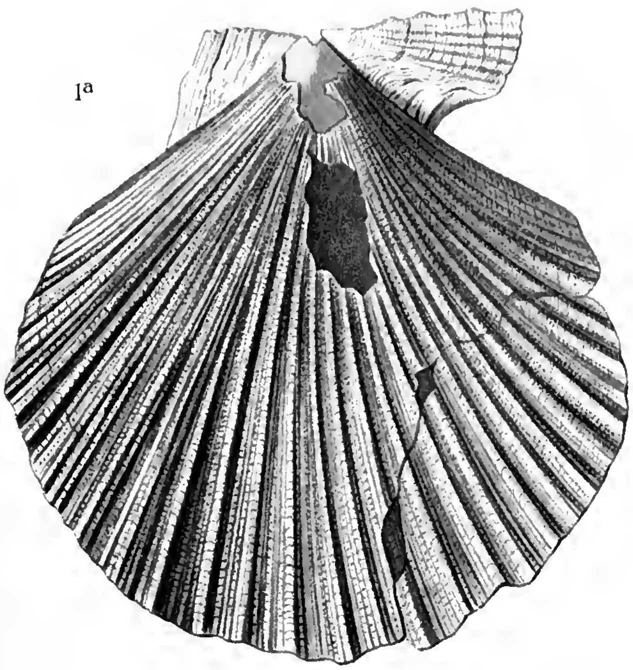
Fig. 2. Perna quadrisulcata v. Ih. 97
Patagonian beds.
2a. Hinge of right valve. Mouth of Santa Cruz River.
2b. Cast of an almost complete specimen. Lake Pueyrredon, base.

Fig. 3. Mytilus magellanicus Chemn. 121
Patagonian beds; Oven Point, San Julian.
Inner and outer casts, imbedded in matrix.

Fig. 4. Modiola andina Ortm. 122
Patagonian beds; Lake Pueyrredon, 400′ above base.
Cast.

All the figures are natural size.

1a



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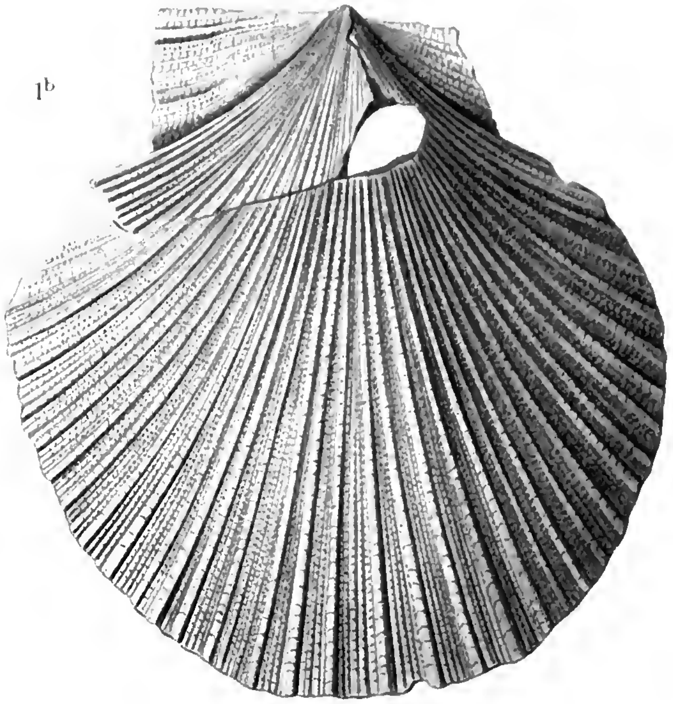
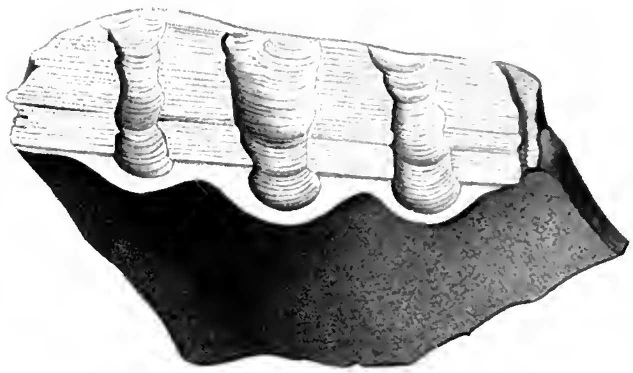


4

2a



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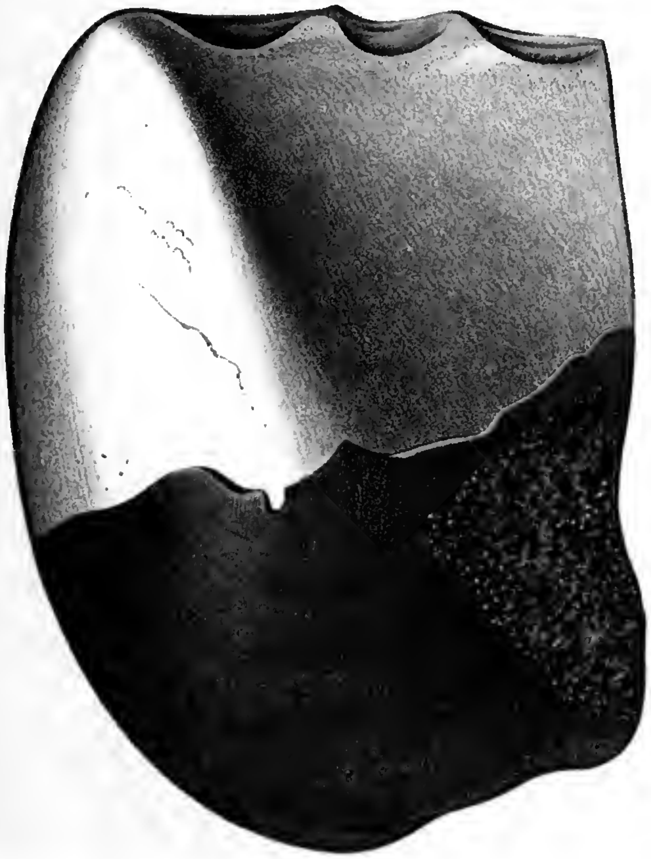

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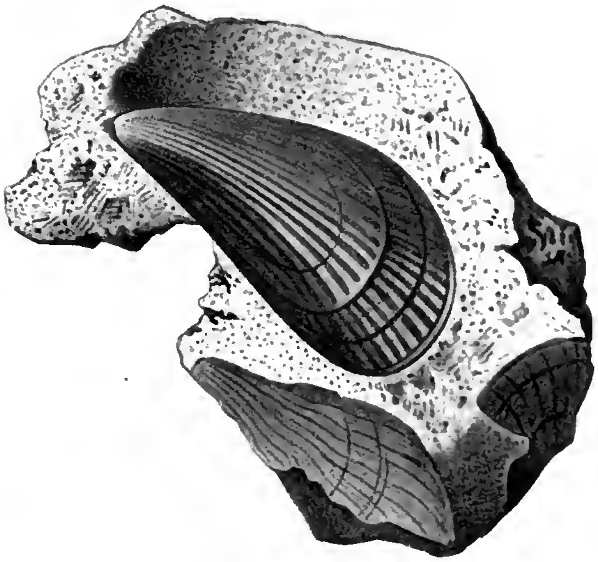

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TERTIARY INVERTEBRATES.

EXPLANATION OF PLATE XXV.

PAGE

Fig. 1. MYTILUS cf. CHORUS Mol. 120

1*a*. Fragment of cast from Patagonian beds of Upper Rio Chalia.

1*b*. Not quite complete cast from Cape Fairweather beds, Cape Fairweather.

Fig. 2. MODIOLA AMEGHINOI v. Ih. 121

Patagonian beds; Mount of Observation, upper horizon.

Left valve.

Fig. 3. ARCA PATAGONICA v. Ih. 93

Patagonian beds; mouth of Santa Cruz River.

3*a*. Outer view of right valve of a specimen of small size.

3*b*. Cardinal view of the same, showing area.

Fig. 4. CUCULLÆA ALTA Sow. 86

Patagonian beds.

4*a*. Outer view of left valve of medium size; Mount of Observation, lower horizon.

4*b*. Inner view of hinge of the same.

4*c*. Cardinal view of a large individual, showing both valves. Mouth of Santa Cruz River.

Fig. 5. CUCULLÆA (CUCULLARIA) DARWINI (Phil.) 90

Patagonian beds; mouth of Santa Cruz River.

5*a*. Outer view of left valve.

5*b*. Details of surface sculpture, enlarged.

Fig. 6. LIMOPSIS INSOLITA (Sow.) 91

Patagonian beds; mouth of Santa Cruz River.

Inner view of left valve.

Fig. 7. NUCULA PATAGONICA Phil. 80

Patagonian beds; mouth of Santa Cruz River.

7*a*. Outer view of right valve.

7*b*. Inner view of right valve of another individual.

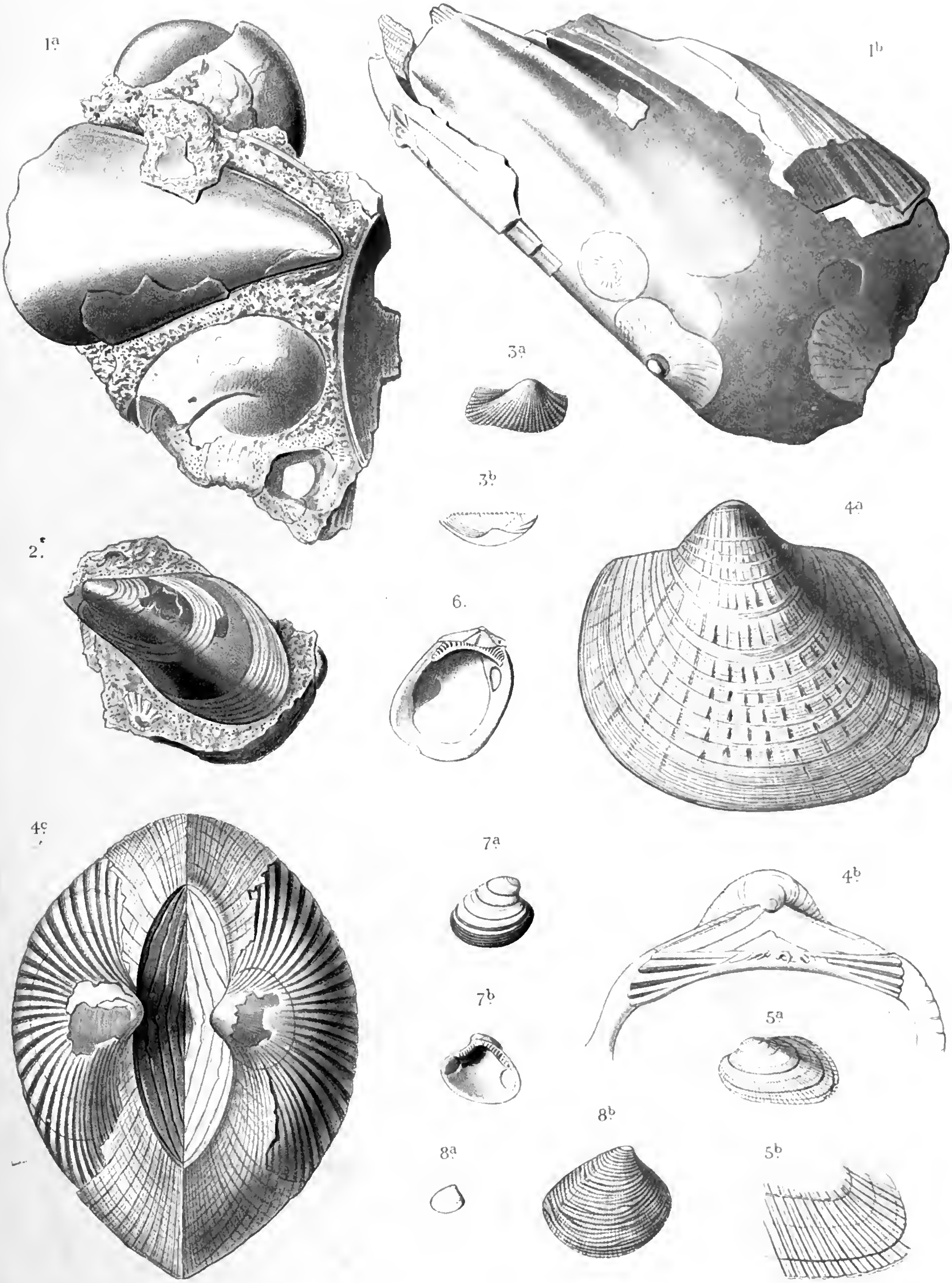
Fig. 8. NUCULA RETICULARIS Ortm. 82

Patagonian beds; mouth of Santa Cruz River.

8*a*. Right valve, natural size.

8*b*. The same, 4/1.

All of the figures, unless otherwise stated, are natural size.



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TERTIARY INVERTEBRATES

EXPLANATION OF PLATE XXVI.

PAGE

Fig. 1. Glycimeris ibari (Phil.) 94
Patagonian beds.
1a. Outer view of right valve of a large individual. Punta Arenas.
1b. Hinge of the same.
1c. Outlines of inner views of three young individuals of different size. Mouth of Santa Cruz River.

Fig. 2. Leda oxyrhyncha (Phil.) 83
Patagonian beds; mouth of Santa Cruz River.
2a. Right valve.
2b. The same, 3/1.

Fig. 3. Leda errazurizi (Phil.) 84
Patagonian beds; mouth of Santa Cruz River.
3a. Left valve.
3b. The same, 3/1.

Fig. 4. Malletia ornata (Sow.) 85
Patagonian beds; Paso del Rio Santa Cruz.
Outer view of right valve.

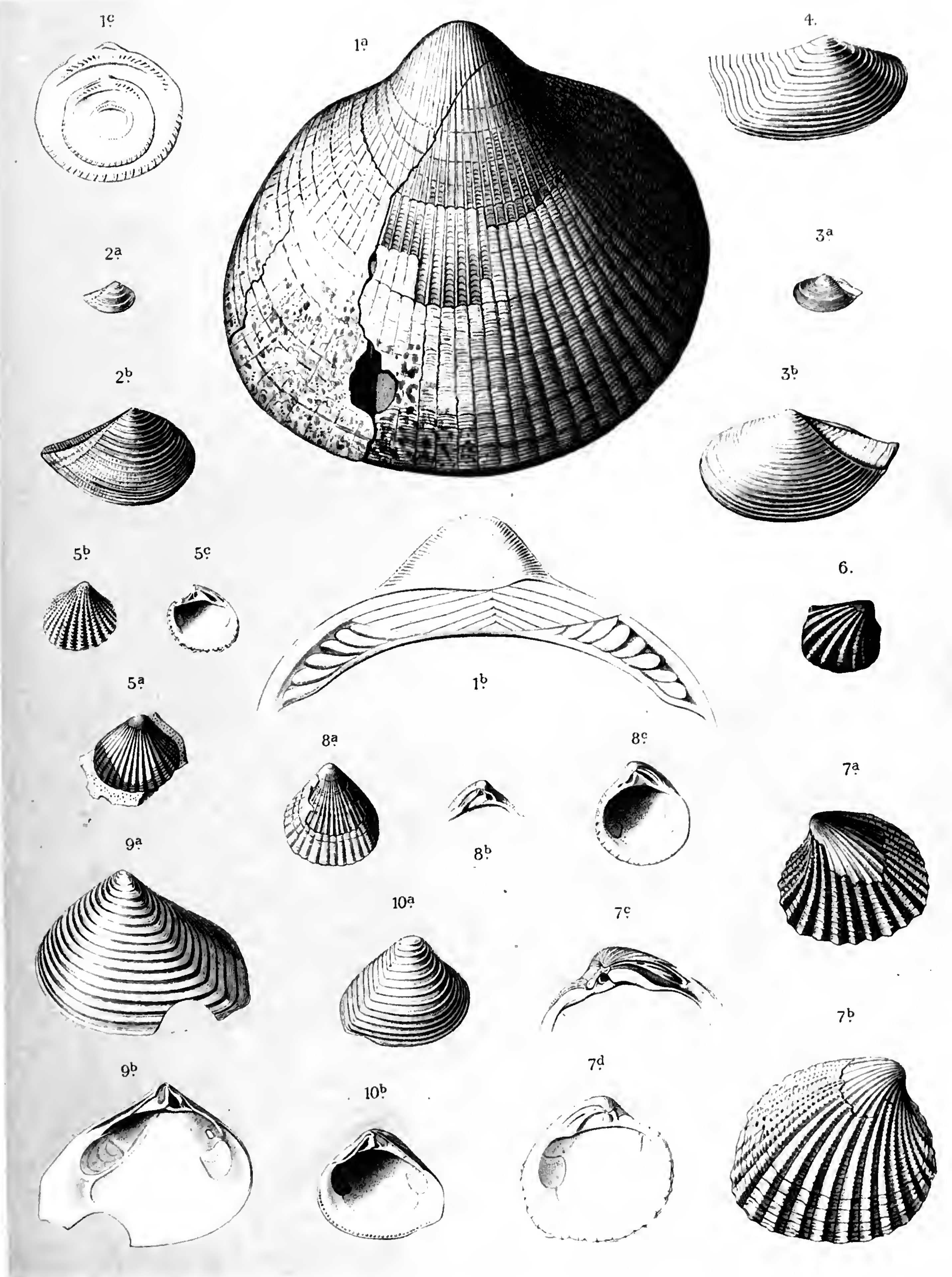
Fig. 5. Cardita elegantoides Ortm. 125
5a. Right valve of type specimen. Upper Magellanian beds; Punta Arenas.
5b. Outer view of right valve of a specimen from the Patagonian beds; mouth of Santa Cruz River.
5c. Inner view of the same.

Fig. 6. Cardita volckmanni Phil. 126
Patagonian beds; Lake Pueyrredon, 600′ above base.
Cast of right valve.

Fig. 7. Cardita inæqualis Phil. 127
Patagonian beds; mouth of Santa Cruz River.
7a. Left valve of specimen of medium size, showing in part original sculpture of shell, partly outer layer removed. (250′ above high tide.)
7b. Right valve of a large individual.
7c. Hinge of the same.
7d. Inner view of left valve, showing hinge.

Fig. 8. Cardita patagonica Sow. 128
Patagonian beds; mouth of Santa Cruz River, 250′ above high tide.
8a. Outer view of left valve.
8b. Inner view of the same.
8c. Inner view of a right valve.

PLATE XXVI



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TERTIARY INVERTEBRATES.

PAGE

Fig. 9. CRASSATELLITES LYELLI (Sow.) 123
Patagonian beds; mouth of Santa Cruz River.
9*a*. Outer view of left valve.
9*b*. Inner view of the same.

Fig. 10. CRASSATELLITES KOKENI (v. Ih.) 123
Patagonian beds; mouth of Santa Cruz River.
10*a*. Outer view of right valve.
10*b*. Inner view of the same.

All of the figures, unless otherwise stated, are natural size.

EXPLANATION OF PLATE XXVII.

PAGE

Fig. 1. Crassatellites quartus (Ortm.). 124
Patagonian beds; mouth of Santa Cruz River. Outer view of left valve.

Fig. 2. Crassatellites longior (v. Ih.). 125
Patagonian beds; Lake Pueyrredon, base. Outer view of right valve.

Fig. 3. Lucina neglecta Ortm. 129
Lower Magellanian beds; Punta Arenas. Outer view of left valve, imbedded in matrix.

Fig. 4. Lucina promaucana Phil. 130
Patagonian beds; Paso del Rio Santa Cruz.
4*a*. Outer view of right valve.
4*b*. Inner view of the same.

Fig. 5. Lucina ortmanni v. Ih. 131
Patagonian beds; mouth of Santa Cruz River. Outer view of right valve.

Fig. 6. Cardium philippii v. Ih. 132
Patagonian beds; mouth of Santa Cruz River. Incomplete right valve, outer view.

Fig. 7. Cardium puelchum Sow. 133
Patagonian beds; Las Salinas. Outer view of right valve.

Fig. 8. Cardium pisum Phil. 133
Patagonian beds; mouth of Santa Cruz River. Outer view of right valve.

Fig. 9. Amathusia angulata Phil. 134
Patagonian beds; mouth of Santa Cruz River, just above high tide.
9*a*. View of hinge of left valve.
9*b*. View of hinge of right valve, of the same individual.

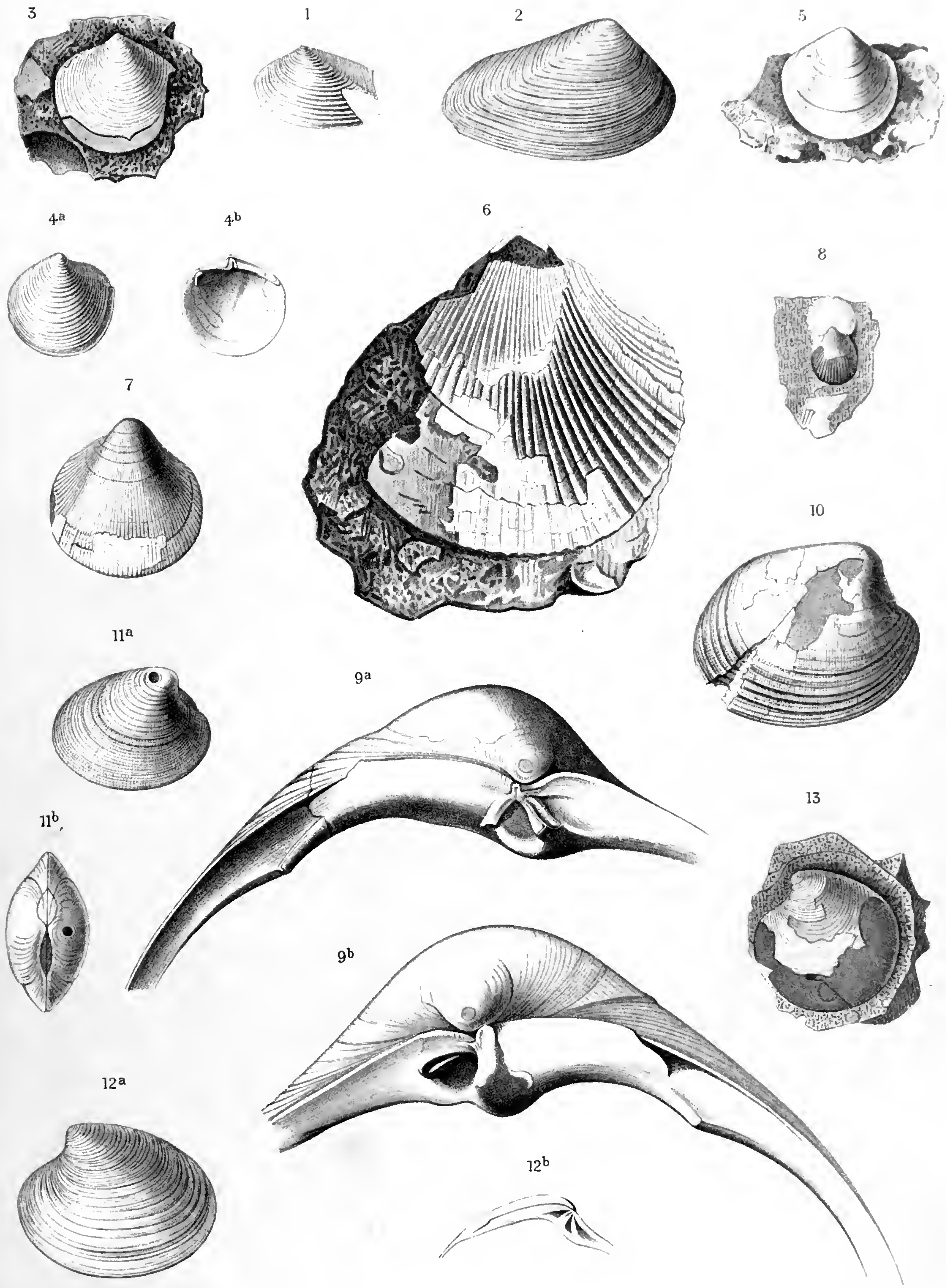
Fig. 10. Venus chiloënsis Phil. 137
Patagonian beds; Punta Arenas. Outer view of right valve.

