THE FRESH-WATER FISHES OF SINGAPORE

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INTRODUCTION

Although the extent of the fresh-water fish fauna of Singapore Island has been fairly well established, no serious attempt has as yet been made to provide a comprehensive catalogue. As early as 1934, the well-known ichthyologist Dr. Albert W. Herre observed (1937: 6), "When I first visited Singapore, rare and beautiful endemic fishes sported in the brooks flowing through the city. Today, those same streams are mere concrete conduits". Pollution from human and factory wastes, and the canalization of many of the streams and rivers, has progressively not only altered the faunal composition but has also led to the elimination of many species. In a recent popular account (Alfred, 1961a) only 32 species are reported. The purpose of the present work is to place on record under a single cover all the species which are recorded from the island.

The species herein reported include all those which may be classified according to Myers (1949) as primary fresh-water fishes. In Singapore the latter comprise the orders Cyprinoidea, Siluroidea (excluding the Plotosidae and Ariidae), Anabantoidea, and Ophicephaloidea, and the families Nandidae, Flutidae, and Mastacembelidae. The remaining species reported on are

either secondary or vicarious fresh-water species (vide Myers, 1949). No cognizance is taken of the many diadromous species.

The classification of families, genera and species generally follows that of Weber & De Beaufort's "The Fishes of the Indo-Australian Archipelago", with such changes as are deemed necessary in the light of more recent systematic studies. Detailed descriptions are given for a few species which have hitherto been inadequately described. As an aid to identification, keys are provided to all the known species, excepting the doubtful and erroneous records. The terminology of the morphological features and the methods of making measurements and counts follows Hubbs & Lagler (1958: 19-26). All measurements up to 100 mm were made with vernier calipers graduated to 0.1 mm. Larger measurements were made with a metre rule graduated to 1 mm.

The species which are believed to be now extinct are indicated with an asterisk. The synonymy is restricted to the original description and to all known citations referring to Singapore. Specific localities are included (in parentheses) wherever they are mentioned by the respective authors; the others refer simply to Singapore without precise localities.

This account covers 73 species including 6 which are new to Singapore. However, only 42 species are recognised as currently occurring in local waters. The remaining 31 species are mainly those which are believed to be now extinct.

MATERIALS

The bulk of the specimens reported on are those in the collection of the National Museum (formerly Raffles Museum), Singapore. A large proportion of these was collected by me at various times from August 1957 up to the end of January 1964.

The Zoologisch Museum, Amsterdam, has an interesting collection, mainly duplicates of the series in the National Museum which were identified by Prof. Dr. L. F. de Beaufort and the late Prof. Dr. M. Weber. These were examined by me when I visited Amsterdam in 1959. A few miscellaneous specimens from Singapore were unearthed when I visited the British Museum (Natural History), London, in the same year.

The type specimens of many of the species covered by the present account are to be found in the Museums in London and Amsterdam and in the Rijksmuseum van Natuurlijke Historie in Leiden. I have listed those that I have examined. These comprise the types of almost all the species described by Bleeker, Cantor, Regan, De Beaufort, Duncker, Boulenger, and Günther.

In referring to the specimens I have examined, the following abbreviations

are used: — NMS = National Museum, Singapore; ZMA = Zoologisch Museum, Amsterdam; BM = British Museum (Natural History), London; and ML = Rijksmuseum van Natuurlijke Historie, Leiden.

THE ENVIRONMENT

The Island of Singapore (fig. 1) is situated at the southern extremity of the Malay Peninsula, from which it is separated by the Straits of Johore which are about 3/4 mile wide. It lies approximately between 1°16′N and 1°28′N and between 103°38′E and 104°E and it occupies an area of about 209.5 square miles. Owing to its proximity to the equator, the climate is fairly uniform throughout the year, with the average annual rainfall at about 95.5 inches (Watts, 1955: 18).

Geologically, there are three distinctive structural units which make up the island (Alexander, 1950). The north and central portion is composed of granitic rocks giving rise to low undulating country about 200 ft in height, which is fringed to the west by a range of hills and includes Bukit Timah (581 ft), Bukit Gombak (437 ft), Bukit Panjang (434 ft) and Bukit Mandai (422 ft). The west and southern portion is made up of sandstones and shales while the eastern portion is composed of sands and gravel.

There are five major drainages, viz., the Kranji, the Seletar and the Serangoon draining north, and the Jurong and Kallang draining south. The important smaller drainages include the Tengeh, Simpang Kiri, Punggol and Bedok. Most of the drainage systems have been considerably altered by artificial means, the most striking change being the impounding of the head-waters of the Seletar, the Whompoe, and the Kallang to form the three reservoirs (fig. 1) for the city's water supply. Elsewhere, especially within the urban areas, many of the streams and rivers have been canalized with concrete and serve as open sewers.

