Memoirs of the Museum of Comparative Zoölogy
AT HARVARD COLLEGE.
Vol. XLIII. Part 1.

THE AMERICAN CHARACIDAE.

BY

CARL H. EIGENMANN.

WITH SIXTEEN PLATES.

CAMBRIDGE, U. S. A.:
Printed for the Museum.
August, 1917.

THE AMERICAN CHARACIDAE.[1]

INTRODUCTION.

The revision of the American Characidae, based on the collections of the Nathaniel Thayer Brazilian Expedition in the Museum of Comparative Zoölogy was commenced by Mrs. Rosa Smith Eigenmann and myself in 1888. A little more than a year later the work was temporarily suspended. The published results, so far as obtained, are enumerated on p. 8–10. Work was resumed in 1903 with the collections of Indiana University and of the United States National Museum, and a monograph completed in 1906.

Types in several museums in London, Paris, and Vienna were examined in 1906 and 1907. In 1907 the study of the collections made by the Thayer Expedition was renewed. This material made it necessary to rewrite the entire monograph, for, forty years after it was gathered, it was still the most important collection of South American fresh-water fishes, and contained a large number of undescribed species and genera.

The revised monograph, through the Tetragonopterinae, was finished in the spring of 1908. During the preparation of this revision it became apparent that the material at my command, from several regions of South America, was deficient. To obtain material from one of these regions, I spent the autumn of 1908 in British Guiana. Volume 5 of the Memoirs of the Carnegie Museum contains a detailed account of this Guiana Expedition.

In May, 1909, my position of Curator of Ichthyology in the Carnegie Museum placed me in charge of another large series of South American fresh-water fishes. This collection was made under my general direction, between November 6, 1907 and January 10, 1910, by Mr. John D. Haseman, one of my former students. For the most part it came from areas not covered by the Thayer Expedition. The Director of the Carnegie Museum, Dr. W. J. Holland, has kindly allowed me to incorporate in the present monograph the results obtained from a study of the Carnegie collections.

[1] Contribution from the Zoölogical Laboratory of Indiana University, No. 98.

Still later (December 1911–April 1912) I made extensive collections in Colombia; and in the early part of 1913 two of my students, Mr. Arthur M. Henn and Mr. Charles Wilson, gathered many fishes in the streams of western Colombia. Mr. Henn remained in South America till 1914 and extended the explorations to western Ecuador. Smaller collections were made by Miss Lola Vance in the streams about Tarma, Peru, and by Dr. Ellis and Dr. William Tucker in British Guiana. The collections of the Yale-National Geographic Society Expedition to the Urubamba River have also been available in the preparation of this monograph.

These different collections admirably supplement each other. They are the most extensive collections that have ever been brought together from South America. In the number of specimens at my disposal they far exceed the combined collections recorded in all other museums of the world.

The number of American species of Characins exceeds six hundred; and as they offer some of the best material to demonstrate several facts of evolution it is hoped to illustrate the species quite thoroughly. To provide for the illustrations of the Tetragonopterinae I am indebted to the Trustees of the Elizabeth Thompson Science Fund for an appropriation of $250.00, and to the Trustees of the Bache Fund for a similar amount. The Carnegie Museum and Mr. H. W. Fowler have granted the reproduction of a number of figures.

The portion of the monograph dealing with Hemigrammus, Hyphessobrycon, and Hasemania was prepared with the collaboration of Marion Lee Durbin, now Marion Durbin Ellis.

This Memoir deals with the Tetragonopterinae,[1] Rhoadsinae, Glandulocaudinae, Iguanodectinae, Stethaprioninae, and Stichanodontinae. All of the then known species of these subfamilies, except the species of Stevardia, were included by Günther (Cat. fishes Brit. Mus., 1864, 5) in the Tetragonopterinae. There are recognized in this Memoir fifty-two genera, and three hundred and twelve species. Over half of these were described during the course of the preparation of the Monograph.

The subfamily Tetragonopterinae, at present the dominant group of tropical American fishes, was defined by Günther (*loc. cit.*) to include Piabucina, Alestes, Brachyalestes, Chirodon, Chalceus, Brycon, Chalcinopsis, Chalcinus, Gasteropelecus, Piabuca, and Agoniates, besides the genera listed below. Eliminating these genera, which are now relegated to various separate subfamilies

[1] The portion of the Monograph dealing with the Cheirodontinae appeared recently in the Memoirs Carnegie Museum, 1916, **7**, p. 1–99, pl. 1–17.

or which (Alestes and Brachyalestes) are geographically extra-limital, there remain: — Tetragonopterus, with thirty-two species; Scissor, with one species; Pseudochalceus, with one species; Bryconops, with two species; Creagrutus, with one species; making a total of five genera, with thirty-seven species.

Of the Iguanodectinae, which were included in Günther's Tetragonopterina, he recorded two species belonging to the genus Piabuca.

He recorded four species of Corynopoma and placed them in his Erythrinina. They are the *Stevardia albipinnis* considered below in the discussion of the new subfamily, Glandulocaudinae.

In the last general review of Günther, there were a grand total of seven genera and forty-three species, as compared with the fifty-two genera and over three hundred species, known today.

SOURCES OF THE MATERIAL.

The Nathaniel Thayer Brazilian Expedition.

In January 1807, Karolina, Archduchess of Austria, was married to the Crown Prince of Brazil. In the retinue accompanying the young couple to Brazil went Johann Natterer of Wien. Natterer remained in Brazil for eighteen years and collected extensively from Rio de Janeiro to Cuyaba, thence down the Madeira to the Amazon and up the Rio Negro and Rio Branco. Taking advantage of the opportunity, the King of Bavaria sent two naturalists, Johann Baptist von Spix and Carl Friedrich von Martius with the bridal party. They also collected natural history specimens. The routes of travel of Natterer and of Spix and Martius are shown on Plate 1.

The fishes collected by Natterer were described by Heckel, Kner, and Steindachner. Those collected by Spix and Martius were being described by Spix when he died. Louis Agassiz, then a student at the University of Munich, was selected to complete the work of Spix. Agassiz's work resulted in a sumptuous folio, and a desire to personally inspect the fauna of Brazil, a desire fulfilled forty years later. In 1865, the generosity of Mr. Nathaniel Thayer made it possible for Agassiz to undertake his journey to Brazil.

The assistants of the Thayer Expedition were James Burkhardt, *artist*, J. G. Anthony, *conchologist*, C. F. Hartt, and Orestes St. John, *geologists*, J. A. Allen, *ornithologist*, and George Sceva, *preparator*. Besides these assistants

several volunteers accompanied the Expedition: these were Edward Copeland, Newton Dexter, Walter Hunnewell, William James, Stephen Van Rensselaer Thayer, and Thomas Ward.

Agassiz had the further assistance of the Brazilian Government through the Emperor, Dom Pedro II. Among Brazilians who joined the Expedition or aided in other ways were Major Coutinho, Messrs. Vinhas, Bourget, Talisman, Dr. Justa, Couto de Magalhaês, and others.

The Expedition started late in March, 1865, and landed at Rio de Janeiro on April 22nd. Three months were spent about Rio. On July 25th Agassiz with Coutinho, Burkhardt, Bourget, Hunnewell, and James, joined later by Dexter and Thayer, went along the coast to Bahia (July 28th), Pernambuco (31st), Parahyba do Norte (August 2nd), Ceará (4th), Maranham (6th) and Para (11th). On August 20th the party started up the Amazon. It was divided in various ways. One or two of the assistants were left, or sent to some place to collect for longer or shorter periods to rejoin the main party at times. The itinerary up the Amazon was:—

August 20, 1865. Start up the Amazon. *20.* Breves. *21.* Tajapuru. *22.* Gurupa. *23.* Porto do Moz. *25.* Montalegre. (Monte Alégre). *26.* Santarem (Dexter, James, and Talisman, a young Brazilian start up the Tapajos from here; Bourget and Hunnewell remain at Santarem. They rejoin the Expedition at Manaos). *September 1.* On an arm of the Rio Ramos, connecting the Amazons, through the Mauhes, with the Madeira. *3.* Return to steamer at Villa Bella. *4.* Manaos. *10.* Leave Manaos. *13.* Coari. *14.* Teffé. *15.* Fonte Bôa. *17.* San Paolo. *18.* Tabatinga. Bourget remains at Tabatinga. *20.* Left Tabatinga. James and Talisman remain at San Paolo to ascend the Içа. *20.* Left Fonte Bôa again. *21.* Teffé again — take up residence on Lake Teffé. Sitio. most remarkable catch in Forest Lake. *October 17.* James and Talisman returned from Içа, and Jutahy. About Oct. 21, left Teffé. Verge of rainy season. Bourget returns from Tabatinga. *23.* Reach Manaos. *27.* Go to Lake Hyanuary. *29.* Return to Manaos for a six weeks' stay. *December 6.* Thayer returns from Lago Alexo, Bourget and Thayer from Cudajas, James from Manacapuru, Coutinho from Lake Hyanuary, José-Fernandez, Curupira, etc. *10.* Dexter and Talisman returned from Rio Branco. Water too high. Leave for Mauhes on war vessel. *14.* Mucaja-Tuba. *16.* Mauhes. *20.* Leave Mauhes. *25.* Manaos. *27.* Leave Manaos to ascend the Rio Negro. *29.* Pedreira. *31.* Manaos. *January 16, 1866.* Villa Bella and Mauhes again. *18.* Lago Maximo. *20.* Leave Villa Bella. *21.* Obidos. *22.* Santarem at the mouth of the Tapajos. *26.* Monte Alégre. Trip to Serra Erere. *29.* Leave Monte Alégre. *About 30.* Porto do Moz on the Xingu: Vinhas brings collections from above and below the cascades of the Xingu. *February 1.* Gurupa. *2.* Tajapurú. *4.* Reached Para. *March 26.* Leave Para for Rio de Janeiro. *April 2.* An inland excursion at Ceará. *6.* Pacatuba and the region about it. *11.* Ceará. *16.* Leave Ceará for Rio. *July 2.* Sail for home.

During Agassiz's trip up the Amazon with his immediate assistants, the rest of his party was divided to collect in the rivers of eastern Brazil from Rio de Janeiro to Para. "One object was kept constantly in view throughout this

Expedition,— namely, that of ascertaining how the freshwater fishes are distributed throughout the great river systems of Brazil."

The routes of the separate parties are indicated on Plate 1. Hartt and Copeland collected in the lower courses of the rivers from the San Francisco to Rio de Janeiro.

They left Rio de Janeiro on June 19. They visited the lower courses of the Parahyba collecting at Campos and San Fidelis and ascended the tributary Muriahy. From San Fidelis they crossed the divide to the Itabapuana and descended that stream to its mouth going thence via the Rio Itapemerim, Rio Novo,[1] and Guarapary to Victoria. On a subsequent journey from Rio they ascended the Rio Doce for ninety miles to the first fall at Porto de Souza and collected also at Linhares in the Rio Doce and the lake and river Juparana. From Linhares they went to San Matheus and the Rio Mucury in which they collected at its mouth, Porto Alegre[2] and some distance inland at Santa Clara. From Santa Clara they went to Philadelphia collecting on the way in the Rio Urucu and thence to Calhoa and Minas Novas both on the Arassuahy. They separately descended the Rio Jequitinhonha, three hundred and sixty miles to the sea. They collected next at Cannavierias and ascended the Rio Pardo to its fall. Collections were also made at Belmonte, Santa Cruz and Porto Seguro on the coast south of the Rio Jequitinhonha. They then visited Bahia and returned to Rio de Janeiro.[3]

St. John, Allen, Ward, and Sceva went from Rio de Janeiro to the Rio Parahyba and Juiz de Fora, across the Serra do Mantequeira to Barbacena. They collected at Rodeio, Rio Macacos, a tributary of the Santa Anna, State Rio de Janeiro. Ward left the party at Barbacena and went over Ouro Preto and Santa Barbara to Diamantina "passing from one river-basin to another in order to examine as many of the tributaries of the Rio Doce and the Jequitinhonha as possible." Ward then crossed the San Francisco at Januaria and went to the Tocantins which he followed to its junction with the Amazon. St. John, Ward, and Allen continued *via* Logoa Dourada and Pradas across the Rio Carandahy and Rio Paraopeba to Sabura (Rio Macacos, into Rio San Francisco), Santa Luiza, Lagoa Santa, Sete Lagoas and Gequitiba. Sceva remained about Lagoa Santa and later went via Rio de Janeiro to Canto-Gallo.

St. John and Allen went down the San Francisco to Januaria. Here

[1] Note also another Rio Novo in Haseman's itinerary, p. 10.

[2] Not the Porto Alegre, Rio Grande do Sul where von Ihering and Haseman collected.

[3] Collections were made by Hartt in the Rio San Francisco below the fall either at this time or on a later trip. Hartt and Copeland sent in specimens recorded as from Jacurpe and Posuca, localities I have not been able to locate.

Allen, on account of his health, was compelled to leave the Expedition. St. John followed the San Francisco to Villa do Barra then went by land through the valley of the Rio Grande, a tributary of the San Francisco to Santa Rita, "thence to Mocambo and across the table-land separating the basin of the Rio San Francisco from that of the Rio Paranahyba." He collected in the Basin of the Rio Paranahyba at Paranagua, Manga, San Gonçallo, and Therezina. Near the latter place he collected in the Rio Poty or Puty a tributary of the Rio Paranahyba. From Therezina he crossed the divide to Caxias on the Itapicurú which empties into the ocean at Maranham.[1] He reached the latter place on January 8, 1866.

The collection of fresh-water fishes made by Louis Agassiz and his assistants is the largest ever brought together by a single expedition. The hope of Agassiz to complete the work on the fishes was not realized, the very wealth of material making a comprehensive report almost herculean. Dr. Franz Steindachner, Hofrat and Intendant of the K. K. Naturhistorisches Hofmuseum, Wien, who has written extensively concerning the collections made by Natterer, obtained leave of absence from May 1870 until June 1873. During this time he accompanied Professor Agassiz on the Hassler Expedition, December 1871 to August 1872, and devoted more than two years to the study of the fishes secured during the Thayer Expedition which he considered "without any exaggeration the richest and most complete in the world."

The following papers are based wholly or in part on the Thayer Brazilian collection:

Agassiz, Louis and Mrs. E. C. A journey in Brazil. Boston, 1868.

Eigenmann, C. H. The evolution of the catfishes. Zoe, 1890, **1**, p. 10–15.

On the presence of an operculum in the Aspredinidae. Amer. nat., 1892, **26**, p. 71.

Steindachneria. Amer. nat., 1897, **31**, p. 158–159.

New genera of South American freshwater fishes, and new names for some old genera. Smith. misc. coll., 1903, **45**, p. 144–148.

Eigenmann, C. H. and R. S. A list of the American species of Gobiidae and Callionymidae, with notes on the specimens contained in the Museum of Comparative Zoölogy, at Cambridge, Massachusetts. Proc. Cal. acad. of sci., 1888, ser. 2, **1**, p. 51–78.

American Nematognathi. Amer. nat., 1888, **22**, p. 647–649.

Preliminary notes on South American Nematognathi, I. Proc. Cal. acad. sci., 1888, ser. 2, **1**, p. 119–172.

Preliminary descriptions of new species and genera of Characinidae. West Amer. sci., 1889, **6**, p. 7–8.

[1] There is another river Itapicurú emptying into the ocean between the bay of Bahia and the mouth of the San Francisco, in which Dr. Haseman made extensive collections, (p. 10).

Description of new nematognathoid fishes from Brazil. West Amer. sci., 1889, **6**, p. 8–10.

Preliminary notes on South American Nematognathi, II. Proc. Cal. acad. sci., 1889, ser. 2, **2**, p. 28–56.

A review of the Erythrininae. Proc. Cal. acad. sci., 1889, ser. 2, **2**, p. 100–116, pl. 1.

A revision of the edentulous genera of Curimatinae. Ann. N. Y. acad. sci., 1889, **4**, p. 409–440.

A revision of the South American Nematognathi or catfishes. Occ. papers, Cal. acad. sci., 1890, **1**, p. 1–508, pl. 1.

A catalogue of the freshwater fishes of South America. Proc. U. S. N. M., 1891, **14**, p. 1–82.

GARMAN, SAMUEL. On the species of the genus Chalcinus in the Museum of Comparative Zoölogy at Cambridge, Mass., U. S. A. Proc. Essex inst., 1890, **22**, p. 1–7.

On the species of Gasteropelecus. Proc. Essex inst., 1890, **22**, p. 8–10.

On the species of Cynopotamus. Proc. Essex inst., 1890, **22**, p. 11–14.

On the species of the genus Anostomus. Proc. Essex inst., 1890, **22**, p. 15–23.

On a genus and species of the Characines (Henochilus wheatlandii, gen. n. et sp. n.). Proc. Essex inst., 1891, **22**, p. 49–52, pl. 1.

The cyprinodonts. Mem. M. C. Z., 1895, **19**, p. 1–180, pl. 1–12.

JORDAN, D. S. and EIGENMANN, C. H. A review of the Sciaenidae of America and Europe. Rept. U. S. comm. fish., 1889, **14**, p. 343–452, pl. 1–4.

A review of the genera and species of Serranidae found in the waters of America and Europe. Bull. U. S. fish comm., 1888, **8**, p. 329–442.

STEINDACHNER, FRANZ. Die süsswasserfische des südöstlichen Brasiliens. Sitz. Akad. wissensch. Wien, 1875, **70**, abth. I, p. 499–538, pl. 1–6. Separate, p. 1–40, pl. 1–6.

Beiträge zur kenntniss der chromiden des Amazonenstromes. Sitz. Akad. wissensch. Wien, 1875, **71**, abth. I, p. 61–137, pl. 1–8. Separate, p. 1–77, pl. 1–8.

Ueber einige neue Brasilianische siluroiden aus der gruppe der doradinen. Sitz. Akad. wissensch. Wien, 1875, **71**, abth. I, p. 138–151, pl. 1–4. Separate, p. 1–14, pl. 1–4.

Die süsswasserfische des südöstlichen, Brasiliens. II. Sitz. Akad. wissensch. Wien, 1875, **71**, abth. I, p. 211–245, pl. 1–6. Separate, p. 1–35, pl. 1–6.

Beiträge zur kenntniss der der characinen des Amazonenstromes. Sitz. Akad. wissensch. Wien, 1875, **72**, abth. I, p. 6–24, pl. 1–2. Separate, p. 1–18, pl. 1–2.

Ichthyologische beiträge. IV. Sitz. Akad. wissensch. Wien, 1876, **72**, abth. I, p. 551–616, pl. 1–13. Separate, p. 1–65, pl. 1–13.

Ichthyologische beiträge. V. Sitz. Akad. wissensch. Wien, 1876, **74**, abth. I, p. 49–240, pl. 1–15. Separate, p. 1–190, pl. 1–15.

Die süsswasserfische des südöstlichen Brasiliens. III. Sitz. Akad. wissensch. Wien, 1876, **74**, abth., I, p. 559–694, pl. 1–13. Separate, p. 1–136, pl. 1–13.

Die süsswasserfische des südöstlichen Brasiliens. IV. Sitz. Akad. wissensch. Wien, 1877, **76**, abth. I, p. 217–230, pl. 1–2. Separate, p. 1–14, pl. 1–2.

Über einige neue und seltene fischarten, etc. Denk. Akad. wissensch. Wien, 1878, **41**, p. 1–52, pl. 1–9.

Beiträge zur kenntniss der flussfische Südamerika's, I. Denk. Akad. wissensch. Wien, 1879, **41**, p. 151–172, pl. 1–3. Separate p. 1–24, pl. 1–4.

Ichthyologische beiträge. VIII. Sitz. Akad. wissensch. Wien, 1880, **80**, abth. I, p. 119–191, pl. 1–3. Separate, p. 1–73, pl. 1–3.

Beiträge zur kenntniss der flussfische Südamerika's. II. Denk. Akad. wissensch. Wien, 1881, **43**, p. 103–146, pl. 1–7. Separate p. 1–46.
Beiträge zur kenntniss der flussfische Südamerika's. III. Denk. Akad. wissensch. Wien, 1881, **44**, p. 1–18, pl. 1–5. Separate, p. 1–18, pl. 1–5.
Beiträge zur kenntniss der flussfische Südamerika's. IV. Denk. Akad. wissensch. Wien, 1882, **46**, p. 1–44, pl. 1–7. Separate, p. 1–44, pl. 1–7.

The Carnegie Museum Expedition to Central South Amreica.

A detailed account of this Expedition is given in volume 9 of the Annals of the Carnegie Museum.

During this Expedition Mr. Haseman collected at the following localities:—

November 6, 1907. Rio Coitc, into the Rio Salitre, into Rio San Francisco. *6.* Rio Aqua Branca, into Rio Itapicurú. *7.* Rio Ipema, into Rio Itapicurú. Rio Lamaras, small creek into Rio Itapicurú. Rio Zinga, small creek into Rio Itapicurú. *8.* Rio Itapicurú Grande, headwater of Rio Itapicurú. Rio Paiaia, into Rio Itapicurú. Rio de Jacobina, into Rio Itapicurú. *10.* Lagoa Salgado — Rio Salitre into Rio San Francisco. *11.* Bom Fim, Rio Amaratú, into Rio Itapicurú. *12.* Saã Thome, Rio Salitre, into Rio San Francisco. *14.* Rio Salitre, into Rio San Francisco. Baixa Grande, Rio Paqui into Rio Salitre, into Rio San Francisco. Rio Paqui, into Rio Salitre near Baixa Grande. *21.* Finca Amaratú, Rio Itapicurú. Creek on farm emptying into Rio Itapicurú Mirim. *27, 28.* Joazeiro, Rio San Francisco. *December 6.* Barra, fork of Rio San Francisco and Rio Grande. *December 12, 18.* Januaria, Rio San Francisco. *15.* Cachoeira de Pirapora, Rio San Francisco. *23.* Lagoa de João Pereira Barra, Rio San Francisco. *24.* Lagoa de Porto, near Barra, Rio San Francisco.

January 4, 1908. Lagoa Barreiras, Rio San Francisco. *6–9.* Boqueirão, Rio Grande of Rio San Francisco Basin. *16.* Lagoa Parnagua or Paranagua, Paranahyba Basin. *24.* Santa Rita de Rio Preto, into Rio Grande, into Rio San Francisco. *27.* Rio Preto, ten miles below fork of Rio Sapão. *February 4.* Cachoeira da Velha, Rio Novo, into Rio Somno, into Tocantins. *6.* Stromé, Rio Somno. Headwaters. *11.* Rio Sapão, into Rio Preto, into Rio San Francisco. Near Prazer. *15.* Rio Preto, into Rio Grande, into Rio San Francisco. *23, 24.* Barra, Rio San Francisco. *March 2.* Queimadas, Rio Itapicurú. *4.* Alagoinhas, Rio Catu. *5.* Rio Itapicurú, 12 miles from Timbo. *11, 13.* About Bahia; *22,* Penedo, mouth of Rio San Francisco. *30.* Propria, Rio San Francisco. *April 2.* Penedo. *6.* Maceio, on the coast. *7.* Penedo. *10.* Acaraju. *14.* Cachoeiro, Rio Paraguassu. *May 4.* Sete Lagoas, into Rio das Velhas, into Rio San Francisco. *10, 11, 13.* Creek, ponds, mountain rills near Rio das Velhas. *14.* Miguel Burnier, headwaters of Rio das Velhas and tributary of Paraopeba. *19.* São João del Rey, Rio das Mortes, into Rio Grande, into Rio Paraná. *21.* Sitio, Rio das Mortès. *22.* Serraria, Rio Parahybuna, into Rio Parahyba. *24–28.* Creeks, pools, river at Rio Doce. *June 1–3.* Entre Rios, Rio Parahyba. *13–15.* Campos, Rio Parahyba. *16.* Lagoa Feia, south of mouth of Rio Parahyba. *18, 19.* Rio Itapemerim and swamp near Munez Freire. *23, 24.* São João da Barra, Rio Parahyba. *July 5.* Barra da Pirahy. *7, 8.* Bom Jardin, above and below falls, Rio Grande, into Rio Paraná. *9, 10.* Santa Rita de Jacutinga, Rio Preto, into Rio Parahyba. *12, 13.* Barra da Pirahy, Rio Parahyba. *14, 15.* Jacarehy, Rio Parahyba. *17, 20.* Mogy das Cruzes, Rio Tieté, into Rio Paraná. *23.* Piracicaba, Rio Tieté, into Rio Paraná. *23.*

Sapina, Rio Tieté, into Rio Paraná. Santos, coast of São Paulo. *25.* Alto da Serra, Rio Tieté, into Rio Paraná. *26, 28.* Mogy, into Santos Bay. Creek at base of mountains, ten miles from Santos. *29.* Piassaguera, near Santos. *29.* Santos. *31.* Rio Pilao, fifteen miles southwest of Santos and Cubatão, Rio Cubatão. Clear, swift and rocky creeks seven miles west of Santos. *August 7.* Mogy Mirim, into Rio Mogy Guassu, into Rio Grande, into Rio Paraná. Corrego de João de Deus. Twelve miles from Mogy Mirim. *14.* Rio Paranahyba, into Rio Paraná. *18, 19.* Jaguara, Rio Grande, into Rio Paraná. *25, 26.* Mogy Guassu, Rio Mogy Guassu, into Rio Grande, into Rio Paraná. *September 1.* Bebedouro, near Rio Grande, and Rio Paraná. *5–9.* Piracicaba, into Rio Tieté, into Rio Paraná. Above and below big falls. *14.* Salto de Avanhandava, Rio Tieté. *22.* Salto das Cruzes, Rio Tieté. *27.* Itapura, Rio Tieté; Ribcrão Azul, twelve miles from Tieté. *October 8.* Riberão Azul. *11.* Miguel Calmon; twenty miles east of Miguel Calmon. Bauhru, Rio Tieté. Salto Grande de Paranapanema, into Rio Paraná. *November 27.* Agua Quente, into Rio Ribeira da Iguapé. *28.* Cavernas das Areas. Sixteen miles southwest of Iporanga in Serra do Mar. *December 1.* Iporanga, Rio Ribeira da Iguapé. *5, 8.* Xiririca, Rio Ribeira da Iguapé. *15, 16.* Iguapé, Rio Ribeira da Iguapé. *22.* Serrinha Paraná, Rio Iguassú, into Rio Paraná. Rio das Mortes, into Rio Iguassú. Creek six miles west of Serrinha, with numerous falls. *27–29.* Porto União da Victoria, Rio Iguassú.

January 2–4, 1909. Morretes, on Marunby, into Rio Nhundiaquara, into ocean at Pranagua. *17–24.* Porto Alegre, Rio Grande do Sul, Rio Guahyba. *26–27.* Cachoeira Rio Jacuhy, into Lago dos Patos at Rio Grande do Sul. *29.* Santa Maria, Rio Vaccacahy-Mirim, into Rio Guahyba into Rio Jacuhy. *31.* Cacequy, Rio Ibacuhy, into Rio Uruguay. *February 1.* Cacequy. *5.* Uruguayana, Rio Uruguay. Rio Negro, Urnguay or Paso de los Torros, into Rio Uruguay. *17.* Arroyo Miguelete, Montevideo. *25, 27.* San Juan, Argentina. *March 4.* Rio Colorado, Argentina. Choel-choel, tributary of Rio Negro. *5.* Rio Negro. *6.* Muddy ponds twenty miles east of town of Colorado. *11.* Buenos Aires, Rio de Prata. *23.* Asuncion, Paraguay. *30.* Cerro de Lambaré, five miles below Asuncion in saline swamp. *31.* Bays in front of and near Asuncion. *April 2.* Sapucay, Paraguay. In mountain rills. *5.* Arroyo Poná near Sapucay. *7, 8.* Arequa, Laguna Ipacary. *11, 13, 14.* Villa Hays. *27.* Urucum Mountains, 25 miles back of Corumba. *28.* Corumba. *May 2.* Urucum Mountains. *6, 7.* Puerto Suarez, 15 km. from Corumba. *9.* Corumba. *23–27.* São Luiz de Caceres, Matto Grosso. *June 2, 3.* Campos Alégre, Rio Jauru, into Rio Paraguay. San Matias, Bolivia, into Rio Paraguay. *10.* Rio São Francisco, into Rio Paraguay. *12.* Rio Santa Rita, into Rio Paraguay. *13.* Rio Petas, Bolivia, into Rio Paraguay. 16. Rio Boa Ventura, into Rio Guaporé. *21, 27.* Posada, into Rio Guaporé, about 40 miles south of Villa de Matto Grosso. *26, 28.* Bastos, Rio Alegre, into Rio Guaporé. *July 8.* Below Rio Paragahu, in Rio Guaporé. *23.* Sixty miles above San Antonio de Guaporé. *July 29–August 13.* San Antonio de Guaporé. *August 28.* Rio Machupo, Bolivia, into Rio Guaporé. Twenty miles below San Joaquin. *September 4–7.* San Joaquin, Bolivia. Rio Machupo. Lake one mile west of town and mud-hole near town. *14, 15.* Berlin, Rio Mamoré. *19.* Rio Mamoré, below mouth of Rio Guaporé. *28.* Guaja-ussu, Rio Madeira. *30.* Palo Grande, Rio Mamoré. In rapids under stones. *October 5.* Villa Bella, Bolivia, Rio Beni, into Rio Madeira. *13.* Cachoele de Theotonio, Rio Madeira. Whirlpools. *17.* Cachoele de Ribeirão, Rio Madeira. *26.* Cachoele de Girão, Rio Madeira. Whirlpools. *November 2, 3.* São Antonio de Rio Madeira. *15, 19, 25, 27–29.* Manaos, mouth of Rio Negro. *30.* Igarapé de Cachoeira Grande, two miles out of Manaos. *December 2.* Manaos. *4.* Ten miles above Manaos on Rio Negro. *6, 8.* Santarem, Rio Tapajos. *7.* Swampy pools of Amazon and Rio Tapajos opposite Santarem. *9.* Upper end of island, Amazon, four miles above Santarem. *10.* Tapajos, in

hollow logs — Amazon, one mile above Santarem. *11*, *19*. Igarapé de Jrura entering Rio Tapajos, two miles above Santarem. *12*. Igarapé de Maica, four miles below Santarem. *14*. Tapajos in front of Santarem. *15*. Island in Amazon, three miles above Santarem. *20*. Rio Tapajos at Santarem. *21*. Amazon. Half-way between Santarem and Para. *24*. Para market. *27*. From Gran Para between Belem and Salinas. *29*. Bragança, Rio Caete. 16 kilometers from ocean, 162 from Para. *January 1, 1910*. Salt water, mouth of Rio Caete. *10*. Alcobaca, Tocantins. Below first falls. *15–22*. Para market.

The Guiana Expedition.