Fig. 11. Venus meridionalis Sow. 137
Patagonian beds; mouth of Santa Cruz River.
11*a*. Outer view of right valve.
11*b*. Cardinal view of the same specimen, showing both valves.

Fig. 12. Venus navidadis Phil. 141
Patagonian beds; mouth of Santa Cruz River.
12*a*. Outer view of left valve.
12*b*. Hinge of same.

Fig. 13. Dosinia magellanica Ortm. 144
Lower Magellanian beds; Punta Arenas. Outer view of left valve.

All the figures are natural size.



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EXPLANATION OF PLATE XXVIII.

PAGE

Fig. 1. Venus difficilis Ortm. 135
Magellanian beds; Punta Arenas.
1*a*. Left valve (of double shell), interior view, showing hinge. Lower Magellanian beds.
1*b*. Cardinal view of both valves of the same individual.
1*c*. Outer view of a left valve. Upper Magellanian beds.

Fig. 2. Venus arenosa Ortm. 136
Upper Magellanian beds; Punta Arenas.
2*a*. Outer view of right valve.
2*b*. Hinge of the same.

Fig. 3. Venus volckmanni Phil. 139
Patagonian beds; mouth of Santa Cruz River.
3*a*. Outer view of a left valve of a double individual.
3*b*. Cardinal view of both valves of the same.

Fig. 4. Venus darwini Phil. 140
Patagonian beds; mouth of Santa Cruz River.
Outer view.

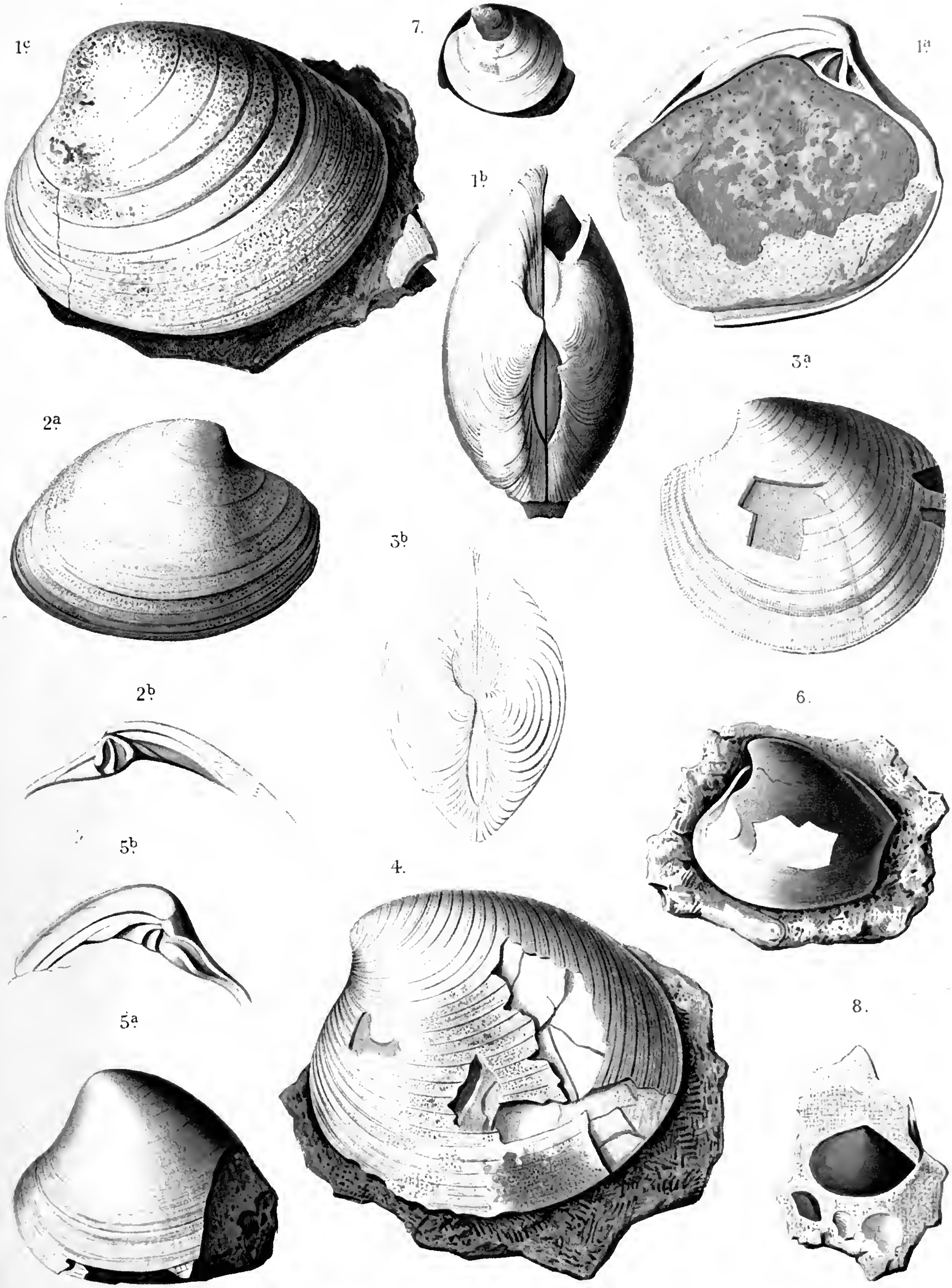
Fig. 5. Meretrix hieringi Cossm. 142
Patagonian beds; Punta Arenas.
5*a*. Outer view of fragment of left valve.
5*b*. Hinge of the same.

Fig. 6. Meretrix rostrata (Kch.). 143
Cape Fairweather beds; Cape Fairweather.
Cast of left valve, with fragments of shell remaining.

Fig. 7. Dosinia læviuscula (Phil.). 147
Patagonian beds; mouth of Santa Cruz River.
Outer view of left valve.

Fig. 8. Tellina jeguaënsis v. Ih. 148
Patagonian beds; Arroyo Gio.
Cast of left valve.

All the figures are natural size.



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PAGE

Fig. 1. Meretrix (?) pseudocrassa (Ortm.) 142
Upper Magellanian beds; Punta Arenas.
1a. Outer view of right valve.
1b. Hinge of the same.

Fig. 2. Dosinia meridionalis v. Ih. 145
Patagonian beds; mouth of Santa Cruz River.
2a. Outer view of left valve.
2b. Hinge of the same.
2c. Inner view of a smaller right valve.

Fig. 3. Tellina tehuelcha v. Ih. 147
Patagonian beds; Shell Gap, Rio Chico, upper horizon.
Cast of left valve.

Fig. 4. Psammobia patagonica Phil. 149
Patagonian beds; mouth of Santa Cruz River.
Outer view of left valve.

Fig. 5. Panopea ibari Phil. 152
Lower Magellanian beds; Punta Arenas.
Two valves, imbedded in matrix.

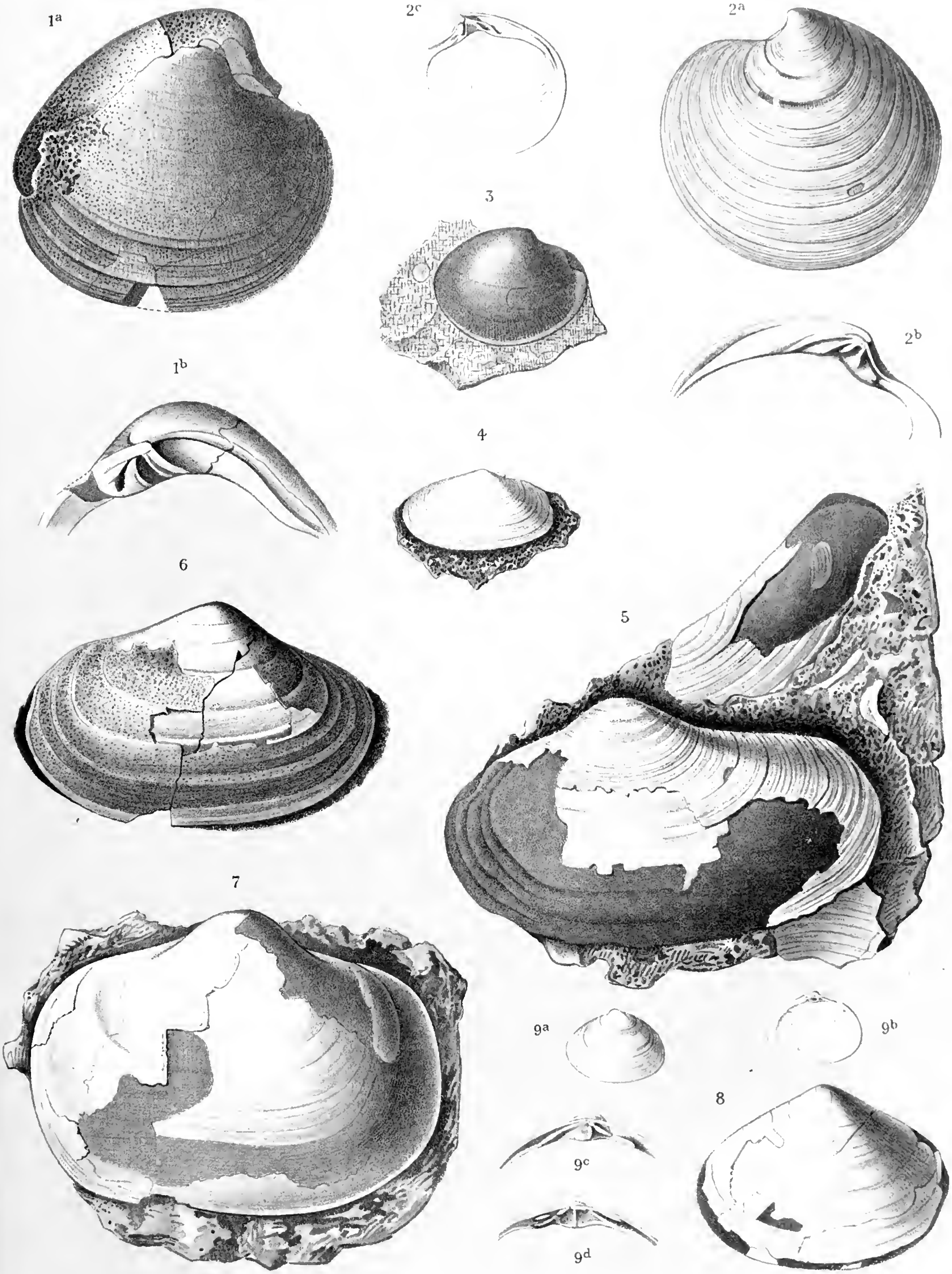
Fig. 6. Panopea subsymmetrica (Ortm.). 153
Upper Magellanian beds; Punta Arenas.
Outer view of right valve.

Fig. 7. Panopea pilsbryi Ortm. 154
Cape Fairweather beds; Cape Fairweather.
Cast of right valve.

Fig. 8. Mactra (?) darwini Sow. 149
Patagonian beds; mouth of Santa Cruz River.
Outer view of right valve.

Fig. 9. Mactra garretti Ortm. 150
Patagonian beds; Mt. of Observation, upper horizon.
9a. Outer view of left valve.
9b. Inner view of the same.
9c. Hinge of the same, 2/1.
9d. Hinge of right valve, 2/1.

All of the figures, unless otherwise stated, are natural size.



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TERTIARY INVERTEBRATES.

EXPLANATION OF PLATE XXX.

PAGE

Fig. 1. Panopea regularis (Ortm.) 153
Patagonian beds.
1*a*. Outer view of fragmentary left valve. Mouth of Santa Cruz River 250′ above high tide.
1*b*. Cardinal view of a double cast. Lake Pueyrredon, base.

Fig. 2. Panopea quemadensis (v. Ih.) 154
Patagonian beds; mouth of Santa Cruz River.
Outer view of left valve.

Fig. 3. Lutraria (?) undatoides Ortm. 151
Lower Magellanian beds; Punta Arenas.
Cast of left valve.

Fig. 4. Corbula hatcheri Ortm. 151
Patagonian beds; mouth of Santa Cruz River.
4*a*. Outer view of right valve.
4*b*. Cardinal view of another, double individual.
4*c*. Ventral view of the same.

Fig. 5. Martesia patagonica (Phil.) 155
Patagonian beds; Mount of Observation, upper horizon.
Outer view of right valve.

Fig. 6. Martesia pumila Ortm. 156
Patagonian beds; mouth of Santa Cruz River.
6*a*. Outer view of cast of right valve.
6*b*. The same, 2/1.

Fig. 7. Patella pygmæa Ortm. 161
Upper Magellanian beds; Punta Arenas.
7*a*. Side view, natural size.
7*b*. Upper view, natural size.
7*c*. The same, 3/1.

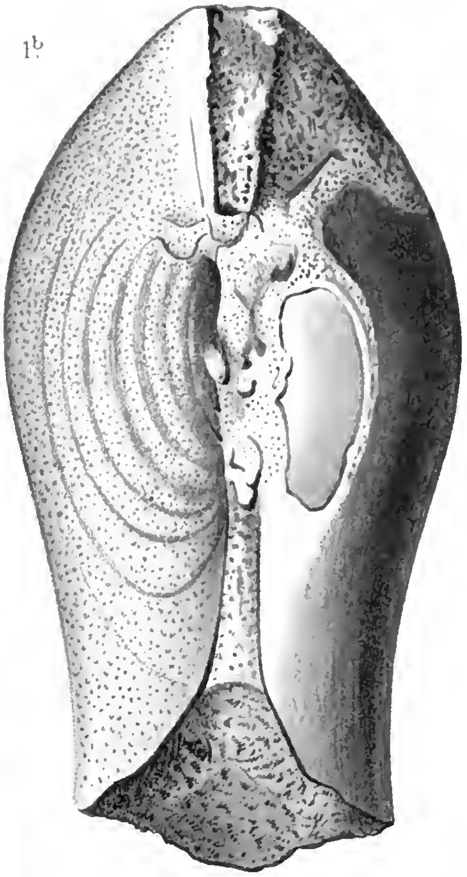
Fig. 8. Fissurella eurytreta Cossm. 161
Patagonian beds; upper Rio Chalia.
Upper view of cast.

Fig. 9. Leptothyra philippii Cossm. 162
Patagonian beds; mouth of Santa Cruz River.
9*a*. Side view of shell.
9*b*. The same, 4/1.

Fig. 10. Liotia scotti Ortm. 162
Patagonian beds; mouth of Santa Cruz River.
10*a*. Side view.
10*b*. Lower view.
10*c*. Upper view, 3/1.

1a.

1b.



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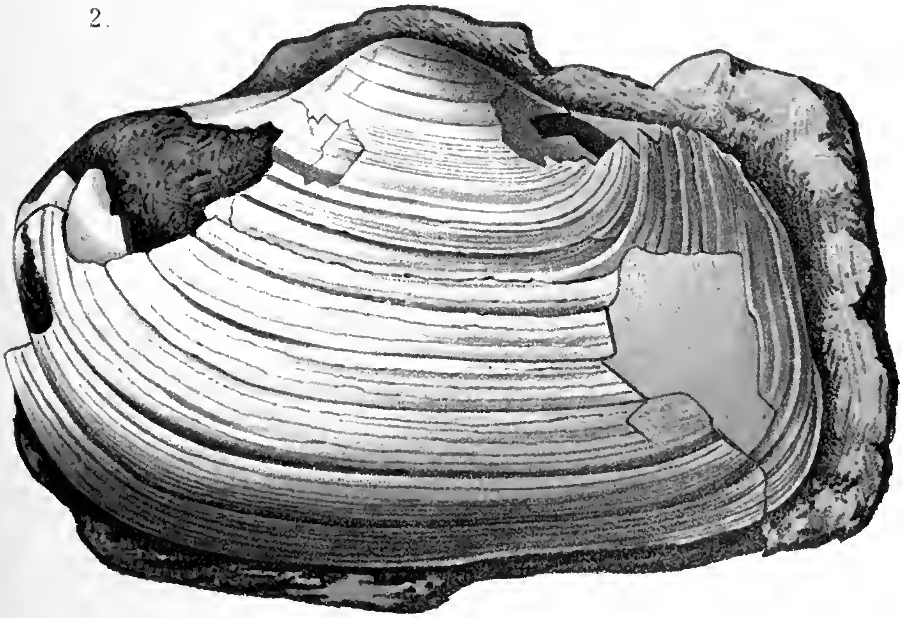

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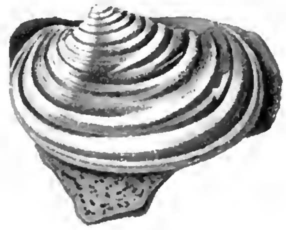
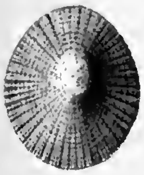


7c.



7a.

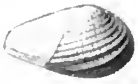
4c.

4b.

4a.

6a.

6b.



5.

7b.

9a.

9b.

11a.

11b.

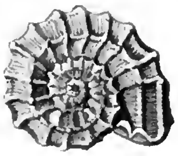
12b.

12a.

10a.

8.

10c.



11c.

10b.

13a.

13b.

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TERTIARY INVERTEBRATES.

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Fig. 11. Solariella dautzenbergi Cossm. 163
Patagonian beds; mouth of Santa Cruz River.
11*a*. Side view.
11*b*. The same, 4/1.
11*c*. Lower view, 4/1.

Fig. 12. Calliostoma philippii (Ortm.) 164
Upper Magellanian beds; Punta Arenas.
12*a*. Side view.
12*b*. Lower view.

Fig. 13. Calliostoma observationis Ortm. 165
Patagonian beds; Mount of Observation, upper horizon.
13*a*. Side view.
13*b*. Lower view.

All the figures, unless otherwise stated, are natural size.

EXPLANATION OF PLATE XXXI.

PAGE

Fig. 1. Dentalium sulcosum Sow. 157
Patagonian beds; mouth of Santa Cruz River.
1*a*. Five fragments, belonging to different individuals, put together so as to show probable form of a complete individual.
1*b*. View of upper end of uppermost fragment.

Fig. 2. Dentalium octocostellatum Plsb. and Sh. 160
Patagonian beds; Mt. of Observation, upper horizon. Largest fragment present in the collection.

Fig. 3. Calliostoma peraratum Cossm. 165
Patagonian beds; mouth of Santa Cruz River.
3*a*. Side view.
3*b*. The same, 2/1.

Fig. 4. Calliostoma cossmanni Ortm. 166
Patagonian beds; mouth of Santa Cruz River.
4*a*. Side view.
4*b*. The same, 3/1.

Fig. 5. Calliostoma santacruzense Cossm. 167
Patagonian beds; mouth of Santa Cruz River.
5*a*. Side view.
5*b*. The same, 3/1.

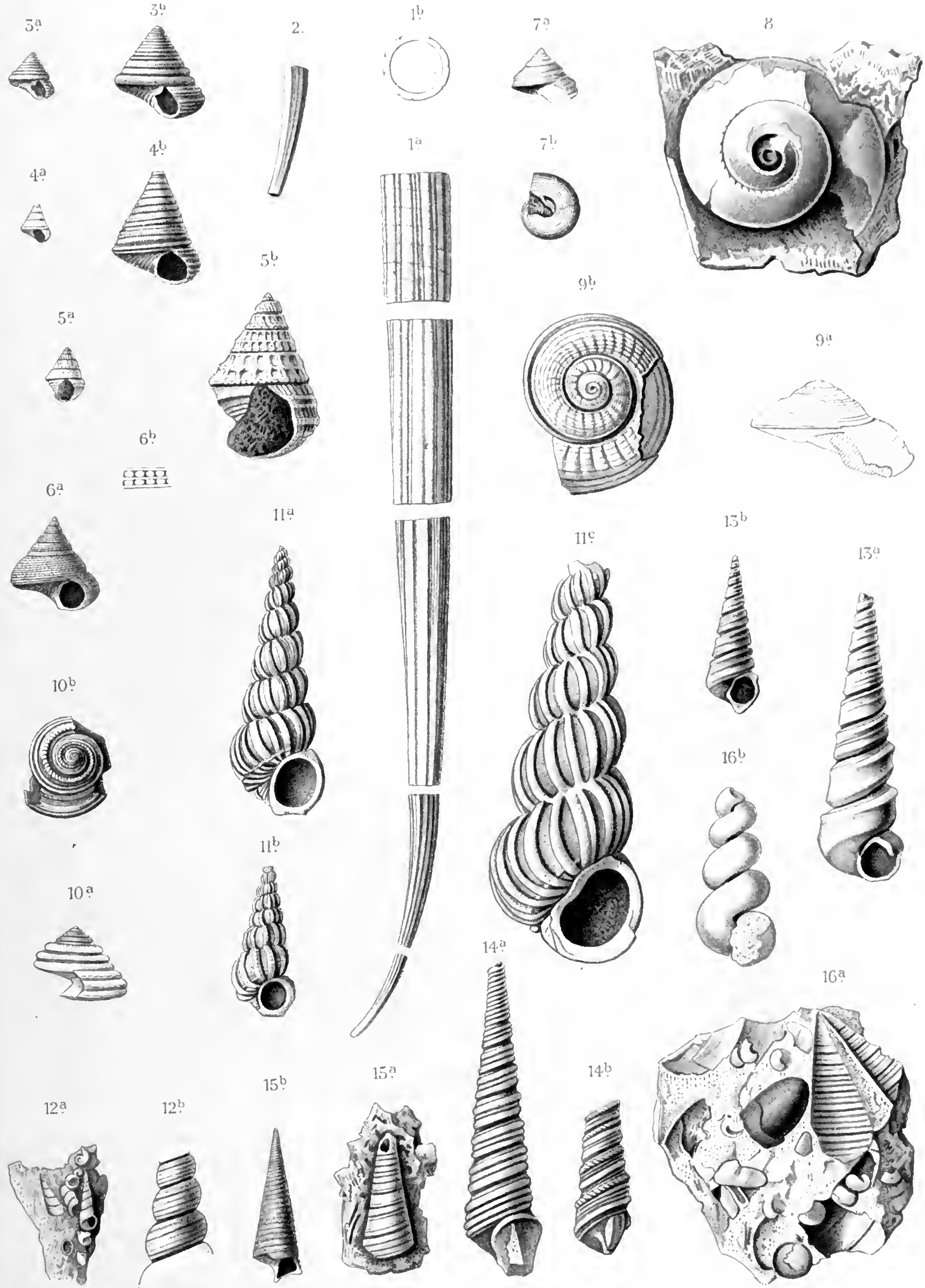
Fig. 6. Calliostoma garretti Ortm. 168
Patagonian beds; mouth of Santa Cruz River.
6*a*. Side view.
6*b*. Portion of surface sculpture, enlarged.