The primary jungle which originally covered the island, was almost entirely cleared during the last century mainly as a result of the shifting cultivation practised by the gambier and pepper planters (Blythe, 1951). Today, most of the island has been built up and cultivated with fruit trees, vegetables, rubber and coconuts. Many areas of originally cultivated land are abandoned and support secondary jungle, or belukar. In the 12 square miles of nature reserves that surround the three reservoirs, a little of the original primary jungle still survives (Wee, 1964), and it is within this relatively undisturbed area of small forest streams and artificial lakes (pl. 1) that most of the surviving species of fishes are found.

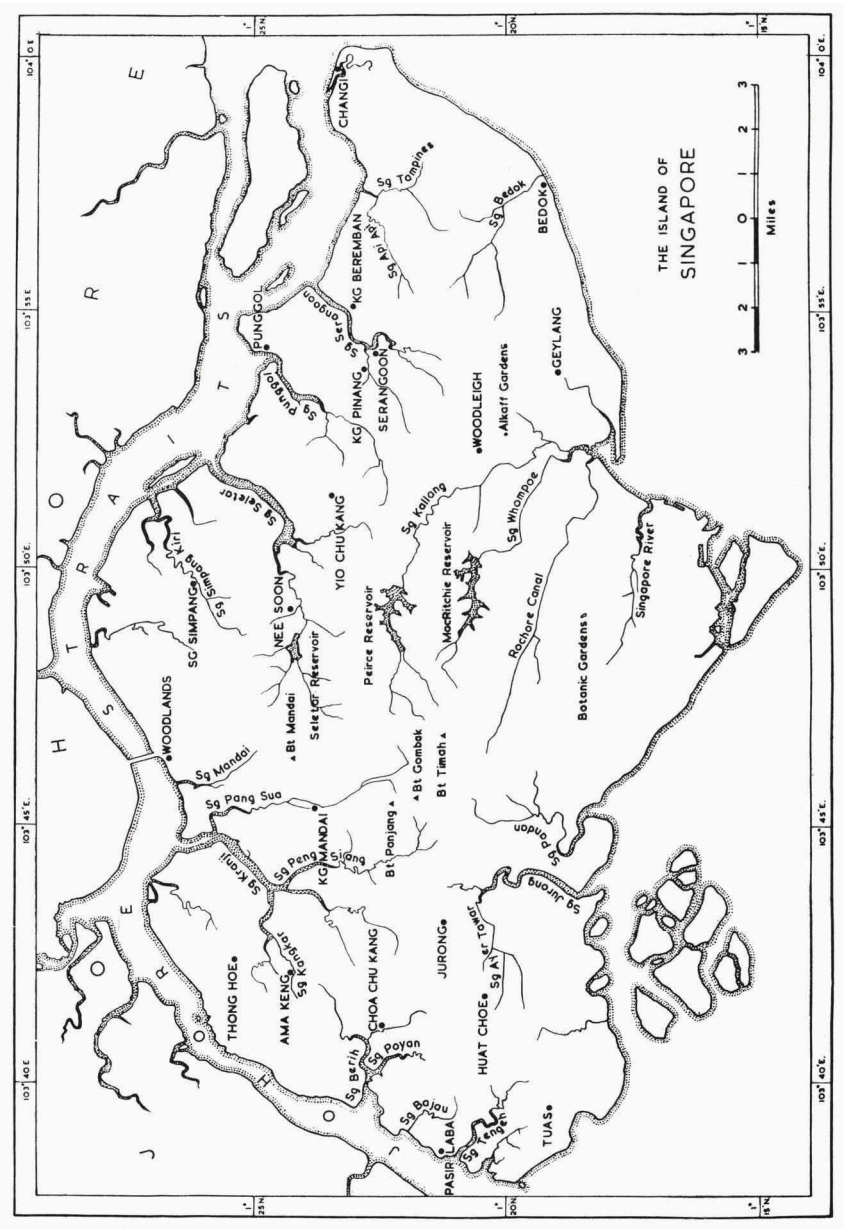

Fig. 1. The island of Singapore showing localities where fresh-water fishes have been collected.

ICHTHYOLOGICAL LITERATURE OF SINGAPORE

As with Malayan ichthyology in general, the earliest published records of Singapore fishes are given by Cantor (1849) in his "Catalogue of Malayan Fishes". He recorded the two species *Anabas scandens* Daldorf and *Ophiocephalus striatus* Bloch from Singapore. In a number of publications which are devoted partly or wholly to Singapore, Bleeker (1858, 1859b, 1860a, 1860c, 1860d, 1860e, 1863-64, 1864-65, 1879) added the following 6 species to the Singapore fauna: *Betta picta* (Valenciennes), *Rasbora einthovenii* (Bleeker), *Puntius maculatus* (Valenciennes), *Systomus lateristriga* (Valenciennes), *Clarias batrachus* (Linnaeus) and *Nandus nebulosus* (Gray). In his report on the fishes collected by Dr. F. Jagor in 1861, Peters (1868) described *Ophiocephalus gachua* var. *malaccensis* from the Kranji River. The Prussian Expedition to Eastern Asia made 3 brief visits to Singapore on 30th July 1860, 15th September 1861, and 17th February 1862. From his observations of the Singapore River and other small streams in the proximity of Singapore town during these visits, Von Martens (1876) observed two fishes which he identified as *Haplochilus panchax* Ham. Buch., and *Barbus maculatus* K.H., C.V. Karoli (1882) listed 12 species collected by a certain J. Xanthus during 1868-1870. Unfortunately, his paper has several inaccuracies and I believe that at least the following 5 records are erroneous mainly on distributional grounds: — *Ophiocephalus affinis* Günther, *Nuria danrica* (Hamilton), *Rasbora argyrotaenia* (Bleeker), *Rasbora daniconius* (Hamilton), and *Hemiramphus phaisoma* Bleeker. Thus by the end of the last century there were altogether some 20 species reported from Singapore.