The joint Expedition of the Indiana University and the Carnegie Museum, led by myself, collected in British Guiana, between September 9 and December 1, 1908. A detailed account of the results of this Expedition is published as volume 5 of the Memoirs of the Carnegie Museum. The localities, enumerated from east to west are:— Maduni Stop-Off, Lama Stop-Off, Cane Grove Corner, the Georgetown Trenches, Morawhanna, Mora Passage, and Koriabo and Issorora Rubber Plantations, all in low tidal land; Christianburg, Wismar, and Malali, the latter about one hundred miles from its mouth, on the Demerara River and Bartica, Rockstone, Gluck Island, Crab Falls, Konawaruk, Warraputa Cataract, and Packeoo Fall, all on the middle course of the Essequibo River. A special effort was made to get a complete series from the Potaro River both above and below the seven hundred and forty-one foot Kaieteur Fall. Collections were made between October 6 and November 4, 1908, at Aruataima, Holmia, and Savannah Landing above the Kaieteur and at Shrimp Creek, Tukeit, Waratuk, Amatuk, Erukin, Kangaruma, Potaro Landing, and Tumatumari below the Kaieteur. Mr. William Grant my Indian guide sent in additional collections from the Rupununi and the Ireng Rivers. The first series of specimens of this Expedition is in the Carnegie Museum, the second series in Indiana University. Other series are in the Museum of Comparative Zoölogy, the U. S. National Museum, the Field Museum, Stanford University, the British Museum, the Museums at Amsterdam, Berlin, Vienna, and Georgetown, British Guiana.

The Gimbel Expedition.

Through the generosity of Mr. Jake Gimbel of Vincennes, Indiana, Dr. Max Mapes Ellis and Dr. William M. Tucker were enabled to go to British Guiana primarily to gather material for a monograph of the Gymnotidae.[1]

[1] The gymnotid eels of Tropical America. Memoirs Carnegie museum, 1913, 6, p. 109–195, pl. 15–23.

They started from New York in August 1910 and went direct to Georgetown. After collecting in the Demerara and along the coast at Georgetown and conducting experiments in the regeneration on various species of the Gymnotidae they ascended the Demerara to canal Number Two. They went through the canal to a tributary of Hubabu Creek, descended to the Demerara and returned to Georgetown. They also ascended the Demerara to Wismar and crossed over to the Essequibo at Rockstone. After collecting on Gluck Island in the Essequibo and in a tributary of the Essequibo at the railway crossing between Rockstone and Wismar they returned to the coast.

The Colombian Reconnaissance.

Preliminary notes of my reconnaissance in Colombia have been published in Indiana University Studies 16 and 18. A detailed account will appear in the Memoirs of the Carnegie Museum. I entered Colombia at Cartagena in December 1911, and left from the same port in April 1912. From Cartagena I went to Soplaviento on the Dique and to Calamar on the Magdalena; from Calamar up the Magdalena River by steamer to La Dorado, collecting at various stopping places, Barbosa, El Blanco, Canaletal, Puerto Wilches, Peñas Blancas, Puerto Berrio. From La Dorado, the route was by rail to the upper part of the Magdalena, collections being made on the way at Honda, especially in Bernal Creek. The upper part of the Magdalena was followed to Girardot, where extensive collections were made. From Girardot, the route led first over the western rim of the plain at an elevation of about 8800 feet to Bogota, on an elevated plain among the eastern Cordilleras; collections were made on the plain near Chapinero, north of Bogota, and at Madrid, near the western margin of the plains of Bogota. A return was made to Girardot, from which *via* Chicoral to Quatro Esquinas, Ibagué, Toche, across the Quindio Pass of the central Cordilleras, at an elevation of 11,200 feet, to Boquia, Piedra Moler, and Cartago near the Cauca River. Up the Cauca Valley *via* Paila, Buga La Grande, Buga to Cali, collections being made at Paila and at Cali, and in the Cauca near Cali.

After collecting at Caldas (elevation of 3722 feet), the valley of the Dagua was descended, collections being made at Cisnero (1046 feet), at Cordova (120 feet), and in tide-water.

From Buenaventura, on the Pacific coast of Colombia, a steamer was taken up the San Juan River to Puerto Negria; thence a dugout carried the Expedition as far as Istmina; collections were made in both the latter places. From Istmina, after a ride of two hours up a little stream, and across the low

continental divide (elevation 300 feet above sea-level) the valley of the Atrato was entered near Tambo. By dugout to the settlement of Boca de Raspadura; thence the Raspadura River was followed into the Quito River, then the Quito River. Collections were made at Boca de Certegui and near the town of Quibdo, at the junction of the Quito River with the Atrato. From Quibdo, a steamer was taken to Rio Sucio, where additional collections were made. From Sucio, a steamer carried the Expedition back to the starting point at Cartagena.

These collections have been supplemented since my return by material collected by Manuel Gonzales, near Puerto Wilches, at Las Juntas on the Rio Bogota, in the province of Santander, and along the way from Bogota to Villavicencio. The first series of the specimens and the duplicates are in the Carnegie Museum, the second series in Indiana University.

The Landon-Fisher Expedition to Colombia.

A second Expedition into Colombia was made possible by Mr. Hugh McK. Landon and Mr. Carl G. Fisher, of Indianapolis.

Mr. Arthur W. Henn and Mr. Charles Wilson, undergraduates in Indiana University, left in December, 1912. They landed at Tumaco, near the southwestern corner of Colombia. After devoting about a month's time to the Telembi River, a tributary of the Patia, they separated. Mr. Wilson went to the San Juan River, collecting in the Upper San Juan Basin, the Condoto River at Condoto, and in the San Juan River at Istmina and Tado of the Pacific side, and later on the Atlantic slope at Tambo, Raspadura, Boco de Raspadura, Managru, Quibdo, in the Atrato between Quibdo and Rio Sucio, and especially in the Truando River emptying into the Atrato near Rio Sucio.

The Landon Expedition to Colombia and Ecuador.

Through the continued liberality of Mr. Hugh McK. Landon of Indianapolis, Arthur W. Henn was able to remain in South America and spend the time between February 15, 1913 and March, 1914 in collecting fresh-water fishes in Colombia and Ecuador.

He sailed from Tumaco, Colombia for Barbacoas on February 15th. From Barbacoas he went by packtrain to Tuquerres (10,090 feet), Ancuya (5000 feet), Los Llanos de Sandona (5000 feet), Tambo, Peñol, and to Guayabillo on the brink of the Cañon of the upper Patia. Descending to the Patia River, about

3000 feet collections were made above the mouth of the Guaitara. He returned *via* Pasto to Tuquerres and Barbacoas. He next descended the Rio Telembi to its mouth and ascended the Rio Patia and the Rio Magui, the first large tributary of the Patia above the Telembi to the village Payan.

Returning to Tumaco on the coast he went *via* Buenaventura to Puerto Negria, the head of steam navigation of the San Juan River. Drifting down the San Juan to the Rio Calima, the last large tributary of the San Juan from the east, he ascended the Calima, collecting in a small creek near its mouth, and at Boca de Guineo about thirty miles from the mouth of the Calima. After ascending the Rio El Guineo to a portage, he crossed over to the San Joaquin and descended it to Buenaventura.

He next went to Guayaquil from where several shorter excursions were made. The first of these lead to Naranjito. Collections were made south of Naranjito in a small creek Estero Verdes, a tributary of the Rio Chan Chan, and in a deep river, the Rio Barranca Alta. The second shorter trip from Guayaquil was to the small rivers at Chone and Portoviejo. The third trip took him to Daule, Santa Lucia, and Colimes on the Rio Daule. Returning to Daule he crossed over along a winding cut-off from the Rio Palenque to Vinces.

Returning to Guayaquil from Vinces, he went by rail to Quito, collecting *en route* at Huigra (4000 feet), Rio Bamba (9020 feet), Latacunga (9055 feet) and Quito (9375 feet). A short trip was made from Quito to Mindo (4108 feet). Later he went to El Angel (10,000 feet) and down the Rio Chota or Mira to Maria Luisa, the property of Sn. César Mena. Collections were also made in the Rio Chota at Guallupi (5,000 feet). He returned to Quito and later went *via* Angel by packtrain to Barbacoas and steamer to Tumaco.

By the various expeditions outlined above, collections have been obtained from most of the Pacific slope streams between Panama and Peru.

The first series of the specimens collected in the Landon Expedition is in Indiana University. Other series are in the Carnegie Museum, the Museum of Comparative Zoölogy, the U. S. National Museum, the Field Museum, and the Museum of Stanford University.

Central American Expeditions.

From time to time specimens have been secured by exchange with the Field Museum of Chicago. These had been collected by the late Dr. S. E. Meek in various parts of Mexico and Central America. Accounts of this material have appeared in various publications of the Field Museum.

In collaboration with Mr. S. F. Hildebrand, Dr. Meek was engaged at the time of his death on a report of the fishes of Panama. Mr. Hildebrand has completed the report in the Laboratory of Indiana University and has given me the opportunity to examine many of the specimens collected in Panama. Dr. Meek as the representative of the Field Museum, and Mr. Hildebrand, Director of the Beaufort Laboratory of the Bureau of Fisheries, as the representative of the Smithsonian Institution, spent two seasons in Panama to collect fishes. A report on their itinerary and on their collections has been published by the Field Museum (Field museum publication 191, zool. ser., 10, 1916, p. 217–374, pl. 6–32). They collected in various localities of the east-slope Chagres Basin, many of which are now covered by Gatun Lake, and in others of the Pacific slope Grande basin of the Canal Zone. In addition they collected in the basins of the Rio Chepo, and Tuyra of the Pacific slope, south of the Canal Zone, and in a few of the smaller rivers both north and south of the Canal Zone on both the east and west slopes.

The Expedition to Guatemala.

During January, February, and March of 1915, Mr. Newton Miller assisted by Messrs. E. B. Williamson, C. C. Deam, and Prof. J. Hines collected fishes at Tenedores, Los Amates, Algeria, Gualan, Zacapa, and El Rancho in the Motagua Basin of Guatemala. Additional collections were secured at Puerto Barrios and Santa Lucia. The first series of specimen is in Indiana University.

THE CHARACIDAE.

< *Dermopteres* Duméril, Zool. analytique, 1806, p. 146.
< *Salmonidi* Rafinesque, Indice littiol. Siciliana, 1810, p. 32.
< *Dermopteria* Rafinesque, Analyse nature, 1815, p. 87.
= *Characini* Müller, Archiv. nat., 1813, **1**, p. 323.
= *Characinidae* Müller, Monatsb. Acad. wiss. Berlin 1842.
= *Characins* (Characidae) Agassiz, Rept. Brit. assos. adv. sci., 1844, p. 293.
× *Characins* Valenciennes, Hist. nat. poissons, 1848, **21**, p. 159.
< *Characina* Vogt, Zool. briefe, 1851, **2**, p. 150.
= *Characinidae* Richardson, Encycl. Brit., 1856, ed. 8, **12**, p. 245.
× *Characinoidei* Bleeker, Enum. sp. piscium Archip. Indico, 1859, p. 31.
= *Characinidae* Günther, Cat. fishes Brit. mus., 1864, **5**, p. 278.
= *Characinidae* Cope, Proc. Amer. assoc. adv. sci., 1872, p. 333.
= *Characinidae* Gill, Arrang. fam. fishes, 1872, p. 16.
= *Citharini* Fitzinger, Sitzungsb. Akad. wiss., Wien, 1878, **77**, p. 37.
= *Characinida* Schmarda, Zool., 1878, **2**, p. 377.
= *Characinidae* Jordan and Gilbert, Synop. fishes N. Amer., 1882, p. 254.
> *Characidae* Gill, Mem. Nat. acad. sci., 1893, **6**, p. 131. Proc. U. S. N. M., 1895, **18**, p. 206.
= *Characinidae* Boulenger, Poissons bassin Congo, 1901, p.132. Cambridge natural history. Fishes 1904, p. 575. Cat. freshwater fishes Africa, 1909, **1**, p. 174.
= *Characidae* Eigenmann, Rept. Princeton univ. exped. Patagonia, 1909, **3**, p. 252; 1910, p. 420.
= *Characiformes* Regan, Ann. mag. nat. hist., 1911, ser. 8, **8**, p. 15.
> *Characidae* Regan, *Loc. cit.*
< *Erythroides* Valenciennes, Hist. nat. poissons, 1846, **19**, p. 480.
= *Erythrinidae* Richardson, Encycl. Brit., 1856, ed. 8, **12**, p. 250.
> *Erythrinoidei* Bleeker, Enum. sp. piscium Archipel. Indico, 1859, p. 31.
> *Erythrinidae* Gill, Ann. Lyc. nat. hist. N. Y., 1858, **6**, p. 410. Mem. Nat. acad. sci., 1893, **6**, p. 131. Proc. U. S. N. M., 1895, **18**, p. 206.
> *Erythrinidae* Cope, Proc. Amer. assoc. adv. sci., 1872, p. 333.
> *Erythrini* Fitzinger, Sitzungsb. Akad. wiss. Wien, 1873, **67**, abth., p. 37.
> *Mylctidae* Adams, Man. nat. hist., 1854, p. 108.
> *Gastropelecidae* Regan, Ann. mag. nat. hist. 1911, ser. 8, **8**, p. 19.
> *Xiphostomatidae* Regan, *Loc. cit.*, p. 20.
> *Anastomidae* Regan, *Loc. cit.*, p. 20.
> *Hemiodontidae* Regan, *Loc. cit.*, p. 21.
> *Citharinidae* Regan, *Loc. cit.*, p. 21.

Zoölogical Position.

The Characins are a family of Ostariophysi which, with the other families of this superorder, are now at their prime. They are the dominant family of fresh-water fishes in Tropical America and they play a prominent rôle in Africa.

The Ostariophysi, which include most of the fresh-water fishes of the world, are distinguished from all other fishes by the peculiar arrangment of a series of

ossicles for placing the air-bladder in communication with the auditory apparatus. The first four vertebrae are modified. The first vertebra lacks the superior arch which is replaced by the "*claustrum*" and "*scaphium*" of the Weberian apparatus; the principal ossicle of the series, the "*tripus*," is associated with the third vertebra consisting of the rib and parapophysis of the third vertebra. The "*intercalarium*," representing the neural arch of the second vertebra, is imbedded in the ligament extending from the tripus to the scaphium. Very frequently the air-bladder comes in close contact with the skin, forming a pseudotympanum above the pectorals. In the Characins the area is not unfrequently marked by a humeral spot, a gathering of pigment cells from contiguous areas. This spot may become shifted away from the tympanum. The air-bladder is usually connected with the intestine by a duct. The pectoral girdle is suspended from the skull by a long posttemporal; the mesocoracoid is present and the ventral fins are abdominal.

The orders and suborders of the Ostariophysi may be separated by the following key:—

a. Maxillary bone usually a toothless vestige carrying a barbel; no suboperele or symplectic; no scales; supraoccipital and parietals coössified; mouth usually with teeth; ribs attached to transverse apophyses; skin naked or covered with bony plates. Usually an adipose dorsal.
NEMATOGNATHI or SILUROIDEA.

aa. Maxillary usually well developed, not forming the base of a barbel, but sometimes one or more small barbels at or near its end; suboperele and symplectic present; parietals distinct from the supraoccipital; thoracic vertebrae without parapophyses; ribs mostly sessile; naked or with scales.
PLECTOSPONDYLI or CYPRINOIDEA.

b. Lower pharyngeals falciform, parallel with the gill-arches; jaws toothless; brain-case produced between the orbits; basis cranii simple; two superior pharyngeals; mouth without teeth, more or less protractile; no adipose fin.....(EVENTOGNATHI or CYPRINIFORMES).

bb. Lower pharyngeals not falciform; three basal branchihyals; basis cranii double, sometimes with myodome; one to four superior pharyngeals; mouth usually not protractile, usually with teeth.

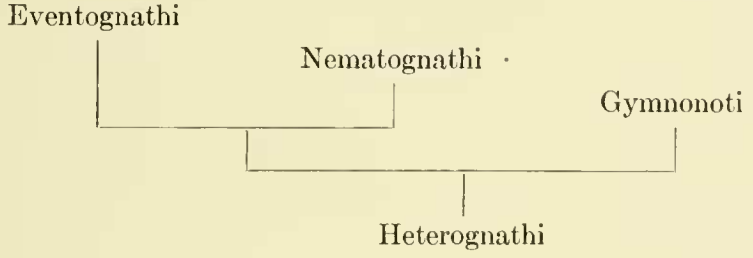
c. Anus submedian; body variously shaped, never eel-shaped; dorsal and usually an adipose fin present; ventrals abdominal.....(HETEROGNATHI or CHARACIFORMES).

cc. Anus at throat; body eel-shaped; dorsal absent, or reduced; ventrals absent...(GYMNONOTI).

The Eventognathi do not enter the Neotropical realm. The Gymnonoti are confined to it, the Heterognathi, as stated, occur in Africa and South America. The Nematognathi have an all but universal distribution.

Sagemehl (Morphologische jahrbüch, 1884, 10) pointed out the similarity of the Erythrinoids to Amia, and suggested the derivation of the family from the Holostei and more particularly from the Cycloganoidea. Boulenger (Poisson bassin Congo, 1901) considers the Characidae, more particularly the Erythrins,

as the primitive Ostariophysi from which the Cyprinidae (Gymnonoti) and Nematognathi have been derived. These families seem to him to represent three states in the evolution of Teleosteans, the Cyprinidae and Siluridae being derived apparently from a common ancestor, very near the Characins, these latter ranging themselves to the holostean Ganoids through the Erythrins. Later Boulenger (Cambridge natural history. Fishes, 1904, p. 575) refers to them as "a very generalized type, although perhaps not directly derived from the bony Ganoids." The relationship recognized by him he represented as follows:



Rowntree (Trans. Linn. soc. Lond., 1903, ser. 2, 9, p. 78) concludes his extensive account of the visceral anatomy of Characins with the following words:—"With the possible exception of the indications of a cellular air-bladder, there appears to be nothing in the visceral anatomy of the Characinidae which strengthens the deductions made from the skull as to the Amioid affinities of the group. In opposition to such deductions are especially the cystoarian ovaries, the asymmetric ductus pneumaticus, the presence of pyloric appendages and the absence of all trace of a valvular conus and of an intestinal spiral valve."

In view of the observations of every naturalist who has studied the Characins, notably Boulenger with the African species, and the author with the American forms, it is doubtful whether the similarity of the Erythrins with the Ganoids is anything more than one of the innumerable radial adaptations this plastic family has undergone.

Radial Adaptation.

Boulenger's remarks (Poissons bassin Congo, 1901, p. 132–135) concerning the African representatives may be translated as follows:—

This is a very natural family whose internal organization shows a great affinity with the Cyprinidae but whose exterior appearance, due to adaptation to various modes of life, varies so much that the beginner in African ichthyology will mistake its various representatives as near the Salmonids, pikes, and roaches of Europe. It is also impossible to state in a

few words the marks distinguishing the members of this family from such other fishes with abdominal ventrals and soft rayed fins as the Siluridae, Mormyridae, and Nototeridae. The presence of an adipose dorsal behind the rayed dorsal, although absent in some non-African genera, is a common character of the African fauna which it shares only with the Siluridae, which differ by their naked skin [one of the South American Characins is naked]. The Salmonids which also possess this adipose fin belong, on account of their general structure, to the same great group as the Clupeids which lack it and are strangers to Africa south of the Atlas.

One of the prime characters used in separating the Characinidae from its nearest related families is the structure of the mouth described as bordered by the premaxillaries in the middle and the maxillaries on the sides, while in the Cyprinidae and Siluridae the upper jaw is said to be bordered by the premaxillaries only. While this definition is valid for the most of the representatives of this family we must not forget, as Segemehl has impressed on us, that there are numerous exceptions which destroy the diagnostic value of this character. Thus the maxillary is so reduced in Serrasalmo, Citharinus, Eugnatichthys, Phago, being confined to the angle of the mouth that it is proper to question if this bone really forms part of the border of the mouth and very recently I have been able to determine that it is absolutely excluded in Ichthyoborus and Neoborus. On the other hand, among Siluridae (Nematognathi), whose premaxillaries are greatly reduced the mouth is bordered laterally by the maxillaries. Chaca has a large maxillary bordering the mouth, Diplomystes and Eutropichthys have a toothed maxillary, and among the Cyprinidae Catostomus shows us the premaxillary and maxillary together forming the mouth border. There are otherwise very great differences in the structure of the jaws among the fishes which are justly united in one family, the Characinidae. Thus the premaxillary, while never protractile, [I have since found Bivibranchia, a new genus, with protractile premaxillaries] is often vertically mobile (like the lower jaw), Ichthyoborinae; the maxillaries are either ankylosed to the premaxillaries or mobile on them, and in the majority of genera they do not directly articulate with the cranium, the only African exception being Sarcodaces.

The character given by other authors to distinguish the Characins from the Cyprinids, *i. e.* the non prolongation of the brain capsule between the orbits in the former is not more constant, for in Citharinus and Xenocharax, for example, it extends forward to the nasal region. There are all degrees between this and the more usual one from which the objectionable definition is drawn. The orbitosphenoid, undivided and often membranaceous, forms a large interorbital septum in front of the cerebral cavity or below its anterior part. We have here an important character although it may not be constant, a specialization in this reduction of the anterior part of the basis cranii and in its replacement by a thin interorbital partition.

The presence of teeth in the jaws does not distinguish the Characins from the Cyprinids because both African and American genera lack them. The teeth vary enormously in structure and furnish valuable characters to distinguish numerous genera of this family. They are found on the premaxillary, the lower jaw, sometimes they are also present on the maxillaries. They are but rarely found on the palate and none of the African genera offer any examples.

The branchiostegal rays number only 3 to 5. There are four branchial arches. Pseudobranchia are lacking or are rudimentary and glandular. The coracoid often forms a ventral ridge. The scapulars, epicoracoid, and postclavicle are distinct. The ventral rays number 10 to 13. The first pectoral, the dorsal, and anal rays are but rarely ossified and never form a formidable spine as in the Siluridae. Vertebrae in the African species vary from 17–33 + 13–24 = 33–57.

The scales, large or small, are ciliated in certain genera — a character very rare among the Physostomes. As Valenciennes says of Distichodus, the free part of the scales is truly ctenoid, the rest cycloid. The head always lacks scales, a rare thing in fishes. The lateral line organ is represented on the opercle by a branch from the suborbital.

The air-bladder is always divided into two parts by a constriction. The anterior part is much smaller than the posterior. In some, Alestes, the air-bladder may be prolonged along the right side of the hemapophyses and interneurals as far as the posterior end of the anal.

There are generally 10–25 coeca on the stomach and this number may be raised to 35 or 40 (Hydrocyon, Citharinus). The intestine in the carnivorous genera is short and makes but one loop; on the other hand, it is excessively long and with many windings in the herbivorous types.

In looking over this review of the characters of the family of Characins it is seen that there is none that taken alone and allowing for the exceptions, justifies its separation from the Cyprinids.

We are forced to content ourselves with a combination of characters, any one of which taken by itself is insufficient.

These words apply almost *verbatim* to the American members of the family.

The American Characins range from the border of the United States to some distance south of Buenos Aires. They form about one third of the entire South American fresh-water fauna and have diverged in adaptation to diverse food, diverse habitat, and diverse enemies to fill nearly every niche open to fishes. The ends of the three lines of adaptation to different food give us mud-eating forms, with long intestinal tract and no teeth,[1] flesh-eaters with shear-like teeth that are able to cut their way out of nets, attack large fishes, horses, and bathers, and conical-toothed forms with sharp, needle-like teeth and comparatively huge fangs. Greater diversity could scarcely be imagined, and one is led to suspect that some of the forms are *over-adapted*. In their divergence in form they have reached almost every conceivable shape, and have approached or paralleled many members of the diverse families of North American fresh-water fishes. Our shads and fresh-water herrings have their counterparts in Elopomorphus, Potamorhina, and Psectrogaster, our salmons are paralleled by Salminus and Catabasis, and our minnows by Astyanax and its relatives. It takes but a slight flight of the imagination to detect the striking similarity of Luciocharax to our gar pikes; our mullets are duplicated by Prochilodus; our top minnows are mimicked by Nannostomus. Bivibranchia, a recent discovery, shows a close similarity to Albula, and even our festive darters are duplicated by members Characidium of this most remarkable family.

This plasticity of the family in both America and Africa, and the *apparent* if not real duplication of forms in the two continents, is the more remarkable

[1] The toothless forms are not represented in Africa where members of the Cyprinidae replace them.

when we consider the very probable long separation of the African and American sections of the family, and that the present forms in Africa and America have probably independently evolved in the two continents from a common rudiment. As von Ihering first pointed out for animals in general, and as I have more particularly shown for the fishes, there has probably been no intermigration between the two continents since or previous to the early Tertiary.

Before the Tertiary von Ihering has postulated an Archhelenic continent between Africa and South America from which the two continents probably derived the ancestors of the Characins among other elements of the present fauna.

It is known that the Characins have inhabited South America since the early Tertiary at a time when the tropical part of the continents probably consisted of two islands, one occupying the Guianas, the other the plateau of eastern Brazil. From this small area and from the primitive group of Characins inhabiting it, the continent and family grew contemporaneously to their present proportions. They spread from these centers over the developing continent till they met unfavorable climatic conditions in the south, and high mountains or contestants in the north. They spread southward in decreasing numbers to and beyond the barren areas of Argentine to the edge of Patagonia, and they spread northward decreasing rapidly in numbers at Panama, only one of them reaching the United States, three southern Mexico, and three the Motagua River.

In South America they have always flourished, their only competitors in the rivers of the growing continent being the indigenous fishes contemporaneously developing from similar small rudiments. They have never been hampered or affected by intrusive elements. Their territory has from the first been unapproachable to foreign fresh-water fishes, and the marine species that have acclimated themselves have not diverged to any extent from their marine relatives.

The African section, on the other hand, came into competition with emigrants from India, and, according to Boulenger, the affinity of the entire African fauna with Asia, "is much greater than with America which is emphasized by the fact that the genera in the two first named regions are identical, while America possesses genera very closely related but not identical with those of Africa."

The American Characins have diverged, as stated before, in the most amazing manner in almost all possible ways towards diverse forms assumed by fishes. Some are long and slender, some nearly as deep as long, some spindle-shaped, others compressed. It is, however, in the teeth and alimentary canal that we find the greatest diversity, as has already been pointed out, and as will be

described in detail. The fact that different authors have associated different members of the Characidae with the herring, trout, cyprinids, and poecilids indicates in a measure their versatility.

Literature.

The earliest observations on Characins are recorded on some ancient monuments of Egypt. Heckel (Die fische Aegyptens chronologisch der zeitfolge ihrer ersten und späteren wissenschaftlichen kenntnissnahme nach geordnet, p. 213 of Abbildungen und beschreibungen der fische Syriens, 1843) identifies *Distichodus niloticus* and *Citharinus geoffroyi* from mural decorations of graves near the Pyramids. Boulenger (Fishes of the Nile, 1907, p. 156) finds that *Citharinus citharus* Geoffroy is represented on the mural paintings of the tombs at Giza and Sapara, at Deir el Gebrawi, and on the tomb of Ti at Sakkara.

The American Characins were first brought to the notice of naturalists by Marcgrav, who, in 1648 in his Historiae rerum naturalium Braziliae, 4, described the following:—

Curimata, p. 156	= *Prochilodus argenteus* (Agassiz).
Tareira do Rio, p. 157	= *Hoplias malabaricus* (Bloch).
Piraya, p. 164	= *Pygocentrus piraya* (Cuvier).
Maturaque, p. 169	= *Hoplias malabaricus* (Bloch).
Piabucu, p. 170	= *Piabucus dentatus* (Koelreuter).
Piaba, p. 170	= An Anostomus (?)

Ten years later, in 1658, Piso followed this account in his Historiae naturalis et medicae Indiae Occidentalis libri quinque, which is but a second edition of the former work, with figures and descriptions of the same species:—

Piabucu, p. 66, Piaba, p. 67, Maturaque, p. 67, Tareira II do Rio, p. 68, Piranha, p. 69, Curimata, p. 70.

The detailed history of the African section of the family will not be given here.[1] The number of known African species is far smaller than the number of American species which exceeds six hundred.

In Seba's Locupletissimi verum naturalium thesauri accurata descriptis,

[1] Boulenger (Fishes of the Nile, 1907, p. 117) indicates that the *Salmo niloticus* Linné, Syst. nat., ed. 12 is not the *Salmo niloticus* of Hasselquist. The date, 1757, of Hasselquist, however, being pre-Linnean, the name *Salmo niloticus* must be applied to the species of Linné ed. 10. The *S. niloticus* of the Systema ed. 12, which is the same as that of ed. 10, is, according to Boulenger, identical with *Myletes baremose* Joannis, and the latter = *Alestes baremose* of Boulenger, p. 117, should stand as *Myletes niloticus*. Further according to Boulenger, p. 141, the *Salmo niloticus* of Hasselquist is *Salmo acgyptiacus* of Gmelin. The name *Salmo niloticus* being a synonym of *Myletes niloticus* cannot be used for any other species and the oldest name after Hasselquist should be applied to his species. This oldest name is *Salmo aegyptiacus* and since this is a Distichodus the species should be *Distichodus acgyptiacus* instead of *Distichodus niloticus* as given by Boulenger, p. 141.

1758, over the signature of Artedi, but according to Gill[1] by another author, the name Tetragonoptrus, coined by Klein and originally intended for entirely different fishes, was applied to the species now known as *Tetragonopterus argenteus*.

In 1754 and 1756 Gronovius in his Museum ichthyologicum defined the following genera: —

Charax, 1754, p. 19.
Gasteropelecus, 1756, p. 7, pl. 7, fig. 5.
Anostomus, 1756, p. 13, pl. 7, fig. 2.
Erythrimus, 1756, p. 6, pl. 7, fig. 6.

The two species referred by Gronovius to Charax were subsequently incorporated in the genera *Charax* (*gibbosus*) and *Astyanax* (*fimaculatus*). The Gasteropelecus is the *Gasteropelecus sternicla* of present authors. His Anostomus is *Anostomus anostomus* and Erythrinus is *Erythrinus salmoneus*. In 1777 Scopoli (Introductio ad historiam naturalem * * *) adopted these genera into the binomial system with Gronovius species as the types.

Linné abandoned all of these genera and distributed the species known to him in the genera Clupea, Cyprinus, and Salmo. The species described or recognized by Linné in his tenth and twelfth editions and in Gmelin's the thirteenth edition of the Systema Naturae are given in the following table modified from that of Gill (Proc. U. S. N. M., **18**, p. 213):

	1758		1766		1788		
	Page	No.	Page	No.	Page	No.	
Salmo argentinus[2]		2	511	12	1372	12	*Piabucus dentatus*
gibbosus	311	19	513	20	1384	20	*Charax gibbosus.*
notatus			513	21	1385	21	*Astyanax fasciatus*
bimaculatus	311	20	513	22	1385	22	*Astyanax bimaculatus*
immaculatus	312	21	513	23	1385	23	(?)
cyprinoides			514	25	1385	25	*Curimatus cyprinoides*
niloticus	312	22	514	26	1386	26	*Myletes niloticus*
aegyptiacus					1386	49	*Distichodus aegyptiacus & rostratus*
pulverulentus	312	23	514	27	1386	27	*Astyanax ?*
rhombeus			514	28	1386	28	*Serrasalmo rhombeus*
anostomus	312	24	514	29	1387	29	*Anostomus anostomus*
?Clupea sima[3]	319	6	524	7	?	?	
sternicla	319	7	524	3	1384	48	*Gasteropelecus sternicla*
Cyprinus cephalus part?	322	7	527	7	1417	6	*Erythrinus cephalus*
dentex	325		531	26	1383	47	*Myletes dentex & baremose*

[1] Proc. U. S. N. M., 1895, **18**, p. 225–227.