Fig. 7. Calliostoma iheringi Ortm. 169
Patagonian beds; mouth of Santa Cruz River.
7*a*. Side view.
7*b*. Lower view.

Fig. 8. Gibbula lævis (Sow.) 170
Patagonian beds; mouth of Santa Cruz River. Upper view of specimen imbedded in matrix.

Fig. 9. Gibbula dalli v. Ih. 171
Patagonian beds; mouth of Santa Cruz River.
9*a*. Side view.
9*b*. Upper view of the same individual.

Fig. 10. Gibbula diametralis Cossm. 172
Patagonian beds; mouth of Santa Cruz River.
10*a*. Side view.
10*b*. Upper view of the same individual.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3b
2.
1b
7a
8
4a
4b
1a
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5b
9b
5a
9a
6b
6a
11a
11c
13b
13a
10b
16b
11b
10a
14a
16a
15b
15a
14b
12a
12b

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TERTIARY [illegible]

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Fig. 11. Scalaria rugulosa Sow. 175

Patagonian beds.

11*a*. View of a complete specimen of medium size. Mouth of Santa Cruz River.

11*b*. View of an almost complete specimen of small size; Darwin Station, San Julian.

11*c*. View of fragment of a very large specimen; Darwin Station, San Julian.

Fig. 12. Turritella exigua Ortm. 192

Lower Magellanian beds; Punta Arenas.

12*a*. Specimen imbedded in matrix.

12*b*. A few whorls, enlarged, showing sculpture.

Fig. 13. Turritella ambulacrum Sow. 192

Patagonian beds; mouth of Santa Cruz River.

13*a*. Side view of a large individual, typical form.

13*b*. Side view of a young individual, representing *T. argentina* v. Ih.

Fig. 14. Turritella breantiana d'Orb. 195

Patagonian beds; mouth of Santa Cruz River.

14*a*. Almost complete individual.

14*b*. Fragment of another one.

Fig. 15. Turritella patagonica Sow. 196

Patagonian beds.

15*a*. Side view of a specimen imbedded in matrix; Oven Point, San Julian.

15*b*. Side view of a spciemen showing sculpture; Paso del Rio Santa Cruz.

Fig. 16. Turritella innotabilis Plsb. 198

Cape Fairweather beds ;Cape Fairweather.

16*a*. Piece of matrix, showing inner and outer casts.

16*b*. Inner cast.

All the figures, unless otherwise stated, are natural size.

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Fig. 1. Vermetus cf. intortus (Lmck.). 198
Patagonian beds; Shell Gap, upper horizon.
Specimen of moderate size.

Fig. 2. Vermetus (?) incertus Ortm. 199
Patagonian beds; mouth of Santa Cruz River.
Fragment of tube.

Fig. 3. Crucibulum dubium Ortm. 177
Patagonian beds; Arroyo Gio.
3*a*. Upper view of cast.
3*b*. Side view of the same.

Fig. 4. Infundibulum merriami (Ortm.). 178
Lower Magellanian beds; Punta Arenas.
4*a*. Upper view of specimen, with shell partly preserved.
4*b*. Side view of the same.

Fig. 5. Infundibulum corrugatum (Reev.). 179
Patagonian beds.
5*a*. Side view of a typical specimen; mouth of Santa Cruz River.
5*b*. Upper view of the same.
5*c*. Side view of another specimen; Mt. of Observation, upper horizon.
5*d*. Lower view of the same, showing diaphragm and umbilicus.
5*e*. Side view of cast of a large individual; Oven Point, San Julian.
5*f*. Side view of a specimen of var. *elatum* Ortm.; mouth of Santa Cruz River.

Fig. 6. Infundibulum clypeolum (Reev.). 180
Patagonian beds; mouth of Santa Cruz River.
6*a*. Upper view of a small individual.
6*b*. Side view of the same.

Fig. 7. Galerus araucanus (Phil.). 181
Patagonian beds; Shell Gap, upper horizon.
7*a*. Upper view of cast.
7*b*. Side view of the same.

Fig. 8. Galerus mamillaris (Brod.). 182
Cape Fairweather beds; Cape Fairweather.
8*a*. Upper view of cast.
8*b*. Side view of another cast, with upper whorls broken away, showing cast of umbilicus.

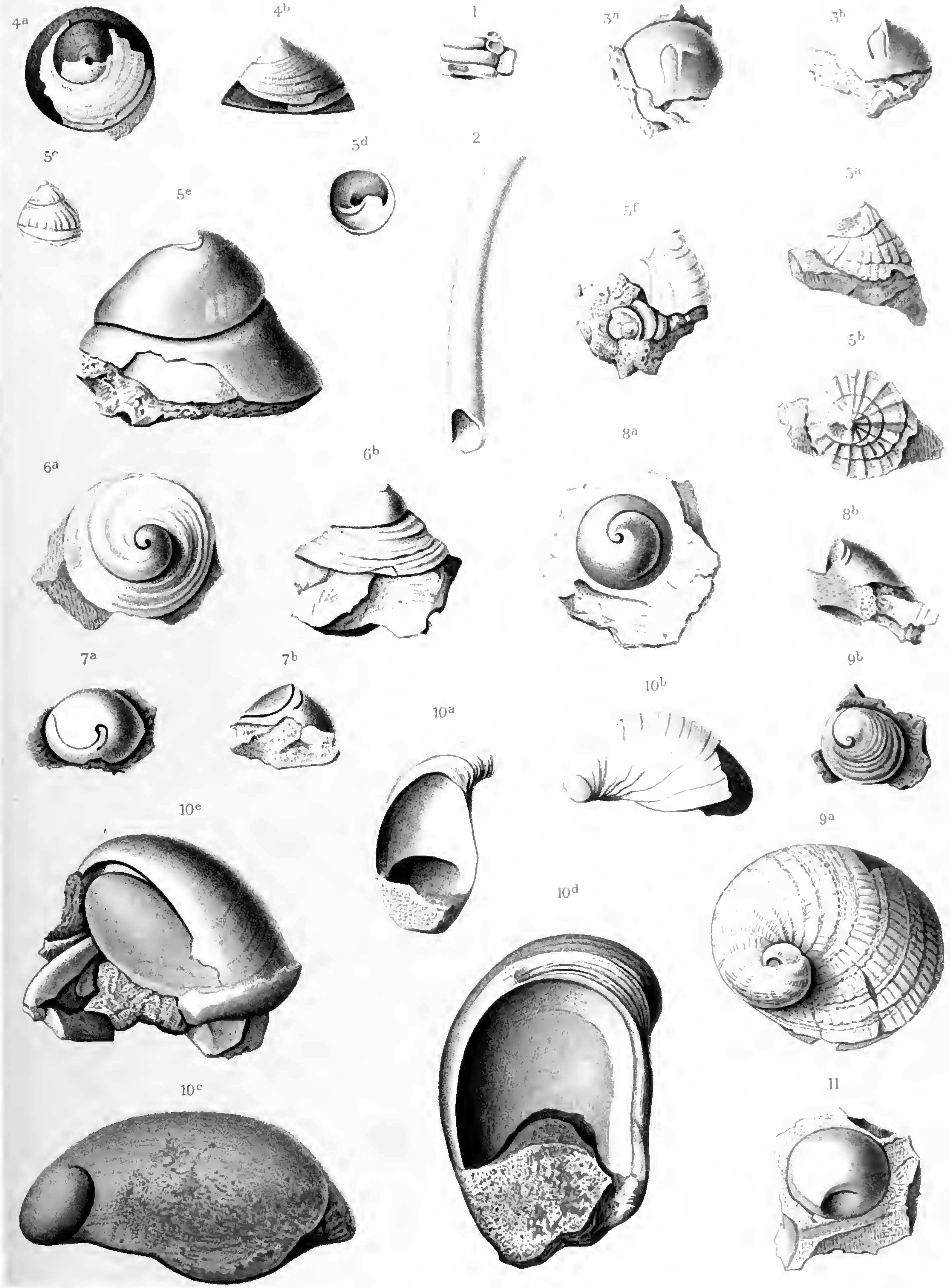

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Fig. 9. SIGAPATELLA AMERICANA Ortm. 183

Patagonian beds.

9*a*. Upper view of a large individual; mouth of Santa Cruz River.

9*b*. Upper view of a smaller individual, from interior of *Ostrea ingens*. Uppermost oyster layer at Punta Arenas.

Fig. 10. CREPIDULA GREGARIA Sow. 184

Patagonian beds.

10*a*. Lower view of a small individual; mouth of Santa Cruz River, 250′ above high tide.

10*b*. Side view of the same.

10*c*. Side view of a giant individual from Punta Arenas, representing Philippi's *Haliotis imperforata*.

10*d*. Lower view of the same.

10*e*. Side view of a cast of this species; upper Rio Chalia.

Fig. 11. CREPIDULA DILATATA Lmck. 185

Cape Fairweather beds; Cape Fairweather.

Upper view of cast.

All the figures are natural size.

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PAGE

Fig. 1. Natica chiloensis Phil. 186
Lower Magellanian beds; Punta Arenas.
1*a*. Large individual, surface of shell partly gone.
1*b*. Smaller individual, complete.

Fig. 2. Natica ovoidea Phil. 187
Patagonian beds; mouth of Santa Cruz River.
Large individual.

Fig. 3. Natica secunda Roch. and Mab. 188
Patagonian beds; mouth of Santa Cruz River.
3*a*. View of an almost complete individual (part of labial callus gone).
3*b*. Lower view of another individual, showing complete callus.

Fig. 4. Natica darwini Hutt. 189
Patagonian beds; mouth of Santa Cruz River.
Front view of an absolutely complete individual.

Fig. 5. Natica subtenuis v. Ih. 190
Patagonian beds; mouth of Santa Cruz River.
Front view of a specimen with callus partly gone.

Fig. 6. Natica consimilis v. Ih. 191
Patagonian beds; mouth of Santa Cruz River.
Side view.

Fig. 7. Odontostomia suturalis (v. Ih.). 173
Patagonian beds; mouth of Santa Cruz River.
7*a*. Front view.
7*b*. The same, 4/1.

Fig. 8. Turbonilla cuevensis v. Ih. 174
Patagonian beds; Mt. of Observation, upper horizon.
8*a*. Front view.
8*b*. The same; 4/1.

Fig. 9. Aporrhais araucana (Phil.). 200
Patagonian beds; mouth of Santa Cruz River.
Back view of the only (damaged) individual.

Fig. 10. Struthiolaria hatcheri Ortm. 201
Lower Magellanian beds; Punta Arenas.
10*a*. Back view of a complete individual.
10*b*. Front view of fragment of another, larger individual.

Fig. 11. Struthiolaria ameghinoi v. Ih. 201
Patagonian beds; mouth of Santa Cruz River.
11*a*. Front view of a rather large, typical specimen.
11*b*. Front view of a specimen of var. *multinodosa* Ortm.

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Fig. 12. Struthiolaria ornata Sow. 203
Patagonian beds; mouth of Santa Cruz River.
12*a*. Side view of a typical individual showing complete curve of outer lip.
12*b*. Front view of a very large individual, having *three* stronger spiral ribs.

Fig. 13. Dolium ovulum Ortm. 204
Patagonian beds; mouth of Santa Cruz River.
13*a*. Back view of largest individual.
13*b*. Front view of the same.

Fig. 14. Pyrula carolina d'Orb. 205
Patagonian beds; mouth of Santa Cruz River.
14*a*. Front view of a small, but complete individual.
14*b*. Back view of a large individual, with lower end of canal slightly damaged.

Fig. 15. Tritonium bicegoi v. Ih. 206
Patagonian beds; mouth of Santa Cruz River.
Front view of a fragment; the last whorl is broken away.

Fig. 16. Tritonium morgani Ortm. 207
Patagonian beds; mouth of Santa Cruz River.
Front view of the only specimen in the collection.

Fig. 17. Buccinum annæ Ortm. 208
Patagonian beds; mouth of Santa Cruz River.
Front view of a fine, complete individual.

Fig. 18. Buccinum obesum var. minor (Phil.). 209
Patagonian beds; mouth of Santa Cruz River.
Back view of an almost complete individual.

Fig. 19. Fusus subspiralis Ortm. 221
Lower Magellanian beds; Punta Arenas.
Fragmentary individual, imbedded in matrix.

Fig. 20. Fusus archimedis Ortm. 222
Patagonian beds; Darwin Station, San Julian.
20*a*. Almost complete individual, with sculpture of surface obscured.
20*b*. Back view of fragment of another individual showing sculpture.

All the figures, unless otherwise stated, are natural size.

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Fig. 1. Fusus torosus Ortm. 223
Patagonian beds; mouth of Santa Cruz River.
Front view, last whorl broken away.

Fig. 2. Chrysodomus cancellatus (Ortm.). 209
Patagonian beds; mouth of Santa Cruz River.
2*a*. Front view of shell.
2*b*. Part of surface enlarged.

Fig. 3. Chrysodomus pilsbryi (Ortm.). 210
Patagonian beds; mouth of Santa Cruz River.
Front view of shell.

Fig. 4. Siphonalia domeykoana (Phil.). 211
Patagonian beds; mouth of Santa Cruz River.
Front view of a large, complete individual.

Fig. 5. Siphonalia noachina (Sow.). 213
Patagonian beds; Darwin Station, San Julian.
Fragment of a very large individual, front view.

Fig. 6. Murex hatcheri Ortm. 214
Patagonian beds; Darwin Station, San Julian.
Front view of shell.

Fig. 7. Trophon patagonicus (Sow.). 215
Patagonian beds.
7*a*. Large individual, somewhat damaged, corresponding closely to the typical form, figured by Sowerby; Darwin Station, San Julian.
7*b*. Individual of medium size, intermediate between the typical form and v. Ihering's *T. laciniatus santacruzensis.* Oven Point, San Julian.
7*c*. Individual of medium size, approaching closely v. Ihering's *T. laciniatus santacruzensis.* Oven Point, San Julian.
7*d*. Fragment of young individual, showing distinct spiral sculpture. Oven Point, San Julian.

Fig. 8. Trophon laciniatus Mart. 217
Cape Fairweather beds; Cape Fairweather.
8*a*. Front view of typical form.
8*b*. Front view of transitional form toward var. *inornatus.*
8*c*. Front view of var. *inornatus* Plsb.

Fig. 9. Urosalpinx elegans Ortm. 219
Patagonian beds; mouth of Santa Cruz River, 250′ above high tide.
Front view of shell.

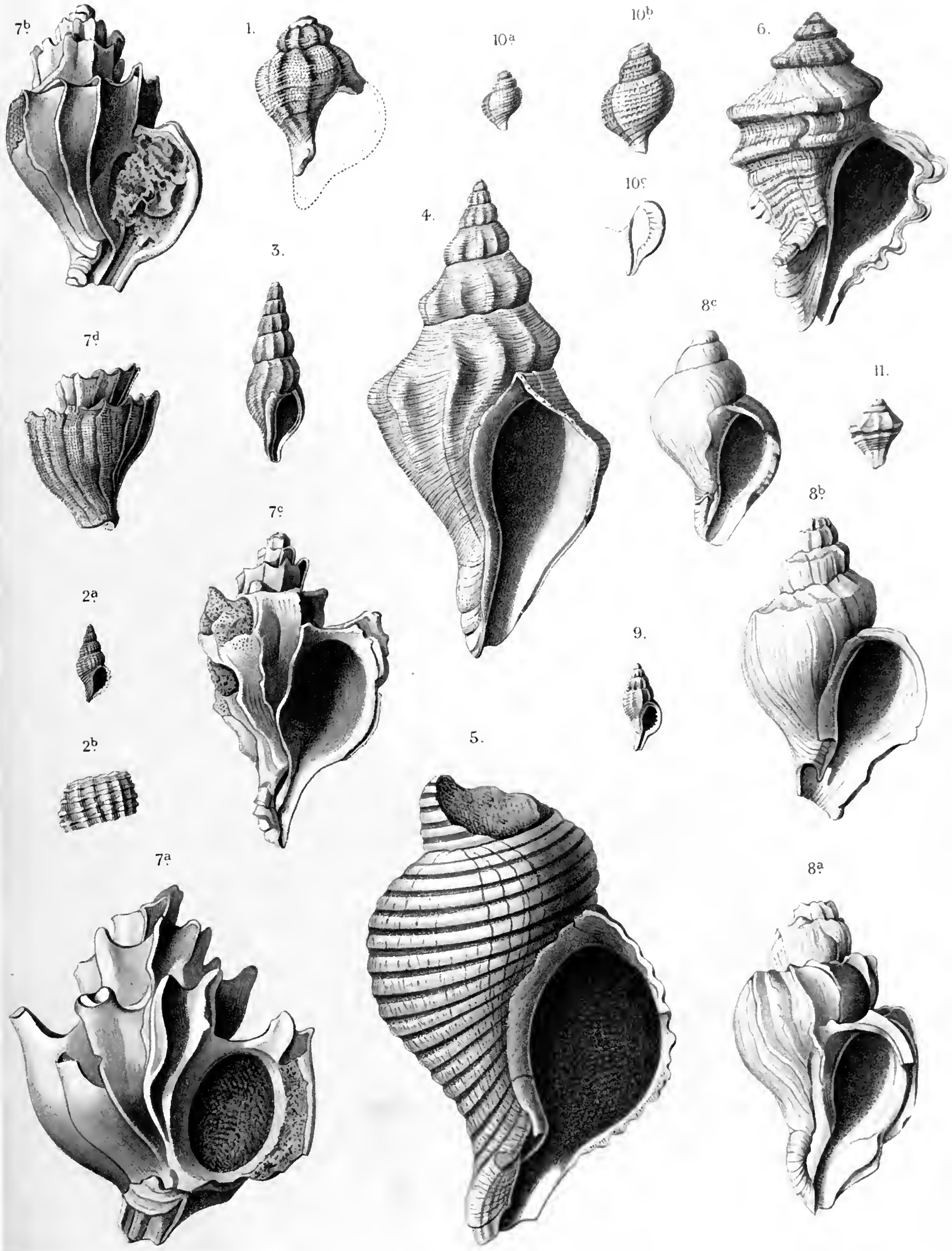

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Fig. 10. UROSALPINX COSSMANNI Ortm. 219

Patagonian beds; mouth of Santa Cruz River.

10*a*. Back view of shell.
10*b*. The same, 2/1.
10*c*. View of mouth of another specimen, 2/1.

Fig. 11. UROSALPINX PYRIFORMIS (v. Ih.). 220

Patagonian beds; Lake Pueyrredon, base.

Back view of shell.

All of the figures, unless otherwise stated, are natural size.

EXPLANATION OF PLATE XXXV.

PAGE

Fig. 1. MARGINELLA GRACILIOR v. Ih. 224
Patagonian beds; mouth of Santa Cruz River.
Back view of shell.

Fig. 2. MARGINELLA PLICIFERA v. Ih. 225
Patagonian beds; mouth of Santa Cruz River.
Front view of shell.

Fig. 3. MARGINELLA OLIVELLA Ortm. 225
Patagonian beds; mouth of Santa Cruz River.
3*a*. Front view of shell.
3*b*. The same, 2/1.

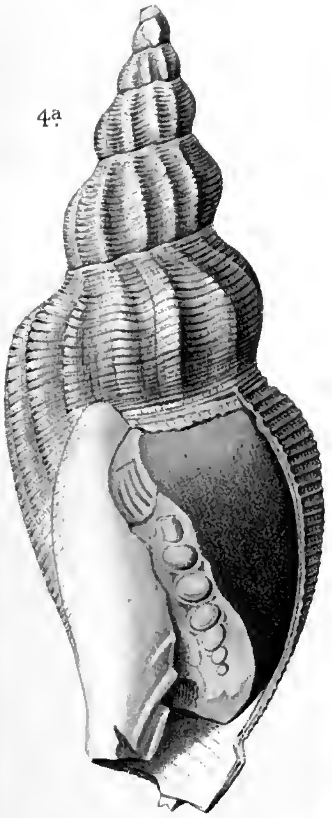
Fig. 4. VOLUTA TRIPLICATA Sow. 226
Patagonian beds; mouth of Santa Cruz River.
4*a*. Front view of a large, typical individual.
4*b*. Front view of a large individual, with less developed "shoulder."
4*c*. Front view of a more slender individual, being transitional to *V. gracilior* v. Ih.
4*d*. Front view of a young individual, having the apex preserved.
4*e*. View of the apex of the latter, enlarged.

Fig. 5. VOLUTA GRACILIOR v. Ih. 227
Patagonian beds; mouth of Santa Cruz River.
5*a*. Front view of a large individual, which is typical in form (showing very high volutions), but has *three* columellar plaits.
5*b*. Front view of a fragmentary individual, showing distinctly only *two* plaits.
5*c*. Front view of a smaller individual, of more swollen outline, and less high volutions; transitional to *V. triplicata* Sow.

Fig. 6. VOLUTA PETERSONI Ortm. 229
Patagonian beds; mouth of Santa Cruz River, 250′ above high tide.
Front view of the only specimen in the collection.

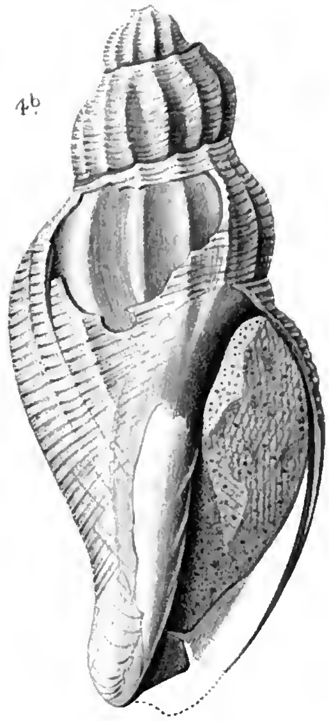
All of the figures, unless otherwise stated, are natural size.

4a.



3b

4b.