In a little-known publication which appeared in 1901, Dr. R. Hanitsch, then Director of the Raffles Museum, published the first list of fishes in the collection of the Museum. He included the following: — *Clarias magur* Ham. Buch., *Silurichthys phaiosoma* Bleeker, *Barbus maculatus* Kuhl & v. Hass., *Rasbora* sp. (near *R. daniconius* Ham. Buch.), *Haplochilus panchax* Ham. Buch. × *H. rubrostigma* Jerdon, *Hemiramphus fluviatilis* Bleeker, *Nandus marmoratus* Ham. Buch., *Ophiocephalus striatus* Bloch, *O. gachua* Ham. Buch., *Anabas scandens* Daldorff, *Betta pugnax* Günther, *Osphromenus siamensis* Günther, and *Trichogaster trichopterus* Pallas. The specimens had been named by G. Duncker when he visited Singapore in September 1900.

The year 1904 saw the important publication on Malayan ichthyology contributed by Duncker himself. He listed all previous records to date besides describing a number of new and additional records, and the new species

Rasbora heteromorpha from Singapore. Simultaneously, Hanitsch (1904) provided the second list of fishes in the Raffles Museum.

During the period 1883 to 1887, Dr. T. I. Rowell, Principal Civil Medical Officer, Singapore, undertook the task of preparing stuffed fish specimens for display in the public galleries of the Museum. Unfortunately, many were misidentified and although Duncker (1904: 137) pointed this out, both Hanitsch (1904) and Maxwell (1922) uncritically incorporated them in their respective lists. Some of the old faded labels read "Singapore: Rowell coll." and I have taken this opportunity to re-diagnose these specimens.

Further noteworthy contributions to Singapore ichthyology were made by Regan (1910, 1913a), Weber & De Beaufort (1913, 1916, 1922), Hanitsch (1912), De Beaufort (1933), Tweedie (1936), Herre (1937) and Herre & Myers (1937). Most of these and many of the previous records are summarized in Fowler's (1938) list of the fishes known from Malaya. The list is extremely useful but unfortunately it has several typographical and other errors, besides omitting the records given by Hanitsch (1901, 1904, 1912, 1914), Ahl (1929), and Mohr (1936).

Following the publication of Fowler's list, a number of authors have contributed papers in the Bulletin of the Raffles Museum (now, Bulletin of the National Museum Singapore) which make reference to Singapore. They include Herre (1940), Tweedie (1940, 1950, 1952, 1961), Hora (1941), Hora & Gupta (1941), Menon (1954), Brittan (1954b), Sufi (1956), and Alfred (1961b, 1964c, 1964d, 1964e). Publications appearing elsewhere include works by Ahl (1939), Haig (1952), De Beaufort (1962), and Alfred (1958, 1961a, 1962b).

In 1956, Mr. A. Werner, a well known collector and naturalist from Munich, visited Singapore and acquired a number of specimens from local aquarium fish dealers. His collections were the subject of a paper by Boeseman (1957) who ascribed 10 species, though 2 of them doubtfully, to Singapore. Unfortunately, with the exceptions of the single species *Puntius hexazona* (Weber & De Beaufort), none are known from Singapore fresh waters. The specimens were undoubtedly collected from localities outside Singapore Island and Boeseman's record are accordingly ignored in this report.

AQUARIUM FISHES

Many of the colourful fishes that are well-known to aquarists throughout the world, are exported from Singapore. The trade in aquarium fishes is a vast one and is primarily concerned with the export to Europe and the United States of specimens collected from Malaya and the surrounding ter-

ritories. Thus, aquarium magazines and books mention Singapore as a locality for certain species which do not occur on the island. In the present report, aquarium publications have been mostly ignored.

Using Hoedeman (1959) as an index of what may constitute aquarium-worthy species, the following aquarium fishes may be listed from Singapore: *Rasbora heteromorpha* Duncker, *R. maculata* Duncker, *Puntius lateristriga* (Valenciennes), *P. pentazona* (Boulenger), *Acantophthalmus kuhlii* (Valenciennes), *Noemacheilus selangoricus* Duncker, *Hemiramphodon pogonognathus* (Bleeker), *Dermogenys pusillus* Van Hasselt, *Aplocheilus panchax* (Hamilton), *Oryzias javanicus* (Bleeker), *Trichopsis vittatus* (Cuvier), and *Trichogaster trichopterus* (Pallas).

Three of these species, viz., *R. heteromorpha, P. pentazona* and *T. trichopterus* are depicted on three of the Singapore postage stamps which are in current use (Alfred, 1962b).