[2] The generic names are those used in the tenth edition.

[3] *Clupa sima* is credited to Asia by Linné. It is placed in the synonymy of *sternicla* by Bloch, p. 418. I know nothing further about it.

The total number of species known to Linné is thus seen to have been from eight to ten in 1758 and from twelve to fourteen in 1766, to which but a single species had been added at the time of the publication of the 13th edition in 1788. Linné apparently knew none of the species described by Maregrav except Maregrav's *piabucu* which is *Salmo argentinus* Linné.

In 1794 Bloch in his Ausländische fische added a number of species without, however, recognizing any distinct Characinid genera.

In Schneider's edition of Bloch's Systema ichthyologiae published in 1801 the following species were recognized: —

Synodus malabricus Bloch, p. 397. (tafel 392 of Bloch).
Synodus erythrinus Bloch & Schneider, p. 397.
Synodus tareira Bloch & Schneider, p. 398, pl. 79.
Synodus palustris Bloch & Schneider, p. 398.
Salmo friderici Bloch, p. 403. (tafel 378 of Bloch).
Salmo fasciatus Bloch, p. 403. (tafel 379 of Bloch).
Salmo argentinus Linné, p. 403. (tafel 382, fig. 1 of Bloch).
Salmo rhombeus Linné, p. 404. (tafel 383 of Bloch).
Salmo falcatus Bloch, p. 404. (tafel 385 of Bloch).
Salmo odoe Bloch, p. 405. (tafel 386 of Bloch).
Salmo pulverulentus Linné, p. 406.
Salmo dentex Linné, p. 407.
Salmo edentulus Bloch, p. 412. (tafel 380 of Bloch).
Salmo melanurus Bloch, p. 412. (tafel 381, fig. 2 of Bloch).
Salmo unimaculatus Bloch, p. 412. (tafel 381, fig. 3 of Bloch).
Salmo bimaculatus Linné, p. 413. (tafel 382, fig. 2 of Bloch).
Salmo anastomus Linné, p. 414.
Salmo niloticus Linné, p. 414.
Salmo cyprinoides Linné, p. 414.
Salmo curimata Bloch & Schneider, p. 417.
Salmo aegyptius Gmelin, p. 418. (*aegyptiacus* of Gmelin).
Salmo gasteropelecus Gmelin, p. 418.
Salmo immaculatus Linné, p. 419.
Salmo gibbosus Linné, p. 419.

In 1802 Lacépède (Histoire naturelle des poissons) created for *Salmo rhombeus* Linné the genus Serrasalmo and adopted the Charax of Gronovius as *Characinus* for *piabuca*, *dentex*, *gibbosus*, *nolatus*, *bimaculatus*, *immaculatus*, *cyprinoides*, *niloticus*, *nefasch*, *pulverulentus*, *anostomus*, *friderici*, *fasciatus*, *melanurus*, and *odoe*. The real advance in our knowledge of the relationships of the Characins did not begin until several years later when Cuvier (1817) published his Règne animal, and a series of articles in the Memoires Museum d'histoire naturelle. In the Règne animal (p. 174) he recognized Erythrinus which he placed in his Clupes and the following genera which were included in

the family of Salmones: — Characinus, Curimatus, Anostomus, Serrasalmo, Piabucus, Tetragonopterus, Myletes, Hydrocynus, Citharinus, and Gasteropelecus.[1]

In 1829, Memoires Museum d'histoire naturelle, 4, he further defined Chalceus and in 1819, 5, apparently substituted Hydrocyon for Hydrocynus. A great advance towards a knowledge of the South American Characinid fauna was made by Spix and Agassiz in the Selecta genera et species piscium Brasiliensis, 1829. They defined Prochilodus Agassiz (= Pacu Spix), Anodus Spix, Leporinus Spix, Schizodon Agassiz, Salminus Agassiz, Hiphorhynchus Agassiz (= Acestrorhynchus Eigenmann), Rhaphiodon Agassiz (= Cynodon Spix), and Xiphostoma; they also described many new species.

Up to this time and for several years later the Characins were distributed among the Salmonids and Clupeids and the peculiar parallelism between some of the genera of these families and the genera of the Characidae made such an association seem natural. In 1842 Johannes Müller in his treatise on the air-bladder of fishes (Monatsb. Acad. wiss., Berlin, June 1842 and Arch. anat. u. phys., 1842, p. 307) described the genera Macrodon (= Hoplias) and Hemiodus and united all of the Characins in his new family Characinidae.

In 1844 Müller and Troschel published a synopsis of the known genera (Wiegmann's archiv, 1844, 1, p. 81) and defined the new genera Chilodus, Distichodus, Alestes, Brycon, Exodon, Epicyrtus, Hydrolycus, Pygocentrus, Pygopristis, Catoprion, and Myleus. They followed this in 1845 by the first monograph on the Characinidae, Die familie der Characinen (Horae Ichthyologicae, 1, 2). Here all of the then known genera, including the new genus Agoniates are described and the known species enumerated. This work by Müller and Troschel was up to that time by far the most important as well as the most comprehensive work on the Characins. It is the first of three general accounts that have appeared. In it were recognized thirty-one genera and eighty-eight species. Of these twenty-seven genera and eighty species were American, the remainder African.

Müller and Troschel's work was closely followed by the second revision of the group. Cuvier and Valenciennes in the 19th (1846) and 22nd (1848) volumes of their Histoire naturelle des poissons described many species and the genera Lebiasina and Pyrrhulina, 19 and Parodon, Piabucina, Tometes, Mylesinus, Chalcinus and Cynopotamus, 22. A retrograde step was taken in rejecting the Characinidae and including the genera in the Salmonidae.

[1] Gasteropelecus is attributed to Bloch.

In 1854 Girard (Proc. Acad. nat. sci. Phil., 6, p. 199) described the genus Cheirodon, the first Characin reported from the Pacific slope of America. This genus was afterward found to be widely distributed on the eastern slope.

In the same year Baird & Girard (Proc. Acad. nat. sci., Phil., 7, p. 27) described *Astyanax argentatus*, the only species that reaches the United States and the first to be recorded of the overflow from South America northward.

The notable work by Castelnau, (1855) Exped. Amerique Sud. Poissons, while containing many figures and description of species added nothing to our understanding of the relations of the various members of the family.

In 1858 Gill published (Ann. Lyc. nat. hist., N. Y., 6) a short paper on the fresh-water fishes of Trinidad. In it he recognized Erythinus and Macrodon as forming a distinct family and described a new subfamily, Stevardiinae. He also established the genera Poecilurichthys and Hemigrammus.

In the following year (1859) appeared a very important contribution to the knowledge of the Characins, Zur familie der Characinen, by Kner. He defined the new genera Microdus, Rhytiodus, and Bryconops and described and figured a large number of new species from various parts of South America. Erythrinus and Macrodon are excluded from the Characidae on account of the absence of an adipose fin. The same author (1863) defined the genera Pseudochalceus, Chalcinopsis, and Saccodon, the latter in connection with Steindachner who has since contributed so much to the knowledge of tropical American fishes. In the same year Günther defined the genus Crenuchus.

In 1864 we have the culmination of an epoch in the history of the Characins. Before 1802, at least during the binomial period, naturalists concerned themselves altogether with the description of new species. Beginning with Lacépède, in 1802, we have a series of descriptions of new genera by Cuvier, Spix, Agassiz, and Müller. To this period belongs the work of Cuvier and Valenciennes although it appeared later. In 1844 and 1845 we have the first attempts by Müller and Troschel of a philosophic review of the material that had been accumulated. All subsequent work was tinged by Müller and Troschel's Die familie der Characinen. In 1864 was published the second revision of the family. Cuvier and Valenciennes's work being an enumeration, or descriptive catalogue, rather than a revision, and Kner's works being confined to American species. Günther, in the Catalogue of the fishes of the British Museum, 1864, 5, reunited the Erythrinidae with the Characinidae. He defined or used for the first time the generic names Caenotropus, Brachyalestes, Creatochanes, Hemibrycon, Scissor, Creagrutus, Anacyrtus, Roestes, Roeboides, Hystricodon,

Sarcodaces, Oligosargus, and Ichthyborus. Günther recognized in all forty-seven genera and two hundred and five species. Of these forty genera and one hundred and eighty-one species are American.

Günther groups the genera in a number of subfamilies whose characters are largely the presence or absence of an adipose fin, perfection or imperfection of dentition, the length of the dorsal fin, and the character of the gill-openings.

The following synopsis will indicate his subfamilies and the characters on which they are based: —

a. *Adipose* fin absent ..... *Erythrinina*,[1] American.
aa. Adipose fin present
b. Dentition imperfect
c. Dorsal fin short ..... *Curimatina*, American.
cc. Dorsal fin rather long ..... *Citharinina*, African.
bb. Dentition well developed
d. Dorsal fin short
e. Gill-openings narrow, the gill-membrane grown to the isthmus
f. Elements of the jaws separate
g. Nasal openings remote from each other ..... *Anostomatina*, American.
(*gg.* Nasal openings close together ..... *Nannocharacina*, African).
ee. Gill-openings wide, the gill-membrane not grown to the isthmus.
h. Teeth compressed, notched, or denticulated.
Tetragonopterina, American and African.
hh. Teeth all conical ..... *Hydrocyonina*, American and African.
(*ff.* Both jaws very movable, their lateral halves being united into one piece.
Phagonina, African).
dd. Dorsal fin rather long
i. Gill-openings of moderate width, the gill-membrane being attached to the isthmus.
Distichodontina, African.
ii. Gill-openings wide, the gill-membrane not being attached to the isthmus.
j. Belly rounded; jaws with conical teeth ..... *Ichthyborina*, African.
jj. Belly rounded; canine teeth none .... *Crenuchina*, American and African.
jjj. Belly with a spinous serrature ..... *Serrasalmonia*, American.

Günther immediately (1865) added the Phagonina and shortly afterwards (1867) the Nannocharacina from Africa, assigning the latter to a place between the Anostomatina and the Tetragonopterina. Both are included in parentheses in the foregoing synopsis.

Günther's work stimulated exploration and description to a great extent, and following the publication of his Catalogue we have contributions by Günther himself between 1864 and 1900; by Gill 1864–1903; Reinhard 1866; Cope between 1870 and 1894; Lütken 1874–1890; Steindachner 1875 to the present; Boulenger from 1887 to the present; Eigenmann and Eigenmann from 1889 to the present; Garman 1890–1895; Perugia 1891–1897; von Ihering 1893 to

[1] Including the Stevardiinae of Gill.

the present; Berg 1895–1901; Lahille 1895 to the present; Ulrey 1895; Regan 1900 to the present; Meek 1885–1916; Fowler; Nichols; Hildebrand and Mrs. Marion Durbin Ellis.

The discovery of the numerous species and genera since 1864 are too complicated for detailed enumeration. Reinhard and Lütken considered chiefly the species inhabiting the basin of the Rio das Velhas a tributary of the Rio San Francisco, Central America and Trinidad. Cope, 1870–1878, dealt largely with species of the Upper Amazons, and later with species from Rio Grande do Sul. Steindachner has published descriptions of numerous new species, collected by Agassiz and his associates during the Thayer Expedition and in part by himself and correspondents. Boulenger has reported on numerous collections received by the British Museum from different parts of South America. Eigenmann and Eigenmann have reviewed the Erythrininae and Curimatinae; Garman has published critical revisions of a few genera; Ulrey has reviewed parts of the Tetragonopterinae. Perugia reported on various collections received by the Museum of Genoa. Regan is describing species from the collections of the British Museum and Holmberg, von Ihering, Senior and Junior, Berg, Lahille, Ribeiro, and Goeldi were the first of a group of resident naturalists who have made important observations on their own faunae, chiefly eastern Brazil and Argentina. While many of the authors suggest modifications in parts of the system proposed by Günther, only Eigenmann and Regan concerned themselves with the broader questions of the classification of the Characins.

In 1884 Sagemehl demonstrated the close relationship of the catfishes, electric eels (Gymnotidae), Cyprinidae, and Characidae, all of which he grouped, on account of the common possession of the complicated Weberian apparatus, in the superorder Ostariophysi. Further studies on the anatomy of the Characins were published in 1903 by Rowntree.

Gill, in 1893, (Families and subfamilies of fishes) admitted the two families of Heterognaths, Characinidae, and Erythrinidae. He had defined these in 1858 and redefined them in 1895 (Proc. U. S. N. M., 18) when he intimated the existence of a third family, the Citharinidae. Together with Müller and Troschel and Kner he considers that the Characinidae, even after the exclusion of the Erythrinidae, "constitute a heterogenous group." Gill recognizes the subfamilies Erythrininae, Pyrrhulininae, Lebiasininae, Tetragonopterinae, Serrasalmoninae, Hydrocyoninae, Myletinae, Distichodontinae, Anostominae, Curimatinae, and Citharininae.

In a recent paper (Cambridge natural history. Fishes, 1904) Boulenger while recognizing that "The classification of the family is still in an unsatisfactory state "divides them into the following groups (hardly deserving the rank of subfamilies)":—

A.	Erythrininae	American.
B.	Hydrocyoninae	African and American.
C.	Serrasalmoninae	American
D.	Ichthyoborinae	African.
E.	Xiphostominae	American.
F.	Anostominae	American.
G.	Hemiodontinae	American.
H.	Distichodontinae	African.
I.	Citharininae	African and American.

Regan (Ann. mag. nat. hist., 1911, ser. 8, 8) comes to quite different conclusions in regard to the "groups" of Boulenger. He divides his Characiformes, *i. e.* the Heterognathi of authors, into six families (a) the Characidae which equals the Erythrininae, Hydrocyoninae, and Serrasalmoninae of Boulenger, (b) the Xiphostomatidae = Xiphostominae of Boulenger, (c) the Anostomidae = Anostominae of Boulenger *plus* Curimatus and Prochilodus, (d) the Hemiodontidae = Hemiodontinae of Boulenger, (e) the Citharinidae = Ichthyoborinae, Distichodontinae, and Citharininae exclusive of Curimatus and Prochilodus of Boulenger, and (f) the Gastropelecidae proposed for the flying Characins included in the Hydrocyoninae by Boulenger.

Regan's paper offers some criticism of my classification published in the Reports of the Princeton University Expeditions to Patagonia, 1909, 3, p. 253–256. In part I heartily agree with Regan, and long ago came to some of the conclusions reached by him. There are, however, many points in Regan's paper in which I think his conclusions are at variance with the facts. I reserve my criticism of Regan's strictures and a discussion of the general classification of the Characins until my study of all the subfamilies is completed. The keys of the subfamilies given in the Patagonian reports do not agree entirely with my present views. (*cf.* Rept. Princeton univ. exped. to Patagonia, 1909, 3, p. 253–256).

Geographical Distribution.

In the study of the Characins, as in that of all Tropical American fishes, the question of the distribution of the genera and species must in the future be among the first topics to be considered.

In 1891 and 1892 Eigenmann and Eigenmann enumerated all the known

Tropical American fishes. They (Proc. U. S. N. M., **14**, **15**) considered and summarized the distribution of the genera and species so far as known. They recognized sixty-five genera and about four hundred and sixty species, as compared with the forty genera and one hundred and eighty-one species enumerated by Günther (1864). It is not necessary to give here the details of the results of their inquiry into the geographical distribution of the species. It was found that nineteen of the genera recognized were distributed over the entire eastern slope of South America and that five of these had representatives in the La Plata and the Amazon, but not in the small rivers emptying into the Atlantic in southeastern Brazil. One genus, Saccodon, was confined to the Pacific slope. Twenty-seven genera were limited to the Amazons, or to the Amazons and the region north of it. The Guianas held two peculiar genera, the Rio Magdalena one, the southeastern coast streams one, while four genera had a wide but irregular distribution.

Many modifications in these summaries of distribution are necessary, both on account of the changes in the boundaries of the genera, and owing to the increase in our knowledge of the distribution of the several species. The papers published since the enumeration of 1891 and 1892 have dealt largely with the fauna of Paraguay, Rio Grande do Sul, Guiana, Colombia, and Mexico at nearly opposite ends of the range of the family and with the fauna of the Pacific slope of Ecuador.[1] A reconsideration of the entire problem of the distribution of the fresh-water fishes of South America may be found in The fresh water fishes of Patagonia and an examination of the Archiplata-Archhelenis theory. (Reports of the Princeton university expeditions to Patagonia, 1909, **3**, p. 225–374. Catalogue of the fresh-water fishes of tropical and south temperate America. *Ibid.*, 1910, **3**, p. 375–512.

[1] While no attempt has been made to trace the details of the evolution of our knowledge of the African Characins the present account would be most inadequate and incomplete without reference to Boulenger's work on the Characins of the Congo and Nile Basins. The new genera and species from the Congo were described for the most part in volume 1 and 2 of the Annales Musée du Congo. A general account in which all the species were considered, formed part of his Les poissons du basin du Congo, 1901. The Nile representatives are described and figured in his superb volume, The fishes of the Nile, 1907. Among other recent authors on the African Characins is J. Pellegrin, who is describing the material of the Paris Museum. Finally Boulenger (Catalogue of the fresh-water fishes of Africa, 1909, **1**, p. 174–298) redefines the subfamilies and genera and redescribes all of the African species. He recognizes twenty genera and one hundred species.

Chronological List of Generic Names.

Original name	*Date*	*Current Name*
Charax Gnonow	1754 & 1777	
Erythrinus Gronow	1756 & 1777	
Gasteropelecus Gronow	1756 & 1777	
Anostomus Gronow	1756 & 1777	
Tetragonopterus Artedi	1758	
Characinus Lacépède	1802	
Serrasalmo Lacépède	1802	
Curimates Cuvier	1815	
Tetragonoptere Cuvier	1815	
Les Curimates Cuvier	1817	Curimatus
Les Anostomes Cuvier	1817	Anostomus
Les Piabuques Cuvier	1817	Piabucus.
Tetragonopterus Cuvier	1817	
Myletes Cuvier	1817	
Hydrocynus Cuvier	1817	
Citharinus Cuvier	1817	
Gasteropelecus Cuvier	1817	
Erythrinus Cuvier	1817	
Curimatus Oken	1817	
Piabucus Oken	1817	
Chalceus Cuvier	1818	
Curimata Cloquet	1818	
Hydrocyon Cuvier	1819	Hydrocynus
Anodus Spix	1829	
Prochilodus Agassiz	1829	
Leporinus Spix	1829	
Schizodon Agassiz	1829	Anostomus
Rhaphiodon Agassiz	1829	
Xiphostoma Spix	1829	
Pacu Spix	1829	Prochilodus
Cynodon Spix	1829	
Xiphorhynchus Agassiz	1829	Acestrorhynchus
Salminus Agassiz	1829	
Macrodon Müller	1842	Hoplias
Hemiodus Müller	1842	
Chilodus Müller & Troschel	1844	
Distichodus Müller & Troschel	1844	
Alestes Müller & Troschel	1844	
Brycon Müller & Troschel	1844	
Exodon Müller & Troschel	1844	
Epicyrtus Müller & Troschel	1844	Charax
Hydrolycus Müller & Troschel	1844	
Pygocentrus Müller & Troschel	1844	
Pygopristis Müller & Troschel	1844	
Catoprion Müller & Troschel	1844	

Original name	*Date*	*Current Name*
Myleus Müller & Troschel	1844	
Xiphorhamphus Müller & Troschel	1845	Acestrorhamphus
Agoniates Müller & Troschel	1845	
Grundulus Cuv. & Valenciennes	1846	
Lebiasina Cuv. & Valenciennes	1846	
Pyrrhulina Cuv. & Valenciennes	1846	
Parodon Cuv. & Valenciennes	1848	
Brycinus Cuv. & Valenciennes	1848	Alestes?
Piabucina Cuv. & Valenciennes	1848	
Tometes Cuvier & Valenciennes	1848	
Mylesinus Cuv. & Valenciennes	1848	
Chalcinus Cuv. & Valenciennes	1848	
Cynopotamus Cuv. & Valenciennes	1848	
Hydropardus Reinhardt	1849	Raphiodon
Cheirodon Girard	1854	
Astyanax Baird & Girard	1854	
Poecilurichthys Gill	1858	Astyanax
Hemigrammus Gill	1858	
Stevardia Gill	1858	
Corynopoma Gill	1858	Stevardia
Nematopoma Gill	1858	Stevardia
Microdus Kner	1859	Caenotropus
Rhytiodus Kner	1859	
Bryconops Kner	1859	
Ctenolucius Gill	1861	Luciocharax
Hydrocyonoides Castelnau	1861	Sarcodaces
Crenuchus Günther	1863	
Pseudochalceus Kner	1863	
Chalcinopsis Kner	1863	Brycon
Saccodon Kner & Steindachner	1863	
Caenotropus Günther	1884	
Brachyalestes Günther	1864	
Creatochanes Günther	1864	
Hemibrycon Günther	1864	
Scissor Günther	1864	
Creagrutus Günther	1864	
Anacyrtus Günther	1864	Charax
Roestes Günther	1864	
Roeboides Günther	1864	
Hystricodon Günther	1864	Exodon
Sarcodaces Günther	1864	
Oligosargus Günther	1864	
Ichthyborus Günther	1865	
Phago Günther	1865	
Piabina Reinhardt	1866	
Characidium Reinhardt	1866	
Nannocharax Günther	1867	
Xenocharax Günther	1867	

Original name	*Date*	*Current name*
Aphyocharax Günther	1868	
Megalobrycon Günther	1869	Brycon
Stethaprion Cope	1870	
Holotaxis Cope	1870	
Plethodectes Cope	1870	Chalceus
Odontostilbe Cope	1870	
Laemolyta Cope	1871	
Nannaethiops Günther	1871	
Iguanodectes Cope	1871	
Nannostomus Günther	1872	
Bryconaethiops Günther	1873	
Leporellus Lütken	1874	
Curimatopsis Steindachner	1876	
Lütkenia Steindachner	1876	Stichanodon
Paragoniates Steindachner	1876	
Bramocharax Gill	1877	
Luciocharax Steindachner	1878	
Elopomorphus Gill	1878	
Potamorhina Cope	1878	
Metynnis Cope	1878	
Leptagoniates Boulenger	1887	
Psectrogaster Eigenmann & Eigenmann	1889	
Curimatella Eigenmann & Eigenmann	1889	
Semitapicis Eigenmann & Eigenmann	1889	
Henochilus Garman	1890	
Schizodontopsis Garman	1890	Laemolyta
Pseudocorynopoma Perugia	1891	
Bergia Steindachner	1891	Pseudocorynopoma
Chalcinopsis Holmberg	1891	Pseudocorynopoma
Neolebias Steindachner	1894	
Asiphonichthys Cope	1894	
Chorimycterus Cope	1894	
Diapoma Cope	1894	
Petersius Hilgendorf	1894	
Nanognathus Boulenger	1895	
Hoplerythrinus Gill	1895	
Eugnathichthys Boulenger	1898	
Paraphago Boulenger	1899	
Neoborus Boulenger	1899	
Micralestes Boulenger	1899	
Neolebias Boulenger	1899	
Catabasis Eigenmann & Norris	1900	
Mesoborus Pellegrin	1900	
Hemistichodus Vaillant & Pellegrin	1900	
Citharidium Boulenger	1902	
Gymnocharacinus Steindachner	1903	
Hoplias Gill	1903	
Anisitsia Eigenmann & Kennedy	1903	

Original name	*Date*	*Current Name*
Lahilliella Eigenmann & Kennedy	1903	
Holoshesthes Eigenmann	1903	Holoesthes
Holoprion Eigenmann	1903	
Holopristis Eigenmann	1903	Pristella
Markiana Eigenmann	1903	
Moenkhausia Eigenmann	1903	
Othonophanes Eigenmann	1903	
Bryconodon Eigenmann	1903	
Stichanodon Eigenmann	1903	
Evermannella Eigenmann	1903	Eucinopotamus
Acestrorhynchus Eigenmann	1903	
Acestrorhamphus Eigenmann	1903	
Acestrocephalus Eigenmann	1903	
Boulengerella Eigenmann	1903	
Gilbertella Eigenmann	1903	Gibertolus
Aenodon Eigenmann	1903	
Myleocollops Eigenmann	1903	
Piaractus Eigenmann	1903	
Orthomyleus Eigenmann	1903	
Colosoma Eigenmann	1903	
Mylosoma Eigenmann	1903	
Eucinopotamus Fowler	1906	
Ophiocephalops Fowler	1906	Hoplerythrinus
Copeina Fowler	1906	
Cyphocharax Fowler	1906	
Steindachnerina Fowler	1906	
Peltapleura Fowler	1906	
Eigenmannina Fowler	1906	
Chilomyzon Fowler	1906	Prochilodus
Hemiodopsis Fowler	1906	
Pithecocharax Fowler	1906	Anostomus
Poecilosomatops Fowler	1906	Characidium
Garmanina Fowler	1906	
Abramites Fowler	1906	Leporinus
Pellegrinina Fowler	1906	Chalceus
Coscinoxyron Fowler	1906	
Thoracocharax Fowler	1906	
Cyrtocharax Fowler	1906	Cynopotamus
Cynocharax Fowler	1906	
Sphyraenocharax Fowler	1906	Acestrorhamphus
Belonocharax Fowler	1906	Luciocharax
Waiteina Fowler	1906	Colosoma?
Reganina Fowler	1906	Colosoma?
Starksina Fowler	1906	Mylosoma
Sealeina Fowler	1906	
Evermannolus Eigenmann	1907	Eucinopotamus
Gilbertolus Eigenmann	1907	
Phenacogrammus Eigenmann	1907	

Original Name	*Date*	*Current Name*
Pogonocharax Regan [1]	1907	
Phoxinopsis Regan	1907	
Mimagoniates Regan	1907	
Ctenocharax Regan	1907	Grundulus
Eobrycon Jordan	1907	
Bryconamericus Eigenmann	1907	
Deuterodon Eigenmann	1907	
Phenacogaster Eigenmann	1907	
Astyanacinus Eigenmann	1907	
Fowlerina Eigenmann	1907	Ephippicharax
Joinvillea Steindachner	1908	Deuterodon
Coelurichthys Ribeiro	1908	
Gymnocorymbus Eigenmann	1908	
Thayeria Eigenmann	1908	
Ctenobrycon Eigenmann	1908	
Pristella Eigenmann	1908	
Psellogrammus Eigenmann	1908	
Hyphessobrycon Durbin	1908	
Brycochandus Eigenmann	1908	
Poptella Eigenmann	1908	
Champsoborus Boulenger	1909	
Anostomoides Pellegrin	1909	
Jobertina Pellegrin	1909	
Pterodiscus Eigenmann	1909	
Carnegiella Eigenmann	1909	
Holobrycon Eigenmann	1909	
Triurobrycon Eigenmann	1909	Brycon
Poecilocharax Eigenmann	1909	
Microcharax Eigenmann	1909	
Poecilobrycon Eigenmann	1909	
Archicheir Eigenmann	1909	
Hollandichthys	1910	
Nematobrycon Eigenmann	1911	
Knodus Eigenmann	1911	
Bivibranchia Eigenmann	1911	
Hasemania Ellis	1911	
Probolodus Eigenmann	1911	
Psalidodon Eigenmann	1911	
Spintherobolus Eigenmann	1911	
Glandulocauda Eigenmann	1911	
Hysteronotus Eigenmann	1911	
Vesicatrus Eigenmann	1911	
Apodastyanax Fowler	1911	Ctenobrycon.
Rhodsia Fowler	1911	
Parastremma Eigenmann	1912	
Genycharax Eigenmann	1912	

[1] This is probably a Cyprinoid from Ceylon not a Characin from South America.

Original name	*Date*	*Current name*
Gephyrocharax Eigenmann	1912	
Pterobrycon Eigenmann	1913	
Argopleura Eigenmann	1913	Bryconamericus
Microgenys Eigenmann	1913	
Zygogaster Eigenmann	1913	Astyanax
Ephippicharax Fowler	1913	
Prionobrama Fowler	1913	
Gnathocharax Fowler	1913	
Tyttocharax Fowler	1913	
Xenurocharax Regan	1913	
Landonia Eigenmann	1914	
Phenagoniates Eigenmann & Wilson	1914	Phanagoniates
Microbrycon Eigenmann & Wilson	1914	
Ceratobranchia Eigenmann	1914	
Bleptonema Eigenmann	1914	Prionobrama
Parecbasis Eigenmann	1914	
Myocharax Fowler	1914	
Xiphocharax Fowler	1914	
Leptobrycon Eigenmann	1915	
Macropsobrycon Eigenmann	1915	
Megalamphodus Eigenmann	1915	
Microschemobrycon Eigenmann	1915	
Oligobrycon Eigenmann	1915	
Aphyocheirodon Eigenmann	1915	
Compsoura Eigenmann	1915	
Mixobrycon Eigenmann	1915	

THE AMERICAN TETRAGONOPTERINAE.

Whether we regard the Heterognaths as a single family, or as several families, the fact remains that there are few groups of fishes within which the lines of evolution are so clearly portrayed by existing forms as in the Characidae. In order more satisfactorily to discuss their evolution I have divided the family into a large number of small groups of genera with undoubted affinity.

Several facts, aside from the general structure point to the Tetragonopterinae or perhaps the closely allied Cheirodontinae as the group nearest to the ancestral Characins.

1. Tetragonopterid fishes have been found fossil in the Tertiary fresh-water deposits at Taubaté.

2. They are found both in Africa and South America, the most nearly allied genera on the two sides, Astyanax and Petersius, are scarcely generically distinct. No other subfamily has representatives on both sides of the Atlantic.

3. They are the dominant groups both in Africa, where they form more than 36% of the Characins, and in America, where they form about 40%.

4. They are found over the entire area of distribution both in America and Africa. In America members of this subfamily form everywhere the vanguard in the distribution.

5. There are several lines of evolution diverging from the two subfamilies, Cheirodontinae and Tetragonopterinae.

Some of the lines of evolution radiating from different sections of the Tetragonopterinae, or the closely allied Cheirodontinae are minor lines that have not diverged greatly. For instance Diapoma and Stevardia are Tetragonopterids with modified opercles. The Gymnocharacinae are naked Tetragonopterinae. The Crenuchinae are apparently an offshoot from the Cheirodontinae. The Stethaprioninae have developed a predorsal spine but are otherwise very close to Tetragonopterus and especially to Moenkhausia. The Mylinae and Serrasalmoninae have possibly diverged from the Stethaprioninae, increasing the number of the dorsal rays, increasing the depth, compressing the ventral surface, and adding spines and emphasizing the dentition without much altering it. Another offshoot from the Cheirodontinae has given rise to a series of fishes with a decrease in the size of the mouth and the effectiveness of the

dentition. This series includes the Anastomatinae, Chilodinae, Prochilodinae, Hemiodontinae, Elopomorphinae, and finally, the toothless Curimatinae.