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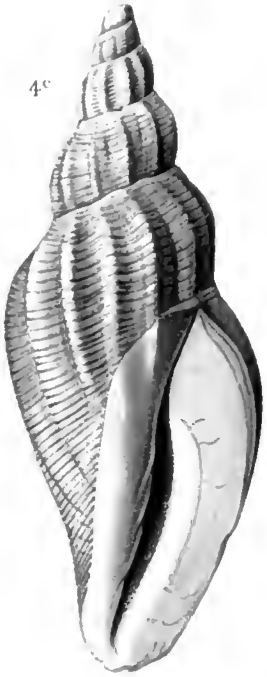

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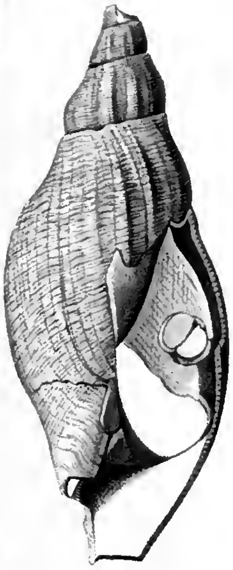

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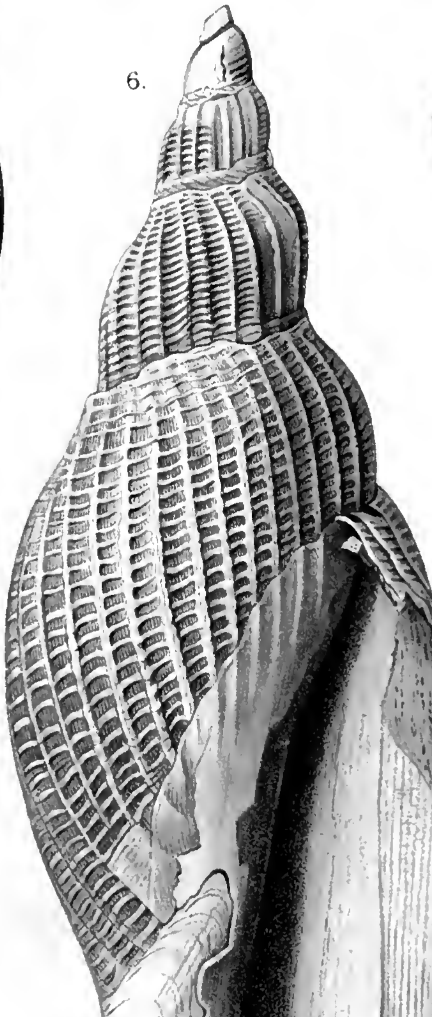

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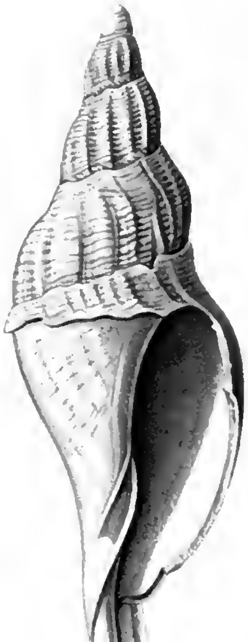

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TERTIARY INVERTEBRATES.

EXPLANATION OF PLATE XXXVI.

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Fig. 1. VOLUTA DORBIGNYANA Phil. 230

Patagonian beds; mouth of Santa Cruz River.

1*a*. Large, full grown individual, with spiral and longitudinal sculpture obliterated (traces of the latter seen only on upper whorls).

1*b*. Young individual, with apex preserved.

1*c*. Apex of the latter, enlarged.

1*d*. Specimen of medium size, with both spiral and longitudinal sculpture well preserved.

1*e*. Fragment of large individual, with longitudinal sculpture partly obliterated, but spiral sculpture strongly pronounced. This represents probably what v. Ihering calls *V. alta*.

Fig. 2. VOLUTA AMEGHINOI v. Ih. 233

Patagonian beds; Mt. of Observation, upper horizon. Front view of shell.

Fig. 3. CANCELLARIA GRACILIS v. Ih. 235

Patagonian beds; Mount of Observation, upper horizon.

3*a*. Front view of shell.

3*b*. The same, 3/1.

Fig. 4. CANCELLARIA cf. MEDINÆ Phil. 236

Patagonian beds; Mt. of Observation, upper horizon.

4*a*. Front view of shell.

4*b*. The same, 3/1.

Fig. 5. TEREBRA COSTELLATA Sow. 236

Patagonian beds; mouth of Santa Cruz River. Front view of shell.

Fig. 6. PLEUROTOMA SUBÆQUALIS Sow. 238

Patagonian beds; mouth of Santa Cruz River. Back view of the only specimen in the collection.

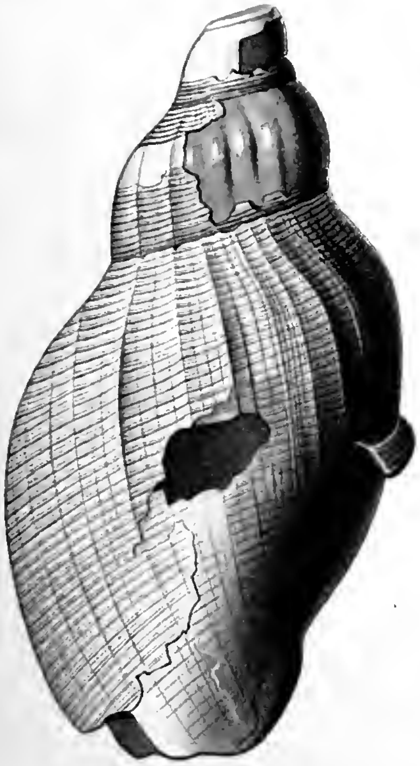
Fig. 7. PLEUROTOMA UNIFASCIALIS v. Ih. 239

Patagonian beds; mouth of Santa Cruz River.

7*a*. Front view of the shell.

7*b*. The same, 2/1.

All of the figures, unless otherwise stated, are natural size.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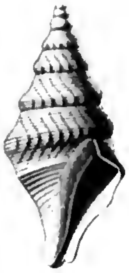
7a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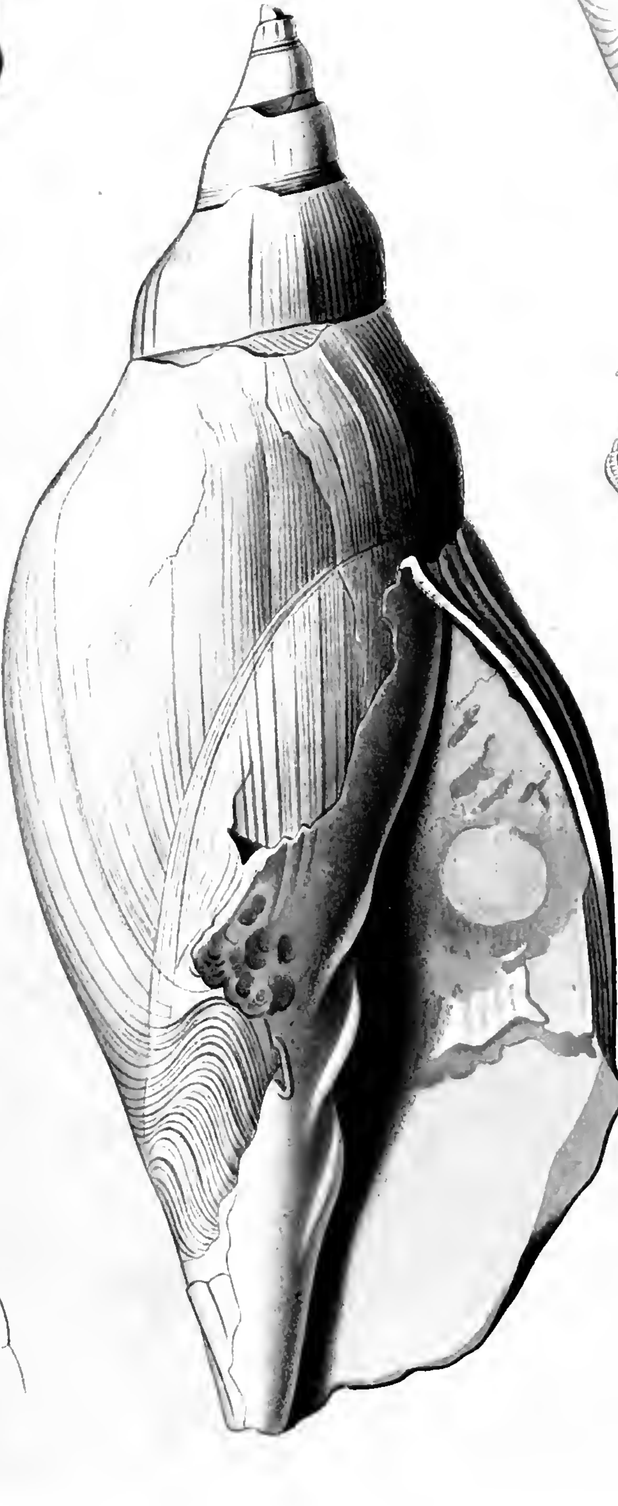
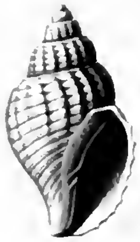

1a


4a


4b

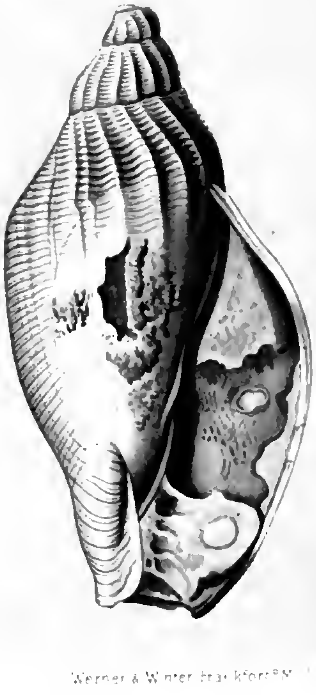

3b


3a


6


1b


5


1d


1e

F. v. Iterson del.

Werner & Winter, Frankfort a/M. Lith.

TERTIARY INVERTEBRATES.

EXPLANATION OF PLATE XXXVII.

PAGE

Fig. 1. Voluta domeykoana Phil. 232

Patagonian beds; mouth of Santa Cruz River.

1*a*. Front view of a typical individual, with well-developed nodes.

1*b*. Front view of an individual, with the nodes scarcely developed.

Fig. 2. Genota cuevensis v. Ih. 240

Patagonian beds; mouth of Santa Cruz River.

Front view of an individual of medium size.

Fig. 3. Drillia santacruzensis Ortm. 241

Patagonian beds; mouth of Santa Cruz River.

3*a*. Front view of a well-preserved individual.

3*b*. The same, 3/1.

Fig. 4. Borsonia patagonica Ortm. 242

Patagonian beds; mouth of Santa Cruz River.

4*a*. Back view of a large individual.

4*b*. Front view of a partly broken individual, showing two columellar plaits.

4*c*. Front view of a broken individual, showing only one plait, the lower one being obliterated.

Fig. 5. Actæon chilensis Phil. 243

Lower Magellanian beds; Punta Arenas.

5*a*. Front view of shell.

5*b*. The same, 3/1.

Fig. 6. Actæon semilævis Ortm. 244

Patagonian beds; Mount of Observation, upper horizon.

6*a*. Front view of shell.

6*b*. The same, 3/1.

Fig. 7. Bulla remondi Phil. 245

Lower Magellanian beds; Punta Arenas.

7*a*. Front view of shell.

7*b*. The same, 3/1.

Fig. 8. Bulla patagonica v. Ih. 246

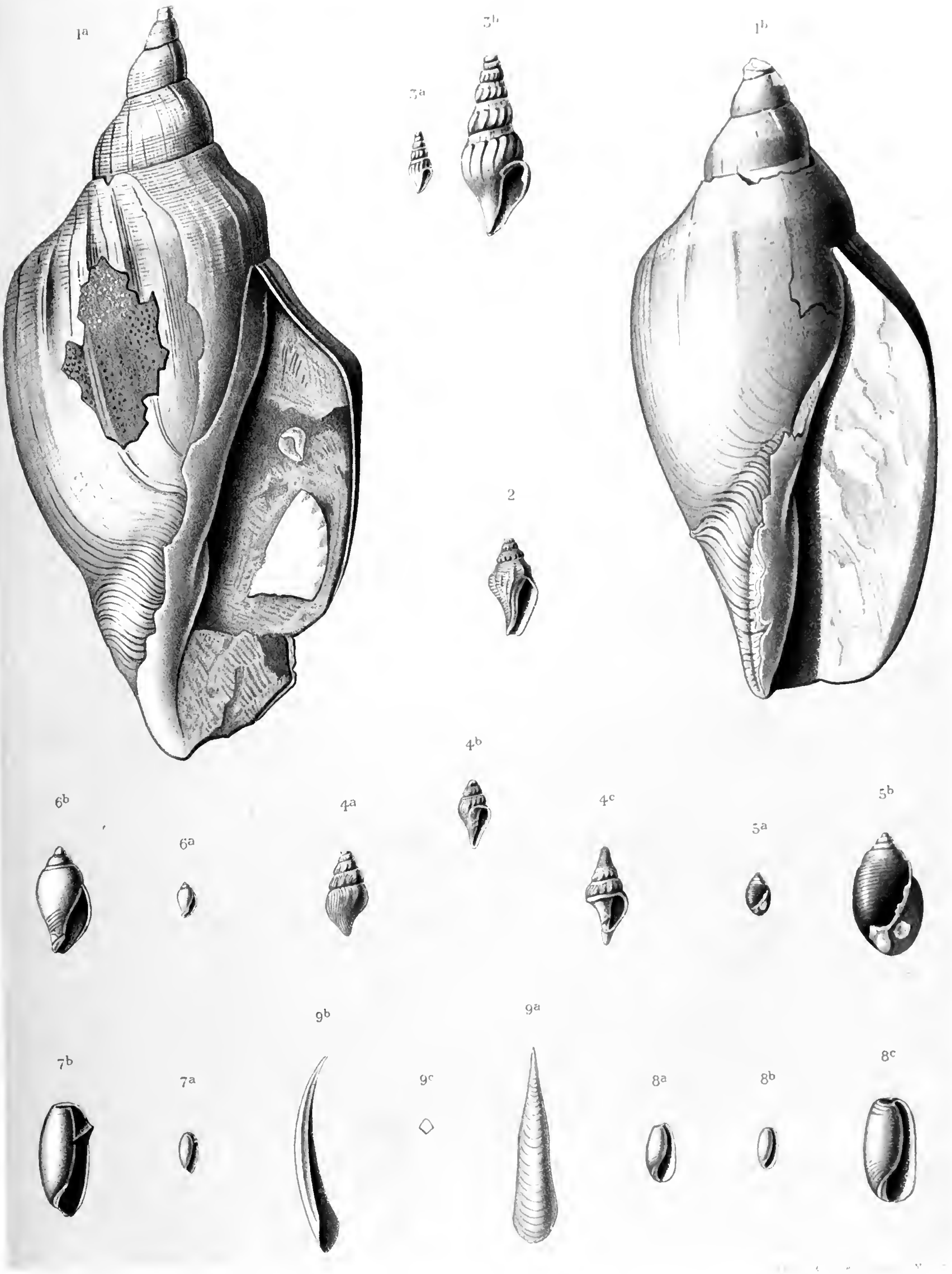
Patagonian beds; mouth of Santa Cruz River.

8*a*. Front view of a large individual.

8*b*. Front view of a young individual.

8*c*. The same, 3/1.

PATAGONIAN EXPEDITIONS



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TERTIARY INVERTEBRATES

PAGE

Fig. 9. SCALPELLUM JULIENSE Ortm. 247

Patagonian beds; Darwin Station, San Julian.

9*a*. Back view of carina.

9*b*. Lateral view of the same.

9*c*. Cross-section near the apex of the same, enlarged.

All of the figures, unless otherwise stated, are natural size.

EXPLANATION OF PLATE XXXVIII.

PAGE

Fig. 1. VERRUCA LÆVIGATA Sow. 248

Patagonian beds; upper Rio Chalia.

1*a*. Fragment of *Turritella ambulacrum*, showing three of the individuals of *Verruca* in situ.

1*b*. Schematic figure, drawn from a combination of the two specimens, which have the left scutum and tergum, fixed, 4/1.

1*c*. Scutum and tergum of latter figure, a little more enlarged.

Fig. 2. BALANUS cf. PSITTACUS (Mol.). 249

Patagonian beds; Lake Pueyrredon, base.

One of the two large specimens, from the outside.

Fig. 3. BALANUS VARIANS Sow. 250

Patagonian beds.

3*a*. Upper view of an individual of form 1; Oven Point, San Julian.

3*b*. Side view of an individual of form 2; Darwin Station, San Julian.

3*c*. Side view of two individuals of form 3; Oven Point, San Julian.

3*d*. Inner view of scutum, from a colony of form 3; Oven Point, San Julian.

3*e*. Inner view of tergum, from the same colony.

Fig. 4. BALANUS cf. TRIGONUS Darw. 252

Cape Fairweather beds; Cape Fairweather.

4*a*. Colony on *Terebratella gigantea*.

4*b*. Scutum, found in this colony.

4*c*. The same, 4/1.

4*d*. Tergum, found in another colony.

4*e*. The same, 4/1.

Fig. 5. BALANUS LÆVIS Brug. 254

Cape Fairweather beds; Cape Fairweather.

5*a*. Colony upon a stone.

5*b*. Scutum, taken from this colony.

5*c*. The same, 3/1.

5*d*. Tergum, taken from the same colony.

5*e*. The same, 3/1.

Fig. 6. GERYON (?) PERUVIANUS (d'Orb.). 255

Patagonian beds.

6*a*. Upper view of carapace. Lake Pueyrredon, 600′ above base.

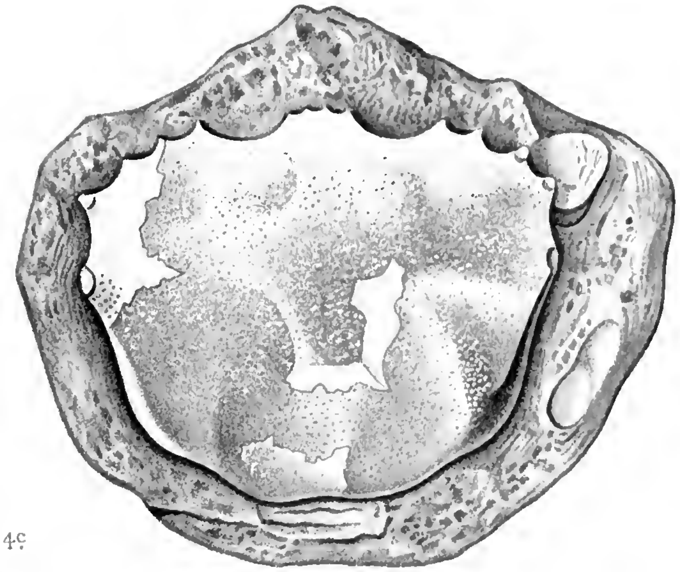
6*b*. Lower view of a part of the body, showing large chela and third maxilliped. Mt. of Observation, lower horizon.

All of the figures, unless otherwise stated, are natural size.

1^{b}

1^{c}

6^{a}



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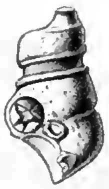
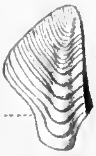
1^{a}

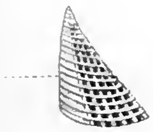


3^{c}

4^{e}



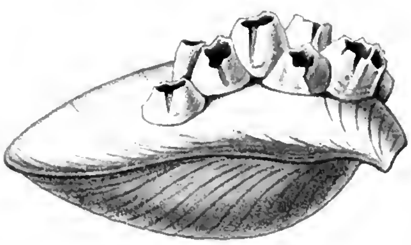
4^{c}



4^{d}

4^{b}

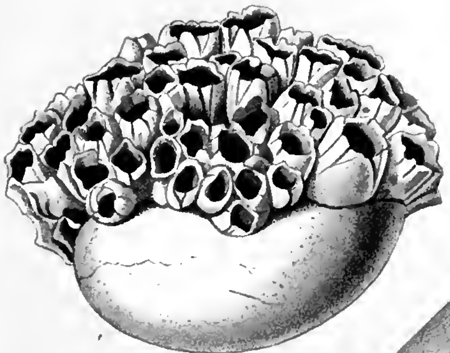
4^{a}



3^{d}

3^{b}

5^{a}



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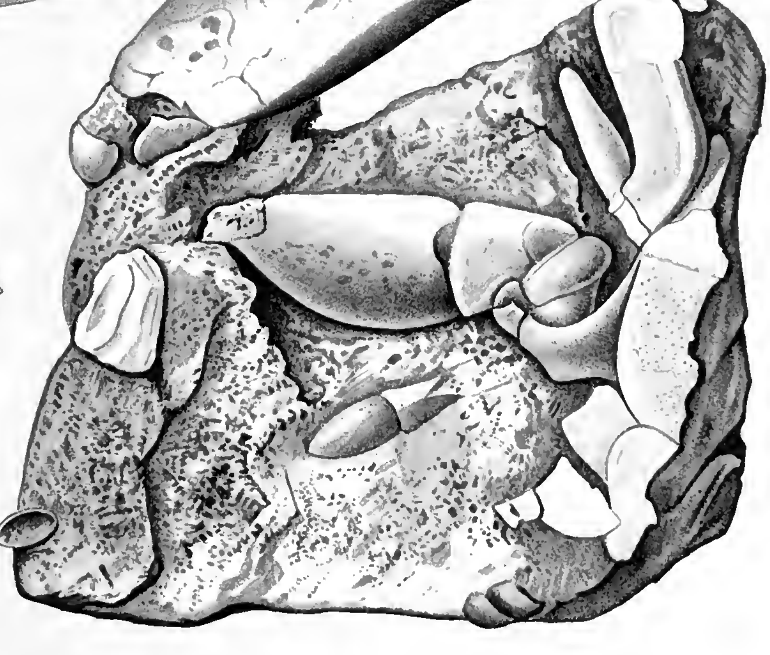

3^{e}

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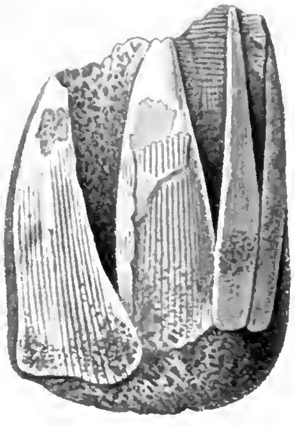
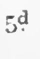


5^{c}

5^{b}

5^{e}

5^{d}



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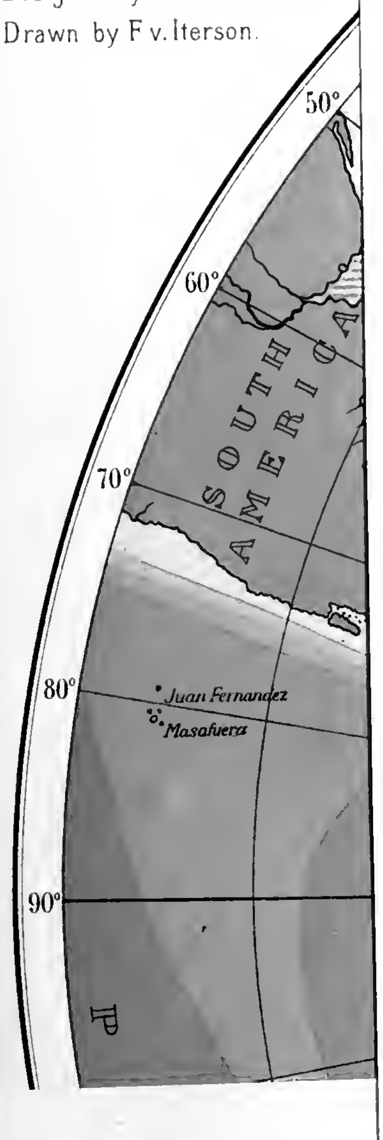
EXPLANATION OF PLATE XXXIX.

