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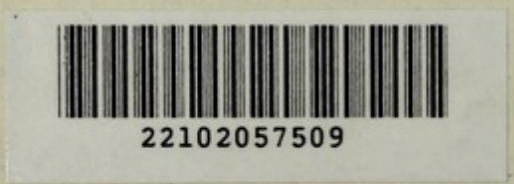
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THE FRESH-WATER FISHES OF CHILE

BY

CARL H. EIGENMANN

PRESENTED TO THE ACADEMY AT THE AUTUMN MEETING, 1924

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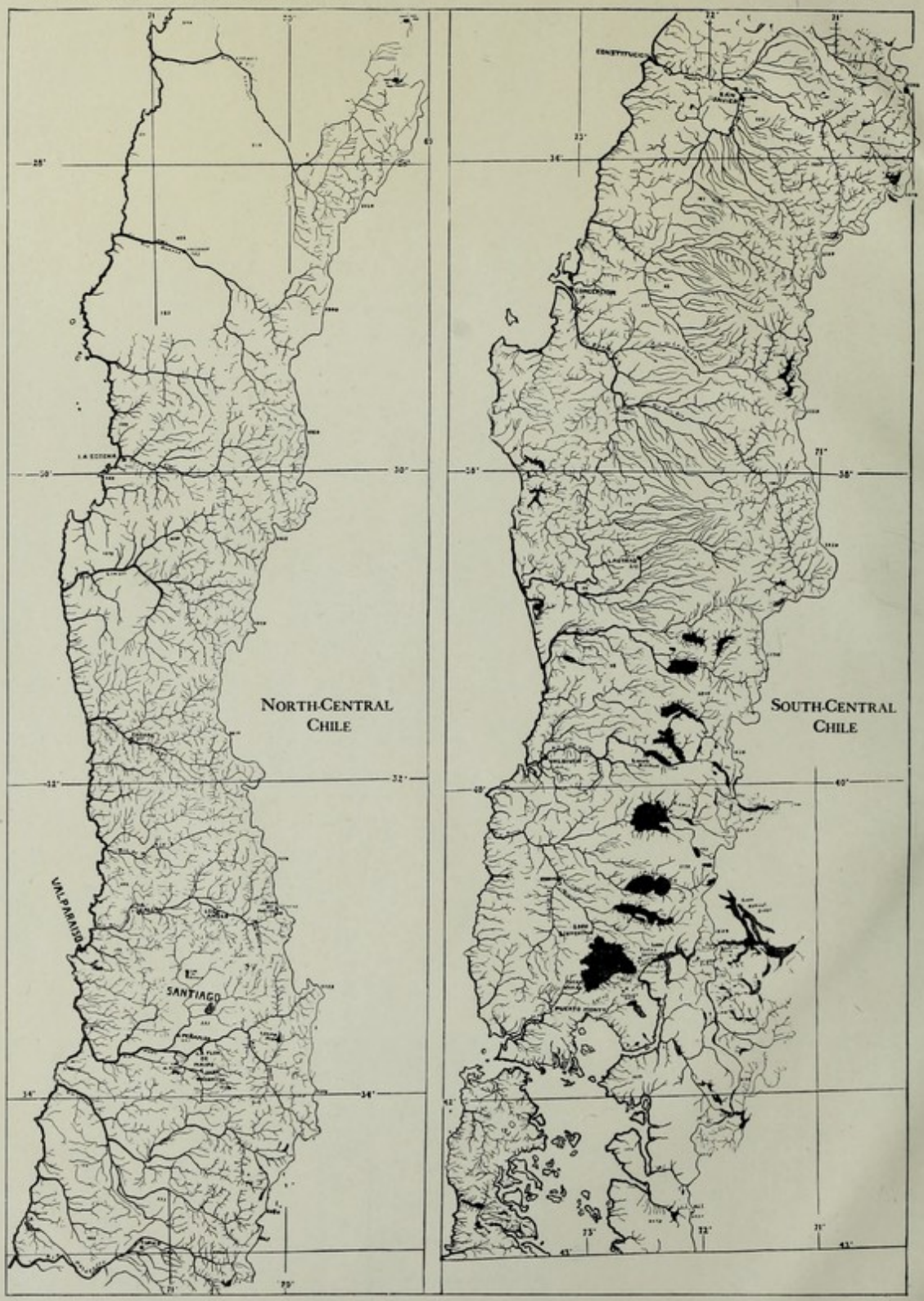

Base map of central Chile, the area covered by the present paper

THE FRESH-WATER FISHES OF CHILE

By Carl H. Eigenmann

INTRODUCTION

The present paper gives a general summary of my studies of the fishes of western South America and deals in detail with the fishes occurring in the lakes and rivers of Chile, north of Puerto Montt, exclusive of those of the highland in the northwest corner which properly belong to the Titicaca fauna.

Chapter I gives a general summary on the origin of the fishes of western South America, north of Chile.

Chapter II presents the summary of Chapter IV, and conclusions reached by a consideration of the facts presented by Chapter V.

Chapter III gives a résumé of previous papers dealing with Chilean fresh-water fishes.

Chapter IV gives an account of the Chilean part of the "Irwin expedition," which collected the material on which the present paper is based, and something of the physical conditions of the region covered.

Chapter V gives a detailed account of the material examined and a systematic revision of the families, genera, and species.

Acknowledgments

The trip to Chile in 1919 formed part of the "Irwin expedition" [1] of the Indiana University and the University of Illinois, made possible by the cooperation of Mr. William G. Irwin, of Columbus, Indiana, the Bache fund of the National Academy of Sciences, and the American Association for the Advancement of Science. It was organized to examine the rivers of the Pacific slope of Peru, the high plateaus of Peru and Bolivia, and the rivers of Chile.

Dr. William Ray Allen, traveling fellow of the University of Illinois, examined the region between Antofagasta and the Bolivian border along the railway. The authorities of the railway granted him free transportation. The Chilean Government provided me with transportation for myself and assistants over all of its lines. Dr. Ernesto Maldonado, Inspector General de Bosques, Pesca y Caza, and Mr. Gustavo Neff, of the Quinta Normal, helped with advice and their company on the trip to the Laguna del Inca. Dr. Carlos Porter, of the Museo Nacional in the Quinta Normal, gave me access to the collections under his care. I am under particular obligation to Colonel M. A. Chilton, at the time military attaché of the American Legation, in whose company the rivers of the southern end of central Chile were examined and who proved an enthusiastic fisherman.

Mr. Carlos Wiebrich was liberal with help and information about the fishes at Valdivia. He sent me several lampreys and the young of *Galaxias maculatus* collected while they were ascending the stream at Valdivia in enormous numbers. Mr. Augosto Brenning very generously contributed all of the Petromyzonidae in the cabinet of the German School of Valdivia at the time of my visit. Mr. Piedro Galusda, superintendent of the state hatchery at Lautaro, planned the collecting at Lautaro and gave much valuable information. He also contributed lampreys. Several specimens were contributed by Sr. Jose Gonzales y Gonzales.

The author began his studies on the fishes of western South America many years ago. Numerous brief papers describing collecting trips, new species, etc. have appeared from time to time since 1912.

[1] Science, N. S., vol. 50, pp. 100-102, 1919.

General conclusions were published in a series of shorter articles, especially:

"South America West of the Maracaibo, Orinoco, Amazon, and Titicaca Basins and the Horizontal Distribution of its Fresh-water Fishes." Indiana University Studies No. 45, pp. 1–24, June, 1920. (Issued December, 1920.)

"The Fishes of the Rivers Draining the Western Slope of the Cordillera Occidental of Colombia, Rios Atrato, San Juan, Dagua, and Patia," l. c., No. 46, pp. 1–19, map, September, 1920. (Issued January, 1921.)

"The Fresh-water Fishes of Panama, East of Longitude 80 W.," l. c., No. 47, A., pp. 1–19, plates (maps) 1–2, December, 1920. (Issued May, 1921.)

"The Magdalena Basin and the Horizontal and Vertical Distribution of its Fishes," l. c., No. 47, B, pp. 21–34, plate (map) 3, December, 1920. (Issued May, 1921.)

"The Origin and Distribution of the Genera of the Fishes of South America West of the Maracaibo, Orinoco, Amazon, and Titicaca Basins," Proc. Am. Philos. Soc., LX, pp. 1–6, 1921.

"The Nature and Origin of the Fishes of the Pacific Slope of Ecuador, Peru and Chile," l. c., LX, pp. 503–523, plates (maps) VIII–X, 1921.

"The Fishes of the Pacific Slope of South America and the Bearing of Their Distribution on the History of the Development of the Topography of Peru, Ecuador, and Western Colombia." Am. Naturalist, LVII, 1923, pp. 193–210.

A larger volume deals with:

"The Fresh-water Fishes of Northwestern South America, Including Colombia, Panama, and the Pacific Slopes of Ecuador and Peru, Together with an Appendix upon the Fishes of the Rio Meta in Colombia." Mem. Carnegie Mus., IX, October, 1922, pp. 1–346, plates I–XXXVIII; 21 text figures. (Issued January, 1923.)

In these papers descriptions and figures of species, maps, and comparative lists of species and their distributions are published, and the reader is referred to them for the details. In the present chapters these papers are reviewed, modified where necessary, or in part copied without quotations.

Fig. 1.—Rio Rimac, above Matucana

Fig. 2—Vitor valley, below Arequipa, in southern Peru. But one species of fishes, a Basilichthys, inhabits this part of the river. Another, a species of Pygidium, occurs at higher elevations

CHAPTER I

GENERAL SUMMARY ON THE ORIGIN OF THE FISHES OF WESTERN SOUTH AMERICA NORTH OF CHILE

From Panama to south-central Chile, everywhere except for a short distance inland from Piura, a mountain chain 10,000 feet and over divides the continent of South America into a broad eastern and a narrow western slope. A secondary eastern and western slope is provided by the Andes of Bogota in Colombia. The first question suggested by the condition is What are the faunas on the two slopes and what relation do the faunas bear to each other and to those of other regions? These and subsidiary questions are considered in detail in the papers quoted above. The general conclusions reached in the previous papers on western South America so far published are these:

1. The Rio Rimac, flowing from the crest of the Andes past Lima into the Pacific near the middle of South America, is inhabited by five different species of fishes. *Orestias elegans* is found only in the lakelets near its sources above 10,000 feet and represents the fauna of Lake Titicaca and the high Andes of central South America. The "Peje del rey," *Basilichthys archaeus*, is the northern vanguard of the fauna of Chile where the genus Basilichthys reigns a truly "regal" fish. The "Bagrecito," *Pygidium punctatum*, is one of a series of Pygidiums found in every mountain stream from Panama to southern Chile. For *Bryconamericus peruanus* and *Lebiasina bimaculata*, fishes of western Ecuador and Peru, the Rimac is the most southern habitat. The fauna is cosmopolitan but not extensive. In the "bagrecito," the "Liza del agua dulce," Lebiasina, the Rimac provides ready agents for the control of yellow fever.

2. The rivers south of Lima are small, periodic, or extinct. The fauna of the Pacific slope south of Lima, Peru, to south of Copiapo, Chile, consists of only a few species, the vanishing remnants of a fauna no doubt more extensive when the Andes were lower than at present and the western slope had a more abundant rainfall and a more extensive fish environment. The fauna consists in this area of (*a*) "runners in" from the ocean, Mugil, to the lower courses of rivers; (*b*) permanently fresh-water species derived from former runners in, Basilichthys; (*c*) left-overs of the mountain-stream fauna, Pygidium; and (*d*) migrants from the highlands, Orestias. Everything else has disappeared.

3. The fauna of the Pacific slopes of northern Peru is also very limited. The rivers of western Peru north of Lima are mostly permanent but with great annual fluctuations. The Piura is periodic in its lower course. The Santa is the largest and most permanent of the rivers; but little is known as yet of its fauna.

4. The fauna of northern Peru (Rio Piura and Rio Jequetepeque) differs from the fauna of the Rimac in the absence of the Chilean and Titicacan elements and the addition to it of a few more Guayaquilian species or genera.

5. The fauna of western Ecuador is much more extensive than that of Peru, in proportion as the Guayas basin offers a more extensive environment than the rivers of Peru. Sixty species have certainly been taken in the Guayas basin. Of these the species of Astroblepus and Pygidium belong to the highest altitudes and follow their own laws of dispersal. Twenty belong to families and genera that are found only in the lowland, some of them indifferently in salt or fresh water (Hexanematichthys, Stolephoridae, Haemulidae, Tylosurus, Centropomidae, and Gobiidae). This leaves of strictly fresh-water species only 34. Of the 34 only *Sternopygus macrurus* and *Lebiasina bimaculata* are certainly found east of the Andes. *Only four of the species extend north of the Rio Esmeraldas.* These are *Chaetostomus fischeri*, north to the Chagres;

Chaetostomus marginatus, north to the San Juan; *Sternopygus macrurus*, found to the Atrato and Magdalena; and *Hoplias microlepis*, which, besides in the Guayas basin, is found also in the Chagres.

Of these four *Sternopygus macrurus* attains a much larger size in the Guayas than elsewhere and may represent a variety distinct from the northern and eastern specimens. It is the only species of the Guayas also found in the Magdalena and east of the Andes.

Hoplias microlepis disappears north of the Esmeraldas to appear again in the Chagres. The entire region between is occupied by *Hoplias malabaricus*.

Only four species of the Guayas extend south into Peru—*Lebiasina bimaculata* and *Bryconamericus peruanus* to the Rio Rimac, *Aequidens rivulatus* and *Brycon atricaudatus* to Pacasmayo.

The remaining species are confined to the Guayas and the immediate neighborhood.

6. The 34 strictly fresh-water fishes of the Guayas belong to 28 genera (not counting Gambusia and Ancistrus, which are in doubt), of which 7 (25 per cent) are peculiar—Paracetopsis, Saccodon, Pseudochalceus, Phenacobrycon, Landonia, Rhoadsia, and Pseudopoecilia. All but one of the rest of the genera, Microglanis, are also found in the north and east of the Andes.

7. The Guayas fauna is as distinct from that of the Magdalena as from that of the Amazon. It differs more from the fauna of the Patia, emptying into the Pacific only a hundred miles north of the Esmeraldas, than the Magdalena fauna differs from that east of the Andes.

8. Whence came the ancestors of the Guayas fishes?

Pseudopoecilia, one of its peculiar genera, is of undoubtedly northern derivation. *Hoplias microlepis*, found elsewhere only in the Chagres, and possibly Rhoadsia, scarcely distinct from Parastremma, which extends to Costa Rica, may also indicate that the ancestors of these present genera came from the north. The probability seems, however, equally great that they arose in the Guayas and moved north or that the species both north and south are independent developments from the fauna originally segregated from the east. Pellegrin records a Poecilia from the Rio Pove. Whatever the species may be it is certainly of northern origin. Regan identifies some specimens from Ecuador as **Bryconamericus scleroparius,** a Costa Rican species.

Of the Guayas genera, Microglanis, Paracetopsis, Leporinus, Prochilodus, and possibly Curimatus, indicate that the ancestors of the Guayas fishes came from the east. Microglanis is found east of the Andes but not in Colombia. Paracetopsis has its nearest relative in the Amazon, not in the north. Plecostomus, Ancistrus?, Leporinus, and Prochilodus are found both in the Amazon and in northern Colombia, but there is a hiatus in their distribution reaching from the San Juan to the Esmeraldas. They probably came independently into the Magdalena and into the Guayas (see No. 11). While Curimatus ranges everywhere in Colombia, the Ecuadorian species are very distinct from *Curimatus lineapunctatus* and its variety *patiae*, the only ones in the region between the Atrato and the Esmeraldas. Curimatus came independently into the Magdalena and into the Guayas. The same may be true of *Sternopygus macrurus*.

It is seen above that the ancestors of one of the genera peculiar to the Guayas, Pseudopoecilia, came from the north, those of another, Paracetopsis, from the east. The other five do not give exclusive evidence in favor of the eastern or northern origin of the Guayas fauna.

Of the genera confined to the Guayas basin, Saccodon is related to Parodon, found both in Colombia and east of the Andes. Its ancestors may have come from either place.

Phenacobrycon is a derivative of Bryconamericus, an artificial conglomeration of fishes, allied to Astyanax, abundant both east of the Andes and in Colombia.

The nearest relative of Pseudochalceus is Hollandichthys of southeastern Brazil. Are they of independent origin from Astyanax? Does the territory between them contain related forms?

Landonia is a minute derivative of Astyanax, a genus which is found everywhere. I do not see that it gives any evidence on the origin of the ancestors of the Guayas fishes.

Rhoadsia was mentioned above. It belongs to a subfamily peculiar to the Pacific slope of Ecuador and Colombia which also extends to Costa Rica. The young show all the characters of the Cheirodontinae found both in Colombia and east of the Andes. It does not help us to solve the question of the origin of the Guayas fauna.

Another genus of importance is Lebiasina, a recent derivative of Piabucina, *into which it still merges*, i. e., a variable per cent of specimens are born Piabucinas. Piabucina is found both in Colombia, Venezuela, and in eastern Ecuador. The ancestors of some of the species of Piabucina in Colombia may have come from Venezuela and those of Ecuador may have come independently from the Amazon. Lebiasina has recently been found in the valley at Cajamarca and down to the Marañon.

The fauna of the Guayas is certainly quite distinct from that of western Colombia. South of the Guayas basin the question has simply been which of the Guayas species originally segregated have been able to live or survive in the unfavorable conditions offered by the desert slopes of Peru.

9. At present the Guayas fauna is more different from that of the Magdalena on the same side of the Andes than that of the Magdalena is from that of the Orinoco basin across the high Andes of Bogota. The Guayas is simply the present gathering place of the Pacific slope fauna of Ecuador, not necessarily the original western habitat of these fishes.

10. It is quite within reason that the present fish fauna of the Guayas did not come from the east across a barrier, but that at a time preceding the origin of the present species a section of a fauna continuous from ocean to ocean was segregated from the rest by the formation of the mountainous screen between them.

The time when the segregation took place can only be given in terms of the lives of species. It happened before the present species were differentiated, long enough ago to permit many genera to develop on the Pacific slope, but *after* the general features of the tropical American fresh-water fish fauna had appeared.

11. Several of the prominent genera of the Guayas are also found in the Atrato-Magdalena, but not in the region between them. They have been independently acquired by the Magdalena and by the Guayas.

12. To summarize: The fauna of western Ecuador had in large part a common origin with that of the Amazon. It has less affinity to that of the Magdalena to the north of it than to that of the Amazon east of it. Its origin can best be explained on the assumption that at a time much earlier than the era of the continuity of the Magdalena fauna with that of the Orinoco there was a continuous fish fauna from the Pacific shores of Ecuador and northern Peru to the Atlantic shores. The development of the western Andes of Ecuador and northern Peru isolated the species living west of them from those living east of them. This isolation took place much earlier than the isolation of the Magdalena fauna by the Cordillera of Bogota. It took place before the development of the present species of Ecuador and before the development of many of the genera of the Guayas, but after the general features of the South American fauna were developed. Only two species of western Ecuador are also (one only possibly) found east of the Andes. Twenty-five per cent of the genera of Ecuador are peculiar.

13. The fauna of Colombia is much more extensive and its origin in toto much more complicated than that of Ecuador. The northern boundary of the Guayas fauna or the southern boundary of the Colombian fauna lies between the Rios Mira and Esmeraldas. As stated above, only four species of the Guayas extend north of the Esmeraldas. Eight species of the north find their farthest south in the Mira-Esmeraldas.

14. In Colombia there was a similar segregation of fishes by the formation of the western Andes, but conditions have been modified by the formation of the Atrato and San Juan Rivers and the migration of fishes around the northern end of the western Cordilleras into the Atrato. It is now impossible in all cases to determine which are original segregates and their derivatives and which are immigrants around the northern end of the western Cordilleras. Certainly the fauna of the Atrato, which empties into the Atlantic, received many species from or was always

continuous with the fauna of the Magdalena. The Atrato passed some species on to the San Juan and through the San Juan to the Dagua and Patia on the south and to the Tuyra on the west.

15. The Atrato-San Juan Valley was developed as the result of the formation of the coastal Cordillera. The Atrato collected the water from the western streams of the northern Pacific slope and conveyed it into the Atlantic; the central Pacific streams were conducted by the San Juan into the Pacific. The height of land separating the Atrato and San Juan is but little over 300 feet. South of the San Juan the Pacific Slope streams still drain directly into the Pacific Ocean. I discussed the fauna of this area in Indiana University Studies No. 46.

16. For the fauna of the streams north of the Esmeralda emptying directly into the ocean the Patia, which is best known, is typical. The only unique feature of the Patia is that in a late period of its life it captured part of the upper drainage of the Cauca. It did this after the area was so elevated it captured only *Hemibrycon tolimae* aside from some highest Andean species. The fauna of the Patia consists, as far as known, of 34 species. These belong to several ecological groups.

I. High Andean forms: *Pygidium taenium, Astroblepus grixalvii* and *chotae, Bryconamericus caucanus, Hemibrycon tolimae.* All but the first of these are also found in the Cauca, and all but the last two are also found south of the upper Patia.

II. Lowland species of remote marine origin: *Tylosurus fluviatilis, Thyrina colombiensis, Pomadasys,* and the members of the Gobiidae. All of these, except possibly *Thyrina colombiensis,* are found both north and south of the Patia.

III. Twenty-five strictly fresh-water fishes living somewhere between brackish water and 3,000 feet. Of these:

a. One has a wide distribution both north and south of the Patia: *Sternopygus macrurus.* It may have come from the south or the north.

b. Other species and varieties: *Bryconamericus guaitarae. Curimatus lineopunctatus patiae,* and *Chaetostomus leucomelas* are peculiar to the Patia. They are modifications of San Juan-Atrato species.

c. *Hemiancistrus annectens* and *Cichlasoma ornatum* are all but confined to the Patia, being found elsewhere only in northwestern Ecuador.

d. The remaining species, 68 per cent of the 25 strictly fresh-water species, are found in one or all of the rivers Dagua, San Juan, Atrato to the north. A few of them, *Pseudopimelodus transmontanus, Pimelodella grisea, Loricaria jubata,* and *Brycon oligolepis,* found in the north, extend a few miles south of the Patia into northwestern Ecuador.

Twenty-two species, 62 per cent of the entire Patia fish fauna, are known to occur in the Atrato, the San Juan, or the Dagua.

The very large per cent of the Patia fishes also found in the Atrato-San Juan, compared with a much smaller per cent found in the nearer Guayas, indicates beyond any peradventure that faunally the Patia belongs to the group of rivers to the north of it.

Leaving out of consideration the high mountain forms, the only species that indicates interchange between the upper Cauca on the one hand and the Dagua or Patia on the other, is *Brycon henni,* a species not found in the Atrato. It is known to reach an elevation of at least 3,700 feet.

The Patia does not contain "boca chicas" (=Prochilodus), "dentones" (=Leporinus) or Plecostomas, all of which are found in the Guayas to the south and in the Atrato to the north, but not in the Dagua or the San Juan.

The fact that the upper Cauca has contributed so very little to the Dagua, or the latter so little to the Cauca, when the passes to cross have an elevation of but 6,000 feet, does away with the probability that any of the Magdalena fishes have come across the present high Cordilleras separating the Magdalena basin from the Orinoco.

17. The faunas of the valley of the Atrato and San Juan, 250 miles long, with gradual slopes and a narrow height of land between them of only 330 feet, are surprisingly different in spite of their great similarity. In the Atrato and San Juan there are now known 112 species of fishes. Only 31, or about 28 per cent, of these are common to the two rivers.

In the Atrato alone 72 species have been observed; in the San Juan alone 71 species. The 31 species common to the Atrato and San Juan form about 44 per cent of the entire San Juan fauna. Of the fishes inhabiting the San Juan and other west-coast streams 42 species have not been taken in the Atrato.

The species common to the Atrato and San Juan basin belong to one of four groups:

a. Those common both north and south of the San Juan.
b. Those common north of the Atrato, finding their farthest south in the San Juan.
c. Those common south of the San Juan, finding their farthest north in the Atrato.
d. Those confined to the two rivers.

To the first of these classes belong *Rhamdia wagneri, Chaetostomus fischeri, Sturisoma panamensis, Hyphessobrycon panamensis,* the latter represented by different varieties in the north and south, *Hoplias malabaricus, Sternopygus macrurus.* Of these only the first and last are found as far south as the Rio Guayas.

Those common north of the Atrato which find their farthest south in the San Juan and which probably migrated south are *Loricaria variegata, Piabucina panamensis, Astyanax fasciatus, Creagrutus affinis, Thoracocharax maculatus, Ctenolucius beani, Rivulus elegans, Aequidens latifrons, Gymnotus carapo.*

Those finding their farthest north in the Atrato, some of which probably moved from the San Juan to the Atrato, are *Hemicetopsis amphiloxus, Loricaria jubata, Curimatus lineopunctatus, Brycon oligolepis, Bryconamericus ortholepis, Parastremma sadina, Tylosurus fluviatilis.* Some of these may have originated in the Atrato and migrated southward.

Those confined to the two rivers are *Ancistrus centrolepis, Lebiasina multimaculata, Argopleura chocoensis, Nematobrycon amphiloxus, Gephyrocharax chocoensis, Priapichthys nigroventralis, Geophagus pellegrini, Aequidens biseriatus, Cichlasoma atromaculatum.* The second of these probably migrated from the San Juan to the Atrato; most of the rest moved in the opposite direction.

Those which find their farthest north in the Atrato, or their farthest south in the San Juan, and which evidently moved north or south, by no means indicate the limit of the intermigration of species between the two river basins. About six genera which are represented by distinct varieties or species in the two river basins and the ancestors of all of these probably migrated from the one to the other in more remote times, or what, in a measure, amounts to the same thing, their now distinct varieties or species diverged from a common center. Noteworthy are the genera Nannorhamdia, Hemiancistrus, Rœboides.

The relation of the San Juan fauna to that of the Atrato is less intimate than that of the Atrato to that of the Magdalena, or that of the Paraguay to that of the Amazon, more intimate than that of the Magdalena to the Orinoco fauna. The insignificant divide at Istmina has been an effective barrier against the southward migration of a number of genera. As mentioned before, the genera Plecostomus, Prochilodus, and Leporinus swarm in the Magadalena and Atrato. They are also found in the Guayas, but not in the San Juan, Dagua, or anywhere between the Atrato and Guayas basins.

Those species or genera which find their farthest north in the San Juan, or their farthest south in the Atrato, very probably arose in the San Juan or south in the one case, or in the Atrato and north (which in this case includes the Magdalena), in the other.

Astyanax fasciatus is overabundant in the Atrato. A few specimens were taken in the San Juan basin near the Atrato basin, and it is quite possible that they have but very recently gone over to the San Juan.

Of the species found both east and west of the Andes of Bogota, only *Astyanax fasciatus, Gymnotus carapo, Sternopygus macrurus,* and *Hoplias malabaricus* are found in the San Juan.

18. Forty-five per cent of the species of the Atrato are known to occur in the Magdalena. Eight more species (about 10 per cent) have parallels in the two rivers. Ninety per cent of its genera are also found in the Magdalena. The affinity or origin of these 90 per cent is certainly Magdalenan.

Four more genera—Bunocephalus, Hemiancistrus, Ancistrus, and Piabucina—are found east of the Cordillera of Bogota and will probably be found in the Magdalena.

The genera of the Atrato not represented in the Magdalena are:

Pristis, a marine genus.
Lebiasina, otherwise found in Colombia only on the Pacific slope. (Probably immigrant from the San Juan and the south.)
Phanagoniates, autochthonous or from the Tuyra.
Nematobrycon, confined to the Atrato and the San Juan.
Parastremma, Atrato, San Juan, and Patia.
Pterobrycon, autochthonous.
Microbrycon, probably the female of the preceding.
Neoheterandria, Atrato.
Thalassophryne, marine.

It appears that either the Atrato and Magdalena received the ancestors of their fishes largely from the same source or the one derived its fauna from the other, or the faunas of the two rivers have always been continuous.

The degree of affinity of the Atrato fauna to that of the Magdalena is about the same as that of the Paraguay to that of the Amazon. As far as known, the per cent of Atrato species found in the Magdalena is really less, but the extreme lowland fauna and the extreme highland fauna of the Atrato will most probably bring the per cent of identical species into the neighborhood of 50, if not to a higher per cent.

19. It is also probable that species of genera found in Guayaquil, the Patia, and the San Juan were also early segregates, such as Rhamdia, Pimelodella, Hemiancistrus, Chaetostomus, Curimatus, Lebiasina, Piabucina, Brycon, Hyphessobrycon, Bryconamericus, Sternopygus, Aequidens, Cichlasoma, Hemicetopsis. It is also probable that such genera as are found both in the Guayas and in the Atrato, but not in the area between the Esmeraldas, and the Atrato are later immigrants into the Atrato which have not been able to surmount the low divide at Istmina. Such genera are Plecostomus.

A large number of interesting and distinct genera are either peculiar to the rivers of Panama, Colombia, and Ecuador draining into the Pacific, or are found only in the Atrato or the Chagres of the Atlantic slope. They are:

1. S., Paracetopsis, (Cetopsidae), Guayas basin.
2. S., Saccodon, (Characidae), Guayas basin.
3. S., Pseudochalceus, (Characidae), Guayas basin.
4. S., Phenacobrycon, (Characidae), Guayas and Esmeraldas.
5. S., Landonia, (Characidae), Guayas basin.
6. S., Rhoadsia, (Characidae), Guayas basin.
7. S., Lebiasina, (Characidae), Atrato to southern Peru.
8. C., Pseudopoecilia, (Poeciliidae), Guayas and west of it.
9. C., Priapichthys, (Poeciliidae), Chagres to Atrato.
10. C., Poeciliopsis, (Poeciliidae), Chagres and Dagua.
11. C., Neoheterandria, (Poeciliidae), Atrato.
12. C., Diphyacanthus, (Poeciliidae), San Juan.
13. C., Neotroplus, (Cichlidae), Chagres and northward.
14. C., Theraps subgen., (Cichlidae), Tuyra and northward.
15. C., Astatheros subgen., (Cichlidae), Guayas, Patia, San Juan, and northward.
16. S., Compsura, (Characidae), Chagres to Tuyra.
17. S., Pseudocheirodon, (Characidae), Chagres to Tuyra.
18. S., Phanagoniates, (Characidae), Tuyra and Atrato.
19. S., Nematobrycon, (Characidae), Atrato-San Juan.
20. S., Parastremma, (Characidae), Atrato-San Juan-Patia.
21. S., Pterobrycon, (Characidae), Atrato.
22. S., Microbrycon, (Characidae), Atrato.
23. P., Hemieleotris, (Gobiidae), San Juan, Pacific slope of Panama.
24. P., Leptophilypnus, (Gobiidae), Chagres.
25. P., Microeleotris, (Gobiidae), Canal Zone, both slopes.
26. S., Leptancistrus, (Loricariidae), Tuyra basin.

The first seven of these, or their ancestors, belong to those supposed to have originally segregated from the Amazonian fauna; Nos. 8 to 15 have filtered into this region from Central America; the ancestors of Nos. 16, 17, 18, 19, 20, 21, and 22 belong to those supposed to have been segregated by the formation of the Colombian portion of the western Cordilleras; 26 is a secondary derivative of these; the rest, Nos. 23, 24, and 25, are peculiar Panamanian derivatives of the marine Gobiidae. The stock to which they belong is indicated in each case by S., South American; C., Central American; P., Panamanian. It is also probable that species of genera found in Guayaquil, the Patia, and the San Juan were also early segregates, such as Rhamdia, Pimelodella, Hemiancistrus, Chaetostomus, Curimatus, Lebiasina, Piabucina, Brycon, Hyphessobrycon, Bryconamericus, Sternopygus, Aequidens, Cichlasoma, Hemicetopsis. It is also probable that such genera as are found both in the Guayas and in the Atrato, but not in the area between the Esmeraldas and the Atrato, are later immigrants into the Atrato which have not been able to surmount the low divide at Istmina. Such genera are Plecostomus, Leporinus, and Prochilodus. The last two of these are very abundant in the Atrato but are not found in the San Juan.

20. The Tuyra River in southeastern Panama descends from a divide of about 410 feet elevation between the Tuyra and Atrato basins to the Pacific. The origin of the Tuyra fauna is comparatively simple. (See Indiana University Studies No. 47 A.) Fifty species of fishes have been taken in the Tuyra, 19 of which were found in the Atrato, whence they came.

The genera of 20 more Tuyra fishes are represented in Colombia. Concerning the origin of most of the 19 species there can not be any doubt; they are abundant in the Atrato-Magdalena, and find their farthest north in the Tuyra or at least in the southern half of Panama. They moved from the Atrato to the Tuyra or were cut off from it.

Such undoubtedly are *Phanagoniates macrolepis, Ageneiosus caucanus, Loricaria variegata, Curimatus magdalenae, Astyanax fasciatus, Ctenolucius beani, Hoplias malabaricus,* and *Hypopomus brevirostris.*

It is possible that some species have more recently gone from the Tuyra to the Atrato, but originally all of them went in the other direction. *There is no direct evidence that any specifically Pacific slope forms have come over to the Atrato.* The tide of migration has all flowed westward. The strictly west-slope things like *Awaous transmontanus* and *Philypnus maculatus* have not come across into the Atrato. A number of species whose ancestors came from the Atrato have become more or less modified in the Tuyra. *Trachycorystes amblops* is a modified *fischeri; Pimelodus punctatus* a modified *clarias.*

The species common to the Atrato-Tuyra (18 per cent) as compared with the number of species common to the Atrato and San Juan (30 per cent) may be taken as an inverse measure of the difficulties both in time and physical barriers in crossing from the Atrato to the Tuyra and from the Atrato to the San Juan.

The 11 species of the Tuyra not found in the Atrato or not represented by a species of the same genus are: 1, *Lasiancistrus planiceps;* 2, *Leptancistrus canensis;* 3, *Astroblepus longifilis;* 4, *Apareiodon dariensis;* 5, *Compsura gorgonae;* 6, *Pseudocheirodon affinis;* 7, *Hemibrycon dariensis;* 8, *Sternarchus rostratus;* 9, *Mollienisia caucana;* 10, *Philypnus maculatus;* 11, *Awaous transmontanus.* Of these the genera of Nos. 1, 3, 4, 7, 8, 9, 10, and 11 are found in the Magdalena or the San Juan and will most probably be found in the Atrato between the two. Leptancistrus is derived from Lasiancistrus, Compsura, and Pseudocheirodon from Cheirodon, both found in Colombia. The genera of Nos. 1 to 8 find their farthest north in Panama.

Every consideration shows the close affinity of the Tuyra fauna to that of the Atrato, from which it has in large part been derived.

The origin of the faunas of two Atlantic streams, the Chagres and the Magdalena. (See Indiana University Studies No. 47, A and B.)

21. Forty-five species of fresh-water fishes were taken from the Chagres before the Panama Canal was cut. Of these, three species are peculiar to the Chagres. They are members of widely distributed genera. *Creagrutus notropoides* of the Chagres is the northern limit of the genus *Creagrutus notropoides* scarcely, if at all, distinct from *C. affinis; Brycon chagrensis* differs

but little from *B. striatulus* of the Pacific side; *Neotroplus panamensis* is the southernmost one of three species of this genus.

The Chagres contained no representatives of such Palearctic families as the minnows, suckers, Ameiurine catfishes, sunfishes, perches and darters, salmon or trout, sturgeons, etc. These families find their farthest south very largely north of Guatemala. The American eel is a sporadic visitant.

The 11 families represented in the Chagres belong to several distinct ecological groups. The Gobiidae, Atherinidae, Mugilidae, Centropomidae, and Poeciliidae are families with both fresh-water and marine species. The fresh-water genera of these families are largely confined to Central America, the Gobiidae finding their optimum about Panama. The Anguillidae spawn in the ocean.

The Poeciliidae and fresh-water Mugilidae are more distinctly Central American types than the Gobiidae, and the Chagres certainly got some of its genera of these families from the north, either by sea or by land. None of the genera of these families find their farthest north in the Chagres and only a few of the genera of the Poeciliidae extend farther south than Panama. Their ancestors most probably came from the north.

Remain then the Siluridae, Loricariidae, Gymnotidae, and Cichlidae.

Of the Siluridae, *Rhamdia wagneri* and *Pimelodella chagresi* represent the farthest north of genera everywhere on the Atlantic slope from Buenos Aires north and on the Pacific slope at least from Guayaquil north. The ancestors of these species undoubtedly came from the south. The Chagres species are common at least as far south as the Magdalena.

The Loricariidae flourish everywhere in South America north of Guayaquil and Buenos Aires and the ancestors of all four of the Chagres species came from the south and found their farthest north in the Chagres. Only one member of the family, *Ancistrus aspidolepis*, has gotten as far as northern Panama.

Of the Characidae, the Cheirodontinae, Piabucininae, and Erythrininae find their farthest north in the Chagres. The Glandulocaudinae reach Costa Rica; the Bryconinae and Characidae reach Guatemala. Only the Tetragonopterinae attain the United States. The Chagres undoubtedly got the ancestors of all of its Characins from the south.

The Cichlidae have undergone an elaborate evolution in Central America and Mexico as well as in South America, and there is evidence that the Cichlid fauna of the Chagres came in part from the north and in part from the south. The genera Geophagus and Aequidens universally distributed between Buenos Aires and Colombia find their farthest north in the Chagres, and the ancestors of *Geophagus crassilabris* and *Aequidens coeruleopunctatus* came from the south. The genus Neotroplus, on the other hand, is a Central American product. One species inhabits Nicaragua, one Costa Rica, and the third the Chagres. The genus reaches its farthest south in the Chagres, and the ancestors of *Neotroplus panamensis* may very well have come from the north. The same is true of *Cichlasoma maculicauda*, which finds its farthest south in the Chagres.

22. A number of species find their farthest north in the Chepo basin emptying into the Pacific south of the Canal Zone. Others have not succeeded in passing north of the Tuyra, as if their line of migration had been stopped at one or another of these rivers.

It is a remarkable fact that while 12 of the 23 species of strictly fresh-water families, the Characidae, Siluridae, Loricariidae, Gymnotidae, and Cichlidae, have crossed the divide at Panama, only *Sicydium salvini* of the 15 species of the marine and lowland Gobiidae is identical on the two sides. It would seem that the marine or lowland forms have been separated long enough to become specifically distinct on the two sides and that the intrusion and intermigration of the strictly fresh-water species has been more recent. The Isthmus may have been a barrier to the intermigration of marine forms long before it became suitable for colonization by fresh-water species which have not been long enough in the area to become altogether distinct on the two sides. It is also quite probable that a certain amount of intermigration from river to river is still taking place.

There is a very great probability that all of the immigrants of the Chagres from the south except the Atlantic slope Eleotridinae (Gobiidae) followed the route Atrato, Tuyra, Chepo (Grande?), Chagres, altho this involved two crossings of the Continental Divide. Only the partly marine Eleotridinae came by way of the ocean.

It appears that the ocean served to a very small extent as a highway for the migration of fresh-water fishes, even for such a short distance as that between the Atrato and Chagres. It is a separate question whether on the Pacific side the ocean, with its high tides and the long tidal areas of the Tuyra and Chepo, facilitated the migration of the fresh-water species from the Tuyra to the Chepo and Rio Grande.

23. The Magdalena fauna is more like that of the Orinoco than the Guayas fauna of Ecuador is like that of the Magdalena. The resemblance is five times greater if the number of identical species is taken as a criterion.

There are 150-odd species belonging to 70-odd genera of fresh-water and brackish-water fishes known to occur in the Magdalena basin.