POND CULTURE FISHES

The age old practice of rearing fishes in ponds was brought to Singapore by the early Chinese immigrants, and it is of interest that the present day methods of carp culture scarcely differ from the traditional Chinese methods. Thus, the Chinese market gardener in Singapore may combine fish culture with the raising of pigs and vegetables, and fishes may be merely a secondary crop. The following five species of carp are reared (Le Mare, 1949): Grass Carp, *Ctenopharyngodon idellus* (Valenciennes); Big Head, *Aristichthys nobilis* (Richardson); Silver Carp, *Hypophthalmichthys molitrix* (Valenciennes); Mud Carp, *Cirrhinus molitorella* (Valenciennes); and Common Carp, *Cyprinus carpio* (Linnaeus).

The fry are obtained from China via Hong Kong and transported to Singapore by sea or by air, as described by Birtwistle (1931b) and Le Mare (1949: 12-23). The current methods of rearing carp in ponds is described by Birtwistle (1931a) and Burdon (1950).

Attempts to introduce other pond culture species have not been entirely successful. When the supply of carp fry ceased during the Japanese occupation of Singapore, the East African fish, *Tilapia mossambica* (Peters) was introduced in 1944. Again in 1948 the Fisheries Department made an experimental attempt to cultivate this fish on the south-west coast (Le Mare, 1949: 24-26; Le Mare, 1951: 180-183). Today, it is reared only occasionally. Two other species that have been cultivated in the past are the Siamese Gouramy, *Trichogaster pectoralis* (Regan) and the Giant Gouramy, *Osphronemus gora-*

my (Lacépède). In addition Green (1928) described an unsuccessful attempt at cultivating the osteoglossid fish, *Scleropages formosus* (Müller & Schlegel).

In 1963, a stock of the cyprinid fish *Puntius gonionotus* (Bleeker), was acquired from the Fisheries Department, Federation of Malaya, and was distributed to local fish culturists (according to the Director of Primary Production, Ministry of National Development, Singapore, in litt.). The species is cultivated successfully elsewhere in Malaya (Soong, 1963) and it should soon establish itself as a pond culture fish in Singapore.

INTRODUCED SPECIES

Specimens of pond-culture fishes may escape into streams and ditches from time to time. However, of the eight species that have been cultivated only one has successfully established itself. The East African fish, *Tilapia mossambica* (Peters), is now a characteristic component of the estuarine fauna of at least 2 of the major rivers. According to Le Mare (1949: 15), the species was introduced from Java by the Japanese sometime towards the end of 1944. Another fish, *Trichogaster pectoralis* (Regan), was introduced from Thailand to Singapore in about 1898 (Smith, 1933). It apparently succeeded in establishing itself here whence part of the type series was collected and the specimens were subsequently described as of a new species by Regan in 1910. The Giant Gouramy, *Osphronemus goramy* Lacépède, is another naturalised fish but in view of its large size it is not known from the streams and ditches and appears to be restricted to the reservoirs. Similarly, the Common Carp, *Cyprinus carpio* (Linnaeus) is known to breed occasionally in fish-ponds but it has not succeeded in establishing itself.

The vast growth in the aquarium fish trade has also led to a few introductions. Chronologically, the first was probably the Siamese Fighting-Fish, *Betta splendens* Regan. Aquarium specimens were seen in Singapore as early as 1840 (Cantor, 1849) but the first record of feral specimens was made only in 1937 (Herre, 1940). More recently Tweedie (1952) reported it as being "found here and there on Singapore Island". There is however only one recent record. Another introduction is the Guppy, *Lebistes reticulatus* (Peters). Its widespread distribution in connection with anti-mosquito work is well known. However, it is uncertain if its introduction locally was due to this agency or to escaped aquarium specimens. The species is now well established and widely distributed in Singapore. Since 1961, another poeciliid fish, *Mollienisia sphenops* (Valenciennes), has successfully established itself as well. Like *Tilapia,* it occurs mainly in brackish localities. A fourth intro-

duced aquarium fish is the cyprinid, *Barbus semifasciolatus* Günther. Its mode of introduction is uncertain but it seems likely that it was accidentally introduced together with Carp fry imported from the Kwantung Province of China. It is now well established in certain localities but it is by no means widely distributed on the island. The date of introduction is not known but the earliest specimens are labelled 1912.