Map of the Antarctic regions, showing the probable largest extent of "Antarctica." For further details see text, p. 316.

Patagonian Exped

ANTARCTIC REGIO

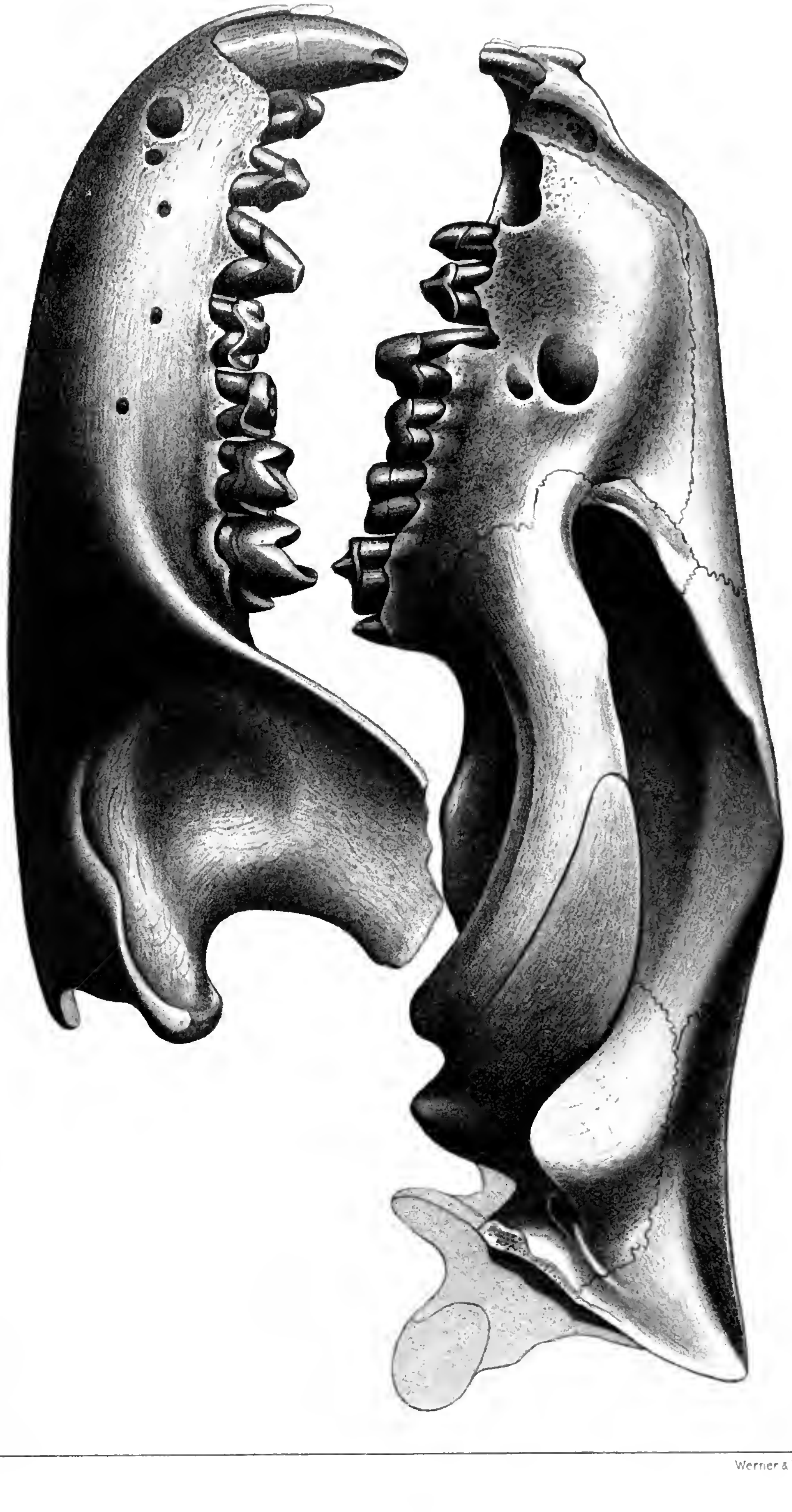
Showing present and supposed f
distribution of land, and depth of se
Designed by Dr A.E.Ortmann
Drawn by F v. Iterson.



EXPLANATION OF PLATE XL.

PAGE

BORHYÆNA TUBERATA: Left side of the skull and mandible, $\times \frac{1}{1}$ (No. 15,701). The lower canine and $M_{\overline{1}}$ are supplied from the opposite side. The occiput is restored to correspond with that of *B. excavata*, and the extent of the restoration is indicated by the neutral tint 356



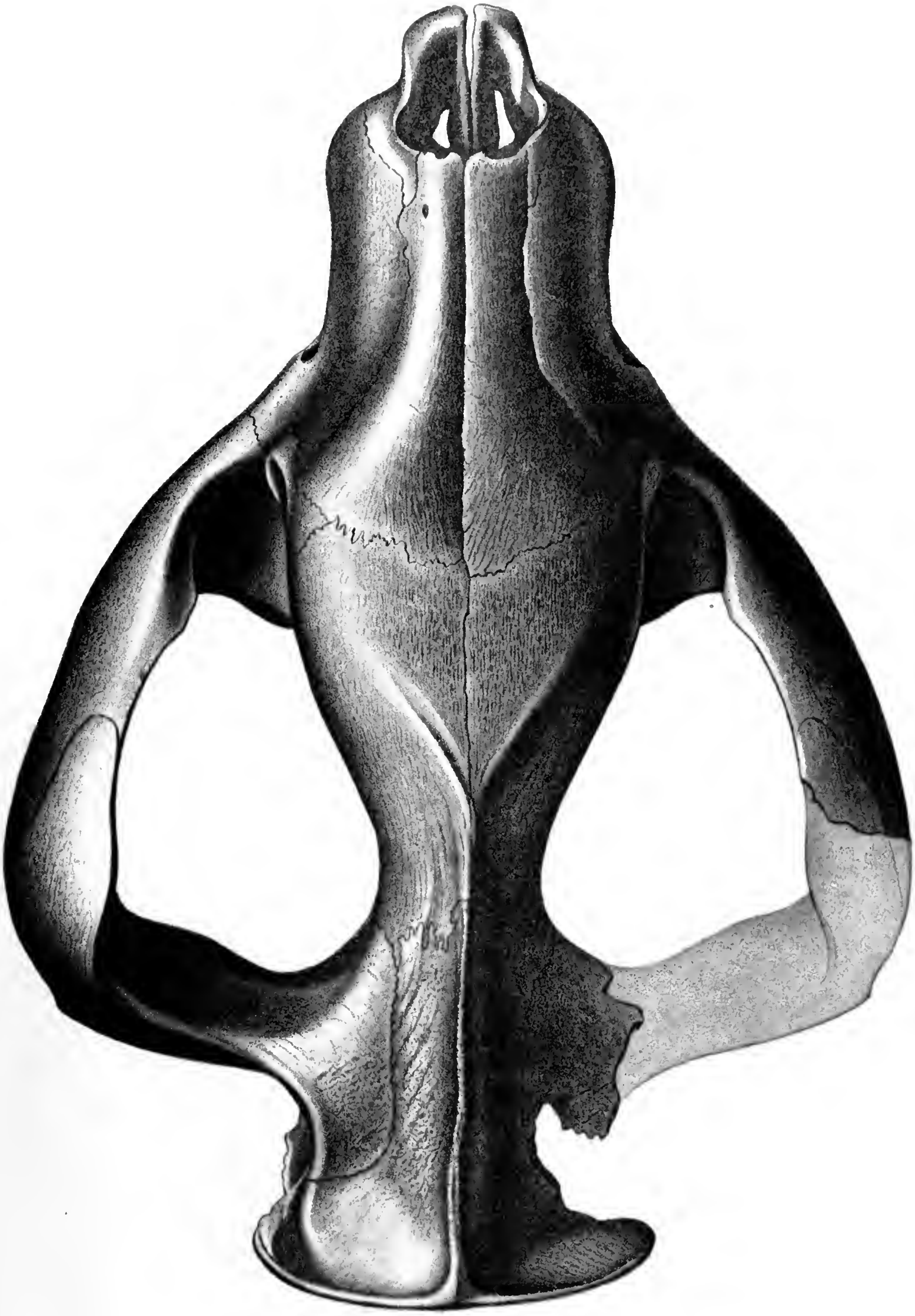
F. v. Iterson del.

Werner & Winter, Frankfort a/M., lith.

BORHYÆNA

EXPLANATION OF PLATE XLI.

	PAGE
BORHYÆNA TUBERATA: Top view of the skull, × $\frac{1}{1}$ (No. 15,701). A part of the right zygoma has been restored, as indicated by the neutral tint .	356



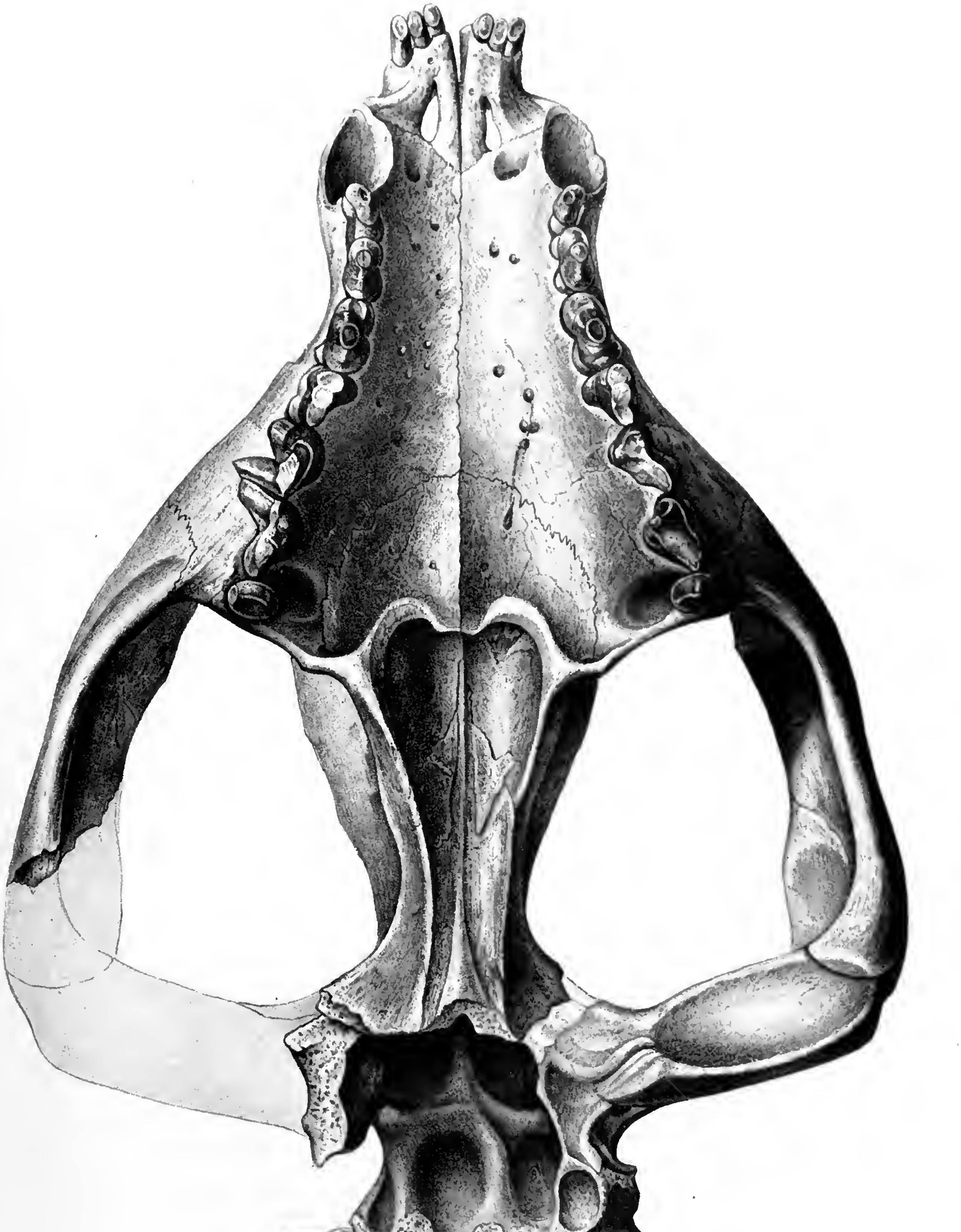
F. v Iterson del.

Werner & Winter, Frankfort ºM., lith.

BORHYÆNA

EXPLANATION OF PLATE XLII.

	PAGE.
BORHYÆNA TUBERATA: Palatal view of the skull, × $\frac{1}{1}$ (No. 15,701). A part of the right zygoma has been restored, as indicated by the neutral tint .	356



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Werner & Winter, Frankfort a/M., lith.

BORHYÆNA

EXPLANATION OF PLATE XLIII.

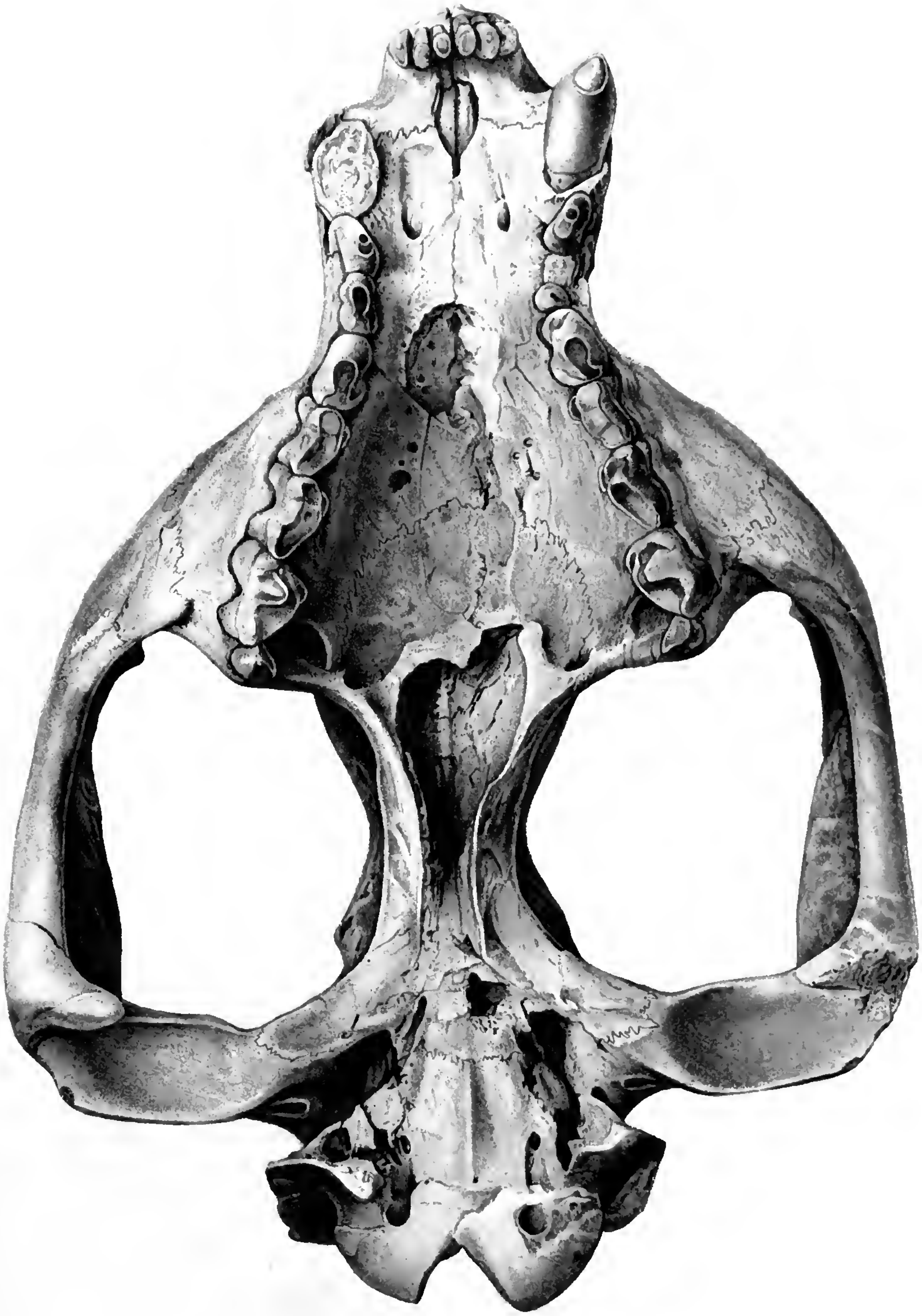
	PAGE
BORHYÆNA EXCAVATA: Top view of the skull, × $\frac{1}{1}$ (No. 15,120) . . .	360

Werner & Winter, Frankfort ªM., lith.

BORHYÆNA

EXPLANATION OF PLATE XLIV.

	PAGE.
BORHYÆNA EXCAVATA: Palatal view of the skull, × $\frac{1}{1}$ (No. 15,120) . . .	360



Werner & Winter, Frankfort a/M. lith.

BORHYÆNA.

EXPLANATION OF PLATE XLV.

			PAGE.
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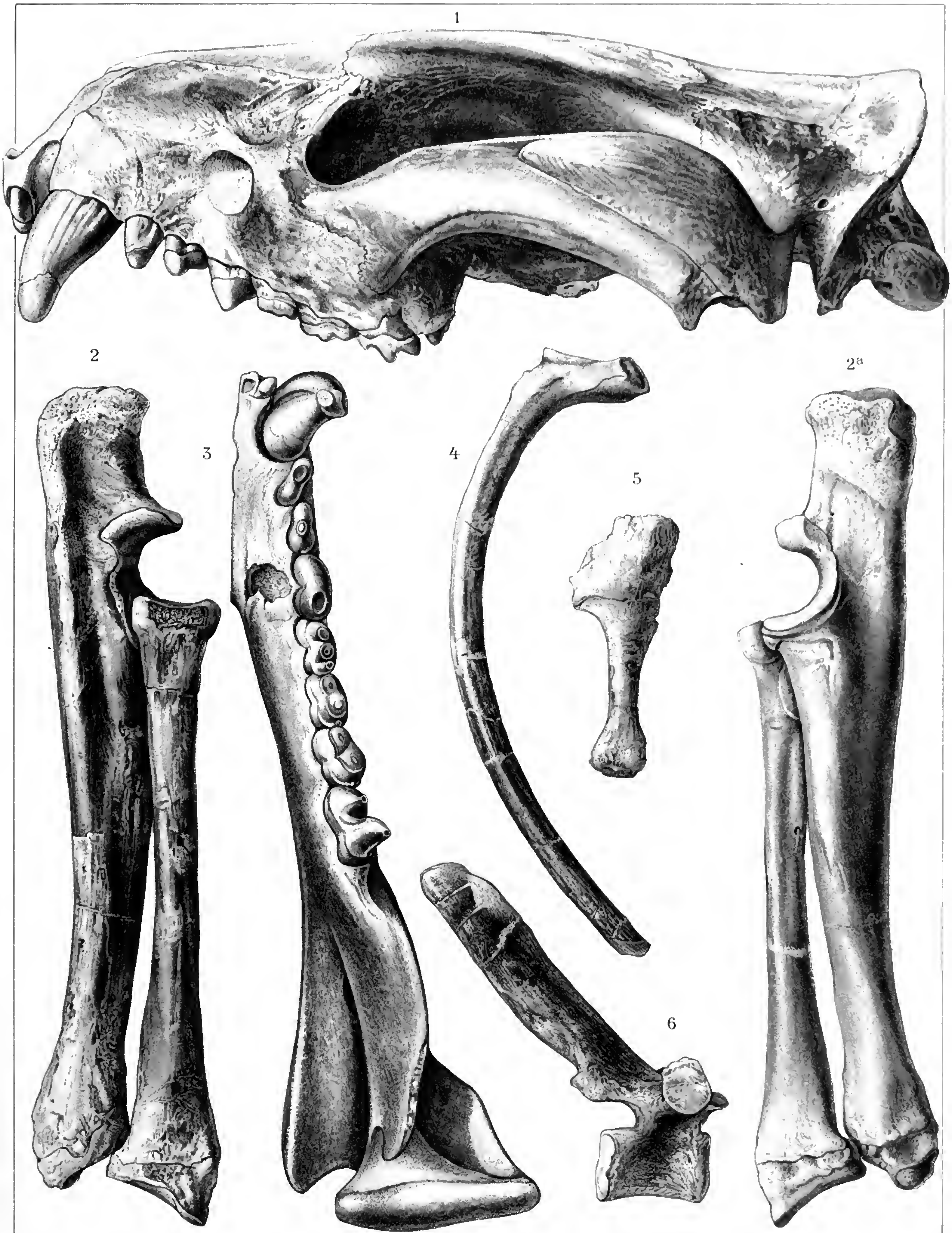
Fig. 2.	Borhyæna tuberata:	Right radius and ulna, outer side (No. 15,701).	352
Fig. 2*a*.	" "	Right radius and ulna, inner side (No. 15,701).	
Fig. 3.	" "	Right half of mandible, crown view (No. 15,701). The median premolar is restored from the opposite side	348
Fig. 4.	" "	Rib, outer side (No. 15,701).	352
Fig. 5.	" "	Presternal segment from below (No. 15,701)	352
Fig. 6.	" "	Seventh? dorsal vertebra, right side (No. 15,701)	351

All the figures are natural size.



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Werner & Winter, Frankfort a/M. Lith.

BORHYÆNA.

EXPLANATION OF PLATE XLVI.