Of these the common eel and the tarpon were contributed by North America through the Caribbean Sea. The tarpon found in the Caribbean Sea and the Gulf of Mexico enters many of the rivers discharging into them.

The common eel of North America descends the ocean to spawn, west of the Bermudas. The young mill about in the ocean for a year and then enter the rivers. So far but one small specimen collected by the expedition from the University of Michigan has been found in the Magdalena, or as far as that goes from any of the rivers of South America, exclusive of Panama. It was a stray.

Gambusia, Mollienisia, Agonostomus, and four genera of the Eleotridinae, possibly also Rivulus, were contributed to the fauna of the Magdalena by Central America.

Several genera pertain to the Andes and may be autochthonous or may have come from the south. Astroblepus is a high Andean genus forming the family Astroblepidae found in Venezuela, Colombia, Ecuador, and Peru, possibly also parts of Bolivia. Several species are found in the Magdalena basin. The genera Lasiancistrus, Pseudancistrus, and Chaetostomus of the Loricariidae or mailed catfishes, have nearly the same distribution as Astroblepus but do not reach such great altitudes. One species of each genus is found in the Magdalena basin. The genus Pygidium is a swift-water mountain genus distributed from southern Panama to Guiana and south to Rio Grande do Sul and Patagonia wherever high altitudes or swift water form a suitable environment for it. Several species are found in different parts of the Andes within the Magdalena basin.

Fifty-odd genera in the Magdalena basin, 76 per cent, are also found east of the eastern-most, the Cordilleras of Bogota. The rest are either peculiar to the Magdalena basin or to the Magdalena-Atrato-Chagres-San Juan. These are in detail:

Xyliphius confined to the upper Magdalena is an offshoot of Bunocephalus, a genus widely distributed from the Atrato to Paraguay but not yet caught in the Magdalena. Cetopsorhamdia and Nannorhamdia are catfishes derived from Pimelodella-like Pimelodinae, which are found abundantly in our area as well as east of the Andes.

Eremophilus, confined to the plain of Bogota, is an offshoot from Pygidium. It is a Pygidium without ventrals.

Grundulus, also confined to the plain of Bogota, is a member of the Cheirodontinae abundantly distributed in western Colombia as well as all through the east.

Genycharax of the Cauca is either a derivative of Charax or of Astyanax, both of which have a universal distribution in tropical America.

Microgenes and Argopleura are derivatives of Bryconamericus, the latter found also in the Atrato and San Juan.

Acestrocephalus replaces Acestrorhamphus of the east.

Ctenolucius replaces Xyphostomus.

Gilbertolus is an offshoot from Charax.

Othonophanes is derived from Brycon, if distinct.

There are no genera in all of those peculiar to the Magdalena which might not equally well have developed anywhere east of the Andes. Genycharax and Gilbertolus offer the greatest difficulty. While some of the genera are highly interesting, even thrilling to the naturalist, none of them is out of the ordinary evolution of genera elsewhere in tropical South America.

This brings us to the genera also found east of the Andes. A few of these belong primarily to Venezuela and the Guianas. They are:

Creagrutus, found along the eastern base of the Andes from the Rio Beni to Lake Valencia and even British Guiana.

Gephyrocharax, but recently discovered about Lake Valencia. Its place of greatest abundance is western Colombia.

Hemibrycon is found as far as Trinidad.

Panaque and Hemicetopsis are also found in the Amazon.

All of the rest of the numerous genera enjoy a universal distribution east of the Andes.

It would scarcely be possible to isolate any place as large as the Magdalena basin anywhere east of the Andes and north of La Plata that would not contain all of the rest of the genera.

Isolation by the formation of a barrier, the Andes of Bogota is the natural, most probable explanation of the present Magdalena fauna. The fauna of the Guayas and of the Dagua, Patia Mira, were segregated by the formation of such a barrier.

It is quite out of the question to transport all of these genera found on both sides over the present barrier, the Cordillera of Bogota, especially if we consider that the Cauca has not been able to contribute anything to the Dagua or Patia over a divide much lower. Either the Cordillera of Bogota is younger than the Magdalena and its growth cut off the Magdalena area with its fauna from a general lowland mass extending eastward from the Cordillera Central or there has existed a possible route of migration perhaps via Lake Maracaibo. The segregation could not have taken place very recently, for in most cases the species are distinct on the two sides of the Cordilleras. The segregation took place before the lifetime of most of the present species, long after the segregation by the western Andes, the Cordillera Occidentalis. It is, nevertheless, startling that about 20 per cent of the species of the Magdalena are also found east of the Andes; that the specific characters of so many species of fishes are older than the Cordillera of Bogota; that, for instance, the color markings, the stripes of the giant catfish, are older than the Andes of Bogota.

CHAPTER II

SUMMARY AND CONCLUSIONS

A. THE NATURE OF THE FISH FAUNA

The fresh-water fish fauna of Chile consists of but 30-odd species belonging to 10 families.

I. **Petromyzonidae**—The Lampreys

Six species of lampreys ascend the rivers of central Chile (a seventh occurs at Punta Arenas). They are reported to occur at times in vast numbers. The larvae are found buried in the mud in quiet stretches of the rivers. Velasia larvae (Pl. III, figs. 7–11) undergo a metamorphosis when they reach about 100 mm. Caragola larvae (Pl. IV, figs. 2–4) metamorphose at about 200 mm.

Velasia chilensis (Pl. III, fig. 11), the "Lamprea" of the fishermen, is very rare and, as far as known, is limited to Chile.

Velasia stenostomus, another "Lamprea," is found in New Zealand as well as in Chile.

Geotria australis (Pl. III, fig. 1). The "Lamprea con bolsa" of the fishermen is abundant and occurs in Australia as well as in Chile.

One species of the genus Caragola, *C. lapicida* (Pl. IV, fig. 1), occurs in the streams of Chile, and two species of Mordacia, *M. acutidens* (Pl. IV, fig. 12), and M. *anwandteri* (Pl. IV, fig. 9). The species of this genus are much smaller than those of Geotria and Velasia. The genus Mordacia also occurs in Australia.

Geotria and *Mordacia anwandteri* are provided with really enormous lymph sacs just behind the head.

Of the scaleless catfishes, or Bagres, there are three families—the Diplomystidae, Nematogenyidae, and Pygidiidae.

II. **Diplomystidae**

Confined to Chile and the Argentine. *Diplomyste chilensis* (Pls. V and VII, fig. 13), "the Pollo de agua dulce," or fresh-water shark of the fishermen, is abundant in Chile between Santiago and Valdivia and is also found in the Argentine. It is an ancient type of catfish with but one short, thick barbel, prolonged from the maxillary. Of all the Americas this is the only catfish with a functional, *normally* toothed, maxillary bone.

III. **Nematogenyidae**

Nematogenys inermis (Pls. VI and VII, figs. 2–4), the "Bagre" of the Santiago market, is confined to Chile. It reaches a considerable size. It seems to be at its best in the Maipo basin, but occurs as far south as Lautaro. It is probably nearer the ancestor of the Pygidiidae than any other living species.

IV. **Pygidiidae**—The "Bagrecitos"

These are confined to South America but are found from Panama to Patagonia and from both coasts to Lake Titicaca. There are two genera and at least three species in Chile.

Pygidium areolatum (Pl. VIII, fig. 3), known as "Bagrecito," is found everywhere south of Choapa. Its relative, *P. chiltoni* (Pl. VIII, figs. 1–1c), is more restricted in its distribution. The genus is found in all mountain streams south of Panama from near sea level to 12,000 feet and over. Additional species will no doubt be found in the northern part of Chile.

Hatcheria, another "Bagrecito," as far as known, is confined to Chile and northern Patagonia; one species, *H. maldonadoi* (Pl. VIII, figs. 2–2b), occurs between the Bio Bio and Lautaro.

V. Characidae

Of this, the largest South American family of fishes, with hundreds of species in the tropical part of the Americas, only one genus, with three species, occurs in Chile.

Cheirodon pisciculus (Pl. IX, fig. 1), "Pocha," is a small fish belonging to a genus widely distributed between Panama and Rio Grande do Sul and the La Plata basin. The genus occurs in weedy stretches of quiet water from Vallenar south, at least to Puerto Montt, wherever conditions are favorable. Its northernmost range, in Panama, 9 degrees north, is much nearer the Equator than Vallenar at 28 degrees 35 minutes south, its most northern point in Chile. Its known southernmost range, 41 degrees 18 minutes, is much farther from the Equator than the farthest north, New Mexico, for any of the other members of the family of Characins to which it belongs. Cheirodon has undergone such modifications southward and northward of the Bio Bio (where it is typical for the genus) that at least three species are recognizable. *Ch. pisciculus, galusdae* (Pl. IX, fig. 2), *australis* (Pl. IX, fig. 3).

VI. Aplochitonidae

The "Peladillas" are naked, trout-like fishes with an adipose fin. One of them, certainly, spawns in the fresh waters, another descends to the sea to lay its eggs. The nearest relative of the genus occurs in New Zealand. In Chile they are abundant in the basins *containing large lakes* in their headwaters.

Aplochiton zebra spawns in fresh water (Pl. XI, fig. 1); *Aplochiton marinus* (Pl. XI, fig. 2) spawns in the ocean; *Aplochiton tæniatus* (Pl. XI, fig. 3) is abundant in the lakes of southern Chile. Its spawning habits are not known.

VII. Galaxiidae—The "Pullas" or "Puyes"

At least four species of this family are found in Chile, three of these within the area under consideration. One, *Galaxias maculatus* (Pl. X, fig. 5), grows to a length of about 200 mm. in fresh water and then probably descends to the ocean to spawn. The young reascend the streams in enormous numbers.

Galaxias platei (Pl. X, fig. 4) reaches a much larger size in the brooks of southern Chile. Nothing is known of its breeding place. *Galaxias globiceps* (Pl. X, fig. 2) resembles the latter, but has a blunt head.

Brachygalaxias bullocki (Pl. X, fig. 1) is the smallest fish of the rivers of Chile, reaching a length of about 56 mm.

VIII. Poeciliidae

Orestias agassizii (Pl. XV, fig. 1), a small fish abundant in the highlands from Cuzco, Peru, to Chile, is found in the saline lagunas at Ascotan.

IX. Mugilidae—The Lizas

Mugil rammelsbergii, the "Liza" of the fishermen, is a marine fish entering the rivers.

X. Atherinidae—The various "Peje reyes"

Basilichthys is found in fresh waters from the Rio Rimac, south.

Basilichthys semotilus is found in Peru and may be found in the northernmost rivers of Chile.

Basilichthys microlepidotus (Pl. XIV, fig. 5) is the "Peje Rey del Rio" of the Santiago markets. Its southern variety, *Basilichthys australe*, is known as "Cauque" about Valdivia.

Cauque mauleanum (Pl. XIV, fig. 2) is known as the "Peje Rey del Rio" in the south. Various other species of Cauque, *C. wiebrichi* (Pl. XIV, fig. 3), *C. itatanum* and *C. brevianalis* (Pl. XIV, fig. 1), occur near the mouths of rivers.

(*Austromenidia laticlava* (Pl. XIV, fig. 4), the "Peje Rey del Mar," occurs along the coast at least south to Puerto Montt).

XI. **Serranidae**—The "Truchas" of Chile and Patagonia

Percichthys trucha (Pl. XV, fig. 2), the "Trucha" of the fishermen, is abundant in Chile, from the Rio Aconcagua to Cape Horn, on both sides of the Andes.

Percichthys pocha, the "Pocha" of the fishermen, is a smaller species confined to Chile between Santiago and Concepcion.

Percilia gillissi and *P. irwini* (Pl. XV, fig. 3), "Truchecitas," are two small, brilliantly colored fishes, related to the trucha and pocha, but too small to be used for food.

B. THE ORIGIN OF THE FISH FAUNA

The fish fauna of Chile is completely distinct from that north of Lima, Peru. A very large per cent of it has immigrated from the ocean, a smaller part came from the north, another small part is ancient and autochthonous.

Part of the oceanic contribution came from the south and is common to Australia, New Zealand, Patagonia, and Chile. The point of origin of this element of the fauna is in doubt, unless there was an antarctic continent (not necessarily a land connection between Australia and South America) in which the Galaxiidae, Aplochitonidae, and Lampreys developed and from which they moved north in all directions. In Chile this part of the fauna moved north various distances, some of the lampreys to Valparaiso, *Galaxias maculatus* and Aplochiton to Concepcion; other fishes apparently only to Valdivia, the northernmost point where the Lampreys, the Galaxiidae, and the Aplochitonidae are still at their best.

The other oceanic contribution to the fresh-water fauna came from the temperate sea. (*a*) The genus Cauque, of the Atherinidae, differs but little from Austromenidia, at the present time abundant on the coast of Peru and Chile. Cauque occurs from La Serena southward on both east and west slopes. (*b*) The genus Basilichthys, also of the Atherinidae, is of older standing. It is confined to fresh water, ranging at least from Lima (possibly the Rio Santa) to Puerto Montt. In this range three species have become differentiated, one in Peru, one in Chile north of Santiago, and one south of Santiago. The two southern species are scarcely distinguishable. (*c*) The genus Percichthys, confined to Chile and Patagonia from Punta Arenas as far north as there is suitable water, is a thoroughly fresh-water genus, belonging to the marine family of the Serranidae. It is an ancient contribution from the sea.[1] (*d*) The genus Percilia, also of the Serranidae, probably has a similar history.

The contribution from the north consists of (*a*) Pygidium, a mountain catfish found in all the mountains of South America; (*b*) Hatcheria, a Patagonian modification of Pygidium; (*c*) Cheirodon, the only contribution from the tropical fauna of South America. The presence of Cheirodon in Chile probably dates to the time when Argentina was a suitable habitat for the genus as far south as the great lakes of Patagonia. It has retained its primitive structure in and near the Bio Bio basin. Less typical species have developed north and south of the Bio Bio region.

The third element of the fauna is the most ancient. It consists of but two species—*Nematogenys inermis* and *Diplomyste chilensis:* (*a*) Diplomyste is found between Santiago and Buenos Aires on the north and Valdivia on the south. It is autochthonous, the first, original Patagonian, a catfish in which the maxillary still carries teeth. (*b*) The last of the Chilean fishes is *Nematogenys chilensis*, confined to central Chile. I have hitherto considered it the most primitive, or generalized, member of the Pygidiidae. It lacks some of the most characteristic features of the family, the double maxillary barbel, the opercular spines. It differs, in fact,

[1] Judging by the rocks off Coquimbo, Chile is at present being elevated at the rate of about 12½ feet a century.

so much that it may well be considered the type of a distinct family. This genus is also autochthonous, the first, original "Chileno."

The fresh-water fishes of Chile and Patagonia are so limited in numbers and show such affinity with the marine fauna that I adhere to an opinion I expressed long ago. During the subsidence from which southern Chile and Patagonia are at present rising,[2] all the fresh-water fishes, except those adjusted to also live in the ocean, were exterminated. There has not been time or opportunity to acquire an extensive, new, purely fresh-water fauna. In northern Chile and Patagonia, during the subsidence, there were opportunities for the continued existence of Cheirodon, Pygidium, Nematogenys, Diplomyste, and, possibly, Percichthys and Percilia.

C. TABLE OF DISTRIBUTION OF THE SPECIES

	Relicts				Chilean			Transition		Austro-Chilean						
	Copiapo	Vallenar	La Serena	Choapa	Aconcagua basin	Maipo basin	San Javier	Bio Bio and Nonguen	Lautaro	Valdivia	Lake Rinihue	Osorno	Maullin basin	Puerto Montt	Petrohué basin	South of Puerto Montt
Petromyzonidae:																
Velasia chilensis					+					+						
Velasia stenostoma										+						
Geotria australis										+		+				
Exomegas macrostomus gallegensis																+
Caragola lapicida					+			+	?	+		+		+		
Mordacia acutidens						+		+	?	+						
Mordacia anwandteri										+						
Diplomystidae:																
Diplomyste pappilosus						+	+	+	+	+	+					
Nematogenyidae:																
Nematogenys inermis						+		+	?							
Pygidiidae:																
Hatcheria maldonadoi								+	+							
Pygidium chiltoni							+	+								
Pygidium maculatum																
Pygidium areolatum				+	+	+	+		+		+	+	+		+	
Characidae:																
Cheirodon pisciculus		+			+	+										
Cheirodon galusdae							+	+	+							
Cheirodon australe										+		+	+			
Aplochitonidae:																
Aplochiton taeniatus										+	?	+	+	+	+	+
Aplochiton zebra										+	+		+	+	+	+
Aplochiton marinus										+						
Galaxiidae:																
Brachygalaxias bullocki								+		+			+			
Galaxias maculatus								+	+	+	+	+	+	+	+	+
Galaxias globiceps													+			
Galaxias platei											+		+		+	
Pœciliidae:																
Orestias																
Mugilidae:																
Mugil rammelsbergii			+				+									
Atherinidae:																
Cauque mauleanum								+	?	+	+	+	+		+	
Cauque wiebrichi										+						
Cauque itatanum								+								
Cauque brevianalis			+													
Basilichthys australis						+	+	+	+	+	+	+				
Basilichthys microlepidotus			+	+	+											
Serranidae:																
Percichthys trucha					+	+	+	+	+	+	+	+	+		+	+
Percichthys melanops						+		+								
Percilia gillissi						+	+		+	+	+	+				
Percilia irwini								+								

[2] Judging by the rocks off Coquimbo, Chile is at present rising at the rate of about 12½ feet per century.

D. ZOOLOGICAL PROVINCES

Chile (Pl. I) is divisible into the following Provinces:

a. The "Austro-Chilean," a region with an abundant rainfall, extends north to Valdivia, possibly to the Rio Tolten, and is characterized by the abundance of Lampreys, Galaxias, and Aplochiton, and the absence of Nematogenys. This is the region of the great lakes.

b. The "Intermediate," between Valdivia and Concepcion, is characterized by the waning of the Galaxiidae and Aplochitonidae. There is an abundant rainfall.

c. The "Chilean," with a decreasing rainfall northward to Santiago, is characterized by Nematogenys, Diplomyste, and the absence of Galaxiidae and Aplochitonidae.

d. The "Region of Relicts," north of Valparaiso. The rivers are small and many have gone dry altogether. Only Cauque, Basilichthys, Cheirodon, and Pygidium have been taken north of the Rio Aconcagua. In Choapa, only Basilichthys; in Vallenar, only Cheirodon; in the Rio Camarones, only Basilichthys.

In ancient times there was an abundant precipitation in northern Chile, the area of relicts. The moisture gathered in rivulets and rivers, carved the many extensive valleys from the crest of the Andes to the coast. No doubt in those days the rivers contained an abundant fish fauna. Gradually the precipitation became extinct and great areas became dry and fossilized. The fishes died. One or another, like Basilichthys, Cheirodon, and Pygidium, may still persist. Basilichthys may still occur anywhere between Peru and Valparaiso between the ocean and the high Andes where there is any encouragement for the continued existence of fishes; Pygidium, anywhere between the tide and the high Andes; Cheirodon, wherever weed-grown, quiet stretches persist.

Through the very center of the driest region of northern Chile flows the Rio Loa. In the lower part of it we may find the ancient fauna persisting. At present we only know that a Titicacan fish, *Orestias agassizii*, occurs at about 1,200 feet.

CHAPTER III

HISTORICAL SKETCH

A. PAPERS DEALING WITH THE FISHES OF CHILE

The earliest account of fresh-water fishes I have been able to find is that of Molina. Dean, in his Bibliography of Fishes, gives this account of Molina's work:

> Saggio sulla storia naturale del Chile, del Signor Abate Giovanni Ignazio Molina. Bologna, 1782. 368 p.
>
> Libro iv. Vermi, insetti, rettili, pesci, uccelli e quadrupedi del Chile, pp. 196–367.
>
> There are numerous later editions in various languages, concerning which see also Philippi's Comentario in Anal. Univ. Chile, 1867, 29, 788–795.

Washington Irving, in his translation ("The Geographical, Natural, and Civil History of Chili," 1808) gives the date of this volume as 1787, saying (p. III):

> He [Molina] applied himself to writing the History of that country, which was published at two different periods; the first part, comprising the Natural History, in the year 1787, and the second, containing the Civil, for reasons mentioned in his preface, not until some years after.

Concerning the fresh-water fishes, Irving's translation reads (p. 157):

> The rivers, streams, lakes, and even the small brooks, produce a surprising quantity, especially those beyond the 34th degree of latitude. The kinds most in estimation are the *lisa*, which I have already noticed; the *trout*; the *cauqui* (cyprinus caucus); the *malche* (cyprinus malchus); the *yuli* (cyprinus julus); the *cumarca* or peladilla (stromateus cumarca); and the *bagre*, or luvur (silurus Chilensis). The bagre has a smooth skin without scales, and is brown upon the sides, and whitish under the belly. In its form it resembles a tadpole, the head being of a size disproportionate to the length of the body, which does not exceed eleven inches at the most. It has a blunt mouth, furnished like that of the barbel, with barbs. It has a sharp spine on the back fin, like the tropical bagre, but its puncture is not venomous, as that is said to be. The flesh is yellow, and the most delicious of any esculent fish that is known. There is said to be another species or variety of this fish, inhabiting the sea, that is black, and which I presume is the same that Commodore Anson's sailors called, from its color, the chimney-sweep.
>
> Eels are found only in the Araucanian provinces, where they are exceedingly plenty, and are taken by the Indians in a kind of basket, placed against the current. The river Talten which waters those provinces, produces a small fish called *paye*, which, as I have been assured by those who have seen them, is so diaphanous, that if several are placed upon each other, any object beneath them may be distinctly seen. If this property is not greatly exaggerated, this fish might serve to discover the secret process of digestion, and the motion of the fluids.

Only the *Silurus chilensis* was described and retained in the literature.

The first Chilean fresh-water fish, named scientifically, appeared in Gmelin's "Systema Naturae" in 1788 as *Silurus chilensis*. The description was based on the earlier one by Molina in "Saggio sulla storia naturale del Chile, Libro IV, 1782."

Cuvier & Valenciennes, between 1833 and 1849, described several species in the "Histoire Naturelle des Poissons."

Jenyn's account of the "Fishes" in the "Zoology of the Voyage of H. M. S. *Beagle*," 1842, includes a number of species of Chilean fishes collected by Charles Darwin during the voyage of the *Beagle*.

The first synoptic account of the fishes of Chile was that of Guichenot, "Peces de Chile," in Gay's Historia fisica y politica de Chile, Vol. II, pp. 137–317, 1848.

Notable contributions were made by Gray to the knowledge of the lampreys in an article variously published as:

"Description of a new form of lamprey from Australia (*Geotria australis*), with a synopsis of the family." Proc. Zool. Soc. London, 1851, pp. 235–241, Pl. IV, and Ann. and Mag. Nat. Hist. (2) XIII, 1854, pp. 58–65, and as:

"List of the specimens of fishes in the collection of the British Museum." Part I, pp. 136–146, Plates I and II, 1851.

During "The U. S. Naval Astronomical Expedition to the Southern Hemisphere during the years 1849, '50, '51, '52," Lieut. J. M. Gilliss collected fishes in the Maypo River basin. These were described and figured by Girard in the second volume of the report on the expedition (33d Cong., 1st sess., H. Ex. Doc. No. 121, pp. 230–253, plates 29–34).

Between 1851 and 1904 Rudolph Amandus Philippi worked in Chile. He was the first naturalist describing fresh-water fishes who knew them first hand. Among the 352 titles published by Philippi on various phases of Chile the following deal in part, or as a whole, with fresh-water fishes.

I. "Ueber einige chilenische Vögel und Fische." Wiegm. Archiv. 1857, I, p. 266.

II. "Beschreibung neuer Wirbelthiere aus Chile." Archiv Naturg. 1858, I, p. 306.

III. "Kurze Nachricht über ein paar chilenische Fische." Archiv Naturg. 1863, I, p. 207.

IV. "Ueber die chilenische Anguilla." Archiv Naturg. 1865, I, p. 107.

V. "Bemerkungen über die chilenischen Flussfische." Monatsb. Königl. Preuss. Akad. Wiss. Berlin, 1866, p. 708.

VI. "Neue Thiere Chiles." Verhandl. Deutsch. Wiss. Vereins. Santiago, Chile, III, 1895–1898, p. 19.

In these papers Philippi described no less than 23 species. They are listed below, chronologically among the other discoveries from Chile. In No. V of the papers enumerated he gives a synopsis of all species known to him.

Dr. L. Plate spent some time in Chile (1893–5). The results were issued as "Fauna Chilensis" in Zoologische Jahrbücher. Plate himself dealt with the Cyclostomes. Supplement V, pp. 651–674. Tafel 19, 1902; and Verh. Intern. Zool. Congress, Berlin, 1902, pp. 551–552. Steindachner reported on the fishes in general. "Fische der Sammlung Plate." Supplement IV, pp. 282–338, Taf. XV–XXI and "Nachtrag." Supplement VI, pp. 201–214, 1903.

Careful studies of the fresh-water fishes of southern Patagonia were made by F. A. Smitt in his "Poissons d'eau douce de la Patagonie. Recueillis par. E. Nordenskiold 1898–99." Bih. Svenska Vet. Akad. Handlingar, Band 26, Afd. IV, No. 13, pp. 3–31. This paper deals with a region south of that covered by the present work.

Louis Dolo dealt with the fishes about the Straits of Magellan. Voyage du S. Y. Belgica. Zoologie, Poissons, 1904. This also deals with a region really south of the territory covered by the present volume.

I included a compilation on the fishes of Chile in "The fresh-water fishes of Patagonia, etc." Reports Princeton University Expeditions to Patagonia, III, 1909, pp. 225–292, plates XXX–XXXVII. In an article on "The Nature and Origin of the Fishes of the Pacific slope of Ecuador, Peru and Chile" (Proc. Am. Philos. Soc. Phila. 1922) I summarized the facts presented in the present volume, which is based on the material collected during the Irwin expedition.

B. LIST OF NOMINAL SPECIES OF FRESH-WATER FISHES AND SPECIES OF AUSTROMENIDIA BETWEEN MOLLENDO AND PUERTO MONTT, ARRANGED CHRONOLOGICALLY, TOGETHER WITH THEIR IDENTIFICATION AND THE LOCATION OF THE TYPE SPECIMENS

Date	New species	Identification in present paper	Location of type
1782	*Silurus chilensis* Molina [1]	*Diplomyste chilensis* (Molina)	
1788	*Silurus chilensis* Gmelin	*Diplomyste chilensis* (Molina)	(?).
1833	*Perca trucha* Cuv. and Val.	*Percichythys trucha* (Cuv. and Val.)	Jardin des Plantes.
1835	*Atherina regia* Humboldt	*Austromenidia regia* (Humboldt)	(?).
	Atherina laticlava Cuv. and Val.	*Austromenidia laticlava* (Cuv. and Val.).	Jardin des Plantes.
1840	*Arius papillosus* Cuv. and Val.	*Diplomyste chilensis* (Molina)	Jardin des Plantes.
1842	*Perca lævis* Jenyns	*Percichythys trucha* (Cuv. and Val.)	(?).
	Atherina microlepidota Jenyns	*Basilichthys microlepidotus* (Jenyns)	(?).
	Mesites maculatus Jenyns	*Galaxias maculatus* (Jenyns)	(?).

[1] Other species are mentioned by Molina, see p. 19.

B. LIST OF NOMINAL SPECIES OF FRESH-WATER FISHES, ETC.—Continued

Date	New species	Identification in present paper	Location of type
1842	*Aplochiton zebra* Jenyns	*Aplochiton zebra* Jenyns	(?).
	Aplochiton taeniatus Jenyns	*Aplochiton taeniatus* Jenyns	(?).
1846	*Trichomycterus aerolatus* Cuv. and Val.	*Pygidium areolatum* (Cuv. and Val.)	Jardin des Plantes.
	Trichomycterus maculatus Cuv. and Val.	*Pygidium maculatum* (Cuv. and Val.).	Jardin des Plantes.
1848	*Trichomycterus inermis* Guichenot	*Nematogenys inermis* (Guichenot)	(?).
1849	*Farionella gayii* Cuv. and Val	*Aplochiton zebra* (Jenyns)	Jardin des Plantes.
1851	*Geotria australis* Gray	*Geotria australis* Gray	British Museum.
	Velasia chilensis Gray	*Velasia chilensis* Gray	British Museum.
	Caragola lapicida Gray	*Caragola lapicida* Gray	British Museum.
1854	*Percichthys chilensis* Girard	*Percichthys trucha* (Cuv. and Val.)	Phila. Acad. Nat. Sciences.
	Percichthys melanops Girard	*Percichthys melanops* Girard	Phila. Acad. Nat. Sciences.
	Percilia gillissi Girard	*Percilia gillissi* Girard	Phila. Acad. Nat. Sciences.
	Cheirodon pisciculus Girard	*Cheirodon pisciculus* Girard	U. S. Nat. Mus. and I. U. Museum.
1857	*Thysanochilus valdivianus* Philippi	*Geotria australis* Gray	Mus. Nac., Santiago.
1858	*Ammocœtes cæruleus* Philippi	(?)	Mus. Nac., Santiago(?).
	Ammocœtes landbecki Philippi	(?)	Mus. Nac., Santiago(?).
	Chilopterus (No specific name) Philippi.	*Caragola* sp	Mus. Nac., Santiago(?).
	Galaxias minutus Philippi	*Galaxias maculatus* (Jenyns)	Mus. Nac., Santiago(?).
	Galaxias punctulatus Philippi	*Galaxias maculatus* (Jenyns)	Mus. Nac., Santiago(?).
	Farionella fasciata Philippi	*Aplochiton zebra* Jenyns	Mus. Nac., Santiago.
1859	*Arius carcharias* Leybold	*Diplomyste chilensis* (Gmelin)	(?).
1863	*Petromyzon anwandteri* Philippi	*Mordacia anwandteri* (Philippi)	Mus. Nac., Santiago.
	Perca pocha Philippi	*Percichthys melanops* Girard	Mus. Nac., Santiago.
	Perca segethi Philippi	*Percilia gillissi* Girard	Mus. Nac., Santiago.
1865	*Petromyzon acutidens* Philippi	*Mordacia acutidens* (Philippi)	Mus. Nac., Santiago.
	Petromyzon fonki	*Velasia chilensis* Gray	Mus. Nac., Santiago(?).
1866	*Percilia gracilis* Philippi	*Percilia gillissi* Girard	Mus. Nac., Santiago.
	Arius villosus Philippi	*Diploymste chilensis* (Molina)	Mus. Nac., Santiago.
	Arius squalus Philippi	*Diploymyste chilensis* (Molina)	Mus. Nac., Santiago.
	Arius micropterus Philippi	*Diplomyste chilensis* (Molina)	Mus. Nac., Santiago(?).
	Arius synodon Philippi	*Diplomyste chilensis* (Molina)	Mus. Nac., Santiago(?).
1868	*Petromyzon macrostomus* Burmeister.	*Exomegas macrostomus* Burmeister	Mus. Nac., Buenos Aires.
1874	*Protistius semotilus* Cope	*Basilichthys semotilus* (Cope)	Phila. Acad. Nat. Sciences.
1878	*Gastropterus archaeus* Cope	*Basilichthys semotilus* (Cope)	Phila. Acad. Nat. Sciences.
1880	*Atherinichthys brevianalis* Günther	*Cauque brevianalis* (Günther)	British Museum.
1881	*Galaxias coppingeri* Günther	*Galaxias maculatus* (Jenyns)	British Museum.
1895	*Galaxias delfini* Philippi	*Galaxias platei* Steindachner?	Mus. Nac., Santiago.
	Galaxias grandis Philippi	*Galaxias platei* Steindachner?	Mus. Nac., Santiago.
1896	*Valasia stenostomus* Ogilby	*Velasia stenostomus* Ogilby	
	Chirostoma mauleanum Steindachner.	*Cauque mauleanum* (Steindachner)	K. K. Mus., Vienna.
	Chirostoma itatanum Steindachner	*Cauque itatanum* (Steindachner)	K. K. Mus., Vienna.
1897	*Macrophthalmia chilensis* Plate	*Velasia stenostomus* Ogilby	K. K. Mus., Vienna.
1898	*Chirostoma affine* Steindachner	*Austromenidia laticlava* (Cuv. and Val.).	Leland Stanford Jr. University.
1899	*Basilichthys regillus* Abbott	*Austromenidia regia* (Humboldt)	Leland Stanford Jr. University.
	Basilichthys octavius Abbott	*Austromenidia regia* (Humboldt)	Leland Stanford Jr. University.
	Basilichthys jordani Abbott	*Austromenidia regia* (Humboldt)	Leland Stanford Jr. University.
	Pisciregia beardslee Abbott	*Basilichthys microlepidotus* (Jenyns)	Leland Stanford Jr. University.
1901	*Galaxias platei* Steindachner	*Galaxias platei* Steindachner	K. K. Mus., Vienna.
	Geotria macrostoma gallegensis Smitt.	*Exomegas gallegensis* (Smitt)	(?).
1906	*Galaxias titcombi* Evermann & Kendall.	*Galaxias titcombi* Evermann & Kendall.	U. S. Nat. Museum.
1908	*Galaxias bullocki* Regan	*Brachygalaxias bullocki* (Regan)	British Museum.
1922	*Hatcheria maldonadoi* Eigenmann		I. U. M.
	Pygidium chiltoni Eigenmann		I. U. M.
	Cheirodon galusdæ Eigenmann		I. U. M.
	Cheirodon austrae Eigenmann		I. U. M.
	Aplochiton marinus Eigenmann		I. U. M.
	Galaxias globiceps Eigenmann		I. U. M.
	Cauque wiebrichi Eigenmann		I. U. M.
	Basilichthys australis Eigenmann		I. U. M.
	Percilia irwini Eigenmann		I. U. M.

Fig. 3.—Rio Loa, near Calama, in northern Chile. One species, Orestias agassizii, in this part of the Loa

Fig. 4.—Rio Copiapo, below Copiapo. No native species of fishes in this part of the river.

Fig. 5.—Laguna del Inca. No native fishes were taken at this point. Some species of imported trout were reported several years ago

CHAPTER IV

THE IRWIN EXPEDITION IN CHILE

A. GENERAL ACCOUNT

Chile, extending from the Rio Sama at 18 degrees south to Punta Arenas at 53 degrees 10 minutes south, ranges in width from 50 to 270 miles. Its eastern edge for most of the distance is formed by the elevated crests of the Andes, from which many river valleys extend to the Pacific.

The northern third of Chile has no rainfall. Here the valleys contain no water or but very meager streams. The largest of the rivers is the Loa. For hundreds of miles there is no symptom of water. Even between the desert of Atacama and Coquimbo many of the valleys are at present without streams. There is every evidence that this condition has not always prevailed. South of Valparaiso rainfall becomes more and more regular and abundant and the streams are far from dead, carrying in the rainy season great torrents of water.

In the dry region north of Valparaiso the watersheds between successive river valleys are strongly marked where the railway crosses them. South of Santiago the watersheds, at least at the points where the railway crosses them, become lower and lower.

During the stop of the steamer at Arica I took a brief run up to Tacna and made a visual examination of the Rio de Tacna. No fishes were observed or reported.

The Tambo River, just north of the Chilean border, was examined by Mr. Nathan E. Pearson during the Mulford expedition and only *Basilichthys semotilus* Cope, of the Peruvian fauna, and the semifluviatile *Mugil rammelsbergii* Tschudi were taken.

North of the desert of Atacama, Dr. William Ray Allen, of the Irwin expedition, examined the Loa basin at Lake Ascotan and at Calama. Doctor Allen found no fishes at Calama, and at Ascotan only *Orestias agassizii* Valenciennes occurs, and this belongs to the fauna of the high plateaus of Bolivia and Peru.

As part of the Irwin expedition, I collected fishes in some of the rivers of Chile between Copiapo and Puerto Montt. I arrived in Santiago, Chile, in February, 1919, and went at once south in order to take advantage of the short remaining portion of the dry season. I then worked northward from Puerto Montt to Santiago by the end of March. Thence I went directly north to Copiapo and worked southward to Santiago. After spending some time in Santiago and its neighborhood, I left Chile at the end of April.

The list at the end of this chapter gives the names of the localities from north to south, the names of the streams or lakes in which collections were made, the elevation above sea level, the latitude and longitude of the place to the nearest minute, and its distance by rail from Santiago, and the average annual precipitation at the locality. The latitude of the collecting stations ranges from 27 degrees 41 minutes to 41 degrees 28 minutes, or 13 degrees and 47 minutes, a distance of 827 miles. The distance given from Copiapo to Puerto Montt by rail is 2,070 kilometers.

The Rio Copiapo is the first river south of the desert of Atacama. Its southernmost tributary, the Rio Manfias, rises near 28 degrees 40 minutes south and 69 degrees 46 minutes west, its northernmost tributary; the Rio Figueroa has dry tributaries arising near 27 degrees north and 69 degrees 15 minutes west. All of its tributaries west of 70 degrees are dry beds. It empties into the ocean near 71 degrees west and 27 degrees 20 minutes south. At Copiapo the river is a clear stream about 2 feet deep and about 12 feet wide, spreading out, however, in places where it is much shallower. The much wider bed of the river is overgrown with shrubs, and there is no indication that the stream is at any time much larger than on April 4 to 6, when

I examined it. It contains no native fishes at Copiapo. The bordering lagunas, or rather swamps, are abundantly supplied with varieties of goldfishes, which no doubt accounts for the report that there are seven sorts of fishes here.

The region between the Copiapo, its southern tributary, the Manfias, and the Rio Huasco, is dry, with a number of dry beds. The Rio Huasco, with is southern tributary, the Rio del Carmen, has the same general northwest trend as the Copiapo with its tributary, Manfias. It empties near 28 degrees 27 minutes south and 71 degrees 15 minutes west.

At the upper end of the town of Vallenar it is a shallow, swift, brook flowing over gravel. Fishing was done where this swifter part flows into a deeper, weed-grown stretch. Only one species was caught here, belonging to the ubiquitous Cheirodon.

The map shows a number of streams between Vallenar and La Serena, but the only water I saw was in a few minute pools at Lambert. At Punta Colorada there is a large and striking valley, but at least at the time of my visit, no water. The evidences of a former large stream are so apparent that one can easily imagine a large stream here responsible for the configuration.

Between La Serena and Coquimbo the land is swampy. The Rio Elgui at Serena is much larger than the Copiapo or the Huasco. It flows at the base of a bluff on which the town is situated. At the time of my visit the water was distributed between a number of anastomosing branches in the wide river bed. I fished in a branch at the very base of the bluff and below a slight fall at the railway bridge. A Liza, Mugil, and a small Peje rey, *Cauque brevianalis* possibly indicate nearness to the sea. This stream should be examined at a higher point.

No attempt was made to stop between La Serena and Illapel. The map shows a river of considerable size at Illapel. But it was reduced to a miserable trickle of water, and I at once left for Choapa, where the river is not unlike that at Vallenar, but with indications that at times it reaches larger dimensions. Peje rey (Basilichthys) and a Bagrecito (Pygidium) were the only things secured. The Rio Petorca and the Rio de Ligua looked promising, but there was not time to stop. They flow near each other but on opposite sides of a sharp ridge and empty near each other into the Bahia La Ligua, at about 32 degrees 25 minutes south. There is promising water at Melon and Nogales, but I made my first stop in the Aconcagua basin at La Calera. It would have been interesting to determine the contents of the Rio Liman at Ovalle and of the Rio Petorca and Rio Ligua, not because these probably contain fishes not obtained elsewhere but to determine which of the fishes caught elsewhere are not found in these streams, to determine, in other words, the northern limits of the Bagre, Pollo, Percilia, and Percichthys.