Another line diverging from the Cheirodontinae has given rise to the Salmininae, Characinae, Acestrorhamphinae, Cynodontinae, and ultimately the Hydrocyninae.

Another line of divergence from the Cheirodon or Tetragonopterus group led through the Bryconinae, Iguanodectinae, Pyrrhulininae, Piabuscininae, to the Lebiasininae. A side branch from this leads to the Chalcininae which points the way to the flying Gasteropelicinae. For the above reasons it seems best to begin the detailed examination of the species with the Tetragonopterinae.

It may be left an open question whether the African and American genera owe their similarity to convergence or to community of origin. They are for the most part small or minute fishes ranging from 50–200 mm. in length. Mylctes in Africa reaches 460 mm. The Tetragonopterinae are closely related to the Cheirodontinae, Diapominae, Glandulocaudinae, Stethaprioninae, Bryconinae and to other subfamilies. In shape they vary from the fusiform Creatochanes to the deeply compressed Tetragonopterus. In the majority of the genera the mouth is small. The lower jaw is heavy, and on account of the obliquity of the mouth, when the mouth is opened it is thrown forward, so as to project beyond the snout; when the mouth is closed the teeth of the lower jaw usually fit in behind the innermost series of the premaxillary. In some genera from Africa there is an inner pair of conical teeth in the lower jaw. These appear *in lieu* of an inner series of teeth which in the American Brycon are still present on the sides of the lower jaw. Conical teeth like these appear in isolated (not closely related) genera of other subfamilies both in Africa and America, and, since they cannot be genetically connected, appear to offer an example of homoplastic development. The skull is smooth in cross-section or slightly grooved in the smaller specimens; two fontanels are well developed in all the genera but Brycinus of Africa. In this genus there is no frontal fontanel. The bridge between the fontanels is either flush with the surface or sunk beneath it; the occipital process varies directly with the depth of the species, and serves to bridge the space between the skull and first interneurals, *i. e.* the space over the coalesced vertebrae which lack interneurals. In the deeper species the process is curved or bent upward and is long, reaching as much as one third of the distance of its base from the dorsal. In the slenderest species it is short and insignificant. It is always grooved to its tip, the groove leading to the parietal fontanel.

The eyes are always large, the species depending largely on living and moving food. The cheeks may be narrow or deep and are one third or entirely covered by the second suborbitals.

The premaxillary teeth are always in at least two series. The inner series consists of from 4–12 graduated; three to many-pointed (a few may be conical) teeth arranged in a regular series. The outer row is very variable both in the group and in individual species and ranges from one or more teeth near the middle of the premaxillary, to a complete, compact series of teeth, narrower than those of the inner series in Tetragonopterus. If the outer row consists of four or more teeth the third tooth usually drops out of line and tends to form a third series of teeth. In *Moenkhausia melanogramma* the third tooth is entirely withdrawn from the line of the others. In the related Brycon in which the teeth are more numerous than in the genera of this subfamily, the fourth tooth and a few others also drop out of line and join the third tooth of the lower inner series which has moved forward. Other teeth of the inner series have also moved forward giving rise to a third series of teeth. A third series of teeth has independently arisen in Creagrutus and Bryconops, and in the Bryconinae.

The maxillary may have no teeth, or a few may be crowded along the part of the margin nearest to the premaxillary, or it may have conical or tricuspid teeth along its entire margin. Usually the variation in any one species is very limited, but in *Astyanax fasciatus nicaraguensis* there is a variation of from one to nine teeth in the maxillary.

The teeth in the lower jaw may all be alike and graduate, or the lateral teeth may be more or less abruptly smaller, the more abruptly the more probably the lateral teeth will be conical. The larger teeth, 3–6 in number, may form a nearly transverse series or be arranged in a curve.

The denticles of the individual teeth of the inner series of the premaxillary may be in a straight line, *i. e.*, the teeth may be strictly incisors or, the line joining the cusps may be more and more curved so that it will be U-shaped, the open part of the U forward. The teeth in the lower jaw are usually the reverse of those of the inner series of the upper jaw.

Gill-rakers are usually slender and not very long, they are all but absent in one genus, Scissor. The gill-membranes are free from each other, the nares close together. The breast is flat or rounded, never keeled. The scales are usually cycloid, rarely crenate or even ctenoid. They vary from 26 to about 60 in the lateral line, which is variously developed.

The caudal may be naked, the scales of the sides passing on to its base and

ending in slightly enlarged scales, or the scales may become minute on the caudal adhering and covering the lobes to a greater or less extent. The anal may similarly have simply a basal sheath or may be covered to near its tip with minute scales.

The scales may be regularly imbricate or in certain regions there may be interpolated rows. In some species there are but a few interpolated scales, *i. e.*, a single series becomes divided into two above the anal. The point of division becomes more and more removed from the anal and the number of divided series increases. In long slender species, or larger-scaled, deep species, there are no interpolated rows. In deep, many-scaled species they sometimes become numerous. Closely allied species or even varieties may differ in this respect. In *Astyanax fasciatus* individuals with interpolated series are rarely found except in the Rio Parahyba where the usual variety has been entirely replaced by one with interpolated series.

The dorsal is short, of between 9 and 12 rays, counting everything, and its origin is usually in the middle of the body. The adipose dorsal is small but almost always well developed. The caudal is always forked, the lobes equal or subequal, rarely markedly different. The anal is another variable element. Its origin usually below or behind the last dorsal ray may (Psellogrammus and Phenacogaster) fall below its origin. Other things being equal the deeper species have the larger number of anal rays. The number of rays varies from 10 to 48.

The reach of the pectorals and ventrals varies with the shape of the fish. In deep species with long anal they overlap, in slender species they ordinarily do not reach each other. The notable exception to this is found in Gephyrocharax.

The alimentary canal varies but little from the entire length of the fish. There are a few pyloric coeca.

The air-bladders are large, the posterior about twice the length of the anterior, curved down behind in the deeper species.

The range of color is limited. In life the caudal of the male is frequently cherry-red, the dorsals and anal (and caudal in females) are frequently yellow. A shoulder-spot of varying shape is usually present. There is usually a silvery lateral band overlying a black band which becomes evident in formalin preparations. There is frequently a dark spot on the base of the caudal which is often continued on the middle caudal rays. In *Moenkhausia dichrourus* and *Bryconamericus exodon* the tips or bands across the caudal lobes are dark. In *Moenk-*

hausia lepidurus and the species of Creatochanes the middle rays and upper caudal lobes are black. In *Astyanax lineatus* and *A. steindachneri*, in *Moenkhausia latissimus*, and in Hollandichthys and Pseudochalceus dark lines follow the spaces between successive rows of scales. The dorsal and anal are marked with black in a few species.

The points of greatest variability within a genus are: —

1. The depth and all that this carried with it, length of occipital process, rows of scales, number of rays of anal. 2. The size of the mouth and the dentition. 3. The degree of armature of the cheek. 4. The scaling of the caudal, anal, predorsal, and preventral areas. 5. The degree of development of the lateral line.

Contrasted Generic Characters.

The following mutually exclusive characters are found variously combined in different genera. The characters appearing in the largest number of genera are given in the first column.

A. Caudal fin naked.	*a.* Caudal scaled.
B. Lateral line complete.	*b.* Lateral line incomplete.
C. Maxillary with few teeth or none.	*c.* Maxillary with teeth along its entire edge.
D. Premaxillary teeth in two series.	*d.* Premaxillary teeth in three series.
E. Cheeks partly naked.	*e.* Cheeks entirely covered by the third suborbital.
F. Anterior edge of maxillary a simple curve.	*f.* Anterior edge of maxillary sigmoid.
G. Predorsal line scaled.	*g.* Predorsal line naked.
H. Teeth of the sides of the dentary abruptly smaller.	*h.* Teeth of the sides of the dentary graduated.
I. Premaxillary meeting the maxillary of an angle.	*i.* Maxillary-premaxillary border a simple curve.
J. Scales entire.	*j.* Scales etenoid.
	j. Scales crenate.
K. Anal naked except at the base.	*k.* Anal scaled to near its tip.
L. Lateral line nearly straight.	*l.* Lateral line sharply decurred in front.
M. Preventral area with normal scales.	*m.* Preventral area with paired scales.
N. Gill-rakers setiform.	*n.* Gill-rakers lanceolate.
O. Adipose fin present.	*o.* Adipose fin wanting.
P. Origin of anal behind origin of dorsal.	*p.* Origin of anal under or in front of origin of dorsal.
Q. Caudal without glandular scales.	*q.* Caudal with glandular scales.

The characters appearing in the larger number of genera and given in the first column are all found in Astyanax, which may for that reason, be the central,

possibly the most primitive member, of the subfamily. Poecilurichthys, which differs from it only in having the character I instead of L, is scarcely distinguishable.[1]

The different characters of the first column are found in various combinations with most of the characters of the second column. Thus *A* is found in combination with all (not counting its contrasted character, *a*) except *k* and *l*. *B* is found in combination with all but *o* and *p*. *C* is found in combination with all the characters of the second column and the same is true of all the rest of the characters of the first column.

Polyphyletic Characters.

It is quite certain that the characters of the right-hand column of the contrasted generic characters have sometimes, at least, been independently derived from the characters of the left-hand column, not only by the different genera possessing the character, but sometimes by different species of the same genus. That is, some of the genera possessing characters given in the second column are of polyphyletic origin.

Beginning at the bottom of the list, the character *o* is found in Hasemania from southeastern Brazil, and in the very different genus, Nematobrycon, from the west of the western Cordilleras of Colombia. The two genera are not related, and are widely separated geographically. There can be no doubt but that they have independently lost the adipose fin.

The next undoubted case is that indicated by *g*. This character is found in Poecilurichthys, scarcely distinct from Astyanax, and in Gymnocorymbus, a very different fish. Here again the character has very probably been independently acquired by the two genera.

[1] In Indiana Univ. Studies, 1914, No. 20, I have tried to carry the inference a step further.

"The common possessions of all members of the Tetragonopterinæ enumerated above, permit us to picture the ancestral type of the subfamily. In brief, it must have been a fish similar in most characters to *Astyanax fasciatus* Cuvier. This species, besides possessing all the characters common to all members of the subfamily, possesses also many of those positive (as contrasted with absent) characters enumerated for the family, and lacks some characters, like the highly specialized scaling of the ventral surface, ctenoid scales, extreme length of anal, extreme development of second suborbital, which are evidently highly specialized characters in a few of the genera. It is more widely distributed than any other species and has given rise to numerous variations.

It represents an average in length of head (4.3), depth, (2.6–3); length of anal (about 30); scales (about 38); size of eye (2.5–3); general shape (compressed subfusiform); position of dorsal (its base being in the space above the origins of the ventral and anal); size of mouth; and the characters of the teeth. The fossil fishes found at Taubaté — south of Rio de Janeiro — are similar to it in most characters. They are a little larger and may be members of the genus Brycon. In all but the teeth, they are very similar to *Astyanax fasciatus*."

The next case is that of *c*, the enlarged third suborbital. This character is found in Knodus with a scaled caudal and in Creagrutus, Piabina, and Bryconamericus with a naked caudal. The last three genera are undoubtedly closely related and for the present purpose count as one. Knodus is a Bryconamericus in all but its scaled caudal. We are, therefore, compelled to assume either that if the ancestors of Knodus had the caudal scaled, that it has paralleled Bryconamericus in the character of its cheek or that if its ancestors were identical with those of the latter genus that its caudal has independently acquired scales.

The case presented by the character *d*, three rows of premaxillary teeth, is much simpler and clearer. This character is found in Microgenys, Creagratus, Piabina, and Bryconops. It is quite certain that the latter genus has been derived from an ancestor like Creatochanes and that the others have been derived from an Astyanax-like ancestor. Microgenys, Creagratus, and Piabina, on the one hand, and Bryconops on the other, have independently acquired three series of teeth. In this case the steps by which this has been accomplished are indicated in a variety of species of the subfamily. In many species alternate teeth of the front series of the premaxillary are withdrawn from the line of the rest, thus forming an incipient third series. In *Moenkhausia melogramma* and in *Bryconamericus exodon* this process has almost yielded additional genera with three series of teeth. The modification from one to the other condition is a perfectly progressive one, without notable breaks or saltations.

The next character *c*, teeth along the entire maxillary, has again been independently derived from *C* several times. Here we have not only the evidence of several distinct, not closely related, genera which have the character but also the evidence from changing species. I have elsewhere called attention to some specimens referred to as *Astyanas aeneus nicaraguensis*. Of thirty-five specimens from Lake Nicaragua, there are nine with two teeth, two with three teeth, five with four teeth, five with five teeth, five with six teeth, five with seven teeth, three with eight teeth and one with nine teeth in the maxillary. The normal number is two. Phenacogaster is in a similar state of transition. Pristella, Hemibrycon, Nematobrycon, Hollandichthys, and Pseudochalceus have acquired complete dentition for their maxillaries in at least three independent groups.

The most interesting and conclusive evidence of the independent origin of the same character in different genera is presented by the character *b*, the incompleteness of the lateral line. Not only have we the evidence from widely divergent genera with this character, but we again have species in a state of true mutation. Most remarkable of all is one species of which I have been able

to examine hundreds of specimens from the Amazon, not one of which showed signs of mutation, while the specimens coming from another region are in an evident state of mutation.

Genera with a complete lateral line and the genera with an incomplete lateral line to which they have given rise are:—

Genera with lateral line complete.	*Genera with lateral line incomplete*
Tetragonopterus	none.
Entomolepis	none.
Moenkhausia	Hemigrammus (further changed into Pristella and Thayeria).
Astyanax	Hyphessobrycon (into Hasemania).
Knodus	none.
Markiana	none.
Gymnocorymbus	none.
Ctenobrycon	Psellogrammus.
Creatochanes	Brycochandus.
Bryconops	none.
Creagrutus	none.
Piabina	none.
Microgenys	none.
Bryconamericus	none.
Zygogaster	none.
Ceratobranchia	none.
Landonia	none.
Deuterodon	none.
Hemibrycon	Hollandichthys, Pseudochalceus, and Nematobrycon.
Phenacogaster	Vesicatrus.
Scissor	none.
Henochilus	none.
Psalidodon	none.

The deviation is so evident in a number of cases that the polyphyletic origin of the charaeter *b*, an incomplete lateral line, is beyond the faintest shadow of a doubt.

Without considering sporadic individuals of otherwise constant speeies, the speeies which are undoubtedly mutuating at the present time are *Hemigrammus inconstans*, *Moenkhausia cotinho*, *Phenacogaster beni*, *Astyanax mutator*, and *Hyphessobrycon poecilioides*. The details for these species are given under their descriptions. Another species which has crossed the line but has not reached a state of equilibrium is *Psellogrammus kennedyi*. Many of the details of this species are again given under the proper caption.

Of *Ctenobrycon hauxwellianus* I have been able to examine over fourteen hundred specimens from various places on the Amazon. In all of these the lateral line is complete. In at least six specimens out of nineteen from the Lagoa

Parnagua, Paranahyba basin, the lateral line "stutters." This species, in other words, is mutuating at Parnagua. *Moenkhausia cotinho* is similarly locally mutating and the same seems to be true of *Hyphessobrycon poecilioides* and *Astyanax fasciatus.*

The scaling of the caudal I am not able to cope with satisfactorily. It is certain that it has several times been acquired independently by different members of the family, if not by different members of the subfamily under consideration.

Selective Grouping of Characters.

Another line of inquiry leads us to consider whether the contrasted unit characters are entirely combined as if by chance or whether there is a selected combination. The characters from *g–q* are found in but one or two genera and these may be omitted from the discussion since they would needlessly complicate it.

Taking only the first six pairs of contrasted characters, there are 62 or 64 possible combinations. Considering each combination a distinct genus we should have 64 genera, without considering the characters between *g* and *q*. In reality we have but about half as many.

Taking only the first three characters we should have eight possible combinations. An examination of the genera shows that six of these combinations are actually found, but not by any means in the same proportions. If we take the first four characters, each of which has probably several times, and independently, been modified into its contrasted character, these four pairs give us sixteen possible combinations. Of these only eight actually occur.

A certain amount of selective grouping is thus found, if we take only three contrasted pairs of characters, a greater amount of selective omission if we take four pairs and this increases rapidly as we increase the number of contrasted forms. It is evident that either many of the possible combinations have never arisen, or, having appeared, they have not been preserved.

Polyphyletic Genera.

In my paper, Indiana University Studies, 1914, no. 20, I wrote —

"This independent origin of characters is responsible for the fact that some of the accepted genera of the Tetragonopterinæ are of polyphyletic origin, i. e. our definitions of genera are in many cases enumerations of characters frequently independently acquired, not enumerations of the characters of the ancestral type of the genus from which the species have diverged. A result of this independent divergence is that frequently in a restricted, isolated area the species of different genera represented in the area are more nearly related to each other than to members of their own genera in remote regions. For instance *Astyanax*

festæ and *Bryconamericus peruanus* of the Pacific slope of Ecuador are more intimately related than *festæ* is to *Astyanax anterior* of the upper Amazon. And in this case, *Astyanax brevirostris* or *Bryconamericus brevirostris* whichever it may be, is intermediate between the two. I am not competent to say whether *brevirostris* is moving from *Bryconamericus* to become an *Astyanax*, or whether it has just completed the reverse process. Certainly *festæ* and *brevirostris* are more intimately related, have had a common ancestor at a less remote time, than either of them with an *Astyanax* or *Bryconamericus* of southeastern Brazil.

We recognize two types of genera, one a group of closely related species, descended from a common ancestor and having certain distinguishing characters in common. Phenacogaster is such a genus. The peculiar scaling of the ventral surface has been developed but once; and the species are all closely allied, differing from each other in but a few characters. The other, a polyphyletic type, consists of species having a certain combination of definite characters in common which easily distinguish members of the genus, but which, instead of indicating a single ancestral line from which the species have diverged, are acquired possibly one at a time along distinct lines converging to a common definition. Sometimes the polyphyletic origin can be detected, sometimes not. Bryconamericus seems to me to be such a genus; Hemibrycon, Deuterodon, and the larger genera are probably also polyphyletic.

"Since it is difficult, or impossible, to say in any case which of the given characters has appeared first, it is extremely difficult to point out lines of evolution leading to different genera or species. We can only insist that certain innate possibilities may become actualities anywhere along the line, possibly wherever they may prove advantageous, though the advantage, to say the least, is not always obvious.

"We may be permitted to assume that the more frequent character is the primitive one, although this is certainly not always a safe assumption."

Deuterodon with the character *h* is a genus of polyphyletic origin. *Deuterodon iquape* is found in southeastern Brazil, *Deuterodon nasatus* in Central America. These two species technically belong to the same genus, genetically they are most certainly not derived from an immediate common ancestor and it is very probable that *Deuterodon pinnatus* and *Deuterodon potaroensis* from Guiana, and *Deuterodon aeanthogaster* from the Paraguay, are also independent derivatives from the genus Astyanax.

A somewhat similar case is presented by a character not mentioned in the list, because I hesitate to propose a generic designation for it. It is this: — In the vast majority of the species of Characins, the innominate bone is feeble and entirely concealed. In *Deuterodon acanthogaster* and in *Astyanax mucronatus*, this bone has become firm and the anterior end projects out of the body as a distinct spine. There is no doubt whatever that this modification is arising independently in the two species.

It must be quite evident from the foregoing that the subfamily is a paradise for the student of divergent evolution. But the very conditions that make it of interest to the student of evolution make it the despair of the systematist whose object is to express relationship by grouping the species in an orderly array of genera and the individuals in an orderly array of species, always, if

possible, in the form of the conventional phylogenic tree. In order to better express the relationship of smaller groups of species the genera have been made as small as consistent with facts. The Tetragonopterinae seem to form an interlacing fabric rather than a branching tree. An illustration of the interest and difficulty is given by the series of genera Poecilurichthys, Ctenobrycon, Psellogrammus. The genus Poecilurichthys as here understood, grades insensibly into the genus Astyanax, and perhaps should have been retained united with the latter. Be that as it may, *P. spilurus* is much more closely related to *Ctenobrycon hauxwellianus* than it is to any species of either Poecilurichthys or Astyanax, and yet there is scarcely a technical character by which it can be separated from the remaining species of Poecilurichthys and united with Ctenobrycon. The latter is sharply distinguished by ctenoid scales from all other members of the subfamily. In an another direction, the specimens of *Ctenobrycon hauxwellianus* from Paranagua form a complete bridge so far as the technical characters are concerned, between the genera Ctenobrycon and Psellogrammus. From the parental form, *P. spilurus*, the Amazonian *Ctenobrycon hauxwellianus* has become generically distinct. *C. hauxwellianus* in its turn, in Paranagua, is becoming and, in Paraguay, has developed the character which distinguishes Psellogrammus.

The difficulties of the systematist could of course be obviated by retaining all of these things in the single old genus Tetragonopterus, but this procedure would neither remove the facts nor explain them.

I have attempted to express the relationship of the genera by the accompanying diagram, in which Astyanax occupies the center, and in which it is made to appear that the scaled caudal has appeared once, of which I am not at all certain, and in which the line of the outer ellipse indicates the boundary within which the lateral line is complete. This boundary has been crossed many times and by different radiating lines.

Fig. 1.— The genera Astyanax, and Moenkhausia, within the central oval, are closely allied and the difference between them is partly bridged by the species *M. intermedia*. They are considered typical and central for the subfamily. From Moenkhausia have radiated directly Markiana, Gymnocorymbus, Tetragonopterus, and Entomolepis. It is left in doubt whether the genera Hemigrammus and Hyphessobrycon have diverged independently from Moenkhausia and Astyanax, and then converged till now only the scaled and naked condition of the caudal separate them, or whether they have been derived from one of the above and then developed or lost the caudal scales. The same applies to the genera Bryconamericus and Knodus. The species *Astyanax mutator* and *Hyphessobrycon proteus* furnish bridges between Hyphessobrycon and Astyanax. *Moenkhausia cotinho* and *Hemigrammus inconstans* furnish a similar bridge between Hemigrammus and Moenkhausia. From Astyanax many lines have radiated, some of which have been continued beyond the line of the outer oval, which indicates that their lateral line has become broken. Where a bridge exists between the so-called genera this has been indicated by extending the name of the genus beyond its boundary or by supplying the name of the species which constitutes the bridge in brackets. The origin of two of the radial lines is uncertain, a fact indicated by an interrogation point.

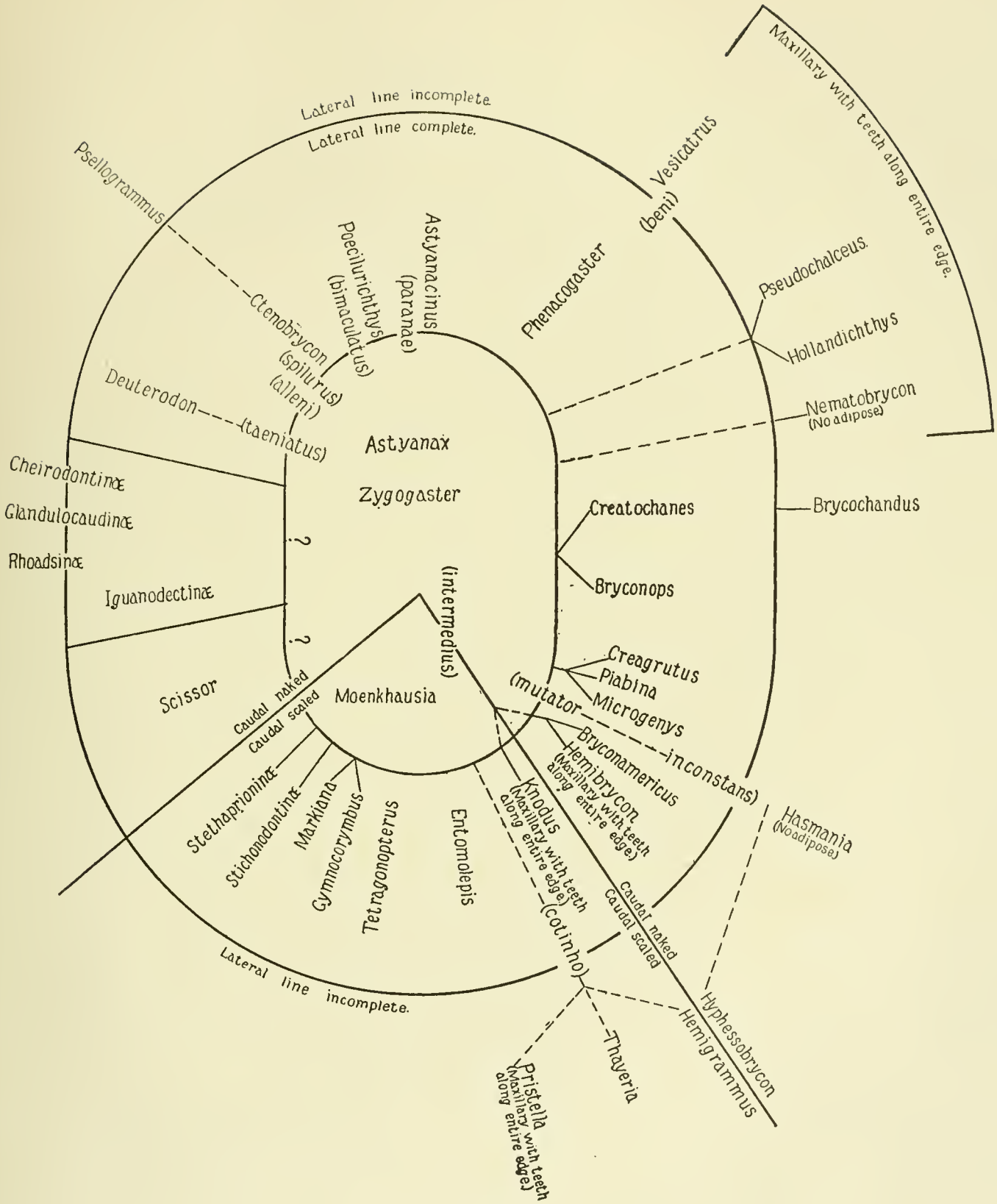

Maxillary with teeth along entire edge.
Lateral line incomplete.
Lateral line complete.
Psellogrammus
Vesicatrus (beni)
Poecilurichthys (bimaculatus)
Astyanacinus (paranae)
Phenacogaster
Pseudochalceus
Hollandichthys
Ctenobrycon (spilurus) (alleni)
Deuterodon (taeniatus)
Nematobrycon (No adipose)
Astyanax
Zygogaster
Cheirodontinæ
Glandulocaudinæ
Rhoadsinæ
Iguanodectinæ
Creatochanes
Brycochandus
Bryconops
(intermedius)
Creagrutus
Piabina
Microgenys
(mutator
inconstans)
Bryconamericus
Hemibrycon (Maxillary with teeth along entire edge)
Scissor
Caudal naked
Caudal scaled
Moenkhausia
Stethaprioninæ
Stichonodontinæ
Markiana
Gymnocorymbus
Tetragonopterus
Entomolepis
Knodus (Maxillary with teeth along entire edge)
(Cotinho)
Hasmania (No adipose)
Caudal naked
Caudal scaled
Lateral line incomplete.
Hyphessobrycon
Hemigrammus
Thayeria
Pristella (Maxillary with teeth along entire edge)

Figure 1.

Key to the Genera.

a. Upper lip covering the teeth of the premaxillary; dentary with a single series of teeth.

b. Some or all of the teeth serrate or notched.

c. Gill-rakers setiform or branched.

d. Preventral area with a median series of scales or with normal scales irregularly arranged, or more or less trenchant with the scales of the two sides bent over the middle.

e. Maxillary border a simple more or less pronounced curve, or with a break in the symmetry of the curve at the end of the tooth bearing portion.

f. Caudal fin at least partly covered with small, normal scales.

g. Lateral line complete (see also under *Hemigrammus inconstans*, *Moenkhausia cotinho*).

h. Predorsal area with a median series of scales which are not notably smaller than the other scales; D. 10–11.

i. Anal with a basal sheath of scales, its margin straight or emarginate.

j. Lateral line much decurved in front, frequently several odd scales in front between it and the next regular series; depth at least half the length; preventral area flat with sharply bent scales on the sides; profile depressed over the eyes; occipital crest $\frac{1}{3}$ of the distance from its base to the dorsal; outer series of premaxillary teeth complete; anal long. . 1. *Tetragonopterus* Cuvier.

jj. Lateral line little decurved, parallel with the row of scales below it.

k. Scales crenulate; an enlarged scale on each side of the base of the occipital crest. . . . . 2. *Entomolepis* Eigenmann.

kk. Scales entire; no enlarged scale on sides of the occipital crest.

(*l.* Preventral area trenchant. . . . . *Stichonodontinae*).

ll. Preventral area rounded.

(*m.* A procumbent predorsal spine. . . . . *Stethaprioninae*).

mm. No procumbent predorsal spine.

n. Second suborbital leaving a naked area between it and the lower limb of the preopercle; at least five teeth in the inner row of the premaxillary; outer series of premaxillary teeth in a line parallel with the inner series except that one tooth frequently retreats from the line of the others. . . . . 3. *Moenkhausia* Eigenmann.

nn. Second suborbital in contact with the suboperculum below; four teeth in the inner row of the premaxillary. Similar to Bryconamericus. . . . . 4. *Knodus* Eigenmann.

ii. Anal scaled to near its tip; caudal unequally lobed; anal margin convex. 5. *Markiana* Eigenmann.

hh. Predorsal line largely naked, a few scales of the sides near the dorsal with their margins bent over the back; D. 11 or 12; ventrals in front of the dorsal; anal emarginate or rounded. . . . . 6. *Gymnocorymbus* [1] Eigenmann.

gg. Lateral line incomplete.

o. Lower caudal lobe much the longer; maxillary without teeth. 7. *Thayeria* Eigenmann.

oo. Caudal lobes equal or subequal.

p. Maxillary with teeth along its entire length. 8. *Pristella* Eigenmann.

pp. Maxillary teeth, if present, crowded on the upper anterior angle. 9. *Hemigrammus* Gill.

ff. Caudal fin naked except at its base.

[1] Poptella (Stethaprioninae) is almost identical with this genus but contains a hidden predorsal spine.

q. Premaxillary teeth in two series.

r. Second suborbital not in contact with the preopercle below, or with 5 teeth in the inner series of the premaxillary.

s. Lateral line incomplete. See Psellogrammus.

t. Few teeth if any near the upper angle of the premaxillary.

u. An adipose fin.....10. *Hyphessobrycon* Durbin.

uu. No adipose fin.....11. *Hasemania* Ellis.

tt. Maxillary with teeth along its entire edge.

v. Anterior teeth of the lower jaw all alike, tricuspid; anterior pair of premaxillary teeth little larger than the rest...12. *Hollandichthys* Eigenmann.

vv. Lateral teeth of lower jaw enlarged, the fourth usually largest; middle teeth of premaxillary much enlarged.....13. *Pseudochalceus* Kner.