			PAGE.
Fig. 1.	Borhyæna tuberata:	Second rib, outer side (No. 15,701) . .	352
Fig. 2.	" "	Right scapula (15,701)	352
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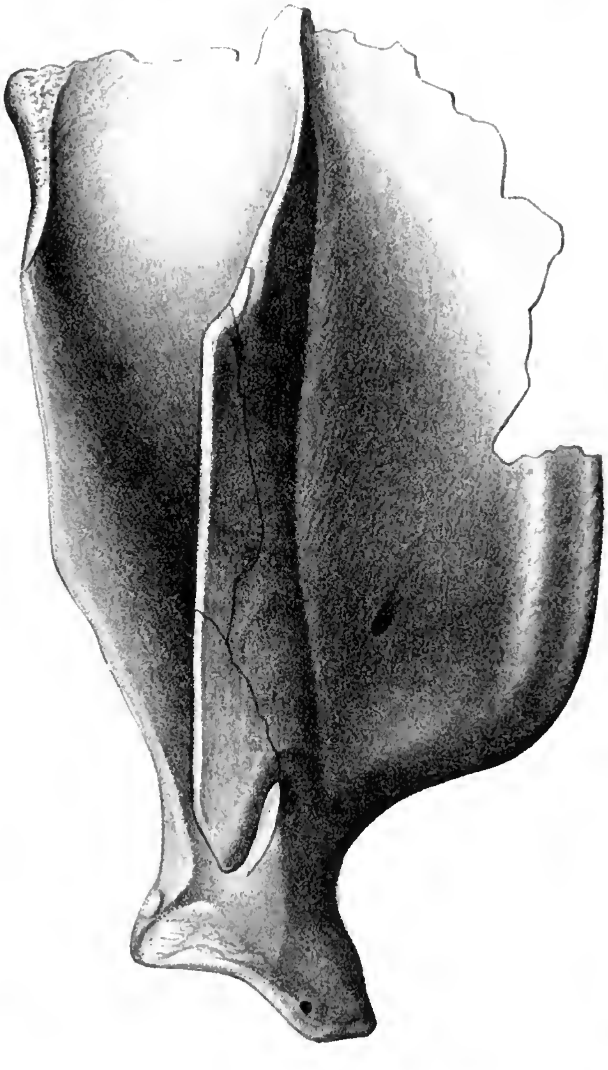
Fig. 4.	Borhyæna excavata:	Skull, posterior view (No. 15,120) . .	349

All the figures are natural size.

3a

1

2



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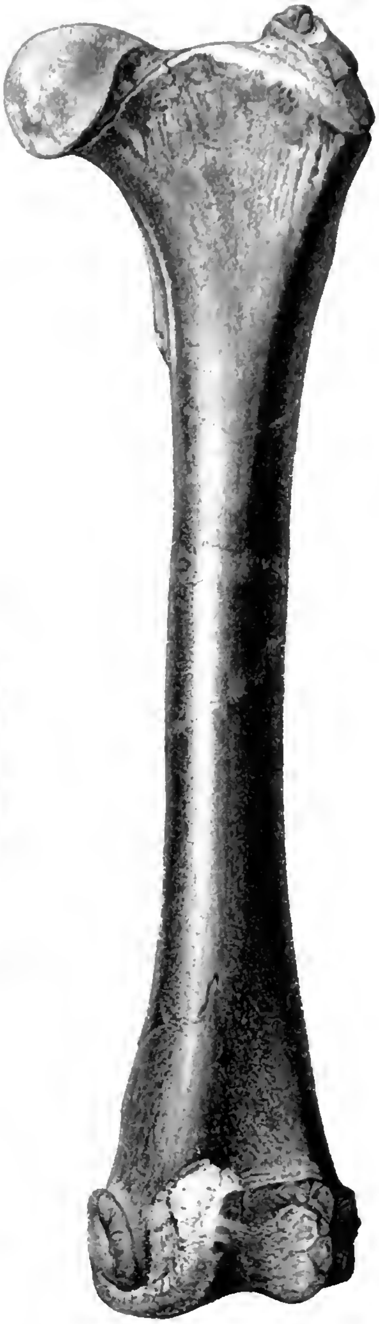

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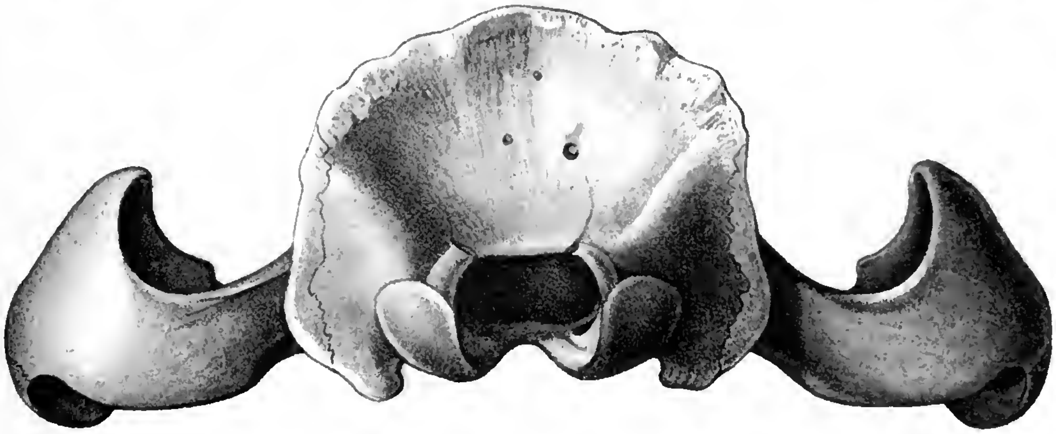
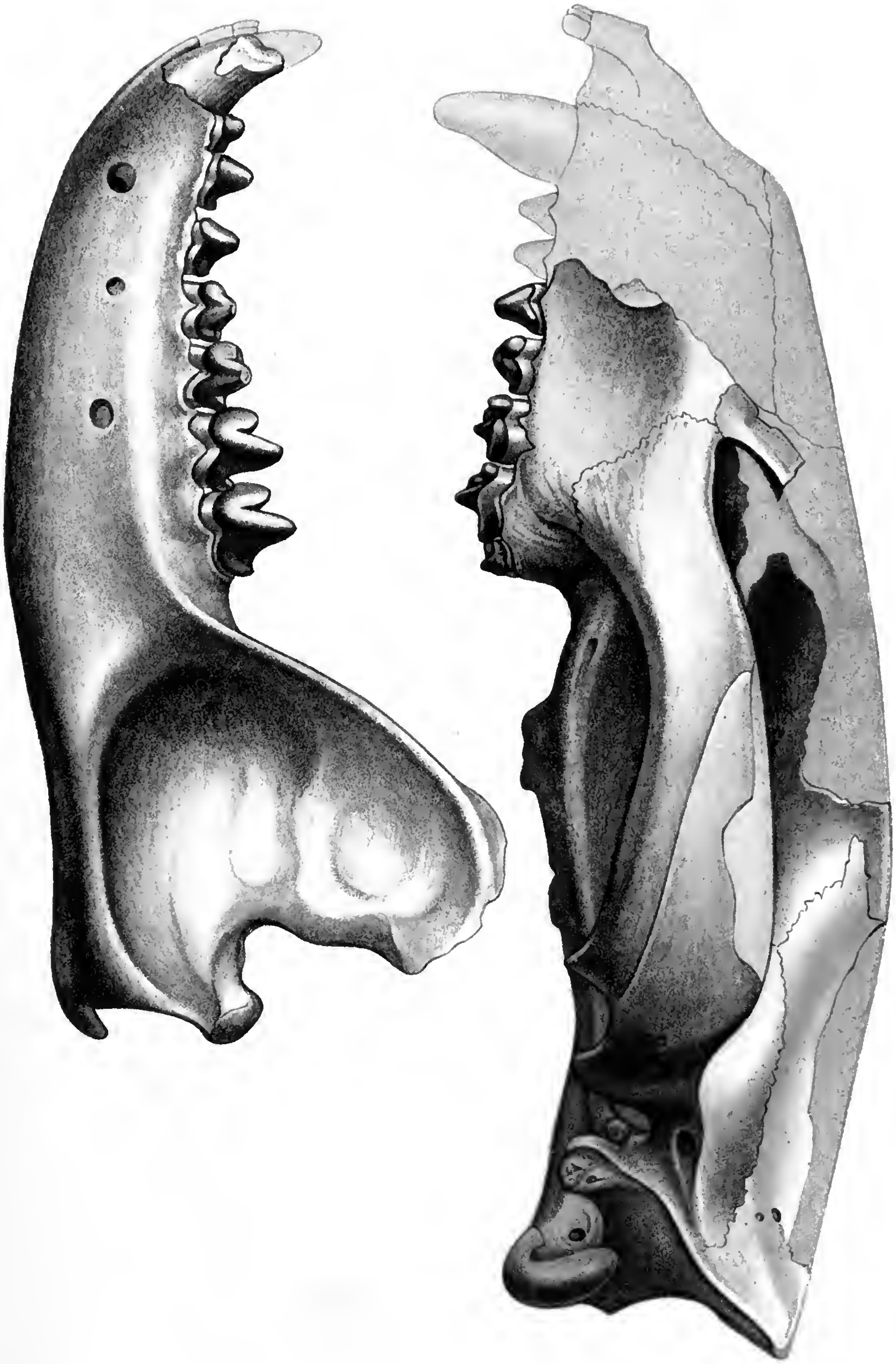


F. v. Iterson del. partim
Werner & Winter, Frankfort ᵒ/M., lith.

BORHYÆNA

EXPLANATION OF PLATE XLVII.

	PAGE.
Prothylacynus patagonicus: Skull and mandible from the left side, × $\frac{1}{1}$ (No. 15,700). Restored parts are indicated by the neutral tint	362



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Werner & Winter, Frankfort a/M., lith.

PROTHYLACYNUS.

EXPLANATION OF PLATE XLVIII.

			PAGE.
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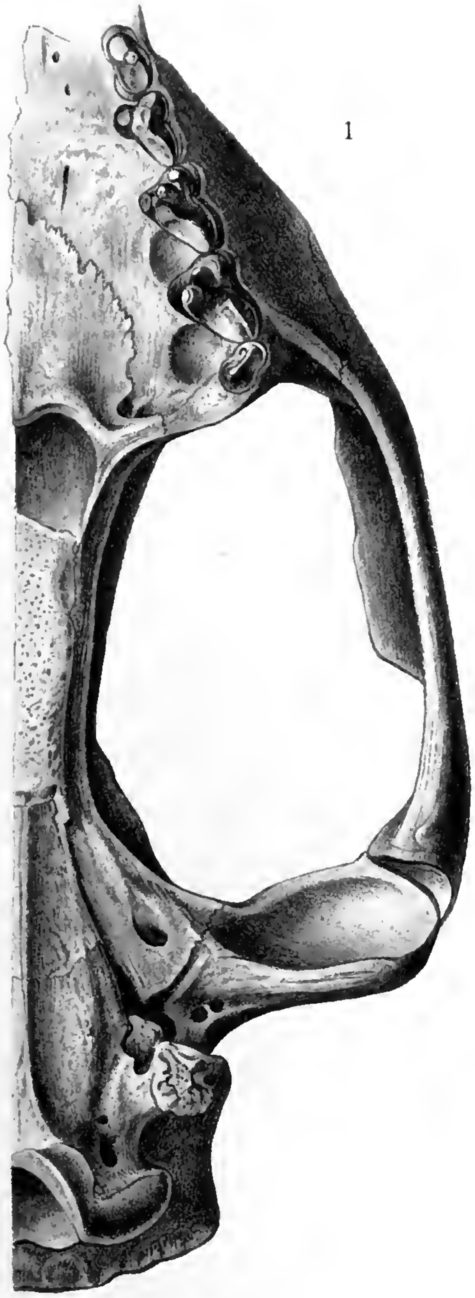
Fig. 3.	" "	Skull, posterior view (No. 15,700) .	364

All the figures are natural size.



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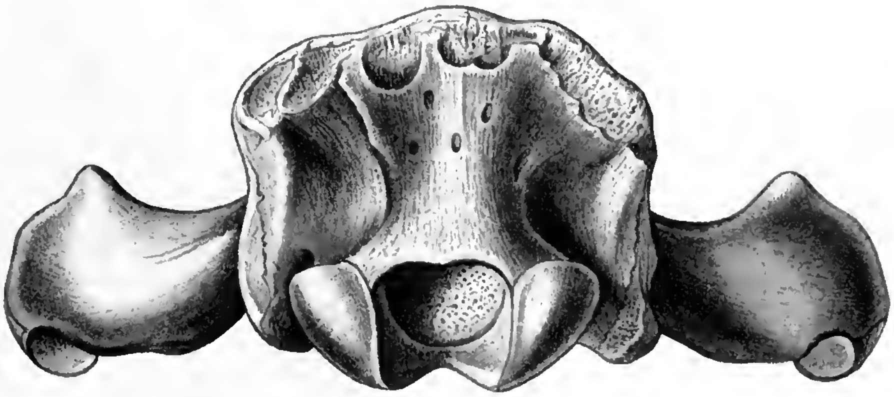

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Werner & Winter, Frankfort a/M., lith.

PROTHYLACYNUS.

EXPLANATION OF PLATE XLIX.

			PAGE.
Fig. 1.	PROTHYLACYNUS PATAGONICUS:	Right humerus, anterior aspect (No. 15,700)	367
Fig. 1*a*.	" "	Right humerus, posterior aspect (No. 15,700).	
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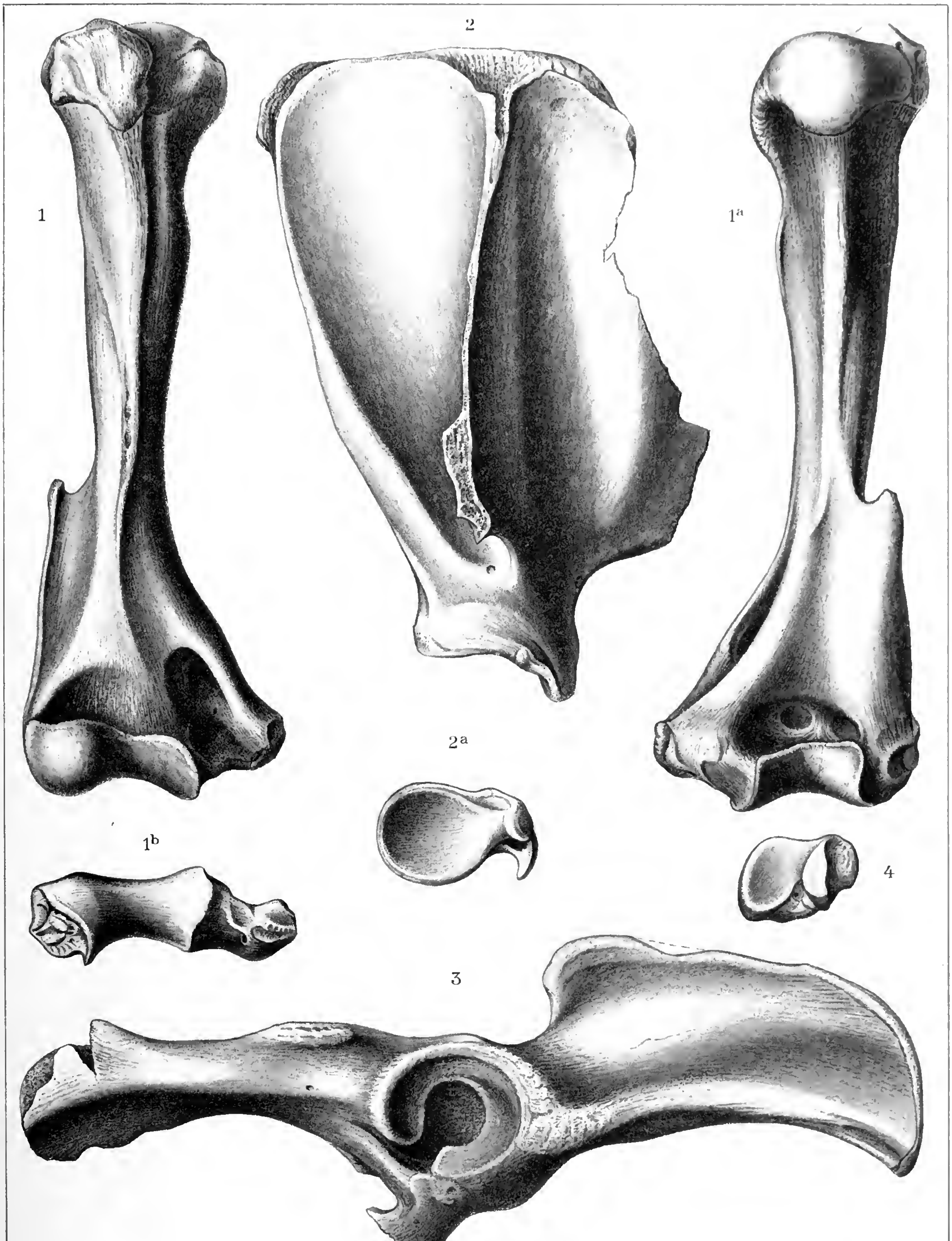
Fig. 3.	" "	Right half of pelvis, outer side (No. 15,700)	369
Fig. 4.	" "	Distal articular surface of tibia (No. 15,700)	370

All the figures are natural size.



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Werner & Winter, Frankfort a/M. Lith.

PROTHYLACYNUS.

EXPLANATION OF PLATE L.

			PAGE.
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Fig. 2*a*.	" "	Right femur, posterior aspect (No. 15,700).	
Fig. 3.	" "	Sacrum from below (No. 15,700) .	366
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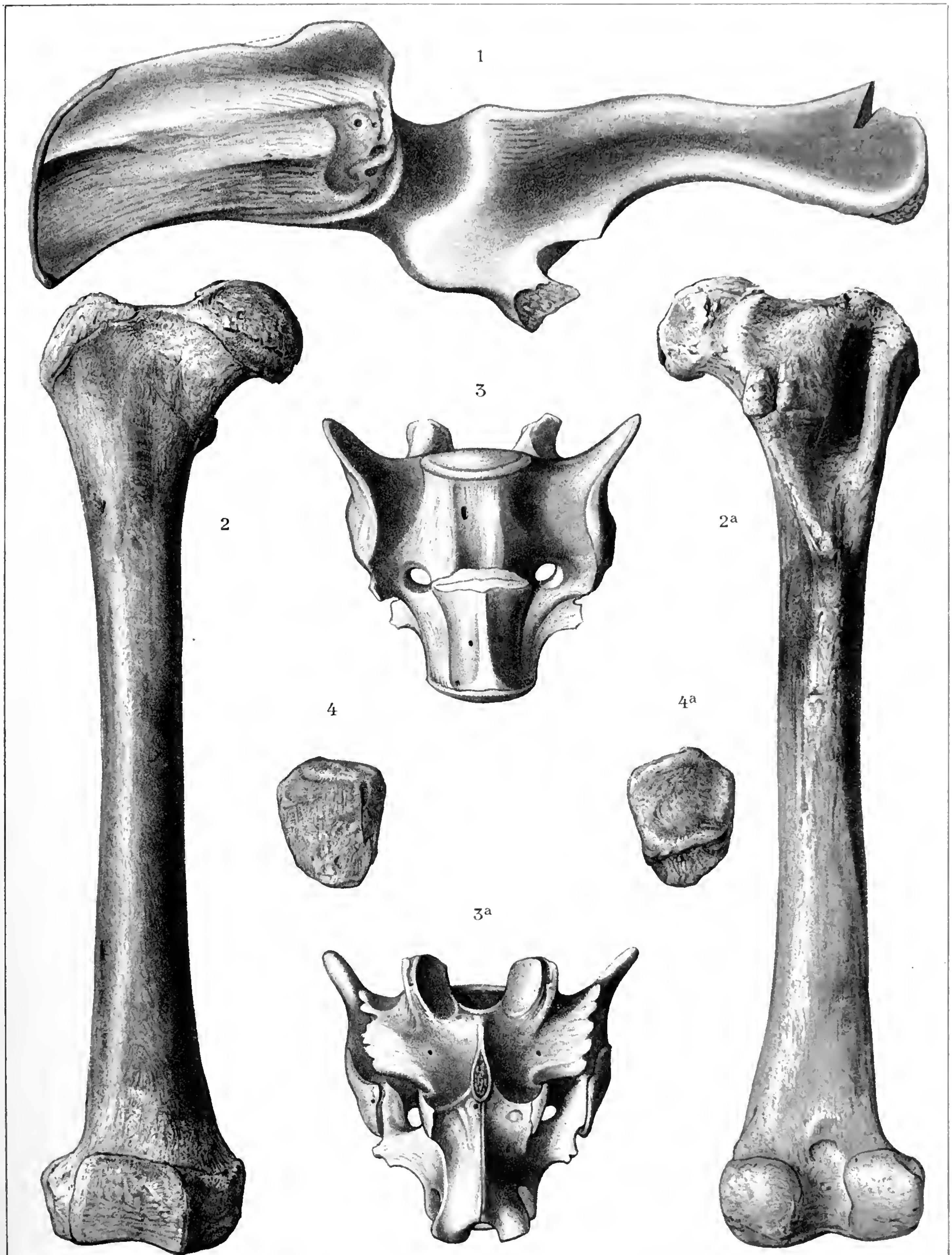
Fig. 4*a*.	" "	Right patella, posterior aspect (No. 15,700).	

All the figures are natural size.



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Werner & Winter, Frankfort a/M. lith.

PROTHYLACYNUS

EXPLANATION OF PLATE LI.

			PAGE.
Fig. 1.	PROTHYLACYNUS PATAGONICUS:	Right radius and ulna, outer side (No. 15,700)	368
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All the figures are natural size.

1

2

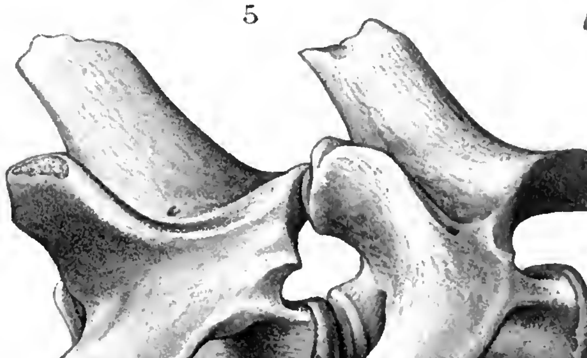
3

1a

1b

4

5



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F. v Iterson del. partim.

Werner & Winter, Frankfort a/M. lith.

PROTHYLACYNUS

EXPLANATION OF PLATE LII.