The Aconcagua at La Calera is a considerable stream, at least at times, and contains the trucha (Percichthys) and near the coast is said to harbor the bagre (Nematogenys). I did not secure either of these myself, confining my operations to a pool and some riffles at the edge of town.

In its tributary, the Rio Blanco, above Los Andes, the introduced trout have eliminated all native fishes. A visit to Laguna del Inca was unpropitious. No fishes were seen.

The Maipo basin, consisting of the Mapocho flowing through Santiago, the Maipo and the Angostura and other tributaries, is well supplied with fishes. The market at Santiago receives truchas, peje rey, bagres, and tollos. The most important of these is the peje rey (Basilichthys). I collected at Peñaflor, La Flor del Maipo, and at Hospital. The small creek at Llo Lleo near the ocean may also be counted in this basin.

As stated elsewhere, south of Santiago the rivers increase in importance. The first place south of Santiago (Maipo basin) at which I collected is San Javier, on the Loncomilla. I seined in the river and poisoned the tributary entering the river at the town.

At the edge of Concepcion, in the grounds of the agricultural college, I very successfully poisoned the lower end of the Estero Nonguen. It enters the Rio Andalien, which enters the Bahia Concepcion. The Bio Bio, the largest of the Chilean rivers, to which the Rio Andalien really belongs, I examined in a most inadequate way at Coihue.

Fig. 6.—A lava flow from the Osorno has dammed the Rio Petrohue and thus formed Todos Santos above this cataract. Photo by J. Wiederhold, Puerto Varas

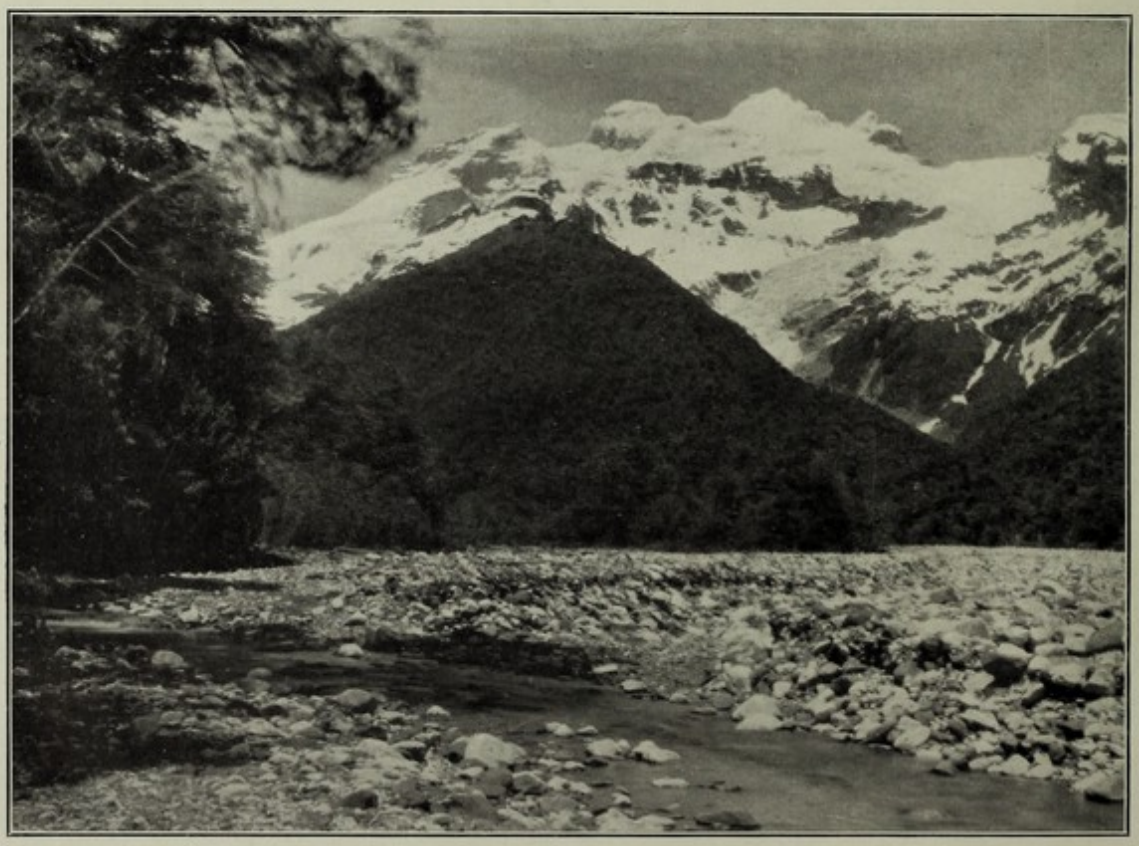

Fig. 7.—Rio de Petrohue with the Tronodor at the divide between Chile and the Argentine, east of Laguna de Todos Santos. Photo by J. Wiederhold, Puerto Varas

A more adequate examination was made at Lautaro, on the Rio Cautin, where several days were spent. The Government maintains a fish hatchery here, under the direction of Mr. Piedra Galusda, who introduced various trouts to Chile.

The Rio Calle Calle is, as far as known, the river richest in fishes. I collected in the Rio Santa Rosa at Valdivia and in the Estero Cutipai below Valdivia. A special trip was made to its origin in Lago Rinihue, one of a series of lakes, the most remote one of which, the Lago Lacar, lies across the main line of the crest of the Andes in Argentina.

At Osorno I collected in the Rio Rahue and in the Rio Damas near the point where they unite.

In the Maullin basin I collected in the small creek flowing through Puerto Varas, in Lago Llanquihue at Puerto Varas, and Ensenada, in the Rio Pescado emptying into the lake between Puerto Varas and Ensenada, in the stream at Ensenada and at Abtao, in a tributary of the Rio Negro on the height between Puerto Varas and Puerto Montt. At Puerto Montt I collected in a small brook just at the edge of town and a larger one east of town.

In the basin of the Rio Petrohué I collected at the falls of the Petrohué. The falls are caused by a lava flow from the volcano Orsono, which impinged on the foot of the Sierra Santo Domingo on the left bank of the river. Above the falls I collected in Lago Todos Santos, at Peulla and in the inlet to the lake, the Rio Negro and in two small brooks emptying into the lake at Peulla. A small collection was also gathered in the Rio Peulla at Casa Panque near the base of El Tronador. On top of the pass of Perez two small streams, the one flowing toward the Pacific, the other toward the Atlantic, were poisoned but no fishes appeared. On the Atlantic side, in Argentina, collections were made in Laguna Fria of the Limai basin, and Puerto Blest about the head of the Lago Nahuel Huapi.

One of the surprises in collecting in Chile is the very few species of fishes contained in all of the numerous rivers. On any favorable afternoon one can catch more different species of fishes in any creek in the central Mississippi Valley than in all of the rivers of Chile in a year's work!

In the Copiapo I caught no native fishes, in Vallenar one species, at La Serena two, at Choapa two. In the Maipo basin we reach a full complement of Chilean fishes, exclusive of Galaxiidae and Aplochitonidae.

Between Santiago and Concepcion one finds the same few species with monotonous regularity. Between Valdivia and Puerto Montt there is a different monotony, since here the genera Galaxias and Aplochiton are always in evidence. One soon gets the notion that everything has been secured since one always catches the old stand-bys. The fact that out-of-the-way places, like Lake Rinihue, Abtao, and especially Esterito Nonguen, near Concepcion, yield distinct novelties would indicate that the headquarters and short river courses near the sea might yield other novelties. The main fauna of Chile is doubtless known.

If opportunity to again visit Chile should arise, I would particularly attempt to examine the lower course of the Rio Loa, the Rio Copiapo near the coast, the Rio Elgui above La Serena, the Rio de la Ligua, the Aconcagua at its mouth and at Los Andes, the Maule and Bio Bio basins. Any of the rivers near their mouths and near their headwaters would repay investigation. Particular problems that will repay investigation are the migrations of the Galaxiidae, Aplochitonidae, and Petromyzonidae.

B. LOCALITIES WHERE COLLECTING WAS DONE

Locality	Elevation in meters	Longitude west	Latitude south	Distance by rail from Santiago in km.	Average annual rainfall in mm.[1]
		° ′	° ′		
Tacna	568	70 18	18 00		
Rio Camarones		[2] 70 00	19 00		
Ascotan	3, 960	68 17	21 35		
Calama	2, 255	68 56	22 27		
Copiapó	370	70 21	27 21	990	17
Vallenar, R. Guasco	373	70 47	28 35	816	80
La Serena	7	71 15	29 55	586	147
Choapa, R. Choapa	235	71 10	31 44	297	(?)
La Calera, R. Aconcagua	217	71 13	32 48	118	336
Rio Blanco	1, 453	70 18	32 54		(?)
Laguna del Inca		70 8	32 50		(?)
Portillo	2, 885	70 12	32 51		1, 552
Santiago	520	70 39	33 26		364
Molloco-Peñaflor	407	70 55	33 36	25	428
Llo Lleo	9	71 37	33 34	109	[3] 509
Buin (El Flor de Maipo)	488	70 45	33 44	32	417
Hospital	384	70 45	33 52	48	528
San Javier, R. Loncomilla into R. Maule	108	71 44	35 35	270	
Concepcion, Estero Nonguen into R. Andalien	9	73 03	36 49	571	1, 296
Coigüe, R. Bio Bio	66	72 36	37 34	539	[4] 1, 089
Lautaro, R. Cautin	214	72 26	38 32	663	[5] 1, 250
Valdivia, R. Calle Calle and tributaries	7	73 15	39 49	[6] 835+28	698
Lake Rinihue, Estero Panqueco	118	72 25	39 48	850+40	
Osorno, R. Rahue	25	73 09	40 35	954	1, 328
Puerto Varas, Estero into L. Llanquihue	74	72 57	41 18	1, 047	
Abtao, R. Negro into R. Maullin	107	72 54	41 24	1, 060	1, 933
Puerto Montt, Estero Pilluco	5	72 57	41 28	1, 080	[7] 2, 160
Rio Pescado into L. Llanquihue	74	72 42	41 13	1, 047+24	[8] 2, 112
Ensenada into L. Llanquihue	74	72 31	41 12	1, 047+38	2, 112
Falls of R. Petrohué	100	72 25	41 09	1, 047+48	[8] 2, 112
Puella, L. Todos Santos	190	72 02	41 05	1, 047+82	3, 263
Casa Panque	320	71 53	41 03	1, 047+95	4, 110
Puerto Blest	756	71 50	41 01		3, 590
Punta Arenas	4	70 54	53 10		470

[1] The averages of the rainfall are taken from Jefferson, "The rainfall of Chile" (Am. Geog. Soc. Research Series No. 7), based on Instituto Meteorologico y Geofisico de Chile. Publicacion Nos. 20, 23, 24, 29.
[2] About.
[3] At San Antonio.
[4] At Nacimiento, lat. 37° 31′ S.
[5] At Temuco, lat. 38° 32′ S.
[6] Distance of the junction from Santiago+the distance on the side line.
[7] About.
[8] Presumably the same as at Ensenada.

The highest rainfall in Chile is at Bahia Félix, elevation 15 m., longitude 74° 4′, latitude 52° 58′, where it averages 5,479 mm. Bahia Félix is but 12 miles north of Punta Arenas, 3° and 10′ of longitude west.

CHAPTER V

SYSTEMATIC REVIEW OF THE FISHES[1]

GEOTRIIDAE

Seven species of lampreys have been recorded from the fresh waters of South America. No one naturalist has seen them all. In fact, no one has had sufficient material to properly delimit any one species. At least two of the species of South America are said to occur also in Australia or New Zealand (*Velasia stenostomus* and *Geotria australis*). A third genus, Mordacia, has a representative in each continent.

Plate (see *infra*) seems to have been the only one who had specimens of any one species from both continents. He compared a specimen from Chile with two from Australia and two from New Zealand and considered them as *Velasia chilensis*. Regan (see *infra*) placed all five of Plate's specimens of *V. chilensis* in the species *Velasia stenostoma*. Regan, in fact, concluded that the only specimen of *Velasia chilensis* known is the type in the British Museum, and that all other records of *V. chilensis* refer to *V. stenostoma* or *Geotria australis*. Plate also had specimens of *G. australis* from both continents—one, 355 mm., from Valdivia, and the other, 380 mm., from King Georges Sound, Australia. His specimens were both immature males.

A third species, *Mordacia mordax*, has been attributed to both continents, but Regan has found that the Chilean specimens, referred by Günther to *Mordacia mordax*, belong to the Chilean *Caragola lapicida*. *Mordacia mordax*, therefore, has no valid standing in the fauna of South America. The species said to occur in both continents have thus been reduced to two: *Velasia stenostomus* and *Geotria australis*. These two species are found on both sides of the Andes. Mordacia and Caragola occur only on the Pacific side of the Andes.

To the difficulty of the very limited amount of material comes the additional difficulty that most of the specimens recorded are in poor or very poor state of preservation.

Several of the species of southern lampreys have large lymph pouches or sacs just behind the mouth. Lymph pouches occur in three of the genera found in the southern hemisphere, Geotria, Mordacia, and Exomegas.

Three reviews of the South American lampreys have been published during the present century—Plate, Studien über Cyclostomen (Zool. Jahrb. Suppl. V, II, 1902, pp. 651–674, pl. 19); Eigenmann, The Fresh-water Fishes of Patagonia (Repts. Princeton Univ. Exped. Patagonia, III, 1909, pp. 231–237, Pl. XXX); and Regan, A synopsis of the Marsipobranchs of the order Hyperoarti (Ann. and Mag. Nat. Hist. (8), VII, 1911, pp. 193–304).

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[1] For the benefit of the novice and traveler, I add a purely artificial key to the families of fishes occurring in the fresh waters of Chile.

A. Body long, eel-shaped, naked. 7 gill-openings on each side. No pectoral or ventral fins ..... **Geotriidae, I.**
AA. Body not eel-shaped.
B. One or more barbels about the head body naked.
C. One dorsal fin. One barbel on the maxillary. No barbels on chin or snout ..... **Diplomystidae, II.**
CC. Two dorsal fins, the first one rayed, the second adipose.
D. Nasal, maxillary and mental barbels; no spines on opercle ..... **Nematogenyidae, III.**
DD. Nasal and double mental barbels; spines on the opercles ..... **Pygidiidae, IV.**
BB. No barbels about the head.
E. A rayed and an adipose dorsal fin.
F. Body covered with scales. Body rather short and deep ..... **Characidae, V.**
FF. Body naked. Body long and slender ..... **Aplochitonidae, VI.**
FFF. Body covered with scales. Body long, rather slender. Brilliantly colored. Introduced **Salmonidae.**
EE. A single short dorsal fin.
G. Dorsal well behind middle of body; mouth horizontal; body naked ..... **Galaxiidae, VII.**
GG. Dorsal near middle of body; mouth nearly vertical; body with scales ..... **Poeciliidae, VIII.**
EEE. Two dorsal fins, the anterior of spines, the posterior with soft rays.
H. Dorsal spines stout, 4; anal with 3 spines ..... **Mugilidae, IX.**
HH. Dorsal spines 0-7, slender; anal, with 1 slender spine ..... **Atherinidae, X.**
EEEE. A single long dorsal fin, divided into an anterior spinous and a posterior soft part ..... **Serranidae, XI.**

In my account of the fishes of Chile (Repts. Princeton Univ. Exped. Patagonia, III) the portion least satisfactory to me is the part dealing with the lampreys (pp. 231–237). I had at the time no specimens, and the descriptions of the specimens in various museums were not always as clear as desirable. My account was a compilation. When, therefore, I reached Chile my most ardent wish was to secure a large and complete series of all the species of lampreys recorded.

Reports reached me from various sources of the occasional great abundance of "lampreas" in Lautaro, Valdivia, and Osorno. It was said that "Some of the species have run up streams in enormous numbers at some time during the spawning season. Once upon a time 'lampreas' occured in such numbers at Osorno that they were picked up by the sackful and smoked. Once upon a time a tailrace of a mill above Valdivia was dammed by the masses of ascending lampreys." Unfortunately, my visit was not at the proper season. I examined the specimens in the museum in the Quinta Normal at Santiago, but without much satisfaction. Large and small specimens were given me by Mr. Piedro Galusda at Lautaro, superintendent of the fisheries stations; others were contributed by Mr. Augosto Brenning, at the head of the German school at Valdivia. He had also furnished Plate with some of his material. At Lautaro I caught a small larva. At Osorno I caught a small, (160 mm.) but mature, Caragola lapicida in a seine near the bridge below town. But the greatest success came by digging up the sand and mud at the bottom of the river at Osorno.

I offered a reward of "diez centavos" for each young "lamprea," which a man hauling sand assured me occured in the mud and sand in the bottom of some parts of the river a short distance above the bridge. I joined him in loading sand, and every shovelful brought from 1 to 10 larval lampreys between 21 and 82 mm. long. At least two species were represented, *Velasia stenostoma* and *Caragola lapicida*. One adult, *Caragola lapicida*, 129 mm. long, was also secured from the sand. Several hundred larvae were collected in a short time.

Mr. Carlos Wiebrich, a most ardent fisherman-naturalist of Valdivia, made strenuous efforts to secure additional material and was able to send me (1924) a recently metamorphosed Velasia, larval Caragolas, and two specimens of Mordacia.

Efforts to get Australian lampreys failed.

LARVAL DEVELOPMENT

Early in March I secured larvae of Velasia between 70 and 99 mm. long, and of Caragola between 21 and 99 mm. It seems probable from these that the lampreys enter the streams to spawn with the beginning of the rise of the rivers, possibly in April.

Adult lampreys can probably be secured most readily at the base of falls or dams in creeks during the rise of the rivers. The outlets of the lakes ought also to be favorable collecting ground. At Puerto Varas, on Lake Llanquihue, I was told that lampreys are sometimes found attached to the hides in the tannery. Plate secured a larva in Lake Llanquihue, so it is quite certain that the lampreys sometimes ascend as far as the lakes. The fact that larvae were found in abundance at Osorno indicates that spawning also takes place in the rivers.

The lampreys of the Southern Hemisphere have at least two types of larval development. In one the larvae have a collar and hood protecting the mouth (Pl. II, figs. 1–3; Pl. IV, figs. 2–4). Metamorphosis takes place when a length of about 125 mm. is reached. The larvae are Ammocoetes larvae. In the other the development is more direct, the metamorphosis takes place earlier, at a length of 100 mm. or less. In this second type the mouth of the young is elliptical, the edge of the mouth is provided with a short tentacle on each side (Pl. II, figs. 4–6; Pl. III, figs. 7–10). When the lips are curled inward the tentacles touch, giving the mouth the shape of a figure 8 (Pl. III, fig. 15). These larvae have neither collar nor hood, and the larger ones, near metamorphosis, have very large eyes (Pl. III, fig. 10). Both sorts, in fact, three types of larvae, were described by Philippi.

Philippi (Wiegmann's Archiv, 1858, I, p. 308) described Chilopterus, a new genus of Cyclostomes based on a larva 76 mm. long, from Valdivia. He says it has but one (?) dorsal fin which is confluent with the caudal. The origin of the dorsal is at the beginning of the last

fourth of the length, the anus is opposite the origin of the (second) dorsal; eye not externally visible. Upper lip when opened nearly circular, 2 lines wide, 1.5 lines long; gill-openings in a groove; olive green, scarcely lighter below.

The first dorsal of this type of larva is very low and was overlooked by Philippi. This, as far as I know, is the first reference to a larval lamprey, with an Ammocoetes head, from Chile. Philippi did not apply a specific name to this species, which is a Caragola or Mordacia.

The same author (l. c. p, 307) described *Ammocoetes landbecki*, a second type of larval lamprey, 89 mm. long. It has two dorsal fins, second confluent with the caudal; origin of dorsal three-fifths of the length behind the snout; anus at the end of the fourth fifth; mouth "on the under side of the snout, elongate and longitudinal, its thick, fleshy edges take the place of lips" a groove along gill-openings; olive green to gray, ventral surface white. Edge of mouth in front and on sides dark. This type has not been recognized again. I should consider it the larva of Velasia, but his statement that the second dorsal is continuous with the caudal and that there is a groove along the gill-openings removes it from Velasia.

Philippi also described (p. 307) *Ammocoetes coeruleus*, a third type of larva from a specimen 83 mm. long with the mouth circular, without Ammocoetes lips; two dorsal fins, second dorsal not confluent with the caudal; origin of dorsal at the end of the fourth seventh of length behind snout; anus at end of the fourth fifth of the length; head not swollen behind the eyes; no groove at gill-openings; blue above, whitish below. This is no doubt a Velasia larva near metamorphosis.

Smitt (Poissons d'eau douce de la Patagonia, Bihand till K. Svensk. Vet. Akad. Handlingar, XXVI, 1901, Pl. IV, figs. 25 and 27) figures what he supposed to be the larva of *Exomegas macrostomus*. It has the larval Ammocoetes head. The nature of the larva of Exomegas has not been established but inasmuch as it is a genus closely related to, if distinct from, Geotria, its larva is most probably like that of Geotria and Velasia. In that case the larvae described and figured by Smitt are probably Caragola or Mordacia, not Exomegas.

The larva and metamorphosed young of a Velasia were described by Plate in his Systematische Revision der Petromyzonten der südlichen Halbkugel (Zool. Jahrb. Suppl. V, 1902, p. 663). He described four supposed stages of *Velasia chilensis*. The first stage was represented by two specimens, 76 and 87 mm. long. He also included in this stage an 84-mm. specimen with lateral labial flaps. It certainly represents a species generically distinct from his 76-mm. and 87-mm. specimens which Plate assumed had passed the stage with the flap. The 84-mm. specimen with the flap is Caragola.

Plate's second stage (first stage in the supposed metamorphosis) was represented by two specimens about 71 mm. long. His third stage (second stage in the metamorphosis) was represented by a specimen 103 mm. long, from Valdivia.

His fourth stage 107 and 118 mm., with very large eyes and teeth, he at first described as *Macrophthalmia chilensis*. He had two specimens, one 107 mm. long, which he had taken in a submerged boat at the source of the R. Maullin, and a second one, 118 mm. long, probably from Puerto Montt.

Plate's descriptions and figures are very good and it is to be regretted that his account is vitiated by the fact that he considered the different types of larvae as different stages in the development of the same species.

Larvae and Young Velasia Examined

Of the young of a species of *Velasia* (*stenostoma*) I have:

16625 I. U. M. 10 specimens between 70 and 80 mm.; 31 between 80 and 90 mm.; 5 between 93 and 99 mm. from the sand at the bottom of the river at Osorno opposite the Abatoire at Osorno.
16044 I. U. M. 92.5 mm. Valdivia. Carlos Wiebrich.
15630 I. U. M. 2, 85, and 96 mm. Valdivia, from the collection of the German School, through Mr. Brenning. The 96-mm. specimen is undergoing metamorphosis.
16043 I. U. M. 86 mm., a metamorphosed young Valdivia. Carlos Wiebrich. (See Pl. II, fig. 4.)
15634 I. U. M. 92 mm., a metamorphosed young from the collection of the German School, through Mr. Brenning. (See Pl. III, fig. 10.)

I take these larvae and young to belong to Velasia on account of the tentacles on either side of the mouth which greatly resemble the tentacles or angular projections on the mouth of *Velasia chilensis* = stenostoma, as figured by Lahille.

The larva of Geotria is not known.

The snout is prominent, the anterior end oblique (Pl. III, figs. 7–9). The mouth is oval or 8-shaped, inferior, extending from the snout backward. The edges of the mouth are slightly incurved. There is neither hood nor collar like those in Caragola. Frequently the anterior part of the mouth is narrower than the posterior, the dividing point marked by a papule or short tentacle. The second dorsal is not continuous with the caudal fold. There are very small fringed lamellae on the inner surface of the oral cavity (the face of the oral disk). The tongue is greatly developed but possesses no teeth in the larvae. It is grooved above, otherwise closing the inner mouth opening. The gill-openings are vertical slits, without a groove; the eye is large, black.

In the 96-mm. specimen undergoing metamorphosis the fringed lamellae surrounding the opening into the gullet have disappeared; the lingual plate is developing three teeth (characteristic of *V. stenostomus*) which at this stage are of equal size; the maxillary plate has four teeth and the mandibular plate a number of notches.

The general color is light ash up to past the metamorphosis. The young lamprey is silvery on the sides, blue above. The edges of the lips are without color. Sides of the head and margin of the colorless area of the lips pigmented. Top of snout also without color.

The mouth of the metamorphosed young, 15634 (Pl. III, fig. 10), of *V. stenostomus*, 92 mm. long, is circular, its edge is provided with fringed laminae. In my specimen the margins of the lips are curled inward, and as there is an angular projection on the sides of the lips of the mouth, the opening approaches the shape represented by Plate in his figure 14 (reproduced in Pl. III, fig. 15).

The maxillary plate has four teeth, the outer ones much larger than the two inner ones; the mandibular plate forms a half circle with about a dozen serrations at the margin. The lingual tooth is tricuspid, the middle denticle being the smallest. The oral disk is covered with numerous short flaps overlapping like scales, increasing in size toward the inner oral opening. In the development of its teeth this specimen is far in advance of the other larvae or young specimens of the same size secured. As some of the larvae are 93 to 99 mm. long and this metamorphosed young is only 92 mm. long, it would seem that the individual is reduced in length during the metamorphosis. The metamorphosed specimen (16043) is even shorter, 86 mm. (Pl. II, fig. 4).

Measurements in millimeters of larvae and young Velasia

	Larvae				Metamorphosed	
	72	91	92.5	97	86	92
Depth	4	4. 5	4. 5	4. 5	4. 5	4. 5
Snout to eye	3. 5	4	3. 5	4. 5	5	(?)
Diameter of eye	1. 5	2	-------	2	2	2
Snout to first gill-slit	7	8	7. 5	8. 5	9	9
To last gill-slit	13	14	14	16	16	16
To first dorsal	42	53	-------	54	-------	54
Length of first dorsal	6	7	7. 8	9. 5	4. 5	8
Interdorsal space	6	8	-------	7	-------	6
To second dorsal	54	71	74	73	65	65
Length of second dorsal	9	11	11	13	9	9
To anus	53	67	70	72	63	66

Larvae of Mordacia or Caragola Examined

Of larval lampreys with an Ammocoetes head, in all probability belonging to a species of Mordacia or *Caragola lapicida*, I have:

15626 I. U. M. Several hundred, 21 to 99 mm. Osorno, taken with No. 15623, *C. lapicida* at Osorno.
15627 I. U. M. 4, 72 to 87 mm. Lautaro.
15628 I. U. M. 4, 72 to 118 mm. Valdivia.
15629 I. U. M. One, 87 mm. with *Caragola lapicida* (15624), given me with marine things by Mr. Gonzales, of the Santiago market.
16042 I. U. M. 12, 88 to 125 mm. Valdivia. Carlos Wiebrich. 1924.

I take these specimens to be Mordacia or Caragola, first, because they differ about the head from the larvae known to be Velasia or Geotria; second, the origin of the first dorsal is midway between the tip of the caudal and some part of the head; third, because the second dorsal is continuous with the caudal finfold; fourth, they were taken together with adult *Caragola lapicida* from the sand at the bottom of the river and probably belong to this species.

The species of Mordacia and Caragola are based on the adult dentition largely. It is, therefore, impossible to distinguish larval species before the teeth are developed. The larvae of the two genera are probably very similar.

The metamorphosis into the adult form of this type of larvae takes place very late. The largest larval form I have is 125 mm., the smallest adult form of Caragola is 123 mm. The latter has all of the characteristics of the adult. The former is larval (typical Ammocoetes larva) about the head. In all of the larvae enumerated the disk about the mouth is densely covered with arborescent papillae, which form a screen over the mouth. These delicate papillae are protected around the lower edge of the oral disk by a thin collar like membrane cut straight across. (It resembles the anterior part of the ministerial collar.) The sides and upper, or anterior, part of the oral papillae are protected by a membrane, hooded over the mouth in front and forming free folds over the mouth and collar from the sides (Pls. II, figs. 1–3; IV, figs. 2–4). My specimens range from 21 to 125 mm. There are no indications of teeth even in the largest.

In the largest, as in the smallest, the inner surface of the hood and collar are without papillae. The oral opening in the largest is very wide, without indications of a tongue; papillae are inserted at the edge of the opening in at least two series, those of the outer series much smaller than those in the inner. They bend inward and branch over the opening. The largest papilla in the largest specimen is attached at the middle of the lower edge of the opening and it reaches entirely across the opening; from this large papilla they decrease forward. In other specimens examined the largest papillae are attached at the side of the oral opening. Together the papillae form a brush filling the oral opening to the level of the edge of the collar. There are several parallel membranes extending from the oral opening to the front edge of the disk. The membranes decrease in height forward and are arborescent at the edge and sometimes divided into separate papillae. The gill-openings are circular and open into a groove extending the entire length of the gill region. The eye is obscure.

The first dorsal is scarcely evident in the youngest and older larvae, well developed at 90 mm. Plumbeous, shading to white below. Turgid in the gill region.

Measurements of specimens of Caragola

	113 mm.	90 mm.	87	41
Snout to eye	5	4. 5	3	2
To first gill	8. 5	7	5. 5	3
To last gill	20	14	14. 5	9
To first dorsal	61	53	50	25(?)
Length of first dorsal	(?)	8	5. 5	(?)
To second dorsal	86	69	64	(?)
To anus	96	67	65	32
Depth	7		5. 5	

Key to the South American genera of lampreys

a. Supraoral lamina undivided, with four notches or teeth; labial teeth discrete, in concentrically divergent series; posterior dorsal separate from the caudal. Metamorphosis taking place at about 100 mm. or less.
b. Oral disk small, the teeth close together, overlapping; gular pouch small or absent.... **Velasia** Gray.
bb. Oral disk large, the teeth remote from each other.
c. Labial teeth largest near the mouth; supraoral lamina prominent; gular sac very large, anterior lingual tooth bi- or tricuspid.... **Geotria** Gray.
cc. Labial teeth largest farthest from the mouth; supraoral lamina hidden; anterior lingual tooth tricuspid; base of first dorsal much larger than its distance from the second, gular sac present or not.... **Exomegas** Gill.
aa. Two lateral supraoral lamina, each with three teeth or points; labial teeth in series radiating from the mouth, each series with a more or less confluent base; second dorsal confluent with the caudal; gular sac, if present, large or small; metamorphosis taking place from an Ammocoetes larva at about 200 mm.
d. Anterior lingual tooth with two strong retrorse hooks.... **Mordacia** Gray.
dd. Anterior lingual tooth with a V-shaped serrated raised edge.... **Caragola** Gray.

VELASIA Gray

Velasia Gray, Proc. Zoöl. Soc. London, 1851, p. 239, Pl. IV, fig. 4; id. List Spec. Fishes Brit. Mus., I, 1851, p. 143, Pl. I, fig. 4.
Macrophthalmia Plate, Sitzb. Ges. Naturf. Fr. Berlin, 1897, p. 137 (*chilensis*).
Type, *Velasia chilensis* Gray.

The species of Velasia

a. Anterior lingual tooth two-pronged; median pair of teeth of supraoral lamina spatulate; length of base of second dorsal much greater than the space between the dorsals; origin of second dorsal nearly equidistant from tip of caudal and middle of branchial region.... **chilensis** Günther.
aa. Anterior lingual tooth tricuspid; median pair of teeth of the supraoral lamina ovate or triangular; length of base of first dorsal little less than its distance from the second.... **stenostoma** Ogilby.

Velasia chilensis Gray. Plate III, figs. 13 and 14

Lamprea

Velasia chilensis Gray, Proc. Zoöl. Soc. London 1851, p. 239, pl. iv, fig. 4 (Chile, in fresh water); id. List Spec. Fishes Brit. Mus. I, 1851, p. 143, pl. i, fig. 4; id. Ann. & Mag. Nat. Hist., XIII, 1854, p. 63; Philippi, Archiv Naturg. 1857, I, p. 266; l. c., 1863, I, p. 207, plate X, fig. a.
Geotria chilensis Günther, Cat. Fishes Brit. Mus., XIII, 1870, p. 509; Eigenmann and Eigenmann, Proc. U. S. Nat. Mus., XIV, 1891, p. 24; Gill, Mem. Nat. Acad. Sci., Washington, VI, 1893; p. 110; ?Berg, An. Mus. Nac. Buenos Aires, IV, 1895, p. 122, Lam. II, figs. 2 and 3 (Rio de Plata); Delfin, Catálogo de los Peces de Chile, 1901, p. 13; Eigenmann, Repts. Princeton Univ. Exp. Patagonia, III, 1909–10, pp. 233 and 376; Regan, Ann. & Mag. Nat. Hist. (8), VII, 1911, p. 196.
?*Petromyzon fonki* Philippi, Archiv Naturg. 1865, I, p. 709; Monatsb. Preuss. Akad., 1866, p. 709.

Habitat, Chile.

I have found no formal description of Philippi's *Petromyzon fonki*. Under the description of *Petromyzon acutidens* Archiv Naturg. 1865, I, p. 109, he says of it that, as in *acutidens*, its second dorsal is separate from the caudal and that it lacks a lymph sac. Its form is more slender than in *acutidens;* its caudal is spatulate; its lips are edged with plates like Velasia.

I should have said that *fonki* is a *lapsus digiti* for *anwandteri*, but he compares *acutidens* with *anwandteri* also, reaffirming his first description of *anwandteri* as possessing a lymph sac, and having the second dorsal confluent with the caudal. His last sentence reads: "But *Velasia chilensis* and *Petromyzon anwandteri* tolerably light gray, *Petromyzon fonki* bluish, and probably *P. acutidens* remains even with longer stay in spirits dark, almost black."

In 1865 he evidently distinguished between three species of what he calls Petromyzon. But in the following year in Monatsbericht König. Preuss. Akad. 1866 (title page 1867), p. 709, he refers only to *Velasia chilensis*=*Geotria australis*, *Petromyzon fonki* and *P. acutidens*, not to mention his larval forms of Ammocoetes and Chilopterum. His *P. anwandteri* is omitted.

According to Regan, this species is known from the type only. He considers that all other references to this species pertain to *Velasia stenostomus* or *Geotria australis*. Regan, does not mention *P. fonki* Philippi.

I secured no specimens of this species. A specimen in bad condition, No. 462, without definite locality, in the National Museum at Santiago, probably belongs to this species and may be the type of Philippi's *Petromyzon fonki*.

Velasia stenostoma Ogilby. Plates II, figs. 4–6; III, figs. 7–12

Geotria chilensis Günther (part), Cat. Fishes Brit. Mus. VIII, 1870, p. 509; Lahille, An. Mus. Nac. Buenos Aires, XXVI, 1915, p. 380, pl. XIII (Rio Santa Cruz to Rio de la Plata).
Macrophthalmia chilensis Plate, Sitzb. Ges. Naturf. Fr. Berlin, 1897, p. 137.
Geotria chilensis Plate, *non* Gray, Zool. Jahrb. Suppl. V, 1902, p. 660, pl. XIX, figs. 7–16
Velasia stenostomus Ogilby, Proc. Linn. Soc. N. S. W. XXI, 1896, p. 409.
Geotria stenostomus Plate, l. c., 1902, p. 671, pl. XIX, fig. 21 (New Zealand); Regan, Ann. & Mag. Nat. Hist. (8), VII, 1911, p. 197 (Otaga, New Zealand, Swan River).

Habitat, South America, North to Rio de la Plata and Valdivia (Santiago?), New Zealand.
Of this species I secured:

15634 I. U. M. 90 mm., a metamorphosed young in the Macrophthalmia stage, from the school collection at Valdivia, through Mr. Brenning.
16043 I. U. M. 88 mm., a metamorphosed young Valdivia. Carlos Wiebrich.

and the larvae enumerated page 30.

GEOTRIA Gray

Geotria Gray, Proc. Zoöl. Soc. London, 1851, p. 238, pl. IV, fig. 3, and pl. V; id. List. Spec. Fishes Brit. Mus., I, 1851, p. 142, pl. I, fig. 3 and pl. 2 (*australis*).
Thysonochilus MS. Philippi, Archiv Naturg. 1857, I, p. 266 (chilensis=australis).

Type, *Geotria australis* Gray.
Only one species of the genus occurs in Chile.

Geotria australis Gray. Plate III, figs. 1–6

Lamprea con bolsa

Geotria australis Gray, Proc. Zoöl. Soc. 1851, p. 238; id., List Spec. Fishes Brit. Mus., I, 1851, p. 142, pl. II, fig. 3 ("Inkarpinki" river, South Australia); Günther, Cat. Fishes Brit. Mus. VIII, 1870, p. 508; Ogilby, Proc. Linn. Soc. N. S. W. XXI, 1896, p. 422; Plate, Zool. Jahrb. Suppl. V, 1902, p. 668, pl. XIX, figs. 17–19 (Valdivia, Chile; King George's Sound, Australia); Eigenmann, Repts. Princeton Univ. Exped. Patagonia III, 1909, p. 234; Regan, Ann. and Mag. Nat. Hist. (8) VII, 1911, p. 197 ("Inkarpinki"; Tasmania).
Thysonochilus valdivianus MS. Philippi, Archiv Naturg. 1857, I, p. 266 (Valdivia).
Velasia chilensis (*non* Gray) Philippi, Archiv Naturg., 1857, I. p. 266; l. c., 1863, I, p. 207, pl. X, fig. a (Valdivia).
Geotria allportii Günther, Proc. Zoöl. Soc. 1871, p. 675, pl. LXX (Tasmania).

Philippi's original account of this species was sent to the editor of the Archiv für Naturgeschicte under the name *Thysonochilus valdivianus*. The editor erroneously identified it with Gray's name, *Velasia chilensis*. In this description (Archiv f. Naturg. 1857, I) Philippi mentions a sac-form enlargement at the throat and the peculiar form of the lips which exclude it from *V. chilensis* Gray. The mouth is described as circular, surrounded by a groove and by a large number of oblique, semicircular, fringed leaflets, beyond which there are a number of cirri.

The teeth of the lips form seven concentric rows and become larger toward the center. The maxillary teeth are four, of which the middle ones are scarcely half as wide as the outer ones. The mandibular teeth are nine in number. There are two powerful teeth on the tongue. Slate color. Reaches a length of one foot. This indeed agrees with *Velasia chilensis* in all but one notable point. It possesses a gular sac and *Velasia chilensis* Gray does not. This difference escaped the editor when he suppressed Philippi's name.

Geotria allportii is placed as a synonym of *Geotria australis* on the authority of Regan. The figure of the head indicates a different species.

There is a fine specimen of this species in the National Museum in the Quinta Normal, Santiago, from the Rio Rahue at Osorno, 1916, and two others in the laboratory of Doctor Maldonado in the Quinta Normal. They are without definite locality.

This species has been recorded from Osorno and Valdivia, Chile; also from Australia.

I received as presents three specimens:

15631 I. U. M. One 430 mm. Valdivia, from the school collection through Mr. Agosto Brenning; and
15632 I. U. M. Two, 470 and 480 mm. Lautaro, from Mr. Piedro Galusda, superintendent of the hatchery.

All three of these are provided with a large gular sac.

EXOMEGAS Gill

Exomegas Gill, Proc. U. S. Nat. Mus., V, 1882, p. 524.

Type, *Petromyzon macrostomus* Burmeister.

The species of this genus have not been recorded from Chile north of Punta Arenas.

Key to the species

a. Back rounded; a gular sac ..... **macrostomus** (Burmeister).
aa. Back with a flattened area, bordered by two dermal folds; no gular sac .. **macrostoma gallegensis** Smitt.