(*vvv.* Anterior teeth of the lower jaw all alike, multicuspid; caudal scaled..8. *Pristella* Eigenmann).

ss. Lateral line complete.

w. Teeth of the sides of the lower jaw more or less abruptly minute.

x. Maxillary-premaxillary border angulated where they meet.

y. Scales cycloid.

14. *Astyanax* Baird & Girard.

(*z.* Predorsal line scaled.....*Astyanax*.

zz. Predorsal line at least partly naked. *Poecilurichthys* Gill).

yy. Scales ctenoid at least on breast; anal long, 39–47, predorsal line scaled.

A. Lateral line complete.

15. *Ctenobrycon* Eigenmann.

AA. Lateral line stuttering.

16. *Psellogrammus* Eigenmann.

xx. Maxillary-premaxillary border a continuous curve, half as long as the head.

17. *Astyanacinus* Eigenmann.

ww. Teeth of the lower jaw all alike in character and regularly graduate from in front to the last tooth on the sides; two teeth in the front row of the premaxillary on each side; teeth of the second row multicuspid incisors with a contracted base, their anterior and posterior surfaces alike, convex, without distinct ridges....18. *Deuterodon* Eigenmann.

www. Teeth of the lower jaw similar, the lateral ones much wider than the anterior ones; maxillary with two very broad incisors whose combined width is about half the length of the maxillary....19. *Landonia* Eigenmann.

rr. Second suborbital in contact with the lower limb of the preoperele; four teeth in the inner series of the premaxillary.

B. No adipose fin; lateral line incomplete; outer and middle caudal rays of the male filiform.

20. *Nematobrycon* Eigenmann.

BB. Adipose fin present.

C. Anal very short, with but ten rays.

21. *Microgenys* Eigenmann.

CC. Anal moderate or long.

D. Outer row or premaxillary teeth the dominant one. Gill-rakers branched.

22. *Ceratobranchia* Eigenmann.

DD. Inner row of premaxillary teeth at least as well developed as the outer. Gill-rakers simple.

E. Few teeth along the upper portion of the maxillary.

23. *Bryconamericus* Eigenmann.

(*F.* Males with a pouch covered with scales at the base of the caudal.

Argopleura Eigenmann.

FF. Males without a pouch on the caudal.

Bryconamericus.)

EE. Teeth along the greater part or along the entire edge of the maxillary.

24. *Hemibrycon* Günther.

qq. Premaxillary teeth in three series.

G. Anal short of not more than 14 rays.

25. *Creagrutus* Günther.

GG. Anal of 20 or more rays.

26. *Piabina* Reinhardt.

ee. Maxillary border meeting premaxillary border at a right angle, its upper anterior margin then describing a quarter circle and continued in a direction nearly parallel with that of the premaxillary border; maxillary slender, partially slipping under the preorbital and first suborbital for nearly its entire length. Plate **2**, fig. 5.

II. Lateral line incomplete.

27. *Brycochandus* Eigenmann.

III. Lateral line complete.

I. Premaxillary teeth five-pointed, in an outer row of 6–10 teeth; anterior mandibular teeth stronger than those of the premaxillary, 10–12 in number; sides of

the lower jaw with a long row of very small single-pointed teeth.

28. *Creatochanes* Günther.

II. Premaxillary teeth in three series.

29. *Bryconops* Kner.

(*dd.* Preventral area compressed, the scales of the two sides separated by a series of narrow median scales, the marginal scales of the two sides with their lower margins straight; outer ventral rays filiform.....*Zygogaster* Eigenmann [1]).

ddd. Preventral area with two series of large overlapping scales; origin of anal in advance of the origin of the dorsal or but little behind it; premaxillary with an inner series composed of several tricuspid and several conical teeth; the outer series of the premaxillary of two or three tricuspid and usually one or more conical teeth.

J. Lateral line complete; caudal naked.

30. *Phenocogaster* Eigenmann.

JJ. Incomplete lateral line.

31. *Vesicatrus* Eigenmann.

bb. Teeth all conical; mouth very large, the lower jaw entering the profile.

32. *Genycharax* Eigenmann.

cc. Gill-rakers short, lanceolate; anal long (29); lateral line complete; maxillary with conical teeth along half of its length; premaxillary and mandibular teeth as in Tetragonopterus.

33. *Scissor* Günther.

aa. Upper lip not covering the premaxillary teeth.

K. Premaxillary teeth in a main outer series and a minor inner series of two or more teeth; a pair of conical teeth behind the main series of the mandibulary teeth in front.

34. *Henochilus* Garman.

KK. Premaxillary with one series of teeth; no conical teeth in the lower jaw.

35. *Psalidodon* Eigenmann.

[1] This has been made a subgenus of Astyanax.

1. Tetragonopterus Cuvier.

τετρας four, γωνία angle, πτερον, το, wing = square winged.

Tetragonopterus Artedi, Seba, Locupl. rerum, 1758, **3**, pl. 34, fig. 3, (*argenteus*).
Tetragonopterus Cuvier, Règne animal, 1817, **2**, p. 166, (*argenteus*). Eigenmann, Rept. Princeton univ. exped. Patagonia, 1910, **3**, p. 438.

Type.— *Tetragonopterus argenteus* Cuvier.

Small fishes, pug-nosed, much compressed and very deep, the depth at least half the length; humped at the occiput, concave over the eyes; interorbital broad, rounded; snout very short, the maxillary nearly vertical; nostrils separated by a valve; a long frontal fontanel extending beyond middle of eye; parietal fontanel continued as a groove to the tip of the occipital crest, which reaches $\frac{1}{3}$ to the dorsal; cheek largely covered by the suborbital; opercle very short (nearly four times as high as long, in the type); premaxillary teeth in two rows, the teeth of the outer series small, of nearly uniform size, the row more or less regular, the teeth of the inner series larger, graduated, multicuspid, the cusps of each tooth arranged in a curve, the middle cusp much the longest; several large, graduated, several pointed teeth in the front of the lower jaw, abruptly minute teeth on the sides; maxillary with or without teeth on its upper anterior edge; gill-membranes entirely free from the isthmus; gill-rakers long, slender; fins all well developed, the anal long, 32–37; scales entire, large on the middle of the sides, becoming smaller in all directions, notably toward front of anal [1]; lateral line complete, much decurved, several scales between its origin and that of the regular series below it, caudal scaled; preventral area flat, bounded by sharp angles, a median series of scales on the breast; seven or more series of scales between the lateral line and the dorsal; postventral surface trenchant; tongue thick, but little free.

Vertebrae 10 + 19; alimentary canal about 1.4 the length over all.

This genus, most nearly allied to Moenkhausia, is readily distinguished from it by the greatly decurved lateral line which is not parallel with the row of scales below it in front.

Habitat.— Orinoco and Guianas, Amazons and south to Rio de Janeiro and La Plata.

[1] In a specimen of *T. argenteus* the exposed edge of the 9th scale of the lateral line is about twice as high as the exposed edge of the 4th, equal to two scales just below the beginning of the dorsal, greater than the width of the flat ventral surface, equal to the scales of the lateral line *plus* the series above and below it on the caudal peduncle, or equal to $\frac{2}{3}$ the depth of the caudal peduncle.

Key to the Species.

a. A. 36 or 37; depth 1.6–1.8 rarely 2; eye in adult less than interorbital; scales toward occiput decreasing in size; occipital process bordered by 5–7 scales on each side; caudal lobes scaled for about half their length; distance of dorsal from tip of snout greater than the distance of the ventrals from tip of snout; ventrals equidistant from tip of snout and last third or last fourth of anal; pectorals reaching beyond origin of ventrals; 12 to 16 azygous, predorsal scales. 1. *argenteus* Cuvier.

aa. A. 32 or 33; depth 1.66–2; eye in adult at least equal to the interorbital; occipital process bordered by 3 or 4 scales on each side; caudal lobes densely scaled to near their tip; dorsal and ventrals about equidistant from tip of snout; ventrals equidistant from tip of snout and end of anal; pectorals usually not reaching origin of ventrals; 8 or 9 azygous predorsal scales. Scales 7–29 to 34–3.5; a caudal spot.....2. *chalceus* Agassiz.

aaa. A. 32; depth 1.66; eye 2.7 in the head, a little less than the interorbital, which is 2.33 in the head; pectorals reaching a little beyond origin of the ventrals; scales 8.5–31–4.5; caudal scaled to its tip.....3. *huberi* Steindachner.

aaaa. A. 31–33; depth 1.66–1.8; eye 2.2–2.4 in the head, greater than interorbital; ventrals nearer the snout than the dorsal, equidistant from snout and last fourth of the anal; pectorals reaching past origin of ventrals; scales 7–28 to 29–3.5 to 4.....4. *gibbosus* Steindachner.

1. Tetragonopterus argenteus Cuvier.

Plate 2, fig. 1; Plate 4, fig. 2.

Tetragonopterus argenteus Cuvier, Mem. Mus. hist. nat., 1848, **4**, p. 455 (Bahia?); Müller & Troschel, Horae ichthyol., 1845, **1**, p. 13 (Brazil & Guiana); Fische British Guiana, 1848, p. 634 (Amucu); Cuvier & Valenciennes Hist. nat. poissons, 1848, **22**, p. 132 (Bahia?); Kner, Characinen, 1859, p. 38 (Cujaba; Guiana); Günther, Cat. fishes Brit. mus., 1864, **5**, p. 318; Steindachner, Ichthyol. beitr., 1876, **5**, p. 46 (Santarem); Flussf. Südamer., 1879, **1**, p. 7 (Orinoco, near Ciudad Bolívar); 1882, **4**, p. 13 (Amazons, Iquitos); Eigenmann & Eigenmann, Proc. U. S. N. M., 1891, **14**, p. 52; Ulrey, Ann. N. Y. acad. sci., 1895, **8**, p. 273; Boulenger, Trans. Zool. soc. London, 1896, **14**, p. 35 (Descalvados, Northern Paraguay); Pellegrin, Bull. Mus. hist. nat., 1899, **5**, p. 157 (Apuré; Manaos); Boulenger, Boll. Mus. univ. Torino, 1900, **15**, no. 370, p. 2 (Urucum); Eigenmann, Ann. Carnegie mus., 1907, **4**, p. 126, fig. 10 (Puerto Murtinho; Bahia Negra); Rept. Princeton univ. exped. Patagonia, 1900, **3**, p. 439; Mem. Carnegie mus., 1912, **5**, p. 319, fig. 37 (Tumatumari); Fowler, Proc. Acad. nat. sci., Phil., 1914, p. 242 (Rupununi).[1]

Tetragonopterus rufipes Valenciennes, d'Orbigny, Voy. Amer. Merid. Poissons, 1847, pl. 11, fig. 1 (Buenos Aires); Cuvier & Valenciennes, Hist. nat. poissons, 1848, **22**, p. 136 (Buenos Aires); Günther, Cat. fishes Brit. mus., 1864, **5**, p. 318 (Buenos Aires); Eigenmann & Eigenmann, Proc. U. S. N. M., 1891, **14**, p. 52; Perugia, Ann. Mus. civ. storia nat. Genova, 1891, ser. 2, **10**, p. 42 (Candelaria, Rio Paraná; Rio Paraguay at Asuncion); Lahille, Rev. Mus. de la Plata, 1895, **6**, p. 7 (Punta Lara, Isla Santiago); Ulrey, Ann. N. Y. acad. sci., 1895, **8**, p. 272.[2]

[1] *Tetragonopterus argenteus* about 100 mm. Cuvier's type (said to contain thirty-four anal rays by Cuvier and forty by Valenciennes) has thirty-seven and a half anal rays; dorsal broken. Lateral line 30; a dark vertical bar at origin of caudal; two vertical bars behind the head.

[2] The types, three specimens, of *T. rufipes* in the Jardin des Plantes from Buenos Aires are in bad condition; they are 100, 110, and 118 mm. long. These are evidently the ones figured and described by Valenciennes who wrote the label. They have A. 37; interorbital slightly convex. It is impossible in their state of disintegration to distinguish them from *T. argenteus*, with which they are very probably identical. I have not seen the type of *T. sawa*.

Tetragonopterus sawa Castelnau, Exped. Amer. Sud. Poissons, 1855, p. 65, pl. 33, fig. 1 (Rio Coxas).
Tetragonopterus chalceus Eigenmann & Kennedy (non Agassiz), Proc. Acad. nat. sci. Phil., 1903, p. 523 (Rio Paraguay; Arroyo Trementina).

Habitat.— From the Orinoco and Guiana to the Paranahyba basin, Amazons and Paraguay, Parana to Buenos Aires. Not in the coastwise streams between Buenos Aires and the Paranahyba. It is rare in Guiana and the only species in the La Plata basin.

Specimens examined.[1]

Catalogue number	Number of specimens	Size in mm.	Locality	Collector
18982[2]	3	80–125	Tabatinga	Bourget
20793, 20794, 20797, 20799	15	55–125	Hyavary	Bourget
820	1	119	Fonte Bôa	Fletcher
20748	1	118	Fonte Bôa	Agassiz
20819	7	70–130	Içа	James
20745	14	65–115	Tocantins	Agassiz
20859	3	100–110	Jutahy	James, Thayer, Talisman.
20822	2	100–115	San Paolo	James
20726	4	87–104		Agassiz
20728	6	69– 85	Lake Hyanuary	Agassiz
20976, 29982	6	75–about 130	Lago Alexo	Thayer
20741	5	68– 84	Tajapurú	Agassiz
20718	4	71– 78	Villa Bella	Agassiz
20847	1	60	Obidos	Bentos
20776, 20777, 20786, 20791, 27729	13	49– 85	Santarem	Bourget.
?	9	63– 85	Monte Alégre	Agassiz
20953	1	83	Jatuarana	Navez
2978 C.	2	69– 72	San Joaquin, Guaporé basin	Haseman.
2976 C.	4	67– 86	Santarem	Haseman.
21007	1	about 90	José Fernandez	Coutinho.
21052, 21053	6	64–108	Rio Puty, into Rio Paranahyba	St. John.

[1] I have also examined the types of *T. argenteus* and *T. rufipes*.

[2] Numbers without designation indicate the Museum of Comparative Zoölogy; C. = Carnegie Museum, Pittsburgh; I. = Indiana University; U. = U. S. National Museum.

Catalogue number	Number of specimens	Size in mm.	Locality	Collector
21051	75[1]	66–107	Rio Puty	St. John.
21056	12	bad	San Gonçallo, Rio Paranahyba	St. John.
10022 I.	1	about 90	Arroyo Trementina, Paraguay	Anisits.
10023 I.	2	about 56–about 85	Asuncion, Paraguay	Anisits.
10253 I.	3	about 82–about 95	Bahia Negra, Paraguay	Anisits.
10255 I.	8[2]	about 64–100	Puerto Murtinho, Paraguay	Anisits.
1489 C.	1	67	Tumatumari, Brit. Guiana	Eigenmann.
3317 C.	3	24–104	Asuncion, Paraguay	Haseman.
3318 C.	1	33	Sapucay, Paraguay	Haseman.
3319 C.	35	38– 96	Villa Hays, Paraguay	Haseman.
2977 C.	3	28– 80	Corumba, Rio Paraguay	Haseman.
2979 C.	1	55 to base of caudal	Rio Jauru, into Rio Paraguay	Haseman.
2980 C.	4	58– 67	Caceres, Rio Paraguay	Haseman.

This species can always be readily distinguished by its great depth and the two vertical humeral bars. The latter, though in some cases shadowy, are evident in all of the specimens examined.

Head 3–3.66; depth 1.6–1.8, rarely 2; D.11; A. usually 36 or 37 [3]; scales 7 to 9–32 to 35–3½–5.[4] Eye 2.25 in the young, 3 in the adult; interorbital less than the eye in the young, greater than the eye in the adult.

Deep, compressed, ventral profile evenly rounded from the tip of the lower jaw to the origin of the anal; anal basis nearly straight, very steep. Dorsal profile depressed over the eyes, humped to the dorsal; dorsal basis straight, oblique; postdorsal to caudal nearly straight, oblique. Preventral area with a median series of flat or slightly keeled scales, bordered on the sides by series of angularly bent scales; postventral area with a median series of small, narrow

[1] Of these, twenty-five ♂, judging by the anal armature, range from 66–90 mm., only three reaching the latter size; the smallest female is 80 mm. long, while thirty-six of them exceed the length of the largest male. Of twelve taken at random six have thirty-six anal rays, four have thirty-seven, two have thirty-eight.

[2] Of these, three have thirty-five anal rays, two have thirty-six, one has thirty-eight, and two have thirty-nine; three have eight scales between the dorsal and lateral line, four have nine; all but one have four and one half scales between the lateral line and the ventrals, one has five. The scales in the lateral line are thirty-two in two, thirty-three in two, thirty-four in two, and thirty-five in two.

[3] Counting all rudimentary rays at the beginning and the double one at the end as one, out of fifty-six specimens taken at random, four have thirty-four, nine thirty-five, eighteen thirty-six, fourteen thirty-seven, seven thirty-eight, and four thirty-nine.

[4] In Amazonian specimens fifteen out of eighteen had seven scales between the origin of the dorsal and the lateral line, the other three had eight. Out of twenty-four Amazonian specimens one has thirty-one, one thirty-two, twelve have thirty-three, nine thirty-four, one has thirty-five. Thirteen out of eighteen have three and one half scales between the ventrals and the lateral line, five have four. In the specimens from Puerto Murtinho there is a larger number of scales above and below the lateral line. Three out of seven have eight, the other four have nine scales between the dorsal and lateral line; six out of seven have four scales between the lateral line and the anal and one has five. The scales in the lateral line do not differ.

bent scales, bordered on the sides with small asymmetrical scales, the area compressed; predorsal region keeled; predorsal scales small, crowded, the median series of scales (12–16) reaching to occipital process.

Occipital process long, one third of the distance from its base to the dorsal, bordered by from five to seven scales on each side, the groove of the occipital fontanel reaching to its tip; interorbital convex; second suborbital not covering the entire cheek; maxillary equal to the distance from tip of snout to pupil. From five to seven (rarely four to eight) teeth forming a continuous front series of the premaxillary, the third (in one case the fourth) usually withdrawn somewhat from a straight line. Five (rarely four or six) teeth in the inner row; maxillary with three (rarely one, two, or four) small teeth. Lower jaw with four, or very rarely five, large teeth; the second largest, graduated to the fourth or fifth; many small teeth on the side.[1] Gill-rakers about 9 + 13, the longest one third the diameter of the eye.

Scales deeply imbricate, an occasional line on the scales of the sides, lines more numerous on those near the caudal; scales of the sides continuous with the anal sheath consisting of three or four rows of scales in front and tapering to a single series on the last ray. Lateral line obliquely descending on the first seven scales, then nearly straight; a well-developed axillary scale; caudal lobes scaled for about half their length. Origin of dorsal about equidistant from tip of snout and base of middle caudal rays, its first divided ray two and one half times as long as the last, three times in the length.[2] Anal in the adult low, its margin nearly straight; in the young the anterior rays are higher than the rest. Origin of ventrals much nearer tip of snout than the dorsal, equidistant from

[1] An examination of a variety of specimens gives the number of teeth in the:

	mandible 4 5	first series of premaxillary 4 5 6 7 8	second series of premaxillary 4 5 6	maxillary 1 2 3 4	Localities
males	10	1 5 4	10	7 2	Rio Puty
females	7 3	7 3	10	1 1 5 3	Rio Puty
	6	2 4	6	5 1	Içá
	13	1 3 6 3	1 10 2	3 10	Santarem
	6	1 3 2	4 2	2 4	

In this table the first line of figures gives the different numbers of teeth found on the structures mentioned above and the following lines represent the number of individuals having the given number.

[2] In the specimen from Tumatumari the first divided ray is three and one half times as high as the last ray which is two thirds the length.

tip of snout and last fourth of anal. Ventrals reaching to anus or anal; pectorals beyond the origin of the ventrals.

Two oblique dark bars, one from in front of the dorsal to the pectoral, the other parallel to it from behind the tip of the occipital crest; a dusky predorsal line continued on the first dorsal ray; a dark spot at end of caudal peduncle, inconspicuous in the adult, sometimes extending across the entire peduncle and base of caudal in the young. Anal sometimes margined with dusky. Dorsal membrane thickly punctate. Otherwise bright silvery.

About twelve of the anterior anal rays of the male with hooklets turned toward the base of the fin, about twelve of the hooklets on the middle half of the first rays, the number decreasing backward.

Air-bladder very large, each section a cone, their bases contiguous, the posterior section nearly twice as long as the anterior, bent downward and extending to the origin of the anal, the diameter of its large end equaling two thirds the length of the head. Alimentary canal about one and two fifths times the length over all.

Vertebrae 10 + 19 counting the coalesced as one. Tip of occipital process extending much beyond the posterior face of the skull.

2. Tetragonopterus chalceus Agassiz.

Plate 4, fig. 1; Plate 98, fig. 4.

Coregonus amboinensis Artedi, Species, 1738, p. 44.

Tetragonopterus argenteus Artedi, Seba, Lecupl. rerum, 1758, **3**, tab. 34, fig. 3, p. 174 (Rio Negro; Surinam).

Tetragonopterus chalceus Agassiz, Spix Selecta gen. et spec. Pisc. Bras., 1829, p. 70, tab. 33, fig. 1 (Brazil); Cuvier & Valenciennes, Hist. nat. poissons, 1848, **22**, p. 140; Kner, Characinen, 1859, p. 38 (Rio Negro; Surinam); Günther, Cat. fishes Brit. mus., 1864, **5**, p. 320 (British Guiana, Essequibo); Cope, Proc. Acad. nat. sci. Phil., 1871, p. 260 (Ambyiacu); Steindachner, Ichthyol. beitr., 1876 **5**, p. 47 (Xingu, near Porto do Moz); Eigenmann & Eigenmann, Proc. N. S. N. M., 1891, **14**, p. 52; Ulrey, Ann. N. Y. acad. sci., 1895, **8**, p. 227; Vaillant, Bull. Mus. hist. nat., 1899, **5**, p. 154 (Carsevenne); Pellegrin, Bull. Mus. hist. nat., 1899, **5**, p. 157 (Apuré); Fowler, Proc. Acad. nat. sci. Phil., 1906, p. 440 (Ambyiacu; Marañon; Pebas); Eigenmann, Rept. Princeton univ. exped. Patagonia, 1910, **3**, p. 438; Mem. Carnegie mus., 1912, **5**, p. 320, fig. 38 (Wismar; Bartica; Tumatumari; Crab Falls; Rockstone); Fowler, Proc. Acad. nat. sci. Phil., 1914, p. 242 (Rupununi).

? Tetragonopterus artedii Cuvier & Valenciennes, Hist. nat. poissons, 1848, **22**, p. 128 (Surinam); Günther, Cat. fishes Brit. mus., 1864, **5**, p. 319; Eigenmann & Eigenmann, Proc. U. S. N. M., 1891, **14**, p. 52; Ulrey, Ann. N. Y. acad. sci., 1895, **8**, p. 272.[1]

[1] The type of this species was given to the Paris museum by the Leyden museum. It measures 68 mm. to base of caudal. Lat. line 31; A. 32 (Valenciennes says 40).

Tetragonopterus schomburgkii Cuvier & Val., Hist. nat. poissons, 1848, **22**, p. 137 (Essequibo)[1].
Tetragonopterus ortonii Gill, Proc. Acad. nat. sci. Phil., 1870, p. 92 (Brazil ?); Cope, Proc. Amer. philos. soc., 1869, **11**, p. 566 (Pebas).

Habitat.—Guianas and Amazons, Rio San Francisco.

Specimens examined.[2]

Catalogue number	Number of specimens	Size in mm.	Locality	Collector
20747	8	76–118	Manes, Rio Madeira	Agassiz.
20994	1	88	Serpa	Thayer.
20714	1	65	Villa Bella	Agassiz.
20828	1	about 68	Obidos	James.
20781	8	81–92	Santarem	Bourget.
21009	1	135	?	Justa.
20923	2	62–88	San Francisco below the falls	Hartt.
20852	2	about 68	Jutahy	James, Thayer, and Talisman.
20746	7		Porto do Moz	Agassiz.
1377 C. 11852 I.	4	58–68	Wismar, Demerara River	Eigenmann.
1378 C. 11853 I.	6	65–71	Bartica, Essquibo River	Shideler.
1379 C. 11854 I.	15	47–76	Tumatumari, Potaro River	Eigenmann.
1380 C. 11855 I.	18	50–91	Crab Falls, Essequibo River	Eigenmann.
1381 C. 11856 I.	48	41–49	Rockstone, Essequibo River	Eigenmann.
2989 C.	2	65–80	Maciél, Rio Guaporé	Haseman.
2990 C.	21	largest 61	Santa Rita, San Francisco Basin	Haseman.
2991 C.	13	60–76	Joazeiro, Rio San Francisco	Haseman.
2992 C.	3	54–80	Penedo, Rio San Francisco	Haseman.
2993 C.	3	52–63 (to base of caudal)	Penedo, Rio San Francisco	Haseman.
2994 C.	6	48–81	Pirapora, San Francisco	Haseman.
2995 C.	5	35–75	Barreiras, Lagoas of Rio Grande, Rio San Francisco	Haseman.
2996 C.	19	largest 42	Boqueirão, near mouth of Rio Preto	Haseman.
2997 C.	31	71	Lagoa Pereira, Rio San Francisco	Haseman.

Head 3.2–3.66; depth $1\frac{5}{6}$–2; D. 11; A. usually 32 or 33.[3] Scales 7–29 to

[1] The type, one specimen in bad condition, from the Essequibo, 160 mm. A. 32; scales large, about 30; depth a little less than 2; head 3.66; eye very large, about 2.33 in the head, about equal to the convex interorbital; maxillary with three small teeth; pectorals extending to ventrals; anal not falcate, dorsal behind the vertical from the ventrals, not reaching the adipose. No occipital process. The nape of the specimen seems to have met with an accident and it is difficult to determine how much of the difference between it and the types of *T. rufipes* is due to bad preservation and to the mutilation. The eye is much larger than in the type of *T. rufipes*. Caudal spot not continued on the middle rays.

[2] I have also examined the types of *T. artedii* and *T. schomburgkii*.

[3] Out of twenty-one one has twenty-eight, one has thirty, four have thirty-one, eight have thirty-two, five have thirty-three, and two have thirty-four anal rays.

34[1]–3½. Eye 2.2–2.3; interorbital 2.2–2.66, equal to the eye or less than the eye in the adult.

Deep, compressed, ventral profile evenly curved to the anal, not as greatly arched as in *T. argenteus;* anal basis nearly straight. Dorsal profile depressed over eye; arched to the dorsal; dorsal basis oblique, straight; postdorsal part of profile nearly straight. Preventral area with a median series of flat or slightly keeled scales, bordered on the side by a series of angularly bent scales; postventral area with a series of small, narrow bent scales, the area compressed; predorsal region bluntly keeled, the scales not notably small, the median series of eight or nine scales reaching the occipital process.

Occipital process long, one third of the distance from its base to the dorsal, bordered by three or four scales on each side; groove of the occipital fontanel reaching to its tip; interorbital convex; second suborbital not covering the entire cheek; maxillary equal to the distance from tip of snout to pupil; five or six teeth in the front series of the premaxillary (five in thirteen cases, six in fourteen), the third tooth from the middle usually withdrawn from the line; five teeth in the inner series of the premaxillary; usually three teeth (two in five cases, three in eighteen, four in four) on the maxillary; lower jaw with four large graduated teeth and many small ones on the side.

Gill-rakers about 4 + 13, the longest about one third the diameter of the eye.

Scales deeply imbricate, striae lacking or an occasional line on the scales, the striae fairly numerous near the caudal; scales of the sides continuous with the anal sheath which is composed of three series of scales near its anterior end, becoming reduced to a single series on the last rays; caudal lobes densely scaled to near their tips in the adult, the scales much more readily caducous than those of the sides; lateral line obliquely descending on the first seven scales then nearly straight. A well-developed axillary scale.

Origin of dorsal equidistant from tip of snout and tip of adipose or caudal, its highest ray three to four times as high as its lowest, two to three in the length; anal in the adult with its margin nearly straight; the anterior rays being but slightly prolonged; origin of ventrals equidistant from the tip of snout with the dorsal and equidistant between the tip of snout and end of anal, reaching to anus; pectorals usually falling short of the ventral, except in Guiana specimens.

[1] Of ten specimens from Lagoa Pereira one has twenty-nine, three have thirty, four thirty-one, and two thirty-two. Of ten specimens from Rockstone one has thirty-one, three have thirty-two, five thirty-three and one has thirty-four.

Fresh specimens from the Essequibo River have the fins more or less suffused with red. The first prolonged anal ray milk-white, the first fully formed dorsal ray either dark or milk-white. In these specimens there is a humeral spot prolonged above and below with a bar and a second bar fainter but evident extends down from the dorsal parallel with the first. There is a well-marked dark band-like spot at the base of the caudal. These approach *T. argenteus* in color. The first three developed rays of the dorsal sometimes reach the caudal, the first three anal rays are also sometimes prolonged to a length about two thirds that of the anal base.

No humeral bars in old alcoholic specimens in which the caudal spot is more or less obscure with age; dorsal membranes thickly peppered; general color bright and iridescent, silvery.

Air-bladder very large, the sections conical, the posterior about twice as long as the anterior, sharply pointed behind, its largest diameter, at its base, equals about half the length of the head.

Alimentary canal somewhat longer than the entire fish.

Vertebrae 10 + 19; occipital process extending much beyond the posterior face of the skull.

3. Tetragonopterus huberi Steindachner.

Tetragonopterus huberi Steindachner, Anz. K. akad. wiss. Wien, 1909, no. 12, p. 172 (Rio Purus); Eigenmann, Rept. Princeton univ. exped. Patagonia, 1910, **3**, p. 438.

Habitat.— Rio Purus, Upper Amazon Basin.

This species known only from the brief description of two specimens is said to differ from *T. argenteus* chiefly in having its caudal completely scaled. It is evidently closely allied if not identical with *T. chalceus*.

Head 2.7; depth 1.66; D. 11; A. 32; scales 8.5–31–4.5. Eye 2.7 in the head; interorbital 2.33.

Belly with lateral keels; profile of head concave, that of nape very convex; maxillary with 3–4 teeth; height of prolonged dorsal rays 3 in the length; pectorals little shorter than head, reaching beyond origin of ventrals; ventrals $1\frac{1}{6}$ in the head; origin of ventrals in front of the vertical from the dorsal; predorsal area keeled; distance between dorsal and adipose equal to the head.

A row of scales along the base of the anal; traces of two dark vertical humeral bands; caudal spot wanting in a small specimen, faint in a large one.