		PAGE.
Fig. 1.	BORHYÆNA TUBERATA: Cervical vertebræ from the left side (No. 15,701). The fourth cervical is missing .	351
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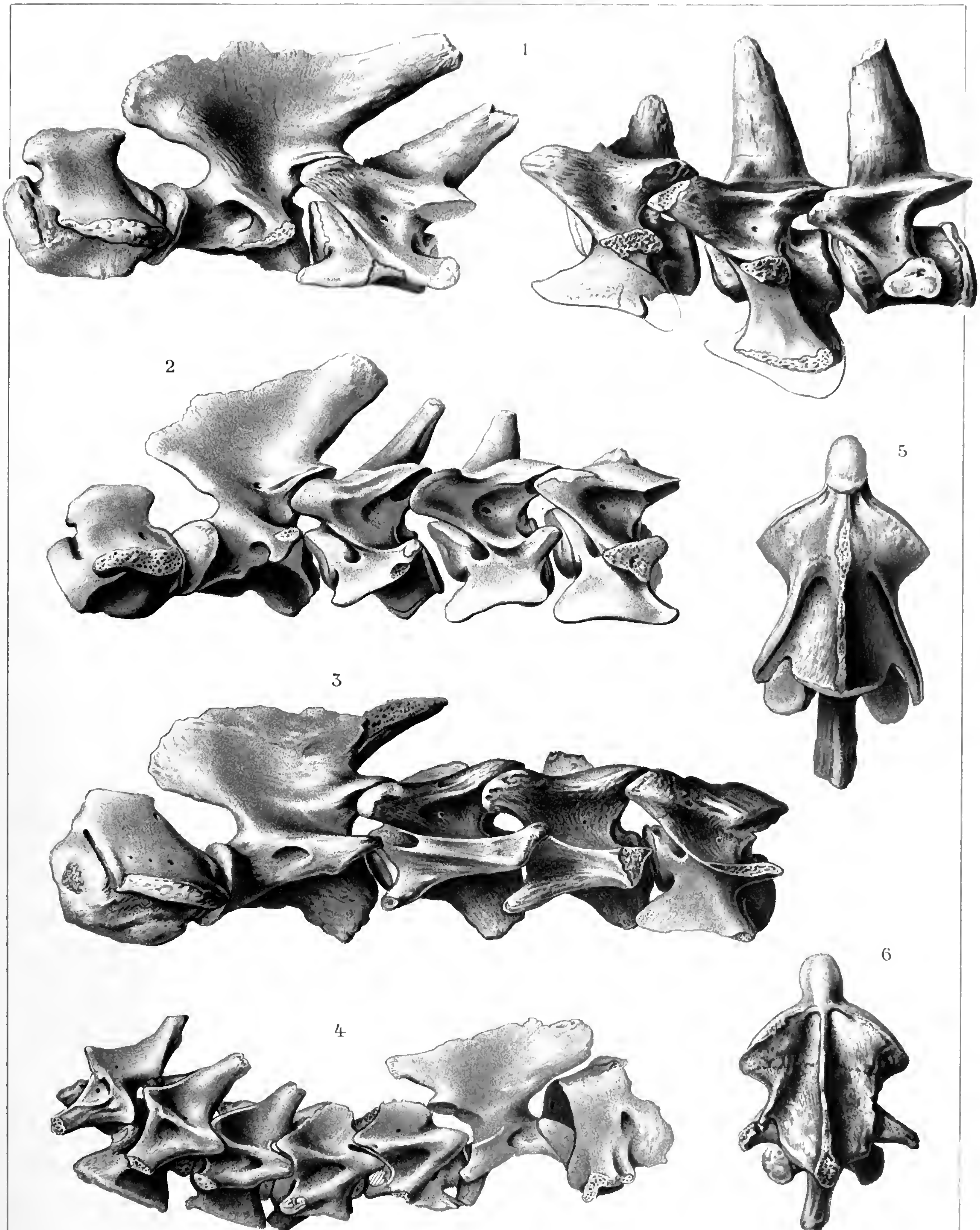
All the figures are natural size.



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BORHYÆNA, PROTHYLACYNUS, CLADOSICTIS

EXPLANATION OF PLATE LIII.

			PAGE.
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All the figures are natural size.

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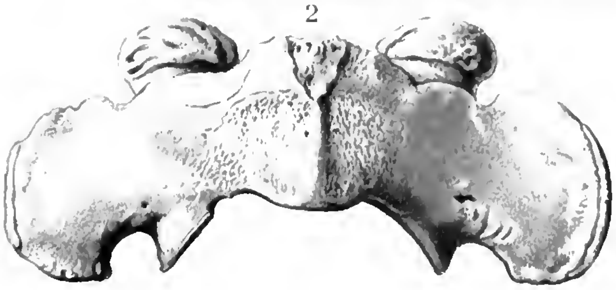

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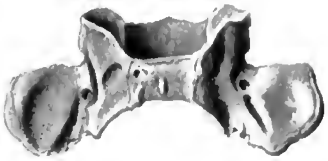

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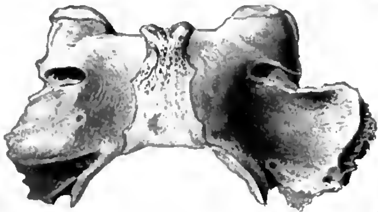

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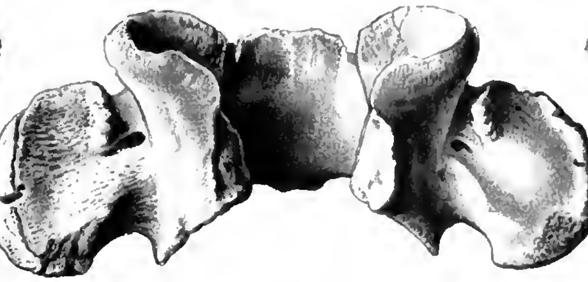

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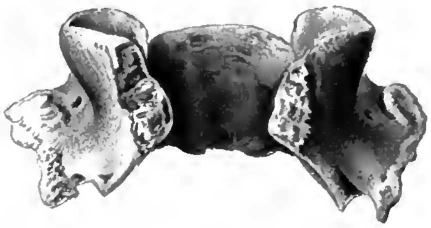

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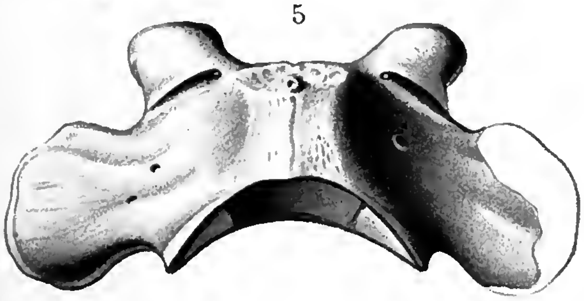

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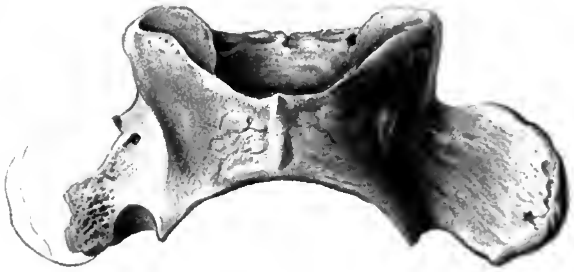

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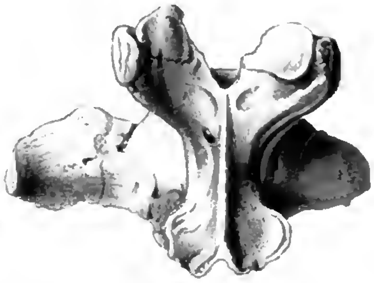

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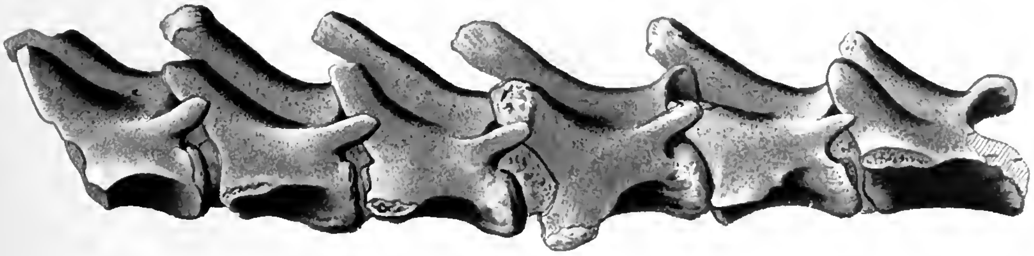

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SANTA CRUZ THYLACYNES

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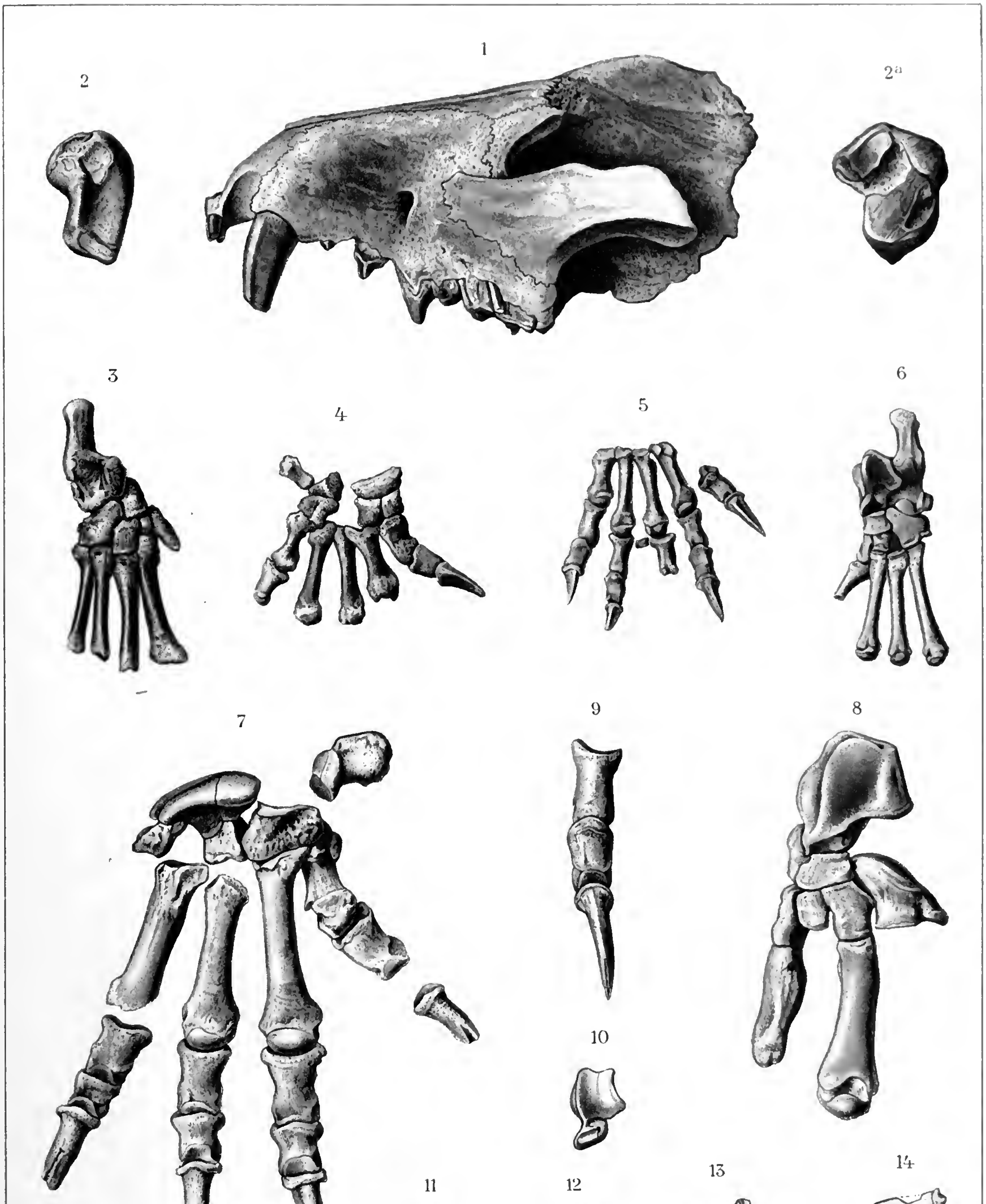

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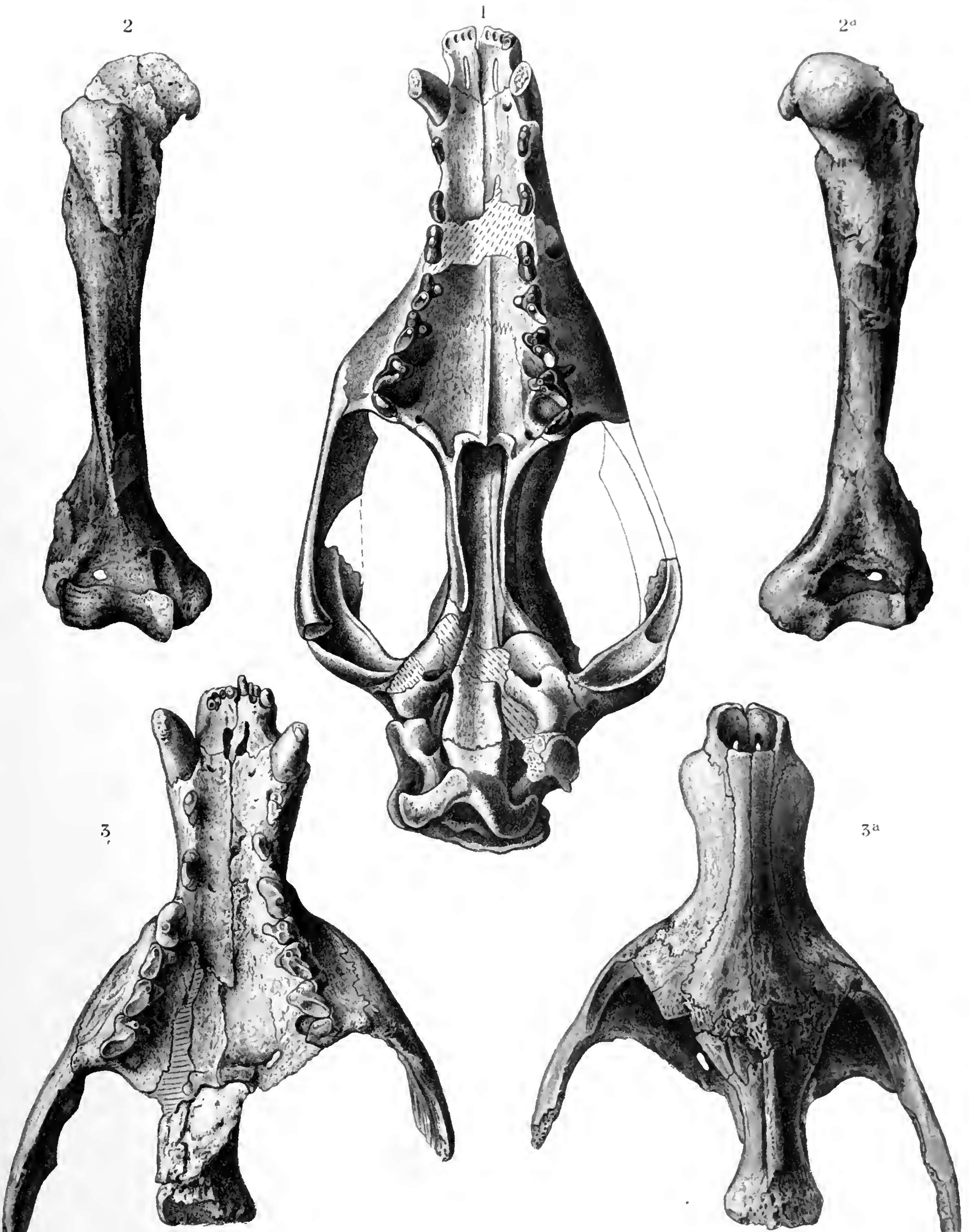

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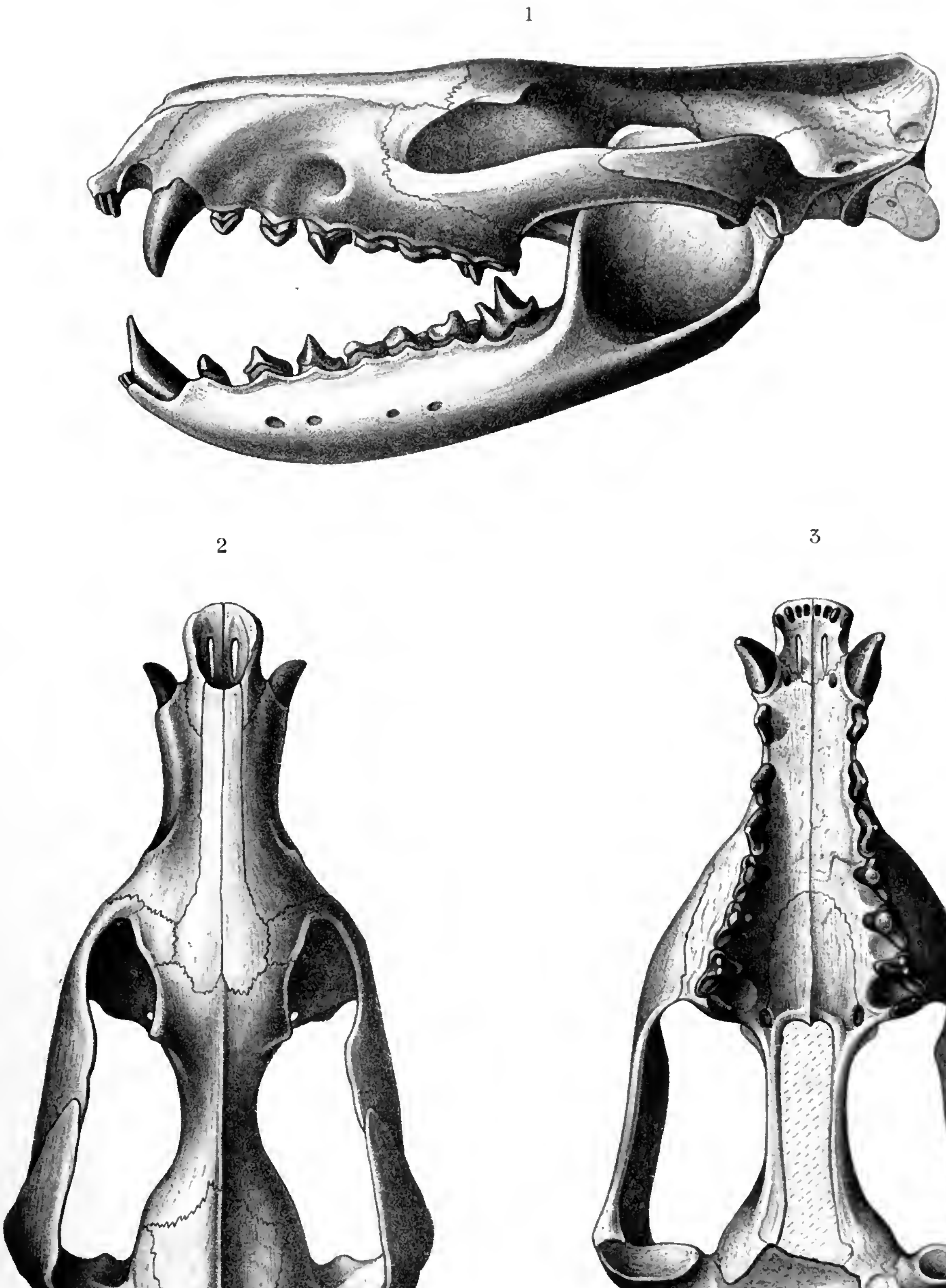

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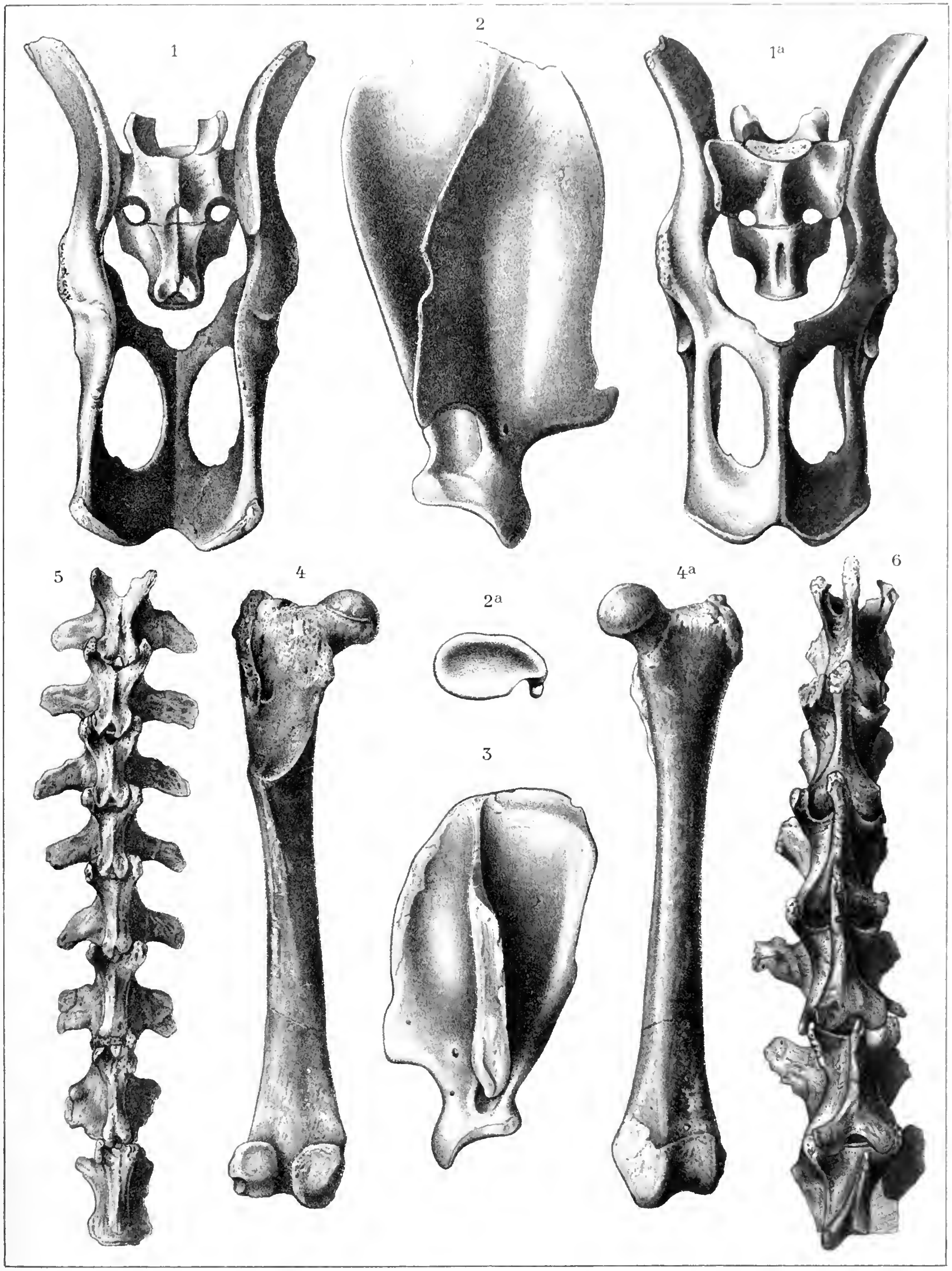