Exomegas macrostomus (Burmeister)

Petromyzon macrostomus Burmeister, Anal. Mus. Buenos Aires, 1868; Act. Soc. Paleont, 1868, XXXVI (Buenos Aires); Günther, Cat. Fishes Brit. Mus. VIII, 1870, p. 506.

Exomegas macrostomus Gill, Proc. U. S. Nat. Mus., V, 1882; Berg, Anales del Museo de la Plata, IV, 1895, p. 4 (Montevideo; Lago Argentino, Santa Cruz, Patagonia, Lakes Nuevo and Nahuel Huapi); Gill, Science, XXIII, p. 30, Jan. 19, 1894; Eigenmann and Eigenmann, Proc. U. S. Nat. Mus. XIV, 1891, p. 24; Gill, Proc. U. S. Nat. Mus. XVII, p. 110, 1894; Berg, Commun. Mus. Buenos Aires, I, p. 91, 1899 (Buenos Aires); Eigenmann, Repts. Princeton Univ. Exped. Patagonia, III, p. 235, 1909 and 1910, p. 376.

Geotria macrostoma Berg, Anales del Museo de La Plata, Zool. I, 1893, p. 3, pl. I; Regan, Ann. and Mag. Nat. Hist. (8), VII, p. 197, 1911.

Recorded from Montevideo, Rio de La Plata, Lakes of Patagonia to Nahuel Huapi.

Exomegas macrostomus gallegensis Smitt. Plate III, figs. 15 to 17

Geotria macrostomus gallegensis Smitt, Poissons d'eau douce de la Patagonia, Bihang till K. Svensk Vet. Akad. Handlingar, XXVI, 1901, pl. IV, figs. 19 to 7, p. 25, pl. IV, figs. 19–24 (Rio Gallegas and its tributaries, Rios Ruben and Turbio).

Exomegas macrostomus gallegensis Eigenmann, Repts. Princeton Univ. Exped. Patagonia, III, 1909, p. 236 and 1910, p. 377, pl. XXX, figs. 4 and 4a (copied).

This variety is known only from the types.

Smitt (figs. 25 and 27) figures what he supposed to be the larva of *Exomegas macrostomus*, which is, however, most probably a Caragola. His figures show the hood of my larvae of Caragola. (See *ante*, p. 31.)

MORDACIA Gray [3]

Mordacia Gray, Proc. Zoöl. Soc. London, 1851, p. 239, pl. IV, fig. 6; id. List Spec. Fishes Brit. Mus. I, 1851, p. 143, pl. I, fig. 6 (*mordax*).

Chilopterus Philippi, Archiv Naturg. 1858, I, p. 308, based on a larva 3 inches long. The genus may be a synonym of Caragola.

Type, *Mordacia mordax* Gray.

Key to the American species of Mordacia

a. Anterior lingual plate triangular, with two strong retrorse hooks; anus near origin of last 7th or 8th of the length, under the 2nd dorsal.

b. No gular sac or the sac very small; teeth of the oral disk mostly on common, radially arranged bases, those nearest the opening largest; two irregularly arranged series of small teeth between the radial teeth and the edge of the lips; the prongs of the anterior lingual teeth diverging; no median tooth in front; second dorsal continuous with the caudal. Lips with minute warts between the rows of teeth. **acutidens** Philippi.

bb. A large gular sac; wreath of radially arranged teeth on the oral disk on separate bases; three crowded rows of teeth between the wreath and the edge of the lip; the largest teeth are in the inner series, those of the outer series being minute and twice as numerous as those of the inner of the three series; the prongs of the anterior lingual teeth in nearly parallel planes; second dorsal continuous with the caudal. **anwandteri** Philippi.

Mordacia acutidens (Philippi) Plate IV, fig. 11

Petromyzon acutidens Philippi, Archiv Naturg. 1864, p. 107, pl. X, fig. b; Ann. and Mag. Nat. Hist., XVI, 1865, p. 221.

Mordacia acutidens Plate, Zool. Jahrb. Suppl. V, 1902, p. 657, Taf. XIX, figs. 5 & 6 (Valdivia); Regan, Ann. and Mag. Nat. Hist., (8), VII, 1911, p. 195 (Chile).

Caragola acutidens Eigenmann, Repts. Princeton Univ. Exped. Patagonia III, 1909, p. 237, plate XXX, fig. 7.

Of this species recorded by Plate from the School collection at Valdivia I was given a specimen by Mr. Agosto Brenning of the German School of Valdivia.

15622. I. U. M. 224 mm. long, a female, Valdivia.

Mordacia anwandteri (Philippi). Plate IV, figs. 9, 10, 12

Petromyzon anwandteri Philippi, Archiv Naturg. 1863, p. 207, taf. X. fig. b. (Valdivia.)

15498 I. U. M. 245 mm., a male, Valdivia.
16040 I. U. M. 265 mm., Valdivia. Carlos Wiebrich.
16041 I. U. M. 260 mm., Valdivia. Carlos Wiebrich.

15498 was given me by Mr. Brenning of Valdivia. It is quite soft and most of the teeth have dropped from their moorings. Nevertheless, enough of them remain to determine the characters given in the key and in the photographs. The second dorsal gradually merges into the caudal.

There is a specimen of this species in the Museo Nacional in Santiago from the Rio Renaico, March 6, 1918. (See photograph.)

[3] Plate (Zool. Jahrb. Suppl. V, 1902, 654, pl. XIX, figs. 1 and 2) described and figured what he supposed to be *Mordacia mordax*. He described the anterior lingual tooth as a curved plate with about 25 small cusps in two curved series which converge toward the center. He had two specimens from the Murray river. But the original Australian *Mordacia mordax* was described and figured as having two conical arched teeth. The figure was adopted by Gray (List Spec. of Fishes, I, fig. 6) and by Günther (Study of Fishes); both Gray and Günther had the type. Regan (Ann. and Mag. Nat. Hist. (8) VII, 1911, p. 195) describes *Mordacia mordax* as having the "enlarged cusps of anterior lingual lamina small, the denticulated ridge evident, the two most anterior of the radial series of labial teeth are entirely separated by a group of three teeth." He also had the type and a second specimen from Tasmania.

I am in doubt whether Plate had *Mordacia mordax* or a specimen of Caragola. Caragola has not otherwise been recorded from Australia.

CARAGOLA Gray

Anguilla

Caragola Gray, Proc. Zool. Soc. London, 1851, p. 239, pl. IV, fig. 5; id. List Spec. Fishes Brit. Mus., I, 1851, p. 143, pl. I. fig. 5, (*lapicida*).

Type, *Caragola lapicida* Gray.

A genus of lampreys consisting of but one species. Anterior lingual plate with a V-shaped serrated edge; one single tooth between the anterior radial series of teeth. No gular sac; anus near origin of last sixth of the length.

Caragola lapicida Gray. Plates II, figs. 1–3; IV, figs. 1–8

Caragola lapicida Gray, Proc. Zool. Soc. London, 1851, p. 239, pl. IV, fig. 5; id. List. Spec. Fishes Brit. Mus. I, 1851, p. 143, pl. 1, fig. 5 (Bay of Valparaiso); Eigenmann, Repts. Princeton Univ. Exped. Patagonia, III, 1909, p. 237, Plate XXX, fig. 6.

Mordacia lapicida Plate, Zool. Jahrb. Suppl. V, 1902, p. 656, pl. XIX, figs. 3 and 4 (Bay of Talcahuano, Tumbes); Regan, Ann. and Mag. Nat. Hist. (8), VII, 1911, p. 195 (Valparaiso).

Mordacia mordax Günther (part), Cat. Fishes Brit. Mus. VIII, 1870, p. 507; Steindachner, Zool. Jahrb. Suppl. IV, 1898, p. 334 (Tumbes).

I secured:

15623 I. U. M. 2, 129, and 160 mm. long. Osorno.
15624 I. U. M. 1, 127 mm. Given me with a bottle of marine things by Mr. Jose Gonzales y Gonzales at Santiago.
16042 I. U. M. 12, largest about 125 mm. Valdivia. Carlos Wiebrich.

II. DIPLOMYSTIDAE

This family consists of one genus of one species.

It is confined to northern Patagonia and south central Chile. It is unique among all American cat-fishes in that the maxillary bears a band of small teeth. It is probably the oldest member of the strictly fresh-water fauna of Patagonia and Chile. The characters of the family are included in the diagnosis of the genus.

Diplomyste Dumeril

Type, Diplomyste papillosus Dumeril.

Air-bladder large, heart-shaped, not enclosed in a bony capsule; fourth vertebra with a broad process, thickened in front and curved downward, fastened toward its angle with the post-temporal in such a way as to leave a canal between them, through which the upper angle of the clavicle passes; fifth vertebra well developed, with a narrow transverse process, in contact on its basal part with the posterior edge of the process of the fourth vertebra. Vomer expanded laterally, its teeth in the adult in an oval patch as wide as the width of the premaxillary; maxillary large, broad behind, articulating with the premaxillary and the palatine in front.

Diplomyste chilensis (Gmelin). Plates V and VI, fig. 1

Tollo

Silurus chilensis Molina, Saggio sulla storia Nat. Chile, 1782 (lib. 4, p. 225, fide Bonaterre); Gmelin, Systema Naturae, I. No. 1358, 1788; Bonnaterre, Ichthyologie, 1788, p. 152; Bloch & Schneider, Systema Ichthyologiae, 1801, p. 378; Gmelin, Systema Naturae, 1806, p. 839; Molina, Geogr. Nat. Civil Hist. Chile, Irving's translation, I., 1808, p. 153.

Pimelodus chilensis Lacépède, Hist. Nat. Poiss., V, 1803, p. 114, 12 mo., ed. IX, p. 146, 1802. XV, 1840, p. 118, pl. 431. (Valparaiso; Santiago); Gay, Hist. Chile, II, 1848, p. 305, pl. fig. 1 (Chile); Philippi, Mb. Ak. Wiss. Berlin, 1866, p. 710 (Chile).

Diplomyste papillosus Dumeril, Ichthyol. Analyt., 1856, p. 487; Eigenmann, Repts. Princeton Univ. Exped. Patagonia III, 1909, p. 252; Plate XXXI, figs. 1–1b, 1909, and 1910, p. 381.

Diplomystes papillosus Bleeker, Nederl, Tijdschr. Dierk. I, 1863, p. 92; Eigenmann & Eigenmann, Proc. Cal. Acad. Sci., 2d ser., I, 1888, p. 149 (Rivers of Santiago); Occasional Papers Cal. Acad. Sci. I, 1890, p. 26.

Diplomystax papillosus Günther, Cat. Fishes Brit. Mus., V, 1864, p. 180 (Chile).
Arius carcharias Leybold, Anales de la Universidad de Chili, 1859, p. 1083 (Chile); Philippi, Mb. Akad. Wiss. Berlin, 1866, p. 711 (Chili).
Arius villosus Philippi, l. c., p. 712 (Santiago).
Arius squalus Philippi, l. c., p. 713 (Peine, Province of Santiago).
Arius micropterus Philippi, l. c., p. 713 (Santiago).
Arius synodon Philippi, l. c., p. 713 (Santiago).

Gmelin, Systema Naturae, p. 839, 1806, describes *Siluris chilensis* thus: "Second dorsal fin fleshy; tail lanceolate. Inhabits fresh waters of Chile; 10 inches long; body brown, beneath white; flesh very excellent.

"D. $\frac{1}{7}$, 0; pect. 8, vent. 8; an. 11, caud. 13 rays."

There are two catfishes in the fresh waters of Chile good to eat and reaching a length of 10 inches or over. Only one of these has a fleshy second dorsal fin, is brown above, white beneath, has the dorsal 1, 8. Its tail, however, is not lanceolate and the rest of the description does not fit. Nevertheless, it seems quite certain that Gmelin named the "tollo."

Bonaterre adds that there are four barbels and the length reaches 11 inches. He described two varieties, and it is quite possible that the four barbelled *Nematogenys* was one of them.

I secured the following specimens:

15522 I. U. M. 9, 130–255 mm. Lautaro. February 13.
15523 I. U. M. 1, 117 mm. San Xavier. March 23.
15524 I. U. M. 5, 47 to 60 mm. and 156 to 168 mm. Estero Nonguen. March 20.
15525 I. U. M. 20, 154–210 mm. Santiago market.
15552 I. U. M. 2, 89 and 130 mm. Lake Rinihue. March 16.

I was informed that the species occurs also at Valdivia. It is brought to the market at Santiago. Doctor Maldonado informs me that it is not found in the Aconcagua River. The Maypu basin seems to be its present northern limit.

Head, 3.5–4.5; depth, 4.25–5.25; D. I, 7 or 8; A., 9–12. Width of head about equal to its length without the opercle; depth at occiput about equal to eye and postorbital part of head; eye small, entirely in anterior half of head; interocular less than snout; snout subconical, mouth inferior, the lower jaw much shorter than the upper; head shark-like, hence the name "Tollo"; no nasal barbel; maxillary barbel very thick and fleshy at its base, encircling the maxillary bone, tapering rapidly to a slender filament, which about reaches to the edge of the gill-membrane; no mental barbels; teeth of the jaws in bands; vomer with two ovate patches of teeth in the young which coalesce into a subcircular, much larger patch in the adult; skin villose, especially in anterior part of body and head; first ray of dorsal and pectorals strong spines; dorsal entirely on the anterior half of the body; ventrals inserted under the last dorsal ray; adipose fin as long as, or much longer than, the anal; caudal slightly forked or emarginate. Dark brown, lighter below.

III. NEMATOGENYIDAE

This family of catfishes consisting of one genus of one species is confined to Chile. It resembles the Pygidiidae in many respects and has hitherto been placed in that family. Its distinguishing characters are given under the head of the genus.

NEMATOGENYS Girard

Type, *Trichomycterus inermis* Guichenot.

This genus differs in a number of essentials from the genera of the family of Pygidiidae. It has but one maxillary barbel; it has a pair of mental barbels; it lacks spines on its opercle and interopercle; the origin of the dorsal is in advance of the middle of the body. In general appearance it resembles Pygidium. It is probably the oldest member of the Chilean fresh-water fauna, and may be near the stem of the Pygidiidae which have developed into one of the characteristic elements of the South American fauna.

Air bladder divided into two lateral halves, surrounded by a bony capsule with large lateral openings. A narrow duct passing in a groove below the vertebra unites the two halves. The capsule is formed for the most part by the modified transverse processes of the fourth vertebra, its anterior face by the skull. The bony walls of the capsule both above and below have many perforations. The post temporal is firmly united with the capsule. Its lower process does not reach to the body of the vertebra, lying along part of the posterior opening of the capsule where it joins the skull.

Nematogenys inermis (Guichenot). Plate VI and Plate VII, figs. 2–4

"Bagre"

Trichomycterus inermis Guichenot, in Gay. Hist. Chile Zoöl., II, 1848, p. 312, pl. ix, fig. 2 (Chile).
Nematogenys inermis Girard, Proc. Acad. Nat. Sci. Phila., VII, 1854, p. 198; id. U. S. Naval & Astron. Exped., 1855, p. 240, pl. xxxii (Rio de Maypu), Günther, Cat. Fishes Brit. Mus., V, 1864, p. 272 (copied); Eigenmann & Eigenmann, Proc. Cal. Acad. Sci., 2d Ser., II, 1889, p. 50 (Curico; Santiago); id. Occasional Papers Cal. Acad. Sci., I, 1890, p. 322 (Curico; Santiago); Eigenmann, Repts. Princeton Univ. Exped. Patagonia, III, 1909, p. 246, plate XXXI, fig. 2, and plate XXXII, fig. 2, and 1910, p. 398.
Nematogenys nigricans Philippi, Mb. Akad. Wiss. Berlin, 1866, p. 716 (Chile).
Nematogenys pallidus Philippi, l. c., p. 716 (Chile).

Of this species hitherto reported from Santiago and Curico, I secured:

15060 I. U. M. 33, 38–108 mm. Estero Nonguen, Concepcion, Chile. March 20.
15550 I. U. M. Several, 165–407 mm. Santiago market.
15551 I. U. M. Several, largest 285 mm. Hospital. April 22.
15496 I. U. M. 2, 124 and 155 mm. Lautaro. February 13.

This species occurs frequently in the Santiago market. Its name, "bagre," is applied also to the ugliest of the female sex of *Homo sapiens*.

It is served in the Santiago restaurants, and in spite of its unsavory, slimy, appearance is quite palatable.

Head, 3.66–4.33; depth, 5–7; D., 10; A., 11; width of head not equal to its length; depth of head at occiput about equal to eye and postorbital part of head; eye small, superior; interocular a little less than the snout; snout much depressed, the jaws subequal. Anterior nostril with a distinct barbel which reaches about halfway to the eye in the full grown, proportionately longer in the young; maxillary barbel and mental barbel not quite reaching gill-openings; caudal peduncle much compressed, about as deep as body; origin of dorsal and ventrals nearer tip of snout than base of middle caudal rays in the young, nearer base of middle caudal rays in the adult; anal much behind the dorsal; fins all rounded; caudal with numerous accessory rays. Back and sides of adult with round black spots, fins spotted. Half grown with a more or less distinct series of spots along the middle of the sides, with light areas between the spots. The markings more streaked in the very young.

IV. PYGIDIIDAE

This family of "catfishes" is found everywhere in South America, from sea level to Lake Titicaca. For an account of the family see Eigenmann, The Pygidiidae, a family of South American Catfishes. Mem. Carnegie Museum, VII, 1918, pp. 259–398, plates XXXVI–LVI, 39 text figures.

Key to the genera of the Pygidiidae found in Chile

a. Caudal peduncle subterete, accessory caudal rays very few ..... **Hatcheria**, Eigenmann.
aa. Caudal peduncle greatly compressed ..... **Pygidium**, Meyen

HATCHERIA Eigenmann

Hatcheria Eigenmann, Repts. Princeton Univ. Exp. Patagonia. III, 1909, p. 248.

Type, *Hatcheria patagoniensis* Eigenmann.

This genus was created to include those Pygidium-like fishes with a slender, subterete caudal peduncle and long dorsal fin. It is quite certain that at least one species, *H. areolata*

(C. & V.), included in it should be placed back in the genus Pygidium. It is quite possible that *H. maculata* (C. & V.) should also be put back into the genus Pygidium. In that case four of the species of this genus occur in northern Argentina and the one new one in Chile near the coast.

The species with their distribution are:

Hatcheria patagoniensis Eigenmann, San Juan, Argentina.
Hatcheria titcombi Eigenmann, Rio Limay basin, Argentina.
Hatcheria burmeisteri (Berg), Rio Mendoza, Argentina.
Hatcheria macraei (Girard), Upsullata; San Juan; Rio Colorado, Argentina.

Hatcheria maldonadoi Eigenmann, sp. nov. Plate VIII, figs. 2–2b.

Bagre

15058 I. U. M. Type and paratypes, many, 30–79 mm. Rio Nonguen, Concepcion. March 20.
15635 I. U. M. 2, 34 and 35 mm. Lautaro. February 13.

Head, 5 in the length; depth, 7.5; D., 15 (10); A., 9.

Heavy at head, tapering to a slender subcylindrical caudal peduncle; outer maxillary barbel extending to the first interopercular spines; nasal barbel reaching to midway between posterior nares and eye; depth of caudal peduncle 3.5 in the length of the head; width of head little less than its length; teeth conical, in narrow bands.

Origin of dorsal about midway between snout and base of caudal or middle of caudal, its base equal to or greater than length of head; last anal ray under or a little in advance of the last dorsal ray, its distance from the caudal about 3.5 in the length; caudal slightly emarginate; origin of ventrals about midway between snout and middle of caudal peduncle; width of caudal peduncle one-half to two-thirds its depth; pectoral without a filament.

A series of distinct quadrate spots from head to middle of caudal, another series above it; dark spots or vermiculations above them.

Vertebrae: coalesced + 35 + 1.

Pygidium Meyen[1]

Type, *Pygidium fuscum* Meyen.

Of the genus Pygidium there have been recorded from Chile six species. Of these six I am certain of but one species in my collections. Of the six species *P. nigricans* was probably a misidentification of a specimen of *P. maculatum*. Three species, *P. marmoratus*, *palleum*, and *tigrinum* are so meagerly described that, without the original specimens, they can not be identified. They were all described in the Monatsbericht Ak. Wiss. Berlin, 1866. Thinking that possibly the types were sent to Berlin, I made inquiry and was informed by the Director of the Berlin Museum, Dr. Kückenthal, that they were not in the Berlin collections. I was not able to find them in Santiago. Until the specimens are found the identity of these species may be left in doubt.

I secured two species of Pygidium. One, very variable in color and to a less extent in the shape of its teeth and position of its fins, is abundant from Choapa to the region about Lakes Llanquihue and Todos Santos. It reaches a maximum length of 116 mm. The second species attaining a larger size, 170 mm., more eel-like, I secured in the Esterito Nonguen, at San Xavier and possibly at Lautaro.

Key to the species of Pygidium

a. Vertebrae coalesced + 40 to 43 + 1; origin of ventrals nearer tip of snout than to base of middle caudal rays; depth about 8 to 8.5 in the length; head about 6.5; caudal about equal to the length of the head; anus midway between origins of pectorals and middle caudal rays; maxillary barbel reaching tip of lower interopercular spines; back and sides profusely spotted with large or small spots; teeth very narrow incisors.

M. C. Z. 53 mm. 5,000 ft. Rio Blanco, Potrerillos, near Mendoza, Argentina.

[1] A specimen of a new species of Pygidium was sent me by Mr. S. Henshaw for examination. Back nearly uniform dark, no lateral band. First pectoral ray not prolonged; teeth pointed, those in the lower jaw very little flattened; maxillary barbel reaching to edge of gill-membrane. Head 6 in the length without the caudal. D., 9; A., 9; origin of anal about under middle of dorsal; origin of ventrals nearer tip of caudal than to tip of snout.

chiltoni Eigenmann

aa. Vertebrae colaesced+36 to 38+1 (rarely 35 or 39); origin of ventrals usually nearer base of middle caudal rays than to tip of snout.

b.[5] Head, 6.33–6.25 in total length, with the caudal (5–6 to base of caudal); depth, 8–8.5 (6–8 to base of caudal); D., 12–13 (10–13 in specimens collected by myself); A., 7–8 (6–8); origin of dorsal equidistant between tip of caudal and a point between eye and occiput; last ray of anal a little behind last ray of dorsal; origin of ventral equidistant between eye and origin of caudal; upper maxillary barbel extending beyond tip of nasal barbel, to opercle; depth of caudal peduncle 2–2.25 in its length; spotted or with traces of longitudinal bands ..... areolatum (C. & V.)

bb. Head, 4.75–5.75; depth, 7.33–9; D., 12–14; A., 7–8; origin of dorsal equidistant from tip of caudal and a point between middle of snout and anterior margin of eye; last ray of anal below last of the dorsal or a little behind it; origin of ventral equidistant from tip of snout and origin of the caudal, or a little nearer tip of snout; upper maxillary barbel extending beyond tip of nasal barbel, reaching the opercle; depth of caudal peduncle 2.25–3 in its length ..... maculatum (C. & V.)

Pygidium chiltoni Eigenmann, spec. nov. Plate VIII, figs. 1–1a; Plate XIII, figs. 5 and 6

15059 I. U. M. many, 35–170 mm. Estero Nonguen. March 20.
15703 I. U. M. 5, largest 112 mm. San Xavier. March 23.

Head, 6–7; depth, 7.5–9; D., 14; A., 10.

Eel-like, much compressed at caudal peduncle; outer maxillary barbel extending very little beyond the first interopercular spines; nasal barbel a little beyond eye. Depth of caudal peduncle, 1.66–2 in the length of the head; width of caudal peduncle 3.5–4 in its depth; width of head about equal to its length behind the posterior nares; teeth very narrowly spatulate, in narrow bands.

Origin of dorsal equidistant from tip of caudal and some point on anterior half of the head, its base equal to the head without the opercular spines; last anal ray considerably behind the vertical from the last dorsal ray, its distance from the caudal 3.75–4.25 in the length; caudal slightly emarginate; origin of ventrals nearer snout than caudal by one-third or one-fourth the length of the head; pectoral without a filament.

Very numerous black spots of variable size, with yellow vermiculations between them.

Vertebrae, coalesced + 40, 41, 41, 43, 43, 43 in six specimens.

This species is very abundant in the Estero Nonguen, Concepcion. It is more eel-like both in looks and movement that the other species of Pygidium of Chile. The distinction is well marked in the adult, less so in the young. In general appearance it resembles *Galaxias maculatus*, a very different fish.

Named for Colonel M. A. Chilton, military attaché of the American embassy at Santiago, who toured the Switzerland of Chile with me.

Pygidium areolatum (Cuvier and Valenciennes). Plate VIII, fig. 3

Bagrecito

Trichomycterus areolatus Cuvier and Valenciennes, Hist. Nat. Poiss., XVIII, 1846, p. 492 (Rio San-Iago, coast of Chile); Guichenot, in Gay, Hist. Chile, II, 1848, p. 309; Günther, Cat. Fishes Brit. Mus., V, 1864, p. 274 (Chile); Philippi, Mb. Ak. Wiss. Berlin, 1866, p. 714; Delfin, Catálogo de los Peces de Chile, 1901, p. 30.

Pygidium areolatum Eigenmann and Eigenmann, Proc. Cal. Acad. Sci. (2), II, 1889, p. 51 (Rio Mapocho, Chile); Occasional Papers Cal. Acad. Sci., I, 1890; p. 330; Proc. U. S. Nat. Mus., XIV, 1891, p. 36;? Berg, An. Mus. Nac. Buenos Aires, IV, 1895, p. 143 (Arroyo del Tala, Catamarca, Argentina).

Hatcheria areolata Eigenmann, Repts. Princeton Univ. Exped. Patagonia, III, 1909, p. 251, pl. XXXIV, fig. 2; 1910, p. 399; Mem. Carnegie Mus. VII, 1918, p. 285.

Trichomycterus marmoratus Philippi, Mb. Ak. Wiss. Berlin, 1866, p. 714; Eigenmann and Eigenmann, Occasional Papers Cal. Acad. Sci., I, 1890, p. 326; Delfin, Catálogo de los Peces de Chile, 1901, p. 31.

Pygidium marmoratum Eigenmann and Eigenmann, Proc. U. S. Nat. Mus., XIV, 1890, p. 36; Eigenmann, Repts. Princeton Univ. Exped. Patagonia, III, 1910, p. 399.

Trichomycterus palleus Philippi, Mb. Ak. Wiss. Berlin, 1866, p. 715; Eigenmann and Eigenmann, Occasional Papers Cal. Acad. Sci., I, 1890, p. 325; Delfin, Catálogo de los Peces de Chile, 1901, p. 30.

Trichomycterus tigrinum Philippi, Mb. Ak. Wiss. Berlin, 1866, p. 714; Eigenmann and Eigenmann, Occasional Papers Cal Acad. Sci., I, 1890, p. 326; Delfin, Catálogo de los Peces de Chile, 1901, p. 31.

[5] The key to *areolatus* and *maculatus* is based on the types of these species and has been kindly furnished by Dr. Pellegrin of the Paris Museum.

Of this species, originally described from fresh waters of Chile, I have seen many thousands of specimens. It seems to have worked its way into all streams south of La Serena, and is abundant wherever there are riffles with rocks.

15637 I. U. M. Many. Largest, 103 mm. Choapa. April 10.
15638 I. U. M. Many. Largest, 90 mm. La Calera. April 13.
15639 I. U. M. Many. Largest, 100 mm. El Flor de Maipo. April 23.
15640 I. U. M. Many. Largest, 104 mm. Peñaflor. March 26.
15641 I. U. M. Many. Largest, 110 mm. Hospital. April 22.
15642 I. U. M. Many. San Javier. March 23.
15643 I. U. M. Many. Largest, 110 mm. Lautaro. February 13.
15644 I. U. M. Many. Largest, 116 mm. Lake Rinihue. March 16.
15645 I. U. M. Many. Largest, 83 mm. Osorno. March 14.
15646 I. U. M. 4. Largest, 100 mm. Puerto Varas. March 12.
15647 I. U. M. 4. Largest, 102 mm. Rio Pescado. March 10.
15648 I. U. M. Many. Largest, 99 mm. Ensenada. March 9.
15649 I. U. M. Many. Largest, 110 mm. Falls of Petrohué. March 8.
15650 I. U. M. Many. Largest, 112 mm. Puella, Lake Todos Santos. February 27.
15701 I. U. M. 2. Largest, 88 mm. Casa Panque. March 6.
15702 I. U. M. Many. Largest, 115 mm. Abtao. February 23.

I have sent a number of specimens of the species of Pygidium to Doctor Pellegrin, who compared them with the types of *P. areolatum* and *P. maculatum*. He identifies the specimens above as being specificially identical with the types of *P. areolatum*. He further reports that the types of *P. areolatum* are 92, 107, 116 mm. long, respectively, with the characters given in the key.

Head, 5 to 6; depth, 6 to 8; D., 10 to 13; not counting short rudimentary rays; A., 6 to 7, without short rudimentary rays.

Outer maxillary barbel about to end of interopercular spines; nasal barbel but little if any shorter; depth of caudal peduncle 1.5 to 2 in the head; teeth narrow incisors in the north, ranging to near conical in the south; base of dorsal a little longer or shorter than the head; last anal ray on or a little behind the vertical from the last dorsal ray. In Choapa specimens origin of ventrals equidistant from base of middle caudal rays and the eye or a little nearer the former; in more southern localities, equidistant between caudal and middle of snout; equidistant from caudal and snout in a few of the specimens from Lake Rinihue, Abtao, and Petrohué; caudal truncate or slightly emarginate, 5.8 to 8 in the length; pectoral without filament.

Color varying from uniform rusty red; sometimes with a deep lying, dark stripe; sometimes with three dusky stripes; sometimes sides and back uniformly spotted, the spots smaller than the eye; sometimes with large, more or less confluent black spots much larger than the eye; fins uniform or slightly spotted, especially at base of the caudal; sometimes a dusky bar across the base of the caudal. The extremes in color may be found at one place, as at Peñaflor, where I secured some without spots and some extremely spotted.

Vertebrae $\frac{35}{1}, \frac{36}{5}, \frac{37}{4}, \frac{38}{6}, \frac{39}{1}$, not counting the coalesced vertebrae or the hypural plate.

It seems evident from the subjoined that the vertebrae vary with the locality. The number of vertebrae run as follows in specimens from Calera, 36, 36, 37, 38; Peñaflor, 35, 36, 36; El Flor de Maipo, 38, 38; San Xavier, 36, 37; Rinihue, 38, 39; Abtao, 37, 37, 38, 38.

It is quite possible that some of the above specimens belong to *P. maculatum* or that *areolatum* and *maculatum* are sepecifically identical. The description of Cuvier and Valenciennes indicates that they had specimens of *areolatum* with longitudinal stripes rather than with spots.

Pygidium maculatum Cuvier and Valenciennes

Trichomycterus maculatus Cuvier and Valenciennes, Hist. Nat. Poiss., XVIII, 1846, p. 493 (Santiago); Guichenot, in Gay, Hist. Chile, II, 1848, p. 311 (Chile); Günther, Cat. Fishes Brit. Mus., V, 1864, p. 273; Philippi, Mb. Ak. Wiss. Berlin, 1866, p. 716 (Chile); Delfin, Catálogo de los Peces de Chile, 1901, p. 30.

Trichomycterus maculatus Girard, Proc. Acad. Nat. Sci. Phila., 1854, p. 199; U. S. Naval and Astron. Exped. 1855, p. 243, Pl. XXXIV, figs. 1–3. (Rio Mapocho.)

Pygidium maculatum Eigenmann and Eigenmann, Proc. Cal. Acad. Sci. (2), II, 1889, p. 51 (Rio Mapocho); Occasional Papers Cal. Acad. Sci., I, 1890, p. 329; Proc. U. S. Nat. Mus. XIV, 1890, p. 36.

Hatcheria maculata Eigenmann, Repts. Princeton Univ. Exped. Patagonia, III, 1909, p. 249, Pl. XXXIII, figs. 1, 1a, and 1b; 1910, p. 399; id. Mem. Carneigie Mus. vii, 1918, p. 248.

I have not recognized any specimens as belonging to this species. As stated the account in the key is taken by Dr. Pellegrin from the types in the Jardin des Plantes, Paris. It is quite possible that it is a synonym of *P. areolatum*.

V. CHARACIDAE

Of this, the largest of the families of fresh-water fishes of South America, but one genus has penetrated to the temperate region of Chile.

CHEIRODON Girard

Type, *Cheirodon pisciculus* Girard.

The genus Cheirodon was created by Girard for small characid fishes taken in pools near Santiago, Chile. They, with the ubiquitous mountain catfish, Pygidium, are the only fresh-water fishes of Chile recalling tropical America. All of the other Chilean fishes are peculiar to Chile, are Patagonian, or recall Australia.

The genus Cheirodon includes a dozen species found from the Chagres River, in Panama, to Uruguay, Paraguay, and western Chile. It is characterized by the single row of notched teeth, the incomplete lateral line, simple scales on the base of the caudal and spinous interhaemals on the caudal peduncle of the male.

At the time I prepared my account, The Cheirodontinae (Mem. Carnegie Mus. VII, 1915), I had no specimens known to have come from Chile, although I have since identified *Cheirodon annae* whose habitat was at the time unknown as the types of *C. pisciculus* from Chile. Since then I have collected several hundred specimens of Cheirodon from between Vallenar, in latitude 28° 25′, to Puerto Montt, about 41° 30′, over a latitude of about 780 miles. There is a hiatus in the distribution as far as indicated by my collections. I did not take it at La Serena, 29° 56′. But as the collecting was done near the sea it is more than probable that it occurs in some parts of the river farther inland. I also failed to find it at Choapa, 31° 43′, in the Rio Choapa. It was abundant at La Calera, 32° 50′, in the Rio Aconcagua, and from there to Puerto Varas without a break. The specimens fall into three groups. Those from Vallenar in the Rio Guasco, the Aconcagua, and Maipo basins have the region in front of the dorsal more or less naked, the teeth five to seven pointed, and the anal short, with 12–16 as the prevailing number of rays. The tip of the anal lobe extends beyond the tip of the last ray, and serrae of the male extend over a comparatively short part of the caudal peduncle; the second suborbital is not in contact with the suborbital below.

Those between San Xavier, 35° 34′, and Lautaro, Rios Maule, Itata, Bio Bio, and Cautin, 39°, over a stretch of 230 miles, have the predorsal area scaled, the teeth five-pointed, the anal rays from 13–18, the prevailing numbers 14–16, the tip of the anal lobe not extending beyond tip of last ray, and the serrae extending over half the caudal peduncle, the suborbital not in contact with the subopercle below.

Those in southern Chile, from Valdivia to at least Puerto Varas, at least 100 miles (as far as I went) have the teeth, usually three-pointed and the predorsal area scaled; the anal rays 15–17, the prevailing number being 16, the tip of the anal lobe not reaching the tip of last ray, falling short of its base in some individuals; the serrae of the caudal peduncle 19–26, extending from in advance of the tip of the last anal ray to the caudal; the preorbital in contact with the suborbital below.

Certainly the naked predorsal area is not primitive. Only one other species of the Cheirondontinae has this character, the *Grundulus bogotensis* of the plains of Bogota. The northern species of Chile, *Ch. pisciculus* is probably a derivative of the species from central Chile.

The southern species has the general appearance of the others, but its teeth remove it from all other species of the genus. As the three-pointed teeth are more primitive than the five and more pointed teeth, the southern species stands in this respect as the most primitive of all the species of Cheirodon. The latitude of Lake Llanquihue is 250 miles farther south than any member of the Characidae is found north of the Equator.

Cheirodon pisciculus Girard. Plate IX, fig. 1

"Pocha"

Cheirodon pisciculus Girard, Proc. Acad. Nat. Sci. Phila., 1854, p. 199; Eigenmann, Mem. Carnegie Mus. VII, 1915, p. 66.

Cheirodon annae McAtee, Proc. Acad. Nat. Sci. Phila., 1903, p. 515; Eigenmann, l. c., p. 67, Pl. XI, fig. 1.

Habitat, Maipo basin and northward.

There is no doubt but that *Ch. annae* and *pisciculus* were based on the same specimens. The types of *C. annae* were received from the U. S. Nat. Mus. as an exchange. They contained no label except that they came from South America. In describing them McAtee says, "This species bears considerable resemblance to *pisciculus*, from which it may be distinguished by the absence of more than one maxillary tooth; the head 3–4 instead of 5, and the dorsal 9–12 instead of 10."

The types of *Ch. annae* are soft and the scales have largely come off. The character of the predorsal scaling was therefore not noted. A re-examination shows that in most individuals there is a variable naked area behind the occipital process. In some the scales extend to the process, but those nearest it are isolated by narrow naked areas. In those at hand the premaxillary teeth are usually 4 in number, rarely 5; there is a single maxillary tooth. The number of serrae on the caudal peduncle ranges from 10 to 16.

Specimens examined

4301 I. U. M. 13, types of *annae* and *pisciculus*. Pools near Santiago.
15501 I. U. M. 27 females, largest 55 mm.; 17 males, largest 51 mm. Vallenar, Rio Guasco. April 7.
15502 I. U. M. 47 females, largest 68 mm.; 20 males, largest 60 mm. La Calera, Rio Aconcagua. April 13.
15503 I. U. M. Many, largest 58 mm. Peñflor, Rio Mapocho, Maipo basin. March 29.
15504 I. U. M. Many, largest 36 mm. Hospital, Rio Angustura of the Maipo basin. April 22.
15505 I. U. M. 20, largest 61 mm. Llo Lleo, a creek near the outlet of the Rio Maipo, but emptying into the ocean. March 30.

Head, 4–4.5; depth, 3.2–3.75; D., 11, rarely 10; A., $\frac{12}{2}$, $\frac{13}{9}$, $\frac{14}{18}$, $\frac{15}{13}$; scales 6–9, with pores, 32–36, most frequently 33 and 34 in a median line, 11 or 12 between ventral and dorsal; serrae on caudal peduncle of male weak, 15 to 19; depth of caudal peduncle 7.5–8.5 in the length; eye about 3 in the head, longer than snout, interorbital greater than eye.

Mouth very small, distance from tip of snout to end of maxillary equal to the eye. Teeth well developed, four or five in the premaxillary (in a ratio of about 3 with four, to one with five), one or two teeth in the maxillary; five or six, rarely eight in the mandible. The teeth usually with five points, more rarely six or seven points in maxillary and premaxillary; suborbital not in contact with the preopercle below, a naked area below as well as behind it; three narrow postorbitals; gill-rakers 11 or 12 below, 7 on upper arch.

Scales regularly imbricate, the region in front of the dorsal very variable, sometimes entirely naked, sometimes with the scales surrounded with a naked area and every gradation between the two; caudal and anal naked.

Origin of dorsal equidistant from anterior nostril and end of middle scale on caudal peduncle; highest ray equal to the head or a little shorter; caudal lobes equal to the head or considerably longer; anal emarginate, the lobe usually extending considerably beyond the tip of the last ray; the first ray little, if any, behind the vertical from the last dorsal ray; ventrals far in advance of the dorsal; pectorals to ventrals, or falling considerably short.

A very distinct silvery lateral band, ending in a diffuse spot at the end of the caudal peduncle.

Serrae on lower surface of caudal peduncle of the male feeble, extending over half the peduncle or less. The spines on the anal and ventrals of the male feeble.

The weakness of these sexual characters may be due to the fact that the northern specimens were further from the spawning season than those from the south.