4. Tetragonopterus gibbosus Steindachner.

Tetragonopterus gibbosus Steindachner Süsswf. südöstl. Bras., 1876, **3**, p. 4, pl. 1, fig. 1 (Rio Parahyba); Eigenmann & Eigenmann, Proc. U. S. N. M., 1891, **14**, p. 52; Ulrey, Ann. N. Y. acad. sci., 1895, **8**, p. 277; Eigenmann, Rept. Princeton univ. exped. Patagonia, 1910, **3**, p. 438.

Habitat.— Parahyba.

This species is known only from the types in the Vienna Museum. If the caudal is naked as the artist has drawn it and if as Dr. Steindachner says the "Oberkiefer, unter der Loupe gesehen, am vorderen Rande dicht mit Zähnen besetzt...." then this species does not belong to Tetragonopterus as here understood. In the characters other than the above and those mentioned in the key this species closely resembles the *Tetragonopterus chalceus* which geographically is its closest neighbor.

Head 3.6; depth 1.66–1.8; D. 10–11; A. 31–33; scales 6.5 or 7–28 or 29–3.5 to 4. Eye 2.2–2.4 in the head; interorbital 3 in the head.

Much compressed, the profile little concave over eye, rising rapidly; ventral profile regular to the anal; depth of caudal peduncle 5 in the greatest depth; mouth oblique, terminal; 10–11 mandibular teeth, with the exception of the outer pair more than twice as long and thick as the premaxillary teeth; second suborbital nearly covering the cheek; origin of the dorsal a little in advance of the middle; pectorals reaching a little beyond origin of the ventrals, equal to the length of the head in the male, considerably shorter in the female, ventral considerably in advance of the vertical from the dorsal, not reaching anal; basis of anal scaled; its base half an orbital diameter longer than the head.

Caudal only moderately forked and about as long as the head. Lateral line rapidly descending on the first six scales; scales of the middle of the sides very deep, radiae variable, 1–7; the three preventral series of scales very bluntly keeled; the lateral keels forming the edge of the belly. Scales of the nape apparently not decreasing in size.

A light yellow lateral band; humeral and caudal spots very faint, the former sometimes absent.

2. Entomolepis, gen. nov.

ἔντομος, cut; λεπίς, ή, scale. In allusion to the crenate scales.

Type.— *Tetragonopterus steindachneri* Eigenmann.

Caudal scaled; lateral line but little decurved, complete; the scales crenate; an enlarged scale on either side of the occipital process; maxillary with few

teeth, second suborbital leaving a narrow naked area on the cheek. This genus differs from Moenkhausia in having crenate instead of entire scales.

Habitat.— Middle and Upper Amazon.

1. Entomolepis steindachneri (Eigenmann).

Plate 3, fig. 1–3, Plate 5, fig. 3.

Tetragonopterus lineatus Steindachner (non Perugia), Ichthyol. beitr. 1891, **15**, p. 26, pl. 2, fig. 1 (Iquitos).

Tetragonopterus steindachneri Eigenmann, Proc. U. S. N. M., 1893, **16**, p. 53.

Moenkhausia steindachneri Eigenmann, Rept. Princeton univ. exped. Patagonia, 1910, **3**, p. 437

?Astyanax oligolepis Fowler (*non* Günther), Proc. Acad. nat. sci. Phil., 1906, p. 439, fig. 37 (Peruvian Amazon).

Habitat.— Middle and Upper Amazon.

Aside from the types in Vienna I have examined the following, from which the present description is drawn:

Two specimens, 20967, 71 and 74 mm. to base of caudal. Cudajas. Thayer & Bourget.

Head 3.6; depth 2.26; D. 10 or 11; A. 25 to 26; scales 5–32 to 33–4 or 4.5. Eye 3–3.2; interorbital 2.4 in head.

Deep oval, without distinct humps or depressions; preventral area somewhat compressed, keeled; postventral area more narrowly compressed; predorsal area with a blunt median keel; a median series of nine scales reaching from dorsal to occipital process.

Occipital process about one fifth of the distance of its base from the dorsal, bordered by one or two scales, the first of which is unusually large; skull heavy and broad; frontal fontanel nearly circular, not half as long as the occipital fontanel; interorbital convex; second suborbital corrugate, leaving but a very narrow naked border; interopercle distinctly visible from the side; maxillary 3.33 in head; four teeth in the outer series of the premaxillary, the middle two close together, the third withdrawn from the line of the others; five teeth in the inner series; one or two teeth on the maxillary; mandible with four large graduated teeth. Gill-rakers 8 and 10, very slender, the longest two thirds of the pupil.

Scales large, *crenate*, very regularly imbricate, the exposed margin of those on the caudal peduncle three fourths as high as the highest on the middle of the sides; the scale at the base of the occipital crest much larger than usual; each

scale with a few widely diverging striae and numerous shorter ones along the margin; anal sheath composed of two series of scales in front, of a single series behind; caudal lobes scaled for about half their length; lateral line not greatly descending, the rows of scales above and below it parallel with it; a well-developed axillary scale.

Dorsal about equidistant from snout and caudal, short and high, its height 3.66 in the length; anal margin nearly straight, but the anterior rays nearly twice as high as the posterior; pectorals reaching ventrals, the latter not to the anal, equidistant from tip of snout and base of last anal ray.

Brownish above, silvery on the sides; a series of dark lines between the series of scales; a faint humeral spot just above the fourth scale of the lateral line; a large caudal blotch not extending forward or to the end of the middle rays.

This species can easily be distinguished by its crenate scales, compressed breast, and peculiar coloration.

It is very probable that Fowler's *Astyanax oligolepis* is this species. If the rows of scales are as Fowler figures then his specimens are distinct, differing from all other species of the group.

3. Moenkhausia Eigenmann.

For William J. Moenkhaus.

Moenkhausia Eigenmann, Smithsonian misc. coll. quart., 1903, **45**, p. 145.

Type.— *Tetragonopterus xinguensis* Steindachner.

Small fishes differing from Tetragonopterus in the course of the lateral line. The line is straight or but little decurved. In other characters some of the species of this genus agrees with Tetragonopterus. The species differ greatly in shape. The extreme in one direction are very compressed and very deep, the depth being more than one half the length. The extreme in the other direction are quite slender, subspindle shaped, the depth being only one fourth of the length. The preventral area may be either narrowly rounded, as in *M. profunda, latissima, comma,* and *oligolepis,* more broadly rounded as in *M. chysargyrea,* or flat with lateral angles as in *M. jamesi, megalops, et al.* There is a regular median series of scales in front of the ventrals. The anal rays range from 18–37, in number; the scales from 22–39; the lateral line is complete except as noted under *M. australe, cotinho,* and *sanctae filomenae.* In these species the

lateral line is complete in the specimens from some localities and incomplete in those from other localities, or both types may be found in the same place. The genus differs from Astyanax in having its caudal partly covered with minute scales. It merges directly into the genus Hemigrammus which has an incomplete lateral line.

Habitat.—Very abundant in Guiana and the Amazons, extending south to the Paraguay and Paraná Rivers and to the Rio Doce. It has not been recorded from the Magdalena Basin from Central America, the western slope of South America, or the lower reaches of the La Plata.

Key to the Species.

a. Depth considerably more than half of the length; much compressed. A. 33; scales 8–34–7.
1. *bondi* Fowler.

aa. Depth 2–2.66 in the length, sometimes 3.25 in *M. costae*. See also *aaa*. A. 23–36; Occipital process one third to one fifth as long as the distance from its base to the dorsal.

b. Five or more scales between the lateral line and ventrals.

c. Horizontal dark lines between the rows of scales; no caudal spot; humeral spot very long, pointed in front. Median line behind occipital process sometimes covered by the bent over margins of the scales along the side of the compressed back. Head 3.75; depth 2; A. 31–36; scales 5½ or 6–33 to 36–6; preventral area narrowly rounded; predorsal area sharply keeled; occipital process two sevenths of the length from its base to the dorsal; origin of ventrals equidistant from tip of snout and origin of last third of anal.
2. *latissima* Eigenmann.

cc. No horizontal dark lines; seven scales between dorsal and lateral line; ventrals equidistant from tip of snout and last anal ray, or nearer the latter; a median series of scales from the dorsal to the occipital process.

d. A caudal spot; a large faint vertically crescentic humeral spot; mouth minute; preventral area flat; head 4; depth 2–2.2.

e. A. 33–35; scales 7–35 to 37–5; anal margin nearly straight; maxillary short, its length equals length of snout; premaxillary teeth three- or five-pointed; maxillary without teeth; five graduated teeth on each side of the lower jaw; second suborbital leaving but a narrow naked area; maxillary 4 in head; mandible 3.....3. *jamesi* Eigenmann.

ee. A. 31; scales 7–36–6; maxillary with a single tooth; premaxillary teeth four or five pointed; four graduated teeth on each side of the lower jaw; maxillary less than snout in length, 5 in head; mandible 3 in head; second suborbital but two thirds the width of the cheek.....4. *justae* Eigenmann.

dd. No caudal spot; a well-defined longitudinally ovate or round humeral spot; preventral area rounded; mouth large; fins large.

f. Maxillary with many teeth; eye large, 2–2.5 in the head, the profile much depressed over the eye; interorbital less than diameter of eye; one fourth of the cheek naked; humeral spot elongate, beginning over the second scale of the lateral line; depth 2.1–2.6; head about 4; A. 34–37; scales 7 or 8–34 to 37–6 or 7; highest dorsal ray not reaching adipose.....5. *doccana* (Steindachner).

ff. Maxillary with 1 or 2 teeth, equal to the distance from tip of snout to pupil; eye 2.5

or more in the head, equals interorbital; profile not much depressed over eye; humeral spot short, nearly equidistant from opercle and dorsal; depth 2.1–2.4; A. 26–30; scales 7–33 or 35–5 or 6; highest dorsal ray usually not reaching adipose.

6. *chrysargyrea* (Günther).

fff. Maxillary with two teeth; maxillary longer than the distance from tip of snout to pupil; eye 2.5 or more in the head, equals interorbital; the profile scarcely depressed; humeral spot prolonged forward to a point; depth 2+; A. 26; scales 6–32–5; highest dorsal rays reaching the adipose.....7. *comma* Eigenmann.

bb. Three and a half or four scales between the lateral line and ventrals.

g. Six scales between the dorsal and the lateral line. Depth 2.3; no caudal spot, no humeral spot; A. 26, lateral line 34; maxillary length equals distance from tip of snout to pupil; third tooth of the anterior premaxillary series entirely withdrawn from the line of the rest, *forming a separate series;* maxillary with 2 teeth; a black line along base of anal; occipital process one fifth the distance from its base to the dorsal.....8. *melogramma* Eigenmann.

gg. Five scales between the dorsal and lateral line.

h. A broad black band across the anterior part of caudal. A. 23–28; preventral area narrowly rounded.....(See also *M. cotinho*).

i. Scales 5–29 to 32–4.....9. *oligolepis* (Günther).

ii. Scales 22–26, rarely 28.....10. *sanctae filomenae* (Steindachner).

hh. Caudal without black band.

j. Some striae of the scales diverging from the middle line of each scale in nearly opposite directions, up and down; eye 2.33–2.5 in the head, equal to the interorbital; origin of dorsal directly over the origin of the ventrals; no caudal spot in the adult; a round humeral spot. Anal usually 26–28, emarginate; depth usually 2 (sometimes 2.4) scales 5–24 to 32–4.

11. *grandisquamis* (Müller & Troschel).

jj. Striae of the scales not as under *j*.

k. Depth 2 in the length; anal not emarginate; dorsal rounded, the anterior rays not much higher than the posterior, its origin behind that of the ventrals. Eye 3 in the head, 1.33 in interorbital; scales 5–31–4 (to ventrals); A. 27, its margin straight; head 3.66; depth 2; profile scarcely depressed; maxillary with two teeth, extending somewhat beyond the anterior margin of the eye; preventral area flat; a large caudal spot, not extending to the end of the middle rays.[1]....12. *ovalis* (Günther).

kk. Depth 2.2–2.6 in the length. Upper caudal lobe not black.

l. Eye 2.4 or more in the head.

m. A. 30–33; scales 5.5–37–4.5; head 4.2–4.3; depth 2.4; interorbital smaller than eye; a faint vertical humeral spot; tips of caudal and middle rays faintly dusky.....13. *barbouri* Eigenmann.

mm. A. 26; scales 5–32–4; head 3.33; depth 2.33; maxillary reaching to near middle of eye; no caudal spot; humeral spot large, faint.

14. *xinguensis* (Steindachner).

mmm. A. 23–24; scales 5–30 to 34–3; head 3.75–4; depth 2.3–2.6. Scales with dark margins; a well-developed humeral spot.

15. *browni* Eigenmann.

ll. Eye 2–2.2 in head; interorbital 2.4–3; scales 5–35–4; head 3.6–3.7; depth 2.5–2.66;

[1] Based on type in the British museum.

n. No caudal spot; a vertical humeral spot. A. 28–30.

16. *megalops* Eigenmann.

nn. A median caudal spot; no humeral spot. A. 26.

17. *shideleri* Eigenmann.

kkk. Upper caudal lobe with an oblique black band, continued downward across the caudal peduncle and along the basal portion of the anal. A. 27–28, scales 5.5–32 or 33–3.5; head 3.4–3.75; depth 2.25–3.25. Longitudinal extent of premaxillary insignificant.

18. *costae* (Steindachner).

aaa Depth usually more than 2.75 in the length (2.6 in *M. dichroura*, *M. lata*, and gravid *M. colletti*), anal less than 28 in all but exceptional specimens of *M. dichroura* and *M. lata*.

o. Base of caudal without definite spot or band.

p. Premaxillary very short; maxillary with its anterior margin very convex. Caudal lobes black at the tips, or with a black band across them, their tips white; base of caudal pale; depth usually 3(2.75); A. 25–27 rarely 28; lat. line 36 or 37 (rarely 34, 35, or 39); gill-rakers one third to one half the length of the eye.....19. *dichroura* (Kner).

pp. Anterior margin of maxillary not sharply and evenly curved premaxillary longer than under *p*, the mouth strong.

q. Tips of caudal lobes black or a black band across the lobes.

r. A. 25; scales 5–35–3.5; depth 3.1–3.75.

20. *intermedia* Eigenmann.

qq. Lobes of caudal without well-defined cross-band.

s. Base of anal without a black line.

t. Base of upper caudal lobe yellow or orange, this followed by black which fades toward the tip with water markings.

u. Depth 3–3.5; A. 24 (21–27).

21. *lepidura lepidura* (Kner).

uu. Depth 2.6; A. 26 (25–28); lateral line 33 or 34, middle caudal rays faintly colored.

22. *lepidura lata* Eigenmann.

tt. Upper caudal lobe not black.

v. Depth 3; A. 23 or 24; lateral line 31–33; pectorals not reaching ventrals; upper caudal lobe and sometimes the distal part of the other rays dusky.....23. *lepidura icae* Eigenmann.

vv. Depth 3.4; A. 24; lateral line 37; pectorals not reaching ventrals; caudal lobes plain.

24. *lepidura hasemani* Eigenmann.

vvv. Depth 4; A. 21–23; lateral line 35–36; pectorals to ventrals; usually the middle caudal rays and distal part of all the other rays dusky.

25. *lepidura gracilima* Eigenmann.

ss. Anal with a dark (zigzag) line along its base; silvery lateral line very narrow, bordered with dark above, no caudal spot; upper part of cheek and opercle with numerous chromatophores.

w. Anal rays 23–24; depth 2.6–3.3; lateral line 33–35; a well-defined humeral spot.
26. *colletii* (Steindachner).

ww. Anal rays 18–20; depth 3.33–3.66; lateral line 32–34.....27. *copei* (Steindachner).

oo. A large, conspicuous black spot on the base of the caudal; origin of ventrals equidistant from tip of snout and base of caudal.

x. Second suborbital leaving a wide naked area; five or six teeth in the inner series of the premaxillary; gill-rakers about 9 and 15, one half as long as eye; 2.5 scales between lateral line and front of anal; middle caudal rays jet black, the color spreading over the base of the fin. Depth 3.25; A. 19; eye greater than interorbital.
28. *ceros* Eigenmann.

xx. Second suborbital leaving a very narrow naked area; five teeth in the inner series of the premaxillary; gill-rakers 7 and 9, one fifth as long as eye; 2.5–3.5 scales between lateral line and front of anal; a very large and conspicuous vertically oval spot occupying nearly all the base of the caudal to near the tip of the middle rays, bordered by milk-white; depth 3+; A. 20 or 21; eye about equal or less than interorbital.
29. *cotinho* Eigenmann.

1. Moenkhausia bondi (Fowler).

Plate 14, fig. 3; Plate 100, fig. 7.

Phenacogaster bondi Fowler, Proc. Acad. nat. sci. Phil., 1911, p. 419 (Corisal, Venezuela).
Moenkhausia profunda Eigenmann, Mem. Carnegie mus., 1912, 5, p. 322, pl. 46, fig. 1 (Issorora Rubber Plantation).

Habitat.— Northern Guiana and Venezuela.

I have been able to examine the type of *M. bondi* in the collections of the Academy of Natural Science in Philadelphia and 2207 C. Type of *M. profunda*, 51 mm. Issorora Rubber Plantation. Shideler.

Head 4; depth 1.66–1.8; D. 11; A. 33; scales 8–34–7 (9 to the anal). Eye 2.6; interorbital 2.5.

Very much compressed; the ventral profile nearly a regular section of a circle; dorsal profile not so greatly and less regularly arched; preventral area very narrowly rounded, without a median series of scales, the lateral scales small and their margins bent over the median ridge; predorsal area narrow,

scaled, but without a distinct median series, the scales along the ridge much smaller than those of the sides.

Occipital process reaching one third of the distance to the dorsal, bordered by about five scales on each side; interorbital slightly convex; mouth small; maxillary with the anterior margin convex, equal to snout and anterior width of iris or snout and half the eye. Second suborbital leaving a considerable naked area; maxillary with two teeth, premaxillary with four teeth in the outer series, five in the inner; mandible with four strong teeth, five-pointed, abruptly minute teeth on the sides.

Gill-rakers about a third as long as the eye.

Scales thin, with a few feeble diverging striae, margins convex; anal with a sheath of two rows of scales; lateral line almost straight; no interpolated rows of scales.

Origin of dorsal considerably behind the ventrals, three in the length; anal long, but little emarginate, its origin and base of last dorsal ray equidistant from the snout; pectorals reaching about to middle of ventrals; ventrals not to anal.

A diffuse humeral band followed after a light band by a fainter dark band.

This species is technically a Moenkhausia. In reality its relationship is with Ephippicharax of another subfamily. It differs from Ephippicharax in not having a movable predorsal spine.

2. Moenkhausia latissima Eigenmann.

Plate 5, fig. 2.

Moenkhausia latissimus Eigenmann, Bull. M. C. Z., 1908, **52**, p. 101 (Tabatinga); Rept. Princeton univ. exped. Patagonia, 1910, **3**, p. 437.

Habitat.— Tabatinga.

Specimens examined.

Catalogue number	Number of specimens	Size in mm.	Locality	Collector
20762 20769	22	about 55–92	Tabatinga	Bourget

This species, resembling *Entomolepis steindachneri* in its coloration, compressed preventral region, and keeled predorsal area, is easily distinguished by its entire scales, small nuchal scale, and much longer anal fin.

Head 3.75; depth 2 on an average; D. 11; A 33–35;[1] scales 5.5 or 6–33–36–6.[2] Eye 2.75–4; interorbital 2.5.

Very deep, compressed, profile slightly depressed over eye, ventral and dorsal profiles about equally arched; preventral area narrowly rounded or keeled; postventral area compressed; predorsal area sharply compressed and keeled, with a few notched median scales, further forward the scales of the sides are bent over the sharply compressed area; postdorsal area narrowly rounded.

Occipital process narrow and long, two sevenths in the length to the dorsal, bordered by four scales; interorbital broad, rounded; fontanels narrow, the anterior less than half as long as the posterior which is continued as a groove to the tip of the occipital process; second suborbital large, striate, leaving a narrow naked area between it and the lower limb of the preopercle; maxillary three in head, mandible 2.33. Usually four, rarely three or five teeth in the outer series of the premaxillary, the second and third close together, the third removed from the line of the others, five teeth in the inner series; two, rarely three, in one case one and in one four teeth in the maxillary; lower jaw with four graduated teeth and numerous minute ones.

Gill-rakers 8 + 11, the longest two thirds as long as the pupil.

Scales regularly imbricate, the exposed margin of those on the caudal peduncle but little lower than that of those on middle of the sides, the width of the exposed part a little more than half of the height; a few divergent striae, the margins not crenate; nuchal scales not enlarged; anal sheath composed of two series of scales in front, of a single one behind; lateral line but little decurved, caudal lobes scaled for at least half their length.

Dorsal about equidistant from tip of snout and base of caudal; its height three and a half in the length, its tip when laid back removed by five scales from the adipose. Lower caudal lobe somewhat the longer, three and a fourth in the length; anal emarginate, origin of anal and last dorsal ray equidistant from tip of snout; origin of ventrals below the third scale in front of the dorsal, equidistant from tip of snout and origin of last third of anal, reaching to or nearly to the anal; pectorals reaching the tip of the axillary scale.

No caudal spot; a well-defined, narrow, but very long, humeral spot reaching from above the third to above the ninth scale of the lateral line, on the upper part of the series of scales above the lateral line and the lower part of the series

[1] Of seventeen one has thirty-one, six have thirty-three, five have thirty-four, four have thirty-five and one has thirty-six.

[2] Of sixteen two have thirty-three, two thirty-four, seven thirty-five, five thirty-six.

next above that. The spot is rounded behind, pointed in front, and bordered by a lighter area; horizontal dark lines between successive series of scales.

Vertebrae 11 + 19.

Posterior air-bladder bent conical, its diameter greater than that of the eye, two and a half in its length; anterior air-bladder one and a half in the length of the posterior.

Alimentary canal about equal to the length; containing insects and small fishes.

3. Moenkhausia jamesi Eigenmann.

Plate 5, fig. 1, Plate 100, fig. 8.

Moenkhausia jamesii Eigenmann, Bull. M. C. Z., 1908, **52**, p. 102 (Iça; Obidos; Lago do Maximo; Tajapurú); Eigenmann, Rept. Princeton univ. exped. Patagonia, 1910, **3**, p. 437.

Habitat.— Amazon Basin.

Specimens examined.

Catalogue number	Number of specimens	Size in mm.	Locality	Collector
20816 Cotypes	2	62, 68	Iça	James.
20827 Cotypes	1	53	Obidos	James.
3734 C.	12	50–68	Santarem	Haseman.
3735 C.	1	65	Rio Mamoré	Haseman.

Head 4; depth 2.2; D. 11; A. 32–35; scales 7–35 to 37–5 (to ventrals). Eye 2.4–2.66; interorbital equals eye.

Deep, compressed, ventral profile slightly more arched than dorsal, symmetrically rounded; dorsal profile slightly humped at the end of the occipital process; preventral area flattish, with a median series of scales and a lateral, angularly bent series; postventral area compressed, very narrowly rounded; predorsal area narrowly rounded, with a median series of ten scales reaching from the dorsal to the occipital process.

Occipital process moderate, bordered by four scales on each side; interorbital distinctly and evenly convex; second suborbital leaving a narrow naked area; mouth very small, maxillary short and anteriorly convex, not nearly reaching to end of first suborbital, its length equal to that of the snout. Three or four tricuspid teeth in the outer series of the premaxillary, the second or third very slightly removed from the line; five tricuspid or quinquecuspid graduated teeth in the second row; five rather small, graduated teeth in each side of

the lower jaw, followed by a few minute ones on the side; maxillary without teeth.

About 8 + 12 gill-rakers, about one third as long as the eye.

Scales deeply imbricated, with a few divergent striae; anal sheath of one or two series of scales which are well demarked from the lateral scales; caudal lobes scaled to near their tip; lateral line scarcely decurved; the rows of scales above it and below it parallel with it.

Origin of dorsal nearer the tip of the snout than the base of the caudal; origin of ventrals a little nearer to the tip of snout than the dorsal, equidistant from tip of snout and about end of anal; highest dorsal ray a little more than three in length, the shortest more than two and a half times in the longest. Anal distinctly emarginate in front, the fourth ray two and three tenths times as long as the fourteenth; ventrals scarcely reaching anal, pectorals to ventrals.

A dark vertical caudal spot on the base of the caudal, sometimes on base of all but the outermost rays; the spot not continued on the middle rays; a silvery lateral band half as wide as the eye; an ill-defined vertical humeral spot crossing the space between the fourth and seventh scales of the lateral line; no other dark markings; iridescent, silvery, and brassy.

4. Moenkhausia justae Eigenmann.

Moenkhausia justae Eigenmann, Bull. M. C. Z., 1908, **52**, p. 102 (——); Rept. Princeton univ. exped. Patagonia, 1910, **3**, p. 437.

One specimen 21014 Type 60 mm.

This species is very similar to *M. jamesi* from which it differs in having a tooth on the maxillary; the teeth four- or five-pointed, four teeth on each side of the lower jaw. A. 31: scales 7–36–6; the second preorbital much narrower than in *M. jamesi*.

The exact locality is unknown. The specimen came with others from Dr. Justa through Major Coutinho and was probably found in the neighborhood of Manaos.

5. Moenkhausia doceana (Steindachner).

Plate **14**, fig. 1.

Tetragonopterus doceanus Steindachner, Süsswf. südöstl. Bras., 1876, **3**, p. 14 (Rio Doce); Eigenmann & Eigenmann, Proc. U. S. N. M., 1895, **14**, p. 52; Ulrey, Ann. N. Y. acad. sci. 1895, **8**, p. 277.
Moenkhausia doceana Eigenmann, Rept. Princeton univ. exped. Patagonia, 1910, **3**, p. 437.

Habitat.— Rio Doce, Rio Mucuri.

Specimens examined.

Catalogue number	Number of specimens	Size in mm.	Locality	Collector
20909	38	69–106	Rio Doce	Hartt & Copeland.
20914	4	61–70	Porto Alegre	Hartt & Copeland.
20879 } 20880 }	12	64–106	Sao Matheos	Hartt & Copeland.

This species has hitherto been known from the types only. It is the only species of Moenkhausia in the coastwise streams of eastern Brazil, south of the Rio San Francisco.

There can be no doubt about the identification, although Steindachner says that the entire maxillary border is toothed.

Head 3.7; depth 2+–2.4; D.11 (rarely 12); A. 34–38[1]; scales mostly removed, 7 or 8–34 to 37–6 or 7. Eye 2.14–2.5; interorbital 2.7–3.25.

Much compressed, the ventral profile regularly arched from the chin to the end of the anal; dorsal outline arched as much as the ventral, but less regularly; the occipital process rising rapidly, the profile of the head correspondingly concave; preventral area rounded, with a median series of scales; predorsal area trenchant, with a median series of about eleven scales.

Occipital process a little less than one third of the distance from its base to the dorsal, bordered by about five scales on each side; interorbital convex; frontal fontanel not much shorter than the parietal exclusive of the groove on the occipital process; second suborbital leaving a naked area about one fourth as wide as the covered portion; length of maxillary equals the distance from tip of snout to pupil; mandible equals distance from tip of snout to end of maxillary; usually five teeth in the front row of the premaxillary, the third tooth removed from the line, more rarely three or four teeth; five, more rarely six, teeth in the second series; maxillary most frequently with five teeth; of the maxillaries examined two have three, four have four, twelve have five, six have six, six have seven, and two have eight teeth; mandible with four large teeth, frequently a smaller one on the side, and then a series of minute ones.

Gill-rakers about 8 + 13, one third the diameter of the eye.

Scales caducous, entire, with a few diverging striae, regularly imbricate; anal sheath of a single series of scales; caudal lobes scaled for a third of their distance at least; lateral line very little decurved, the scales below it parallel with it, a few auxiliary scales over the muscles of the anal.

[1] Of seventeen specimens examined two have thirty-four, one thirty-five, six thirty-six, seven thirty-seven, and one thirty-eight rays.

Origin of dorsal a little in advance of the middle, its height four in the length; caudal large, the lower lobe slightly longer, about one third of the length; anal basis equals distance from dorsal to caudal, its origin equidistant from tip of snout and base of middle caudal ray; anal emarginate, the highest anterior ray twice the height of the fifteenth ray; ventrals reaching beyond origin of anal, equidistant from tip of snout and last third of the anal; pectorals reaching to middle or the second third of the ventrals.

A large, horizontally oval, humeral spot, nearly two thirds as long as the head; a silvery lateral stripe not much more than half the width of the pupil; general color, including all the fins dark, the fins with numerous pigment cells.

Vertebrae 12 + 20.

Alimentary canal not equal to the total length. Contains ants in the one dissected.

Measurements of eleven specimens M. C. Z. 20909.

Specimen	Dorsal	Anal	Length mm.	Depth mm.	Head mm.	Eye mm.	Inter-orbital mm.	Premaxillary teeth	Maxillary teeth
1	11	34	80	38	21	8.5	8	5[1]–5[2]	5[3]–6[4]
2	11	36	81	38	20	8	7	5–5	5–4
3	11	37	80	35	19	8	7	5–5	3–7
4	11	36	78	33	19	8	6.5	5–5	6–7
5	12	37	52	22	14	6.5	4.5	5–5	5–6
6	11	36	56	22	15	6	5	5–6	5–5
7	11	37	49	20	13	6	4.5	4–5 3–6	7–5
8	11	36	48	20	13	6	4	4–5	7–7
9	11	37	69	29	18	8	6	5–5	6–5
10	11	39	64	26	16	7	5	4–5	4–4
11	11	36	59	25	15	7	5	5–5	8–7

6. Moenkhausia chrysargyrea (Günther).

Plate 6, fig. 3; Plate 100, fig. 9, 10.

Tetragonopterus chrysargyreus Günther, Cat. fishes Brit. mus., 1864, **5**, p. 328 (Essequibo); Eigenmann & Eigenmann, Proc. U. S. N. M., 1891, **14**, p. 53; Ulrey, Ann. N. Y. acad. sci., 1895, **8**, p. 281.

Moenkhausia chrysargyrea Eigenmann, Rept. Princeton univ. exped. Patagonia, 1910, **3**, p. 45. Mem. Carnegie mus., 1912, **5**, p. 323.

Moenkhausia chrysargyrea leucopornis Fowler, Proc. Acad. nat. sci. Phil., 1914, p. 245 (Rupununi).

Habitat.— Essequibo, Amazons.

[1] Front row. [2] Second row. [3] On one maxillary. [4] On the other.

Specimens examined.

Catalogue number	Number of specimens	Size in mm.	Locality	Collector
3070 C. 11841 I.	43	51–61	Rockstone, Essequibo River	Eigenmann.
1371 C. 11842 I.	7	51–91	Crab Falls, Essequibo River	Eigenmann.
1372 C. 11848 I.	15	53–69	Konawaruk, Essequibo River	Eigenmann.
1366 C.	1	58	Warraputa Cataract, Essequibo River	Eigenmann.
1373 C. 11844 I.	25	52–101	Paekeoo Falls, Essequibo River	Eigenmann.
1374 C. 11845 I.	10	60–87	Tumatumari, Potaro River	Eigenmann.
1375 C.	1	60	Wismar, Demerara River	Eigenmann.
1376 C. 11846 I.	2	58–60	Rupununi River	Grant.
20754	3	About 45–70	Tabatinga	Bourget.
20705	1	About 60	Teffé	Agassiz.
20851	2	About 68 and 75	Jutahy	James, Thayer, and Talisman.
21003 } 21005 }	5	About 56–54	José-Fernandez	Coutinho.