ACKNOWLEDGEMENTS

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KEY TO MAJOR GROUPS OF FISHES

The 73 species of fresh-water fishes reported from Singapore fall into 8 orders and 18 families which may be distinguished as follows:

1. Ventral fins absent. Body extremely elongate and eel-like. Barbels absent . . 2
— Ventral fins present. Body form variable. Barbels present or absent . . . 3
2. Dorsal and anal fins without spines. A single ventral gill-opening. Snout not elongate and fleshy . . . . . Synbranchia: Flutidae
— Dorsal and anal fins with strong spines. Two lateral gill-openings. Snout elongate and fleshy . . . . . Opisthomi: Mastacembelidae
3. Ventral fins thoracic or jugular 4
— Ventral fins abdominal 9
4. Anal fin with more than 15 rays. Respiratory supra-branchial chamber present **Labyrinthici: 5**
— Anal fin with less than 15 rays. No respiratory supra-branchial chamber present 7
5. Ventrals fin without spines. Scales cycloid . . . . . Ophicephalidae
— Ventral fin with one spine or reduced to one filamentous ray. Scales ctenoid 6
6. Snout elongate. Mouth opening almost as wide as depth of body. Anal fin deeply notched . . . . . Luciocephalidae

— Snout not elongate Mouth opening much less than depth of body. Anal fin not notched . . . . . Anabantidae
7. Ventral fins close together and united by a basal membrane . . . . . Gobioidea: Gobiidae
— Ventral fins well separated and not united by a basal membrane . . . . . Percomorphi: 8
8. A single nostril on each side. Palate toothless. Entopterygoid present . . Cichlidae
— Two nostrils on each side. Palate toothed. Entopterygoid absent . . . Nandidae
9. Body elongate and more or less cylindrical. Lower jaw much prolonged beyond upper jaw . . . . . Synentognathi: Hemiramphidae
— Body form variable. Lower jaw not prolonged beyond upper jaw 10
10. Origin of dorsal fin behind origin of anal. Lateral line absent Microcyprini: 11
— Origin of dorsal fin before origin of anal. Lateral line present or absent . . . Ostariophysi: 12
11. Anal fin with more than 12 rays, not modified in males to form an intromittant organ. Oviparous . . . . . Cyprinodontidae
— Anal fin with less than 12 rays, modified in males to form an intromittant organ. Viviparous . . . . . Poeciliidae
12. Pectoral fins without spines Skin generally with distinct cycloid scales. Jaws without teeth 13
— Pectoral fins with spines. Skin without scales. Jaws with teeth 14
13. Mouth inferior, with 3 or more pairs of barbels. Pharyngeal teeth in one row. Air bladder enclosed in bone . . . . . Cobitidae
— Mouth terminal or inferior, with 2 pairs or no barbels. Pharyngeal teeth in one to three rows. Air bladder not enclosed in bone . . . . . Cyprinidae
14. Adipose fin present 15
— Adipose fin absent 16
15. Gill membranes united to each other but free from isthmus . . . . Bagridae
— Gill membranes united to isthmus . . . . . Sisoridae
16. Dorsal fin with spine. Anal with less than 15 rays . . . . . Akysidae
— Dorsal fin without spine. Anal with more than 15 rays 17
17. Dorsal fin small, with less than 5 rays. Two pairs of barbels. Gill cavity without supplementary air-breathing organ . . . . . Siluridae
— Dorsal fin large, with more than 50 rays. Four pairs of barbels. Gill-cavity with supplementary air-breathing organ . . . . . Clariidae

Order Ostariophysi

Suborder Cyprinoidea

CYPRINIDAE

Apart from the 6 exotic species which are cultured in ponds, and 3 doubtful records, the cyprinid fishes are represented by 25 species which fall into 9 genera. Three sub-families are recognised:

1. Abdomen completely or partly compressed into a trenchant edge . . Abramidinae
— Abdomen not compressed into a trenchant edge but rounded or flattened . . 2
2. Lateral line running along lower half of caudal peduncle. Median symphysis of lower jaw formed into a knob which fits into an indentation in upper jaw when mouth is closed . . . . . Rasborinae
— Lateral line running along centre of caudal peduncle. Median symphysis of lower jaw not formed into a knob . . . . . Cyprininae

ABRAMIDINAE

Two genera are represented, viz., *Chela* Hamilton, in which the trenchant edge of the abdomen extends from the anus to the throat, and *Rasborichthys* Bleeker, in which this edge extends up to only the base of the ventral fins.

Chela Hamilton, 1822

Smith (1945: 74) and Silas (1958: 61) separated *Oxygaster* Van Hasselt from *Chela* Hamilton on the basis of the following two main contrasting characters: in *Oxygaster* the predorsal scales extend to between the eyes, and the mandibular symphysis has a well-developed hook fitting into a notch in the upper jaw; in *Chela* the predorsal scales do not extend between the eyes and the mandibular symphysis is without such a hook. However, Inger & Chin (1962: 51) have now described a large series of *Oxygaster anomalura* Van Hasselt in which the predorsal scales fail to reach the interorbital space, and accordingly they concluded that it is a mistake to recognise two genera. Until such time as a thorough revision of the Abramidinae is undertaken I prefer to use *Chela* Hamilton.

***Chela anomalura** (Van Hasselt)

Oxygaster anomalura Van Hasselt, 1823: 133 — Java.
Cyprinus oxygaster Valenciennes, in: Cuvier & Valenciennes, 1844: 349 — Batavia, Java.
Chela oxygaster Herre & Myers, 1937: 54.

The species is known locally from only 3 specimens, 85 to 91 mm in standard length, collected by A. W. Herre in March 1934 (Herre & Myers, 1937).