Cheirodon galusdae Eigenmann,[6] spec. nov. Plate IX, fig. 2

"Pocha"

15506 I. U. M. Type, a female, 77 mm. San Xavier. Paratypes, 76 females, largest 72 mm.; 34 males, largest 59 mm. San Xavier, Rio Locomilla. March 23.
15636 I. U. M. Many. Estro Nonguen. March 20.
15507 I. U. M. 35 females, largest 61 mm.; 19 males, largest 60 mm. Coigüe, Rio Bio Bio. March 18.
15508. Many, largest female 59 mm.; largest male 59 mm. Lautaro, Rio Cautin and tributary. February 13.

Habitat, San Xavier to Rio Cautin.

More elongate than *Ch. australe*. Head, 4.35 to 4.4; depth, 3.1 in female, 3.16 in male; D., 11 (rarely 10); A., $\frac{13}{3}$, $\frac{14}{10}$, $\frac{15}{15}$, $\frac{16}{12}$, $\frac{17}{4}$, $\frac{18}{1}$; 5 to 11 scales with pores, $\frac{32}{2}$, $\frac{33}{7}$, $\frac{34}{8}$, $\frac{35}{5}$ in a longitudinal series; 11 scales between ventrals and dorsal; serrae on caudal peduncle of male 19 to 26. Depth of caudal peduncle 7 in the length; eye 3 in the head, longer than snout, very little less than interorbital.

Distance from tip of snout to end of maxillary about equal to the eye; teeth well developed, 5-pointed, usually 5, more rarely 4, on the premaxillary, 1 or 2 on the maxillary, 5 on the mandible; suborbital margin rounded, not in contact with the preopercle; three narrow postorbitals; gill-rakers 10 below, 9 above. Scales regularly imbricate, with several radial striae; predorsal area fully scaled, rarely some of the scales near the occipital process surrounded by a narrow naked area; fins naked.

Origin of dorsal equidistant from anterior nostril and end of middle scale of the caudal peduncle, the highest ray about equal to the length of the head; caudal lobes about equal to the head; anal slightly emarginate, the highest ray not reaching tip of the last ray; base of anal less than length of caudal peduncle; first anal ray behind the vertical from the last dorsal ray; ventrals far in advance of the dorsal; pectoral reaching ventral.

A distinct, silvery lateral band, a more or less distinct caudal spot.

Serrae in the male beginning at the tip of the last anal ray. Spines on the anal and ventrals much as in *Ch. australe*. This species found in the Rio Bio Bio, and the rivers just north and south of it, occupies the ecological niche occupied by *Ch. australe* in the more southern waters and *Ch. pisciculus* in the northern.

Cheirodon australe Eigenmann, spec. nov. Plate IX, fig. 3

Pocha

Cheirodon pisciculus Steindachner (non Girard) Zool. Jahrb. Suppl. IV, 1898, p. 328 (Lake Llanquihue).
15509 I. U. M. Type, a female, 62 mm. long. Puerto Varas, March 12. Paratypes, 119 females, largest 68 mm., 68 males, largest 55 mm., Puerto Varas, mostly from a creek flowing through the town into Lake Llanquihue.
15510 I. U. M. 32 females, largest 61 mm., 16 males, largest 51 mm. Ensenada, in a small creek entering Lake Llanquihue. March 9.
15511 I. U. M. 51 females, largest 60 mm., 78 males, largest 54 mm. Osorno, in Rio Rahue, just below town. March 14.
15512 I. U. M. Eight, largest 40 mm. Valdivia. February 19.
15580 I. U. M. Three. Rio Pescado. March 10.

Habitat, Valdivia to Puerto Varas.

Head, 4.2 in male, 4.1 in female; depth, 3.13 in male, 2.6 in female; D., 11, rarely 10; A., $\frac{15}{7}$, $\frac{16}{19}$, $\frac{17}{12}$; scales, 6 to 10, with pores, $\frac{32}{3}$, $\frac{33}{6}$, $\frac{34}{2}$, $\frac{35}{3}$, in a median series; 11 scales

[6] For Piedro Galusda, who has successfully introduced several species of trout into the rivers of Chile.

between ventral and dorsal; serrae on caudal peduncle of male, 19 to 26 (16 in one); depth of caudal peduncle, 6.4 in the length; eye, 3–3.3 in the length of the head, longer than snout; interorbital very little greater than eye.

Mouth very small, distance from tip of snout to end of maxillary equal to the eye. Teeth feeble, three-pointed, 4 or 5 in the premaxillary, 1 in the maxillary, 5 in the mandible; suborbital in contact with the preopercle below, a naked area below its angle and behind; three narrow postorbitals; gill-rakers 10 below, 6 above.

Scales regularly imbricate, with several radial striae; dorsal area fully and regularly scaled; caudal naked, a few scales at the base of the anterior anal rays but not attached to them. In the Osorno specimens the females have 7 to 10 scales with pores, the males 6 to 8.

Origin of dorsal equidistant from anterior nostril and end of middle scales on caudal peduncle; highest ray about equal to length of head; anal emarginate, its base equal to the length of the caudal peduncle, the highest ray not reaching tip of the last, the first ray behind the vertical from the last dorsal ray; ventrals far in advance of the dorsal; pectoral reaching ventrals.

A silvery lateral band, a distinct but not always sharply defined spot at end of caudal peduncle; back reticulate.

The serrae on the lower edge of the caudal peduncle are developed in both sexes but much stronger in the male; they begin in advance of the end of the last anal ray, and in the male they have strong lateral wings. Numerous spines are developed on the ventral surface of the ventral rays and on all but the first and last few anal rays.

This is the most southern of the Characidae. It is especially abundant in weedy patches of small brooks. It stands out from all the other members of the genus by its three-pointed teeth. It differs from the northern *Ch. pisciculus*, also, in the length and shape of the anal, the serrature on the caudal peduncle and the scaling in front of the dorsal.

VI. APLOCHITONIDAE

The Aplochitonidae are fresh-water or catadromous fishes of New Zealand, Queensland, South Australia and southern South America. The South American species are all naked and go by the name of Pelladillos.

APLOCHITON Jenyns

Type, *Aplochiton zebra Jenyns.*

The genus Aplochiton is confined to South America south of Concepcion. There are three or four different forms between Concepcion and Puerto Montt.[7]

One of these, *Aplochiton marinus*, is found along the shores and inland a very short distance. It is said to extend as far north as Concepcion. I was able to purchase a number of individuals in the Valdivia market, to which it is brought very rarely. I caught one specimen in Estero Cutipai, a small stream below Valdivia, separated from the ocean by a ridge, but so near it that the booming of the waves could be heard distinctly. The specimen is represented in Plate XI, Figure 5. Its sides and upper parts are covered with small spots which, I was told, is the river coloration. Those in the ocean are said to be without spots, translucent, smelt-like. The species spawns in the sea.

The second species, *Aplochiton taeniatus*, is more slender than *A. marinus* and is either without markings or there are spots or less perfect bars than in *A. zebra*. It was taken either in lakes or brooks near their mouths or in clear, open parts of rivers (Osorno). It is possible that *marinus* is but the adult, breeding form, of this species. I secured no breeding individuals of *taeniatus*, so am unable to say whether it breeds in lakes or in the ocean. If it breeds in the ocean it is able to ascend the falls of Petrohué, for it is abundant in Lake Todos Santos, above these falls.

[7] Philippi (Mb. König. Preuss. Akad. Wiss. Berlin, 1866, p. 709) says he knows at least four species, all from the Province of Valdivia.

The third species is *Aplochiton zebra*, reaching its optimum in small brooks. I found conspicuously marked specimens at Abtao, a railway station between Puerto Montt and Puerto Varas, at the falls of the Petrohué, in a brook near Puerto Montt, in the Estero Cutipai, and in a brook at Casa Panque. Aside from the structural differences this species is readily distinguishable by its zebra stripes which vary, very greatly in number, and in width. The young, before the stripes become marked, can be distinguished by a dark bar just behind the upper part of the gill-openings. This species was spawning March 16 in a small brook entering Lake Rinihué.

Key to the species

a. Vertebrae 73–75. Mouth very large, the maxillary extending beyond the pupil; distance between tip of snout and end of maxillary 2 in the length of the head; snout much longer than the eye, sometimes twice as long; eye much less than its distance from the anterior margin of the opercle; length of pectoral less than postorbital part of head; a silvery lateral band; no color markings, or the back and sides with numerous small spots ..... **marinus** Eigenmann.

aa. Vertebrae, 67 or 68. Mouth small, the maxillary not extending to the pupil; distance between tip of snout and end of maxillary, 2.4 to 3 in the length of the head; snout little longer than eye; eye equal to its distance from anterior margin of opercle; pectoral equals postorbital part of head and half of the eye.

b. Anal lobe not extending beyond base of last anal ray; depth, 6 to 7; depth of caudal peduncle, 2.5 in its length; silvery or with faint spots or cross markings; no bar behind gill-opening in the young; lobe of anal not reaching base of last anal ray ..... **taeniatus** Jenyns.

bb. Anal lobe sometimes extending beyond base of last anal ray; depth, 4.76–5.44; depth of caudal peduncle, 1.75 to 2 in its length (2.27 in Rinihue); lobe of the anal extending beyond base of last anal ray, sometimes beyond tip of last ray. Conspicuous cross banding, a dark bar behind the gill-opening in the young ..... **zebra** Jenyns.

Aplochiton marinus Eigenmann, spec. nov. Plate XI, figs. 2 and 5

15535 I. U. M. One, type, 211 mm. Estero Cutipai, near Valdivia. February 19.
15536 I. U. M. 182–203 mm. Below Valdivia, near the sea. February 19.

Average measurements of five specimens between 159 and 176 mm. to base of caudal, averaging 168 mm. Snout, 13.6 mm.; eye, 6.6 mm.; distance from tip of snout to end of maxillary, 19.5 mm.; interorbital, 11 mm.; head, 40.4 mm.; depth, 29.1 mm.; distance between last anal ray and base of middle caudal ray, 25 mm.; depth of caudal peduncle, 10 mm.; length of pectoral, 18 mm.; D., 13 to 15; A., 15 to 18, most frequently 16; origin of ventrals equidistant from base of middle caudal ray and anterior half of eye; origin of dorsal midway between base of middle caudal rays and a point between the eye and the preopercle.

Distinguished by its long snout and large mouth.

Snout, 3 in the head; eye, 6.12; distance between snout and end of maxillary, 2.07; interorbital, 3.67; head, 4.15 in the length; depth, 5.77; depth of caudal peduncle, 2.5 in its length; longest anal ray not reaching base of the last.

It is possible that these are but breeding adults of *A. taeniatus*.

Aplochiton taeniatus Jenyns. Plate XI, figs. 3 and 6

"Pelladillos"

Aplochiton taeniatus Jenyns, Zoöl. Voyage of the Beagle, Fishes, 1842, p. 132, pl. xxiv, fig. 2 (mouth of fresh-water streams, Goree Sound, Tierra del Fuego); Eigenmann, Repts. Princeton Univ. Exped. Patagonia III, 1909, p. 278, Plate XXXV, figs. 6 and 6a, copied from Smitt.

Haplochiton taeniatus Günther, Cat. Fishes Brit. Mus. V, 1864, p. 382 (Goree Sound); Smitt, Bih. Svenska Akad. Handl. XXVI, Afd. IV, I, 1901; Dollo, Voyage, S. Y. Belgica, Poissons, 1904, p. 81 (Lapataia, Beagle Channel).

?*Stromateus cumarca*, Molina. Geogr. Nat. & Civil Hist. Chili. Irving's translation, I, 1808, p. 153.

Habitat: Valdivia to southern Patagonia and Tierra del Fuego.

This species has been reported from the mouths of streams emptying into Goree Sound, Tierra del Fuego; from Lago Toro (lat. 51° 50′ S., long. 72° 45′ W.), and Lapataia, Beagle Channel (lat. 54° 50′ S., long. 68° 35′ W.).

I took many individuals.

15537 I. U. M. Largest, 152 mm. Rio Pescado. March 10.
15538 I. U. M. Largest, 83 mm. Osorno. March 14.
15539 I. U. M. Largest, 83 mm. Puerto Montt. February 22.
15540 I. U. M. Largest, 91 mm. Falls of Petrohué. March 8.
15541 I. U. M. Largest, 90 mm. Puerto Varas. March 12.
15542 I. U. M. Largest, 183 mm. Peulla, Lago Todos Santos. February 27.
15581 I. U. M. One, 80 mm. Estero Santa Rosa, near Valdivia. February 18.
15582 I. U. M. Four, largest, 79 mm. Estero Cutipai, below Valdivia. February 19.

They differ vastly from *A. marinus* of the same size in the length of the snout and maxillary, the size of the eye, agreeing with them in the shape of the anal.

Head, 4; depth, 6.4; snout, 3.4 in head, eye, 4; depth of caudal peduncle, 2.4 in its length; D., 12 (rarely 11 or 13); A., 14 or 15.

Very similar to *A. zebra* but more slender and scarcely, if at all, marked. Distance from snout to end of maxillary equal to snout and eye to pupil; bony interorbital equal to eye; origin of dorsal equidistant from base of middle caudal rays and preopercle or eye; highest dorsal ray equal to snout and eye; caudal lobes equal to length of head without opercle; anal emarginate, the lobe usually not reaching base of last anal ray; origin of ventrals equidistant from base of middle caudal ray and posterior half of eye; pectorals equal to snout and eye or a trifle longer.

An ill-defined, silvery lateral band; no distinct markings or with obscure spots or cross bands.

Comparison of two individuals of marinus and tæniatus

	marinus	*tæniatus*
	mm.	*mm.*
To end of middle caudal rays	173	169
To base of caudal	163	161
To base of upper ray of pectoral	40	35
Snout to eye	13	10
Snout to end of maxillary	18. 5	12. 5
Eye	6	7. 5
Interorbital	9	8
Interocular	11	9. 5
Eye to opercle	11	7. 5

The eye in *tæniatus* is seen to be much larger, equal to its distance from the anterior margin of the opercle, the snout is much shorter and the distance between the tip of the snout and the end of the maxillary is only about two-thirds as long as in *marinus*.

Aplochiton zebra Jenyns. Plate XI, figs. 1 and 4; Plate XV, figs. 1–6

"Pelladillos"

Aplochiton zebra Jenyns, Zoöl. of the Voyage of the Beagle, Fishes, 1842, p. 131, pl. xxiv, fig. 1 (Falkland Islands); Eigenmann, Repts. Princeton Univ. Exped. Patagonia, III, 1909, p. 278, Plate XXXV, figs. 5 and 5a (copied from Smitt).

Haplochiton zebra Günther, Cat. Fishes Brit. Mus. V, 1864, p. 381 (Port Louis); id. Zoöl. Coll. H. M. S. Alert, 1881, p. 22 (East Bay, freshwaters at Tom Bay); id. Rep. Voy. Challenger, Shore Fishes, 1889, p. 23; Smitt, Bih. Svenska Akad. Handl. XXVI, Afd. IV, No. 13, 1901, p. I (Rio Tres Pasos, a tributary of Lago Toro); Delfin, Catalogo Peces Chile, 1901, p. 32 (Puerto Montt; Rio Renaico; Puerto Otuai).

Farionella gayii, Cuvier & Valenciennes, Hist. Nat. Poiss. XXII, 1849, p. 508, pl. 640.

Farionella fasciata Philippi, Archiv Naturg., 1858, I, p. 310 (Vladivia).

Habitat: Valdivia, south to the Falkland Islands.

Of this species I secured the following specimens:

15526 I. U. M. Largest, 153 mm. Puerto Montt. February 22.
15527 I. U. M. Largest, 197 mm. Abtao. February 23.

15528 I. U. M. Largest, 117 mm. Rio Pescado. March 10.
15529 I. U. M. Largest, 136 mm. Peulla, Lago Todos Santos. February 27.
15530 I. U. M. Largest, — mm. Casa Panque, at base of Andes near the Volcano Tronador. March 6.
15531 I. U. M. Largest, 167 mm. Falls of Petrohué. March 8.
15532 I. U. M. [8] Largest, 195 mm. Small tributary of Lake Rinihue. March 16.
15533 I. U. M. Largest, 227 mm. Estero Cutipai, below Valdivia. February 19.

Average measurements of six individuals between 111 and 174 mm. long to base of caudal, averaging 143 mm. from Abtao, Falls of the Petrohué and Estero Cutipai. Snout, 10 mm.; eye, 7.3 mm.; distance between tip of snout and end of maxillary, 12.5 mm.; interorbital, 9 mm.; head, 33 mm.; depth, 30 mm.; distance between last anal ray and base of last caudal ray, 20 mm.; depth of caudal peduncle, 10.3 mm.; length of pectoral, 20 mm.; D., 13 to 14; A., 15 to 17; origin of ventral midway between base of middle caudal rays and anterior half of eye; origin of dorsal midway between base of middle caudal rays and a point between middle of eye and preopercle.

Snout, 3.3 (3.2) in the head; eye, 4.5; distance from snout to end of maxillary, 2.6 (3.2); interorbital, 3.66; head, 4.35 (4.8) in the length; depth, 4.76 (5.44); depth of caudal peduncle, 1.90 (2.27) in its length.

The averages of four specimens 159–165 mm. long from Lake Rinihue, where they differ from the averages of specimens from other localities, are given in parentheses. Although spawning, the four specimens are more slender than other specimens of *A. zebra*. In color they differ from both *A. zebra* and *A. tæniatus;* the adult are barred, but less conspicuously so than in the typical *zebra*, the bars sometimes broken into spots. It is possible that they really belong to *A. tæniatus*, being in their nuptial color, and that after spawning they enter Lake Rinihue, become more slender, and lose their color markings. There are, among the young, some specimens with the proportions and color of typical *zebra*. There is no difference in the color markings in the adult males and females in Rinihue specimens. The anal lobe is a little shorter in the male than in the female. It just reaches the base of the last anal ray in the female.

VII. GALAXIIDAE [9]

The members of the Galaxiidae occur around the Southern Hemisphere, in Australia, Tasmania, New Zealand, Cape of Good Hope, and southern South America. In Chile one species is found as far north as Coigüe, lat. 38° 32′; a second species occurs as far north as Concepcion; a third appears at Puerto Varas; and a fourth and fifth near the latitude of Puerto Montt. Others are confined to the waters farther south. They seem to be at their optimum about the southern end of South America and the Falkland Islands.

It is certain that some species of Galaxias live in the ocean or descend to the ocean to spawn. I caught some specimens at the mouth of a small creek at Puerto Montt. Philippi also reported it from the ocean (under Fucus) at Puerto Montt. It is more than probable that the type of *Galaxias grandis* was taken in the ocean at Puerto Montt. Clarke, in "Notes on New Zealand Galaxiidae" (Trans. & Proc. New Zealand Inst., XXXI, 1898, pp. 78–91) says of *Galaxias attenuatus* which seldom exceeds 6 inches in length, that it "periodically descends to the sea in January, February, and March, where it spawns, returning in March, April, and May. The young begin to make their appearance in the rivers sometimes as early as the end of June, but they definitely commence to arrive in August, the shoals increasing in size and number in September and October and keep practically unmixed with other fry until the end of October. At this time, and in November, the shoals begin and continue to consist of a mixed character—fry of Eleotris, Retropinnae, and Prototroctes forming a greater percentage of them till the inrun ends."

It has been used as manure and "is being utilized for canning." It "runs up to the heads of all streams, of whatever size and almost of whatever nature."

It is quite probable that *Galaxias minutus*, occurring in Valdivia in seasons in enormous numbers, is the larval form of *Galaxias maculatus* coming from the ocean.

[8] These specimens were spawning in a small tributary within a few hundred feet of the lake. They are strongly marked, but in depth and shape of the anal some of the specimens approach *A. tæniatus*.

[9] For "A revision of the fishes of the family of Galaxiidae" see Regan, Proc. Zool. Soc. 1905, II, published Apr. 5, 1906.

Key to the genera of the Galaxiidae occurring in Chile

a. Origin of anal in advance of the vertical from the origin of the dorsal; ventrals with 5 or 6 rays; branchiostegals, 5 or 6; body short; distance between origin of dorsal and base of middle caudal rays 3 to 4 in the length; ventrals, 1.25 to 2 in the distance from their base to the anal; caudal emarginate, without spots or blotches. Reaching a length of 60 mm.....**Brachygalaxias** Eigenmann gen. nov.

aa. Origin of anal on or behind the vertical from the origin of the dorsal (see *titcombi*); ventral with 7 to 9 rays; young to 50 mm. or over, without spots; blotched or spotted in old.....**Galaxias.**

Brachygalaxias Eigenmann, gen. nov.

Origin of anal in advance of the vertical from origin of the dorsal; ventrals with 5 or 6 rays; anus at the beginning, or behind the beginning of the last third of the length. One species.

Brachygalaxias bullocki (Regan). Plate X, fig. 1

Galaxias bullocki Regan, Ann. & Mag. Nat. Hist. (8), I, April, 1908 (Moguehue, Temuco, lat. 38° 57′ S., long. 71° 17′ W. Elevation, 1230 m.)

Habitat: Concepcion to Puerto Varas and probably southward.

15574. I. U. M. 4. Largest, 35 mm. Estero Nonguen. March 20.
15575. I. U. M. Many. Largest, 35 mm. Weedy ditch at Cutipai, near Valdivia. February 19.
15576. I. U. M. 9. Largest, 56 mm. Puerto Varas. March 12.
15577. I. U. M. 11. Largest, 48 mm. Abtao. February 23.
15578. I. U. M. 11. Largest, 37 mm. Ensenada. March 9.

This is the smallest of the Galaxiidae in Chile. It is known to range from sea level to near 4,000 feet and from Concepcion south at least to Puerto Montt. I found it especially abundant in a weedy ditch at Cutipai near sea level, below Valdivia. It was seen along rocky parts of the shore of Lake Llanquihue. In life it has an iridescent spot on the shoulder which is entirely obliterated in alcohol.

D., 9 to 12, usually 11, counting everything; A., 14 to 18, most frequently 16, counting everything. Mouth differing considerably; the distance from the snout to the end of the maxillary, 2.5 to 3 in the head. (The specimens from Cutipai have the small number of dorsal rays [8 to 10], fewer anal rays [12 to 14], and larger mouth; tip of snout to end of maxillary, 2.5 in the length of the head.)

GALAXIAS Cuvier

Type, *Galaxias truttaceus* Cuvier.

Key to the species of Galaxias occurring north of Puerto Montt

a. Origin of anal very close to the vertical from the origin of the dorsal; branchiostegals, 6 or 7; distance between origin of dorsal and base of middle caudal rays, 3.8—4.4 (3.5 in one) in the length. Caudal emarginate; ventrals, 8 or 9. Colorless in young, more and more profusely spotted with age, the ground color all but obliterated in the old. Reaching a length of 120 mm.....**maculatus** (Jenyns).

aa. Origin of anal, at least in the adult, considerably behind the vertical from the origin of the dorsal; caudal very slightly emarginate truncate or rounded. Profusely and variously spotted.

b. Distance between origin of dorsal and base of middle caudal rays, 3.75 to 4 in the length; branchiostegals, 8 or 9; ventrals, 2.5 to 3 times in the distance between their origin and the anal; profusely spotted or mottled, without indications of crossbands or lines. Reaching a length of at least 119 mm. **globiceps** Eigenmann.

bb. Distance between origin of dorsal and base of middle caudal rays, 3.2 to 3.6 in the length; ventrals, 2 to 2.2 (rarely 2.4) in the distance between their base and the anal.

c. Sides in adult usually with distinct cross markings, sometimes simply punctuate; branchiostegals, 8 or 9, reaching a length of 330 mm.....**platei** Steindachner.

[*cc.* Sides in adult profusely punctuate, without cross markings; branchiostegals, 6—8 (rarely 9), reaching a length of at least 230 mm.....**titcombi** Evermann & Kendall.] [10]

[10] **Galaxias titcombi** Evermann and Kendall. Plate X, fig. 3; xii, fig. 5.
15598. I. U. M. 7. 50-230 mm. Laguna Fria, Argentine. March 3.
15599. I. U. M. Many. Largest, 100 mm. Puerto Blest, Lake Nahuel Huapi, Argentine. March 4.
This species was not taken in Chile. It was found just across the border. It differs but little from *G. platei*. Small individuals were taken in Laguna Fria near the landing. The largest one was caught at night with a hook. This species was originally described from Rio Traful, belonging to the same basin as Lake Nahuel Huapi. The type is but 2.62 mm. long (given as 5.62 in the description). It can readily be distinguished from specimens of *G. platei* taken in Todos Santos, the nearest point across the Andes from Lago Fria, by its general appearance. But there is so much variation, especially in the color, of *G. platei*, in different localities that it may be questioned whether *G. titcombi* is really distinct.

Galaxias maculatus (Jenyns). Plate X, fig. 5

Paye, Molina, Geogr. Nat. & Civil Hist. Chili. Irving's translation, I, p. 153, 1808 (Rio Talten).

Stomias variegatus Lesson, Voy. La Coquille, II, 1830, p. 142 (Malouines).

Mesites maculatus Jenyns, Zoöl. Voyage Beagle, Fishes, 1842, p. 119, pl. xxii, fig. 4 (Fresh-water brook in Hardy Peninsula, Tierra del Fuego; higher tributaries of the Rio Santa Cruz).

Galaxias maculatus Cuvier & Valenciennes, Hist. Nat. Poiss. XVIII, 1848, p. 355 (Malouines); Günther, Cat. Fishes Brit. Mus., VI, 1866, p. 212; Vaillant, Miss. Scient. Cap Horn. Poiss. 1888, p. 18 (Fresh-water of Orange Bay); Perugia, Ann. Mus. Civico Storia Nat. Genova (2a) X, 1891, p. 54 (Lake and River of Porto Cook); Philippi, Verh. Deutsch. Wiss. Var. Santiago, III, 1895, p. 21; Steindachner, Zool. Jahrb., 1898, Suppl. IV, p. 328 (Rio Pescado near Punta Arenas); Delfin, Catálogo Peces Chile, 1901, p. 33 (Puerto Montt; Valdivia); Dollo, Voyage S. Y. Belgica, Poissons, 1904, p. 80, pl. x, fig. 4 (Lapataia, Beagle Channel); Regan, Proc. Zoöl. Soc. London, 1905, II (April, 1906), p. 370 (Alert Bay; Orange Bay; Falkland Islands, Estero de Penco); Evermann & Kendall, Proc. U. S. Nat. Mus. XXXI, 1906, p. 91 (Lake Nahuel-Huapi, one of the sources of the Limay River; elevation 2,500 feet); Eigenmann, Repts. Princeton Univ. Patagonia III, 1909, p. 275, Plate XXXV, fig. 4.

Galaxias minutus Philippi, Archiv Naturg. XXIV, 1858, p. 309; Verh. Deutsch. Wiss. Ver. Santiago, III, 1895, p. 21 (Valdivia); Delfin, l. c., 1901, p. 34.

Galaxias punctatus Philippi, Archiv Naturg. XXIV, 1858, p. 310; Verh. Deutsch. Wiss. Ver. Santiago, III, 1895, p. 21; Delfin, l. c. (Valdivia and Puerto Montt).

Specimens examined

15583 I. U. M. Largest, 90 mm. Estero Nonguen, Concepcion.
15579 I. U. M. 5, 67–77 mm. Coigue. March 18.
15584 I. U. M. Largest, 80 mm. Lautaro. February 13.
15580 I. U. M. 1, 33 mm.; 2, 50 to 55 mm.; 35, 55 to 60 mm.; 104, 60 to 70 mm.; 17, 70 to 75 mm.; 8, 75 to 80 mm.; 9, 83 to 89 mm.; 4, 91 to 95 mm.; 3, 102 to 109 mm.; 1, 120 mm. Cutipai, near Valdivia. February 19.
15581 I. U. M. Many. Largest, 113 mm. Esterito Santa Rosa, near Valdivia.
15587 I. U. M. Over 500. 25, 42 and 43 mm.; 24, 44 and 45 mm.; 33, 46 and 47 mm.; 33, 46 and 47 mm.; 52, 48 and 49 mm.; 166, 50 to 60 mm.; 62, 60 to 70 mm.; 48, 70 to 80 mm.; 45, 80 to 90 mm.; 19, 90 to 100 mm.; 9, 100 to 110 mm.; 2, 110 to 120 mm. Puerto Montt. February 22.
15582 I. U. M. Many. Largest, 90 mm. Lake Rinihue. March 16.
15585 I. U. M. Many. Largest, 80 mm. Osorno. March 14.
15586 I. U. M. Many. Largest, 70 mm. Puerto Varas. March 12.
15588 I. U. M. Many. Largest, 90 mm. Rio Pescado. March 10.
15589 I. U. M. Many. Largest, 94 mm. Ensenada. March 9.
15590 I. U. M. Many. Largest, 90 mm. Peulla. March —.
15599a I. U. M. Many. Largest, 82 mm. Puerto Blest. Lake Nahuel-Huapi. March 4.

It is possible that more than one species are included in the above list. But it is more probable that the differences of reported species are due to age, modifications due to metamorphosis and hastened or delayed metamorphosis, due to proximity to or remoteness from the sea.

This species of Galaxias extends farther north than the other species. It rarely attains a length of 120 mm. Individuals of this size appear emaciated and beyond their prime. They begin to spawn when they are between 50 and 60 mm. long. The young are translucent, without spots. Color markings appear along the back at various sizes above 50 mm. In some cases the juvenile lack of spots lasts much longer than in others. The spots vary much in shape and intensity. They increase in size with age, so that in the old the original background may be reduced to narrow vermiculating lines. At Puerto Montt, just beyond the railway station, a small brook enters the ocean. At this point many translucent individuals larger than the average retaining this juvenile color, were found in the sea lettuce, Ulva, at the edge of the sea.

The species can readily be distinguished at sight from the much shorter *Brachygalaxias bullocki*, and the deeper, differently colored *G. platei*, with which it is frequently found in brooks. It seems to be the dominant form in the lakes. At Puerto Varas it occurs in numbers in the shade under the wharf.

I am unable to distinguish in all cases between this species and the young of *G. titcombi*.

This is the species whose young was described by Philippi as *Galaxias minutus*. He says it is known at Valdivia, as Puye, and at times caught in unbelievable masses. Philippi considers specimens taken under Fucus, at Puerto Montt, to be distinct (*Galaxias punctulatus*), because individuals of the same length are deeper and thicker.

Galaxias globiceps Eigenmann, sp. nov. Plates X, fig. 2; XIII, fig. 7

15597. I. U. M. 8, 67–119 mm. Abtao, north of Puerto Montt. February 23.

These specimens were taken in a brook on the heights between Puerto Varas and Puerto Montt in tea-colored water. They differ uniformly in color from specimens of *G. platei* from both Puerto Varas and Puerto Montt and from other localities. The dorsal and anal are nearer the caudal than in *G. platei*. The distance between the ventrals and anal is relatively greater. The head, also, has a more blunt appearance, but the differences are not readily measurable.

Head, 4.5 to 5.5; depth, 6.6 to 7.3; D., 12; A., 14 or 15. The first two rays in both dorsal and anal are short and entirely hidden in tissue; V. 7, the outer ray short, attached to the second; branchio stegals, 9; gill-rakers, 8 in the lower limb; eye, 5 to 5.5 in the length of the head, 1.33 in the snout, 2 to 2.5 in the interocular. Jaws equal, the maxillary reaching to below anterior third of eye.

Distance from origin of dorsal to base of middle caudal rays, 2.5 or more in its distance from the snout. Distance from origin of anal to base of middle caudal ray, 3.4 to 4 in its distance from the snout; origin of ventrals equidistant from base of middle caudal ray and some point in anterior half of eye; depth of caudal peduncle, 1.33 to 1.66 in its length. Ventrals reaching a little more than one-third of the way to the anal in the young, less than one-third of the way in the adult. Pectorals reaching about one-third of the distance to the ventrals (the ventrals 2 to 2.5 in the distance from their origin to the caudal in *G. platei*). Caudal rounded; sides very closely mottled with dark in the largest, less so in the smallest.

Galaxias platei Steindachner. Plate X, fig. 4

Galaxias grandis (name preoccupied) Philippi, Verh. Deutsch. Wiss. Ver. Santiago, III, 1893, p. 19; Delfin, Catláogo Peces Chile, 1901, p. 33 (Punta Arenas).

?*Galaxias Delfini* Philippi, Verh. Deutsch. Wiss. Ver. Santiago, III, 1893, p. 19; Delfin, Catálogo Peces Chile, 1901, p. 33 (Punta Arenas).

Galaxias platei Steindachner, Zool. Jahrb., 1898, Suppl. IV, p. 329 (Rio Pescado near Punta Arenas); Delfin, Catálogo Peces Chile, 1901, p. 34); Dollo, Voyage S. Y. Belgica, Poissons, 1904, p. 97; Eigenmann, Repts. Princeton Univ. Exped. Patagonia, III, 1909, p. 18, Plate XXXV, figs. 1–3a (Rio Chico, Punta Arenas).

Galaxias alpinus (part) Smitt, Bih. Svenska Akad. Handl. XXVI, 1901, IV, No. 13, p. 9, pl. iii.

Specimens examined

15591 I. U. M. 48–200 mm. Small brook emptying into Lake Rinihue. March 16.
15592 I. U. M. 39–192 mm. Puerto Varas. March 12.
15593 I. U. M. 115–130 mm. Falls of Petrohué. March 8.
15594 I. U. M. 48–165 mm. Rio Pescado. March 10.
15595 I. U. M. Ensenada. March 9.
15596 I. U. M. 98 mm. Peulla. February —.

This is the largest Galaxias of Chile between Valdivia and Puerto Montt. I took it in small brooks entering lakes Rinihue, Llanquihue and Todos Santos. It was especially abundant in the brook passing through Puerto Varas. No fishes were seen in it till I used poison, when it shed an inordinate number of Galaxias and Cheirodon.

A specimen, possibly belonging to this species, is in the National Museum at Santiago labelled *Galaxias grandis* Philippi, Puerto Montt. The specimen is 340 mm. long, larger than any I caught. Its entrails, dorsal, anal and pectoral fins were removed as if it had been prepared for the market. If it really came from Puerto Montt, as its present label indicates, it was probably taken in the ocean, as no fresh-water fishes are brought to the market at Puerto Montt. It is light in color (evidently faded), with numerous small spots. Length over all,

340 mm.; head, 74 mm.; to origin of ventrals, 94 mm.; to origin of dorsal, 143 mm.; to anal 161 mm.; caudal, 43 mm.

A second specimen in the same museum bears the label "288, Paladillo, *Galaxias delfini* Philippi, Punta Arenas." It is a poorly prepared skin. It has evidences of marbling. It measures 263 mm. over all; head, 39 mm.; to dorsal, 133 mm.; to anal, 146 mm.

VIII. POECILIIDAE

ORESTIAS Valenciennes

A poeciliid genus without ventrals and with united pharyngeals. Quiet water in Death Valley of Nevada and of the high plateau of Peru, Bolivia, and northern Chile.

Orestias agassizii Valenciennes. Plate XIII, fig. 8

This species is found near Cuzco to Ascotan. It belongs to the high Andean fauna of Bolivia and Peru, rather than to that of Chile.

15347 I. U. M. Many. Largest, about 65 mm. Lake Ascotan. W. R. Allen.

The specimens secured by Doctor Allen, in weedy patches of Lake Ascotan, are below maximum size for the species.

Ascotan is on the railway from La Paz to Antofagasta, just within the border of Chile.

Head, 3.4–3.8; depth, 4–4.25; D., 13–15; A., 13–14. Abdomen naked; scales smooth or minutely striate.

Doctor Allen notes that the color variation in Lake Ascotan is greater than elsewhere. Specimens vary from rich golden yellow to bright silvery below; dorsad they are gray, green, olivaceous, brown, etc. The spots above vary from distinct to nearly indistinct.

Some of the females secured in February, 1919, are with ripe eggs.

As part of the courses of tributaries of the Rio Desaguadero, the outlet of Lake Titicaca flows through the northeast corner of Chile, other species of this genus occur in Chile. However, they belong properly to the fauna of the Titicaca basin, and will be considered in the monograph on the fishes of Titicaca, which is in preparation.

IX. MUGILIDAE

The Mugilidae, "Lizas," are marine fishes entering fresh water.[11]

Mugil rammelsbergii Tschudi. Plate XV, fig. 7

Liza

Liza, Geogr. Nat. & Civil Hist. Chili. Irving's translation, I, 1808, p. 153.
Mugil rammelsbergii Tschudi, Fauna Peruana, Ichthyol., 1845, p. 20 (Peru).
Mugil cephalus Steindachner (*non* L.), Denkschr. K. Akad, Wiss, Wien, LXXVI, 1902, p. 128 (Callao; Rio Tambo); Evermann and Kendall, Bull. U. S. Nat. Mus. No. 95, 1917, p. 51 (Callao; Ancon; Rio Tambo; Rio Eten; Rio Rimac; Pacasmayo).

Of this species I secured:

15294 I. U. M. 42–60 and 155–197 mm. Pisco, Peru. The smaller from a ditch in town, the larger caught off the wharf.
15295 I. U. M. Several about 245 mm. Santiago market.
15297 I. U. M. Several, 37–70 and 225–280 mm. La Serena.
15345 I. U. M. 17, 110–173 mm. Rio Tambo, Chucarati, Peru. N. E. Pearson.

A Mugil was also running up the Rio Loncomilla, at San Xavier, but no specimens were secured.

Mugil rammelsbergii differs from *Mugil cephalus* in having a longer head. It is possible that both species are found in Peru and Chile. Steindachner calls attention to a specimen in his possession from the Rio Tambo in southern Peru which had the head 3.66 inches in length.

[11] No doubt many other marine species enter the mouths of rivers. I want to call attention only to *Eleginus maclovinus*, regularly brought into the market, at Valdivia, and which I also took in a small rivulet at Puerto Montt.

He had others from Callao in which the proportions were as in *M. cephalus* and therefore considered both the Peruvian specimens as belonging to the common European species *M. cephalus*. Among the many specimens enumerated above the two from the Santiago market have the head a trifle over 4 in the length. In those from the Rio Tambo it is, on an average, 3.61; in those from the ocean at Pisco it averages 3.7; in those from the river at La Serena it is from 3.7 to 3.8; the scales vary from 40 to 42, rarely more. The depth differs much between males and females.

X. ATHERINIDAE

The *Peje reyes*

Members of the Atherinidae are found in the sea, others in fresh water. Some living in the ocean enter streams.

There has been considerable confusion concerning the "peje rey" of the Pacific side of South America. I have collected masses of Peje reyes from Lima to Puerto Montt and from the sea to Arequipa and Lake Nahuel-Huapi, and will try to untangle the mess within these limits. Let me hope I will not make it worse. Peje reyes are abundant both in the ocean and in fresh water everywhere, from the Santa River to Puerto Montt, from sea level up to at least 7,500 feet. Peje reyes, probably Basilichthys sp., have been reported to me even from the Rio Camarones and the Rio Loa in the arid area of northern Chile.

The first one described is *Atherina regia* Humboldt, 1809, from "dans l'océan—Pacifique, près du Callao de Lima." Next came *Atherina laticlava* Cuv. & Val. 1835, from Valparaiso. Valenciennes (Hist. Nat. Poissons, X, p. 474), after describing *laticlava*, says further: "M. Gay nous a rapporté de la lagune de Taguatagua du Chile, une athérine qui n'en est peut-être qu'une variété." Evidently he noticed the difference between the marine and fresh-water species. The third species described is *Atherina microlepidota* Jenyns, 1842, from fresh waters near Valparaiso,[12] very probably the "variété" mentioned by Valenciennes. Then came *Protistius semotilus* Cope 1874, said to have been taken from the Peruvian Andes at 12,000 feet, and *Gasteropterus archaeus* Cope, 1878, from Arequipa at 7,500 feet. Girard records a "peje rey" from the Rio Mapocho which he identifies with *Atherina microlepidota* of Jenyns and for which he created the new genus, Basilichthys.[13]

In 1898, Steindachner added *Chirostoma mauleanum* from Lake Llanquihue, *itatana* from the Rio Itata, and *affinis* from Iquique. Abbott, 1899, added the synonyms *Basilichthys regillus*, *octavius* and *jordani* and *Pisciregia beardsleei* all from Callao.