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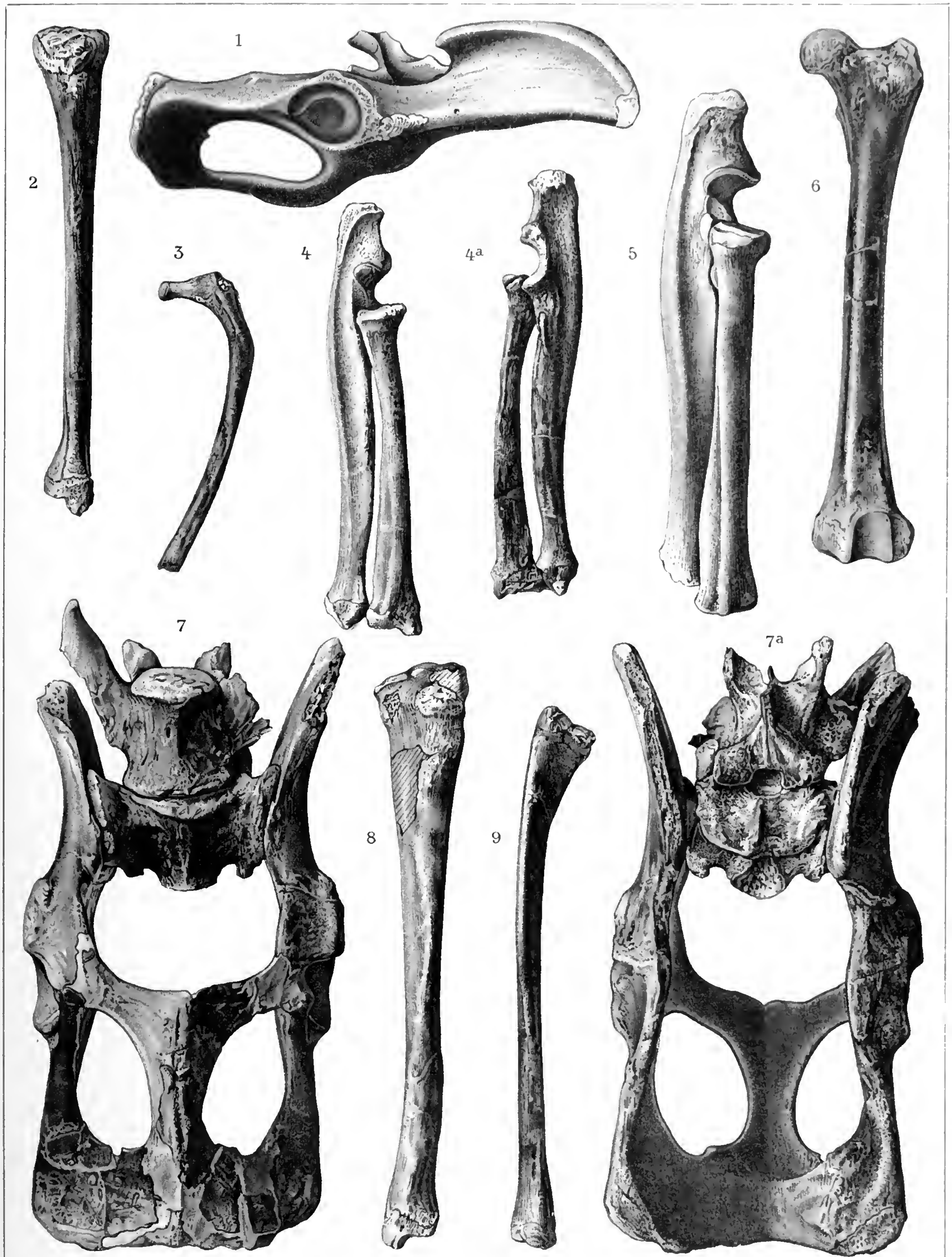

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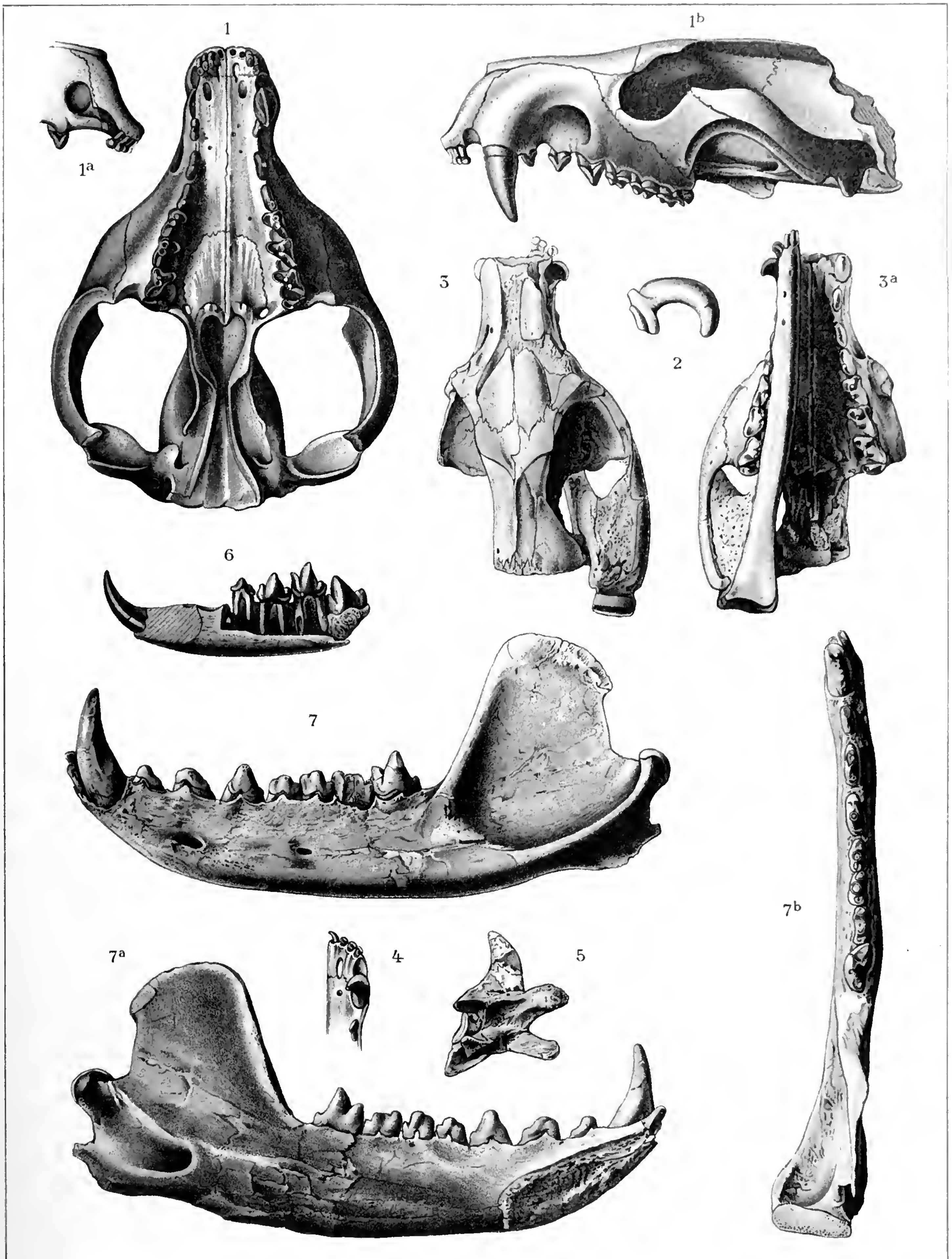

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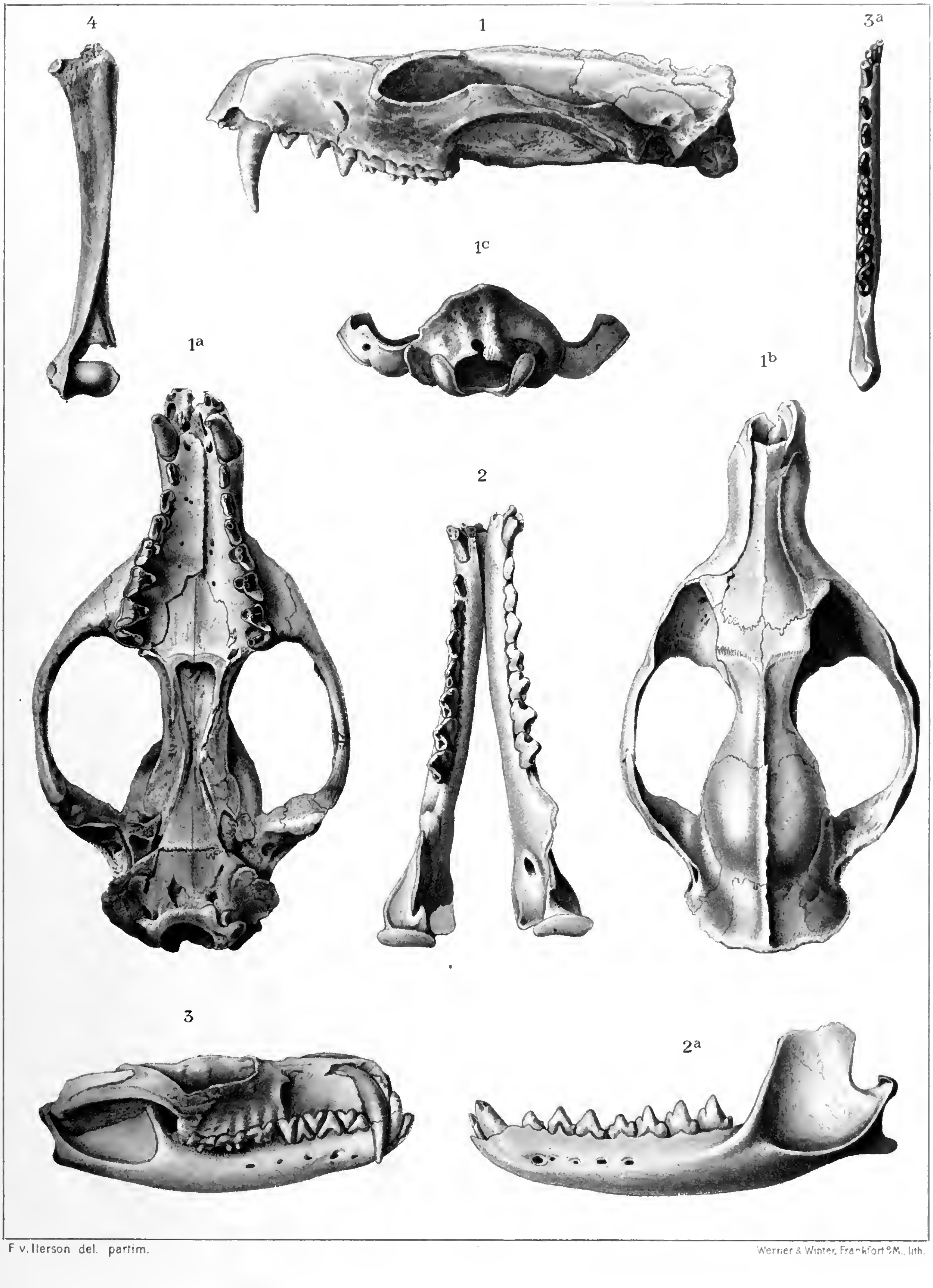

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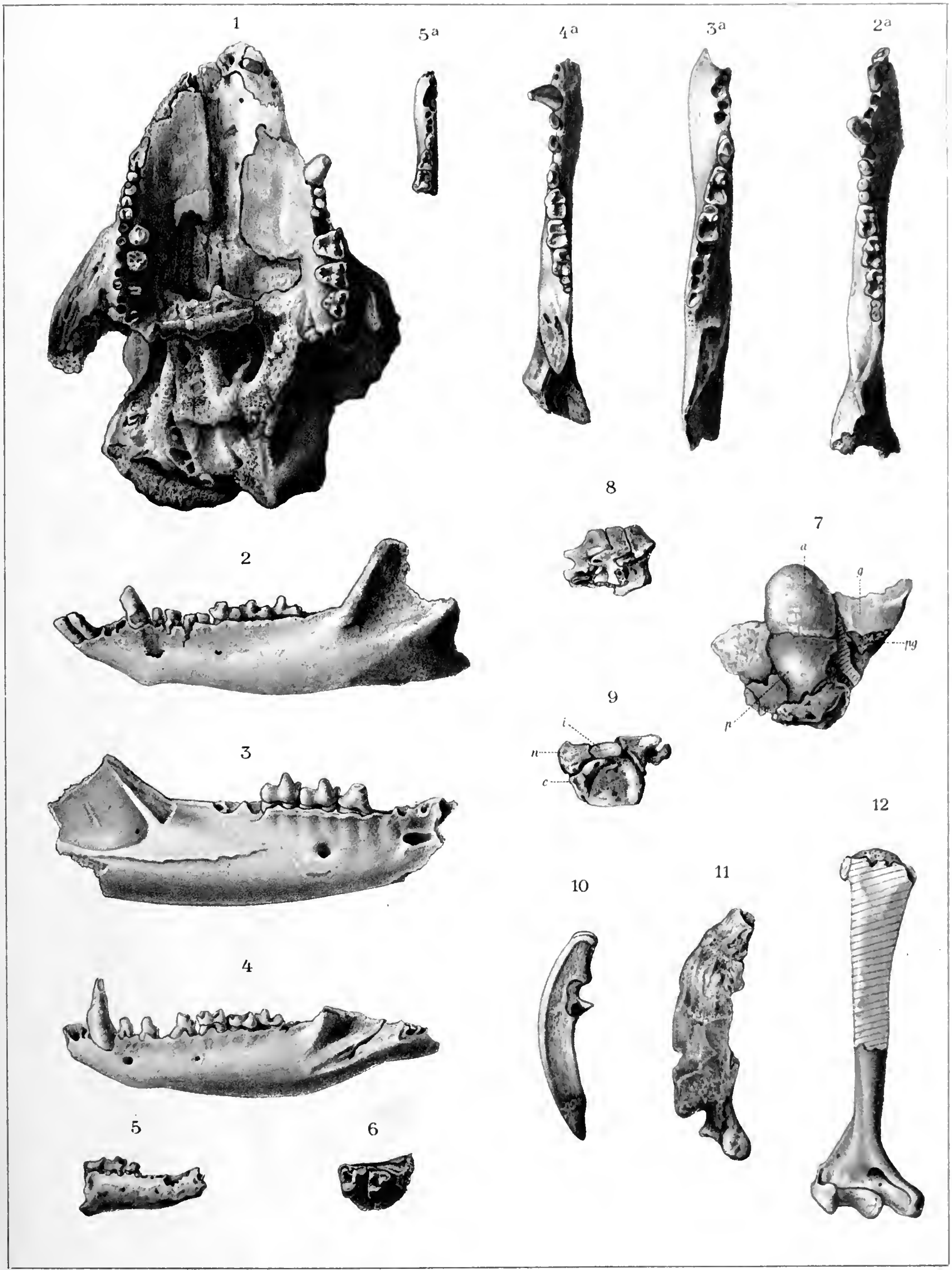

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MICROBIOTHERIUM.

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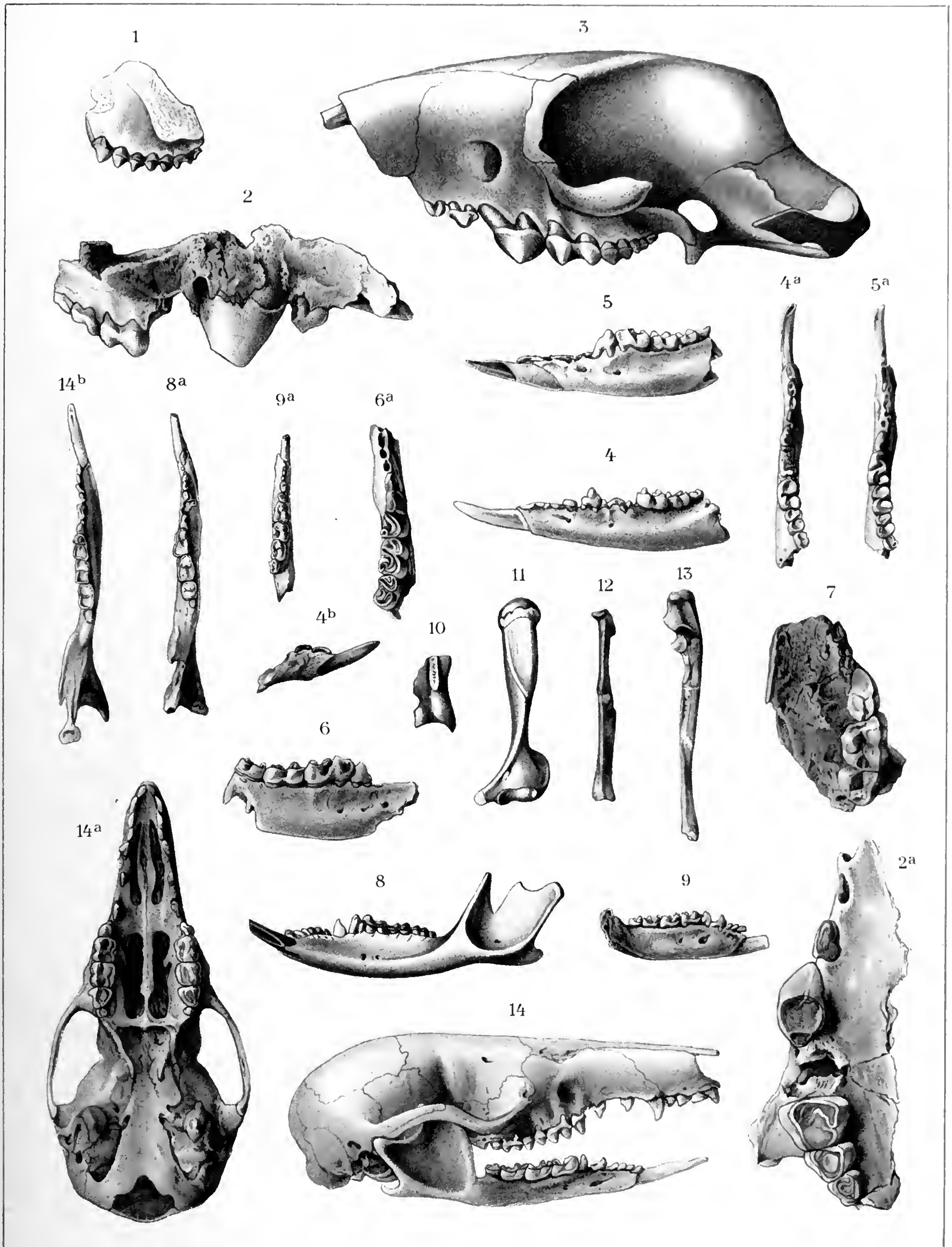

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All the figures are three times the natural size.

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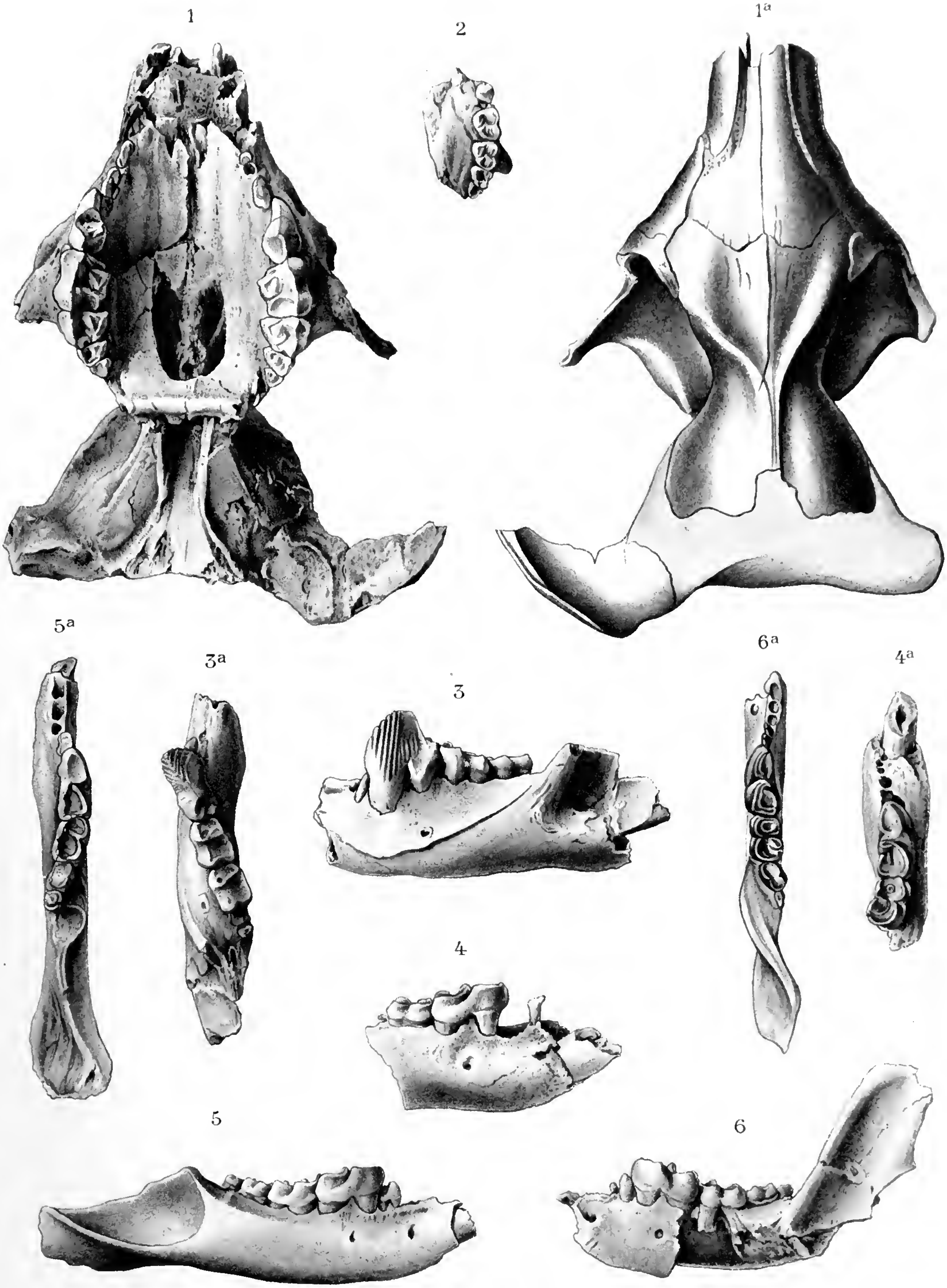

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CÆNOLESTIDÆ.

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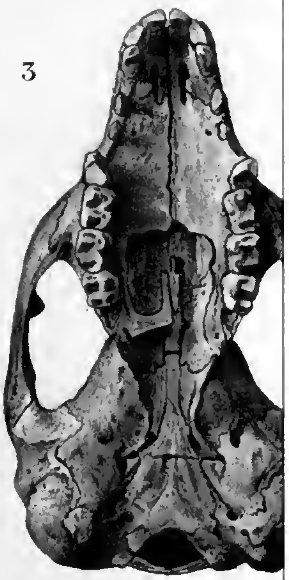

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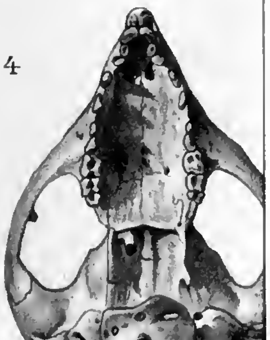

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