Although Weber & De Beaufort (1916: 52) have dismissed Van Hasselt's description of the species (1823) and attributed the original description to Cuvier & Valenciennes (1844), Smith (1945) has accepted the specific name *anomalura* Van Hasselt on the grounds that "the species is the only one mentioned in the description of the genus and is clearly entitled to recognition over *Leuciscus oxygaster* described by Cuvier and Valenciennes more than 20 years later". Van Hasselt's description reads in full, "*Oxygaster* Mihi, onderscheiden vooral door eene mesvormige carina aan de buiksvlakte, is misschien ten onregte door mij onder de Cyprinaceen gesteld, waarom ik nader hierop zal terugkomen; *Anomalura* heb ik als species naam onder de Tafel geschreven". As has been kindly pointed out to me (in litt.) by Dr. L. B. Holthuis of the Rijksmuseum van Natuurlijke Historie, Leiden, the single character mentioned by van Hasselt, viz., "mesvormige carina aan de buiksvlakte", is a good objective character which is sufficient to make *anomalura* Van Hasselt an available name.

Rasborichthys Bleeker, 1860b

As far as is known, the fishes of this genus occur only in Sumatra, Borneo and Singapore (Weber & De Beaufort, 1916: 55) and it is confusing that Silas (1958: 61-62) has considerably extended the range to cover "Malaya Archipelago and Indo-China". Only two species are known, viz., *R. helfrichii* Bleeker from Sumatra and Borneo, and *R. altior* Regan from Singapore. In spite of intensive collecting from various mainland localities in Johore, I have no records of *R. altior* from there and I have to conclude that the species does not occur north of Singapore and is probably endemic to Singapore Island.

Rasborichthys altior Regan (pl. 2 fig. 1)

Rasborichthys altior Regan, 1913a: 394 — Singapore.
Rasborichthys altior Weber & De Beaufort, 1916: 55; Tweedie, 1936: 21 (Botanic Gardens & Serangoon); Herre & Myers, 1937: 54 (Mandai Road); Fowler, 1938: 56, 250; Menon, 1954: 7; Alfred, 1961a: 9, pl. 2 fig. 10 (various localities).

Material examined. — BM.1913.3.6.9, lectotype, Singapore, Gaukel; BM.1913.3.6.10, paratype, Singapore, Gaukel; BM.1912.3.2.1, paratype, Singapore, Arnold; ZMA.103191, Singapore, donated by British Museum, 1915, no other data, one; BM.1913.10.30.30, Singapore, on exchange from M. Weber, 15.10.1913, no other data, one; NMS.1062, Serangoon Road, R. Hanitsch, 16.5.1912, two; NMS. 1063, Botanic Gardens, F. N. Chasen, February 1923, two; NMS.1064, Singapore, A. W. Herre, May 1934, three; NMS.1065, Singapore, October 1931, no other data, two; NMS. 1046, MacRitchie Reservoir, S. Sarmani, 25.3.1962, fourteen; NMS. 1135, same locality, E. Alfred, 3.3.1963, two; NMS.1167, Sungei Seletar, north of Seletar Reservoir, E. Alfred, 4.4.1963, four; NMS.1191, Sungei Seletar, west of Seletar Reservoir, E. Alfred, 8.4.1963, twenty-seven; NMS. 1176, Alkaff Gardens, Serangoon Road, T. Oates, 15.1.1964, one; NMS. 1214, Sungei Whompoe, west of MacRitchie Reservoir, S. Sarmani, 23.1.1964, five; NMS.1224, Sungei Whompoe, outlet from MacRitchie Reservoir, T. Oates, 2.1.1964, fifty-four; NMS.1269, Sungei Kallang, outlet from Peirce Reservoir, E. Alfred, 3.1.1964, twenty; ML.24971, Sungei Seletar, outlet from Seletar Reservoir, E. Alfred, 4.1.1964, forty.

Dorsal rays iii. 7-8; anal iii. 15-17; pectoral i. 13-16; ventral i. 7-8. Lateral line scales 35-37; transverse scales 7½/1/6-7½; predorsals 21-24; circumpeduncular scales 3½/1/2½. Depth 2.9-3.9; head 3.0-4.0; eye 2.8-3.5; snout 3.3-3.8; standard length 28.7-86.3 mm; total length 38.2-106.0 mm. Dorsal origin opposite 16th or 17th scale of lateral line. Dorso-hypural distance carried forwards, falling on centre of eye. Anal origin opposite 21st or 22nd scale of lateral line, situated nearer base of ventrals than caudal base.

Colouration (in life and when freshly preserved). Silvery, with a yellowish tinge. Dorsum and upper parts of sides dusky. A thin black axial streak. A series of 8 to 10 thin, longitudinal, dusky stripes following the lateral scale rows, especially in small specimens.

The specimen measuring 84.0 mm total length and 67.0 mm standard length, BM.1913.3.6.9, is hereby selected as the lectotype, and the type locality is hereby restricted to the MacRitchie Reservoir, Singapore.