The confusion was started when Steindachner (Denk. Akad. Wiss. Wien, LXXII, 1902, p. 39) identified the fresh-water *Atherina microlepidota* with Humboldt's marine *Atherina regia*. It was furthered when Fowler (Proc. Acad. Nat. Sci. Phila. 1903, p. 734) placed *regia* in the genus *Basilichthys*, created for the fresh-water *microlepidotus*; when Eigenmann (Repts., Princeton Univ. Exped. Patagonia III, 1909, p. 282) followed Steindachner, and it reached its culmination when Evermann and Radcliffe (Bull. U. S. Nat. Mus. 95, 1917, p. 45) wrote:

> Humboldt's conclusion that this (*Atherina regia* Humboldt) is the common peje rey of the Calla market, and that it occurs in large numbers in the ocean within the limits of Peru, is doubtless an error. That it is the "pesce rey" reported to occur in the mountain lakes of Peru and in Titicaca; identified by Abbott from specimens from Callao as *Pisciregia beardsleei*; by Cope on specimens from Arequipa as *Gastropterus archaeus*; by Steindachner on specimens from the Rio Tambo as *Atherinopsis regius*; and by Jenyns on specimens from fresh water at Valparaiso as *Atherina microlepidota*, appears to us to be true. It is the "peje-rey de Rio," and not one of the salt-water forms which belong to the genus Basilichthys.[14]

[12] Jenyns says: "This species was found by Mr. Darwin at Valparaiso in fresh water." It probably came from the Aconcagua, some miles up the coast.

[13] Thompson (Proc. U. S. Nat. Mus., vol. 50, 1916, p. 465) erroneously considers the *microlepidota* of Girard to be not only specifically, but also generically, distinct from the *microlepidota* of Jenyns.

[14] One of the species of Orestias of Titicaca is called peje rey ("pesce rey"), and Miss Peck in her charming volume, "The South America Tour," p. 155, says: "It is believed that along here (Arica) is a subterranean outlet of Lake Poopo, as the fresh-water fish of Lake Titicaca, *peccajay*, are caught in the ocean, and driftwood of the mountain vegetation appears." I am tempted to inject the unichthyological remark here that any subterranean outlet big enough to let peje rey (not peccajay) and driftwood come down from the treeless regions about Titicaca and Poopo should long ago have drained Poopo.

As will be seen below, my conclusions differ from this statement in every point. Humboldt did not "conclude"; he stated a fact which remains a fact. The peje rey, i. e., an Atherinid, had not been reported from the "mountain lakes of Peru and in Titicaca." Humboldt's species is not *Pisciregia beardsleei* of Abbott, nor *Gastropterus archaeus* of Cope, nor the *Atherinopsis regius* of Steindachner, nor *Atherina microlepidota* of Jenyns. Finally, it is not the "peje rey de Rio," but is the salt-water form of Peru; and the salt-water forms do not belong to the genus Basilichthys, which was especially created for a fresh-water species.

The answers to two questions seem to me to help solve the problem. First, what did Humboldt describe, a marine or a fresh-water species? Second, what is the fish *Basilichthys microlepidotus* which Girard got from the Mapocho River near Santiago, Chile, and for which he created the genus Basilichthys? Is it the same that Jenyns called *Atherina microlepidota* which Darwin collected at Valparaiso?

First, then, what did Humboldt describe? He says: "Le Pexerey dans tous les pays limitrophe du Pérou, paroît propre a l'hémisphère austral. On le trouve surtout dans l'Océan-Pacifique, près du Callao de Lima où j'en ai fait la description XXX aussi en consomme-t-on, dans la capitale du Pérou, journellement, une immense quantité." All of this in his general discussion relates entirely to the ocean peje rey and not at all to the river peje rey. His technical description applies for the most part to both the river and the ocean peje rey, his "ore protractili" applies particularly to the ocean species. Moreover, he says there are five dorsal spines, which is very rarely the case in the fresh-water species of the Rio Rimac.[15] Moreover, he says "*anus fere in medio corpore*," which applies to the marine species but does not apply to the fresh-water species. All of the evidence points in the direction that Evermann's statement that "Humboldt's conclusion that this is the common peje rey of the Callao market and that it occurs in large numbers in the ocean within the limits of Peru is doubtless an error" is itself an error. Humboldt intended to describe the common peje rey of the Callao market and no other fish and the name *regius* must go with the ocean species.

Second, what is *Basilichthys microlepidota* Girard? The genus Basilichthys was based on a specimen collected in the Mapocho, a tributary of the Maypu, and referred to *Atherina microlepidota* Jenyns. It is far from clear, therefore, why Evermann and Radcliffe, while placing Jenyns' *microlepidota* in the synonymy of *Atherina regia* of Humboldt, which they consider the fresh-water peje rey, attach the name *Basilichthys* to the marine peje rey of Peru.

I examined large numbers of fresh-water peje reyes brought to the market at Santiago and myself caught many in the Mapocho at Peñaflor. All of these have the mouth but little protractile, the skin being uninterrupted over the middle of the snout. It is more than probable that Girard's specimen from the same river was identical with these. I have compared a specimen, 178 mm. long, with Girard's description and figure of a specimen 188 mm. long. Both drawing and description agree with the specimen except in one point. Girard says the upper jaw *is protractile*. The upper jaw *is* protractile, but only moderately so, and not in the modern sense. The skin on the snout is continuous with the skin of the head without a fold. There are peje reyes in the fresh waters of Chile that have the mouth truly protractile but they are found only much farther south and the mouth is very different from that figured by Girard.

Basilichthys is a genus of Atherinids in which the mouth is not protractile in the modern sense and agrees in this and so many other respects with Gastropterus and Protistius that the latter two are certainly synonyms of the former.

[15] Only 6 out of 88 specimens from the Rimac have 5 dorsal spines.

Key to the Genera of the Atherinids of the Pacific side of Peru and Chile between Callao and Puerto Montt.

a. Upper jaw protractile, the skin of the snout not directly continued with that of the top of the head.
b. Scales entire.
c. Snout pointed; mouth large; jaws equal; teeth in the jaws in two rows, those of the outer row of the lower jaw larger, those of the inner row obliquely directed backward; usually three patches of teeth on the vomer; a large patch on the pterygoid.....**Austromenidia** Hubbs.[16]

[16] AUSTROMENIDIA Hubbs.

Menidia Eigenmann (*non* Bonapart), Rept. Princeton Univ. Exped. Patagonia III, 1909, p. 280.
Basilichthys Evermann & Radcliffe (*non* Girard), Bull. U. S. Nat. Mus. 95, 1917, p. 47.
Austromenidia Hubbs, Proc. Acad. Nat. Sci., 1917, p. 307 (*regillus* Abbott=*regia* Humboldt).
Type, *Atherina regia* Humboldt.

Humboldt's species, *Atherina regia*, being without any shadow of doubt the common marine peje rey of Peru the secondary question arises, What are *Atherinus laticlavus* Cuv. & Val., from Valparaiso, and *Chirostoma affine* described by Steindachner from Iquique and later recorded by him from Callao and by Evermann and Radcliffe from Callao, Pisco, and Ancon?

I collected many specimens of the marine peje rey in Callao, Antofagasta, Valparaiso, and Valdivia. The Callao specimens are the *Atherinus regius* of Humboldt. The Valparaiso specimens represent the *Atherinus laticlavus* described by Valenciennes, who had not seen Humboldt's species. *Ch. affine* was described by Steindachner from a single specimen from Iquique and later reported by him from Callao. The northern and southern forms may be distinct. The head averages 3.96 in the length in nineteen specimens from Callao and 4.56 in specimens from Antofagasta and the south.

Table of dorsal spines and dorsal and anal rays

	Dorsal spines				Dorsal rays					Anal rays					
	V	VI	VII	VIII	9	10	11	12	13	15	16	17	18	19	20
15192 I. U. M. Valdivia (*laticlava*)	0	4	5	0	0	1	3	0	2	0	0	3	2	3	1
15188 and 15189 I. U. M. Valparaiso (*laticlava*)	0	7	14	4	0	2	15	6	0	1	0	10	8	3	1
15190 I. U. M. Antofagasta (*laticlava*)	0	2	3	1	0	1	5	0	0	0	0	3	3	0	0
15191 I. U. M. Callao (*regia*)	2	12	7	3	0	2	4	3	0	1	0	6	2	0	0
Iquique Steind.	0	0	1	0	1	0	0	0	0	0	0	1	0	0	0

The roof of the mouth has a few teeth at the tip of the vomer and a few at the ends of the anchor on each side. The teeth are a little more numerous and uniform in the northern specimens (*regia*) than in the southern (*laticlava*). The teeth in the jaws are in two (rarely three in the largest) series; those of the outer series of the lower jaw the largest, those of the upper jaw subequal; pterygoid with a large patch of teeth.

The scales are entire; in 13 specimens from Valdivia and Valparaiso (*A. laticlava*) they range ordinarily from 87 to 95; one has 106. In ten from Callao (*A. regia*) they range from 84 to 95. The pharyngeal teeth are all pointed; in the upper they are much larger on the anterior half, becoming minute on the posterior angle; in the lower they are largest on the posterior half of the inner edge.

In all forms the caudal is yellow at its base and margined with black. In all of them the lateral band is wide, and sharply defined, widest above the anterior part of the anal. Its lower half is silvery, in its upper half it shades into greenish or plumbeus.

Key to the marine species of peje rey

a. Head about 3.96 in the length.....**regia** (Humboldt).
aa. Head about 4.56 in the length.....**laticlava** (Cuv. & Val.).
aaa. Head about 4.33 in the length; origin of first dorsal nearer tip of caudal than snout. Lateral line, 55–61 (extralimital)..**bonariensis** (Cuv. & Val.).
aaaa. Head 5; lateral line 100; origin of spinous dorsal over tip of ventrals. A. I, 18–20 (extralimital).....**nigricans** (Richardson).

Austromenidia regia (Humboldt). Plates XII, fig. 4; XIV, fig. 4

Atherina regia Humboldt, Rec. d'Obs. Zoöl. Anat. Comp., 2, 1835, pp. 187; Cuv. & Val. Hist. Nat. Poiss, 10, 1835, p. 474.
Basilichthys regia Fowler, Proc. Acad. Nat. Sci. Phila., 40, 1904, p. 734.
Menidia regia Thompson, Proc. U. S. Nat. Mus., 50, 1916, p. 465 (Callao).
Atherinichthys laticlavia Günther, Cat. Fishes Brit. Mus., 3, 1861, p. 402 (reference only).
Atherina laticlavia Cope, Proc. Amer. Phil. Soc., 17, 1878, p. 44 (not *Atherina laticlavia* Cuvier and Valenciennes).
Basilichthys regillus Abbott, Proc. Acad. Nat. Sci. Phila., 1899, p. 339; Starks, Proc. U. S. Nat. Mus., 30, 1906, p. 783.
Menidia regillus Thompson, Proc. U. S. Nat. Mus., 50, 1916, p. 466 (Callao).
Basilichthys octavius Abbott, Proc. Acad. Nat. Sci. Phila., 1899, p. 340; Evermann and Radcliffe, Bull. U. S. Nat. Mus., 95, 1917, pp. 47–49 (Callao).
Basilichthys jordani Abbott, Proc. Acad. Nat. Sci. Phila., 1899, p. 341 (Callao).
Chirostoma affine Steindachner, Denkschr. Akad. Wiss. Wien, 72, 1902, p. 40 (specimens from Callao, Peru, only; not of 1898).
Basilichthys affinis Evermann and Radcliffe, Bull. U. S. Nat. Mus. 95, 1917, p. 47 (specimens from Callao, Paracas Bay, and Ancon, Peru).
Habitat: Coast of Peru and south to Iquique.

Austromenidia laticlavia (Cuvier and Valenciennes)

Atherina laticlavia Cuvier and Valenciennes, Hist. Nat. Poissons, 10, 1835, p. 473.
Atherinichthys laticlavia Günther, Cat. Fishes Brit. Mus., 3, 1861, p. 402 (in part?); Quijada, Bol. Mus. Nac. Chile, 5, 1913, p. 56, pl. 9 (and of other authors).
Chirostoma laticlavia Steindachner, Zool. Jahrb., Suppl. IV, 1898, p. 313.
Menidia laticlavia Eigenmann, Repts. Princeton Univ. Exped. Patagonia, III, 1903, p. 281 (references in part). (Valparaiso, Chile.)
Chirostoma affine Steindachner, Zool. Jahrb., Suppl. IV, 1898, p. 313. Bol. Mus. Nac. Chile, 5, 1913, p. 184.
Basilichthys affinis Abbott, Proc. Acad. Nat. Sci. Phila., 1899, p. 342 (Iquique, Chile).
Habitat: Coast of Chile, between 20 degrees and 38 degrees S. latitude.

cc. Snout blunt, as in Cauque, lower jaw shorter, included; teeth in several series, a few caducous teeth on the vomer in the adult ..... **Patagonina** Eigenmann.[17]

bb. Scales scalloped, especially above anal and backward; mouth small, lower jaw included; teeth similar, in narrow bands, those of the outer row of the upper jaw slightly larger; no teeth on pterygoid or vomer ..... **Cauque** Eigenmann.

aa. Upper jaw not protractile, premaxillary teeth in a band. Dorsal spines varying from 0 to 7. **Basilichthys** Girard.

CAUQUE Eigenmann gen. nov.

Type, *Chirostoma mauleanum* Steindachner.

This genus differs from Austromenidia in having the scales more or less scalloped, especially on the sides over the anal. The teeth in the larger species are in bands. The mouth is smaller than in Austromenidia. As far as known, the species inhabit the fresh water only, while those of Austromenidia are marine.

Key to the species of Cauque

a. Scales, 70 to 90; head, 4 to 4.5 in the length; pectorals reaching halfway to tips of ventrals; teeth in about four series.

b. Scales of sides deeply scalloped; snout rather blunt, the lower jaw distinctly shorter; base of anal distinctly shorter than the head without the opercle; depth of caudal peduncle, 2.8–3.25 in the distance between the base of last anal ray and base of middle caudal ray; A., 14 to 16; origin of spinous dorsal at some point over middle third of ventrals ..... **mauleanum** (Steindachner).

bb. Scales of sides little scalloped; snout sharp, the lower jaw scarcely shorter; base of anal equal to head without opercle; depth of caudal peduncle, 3.5 in the distance between base of last anal ray and base of the middle caudal ray; A., 17; origin of spinous dorsal over last fifth of ventrals, distinctly behind the middle. Scales, 84. Lateral band in the 7th, 8th, and 9th scales under the dorsal. **wiebrichi** Eigenmann.

bbb. Origin of dorsal in the middle of the length, over the middle of the ventrals; depth of caudal peduncle a little longer than the head, not quite 3 in its length. Scales, 87–90. Lateral band on the 9th, 10th, and 11th scales under the first dorsal ..... **itatanum** (Steindachner).

aa. Scales, 54–67; head, 3.7 to 4 in the length; A., 15; pectorals reaching halfway to anal; teeth in two irregular series; origin of first dorsal nearer caudal than snout, over middle of ventrals; depth of caudal peduncle 2.33 in its length; lateral band on the 6th, 7th, and 8th scales below the first dorsal. **brevianalis** (Günther).

Cauque mauleanum (Steindachner). Plates XII, fig. 2; XIV, fig. 2

Chirostoma mauleanum Steindachner, Ann. Naturh. Hofmus. V, II, 1896, p. 213 (Pichi Laguna, a branch of Lake Llanquihue); Zool. Jahrb. 1898, Suppl. IV, p. 313; Eigenmann, Repts. Princeton Univ. Exped. Patagonia, III, 1909, p. 280, 1910, p. 465.

Menidia mauliana Thompson, Proc. U. S. Nat. Mus. 50, 1916, p. 465 (Tome and Lota).

Habitat: Abundant in the rivers and lakes in south central Chile.

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[17] **Patagonia hatcheri** (Eigenmann). (Plate XII, fig. 1)

Atherinichthys microlepidotus (*non* Jenyns) Perugia, Ann. Mus. Genova, 1891, p. 32; Berg. An. Mus. Nac. Buenos Aires, IV, 1895, p. 66.

Basilichthys microlepidotus Evermann and Kendall, Proc. U. S. Nat. Mus. XXXI, 1906, p. 97; Thompson, ibid., L, 1916, p. 464 (not *Atherina microlepidota* Jenyns).

Menidia hatcheri Eigenmann, Repts. Princeton Univ. Exped. Patagonia, III, 1909, p. 281, pl. 37, fig. 4 (Lake Pueyrredon).

Type-locality, Lake Pueyrredon, Patagonia.

Habitat: Fresh waters of Argentina.

Specimens examined

15199. I. U. M. 240 mm. Puerto Blest, Lake Nahuel-Huapi. March 4.

15200. I. U. M. Six, 107–153 mm.; eight, 45–75 mm. Same place.

15201. I. U. M. Six, 210–260 mm.; many, 50 mm. and smaller. Laguna Fria, draining into Lake Nahuel-Huapi. March 8.

Head, 4.66–5; depth, 6–6.5; D., $\frac{IV}{1}, \frac{V}{2}, \frac{VI}{7}, \frac{VII}{1}, \frac{10}{3}, \frac{11}{4}, \frac{12}{2}, \frac{13}{2}$; A., $\frac{15}{1}, \frac{16}{3}, \frac{17}{2}, \frac{18}{2}, \frac{19}{1}$; the scales in a lateral series, 76–83; interorbital, 3–3.5 in the head; snout 3+; eye, 4 to 4.66; distance between snout and end of maxillary equals distance between snout and eye; depth of caudal peduncle 3.5 to 4 in the distance between base of last anal ray and base of middle caudal ray.

Teeth in about four series in the lower jaw, in five series in the upper jaw, the outer ones a little enlarged; vomer in adult three-lobed, with caducous teeth; upper pharyngeal teeth thick-paved on the inner half, conical, much smaller toward the outer.

Distance between origin of spinous dorsal and the snout a little less than distance between snout and tip of ventrals; tip of spinous dorsal and origin of anal equidistant from the snout; origin of second dorsal over middle of anal, tip of last ray of second dorsal and tip of last anal ray nearly equidistant from base of middle caudal rays; pectorals reaching about halfway to tip of ventrals.

Eighteen to twenty scales between origin of dorsal and origin of anal; dorsal and anal without scales; scales entire.

A sharply defined lateral band covering 2.5 to 3 series of scales; fins all dusky.

?*Cyprinus caucus* Molina, Geogr. Nat. & Civil History Chili. Irving's translation, I, 1808, p. 153.

This species is the "*Peje rey del Rio*" in the south, a name that is applied to *Basilichthys microlepidota* in the north.

This species, hitherto known only from Lake Llanquihue, is abundant everywhere south of Valdivia. I did not take it north of that place except in the Bio Bio at Coigüe.

Specimens examined

15194 I. U. M. Four, 200–295 mm. Osorno. March 14.
15217 I. U. M. Four, largest 86 mm. Osorno.
15195 I. U. M. Many, about 200 mm. Valdivia market. February 19.
15219 I. U. M. Many, largest 183 mm. Valdivia. February 18.
15196 I. U. M. Eleven, 80–145 mm. Lake Todos Santos, Puella. February 27.
15197 I. U. M. Many, largest 260 mm. Lake Llanquihue, Puerto Varas. March 12.
15220 I. U. M. Four, largest 80 mm. Lake Rinihue. March 16.
15198 I. U. M. One, 207 mm. Creek halfway between Valdivia and the sea. February 19.
15222 I. U. M. Many, largest 205 mm. Coigüe, Rio Bio Bio. March 18.

Head, 4 to 4.5; D., V to IX–10 to 12; A., 14 or 15, rarely 16; scales, 70 to 90; snout, 3 to 3.5; eye, 4 in the young, 5 in adult (5.5 in largest); interorbital, 3 to 3.66; snout rather blunt, the lower jaw distinctly shorter; distance between snout and end of maxillary less than distance between snout and eye in the adult, equal to it in the young (120 mm.); distance between snout and lower angle of premaxillary, 2 in the distance from snout to pupil in medium-sized specimens, to posterior margin of pupil of largest; gape equals half the distance from snout to eye; teeth subequal, in about four irregular series; depth of caudal peduncle, 2.8 to 3.25 in the distance between the base of the last anal ray and the base of the middle caudal ray.

Scales of the sides deeply scalloped.

Origin of spinous dorsal and second or third of ventrals equidistant from the snout; end of first dorsal nearer the snout than the anus; origin of second dorsal about equidistant from snout with origin of anal or one of the first four rays; tip of last anal ray equidistant from base of middle caudal rays with tip of last dorsal ray, or a little nearer; base of anal distinctly less than head without opercle; pectorals extending at least halfway to tip of ventrals.

A well-defined lateral band, its width half to two-thirds the length of the eye; it occupies the full width of a series of scales with the angles of the series above and below it, or to the second row of scales above and below it, its upper margin dark. Margin of caudal and dorsal, tip of ventrals and of anal lobe blackish.

Dorsal and anal rays

Localities	Dorsal spines					Rays			Anal rays		
	V	VI	VII	VIII	IX	10	11	12	14	15	16
Osorno	2	1	1				3	1	1	2	1
Valdivia	3	4					6	1	4	3	
Lake Todos Santos	1	4	1			2	4		5	1	
Lake Llanquihue		2	7	1	1	3	1	1	4	1	

Number of scales in individuals

Localities	Scales			
	70–74	75–80	81–86	87–90
Osorno		1	1	3
Valdivia		4	2	
Lake Todos Santos	2	3		
Lake Llanquihue	2	3		

Cauque wiebrichi Eigenmann, sp. nov. Plate XIV, fig. 3

15202 I. U. M. Type 217 mm. Valdivia market. Eigenmann. February 19.

Among a lot of peje reyes bought in the market at Valdivia I secured the above specimen. It was not distinguished at the time from the peje rey del rio. It is either a distinct species or a hybrid between the marine *Austromenidia regia* and the fresh-water *Cauque mauleanum*, being nearly intermediate between the two.

The teeth in bands in the jaws would technically place it in the genus with *C. mauleanum*.

Head exactly 4 in the length behind the eye; depth about 5; D. VII, 11; A., 17; scales, 84; snout, 3.2; eye, 5.4; interorbital, 3.33; snout pointed, the lower jaw slightly shorter; distance between snout and end of maxillary less than distance between snout and eye; distance from snout to lower angle of premaxillary half the distance between snout and middle of eye; gape equal to length of eye; teeth subequal, in about four irregular series; depth of caudal peduncle, 3.5 in the distance between the base of the last ray of the anal and the base of the middle caudal ray.

Most of the scales slightly scalloped.

Origin of spinous dorsal and last fifth of ventrals equidistant from snout, end of this fin and anus equidistant from snout; origin of second dorsal and base of sixth anal ray equidistant from snout; tip of last dorsal ray a little further from caudal than tip of last anal ray; base of anal equals length of head without opercle; pectorals reaching halfway to tip of ventrals.

A well-defined lateral band, its width distinctly more than half the length of the eye, distinctly wider than in *mauleanum* and distinctly narrower than in *regia;* the band occupies the width of a series of scales and to the corners of the second series of scales above and below it; the portion lying above the upper angle of the median series of scales of the band is dark; caudal margined with dark; other fins dusky, especially toward tips.

Cauque itatanum (Steindachner)

Chirostoma itatanum Steindachner, Ann. Naturh. Hofmus. Wien. II, 1896, p. 232 (Itata River).

Closely related to *wiebrichi;* differing in the characters given in the key.

Cauque brevianalis (Günther). Plate XIV, fig. 1

Atherinichthys brevianalis Günther, Rept. Voy. Challenger, I, pt. 6. Shore Fishes, 1880, p. 25.

This species is known from a specimen 5 inches long from Valparaiso and:

15221 I. U. M. 3, largest 92 mm. La Serena. April 8. Eigenmann.

These specimens were secured with a very much larger number of specimens of *Basilichthys*, in the river near the railroad bridge at La Serena, a mile or two from the ocean.

Head, 3.7 to 3.8; depth, 4.5 to 4.66; D., V in two, VI in one—10 in one, 11 in two; A., 14; scales, 54, 61, 65; 12 to 14 scales between dorsal and anal; eye, 3.33–4 in the head, equal to the snout in the largest; interorbital, 3.25 to nearly 4 in the head; mouth small, freely protractile, no teeth on the palate; teeth in the jaws in two irregular series; premaxillary to its lower anterior angle 2 in the distance from its tip to the middle of the eye; distance from its tip to the end of the maxillary equals the length of the snout. Depth of caudal peduncle, 2.25–2.5 in distance from base of last anal ray to base of middle caudal ray.

Scales, especially toward the caudal peduncle, scalloped.

Origin of spinous dorsal equidistant from snout with middle of ventrals, its tip a little behind the tip of the ventrals; origin of dorsal and base of fourth anal ray equidistant from snout; tip of last anal ray very little nearer base of middle caudal ray than the tip of the last dorsal ray; pectorals reaching halfway to anal; base of anal less than head without opercle.

A silvery lateral band, its width less than half the length of the eye, its upper margin darker.

Fins nearly evenly peppered.

BASILICHTHYS Girard

Peje Rey del Rio

Basilichthys Girard, Proc. Acad. Nat. Sci. Phila. VII, 1854, p. 198; U. S. Astron. Exped., 1855, p. 238, Plate XXX, figs. 6–9 (*microlepidotus*).
Protistius Cope, Proc. Acad. Nat. Sci. Phila., 1874, p. 66 (*semotilus*).
Gastropterus Cope, Proc. Amer. Philos. Soc. XVII, 1878, p. 700 (*archæus*).
Pisciregia Abbott, Proc. Acad. Nat. Sci. Phila., 1899, p. 342 (*beardsleei*).

Type, *Atherina microlepidota* Jenyns.

Habitat: Fresh waters of the Pacific slope from the Rio Santa in Peru south at least to Osorno in south central Chile, from sea level to at least 7,500 feet in places. Said to have been taken at 12,000 feet. At present it is barely able to maintain itself at Matucana at 7,000 feet.

Key to the species of Basilichthys

a. Pectorals reaching halfway to middle of ventrals; vomer usually without teeth; depth of caudal peduncle, 3 to 3.33 in the distance between the base of the last anal ray and the base of middle caudal ray; D., usually IV or V (III to VII).
b. Scales between 100 and 112, rarely 95. Dorsal spines most frequently V. Santiago southward. **australis** Eigenmann.
bb. Scales between 80 and 95. Dorsal spines most frequently V. Valparaiso and northward. **microlepidotus** Jenyns.
aa. Pectorals halfway to tips of ventrals or halfway to anus; vomer usually with a patch of teeth; depth of caudal peduncle, 2.5 to less than 3 in the distance between the base of the last anal ray and base of middle caudal ray; D., usually III or IV (O–V)..... **semotilus** Cope.

Basilichthys australis Eigenmann, spec. nov. Plates XII, fig. 3; XIV, fig. 5

Austromenidia laticlava Cuvier & Valenciennes in part. Hist. Nat. Poiss. X, 1835, p. 473 (Laguna de Taguatagua.)
Basilichthys microlepidotus Girard, Proc. Acad. Nat. Sci. Phila., VII, 1845, p. 198; U. S. Nav. & Astron. Exped. 1855, p. 238, plate XXX, Figs. 8 and 9 (Mapocho).
Atherinopsis microlepidotus Thompson, Proc. U. S. Nat. Mus. 50, 1916, p. 463 (Tome and Lota).

Habitat Santiago and southward to Osorno.

This is the "Peje rey del rio" of Santiago and southward to near Valdivia, where it is known as "Cauque" and the name "peje rey del rio" passes to *Cauque mauleanum*. I did not find this species in Lakes Llanquihue or Todos Santos.

Specimens examined

Catalogue No.	Number of specimens	Length of largest	Locality	Date
		mm.		
15553 I. U. M.	Two	273	Santiago market	
15206 I. U. M.	Fifteen	190	Llo Lleo	Mar. 28
15208 I. U. M.	Many	192	Peñaflores	Mar. 26
15210 I. U. M.	Many	138	Hospital	Apr. 22
15211 I. U. M.	Many	210	San Javier	Mar. 23
15212 I. U. M.	Many	165	Rio Nonguen	Mar. 20
15209 I. U. M.	Many	248	Coigüe	Mar. 18
15213 I. U. M.	Many	260	Lautaro	Feb. 13
15215 I. U. M.	Fifteen	203	Valdivia	Feb. 18
15218 I. U. M.	Many	192	Valdivia	Feb. 18
15214 I. U. M.	Many	100	Lake Rinihue	Mar. 16
15207 I. U. M.	Many	328	Osorno	Mar. 14
15216 I. U. M.				

BASILICHTHYS MICROLEPIDOTUS (Jenyns) [18]

Atherina microlepidota Jenyns, Zool. Voyage of the *Beagle*, Fishes, IV, 1842, p. 68, Pl. VII, fig. 1 (Valparaiso, type, a specimen 100 mm. long); Guichenot in Gay, Hist. Chile, Zool. II, 1848, p. 253.

Atherinichthys microlepidota Günther, Cat. Fishes Brit. Mus. III, 1861, p. 403; Kner, Novara, Fische 1869, p. 222; Delfin, Catálogo Peces Chile, 1901, p. 47.

Not *Basilichthys microlepidotus* Evermann and Kendall.

Not *Atherinopsis regius* Steindachner, Eigenmann, et al.

Habitat: Valparaiso northward. Peje reyes are reported from near the mouth of the Rio Copiapo, from the Rio Loa, and from the Rio Camarones north of Iquique. They may be this species or *B. semotilus* Cope.

Specimens examined

Catalogue No.	Number of specimens	Length of largest	Locality	Date
		mm.		
15204 I. U. M.	Many	150	La Serena	Apr. 8
15205 I. U. M.	Fifty	170	Choapa	Apr. 10
15203 I. U. M.	Forty	190	Calera	Apr. 13

General description of B. microlepidotus and B. australis.

Head, 4.5 to 5; depth, 4.75 to 7; D., III to VII (for details see below) 10 to 12, usually 11; A., 13 to 17, most frequently 15; scales usually 85 to 95 north of Santiago, *microlepidotus;* usually 100 to 112 from Santiago south *australis;* eye, 4.5 to 5; snout, 3.25 to 3.5; interorbital, 3 to 3.5; teeth in four or five series in the jaws; vomer usually without teeth, but a small patch of teeth was found at the tip of the vomer in some specimens from almost all of the localities; snout to end of maxillary not quite equal to its distance from the eye; snout to angle of premaxillary equal to the gape; depth of caudal peduncle, 3 to 3.33 in the distance between the base of the last anal ray and the base of the middle caudal ray; scales entire; dorsal and anal naked; caudal lobes scaled for about half their length; origin of first dorsal over tip of ventrals or a little distance behind them; tip of first dorsal above anus; origin of second dorsal and second fifth or second third of anal equidistant from snout; tip of last dorsal and last anal ray nearly equidistant from base of middle caudal ray; base of anal less than length of head without the opercle. Pectorals extending halfway to middle of ventrals.

Upper half with dorsal, caudal and pectoral dusky; width of lateral band about equal to length of eye.

Dorsal spines in Basilichthys microlepidotus and B. australis

	Localities	III	IV	V	VI	VII
B. microlepidotus	La Serena	9	35	8		
Do	Choapa	3	18	17	1	
Do	Calera	1	5	22	8	5
B. australis	Llo Lleo		4	10		
Do	Peñaflor	1	2	10	4	1
Do	San Javier		1	2		
Do	Rio Nonguen		1	4	2	
Do	Coigüe		1	6	2	
Do	Valdivia		3	9	2	
Do	Osorno		1	4		

In the La Serena specimens the dominant number of spines is IV; in Choapa IV and V; everywhere else it is V.

[18] The *Basilichthys microlepidotus* Evermann & Kendall, Proc. U. S. Nat. Mus., XXXI, p. 97, is not a Basilichthys but a Patagonina, Austromenidia or Cauque. No. 53431 is probably *hatcheri;* the rest were not found in the National Museum.

XI. SERRANIDAE

The Truchas

The members of the Serranidae are mostly marine. Two genera inhabit the fresh waters of Chile.

a. Maxillary with supplemental bone; palatines toothed; scales small.....Percichthys Girard.
aa. Maxillary without supplemental bone; palate without teeth; scales large.....Percilia. Girard.

PERCICHTHYS Girard

Type, *Perca trucha* Cuvier and Valenciennes.

There are two species of Percichthys in Chile between Santiago and the Rio Bio Bio. The species are quite distinct and recognized by the fishermen. The "pocha," a smaller, deeper, blunt-nosed species, was not brought to the market at Santiago. I was told it was at its best about Curico. I got it from the Bio Bio and Mapocho basins.

The "trucha" is a larger, more slender, sharper-nosed species, of considerable economic importance. It is abundant everywhere south of the Rio Aconcagua. There is a great deal of variation in the color, length of dorsal spines, etc., the southern specimens are more spotted and the dorsal spines average longer. While the two species of Percichthys are quite distinct and readily recognized there is scarcely a single character that does not intergrade.

Key to the species of Percichthys

a. Snout pointed, the mucus cavities inconspicuous; distance between tip of snout and end of maxillary greater than snout; spines on lower limb of preopercle usually fewer than ten (some of the spines with two or three points); scales, 66–73 (58–63 in specimens from Punta Arena); depth of caudal peduncle, 2 or more in its length; highest dorsal spine equal to snout and half the eye, to much longer than snout and eye; depth, 3.5–4; opercular spine usually flat, triangular. Adult nearly uniform in the northern part of its range, with lines between the rows of scales in specimens from Coigüe, Nonguen, Lautaro, profusely dotted in specimens from the south, especially Laguna Fria. Young from all places spotted, D., VIII–XI, I, 10–13; A., III, 8–10.....trucha (Cuv. & Val.).

aa. Snout turgid, blunt, the mucus cavities about the head prominent; distance between tip of snout and end of maxillary about equal to the snout; spines on lower limb of preopercle, 12 to 18 (27 in one), increasing in number with age; scales, 54–64; depth of caudal peduncle, 2 or less than 2 in its length; highest dorsal spine equal to snout and half the eye to more than snout and eye; opercular spine usually terete, sometimes flat, triangular. Dark ash above, lighter below, sometimes with dark lines between the rows of scales; young peppered above. D., IX–X, 10.5–11.5; A., III, 9.5.....melanops Girard.

Percichthys trucha (Cuvier and Valenciennes). Plates XIII, fig. 4; XVI, fig. 3

Trucha

The trout Molina, Geog. Nat. & Civil Hist., Chili. Irving's translation I, 1808, p. 153.

Perca trucha Cuvier & Valenciennes, Hist. Nat. Poiss. IX, 1833, p. 429 (Rio Negro, Chile); Guichenot, in Gay, Hist. Chile, Zool. II, 1848, p. 146 (Chile); id. Atl. Ichthyol. I, v, fig. 1, 1854.

Percichthys trucha Girard, Proc. Acad. Nat. Sci. Phila., VII, 1854, p. 197, and U. S. Naval and Astron. Exped. II, 1855, p. 230; Günther, Cat. Fishes Brit. Mus. I, 1859, p. 61; Jordan & Eigenmann, Bull. U. S. Fish. Com. VIII, 1890, p. 427 (Santiago and Curico, Chile); Boulenger, Mem. Soc. Sc. Chile, IV, 1894, p. 10; id. Cat. Fishes Brit. Mus. I, 1895, p. 119; Steindachner, Zool. Jahrb, 1898, Suppl. IV, p. 281 (Pichi-Laguna, an arm of Lake Llanquihue at Puerto Montt); Delfin, Catálogo Peces Chile, 1901, p. 58; Evermann & Kendall, Proc. U. S. Nat. Mus. XXXI, 1901, p. 100 (Rio Negro; Rio Limay; Lake Nahuel-Huapi; Lake Traful) Eigenmann, Repts. Princeton Univ. Exped. Patagonia, III, 1909, p. 285, plates XXXVI, fig. 3 and XXXVII, fig. 2 (Rio Santa Cruz).

Perca lævis Jenyns, Zool. Voy. *Beagle*, Fishes I, 1842, pl. i (Rio Santa Cruz).

Percichthys lævis Günther, Cat. Fish. Brit. Mus. I, 1859, p. 61; Kner, Novara Fische II, 1865 (Valparaiso); Vaillant, Miss. Scient. Cap Horn, Poiss. 1888, C. p. 31, (Santa Cruz); Jordan & Eigenmann, Bull. U. S. Fish Com. VIII, 1890, p. 428; Perugia, Ann. Mus. Civ. Stor. Nat. Genova, Ser. 2a, X (XXX) 1891, p. 609 (Tierra del Fuego; Laguna del Rio Negro; Rio Santa Cruz).

Percichthys chilensis Girard, Proc. Acad. Nat. Sci. Phila, VII, 1854, p. 197; id., U. S. Naval and Astron. Exped. 1855, p. 231, Pl. XXIX, figs. 1–4 (Rio Maypu, near Santiago, Chile); Philippi, Mb. Berl. Acad. 1866, p. 707.

Specimens examined

15559 I. U. M. 3, 142–330 mm. Santiago Market.
15560 I. U. M. 2, 203 and 242 mm. Hospital. April 22.
15561 I. U. M. 10, largest 213 mm. Llo Lleo. March 28.
15562 I. U. M. 1, 278 mm. Laguna Fria.[19] March 3.
15563 I. U. M. 8, 48–66 mm.; 2, 158 and 182 mm. San Xavier. March 23.
15564 I. U. M. Several, 55–295 mm. Rio Nonguen. March 20.
15565 I. U. M. 9, 63–160 mm. Coigüe. March 18.
15566 I. U. M. Many, largest 335 mm. Lautaro. February 13.
15567 I. U. M. 4, largest 47 mm. Valdivia. February 19.
15568 I. U. M. 21–45 mm. Lake Rinihue. March 16.
15569 I. U. M. Largest 59 mm. Osorno. March 14.
15570 I. U. M. Largest 115 mm. Puerto Varas. March 14.
15571 I. U. M. 1, 224 mm. Rio Pescado. March 10.
15572 I. U. M. Largest 135 mm. Ensenada. March 9.
15573 I. U. M. Many, 32–212 mm. Peulla, Lake Todos Santos. February 27.
11373 and 11374 I. U. M. 3, about 150–205 mm. Punta Arenas. Hatcher.
11120 I. U. M. 1, 225 mm. Arroyo Comajo, Territory of Neuquen, Argentina, J. W. Titcomb. 1903–4.
11075 I. U. M. 2, 284 and 305 mm. Santa Cruz, Patagonia, Italian Antarctic expedition.

With the characters given in the key.

Percichthys melanops (GIRARD). Plates XIII, fig. 3; XVI, fig. 2

Pocha

Percichthys melanops Girard, Proc. Acad. Nat. Sci. Phila. VII, 1854, p. 197 (Rio de Maypu, Chile); id., U. S. Nav. and Astron. Exped., 1855, p. 233, Pl. XXX, figs. 1–5 (Rio de Maypu, Chile); Günther, Cat. Fishes Brit. Mus. I, 1859, p. 61; Jordan & Eigenmann, Bull. U. S. Fish Com. VIII, 1890, p. 428; Boulenger, Mem. Soc. Sc. Chile IV, 1894, p. 13; id., Cat. Fishes Brit. Mus. I, 1895, p. 120; Delfin, Catálogo Peces Chile (Rio Maipo, Central Chile, Colima); Eigenmann, Reports Princeton Univ. Exped. Patagonia, III, 1909, p. 288, Plate XXXVI, figs. 2–2b.