Head 3.5–4; depth 2.4 in young, 2 in old; D. 11; A. 27–30; scales 7–33 to 34–5. Eye 2.5–2.75 in head; interorbital equals eye.

Deep, compressed, subrhomboidal, the anal basis straight, nearly parallel with the upper anterior profile in the young, more oblique in the oldest; profile depressed slightly over the eyes and rounded above the occipital process. Preventral area rounded, with a median series of scales, the lateral series not sharply angulated except just in front of the ventrals; predorsal area keeled, with a median series of about 10 scales from the dorsal to the occipital crest.

Occipital process long, equal to one third of the distance from its base to the dorsal, bordered on the sides by three scales; second suborbital leaving a narrow naked area which is widest below; maxillary not nearly reaching end of first suborbital, but little beyond anterior margin of eye, its length equal to distance from tip of snout to pupil. Four or five teeth in the outer series of the premaxillary; five or six five-pointed, graduated teeth in the inner series; maxillary with one or two minute teeth; lower jaw with four large graduated teeth on each side and many minute ones.

Gill-rakers about 6 + 14, one third as long as eye.

Scales deeply imbricate, with several divergent striae; anal sheath of two scales in front; caudal lobes scaled for more than half their length. Lateral line somewhat descending, parallel with the row of scales below it.

Origin of dorsal equidistant from tip of snout and base of caudal, its highest

ray three in the length; ventrals a little nearer to tip of snout than the dorsal, about equidistant from tip of snout and end of anal; ventrals reaching to anal somewhat shorter in old specimens; pectorals reaching two scales beyond ventrals; anal emarginate, the highest ray about two thirds the length of the base. Iridescent silvery. A deep lying, well-defined, horizontally oval, circular or rhomboidal, black, humeral spot over the space between the fifth to the eighth scale of the lateral line and at least the width of a scale removed from it; a few scattered cells nearer the surface extend from the front of the spot across the lateral line; humeral spot surrounded by a light court behind which there is a faint vertical bar; a narrow silvery lateral line, its width equal to about one fourth the length of the maxillary; no caudal spot; sides variously dotted with chromatophores. In the Tumatumari specimens the scales of the abdomen are margined with dark, there being faint streaks following the rows of scales. Scales of the second row below the dorsal each with an oblique dark band noticeable only with a lens; outer margin of pectoral and ventral dark; middle of anal lobe and bases of the remaining rays yellow; dorsal rays each tinged with yellow at its middle, pectoral tinged with yellow; upper part of iris red. Vertebrae 11 + 19.

Posterior section of air-bladder about twice as long as anterior; its width about equal to the eye; bent down behind and reaching to near the origin of the anal.

7. Moenkhausia comma Eigenmann.

Plate 6, fig. 2.

Moenkhausia comma Eigenmann, Bull. M. C. Z., 1908, **52**, p. 102 (Cudajas); Rept. Princeton univ. Exped. Patagonia, 1910, **3**, p. 437.

One specimen 20972 part Type 77 mm. Cudajas Thayer and Bourget.

A second specimen in very bad condition of the same length and from the same place.

This species can readily be distinguished by its elevated dorsal, and the peculiar humeral spot.

Head 3.4; depth 2+; D. 11; A. 26; scales 6–32(?)–5. Eye 2.5; equal to interorbital.

Deep, compressed, subrhomboidal, the anal basis much steeper than the predorsal profile. Profile very slightly depressed over the eye. Preventral area narrowly rounded, the lateral series of scales without a distinct bend. Postventral area compressed; predorsal area narrowly compressed and keeled, with eight median scales between occipital process and dorsal.

Occipital process long, equal to one third of the distance between its base and the dorsal, bordered on the side by three scales. Second suborbital leaving a naked border distinctly wider than in *M. chrysargyreus;* maxillary rather longer than the distance from tip of snout to pupil, a little more than three in the head.

Three to six teeth [1] in the front row of the premaxillary, five or six in the second row; maxillary with two small teeth; mandible with four large teeth and numerous small ones on the side.

Gill-rakers 7 + 15, a little more than half the length of the pupil.

Scales regularly imbricate, each with a few divergent striae, the exposed portion of those on the caudal peduncle about two thirds of the depth of the exposed portions of those on the middle of the sides; anal sheath composed of two scales in front; (all but one of the caudal scales missing); lateral line but little decurved.

Origin of dorsal a little nearer tip of snout than to caudal, the anterior rays elevated, three in the length, reaching adipose when depressed; caudal lobes equal to height of dorsal; origin of anal equidistant from tip of snout with a point midway between the dorsals, the margin damaged but evidently emarginate, the highest anterior ray reaching at least to the base of the seventh from the last when depressed; ventrals reaching anal, one and a half in the head, their origin equidistant from tip of snout and caudal; pectorals reaching beyond origin of ventrals.

A deep lying, well-defined humeral spot, beginning in a point above the origin of the lateral line increasing in width backward and ending above the seventh scale of the lateral line; a very narrow, silvery lateral line; upper posterior part of the interradial membranes of the dorsal dark; remaining fins hyaline.

Vertebrae 11 + 19.

8. Moenkhausia melogramma Eigenmann.

Plate 6, fig. 1; Plate 100, fig. 4.

Moenkhausia melogrammus Eigenmann, Bull. M. C. Z., 1908, **52**, p. 102 (Tabatinga); Rept. Princeton univ. exped. Patagonia, 1910, **3**, pt. 4, p. 437.

One specimen 20825 Type 40 mm. to base of caudal Tabatinga Bourget

Readily distinguished by the depth and by the black line along the base of the anal.

[1] In the type there are four on the left side and five on the right, but one has evidently been lost from the latter; in the second specimen there are five on the left and three on the right side.

Head 4; depth 2.5; D. 11, counting the divided ray as 2; A. 26; scales 6–34–4. Eye equals twice the length of the snout, 2.4 in the head; interorbital 3 in the head.

Compressed, dorsal and ventral profiles nearly equally curved, the ventral more regularly; profile slightly depressed over eye; preventral area rounded, postventral area compressed; predorsal area slightly keeled, with a median series of ten scales from dorsal to occipital crest.

Occipital process a little more than one fifth of the distance between its base and the dorsal, bordered by three scales on each side; interorbital very slightly convex; second suborbital leaving a naked area on cheek which is widest below; maxillary not reaching to the end of the first suborbital, equal to the distance from tip of snout to pupil. Five teeth in the front row of the premaxillary, the third *entirely* withdrawn from the line of the rest; five graduated teeth in the inner series; two teeth on the maxillary; four graduated, large teeth on each ramus of the lower jaw followed by smaller ones on the side.

Scales deeply imbricate, with a few not greatly divergent striae; anal without a sheath (in this specimen only ?); caudal lobes covered with caducous scales for at least half their length; lateral line scarcely descending in front. Origin of dorsal equidistant from tip of snout and base of caudal, distinctly further from tip of snout than the ventrals; ventrals equidistant from tip of snout and base of penultimate anal ray, reaching not quite to anal, pectorals to ventrals. Anal probably emarginate.

A black line along the base of the anal; a faint dark line along the sides, otherwise faintly silvery without spots.

9. Moenkhausia oligolepis (Günther).

Capaule of the Potaro Indians.

Plate **7**, fig. 4; Plate **95**, fig. 4; Plate **100**, fig. 5.

Tetragonopterus oligolepis Günther, Cat. fishes Brit. mus., 1864, **5**, p. 327 (British Guiana), Eigenmann & Eigenmann, Proc. U. S. N. M., 1891, **14**, p. 53; Ulrey, Ann. N. Y. acad. sci., 1895, **8**, p. 282; Vaillant, Bull. Mus. hist. nat., 1899, **5**, p. 155 (Carnot).

Moenkhausia oligolepis Eigenmann, Rept. Princeton univ. exped. Patagonia, 1910, **3**, p. 437; Mem. Carnegie mus., 1912, **5**, p. 321, pl. 46, fig. 3.

Tetragonopterus agassizii Steindachner, Ichthyol. beitr., 1876, **5**, p. 41, pl. 8, fig. 2 (Tabatinga; Cudajas; Hyavary); Cope, Proc. Amer. philos. soc., 1878, **17**, p. 691 (Peruvian Amazon); Eigenmann & Eigenmann, Proc. U. S. N. M., 1891, **14**, p. 53; Ulrey, Ann. N. Y. acad. sci., 1895, **8**, p. 281.

?Astyanax atahualpuanus Fowler, Proc. Acad. nat. sci., Phil., 1906, p. 436, fig. 36 (Pebas).[1]

?Moenkhausia atahualpiana Eigenmann, Rept. Princeton univ. Exped. Patagonia, 1910, **3**, p. 437.

[1] This species is said to have: Head 3.3; depth 2.75; D. 12; A. 24; lat. l. 26–27.

Habitat.— Amazons and north to Guiana.

I have examined the types of *T. oligolepis* and there is no doubt but that they are identical with *T. agassizii*.

Specimens examined.

Catalogue number	Number of specimens	Length in mm.	Locality	Collector
20756, 20759, 20761, 20775	106	41–95	Tabatinga	Bourget
20854	1	59	Jutahy	James, Thayer, and Talisman
20808	1	85	Manaeapuru	James
20729	8	about 50–66	Lake Hyanuary	Agassiz
20693	8	54–65 (to base of caudal)	Goyaz	
20966, 20972, 20963, 20974, 20975	118	45–85	Cudajas	Thayer and Bourget
21018	81	59–90	Curupira	Coutinho
1361 C., 11835 I.	30	35–96	Holmia, Upper Potaro	Eigenmann.
1362 C., 11836 I.	11	39–118	Arnataima Cateract, Upper Potaro	Eigenmann and Grant
1363 C., 11837 I.	11	33–53	Potaro River, 2 hrs. below Holmia	Eigenmann
1364 C., 11838 I.	7	28–44	Savannah Landing, Upper Potaro	Eigenmann
1365 C., 11339 I.	3	37–61	Erukin, a tributary of the Potaro below Amatuk.	Eigenmann
1367 C.	1	88	Potaro Landing	Eigenmann
1368 C., 11840 I.	8	40–47	Tumatumari	Eigenmann
1369 C.	1	78	Maripieru, branch of Ireng.	Grant.

Head 3.64; depth 2.25 on an average; D. 11; anal most frequently 25 or 26[1]; scales 5–30 to 31–4[2]. Eye 2.5–3 in the head; interorbital wider than eye.

Rather deep, compressed, especially above the anal; ventral profile somewhat more arched than the dorsal, no distinct humps or depressions, the outline subrhomboidal. Preventral area narrowly rounded or with an indistinct median keel, no lateral keels except in the very largest; postventral area compressed, with a median series of bent scales, the scales bordering it not much smaller than those above it; five scales from the median scale to the lateral line;

[1] Of fifty-two specimens, two have twenty-three, six have twenty-four, nineteen have twenty-five, fourteen have twenty-six, ten have twenty-seven, and one has twenty-eight.

[2] Of fifty specimens among those in the M. C. Z., six have twenty-nine, twenty-five have thirty, sixteen have thirty-one and three have thirty-two scales in the lateral line.

predorsal area rounded, with an obscure median keel; eight scales between the dorsal and the occipital process; postdorsal area rounded.

Occipital process equal to about one fifth the distance from its base to the dorsal, bordered by two or three scales on the sides; interorbital broad, but little convex, the frontal fontanel narrower and about half as long as the parietal; second suborbital very broad, covering the entire cheek or leaving a very narrow naked border behind; maxillary but little longer than snout, more than three in the length of the head; four or five teeth in the front row of the premaxillary, the third withdrawn from the line, the second and third and sometimes the fourth close together; five teeth in the inner series; usually two teeth on the maxillary; mandible with four large teeth and a number of minute ones on the sides.

Gill-rakers about 8 + 11, a little more than half the length of the pupil.

Scales very regularly imbricate, the exposed edge of those on the caudal peduncle about two thirds as high as that of the largest scale on the middle of the sides; scales above the lateral line in specimens 50 mm. long with about four nearly parallel striae, in the largest with 6–10 striae, frequently a notch in the margin of the scale at the end of a line; anal sheath composed of two or three series of small scales in front of a single series behind; caudal lobes scaled to near their tip; lateral line nearly straight from its sixth scale; axillary scale well developed.

Dorsal equidistant from tip of snout and base of caudal, its highest ray nearly four in the length, its eighth ray about two thirds of the height of the second. Anal emarginate in the young, the highest ray reaching base of fifth from the last; not emarginate in the adult but the anterior rays two and a half times as long as the one next to the last; origin of the ventrals equidistant from tip of snout and tip of last anal ray, nearly or quite reaching the anal in the young; pectorals beyond origin of ventrals for one or two scales.

Dorsal, adipose, ventrals, and anal pink to orange; upper part of iris red, the rest golden. A broad black band across the end of the caudal peduncle and base of caudal, distal part of all the caudal rays light pink; in life a faint vertically oval humeral spot; no silvery lateral band; color otherwise variable in intensity with the locality, the margins of all the scales dark, the centers light; in life the younger ones have the adipose and caudal peduncle bright yellow.

Vertebrae 12 + 16.

Posterior air-bladder as wide as and three times as long as eye, twice as long as the anterior, curved down behind to near the origin of the anal.

Alimentary canal not quite equal to the length, without the caudal.

10. Moenkhausia sanctae filomenae (Steindachner).

Plate 16, fig. 1, 2.

Tetragonopterus agassizii Boulenger (non Steindachner), Bull. Mus. univ. Torino, 1895, **10**, no. 196, p. 3 (Colonia Risso); Trans. Zool. soc. London, 1896, **14**, p. 35 (Descalvados and Monte Sociedad); Boll. Mus. univ. Torino, 1897, **12**, no. 279, p. 4 (San Lorenzo); 1900, **15**, no. 370, p. 2 (Urucum).

Poecilurichthys agassizii Eigenmann, Proc. Acad. nat. sci., Phil., 1903, p. 522 (Arroyo Trementina; Arroyo Chagalalina).

Moenkhausia agassizii Eigenmann, Ann. Carnegie mus., 1907, **4**, p. 138, pl. 12, fig. 2 (Corumba).

Tetragonopterus sanctae filomenae Steindachner, Anz. K. akad. wiss. Wien, 1907, p. 82 (Sancta Filomena, Parnahyba).[1]

Moenkhausia australe Eigenmann, Bull. M. C. Z., 1908, **52**, p. 102.

Habitat.— Paraguay Basin, Rio Parnahyba, and southern Madeira.

Specimens examined.

Catalogue number	Number of specimens	Size in mm.	Locality	Collector
9991 I.	1	41 (to base of caudal)	Arroyo Trementina	Anisits
9992 I.	1	32 (to base of caudal)	Arroyo Chagalalina	Anisits
3315 C.	2	41–68 (to base of caudal)	Jauru	Haseman
2998 C.	1	55	Barreiras, Lagoas of Rio Grande	Haseman
3307 C.	2	39–49	Cacequy	Haseman
2999 C.	1	49	San Francisco	Haseman
3303 C.	10	33–66	Rio Sapon, Prazer, Bahia	Haseman
3304 C.	4	32–69	Above Cachoeira da Velha, Rio Novo, Goyaz	Haseman
5305 C.	1	47	Rio Tieté above the fall	Haseman
3306 C.	1	34	Salto das Cruzes, Rio Tieté	Haseman
3308 C.	10	36–43	Arequa, Lake Ipacarary, Paraguay	Haseman
3310 C.	2	42–43	Corumba	Haseman
3309 C.	4	40–45	Puerto Suarez	Haseman
3311 C.	22	36–65	San Luiz de Caceres	Haseman
3312 C.	8	32–67	San Luiz de Caceres	Haseman

[1] The following is an abstract of Steindachner's description of the types:—

Head 3.6–3.5; depth 2.25–2.2. A. 25–27; scales 4.5–22 to 24–3.5; eye nearly 3 in head; interorbital 2.33–2.

Interorbital slightly convex; snout equals eye; maxillary not reaching center of eye; mandibular teeth brown, darkest at tip; two small teeth on maxillary.

Origin of dorsal equidistant from caudal and front of eye; ventral in front of vertical from dorsal; pectoral reaching ventral, ventral not to anal.

Lateral line frequently interrupted, skipping several scales in the posterior part of the body.

Silvery dark above; scales margined with darker; humeral spot not sharply demarked, rounded or oval; caudal spot deep, dark brown, very large, forming a crossband in base of caudal.

Catalogue number	Number of specimens	Size in mm.	Locality	Collector
3313 C.	2	42–43	Rio Santa Rita	Haseman
3314 C.	6	40–50	Rio Boa Ventura	Haseman
3315 C.	5	39–47	San Joaquin	Haseman

This species differs from the Amazonian *M. oligolepis* in having usually but twenty-five scales in the lateral line instead of thirty or thirty-one.

In many of the smaller specimens the lateral line is either interrupted, *i. e.* it skips a scale or more, or it is incomplete. The incompleteness is positively correlated with the shorter lateral line. This is especially well brought out in the specimens from San Luiz de Caceres. These specimens with a complete lateral line have usually thirty scales in the lateral line, while those with an incomplete lateral line have usually only twenty-five though of the former one has but twenty-five and of the latter one has as many as twenty-eight scales in the lateral line. Out of eighty-four specimens examined twenty-nine have imperfect lateral lines.

The count of the anal rays and lateral lines is given in detail for different localities in the first part of the following table, and summarized in the second part of the table for those specimens of both *M. oligolepis* and *sanctae filomenae* in which the character of the entire line could be determined.

		Anal rays							Scales in the lateral line										
Locality	Species.	22	23	24	25	26	27	28	22	23	24	25	26	27	28	29	30	31	32
Amazon	oligolepis	...	2	6	19	14	10	1	...	...	...	...	...	...	...	6	25	16	3
Rio Sapon	sanctae filomenae	3	6	...	...	...	...	...	1	1	4	3	1						
Rio Tieté	sanctae filomenae	...	1	...	1	...	...	...	...	1	...	1							
Rio Santa Rita	sanctae filomenae	...	...	2															
Cacequy	sanctae filomenae	...	...	...	1	...	...	...	...	...	...	...	1						
Caehoeira	sanctae filomenae	...	...	2	1	...	...	...	...	1	1	2							
Arequa	australe	...	...	1	4	...	...	...	...	1	2								
Corumba	australe	...	...	1	1	...	...	...	...	...	...	2							
Puerto Suarez	australe	...	...	1	2	...	1	...	1	...	...	2	1						
Rio Boa Ventura	australe	1	1	3	...	...	1	...	...	1	1	1	3						
Rio Jauru	australe	...	...	...	1	...	...	...	...	...	...	1							
Caceres *	oligolepis?	...	3	3	1	1	...	...	...	...	...	1	...	...	...	...	5	1	
Caceres *	australe	...	1	2	4	...	...	...	...	...	...	5	1	...	1				
Totals		4	14	21	35	15	12	1	1	5	8	18	7	...	1	6	30	17	3
Correlation between completeness of the lateral line and anal and number of scales in the lateral line.																			
Lateral line complete		2	9	8	9	15	12	...	...	2	3	7	2	...	...	6	29	17	
Lateral interrupted		1	2	2	1	...	...	...	1	2	2	2	1	...	...	1			
Lateral line incomplete		2	4	6	11	...	...	...	1	2	2	12	4	1					

In the specimens with the lateral line imperfect the scales along the lateral line series are as follows, the scales with pores being in italics:—[1]

Corumba *10* + 15; *8* + 16; Puerto Suarez *8* + 14; Caceres *22* + 1 + *49*; *22* + 3 + *3*; *8* + 17; *10* + 15; *9* + 16; *10* + 16; *9* + 16; *8* + 17; Rio Boa Ventura *8* + 16; *10* + 16; *10* + 16; *3* + 1 + *3* + 16; *9*+ 17; Rio Sapon 6 + *18*; *19* + 2 + *2*; *12* + 1 + *3*; Cachocira *12* + 2 + *9* + 1; *14* + 2 or 3 + *9*; *15* + 1 + *8* + 1; Rio Tieté *13* + 11 and two small ones with short lateral line; Caceguy *15* + 3 + *7* + 1; Arequa *8* + 16; *10* + 15; *10*+ 15; Rio Jauru *11* + 14; San Joaquin *8* + 17; *10* + 17 (and three others with an incomplete line). In the other specimens the lateral line is complete.

Summarizing the data we find that there are two groups of specimens. The first consist of one with six scales with pores, seven with seven scales, three with nine scales, eight with ten scales, one with eleven and one with thirteen scales with pores. In each of these cases the remaining scales of the series are without pores.

To this series also belongs one specimen in which the lateral line series consists of three pores, one scale without a pore, three with pores and sixteen without pores. This is evidently a modification of seven scales with pores and sixteen without pores. Most of these come from the Paraguay and Paraná Basins and represent *M. australe*.

In the remainder of those enumerated the modifications are of another sort. The lateral line reaches the caudal or within one scale of the caudal, but is interrupted, skipping one, two, or three scales. All of these with the exception of two from Caceres came from southeastern Brazil and represent *M. sanctae filomenae*. It is scarcely possible that they indicate the road from the complete lateral line to the incomplete, for in those with the incomplete lateral line the number of scales at the beginning of the line with pores is usually eight to ten, and specimens having this character occur at the same locality with others with complete lateral lines. In those with the interrupted lateral line there are from fourteen to twenty-two scales at the beginning of the line with pores, and while these also occur along with others with complete lateral line, they in general are found in other river basins in an area geographically widely separated from the area in which those with incomplete lateral lines occur.

There seem to be variations (constantly occurring or mutations) in two different directions, one of these directions leads to Hemigrammus which is a

[1] I am indebted to Mrs. Marion Durbin Ellis for the examination of these specimens in connection with her study of Hemigrammus and Hyphessobrycon.

Moenkhausia with an incomplete lateral line, the other leads towards the condition found in Psellogrammus in which the lateral line is always interrupted but continued to the caudal.

11. Moenkhausia grandisquamis (Müller and Troschel).

Plate 12, fig. 3; Plate 100, fig. 6.

Tetragonopterus grandisquamis Müller & Troschel, Horae ichthyol, 1845, **1**, p. 27, tab. 8, fig. 2 (Surinam); Günther, Cat. fishes Brit. mus., 1864, **5**, p. 324 (British Guiana); Eigenmann & Eigenmann, Proc. U. S. N. M., 1891, **14**, p. 53.

Moenkhausia grandisquamis Eigenmann, Rept. Princeton univ. exped. Patagonia, 1910, **3**, p. 437; Mem. Carnegie mus., 1912, **5**, p. 323; pl. 77, fig. 2.

Habitat.—Guianas, Amazons.

Specimens examined.

Catalogue number	Number of specimens	Length in mm.	Locality	Collector
20694	19	about 64–91	Goyaz	Sn. Honario
20811, 20815	7	40–85	Içá	James
20981, 20979	3	70–97	Lago Alexo	Thayer
20977				
20875	1	66	Manacapuru	James
20988	2	45–52	Serpa	Thayer
20707		47–53	Villa Bella	Agassiz
20879 (part)	2	44–51	Obidos	James
20830, 20879 (part)	4	44–53	Obidos	James
20844	6	16–84	Obidos.	Col. Bentos
20739	3	60–75	Monte Alégre	Agassiz
20014	2	74		Justa
20725	14	poor	Gurupa	Agassiz
3736 C.	6	48–52	Santarem	Haseman
1348 C., 11857 I.	51	45–79	Bartica, Essequibo River	Shideler
1349 C., 11858 I.	66	51–86	Rockstone, Essequibo River	Eigenmann
1350 C., 11859 I.	35	50–115	Crab Falls, Essequibo River	Eigenmann
1351 C., 11860 I.	8	64–110	Tumatumari, Lower Potaro	Eigenmann
1352 C.	1	122	Cangaruma, Lower Potaro	Eigenmann
1353 C.	1	55	Wismar, Demerara R.	Eigenmann
3000 C.	1	54[1]	Maciél, Rio Guaporé	Haseman

This species can very readily be distinguished from all others of the genus by the very widely diverging striae of the scales. The striae are very irregular

[1] To base of caudal July 23, 1909.

in the type forming a network in the median scales. In others they are more regular, rarely anastomosing but those from above and below meeting along the median line.

Head 3.5–4; depth usually 2 in the adult (2.4 in some of the specimens from Obidos and in the young). D. 10 or 11; A. usually 26–28[1]; scales 5–31 to 34[2]–4. Eye 2.33–2.5 in the head; interorbital equals eye, or but a trace larger.

Compressed, oval, without notable breaks in the nearly symmetrical curves; profile scarcely depressed over the eyes, ventral profile slightly more arched than the dorsal; preventral area with a median series of about twelve flat scales bordered on the sides by series of angularly bent scales; postventral area with a median series of moderate sized thin scales, bent and bordered on the sides with a series of symmetrical or nearly symmetrical scales, the area compressed; predorsal region narrowly rounded, the median series of about nine scales extending from dorsal to occipital crest.

Occipital process one fourth to one fifth in the distance from its base to the dorsal, bordered on the sides by three scales; interorbital very slightly convex; second suborbital leaving but very narrow naked border; maxillary not reaching to end of second suborbital, equal to the distance from tip of snout to pupil; four or five, rarely six, in one case seven, teeth in the front series of the premaxillary forming a continuous series on each side; the third tooth slightly behind the line of the others; five graduated teeth in the second row; four large teeth in the mandible, slightly graduated; minute teeth on the sides of the lower jaw, maxillary with one or two teeth.

Gill-rakers about 9 + 12.

Scales deeply imbricate with one to two pairs of widely divergent striae exposed and several pairs concealed; anal sheath consisting of one to three rows of minute scales in front and a single row behind, more or less sharply marked off from the scales of the sides; lateral line scarcely bent up in front, a well-developed axillary scale; caudal lobes densely scaled to near their tip.

Origin of dorsal a little in advance of middle. Its first divided ray two and a half times as long as the last, three and a half in the length; anal emarginate, the first rays at least twice the length of some of the posterior ones; origin of ventrals about equidistant from tip of snout and tip of last anal ray, equidistant from tip of snout with the dorsal; ventrals scarcely reaching anal in

[1] In thirty specimens from the Amazon Basin one has twenty-four, one twenty-five, seven twenty-six, ten twenty-seven, five twenty-eight, two twenty-nine, two thirty, and two thirty-two anal rays.

[2] Of nineteen specimens from the Amazon Basin, three have thirty-one, five thirty-two, eight thirty-three, and three thirty-four scales with pores.

the young, shorter in adult, pectorals to ventrals or the width of one scale farther in young, not to ventrals in the largest.

A round humeral spot over the third to fifth scales of the lateral line, disappearing with age; no caudal spot in adult, sometimes a dusky area at end of caudal peduncle in young; a distinct silvery lateral band, the width of the free margin of a row of scales; fins all plain, mostly hyaline; sides silvery, highly iridescent.

Air-bladder slender, not bent down behind to the anal, posterior section not twice as long as the anterior, abruptly narrowed behind; diameter at its widest part about equal to the eye. Alimentary canal about one and one third times the entire length with the caudal; intestines containing insects and vegetable fibers.

Vertebrae 11 + 18. Tip of occipital process not extending beyond the posterior face of the skull.

As stated above, specimens from Obidos are distinctly more elongate than others, whereas the largest specimen, the one from Cangaruma, is more than half as deep as long.

12. Moenkhausia ovalis (Günther).

Plate 7, fig. 3.

Tetragonopterus ovalis Günther, Proc. Zool. soc. Lond., 1868, p. 245 (Xeberos); Eigenmann & Eigenmann, Proc. U. S. N. M., 1891, **14**, p. 53; Ulrey, Ann. N. Y. acad. sci., 1895, **8**, p. 282; Fowler, Proc. Acad. nat. sci., Phil., 1906, p. 441, fig. 38 (Marañon); Regan, Ann. mag. nat. hist., 1913, ser. 8, **12**, 281 (Ucayali).

Tetragonopterus chalceus Cope, Proc. Amer. philos. soc., 1878, **17**, p. 691 (Marañon).

Moenkhausia ovalis Eigenmann, Rept. Princeton univ. exped. Patagonia, 1910, **3**, p. 437.

Habitat.— Marañon.

I have examined the type in the British Museum, represented in Plate 7, figure 2. It is evidently closely related to *M. grandisquamis.*

Head 3.66; depth 2; D. 11; A. 27; scales 5–31–4 (6 to anal). Eye 3 in the head, 1.33 in interorbital.

Upper profile rather more convex than the lower, scarcely concave at the nape; preventral area flat; maxillary with two teeth, extending somewhat beyond front margin of the eye; origin of dorsal just behind origin of ventrals; pectoral extending beyond the ventrals, ventrals to the vent. Humeral spot indistinct, caudal spot diffuse, extending over the base of the fin, not to the end of the middle rays.

13. Moenkhausia barbouri Eigenmann.

Plate 7, fig. 1; Plate 100, fig. 1.

Moenkhausia barbouri Eigenmann, Bull. M. C. Z., 1908, **52**, p. 103 (Villa Bella); Rept. Princeton univ. exped. Patagonia, 1910, **3**, p. 437.

Habitat.— Amazon Basin.

Specimens examined.

Catalogue number	Number of specimens	Size in mm.	Locality	Collector
20708 Cotypes	2	62, 65	Villa Bella	Agassiz
3723 C.	1	64	San Antonio, Rio Madeira	Haseman

Very similar to *M. grandisquamis*, the striae of the scales are different and the caudal lobes dark.

Head 4.2–4.3; depth 2.4; D. 11; A. 30–33; scales 5.5–37–4.5. Eye 2.5; interorbital slightly smaller than eye.

Compressed, moderately deep, the dorsal and ventral profiles symmetrically curved, without humps or depressions; preventral area rounded, with obscure lateral keels; postventral area narrowly rounded; predorsal area obscurely keeled, with a median series of nine scales from the dorsal to the occipital process.

Occipital process equals one fourth the distance from its base to the dorsal, bordered by three scales on the sides; the occipital fontanel continued as a groove to its tip; interorbital distinctly convex; second suborbital leaving but a very narrow naked border; maxillary 2.66 in head, equal to the distance from the tip of the snout nearly to pupil; four teeth in the front series of the premaxillary, five teeth in the second series; maxillary with a single tooth. Lower jaw with four large teeth in front and several minute ones on the sides. Gill-rakers about 7 + 13, the longest about one fourth of the eye.

Scales of the sides with four or more diverging striae; anal sheath consisting of a single series of scales; caudal lobes scaled for at least half their length; lateral line nearly straight.