RASBORINAE

Rasbora Bleeker, 1860b

The subfamily Rasborinae is represented by the single genus *Rasbora* Bleeker. In his studies of the genus, Brittan (1954a, 1954b) fully described the six species known from Singapore. I have therefore merely brought the synonymy on these species up-to-date, besides later commenting on two erroneous records which are not discussed by Brittan. The following key which is modified from Brittan (1954a) will serve to identify the local species:

1. Lateral line incomplete or absent 2
— Lateral line complete 3
2. Lateral line absent. Depth of body more than 3 times in standard length. Maximum size not exceeding 20 mm standard length . . . . . *R. maculata*
— Lateral line incomplete. Depth of body less than 3 times in standard length. Maximum size exceeding 20 mm standard length . . . . . *R. heteromorpha*
3. Body markings consisting of two lateral blotches, one below the dorsal and one at the caudal base . . . . . *R. elegans*
— Body markings not consisting of two lateral blotches but of a lateral stripe . . 4
4. Dark lateral stripe of more or less uniform intensity running between the caudal base and the eye 5
— Dark lateral stripe running from caudal base and markedly fading anteriorly below the dorsal fin . . . . . *R. bankanensis*
— Dark lateral stripe running from caudal base and markedly fading anteriorly uneven edges . . . . . *R. einthovenii*
— Dark lateral stripe running along midline of body throughout its length, and consisting of 2 parallel rows of spots . . . . . *R. cephalotaenia*

Rasbora bankanensis (Bleeker) (pl. 2 fig. 2)

Leuciscus bankanensis Bleeker, 1853a: 192 — Marawang, Banka.
Rasbora lateristriata sumatrana Herre & Myers, 1937: 55.
Rasbora bankanensis Brittan, 1954a: 96; Brittan, 1954b: 142 (Mandai Road).

Material examined. — NMS.1053, Mandai Road, M. Tweedie, February 1938, four; NMS.1192, Sungei Seletar, west of Seletar Reservoir, E. Alfred, 8.4.1963, twenty-six. Also, holotype, BM.1866.5.2.160, Marawang, Banka, H. L. van Bloemen Waanders.

This species was first reported locally by Brittan (1954a) who recorded 22 specimens collected by Herre in March 1934. These were originally reported as *R. lateristriata sumatrana* (Bleeker) by Herre & Myers (1937). Brittan (1954b) reported 4 further examples collected in February 1938. Despite careful collecting since 1957, I was unable to obtain any samples and I had therefore believed it to be extinct. Its recent re-discovery in April 1963, is of particular interest.

*Rasbora cephalotaenia (Bleeker)

Leuciscus cephalotaenia Bleeker, 1852a: 97 — Tjirutjup River, Biliton.
Rasbora einthovenii (p.p.) Herre & Myers, 1937: 54.
Rasbora cephalotaenia (p.p.) Herre & Myers, 1937: 54 (Mandai Road).
Rasbora cephalotaenia Brittan 1954a: 153; Brittan, 1954b: 149.

First reported locally by Herre & Myers (1937) from examples collected on the Mandai Road in March 1934, Brittan subsequently re-diagnosed (in synonymy, 1954a, 1954b) as also this species, the 3 other specimens reported by Herre & Myers (1937) as *R. einthovenii* (Bleeker). There are no other records from Singapore.

Rasbora einthovenii (Bleeker) (pl. 2 fig. 3)

Leuciscus einthovenii Bleeker, 1851d: 434 — Sambas, Borneo.
Rasbora einthovenii Bleeker, 1860d: 334; Bleeker, 1864-1865: 36, 120, pl. 122 fig. 1; Herre & Myers, 1937: 54; Fowler, 1938: 57, 251; Menon, 1954: 8 (Mandai Road); Brittan, 1954a: 149; Brittan, 1954b: 148.
Rasbora einthoveni Bleeker, 1860f: 35, 440; Weber & De Beaufort, 1916: 72; Tweedie, 1936: 21 (Ponggol and Mandai); Alfred, 1961a: 9, pl. 2 fig. 11 (Sungei Tengeh and Nee Soon swamp forest).
Rasbora cephalotaenia (p.p.) Herre & Myers, 1937: 54.

Material examined. — BM.1912.10.31.18 & 21-22, A. Rachow, four; NMS. 1054, Punggol, V. Knight, 9.2.1913, three; NMS.1055, Mandai Road, collected by Fisheries Department, 15.7.1921, four; ZMA.103230, same data, three; NMS.1056, Mandai Road, A. W. Herre, May 1937, eight; NMS.1057, Jurong, A. W. Herre, May 1937, four; NMS.1151, Sungei Tengeh, 1 mile N.E. of Tuas, E. Alfred, 20.3.1963, forty-four; ML.24972 Sungei Tengeh, Tuas Road, E. Alfred, 19.3.1963, twelve.

Unlike the other species of *Rasbora* which are now restricted to the vicinity of the three reservoirs, the present species also occurs on the western side of the island. There is also an earlier record (Tweedie, 1936), of specimens from Punggol on the eastern side. The species was recorded from Singapore as early as 1859 when Bleeker himself (1860d) reported that specimens were sent to him by the Count Francis de Castelnau. There have been several records since then.