Specimens examined

15554 I. U. M. 11, 90–136 mm. Hospital. April 22.
15555 I. U. M. Many, 67–161 mm. Estero Nonguen. March 20.
Locally abundant in north-central Chile, with the characters given in the key.

PERCILIA Girard

Type, *Percilia gillissi* Girard.

The species of this genus live in swift shallow water, among the weeds or rocks; they occupy the nitch occupied in North America by the darters. They are as brilliant in color as the most festive of the darters.

Percilia gillissi Girard. Plate XIII, fig. 1

Truchecita

Specimens examined

15516 I. U. M. Largest 86 mm. Peñaflor. March 29.
15517 I. U. M. Largest 89 mm. Hospital. April 22.
15518 I. U. M. 35, largest 74 mm. Osorno. March 14.
15519 I. U. M. 13, largest 70 mm. Lake Rinihue. March 16.
15520 I. U. M. Many. Largest 73 mm. Lautaro. February 13.
15521 I. U. M. Largest 54 mm. San Xavier, Rio Maule. March 23.
15583 I. U. M. 3, largest 58 mm. Esterito Santa Rosa, Valdivia. February 18.

The largest specimen secured measured 89 mm.

D., IX (rarely VIII), 11 or 12 (rarely 10 or 13); A., III, 9 or 10.

Pores in the lateral line between 31 and 35 in Hospital specimens; usually 35 to 37 in other localities; 36 to 42 in those from Lake Rinihue.

[19] A specimen much spotted was preserved at Laguna Fria. I am sure it reached Bloomington, but no specimen bearing the Laguna Fria label can now be found. A specimen labeled "Santiago Market" is probably this specimen.

Color in alcohol: Sides and back in young profusely spotted and mottled, a series of spots or a wavy stripe along the middle of the sides, of 20 mm. specimens; a narrow vertical line at the end of the caudal peduncle, sometimes broken; a dark line from the snout obliquely through the upper part of the eye; a parallel band from just behind the maxillary up and back, tangent to the eye, both bands obscure; a dark spot behind the gill-opening above. In the adult the color is much darker, the markings becoming obscure. Caudal, anal, and soft dorsal hyaline or dark, without or with very faint markings near the base except in the specimens from Rinihue. Spinous dorsal dark at base.

In the specimens from Rinihue the contrasts are greater, the soft dorsal and caudal with distinct bars.

Percilia irwini Eigenmann, sp. nov. Plates XIII, fig. 2; XVI, fig. 1

Types, many specimens, the largest 96 mm. Rio Nonguen, in the grounds of the Agricultural School, Concepcion. March 20, 1919.

Head, 3.66 to 3.75; depth, 3.5 to 3.8 (4 in young); D., IX (rarely VIII), 12 (rarely 13); A., III, 8–10, usually 9; pores in the lateral line $\frac{37}{1}$, $\frac{38}{4}$, $\frac{39}{3}$, $\frac{40}{1}$, $\frac{44}{1}$; depth of caudal peduncle, 2 to 2.5 in its length (1.5 to 2 in *gillissi*); distance from base of dorsal ray to base of middle caudal ray about equal to the length of the head (distinctly shorter than the head in *gillissi*); opercle ending in a sharp point.

Color in the young similar to that of *gillissi*; soft dorsal and caudal of the half grown with distinct crossbands, or marblings, becoming nearly uniform dark with age, a black band through the center of the spinous dorsal. Adults most brilliant with orange and yellows.

INTRODUCED SPECIES

The goldfish, the German carp, the tench, and several species of trout have been introduced in the rivers of Chile. I was told that there were seven different sorts of fishes at Copiapo. They all proved to be variations of the goldfish. There are no native fishes about Copiapo. I found goldfishes also at Hospital, Peñaflor, and Llo Lleo. The carp I found at La Serena, Llo Lleo, and Hospital. The tench I got at Lautaro.

I was told that some trout *Salmo salar*, *irideus*, and *fontinalis* were planted in Laguna del Inca in 1905, and several years afterwards, in 1914, during especially low water, a number of very large trout, weighing 25 pounds each were secured from a little pocket isolated from the main body of the lake by the unusual lowering of the surface of the lake. I secured trout, *Salmo fario*, at Lautaro, Puerto Montt, and Rio Blanco, and *Salmo irideus* at Lautaro and Rio Blanco. Young trout (sp.?) were found at Lake Rinihue.

The introduced trout have been reported from various Andean lakes. In some of the upper reaches of the rivers the introduced species are exterminating the native species. They have accomplished this in the upper Aconcagua. I found nothing but trout at Rio Blanco, a tributary of the Aconcagua above Los Andes.

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PLATES

PLATE II.—Drawings by W. S. Atkinson

FIG. 1.—Outline of a specimen of Mordacia or Caragola. I. U. M., 16042a. 117 mm. Valdivia. Carlos Wiebrich.

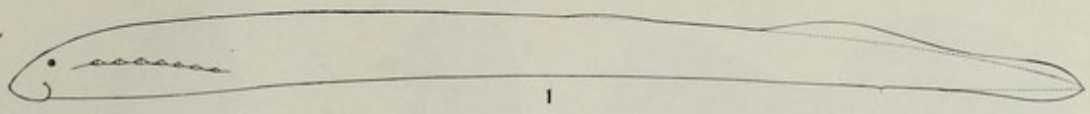
FIG. 2.—The anterior end of the same more enlarged.

FIG. 3.—The mouth of the same from below with the hood expanded.

FIG. 4.—Outline of a specimen of Velasia, recently metomorphosed. I. U. M., 16043, 86 mm. Valdivia. Carlos Wiebrich.

FIG. 5.—The anterior end of the same more enlarged.

FIG. 6.—The mouth of the same from below, showing the absence of hood and the presence of two lateral papillae.



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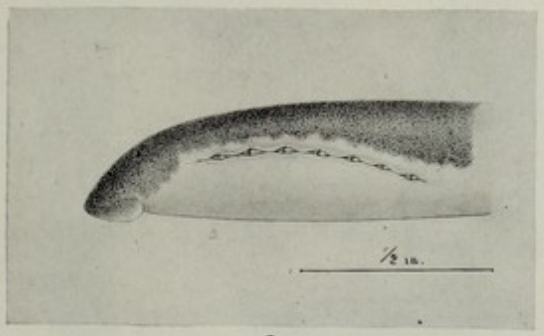

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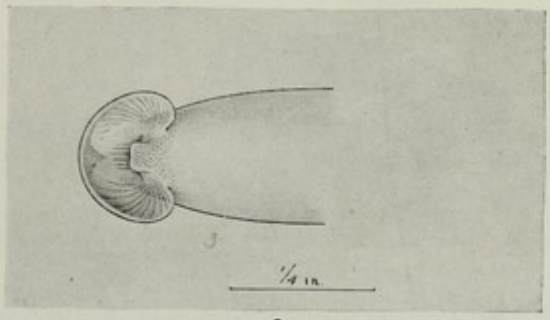

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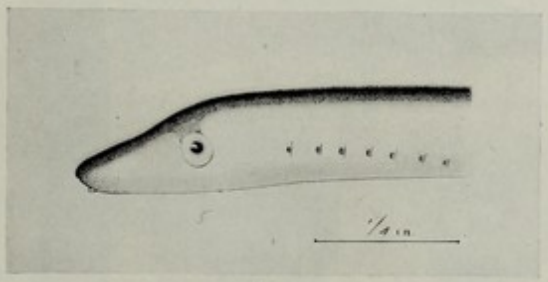

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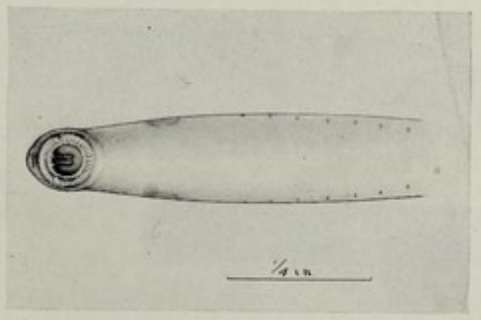

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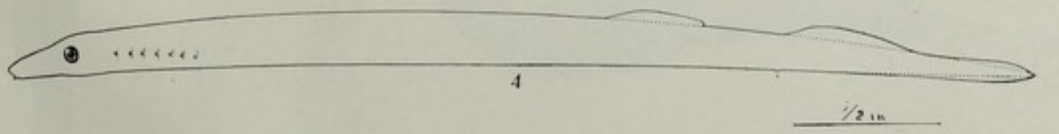

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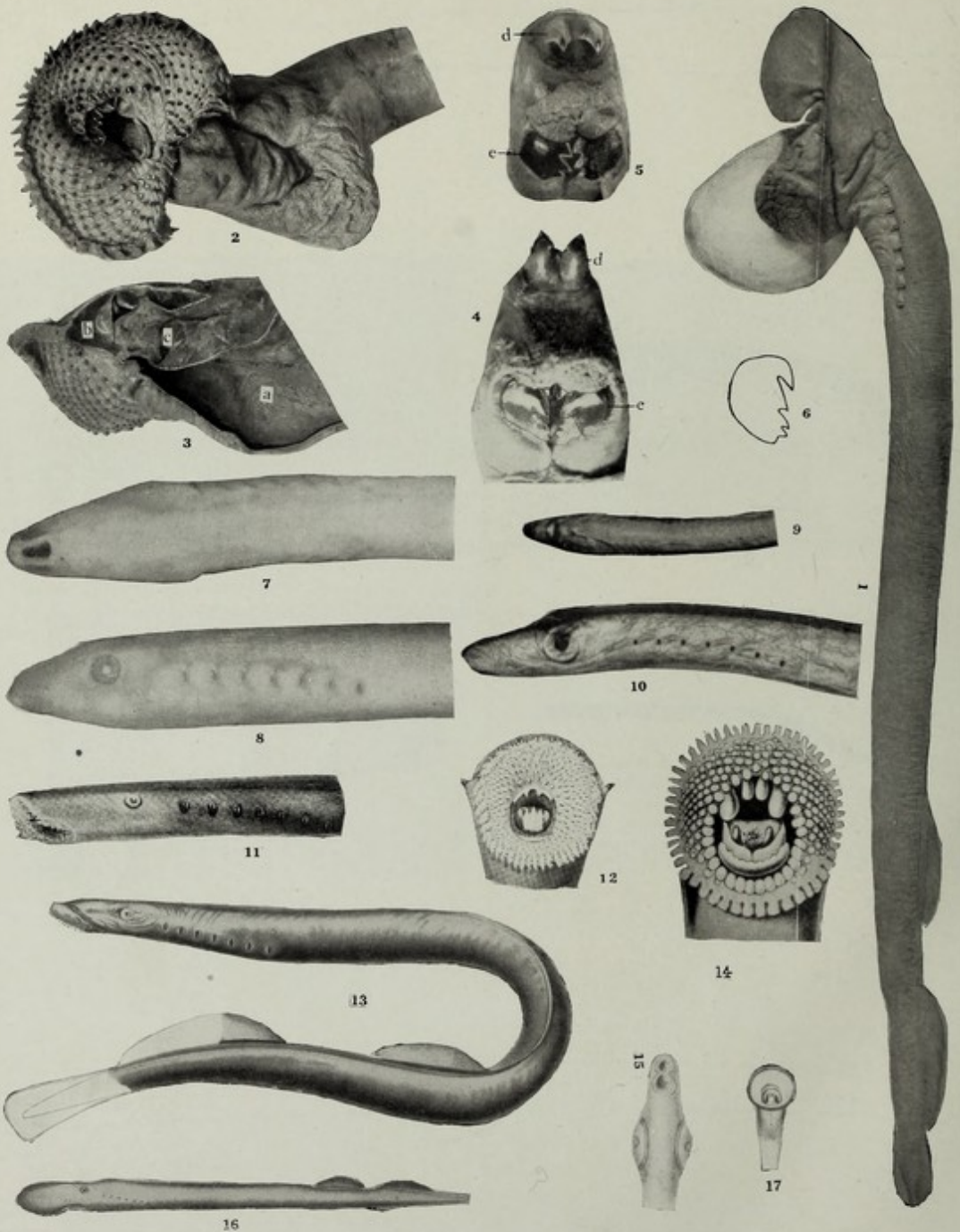
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PLATE III.—Geotria and Velasia

(The photographs are by the author)

FIG. 1.—*Geotria australis* Gray. 15632 I. U. M., 470 mm. Lautaro.

FIG. 2.—Mouth and lymph sac.

FIG. 3.—Sagittal section of the head; *a*, Lymph cavity; *b*, mouth cavity; *c*, muscles of the tongue.

FIGS. 4 and 5.—Tongues of specimens from above, showing the anterior fangs *d* and the posterior notched teeth of the tongue *e*.

FIG. 6.—Camera outline of one of the posterior lingual teeth.

FIG. 7.—Ventral view of a larva Velasia, about 90 mm. long. Much enlarged.

FIG. 8.—Side view of a similar larva, with the same magnification.

FIG. 9.—Dorsal view of a similar larva, less enlarged.

FIG. 10.—Young Velasia, immediately after metamorphosis. 15634 I. U. M., 92 mm.

FIG. 11.—Side view of *Velasia stenostoma*, after Lahille, Anales Mus. Nac. Buenos Aires, Plate XIII, fig. 4.

FIG. 12.—Mouth of the same, after fig. 2 of the same plate.

FIG. 13.—Type of *Velasia chilensis* Gray, in the British Museum. Drawn by Greene.

FIG. 14.—Mouth of the same.

FIG. 15.—Lower surface of head of *Velasia stenostoma*. After Plate, fig. 14, Taf. 19. Zool. Jahrb. Suppl. V. 1902.

FIG. 16.—Mouth of *Exomegas macrostomus gallegensis*, after Smitt, fig. 22.

FIG. 17.—*Exomegas macrostomus gallegensis* after Smitt, 334 mm. Bih. Svenska Vet. Akad. Handlingar XXVI, Afd. IV, No. 13, Plate IV, fig. 19.

PLATE IV.—Mordacia and Caragola

(The photographs are by the author)

FIG. 1.—*Caragola lapicida* Gray. 15626 I. U. M., 129 mm. Osorno.

FIG. 2.—Larva of *Caragola lapicida*?. 15626 I. U. M., about 90 mm. long from above. Osorno.

FIG. 3.—Another larva of about the same size from the side.

FIG. 4.—Another larva of about the same size from below. Under less magnification.

FIG. 5.—Sagittal section of the anterior part of a *Caragola lapicida*. 15626 I. U. M., 160 mm. long. Osorno. *b*, Mouth cavity; *c*, tongue; *f*, notochord; *g*, gill-sacs.

FIG. 6.—Mouth of the same specimen.

FIG. 7.—Mouth of *C. lapicida*, after Plate.

FIG. 8.—Anterior part of another specimen. 15624 I. U. M., 123 mm. From the ocean.

FIG. 9.—*Mordacia anwandteri* (Philippi). 16041 I. U. M., 260 mm. Valdivia, Carlos Wiebrich. Drawn by W. S. Atkinson.

FIG. 10.—*Mordacia anwandteri* (Philippi). Sagittal section of a specimen. 15498 I. U. M., 245 mm. long. Valdivia.

FIG. 11.—Mouth of *Mordacia acutidens* (Philippi), after Plate.

FIG. 12.—A specimen of the same species in the National Museum in Santiago.

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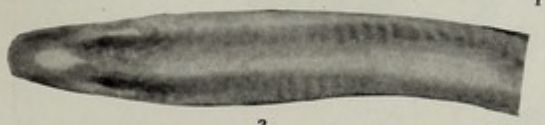

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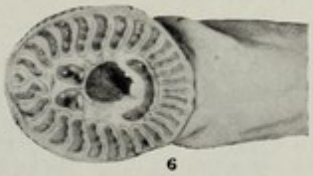

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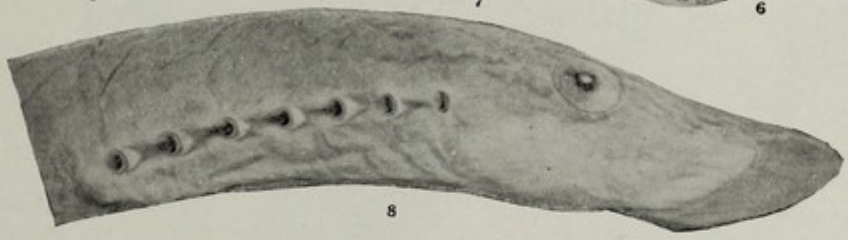

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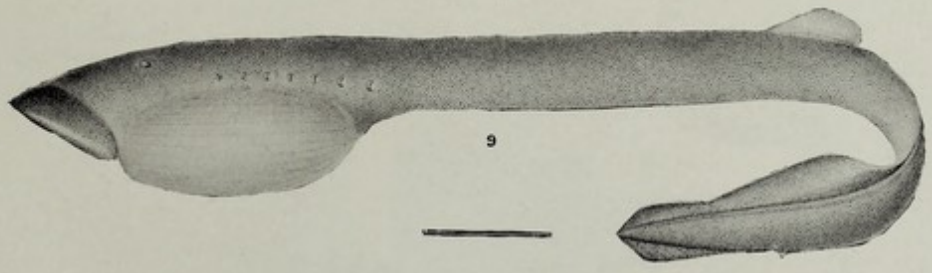

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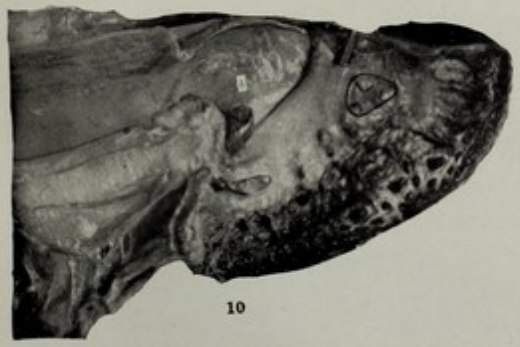

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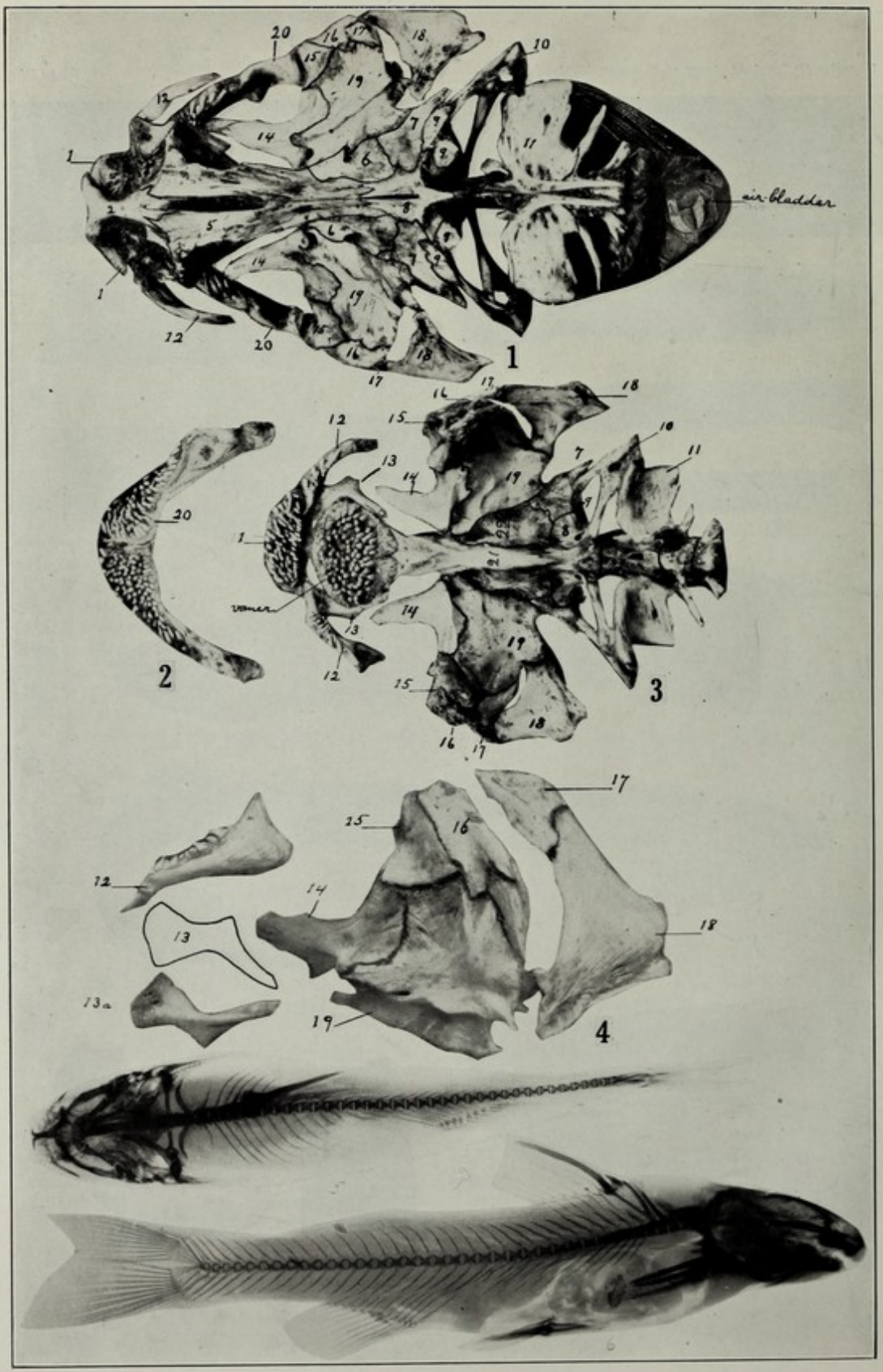
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vomer
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Plate V

(Photographs by the author; radiographs by Dr. J. E. P. Holland)

Diplomyste chilensis (Gmelin)

Explanation of notations: 1, Premaxillary; 2, ethmoid; 3, lateral ethmoid; 4, nasal; 5, frontal; 6, sphenotic; 7, pterotic; 8, supraoccipital; 9, epiotic; 10, supraclavicle; 11, parapophysis of coalesced vertebrae; 12, maxillary; 13, palatine; 14, metapterygoid; 15, quadrate; 16, preopercle; 17, interopercle; 18, opercle; 19, hyomandibular; 20, mandible; 21, parashpenoid; 22, prootic; 23, alisphenoid.

Fig. 1.—Dorsal aspect of the anterior end of the skeleton.

Fig. 2.—Mandible from above.

Fig. 3.—Ventral view of the anterior end of the skeleton.

Fig. 4.—Suspension of the right side. N. B.—The right instead of the left palatine (13) is photographed. The outline only of the right one is given.

Fig. 5.—Radiograph from the side.

Fig. 6.—Radiograph from above.

Plate VI

Nematogenys inermis (Guichenot)

(Photographs by the author; radiographs by Dr. J. E. P. Holland)

(Notations as in Plate V)

Fig. 1.—Anterior end of skeleton from below, the skull separated from the vertebrae.

Fig. 2.—The same from above, the skull not separated from the vertebrae.

Fig. 3.—Skull and coalesced vertebrae from below; the canal in which lies the duct connecting the two lateral halves of the air bladder well shown.

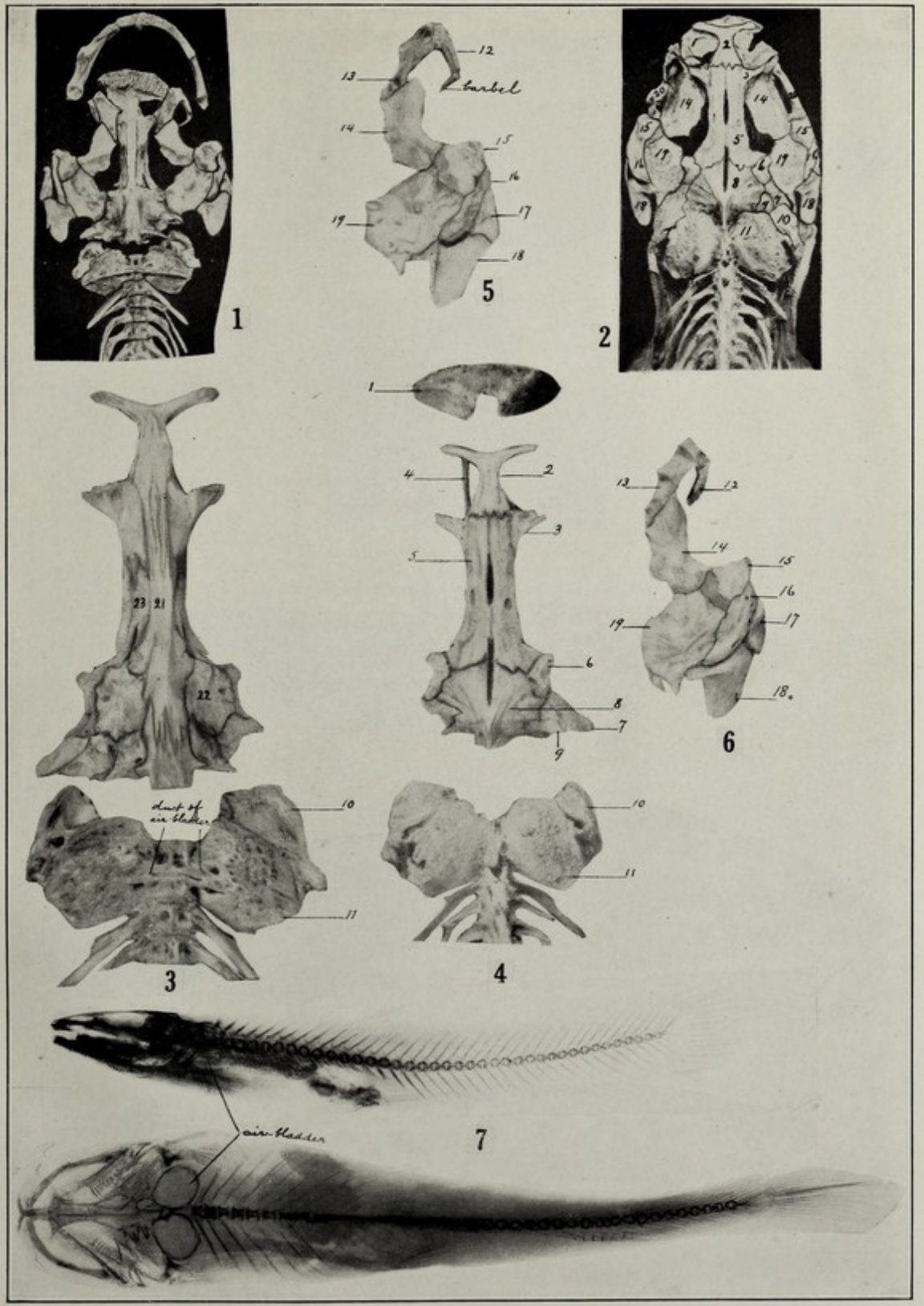
Fig. 4.—The same from above.

Fig. 5.—Left suspensorium from within.

Fig. 6.—Right suspensorium from without.

Fig. 7.—Radiograph from the side.

Fig. 8.—Radiograph from above, showing the two lateral halves of the air bladder.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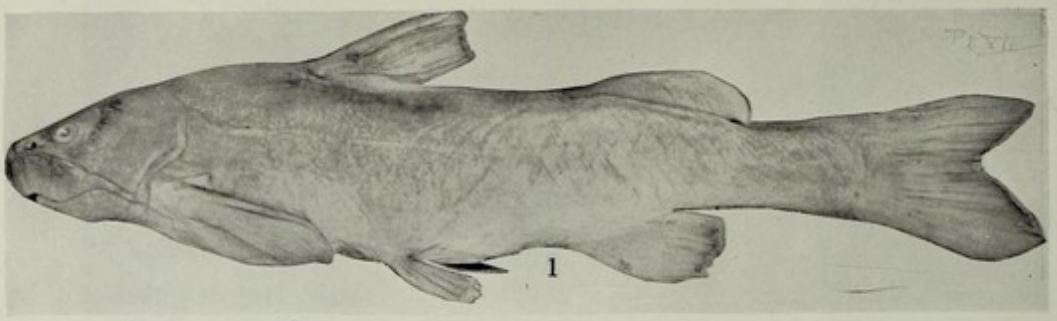
barbel
duct of air bladder
air bladder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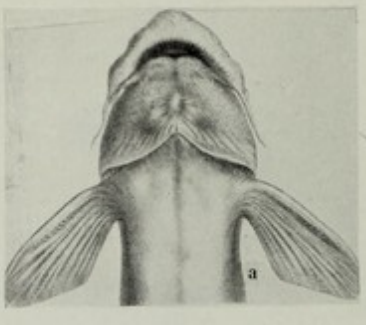
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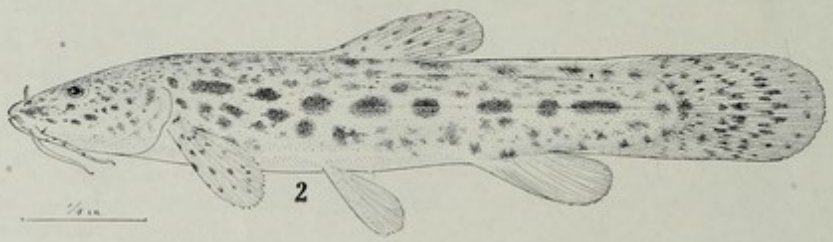
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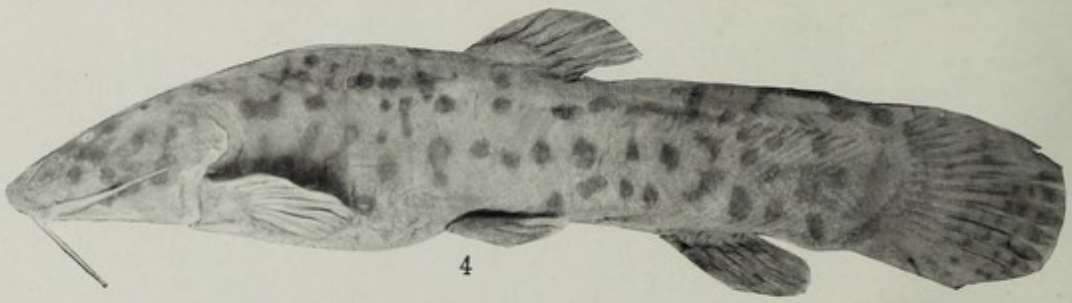
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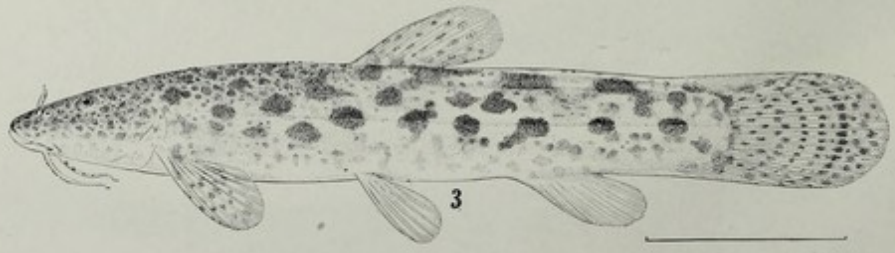
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Plate VII

(Photographs by the author; drawings, figs. 2 and 3, by W. S. Atkinson)

Fig. 1.—*Diplomyste chilensis* (Gmelin). 15525 I. U. M., 215 mm. Santiago Market.
Fig. 1a.—Head, after Eigenmann. Rept. Princeton Univ. Exped. Patagonia.
Fig. 2.—*Nematogenys inermis* (Guichenot). 15060 I. U. M., 42 mm. Estero Nonguen.
Fig. 3.—A larger specimen, 108 mm., from the same place.
Fig. 4.—Adult, 15550 I. U. M., 365 mm. Santiago Market.

Plate VIII

(Drawings by W. S. Atkinson)

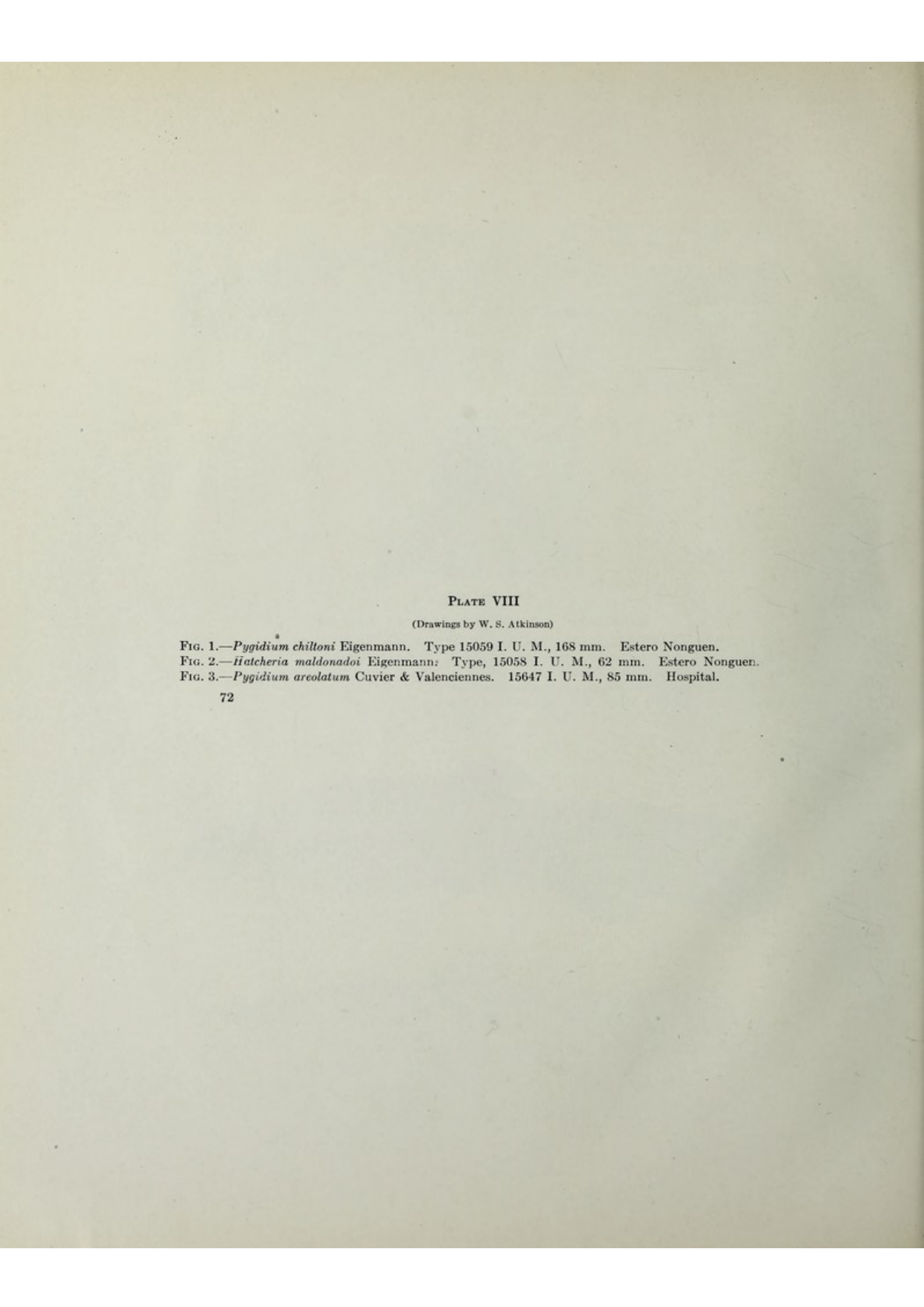
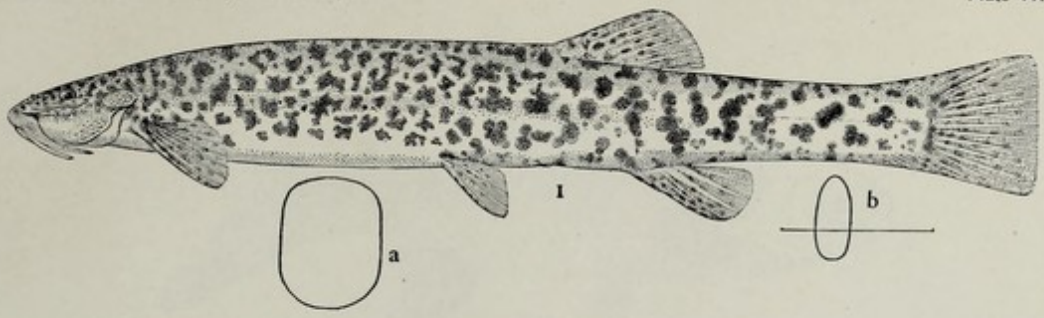


Fig. 1.—*Pygidium chiltoni* Eigenmann. Type 15059 I. U. M., 168 mm. Estero Nonguen.
Fig. 2.—*Hatcheria maldonadoi* Eigenmann. Type, 15058 I. U. M., 62 mm. Estero Nonguen.
Fig. 3.—*Pygidium areolatum* Cuvier & Valenciennes. 15647 I. U. M., 85 mm. Hospital.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a
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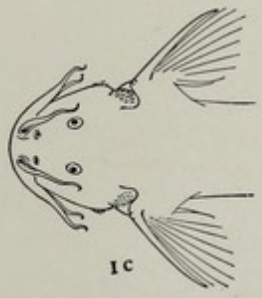
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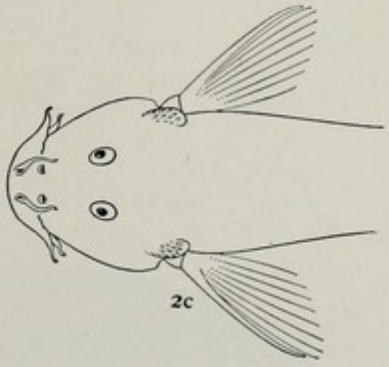
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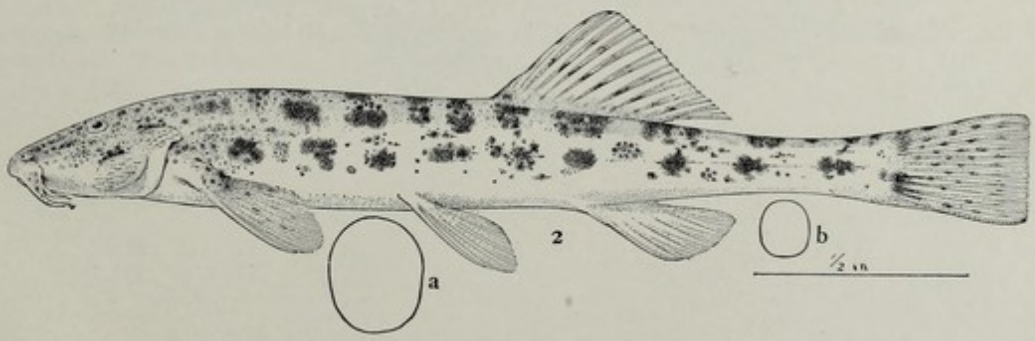
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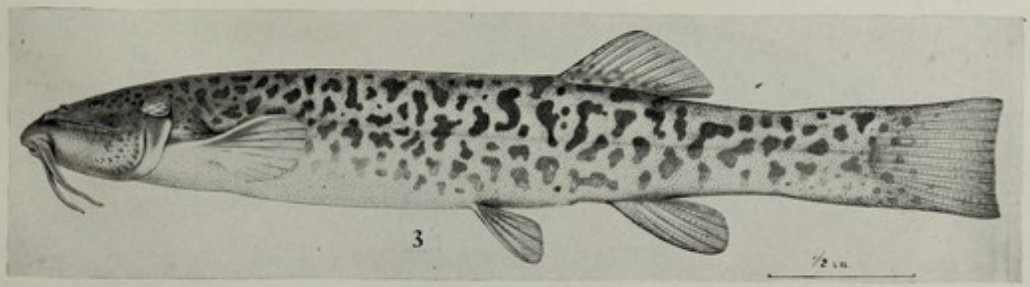
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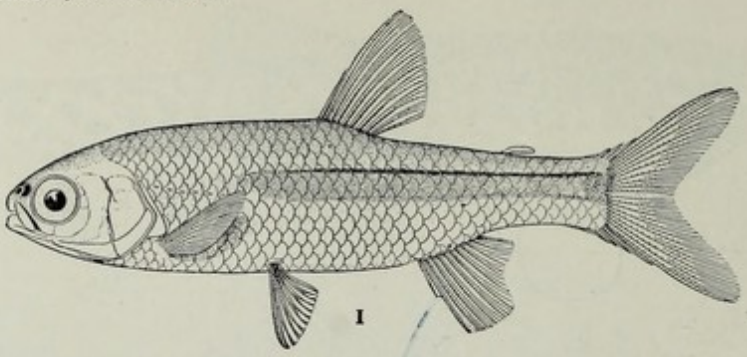

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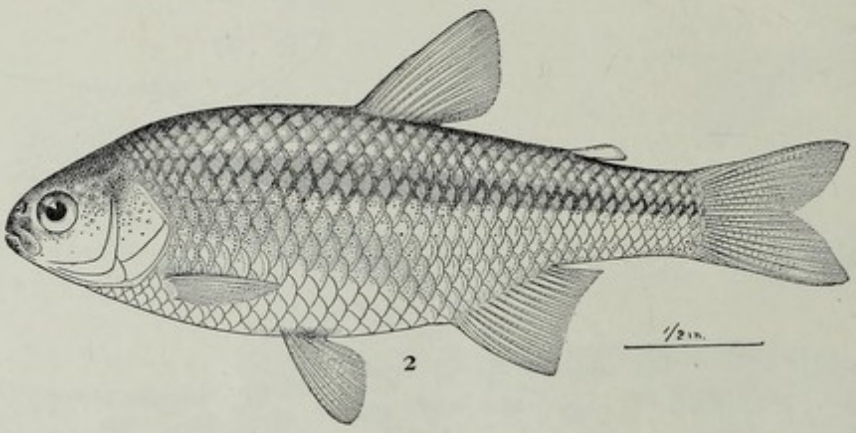

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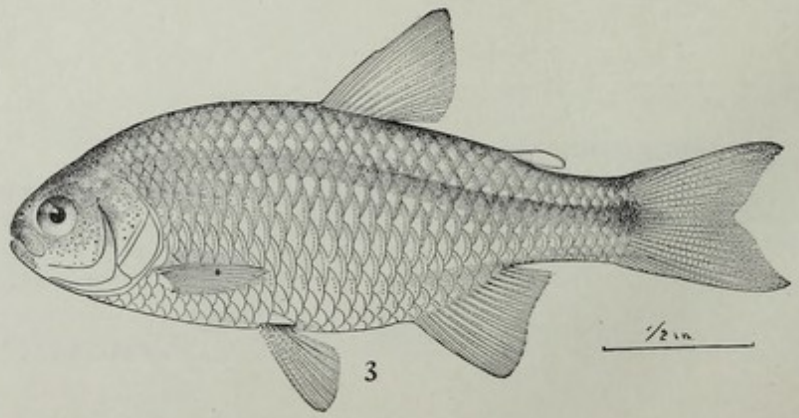

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Plate IX

Fig. 1.—*Cheirodon pisciculus* Girard. Cotype, 4301 I. U. M., 41 mm. After fig. 1, Plate XI, Mem. Carnegie Mus. VII.