Origin of dorsal equidistant from tip of snout and base of upper caudal lobe; ventrals equidistant from tip of snout and base of last but four rays of

anal, their distance from tip of snout slightly less than that of the dorsal; highest dorsal ray three and one half in the length, equal to the caudal lobes; anal but slightly emarginate, its highest ray reaching about to the base of the sixteenth ray, its base about one third of the length; ventrals not reaching to anal, and the pectorals not quite to the ventrals.

A faint vertical humeral spot; tips of caudal lobes and middle rays faintly dusky; a well-defined, silvery lateral band, two thirds as wide as the eye; sides iridescent silvery.

14. Moenkhausia xinguensis (Steindachner).

Tetragonopterus xinguensis Steindachner, Flussf. Südamer., 1882, **4**, p. 32 (Xingu); Eigenmann & Eigenmann, Proc. U. S. N. M., 1891, **14**, p. 53; Ulrey, Ann. N. Y. acad. sci., 1895, **8**, p. 281.
Moenkhausia xinguensis Eigenmann, Rept. Princeton univ. exped. Patagonia, 1910, **3**, p. 438.

This species is known only from the types.

"Head 3.33; depth 2.33; D. 11; A. 26; scales 5–32–4; interorbital 3 in the head, snout 3.6.

Dorsal profile a little more arched than ventral; interorbital nearly flat; maxillary narrow, reaching nearly to the vertical from the middle of the eye. Height of dorsal equals length of head; pectoral equals length of head without the snout, reaching ventrals; ventrals shorter than pectorals, reaching to anal; caudal slightly longer than head. Golden brown, lower parts of head silvery; humeral spot large, ill defined. No caudal spot. Differs from *lepidurus* in having fewer scales in the lateral line and in the greater depth." Steindachner.

15. Moenkhausia browni Eigenmann.

Conia of the Wacusi Indians.

Plate **12**, fig. 2.

Moenkhausia browni Eigenmann, Ann. Carnegie mus., 1909, **6**, p. 13 (Aruataima Falls, Potaro River); Rept. Princeton univ. exped. Patagonia, 1910, **3**, p. 438; Mem. Carnegie mus., 1912, **5**, p. 324, pl. 47, fig. 3.

Habitat.— Potaro River both above and below the Kaieteur Fall.

Specimens examined.

Catalogue number	Number of specimens	Size in mm.	Locality	Collector
1004 C. Type Paratypes	1	66	Arnataima, Upper Potaro River	Eigenmann
1005 C., 11711 I.	25	46–82	Holmia, Upper Potaro River	Eigenmann
1006 C., 11712 I.	12	28–68	Two hours below Holmia	Eigenmann
1007 C., 11713 I.	69	23–80	Savannah Landing above Kaieteur	Eigenmann
1008 C.	1	31	Creek below Savannah Landing above Kaieteur	Eigenmann
1009 C., 11714 I.	9	30–62	Tukeit, Lower Potaro River	Eigenmann
1010 C., 11715 I.	2	48–50	Amatuk, Lower Potaro River	Eigenmann
1011 C.	1	65	Tumatumari, Lower Potaro River	Eigenmann

Very similar to *M. oligolepis* but without trace of caudal spot and with the anal falcate.

Head 3.75–4; depth 2.3–2.6; D. 11; A. 23 or 24; scales 5–30 to 34–3. Eye 2.4–2.5; interorbital 2.8–3.

Compressed, elevate; the dorsal profile high, angulated at the origin of the dorsal; profile depressed over the eye; ventral profile regularly arched from the snout to the end of the anal. Predorsal area narrowly rounded, with a median series of eight to ten scales; preventral area bluntly keeled, with a median series of scales; postventral area narrowly rounded, with a series of saddle-shaped median scales.

Occipital process four in the distance from its base to the dorsal, bordered by three scales on the side; head narrow, interorbital convex, smooth; fontanels of equal width, the posterior considerably longer, continued as a groove to the tip of the process. Second suborbital, striate, leaving a considerable naked area. Maxillary 2.6 in the head. Usually five teeth in the front row of the premaxillary, the third tooth withdrawn from the line of the rest; five graduated teeth in the inner series; the mandible with four large graduate teeth in the front and small ones on the sides. Three small teeth in the maxillary.

Scales regularly and deeply imbricate, without interpolated rows; each scale with numerous radiating striae; lateral line sagging to below the middle of the dorsal; anal sheath of a single series of scales along the first twelve rays; caudal lobes scaled for half their length.

Origin of dorsal in advance of the middle of the body, its longest ray two and a half as long as the penultimate, three and a third in the length; caudal lobes equal, a little longer than the longest dorsal ray; anal emarginate, its longest

ray when depressed reaching the base of the last but four anal ray; ventrals reaching anal, pectorals about one scale beyond origin of ventrals.

No caudal spot, a large horizontally oval humeral spot continued below to the origin of the pectoral; a dark band from origin of dorsal obliquely downward and forward to the lateral line; a dark median lateral line; white below, dark along back, each scale of the side with a conspicuous dark crescent along its middle.

In life all fins but the adipose strongly tinged with red; middle of adipose yellow.

16. Moenkhausia megalops Eigenmann.

Plate 7, fig. 2.

Tetragonopterus grandisquamis Ulrey (*non* Müller & Troschel), Ann. N. Y. acad. sci., 1895, **8**, p. 281 (Itaituba).

Astyanax megalops Eigenmann, Proc. U. S. N. M., 1907, **33**, p. 29 (Itaituba, Brazil).

Moenkhausia megalops Eigenmann, Rept. Princeton univ. exped. Patagonia, 1910, **3**, p. 438; Mem. Carnegie mus. 1912, **5**, p. 325 (Rockstone).

Habitat.— Amazon and Guiana.

Specimens examined.

Catalogue number	Number of specimens	Size in mm.	Locality	Collector
5192 Type	1	42 [1]	Itaituba	Agassiz
20723	1	50 [1]	Gurupa	Agassiz
2488 C.	1	56	Rockstone, Essequibo River	Eigenmann
3724 C.	1	65	Santarem, in Rio Tapajos	Haseman

Allied to *M. grandisquamis* with different proportions and different striae, with larger eye.

Head 3.6–3.7; depth 2.5–2.66; D. 9–11; A. 28–30; scales 5–34–3 or 4. Eye 2–2.2 in head, twice as long as snout; interorbital 2.8–3 in the head.

Elongate, compressed, dorsal and ventral profile evenly curved, a slight depression over eye; preventral region with a median series of flat scales bordered by a series of scales angularly bent; postventral region compressed, with a median series of large, thin scales, bordered on each side by slightly asymmetrical scales; predorsal region compressed, the median series of eight scales extending from the dorsal to the occipital crest which is contained three to three and a

[1] To base of caudal.

half times in the distance of its base from the dorsal, and bordered by three scales on each side.

Groove of the occipital frontanel reaching to tip of occipital process; interorbital slightly convex; second suborbital leaving a narrow naked margin of the cheeks; maxillary not reaching to the end of the first suborbital two and three fourths in the head, equal to the distance of the tip of the snout from the pupil. Four teeth in the front row of the premaxillary, the third slightly withdrawn from the line of the others, five graduated teeth in the inner series; maxillary with three teeth; mandible with four teeth and numerous small ones on the side.

Gill-rakers 9 + 14.

Scales deeply imbricate, each with several divergent striae. Anal sheath of a single series of scales. Lateral line but little descending. A well-developed axillary scale; caudal scales caducous.

Origin of dorsal in front of middle of body; ventrals nearer tip of snout than the dorsal, equidistant from tip of snout and base of last anal ray or a little nearer the former; pectorals extending little beyond origin of ventrals; ventrals not quite to anal; anal slightly emarginate.

A vertical humeral spot above the space between the third to the fifth scale of the lateral line, faint; no caudal spot; a broad silvery lateral line. Some metallic reflections.

The specimen from the Essequibo 2488C. is deeper and has a narrower second suborbital than the type.

17. Moenkhausia shideleri, Eigenmann.

Plate 12, fig. 1.

Moenkhausia shideleri Eigenmann, Annals Carnegie mus., 1909, **6**, p. 15 (Bartica); Rept. Princeton univ. exped. Patagonia, 1910, **3**, p. 438; Mem. Carnegie mus., 1912, **5**, p. 325, pl. 47, fig. 4.

Habitat.— Essequibo River.

Specimens examined.

Catalogue number	Number of specimens	Size in mm.	Locality	Collector
1012 C. Type	1	65	Bartica	Shideler
11716 I. Cotype	1	73	Bartica	Shideler

Head, 3.7–3.8; depth 2.5–2.7; D. 10; A. 26; scales 5–34–3 or 4. Eye 2.1; interorbital 2.4 or 2.5.

Elongate, subrhomboidal, the ventral surface in front of the anal distinctly arched; a very slight depression over the eye; preventral area rounded, a series of median scales; postventral region narrowly rounded, with a median series of large scales, bordered by slightly asymmetrical scales. Predorsal area keeled to near the occipital crest. A median series of scales between the dorsal and occipital crest whose length is about one fifth of the distance from its base to the dorsal.

Interorbital slightly convex; second suborbital leaving a narrow naked border on the cheek. Maxillary three in the head; four or five teeth in the front row of the premaxillary, the third somewhat removed from the rest; five graduated teeth on the inner row; two small teeth on the maxillary; mandible with four large teeth and numerous small ones on the side.

Gill-rakers about 9 + 12.

Scales regularly and deeply imbricate, each with several divergent striae. Anal sheath of a few scales in a single row near front of anal; lateral line but little decurved; caudal scaled for about one fourth of its length.

Origin of dorsal in front of middle of body, but little more remote from snout than dorsal; highest dorsal ray about two and two thirds in the length; caudal deeply forked, the lobes longer than the dorsal; anal deeply emarginate; ventrals not reaching anal, pectorals just to ventrals.

No humeral spot; caudal with a small diffuse dark spot at the base of the middle rays. Scales of sides margined with dark, the marginal spots tending to form lines along the sides; pigment more profuse toward the back; a series of dark spots on the median series of scales of the back.

18. Moenkhausia costae (Steindachner).

Plate 14, fig. 2; Plate 100, fig. 2.

Tetragonopterus costae Steindachner, Anz. K. akad. wiss. Wien, 1907, p. 83 (Rio San Francisco; Rio Grande do Norte; Rio Preto).

Habitat.— Rio San Francisco; Rio Itapicurú.

Specimens examined.

Catalogue number	Number of specimens	Size in mm.	Locality	Collector
3713 C.	19	57–64	Joazeiro	Haseman
3714 C.	51	largest 59	Pirapora	Haseman
3715 C.	76	largest 61	Lagoa Pereira	Haseman
3716 C.	1	69	Lagoa de Porto	Haseman
3717 C.	26	48–60	Barreiras, Lagoas of Rio Grande	Haseman
3718 C.	18	36–57	Boqueirao	Haseman
3719 C.	31	35–58	Santa Rita	Haseman
3720 C.	37	35–56	Queimadas, Rio Itapicurú	Haseman
3721 C.	44	40–70	Penedo	Haseman
3722 C.	16	11[1]–48	Penedo	Haseman

Head 4; depth 2.25–3.25; D. 11; A. 26–28; scales 5–32 to 34–3.5. Eye 2.6 in the head; interorbital equal to the eye or a little narrower.

Much compressed, the depth varying greatly; dorsal and ventral outline regularly and nearly equally arched; area immediately in front of ventrals flat, region between the pectorals bluntly keeled, about fourteen scales in the median series in front of the ventrals; predorsal area bluntly keeled, with a median series of ten scales.

Occipital process about one fifth of the distance from its base to the dorsal, bordered by three scales on each side; interorbital convex; frontal fontanel distinctly shorter than the parietal without its groove.

Third suborbital covering the entire cheek, leaving but a small naked triangle under its anterior corner; mouth small, the antero-posterior extent of the premaxillary very small, maxillary large, about as long as the eye, its anterior margin convex; the mouth similar to that of *M. dichrourus*. Teeth all feeble, each ramus of the mandible with five or six graduate teeth, of which the second is more forward, out of line with the rest, forming an incipient second series, sides of the ramus with about seven to ten minute conical teeth; premaxillary with three to five teeth in the outer row, five in the inner; maxillary with or without a microscopic conical tooth.

Gill-rakers slender, about equal to the snout in length, 11 + 14. Scales thin, entire, with widely diverging radiae; no interpolated scales; anal with a feeble sheath of one series of scales in its front half; caudal lobes densely scaled to near the tip, the central rays nearly naked.

Dorsal pointed, the first rays about three and a half in the length; anal

[1] Specimens only fifteen mm. long have the characteristic coloration.

emarginate, its origin behind the vertical from the base of the last dorsal ray; ventrals reaching anal, pectorals about one scale beyond base of ventrals.

Straw-color in alcohol, a narrow silvery, lateral band; sometimes a faint, always minute, humeral spot; a black stripe along base of anal, along ventral surface of caudal peduncle, then upward and backward along the posterior margin of the upper caudal lobe. This black stripe is diagnostic for the species, although it is at times (Penedo specimens) scarcely perceptible. It is especially conspicuous in the specimens from Queimadas.

19. Moenkhausia dichroura (Kner).

Plate 8, fig. 3; Plate 15, fig. 1; Plate 95, fig. 3; Plate 100, fig. 3.

Tetragonopterus dichrourus Kner, Characinen, 1859, p. 41, tab. 9, fig. 21 (Rio Guaporé; Caiçara; Paraguay); Günther, Cat. fishes Brit. mus., 1864, **5**, p. 324; Eigenmann & Eigenmann, Proc. U. S. N. M., 1891, **14**, p. 53; Ulrey, Ann. N. Y. acad. sci., 1895, **8**, p. 279; Perugia, Ann. Mus. civ. storia nat. Genova, 1891, ser. 24, **10**, p. 45 (Chaco Centrale); Boulenger, Trans. Zool. soc. Lond., 1896, **14**, p. 35 (San Luis and Descalvados); Boulenger, Boll. Mus. univ. Torino, 1897, **12**, no. 279, p. 4 (San Lorenzo); 1900, **15**, no. 370, p. 2 (Urucum); Eigenmann & Kennedy, (in part), Proc. Acad. nat. sci., Phil., 1903, p. 522 (Ascuncion; Arroyo Trementina).

Moenkhausia dichrourus Eigenmann, Ann. Carnegie mus., 1907, **4**, p. 138, pl. 41, fig. 1 (Tuyuyu; Corumba; Asuncion); Rept. Princeton univ. Exped. Patagonia, 1910, **3**, p. 438.

Moenkhausia diehroura Eigenmann, Mem. Carnegie mus., 1912, **5**, p. 326.

Habitat.— Guiana south to Bolivia, Paraguay and the Paranagua.

Catalogue number	Number of specimens	Length in mm.	Locality	Collector
3698 C.	5	28–62	Rio Jauru	Haseman
3699 C.	3	44–91	Puerto Suarez	Haseman
3701 C.	5	53–75	San Joaquin, Bolivia	Haseman
3703 C.	2	43–52	San Joaquin	Haseman
3704 C.	2	51–60	Corumba	Haseman
3705 C.	2	56–60	Bastos	Haseman
3706 C.	8	52–66	Asuncion	Haseman
3707 C.	2	62–65	Arequa	Haseman
3708 C.	26	40–66	Villa Hays	Haseman
3709 C.	16	52–67	Lagoa de Paranagua	Haseman
3738 C.	2	58–62	Santarem	Haseman
1345 C., 11861 I.	2	59–62	Warraputa Cataraet, Essequibo River	Eigenmann
1346 C.	2	28–65	Crab Falls, Essequibo River	Eigenmann
1347 C., 11862 I.	12	58–63	Konawaruk, Essequibo River	Eigenmann

These specimens are without exception more slender than the types. In shape the types resemble *M. barbouri*, from which they differ in the number of

anal rays. Distinguished by the oblique mouth, feeble dentition, rounded anterior margin of the maxillary, and color of the caudal.

Head about 4; depth usually 3, ranging from 2.75 to 3.5; D. 11; A. 25–28[1]; scales 5 or 5.5–34 to 39[2]–3 or 3.5 (to ventrals). Eye 2.4–2.6 in the head; interorbital slightly less than eye.

Elongate, moderately compressed; dorsal and ventral profiles nearly symmetrical, the ventral profile slightly more convex than the dorsal which is slightly depressed over the head; preventral area rounded with obscure keels on the sides, postventral area very narrowly rounded or keeled; predorsal area keeled, with a median series of about ten scales from the occiput to the dorsal.

Occipital process one fifth the distance from its base to the dorsal, bordered by three scales on the sides; interorbital distinctly and evenly convex; second suborbital variable, leaving a narrow naked area on the cheek; maxillary about three in the head, equal to the distance from the tip of the snout to the pupil, its anterior margin regularly arched; mandible two and a half in the head, very oblique; mouth small, dentition feeble, usually four (3–5) teeth in the front row of the premaxillary, the third removed slightly from the line of the others; five, rarely six teeth in the inner series; maxillary without teeth or with one, rarely two, feeble ones; lower jaw with four larger teeth and several minute ones on the sides, the mouth is much smaller (narrower) and the dentition much feebler than in *M. lepidura* of the same size.

Gill-rakers long and slender, much longer than *M. lepidura*, about 11 + 16, those of the upper arch similar to but shorter than those of the lower, the longest one third to half the length of eye.

Scales nearly semicircular, deeply imbricate, with several diverging striae[3]; anal sheath of a single series of scales; caudal lobes scaled for two thirds of their length; a well-developed axillary scale.

Dorsal about equidistant from tip of snout and base of caudal, its height three and a half in the length; ventrals nearer tip of snout than the dorsal, about equidistant from tip of snout and end of anal; origin of anal behind

[1] In twenty specimens from the Amazon Basin, six have twenty-five, seven twenty-six, five twenty-seven, and two twenty-eight rays.

[2] In sixteen specimens from the Amazon Basin one has thirty-four, two have thirty-five, seven thirty-six, and six thirty-seven pores in the lateral line. A specimen from Paraguay has thirty-nine; of fifteen specimens from the Essequibo, six have thirty-six, eight thirty-seven, and one has thirty-nine.

[3] The striae usually start from about the same vertical line and diverge backward, one specimen from Villa Bella (20711) and two from José-Fernandez (21006) differ from the rest. The condition approaches that of *M. grandisquamis*. Successive pairs of striae are joined at the base and follow each other like a series of stacked v's placed horizontally. The specimen from José-Fernandez have the depth 2.75 in the length.

the vertical from the last dorsal ray; ventrals not reaching anal, pectorals to ventrals.

A well-defined, silvery, lateral band, half as wide as the eye along the middle of the sides, tapering from below the dorsal forward; middle caudal rays black, caudal lobes beyond the tips of the middle rays black, the tips milk-white. The intensity of the caudal color differs very much with the condition of the specimens, the method of preservation, and the locality; an insignificant humeral spot not evident in alcoholic specimens.

The silvery lateral band of the sides is underlaid with a black band of the same size and shape. In formaline specimens in which the silvery band is dissolved a black band takes its place. Base of caudal lobes in life bright yellow, dorsal and adipose yellowish.

Vertebrae 13 + 18.

Posterior air-bladder sausage-shaped, its diameter about equal to that of eye, its length twice that of the anterior section, bent down somewhat to near the origin of the anal.

Alimentary canal less than the total length with the caudal.

20. Moenkhausia intermedia Eigenmann.

Plate **15**, fig. 2; Plate **101**, fig. 8, 9.

Moenkhausia dichrourus intermedius Eigenmann, Bull. M. C. Z., 1908, **52**, p. 103 (Tabatinga); Rept. Princeton univ. exped. Patagonia, 1910, **3**, p. 438.

Moenkhausia lepidura madeirae Fowler, Proc. Acad. nat. sci. Phila., 1913, p. 540, fig. 11 (Tributary of Rio Madeira near Porto Velho).

Habitat.— Amazon, Paraguay, and Paraná Basins.

Specimens examined.

Catalogue number	Number of specimens	Length in mm.	Locality	Collector
20762 Cotypes	2	42–64	Tabatinga	Bourget
3709 C.	4	25–43	San Louiz de Caceres	Haseman
3700 C.	1	47	Rio Santa Rita, near frontier of Bolivia	Haseman
3702 C.	2	60–67	Salto Avanhandava	Haseman

Closely resembling *M. dichroura* from which it differs mostly in the shape of the open mouth.

Head 4+; depth 3+; D .11; A. 25; scales 5–35–3.5. Eye 2.25–2.75; interorbital 3 in the head.

Slender, dorsal and ventral profiles regular; preventral area flat, with a median series of twelve scales; predorsal area rounded, with a median series of ten scales; occipital process about one fifth of the distance from its base to the dorsal; interorbital very little arched; second suborbital nearly covering the entire cheek in the largest, with a wider naked border in the smaller; maxillary about one third of the length of the head; its anterior margin not as greatly arched as in *M. dichroura*. Premaxillary with three or four teeth in the anterior series, five in the inner series; dentary with four large teeth, the anterior two not in a continuous series with the posterior two in the larger specimens, the third tooth being farther in. Gill-rakers one fourth to four tenths the length of the eye.

Origin of dorsal in middle of the body; origin of ventrals further forward; pectorals reaching the ventrals, ventrals to anal. Scales with up to eight divergent striae.

A silvery lateral band, middle caudal rays and tips of the lobes or a submarginal band black.

The specimens described by Fowler are more slender than the others.

21. Moenkhausia lepidura lepidura (Kner).

Plate 8, fig. 2.

Tetragonopterus lepidurus Kner, Characinen, 1859, p. 40, tab. 8, fig. 20 (Rio Guaporé); Günther, Cat. fishes Brit. mus., 1864, **5**, 328; Steindachner, Flussf. Südam., 1882, **4**, p. 32 (Tabatinga; Cudajas; Obidos; Villa Bella); Eigenmann & Eigenmann, Proc. U. S. Nat. Mus., 1891, **14**, p. 53; Ulrey, Ann. N. Y. acad. sci., 1895, **8**, p. 278; Vaillant, Bull. Mus. d'hist. nat., 1899, p. 155 (Carnot).
Moenkhausia lepidurus Eigenmann, Rept. Princeton univ. exped. Patagonia, **3**, 1910, p. 438.
Moenkhausia lepidura Eigenmann, Mem. Carnegie mus., 1912, **5**, p. 326.

Habitat.— Amazons Basin and north to Guiana.

The types in the Vienna Museum have the depth three and one half in the length. Aside from the types I have examined the following:

Catalogue number	Number of specimens	Length in mm.	Locality	Collector
20954	5	63 to about 90	Jatuarana	Navez
20743	4	70–85	Tajapurú	Agassiz
21062	12	68–80	Arary	Thayer
20722	1	90	Gurupa	Agassiz
20790, 20788, 20778	34	63–84	Santarem	Bourget

Catalogue number	Number of specimens	Length in mm.	Locality	Collector
20965, 20863, 20864	7	45–81	Rio Tapajos	Dexter, James, and Talisman
20849	2	88	Obidos	Bentos
Part of 20829	2	about 40 to about 50	Obidos	James
20712	3	about 70	Villa Bella	Agassiz
21019	1	about 75	Ueranduba	Coutinho
20992	7	about 60 to about 80	Serpa	Thayer
21010	1	85		Justa
20730, 20733	6	54–72	Lake Hyanuary	Agassiz
20735	12	about 55–73	Lago Maximo	Agassiz
20701, 20702, 20703 [1]	33	49–85	Teffé	Agassiz
20744	1	about 76	Tocantins	Agassiz
20853, 20857	3	45–60	Jutahy	James, Thayer, and Talisman
3733 C.	1	68	Cachoele de Riberão, Rio Madeira	Haseman
3731 C.	7	44 to about 89	Maeiel, Rio Guaporé	Haseman
3732 C.	3	67–77	Bastos	Haseman
1335 C., 11825 I.	203	54–75	Bartica, Essequibo River	Shideler
1336 C., 11826 I.	12	47–71	Roekstone, Essequibo River	Eigenmann
1337 C., 11827 I.	8	42–56	Gluck Isl., Essequibo River	Eigenmann
1338 C., 11828 I.	51	44–80	Crab Falls, Essequibo River	Eigenmann
1339 C., 11829 I.	22	45–58	Konawaruk, Essequibo River	Eigenmann
1340 C., 11830 I.	7	45–82	Warraputa, Essequibo River	Eigenmann
1341 C., 11831 I.	215	42–95	Tumatumari, Potaro River	Eigenmann
1342 C., 11832 I.	20	45–94	Creek below Potaro Landing	Shideler
1343 C., 11833 I.	4	51–61	Erukin, Potaro below Amatuk	Eigenmann
1344 C., 11834 I.	4	62–108	Malali, Demerara River	Shideler

The species is very variable in shape, number of anal rays and scales. It is distinguished by the peculiar coloration of the upper half of the caudal.

Head 3.75–4.4; depth 3 [2]–3.5; D. 11; A. most often 24, ranging from 22–27 [3]; scales 5–35–4 [4]. Eye 2.5–3, about equal to the interorbital.

Elongate, moderately compressed, greatest depth under origin of dorsal, the dorsal and ventral profiles evenly curved, or the ventral profile more arched, or preventral area broadly rounded; postventral area very narrowly rounded.

[1] In part.

[2] In some of the specimens (20788) from Santarem, and some of those from Guiana, the depth is much greater, 2.75 in the length.

[3] Of fifty-five specimens six have twenty-two anal rays, sixteen twenty-three, twenty-one, twenty-four, seven twenty-five, two twenty-six, and three twenty-seven.

[4] In one case there were found six scales above the lateral line, in two cases five and one half. The scales along the lateral line average thirty-five, but range from thirty-one to thirty-seven. In twenty-four one has thirty-one scales, five thirty-four, eleven thirty-five, five thirty-six, and two thirty-seven.

Predorsal area obscurely keeled, a median series of scales may extend from the dorsal to the occipital process or a variable number of the median scales near the occipital process may be divided into two halves, leaving a naked line continued from the occipital process; the median series of scales thus varies from six to nine.

Occipital process moderate, four or five times in the distance from its base to the dorsal, bordered by three scales on the side. Interorbital convex; second suborbital covering a variable amount of the cheeks but always leaving a comparatively broad naked border even in the large specimens (20722); maxillary not reaching to the end of the first suborbital, equal to the length of the snout or a little more. Premaxillary usually with four teeth in the front series, the second tooth withdrawn from the line; rarely three or five teeth (in one case six) in the front row, second row with five graduated teeth; maxillary usually with one, rarely with two teeth; lower jaw with four, large graduated teeth on each side and a number of smaller ones.

Gill-rakers very small, about 6 + 9, longest about four in the diameter of the eye.

Scales regularly imbricate, thin, those on the sides with two to ten striae. Anal naked, or its sheath composed of a single series of scales; caudal lobes scaled for at least half their length; lateral line very slightly decurved; four scales between the origin of the anal and the lateral line; axillary scale well developed.

Origin of dorsal little nearer tip of snout than base of caudal; origin of ventrals scarcely nearer tip of snout than the dorsal; highest dorsal ray three and a half in the length; anal emarginate, its origin below the first or second scale behind the dorsal; ventrals about reaching anal or but little beyond anus, pectorals nearly or quite to ventrals.

Upper half of caudal, except a semicircular spot at the upper part of its base, black of varying intensity, sometimes shading into light at the upper margin and with the tip light; lower half of the caudal hyaline or dusky toward the tip (20730) shading into the black of the upper lobe at the middle; a small, horizontally oval, or round humeral spot over the second and third scales of the lateral line; a silvery lateral band one fourth the diameter of the eye in width, bordered above by dusky; iridescent steel-blue above, brassy below. In the young the caudal markings are very faint.

In living specimens from Guiana the base of the upper caudal lobe is conspicuously yellow or orange or cherry, base of lower caudal lobe, adipose, dorsal

rays and anal lobe less intensely yellow or orange. The black of the caudal is most variable, darkest near the orange spot or nearer the tip, the part of one color shading gradually into that of the other or with an abrupt broken dividing line or "water marked."

Vertebrate 14+17.

Posterior air-bladder of nearly equal width throughout, its width equal to the diameter of the eye, its length nearly twice that of the anterior section; alimentary canal not quite equal to the entire length.

22. Moenkhausia lepidura lata Eigenmann.

Plate **101**, fig. 10.

Moenkhausia lepidurus latus Eigenmann, Bull. M. C. Z., 1908, **52**, p. 103 (Rio Tapajos); Rept. Princeton univ. exped. Patagonia, 1910, **3**, p. 438.

20860 Cotypes	27	55–75 mm.	Rio Tapajos.	Dexter, James, and Talisman.

These specimens differ from others from the Tapajos and from various other localities. The anal rays average 26+; five specimens have twenty-five, eleven twenty-six, eight twenty-seven, and four twenty-eight rays. The body is deeper, the depth averaging 2.6 of the length; the scales in the lateral line vary from 32 to 34, being most frequently 33.

The middle caudal rays are but faintly colored if at all, but the upper caudal lobe is black.

23. Moenkhausia lepidura icae Eigenmann.

Plate **101**, fig. 6.

Moenkhausia lepidurus içae Eigenmann, Bull. M. C. Z., 1908, **52**, p. 103 (Iça); Rept. Princeton univ. exped. Patagonia, 1910, **3**, p. 438.

Habitat.— Iça.

20810, 20812 Cotypes	46	30–50 mm.	Iça	James

Deep, compressed fishes, depth three in the length; anal rays usually twenty-three or twenty-four; two have twenty-one, six twenty-two, ten twenty-three, thirteen twenty-four, and one has twenty-five rays; the scales in the

lateral line number with about equal frequency, thirty-one, thirty-two, or thirty-three.

Pectorals just reaching ventrals.

Upper caudal lobes and sometimes the distal part of the other rays dusky, a very small but well-defined humeral spot of about ten chromatophores over the fourth or fifth scale of the lateral line; tip of anal lobe sometimes milk-white.

24. Moenkhausia lepidura hasemani, subsp. nov.

Plate 15, fig. 3; Plate 101, fig. 5.

3746 Type	45 mm. to base of caudal	Santarem, Dec. 12, 1909	Haseman

Head 4+; depth 3.4; D .11; A .24; scales 5–37–3.5. Eye 2.66 in the head, snout 3.33; interorbital 2.66.

Slender, dorsal and ventral profiles gently and evenly curved, preventral area flattish with a median series of thirteen scales; predorsal area rounded with a median series of ten scales. Occipital process one fifth as long as the distance from its base to its dorsal, bordered by three scales. Interorbital rounded, maxillary a little less than one third of the length of the head, its anterior margin greatly arched forward, less so posteriorly. Second suborbital leaving a naked border all around. Three or four teeth in the anterior row of the premaxillary, a small tooth on the maxillary; dentary with four large teeth and abruptly small ones on the sides.

Origin of dorsal midway between tip of snout and base of middle caudal rays; pectorals not reaching the ventrals whose origin is in advance of the vertical from the origin of the dorsal; anal slightly falcate.

Scales firm with up to ten prominent radiae. Anal sheath very feeble, axillary scale well developed.

A faint humeral spot on and above the third and fourth pores of the lateral line. A silvery lateral band, most prominent between the dorsals and ending a few scales in advance of the lateral line. No caudal spot.