Fig. 2.—*Cheirodon galusdae* Eigenmann. Type, 15506 I. U. M., 69 mm. to end of middle caudal rays. San Xavier. Drawing by W. S. Atkinson.

Fig. 3.—*Cheirodon australe* Eigenmann. Type 15509 I. U. M., 58 mm. to end of middle caudal rays. Puerto Varas. Drawing by W. S. Atkinson.

Plate X

(Drawings by W. S. Atkinson)

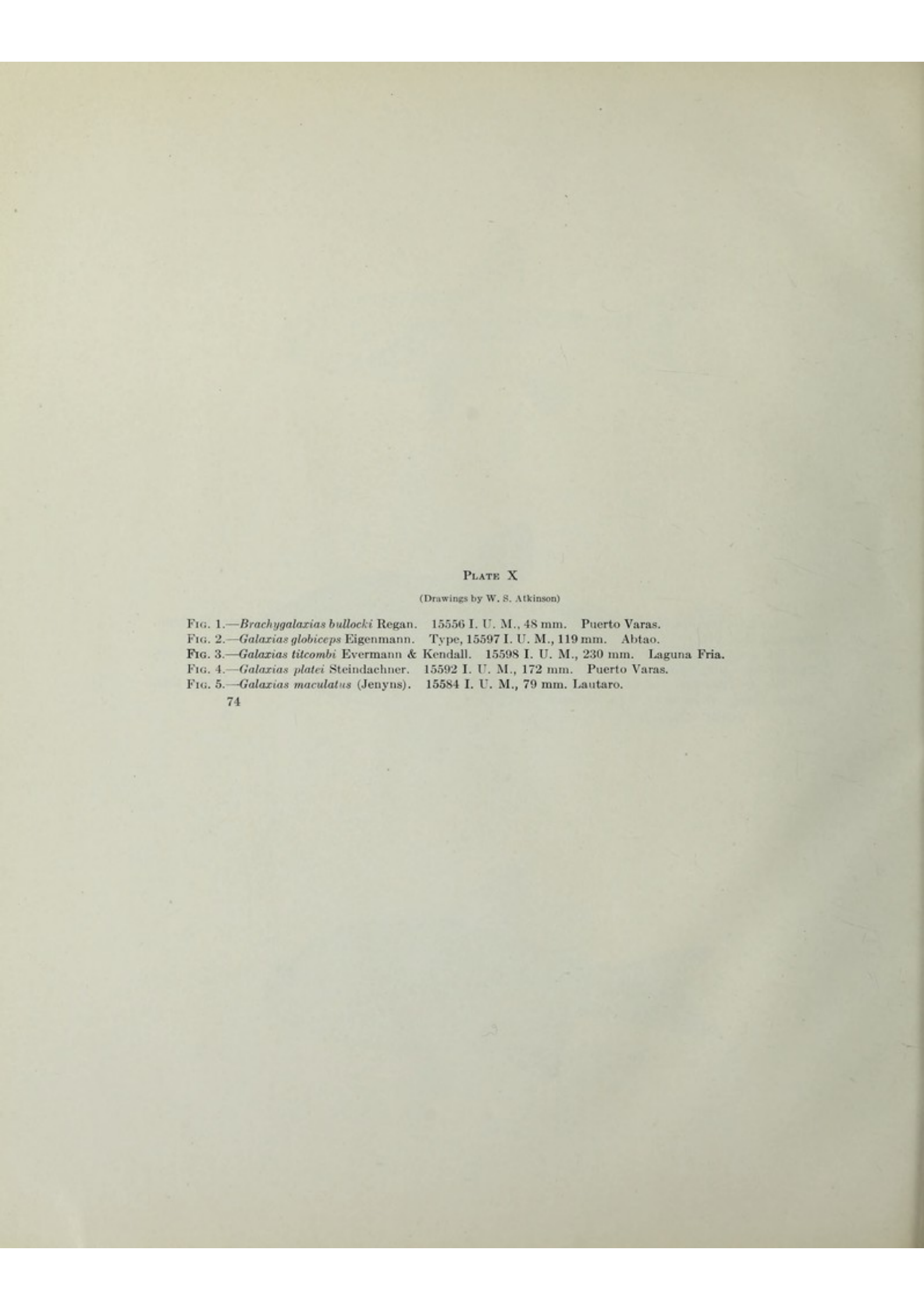
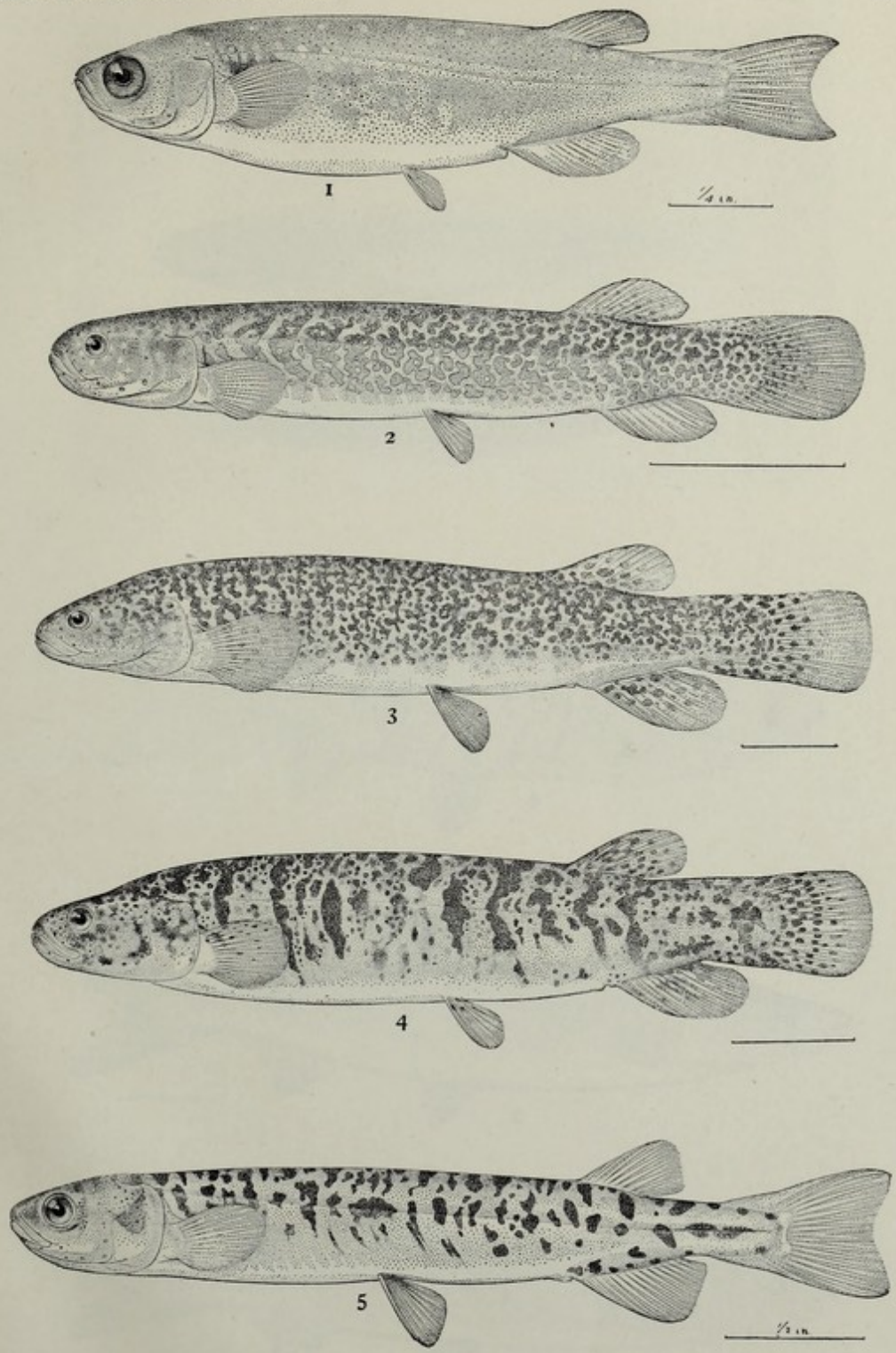


Fig. 1.—*Brachygalaxias bullocki* Regan. 15556 I. U. M., 48 mm. Puerto Varas.
Fig. 2.—*Galaxias globiceps* Eigenmann. Type, 15597 I. U. M., 119 mm. Abtao.
Fig. 3.—*Galaxias titcombi* Evermann & Kendall. 15598 I. U. M., 230 mm. Laguna Fria.
Fig. 4.—*Galaxias platei* Steindachner. 15592 I. U. M., 172 mm. Puerto Varas.
Fig. 5.—*Galaxias maculatus* (Jenyns). 15584 I. U. M., 79 mm. Lautaro.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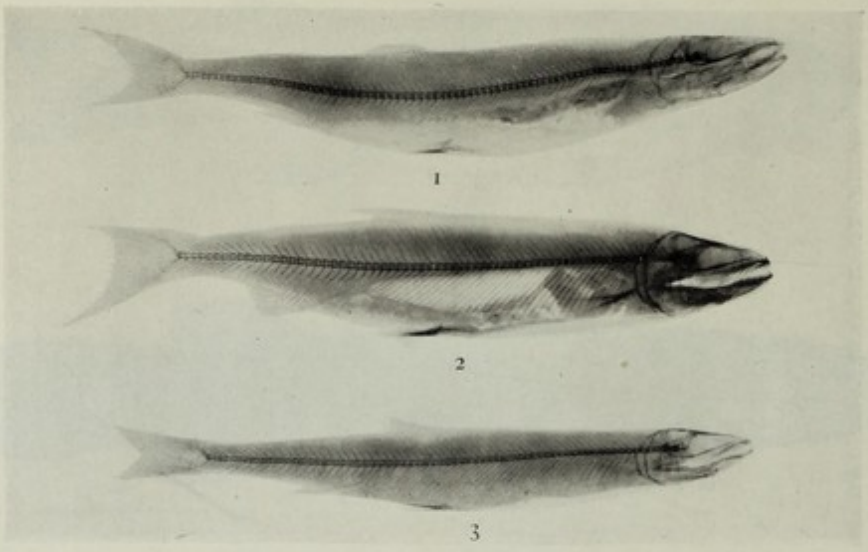

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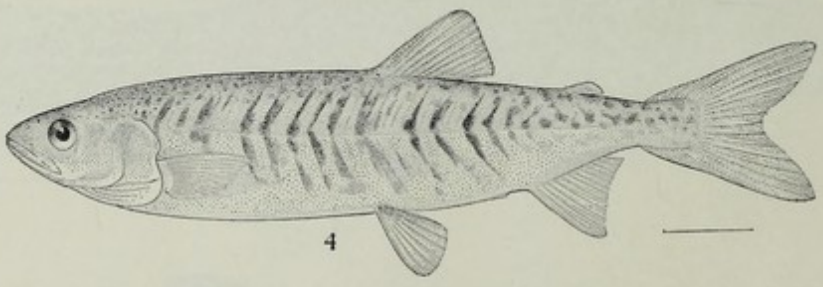

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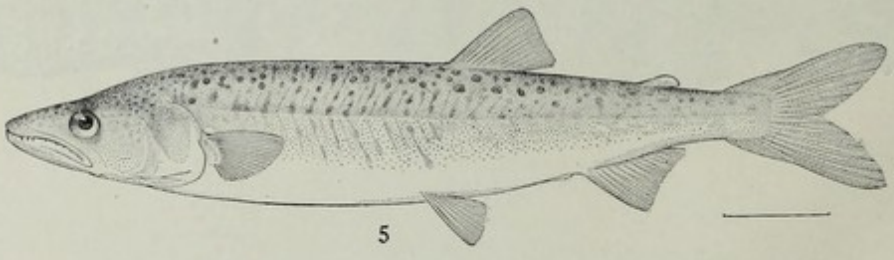

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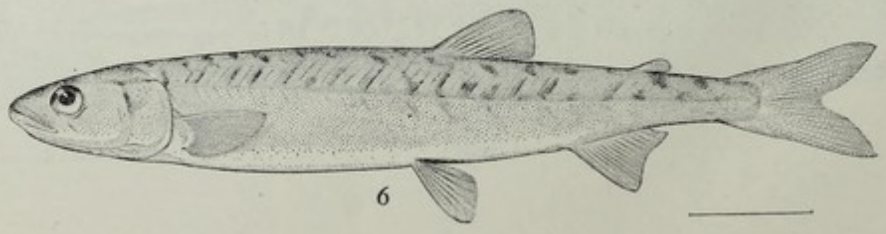

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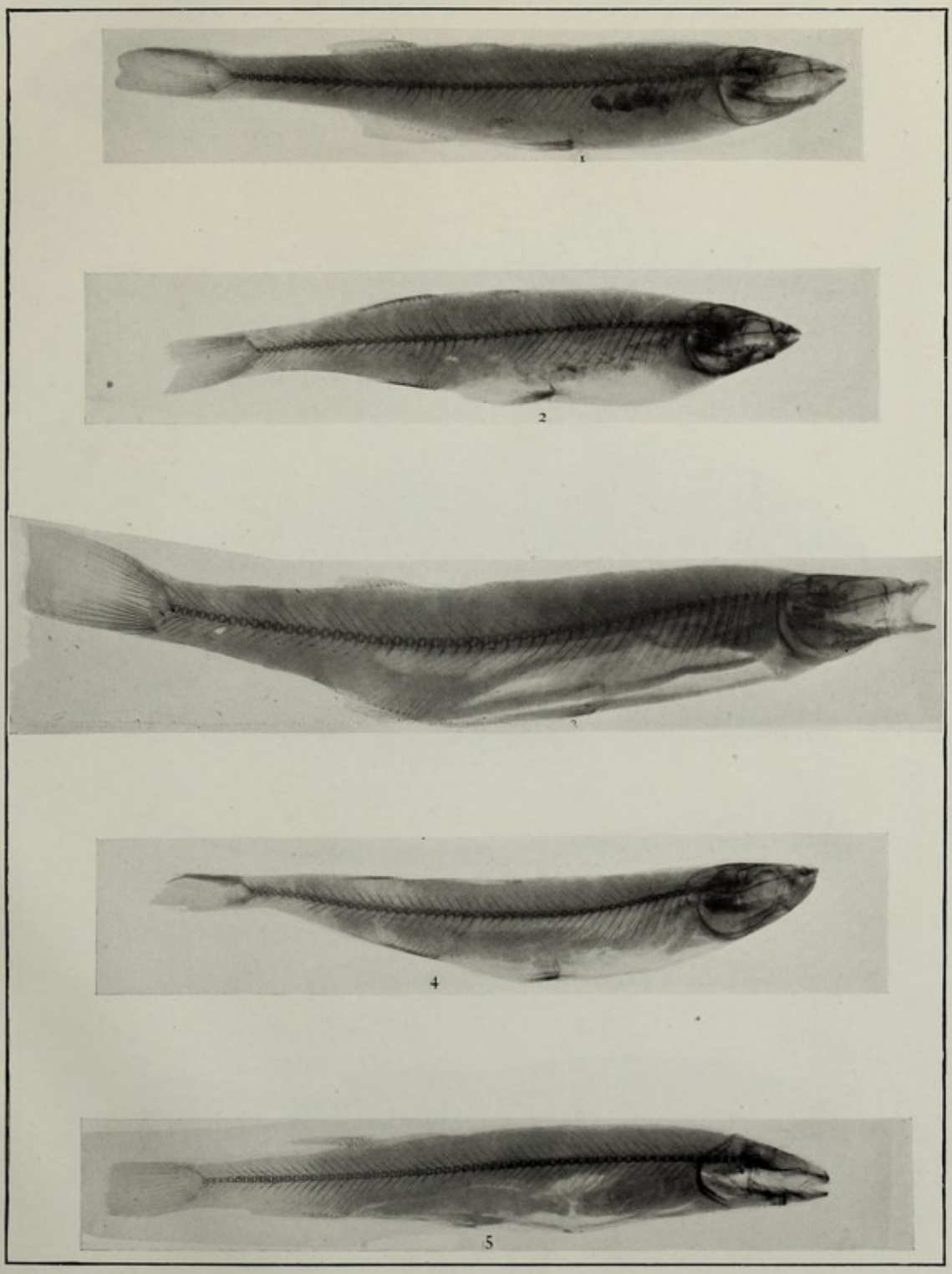
Plate XI

(Radiographs by Drs. Beeler and Cole; drawings by W. S. Atkinson)

Fig. 1.—*Aplochiton zebra* Jenyns. 15533 I. U. M. Estero Cutipai, below Valdivia.
Fig. 2.—*Aplochiton marinus* Eigenmann. 15536 I. U. M. Cutipai.
Fig. 3.—*Aplochiton taeniatus* Jenyns. 15542 I. U. M. Puella.
Fig. 4.—*Aplochiton zebra* Jenyns. 15535 I. U. M., 211 mm. Estero Cutipai.
Fig. 5.—*Aplochiton marinus* Eigenmann. Type, 15535 I. U. M., 211 mm. Estero Cutipai.
Fig. 6.—*Aplochiton taeniatus* Jenyns. 15542 I. U. M., 180 mm. Puella.

Plate XII

Fig. 1.—*Patagonina hatcheri* (Eigenmann). 15199 I. U. M. Puerto Blest, Lake Nahuel-Huapi.
Fig. 2.—*Cauque mauleanum* (Steindachner). 15187 I. U. M. Valdivia.
Fig. 3.—*Basilichthys australis*, Eigenmann. 15553 I. U. M. Santiago market.
Fig. 4.—*Austromenidia regia* (Humboldt). 15191 I. U. M. Laguna Fria.
Fig. 5.—*Galaxias titcombi* (Evermann & Kendall). 15598 I. U. M. Laguna Fria.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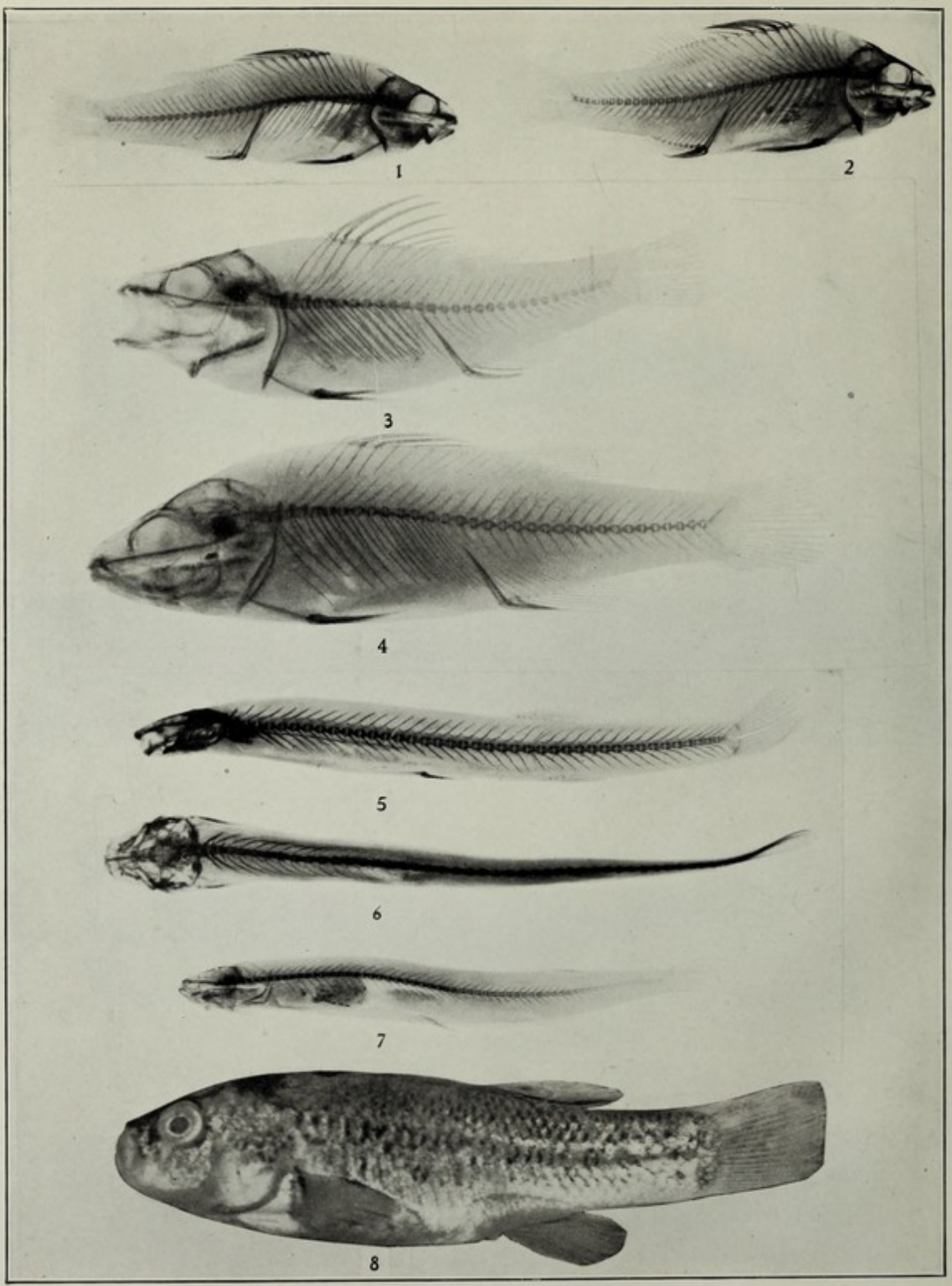
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Plate XIII

Fig. 1.—*Percilia gillissi* Girard. 15517 I. U. M. Hospital.
Fig. 2.—*Percilia irwini* Eigenmann. 15514 I. U. M. Estero Nonguen.
Fig. 3.—*Percichthys melanops* Girard. 15554 I. U. M. Estero Nonguen.
Fig. 4.—*Percichthys trucha* (Cuvier & Val.). 15573 I. U. M. Peulla.
Figs. 5 and 6.—*Pygidium chiltoni* Eigenmann. 15059 I. U. M. Estero Nonguen.
Fig. 7.—*Galaxias globiceps* Eigenmann. 15597 I. U. M. Abtao.
Fig. 8.—*Orestias agassizii* Valenciennes. 15347 I. U. M. Lake Ascotan.

PLATE XIV

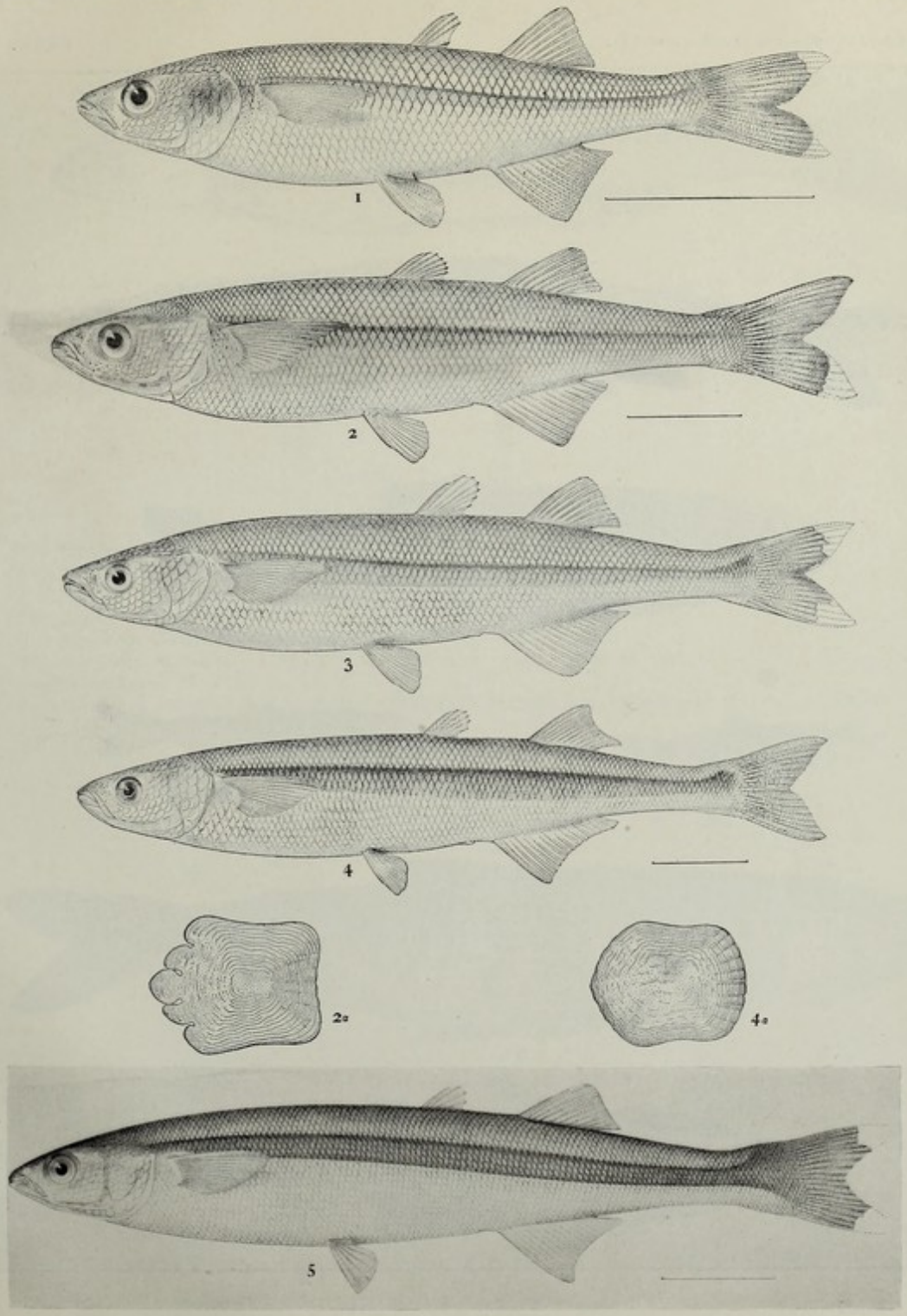
FIG. 1.—*Cauque brevianalis* (Günther). 15221 I. U. M., 92 mm. La Serena.

FIG. 2.—*Cauque mauleanum* (Steindachner). 15197 I. U. M., 180 mm. Lake Llanquihue. 2a. Characteristic scale of the same.

FIG. 3.—*Cauque wiebrichi* Eigenmann. 15202 I. U. M. Type, 217 mm. Valdivia market.

FIG. 4.—*Austromenidia regia* (Humboldt). 15191 I. U. M., 200 mm. Callao, Peru. 4a. Scale of the same.

FIG. 5.—*Basilichthys australis* Eigenmann. 15215 I. U. M., 169 mm. to base of caudal. Valdivia.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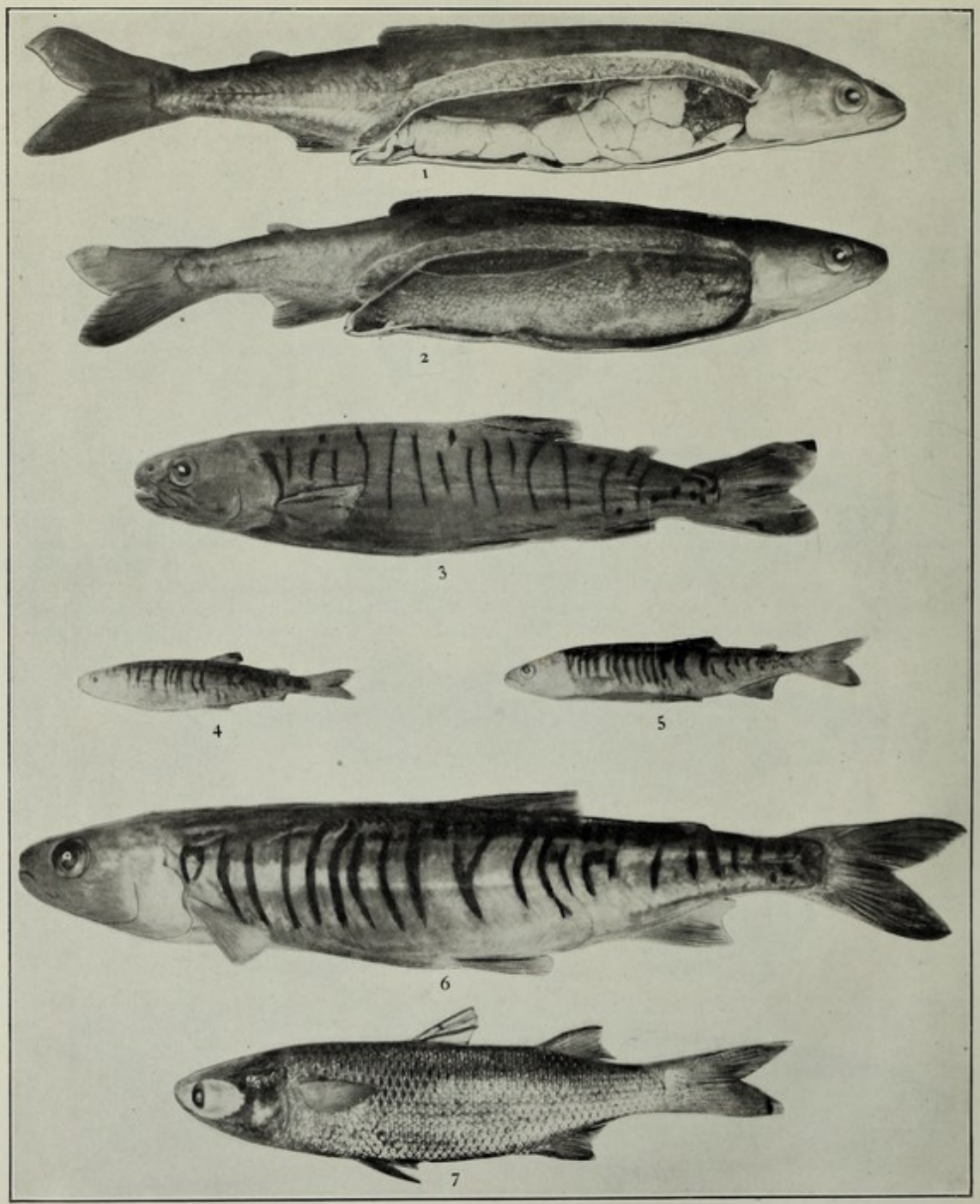
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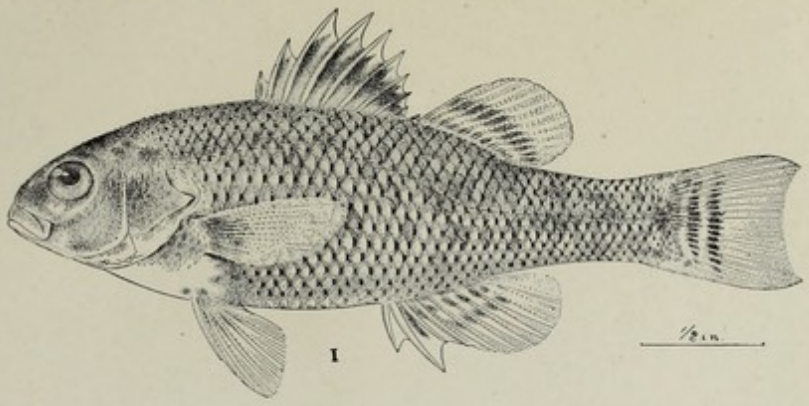
Plate XV

Aplochiton zebra Jenyns

Fig. 1.—Ripe male. 15532 I. U. M., 87 mm. long. Lake Rinihue. March 16, 1919.
Fig. 2.—Ripe female. 15532 I. U. M., 177 mm. long. Lake Rinihue. March 16, 1919.
Fig. 3.—15531 I. U. M., 150 mm. Falls of Petrohué.
Fig. 4.—Color variation. 15527 I. U. M., 155 mm. Abtao.
Fig. 5.—Color variation. 15527 I. U. M., 195 mm. Abtao.
Fig. 6.—Color variation. 15533 I. U. M., 277 mm. Estero Cutipai. Below Valdivia. (See radiograph of the same specimen, Plate XI, fig. 1.)
Fig. 7.—*Mugil rammelsbergii* Tschudi. 15345 I. U. M., 173 mm. Chucarati, Rio Tambo, Peru.

Plate XVI

Fig. 1.—*Percilia irwini* Eigenmann. Type, 15514 I. U. M., 96 mm. Rio Nonguen.
Fig. 2.—*Percichthys melanops* Girard. 15555 I. U. M., 147 mm. Rio Nonguen.
Fig. 3.—*Percichthys trucha* Cuvier & Valenciennes, 15562 I. U. M., 278 mm. Laguna Fria.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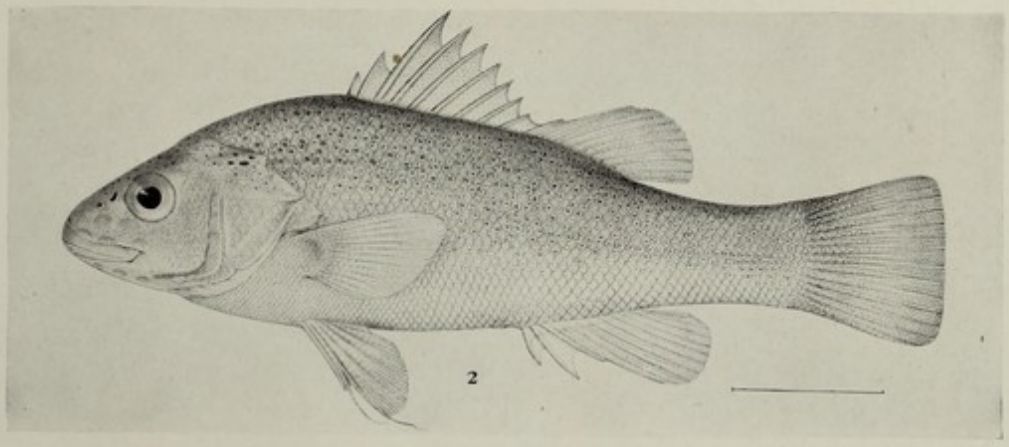
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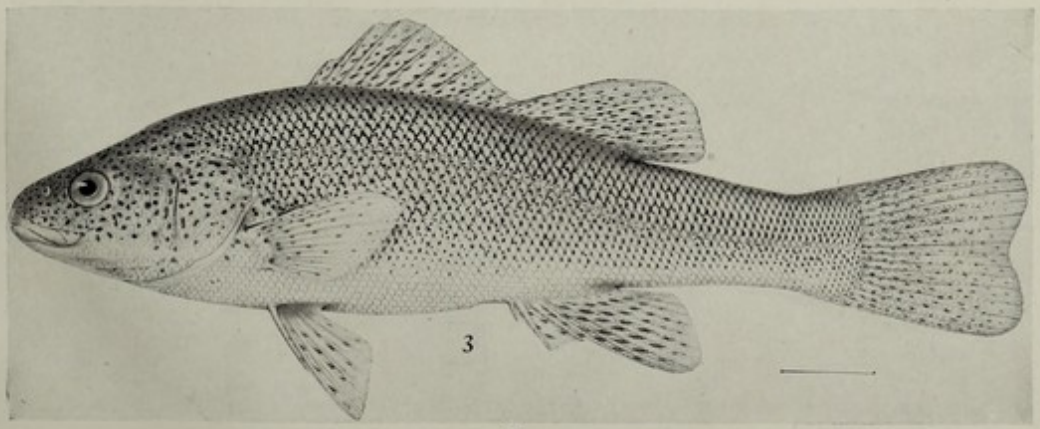
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