I have not been able to locate the holotype (Alfred, 1964b) among the Bleeker specimens mentioned by Brittan (1954a: 152, 153).

Rasbora elegans elegans Volz (pl. 2 fig. 4)

Rasbora elegans Volz, 1903: 558 — Brooks in the interior of Palembang Residency, Sumatra.
Rasbora lateristriata var. *elegans* Weber & De Beaufort, 1916: 78.
Rasbora lateristriata Tweedie, 1936: 21; Fowler, 1938: 251.
Rasbora elegans Herre & Myers, 1937: 54; Brittan, 1954b: 135; Alfred, 1961a: 10, pl. 3 fig. 13 (north shore of Seletar Reservoir and Nee Soon swamp forest).
Rasbora elegans elegans Brittan, 1954a: 64.

Material examined. — NMS.1032, Sungei Seletar, Nee Soon Rifle Range, E. Alfred, 17.2.1958, seventeen; NMS.1047, MacRitchie Reservoir, S. Sarmani, 25.3.1962, eighteen;

NMS.1133, same locality, E. Alfred, 3.3.1963, six; ML.24973, Sungei Seletar, north of Seletar Reservoir, E. Alfred, 4.4.1963, sixty-six; NMS.1193, Sungei Seletar, west of Seletar Reservoir, E. Alfred, 8.4.1963, two hundred and five; NMS.1211, Sungei Whompoe, west of MacRitchie Reservoir, S. Sarmani, 23.1.1963; seven; NMS.1223, Sungei Whompoe, outlet from MacRitchie Reservoir, T. Oates, 2.1.1964, ten; NMS.1285, Sungei Seletar, outlet from Seletar Reservoir, E. Alfred, 4.1.1964, thirty-three.

Weber & De Beaufort (1916) considered the species as no more than a variety of *R. lateristriata* (Bleeker) and later De Beaufort again (in Tweedie, 1936) synonymised the two species. However, Brittan (1954a) showed that the two are quite distinct and correctly re-diagnosed the 3 specimens (St. 31210) listed in Tweedie (1936).

The colour pattern of the large series in hand agrees well with Brittan's (1954b: 136, fig. 2a) "typical form". The lateral line scales are 25 to 27, being slightly less than Brittan's count of 27 to 29.

Rasbora heteromorpha Duncker

Rasbora heteromorpha Duncker, 1904: 182, pl. 1 fig. 5 — Kuala Lumpur; Negri Sembilan?; Singapore (pond in Botanic Gardens).

Rasbora heteromorpha Tweedie, 1936: 21 (Mandai); Fowler, 1938: 57, 251; Brittan, 1954a: 187; Brittan, 1954b: 152; Alfred, 1961a: 9, pl. 2 fig. 12 (Peirce Reservoir and Nee Soon swamp forest); Alfred, 1962b: 150; Alfred, 1964d: 166.

Material examined. — NMS.1058, Pond near Peirce Reservoir, R. Hanitsch, 16.5.1912, four; NMS.1059, Mandai, N. Smedley, 1927, two; NMS.1060, Mandai Road, no other data, four; NMS.1168, Sungei Seletar, north of Seletar Reservoir, E. Alfred, 4.4.1963, two; ML. 24974, Sungei Seletar, west of Seletar Reservoir, E. Alfred, 8.4.1963, two. Also, 3 paratypes, ZMA.103218, 2-3 milestone Semenyih-Beranang Road, Selangor, G. Duncker, 1901.

This popular aquarium fish was first described from specimens taken from Kuala Lumpur, Singapore, and doubtfully from Negri Sembilan. Unfortunately, it has since then been exterminated from the Singapore type locality, the lake in the Botanic Gardens. I have recently shown (Alfred, 1964d) that the doubtful Negri Sembilan locality should be corrected to the 2-3 milestone, Semenyih-Beranang Road, Selangor.

Rasbora maculata Duncker

Rasbora maculata Duncker, 1904: 182, pl. 1 fig. 6 — Bukit Tray near Bandar Maharani, Malaya.

Rasbora maculata Brittan, 1954a: 194; Brittan 1954b: 153; Alfred, 1961a: 10, pl. 3 fig. 14 (Nee Soon swamp forest).

Material examined. — NMS.1061, Nee Soon, M. Tweedie, January 1950, six. Also, 5 paratypes, ZMA.103216, Bukit Terah, Bandar Maharani, Johore, G. Duncker, 1901.

This diminutive cyprinid was synonymised with *R. kalochroma* (Bleeker) by Weber & De Beaufort (1916: 70) who examined part of Duncker's

type series now in the Zoologisch Museum, Amsterdam. Herre & Myers (1937: 55) have already pointed out that the two species are quite distinct.

CYPRININAE

The subfamily Cyprininae is represented by 6 genera which may be identified from the following key:

1. Dorsal fin with more than 20 branched rays . . . . . *Labiobarbus*
— Dorsal fin with less than 20 branched rays 2
2. Dorsal fin with more than 10 branched rays . . . . . *Osteochilus*
— Dorsal fin with less than 10 branched rays 3
3. Maxillary reaching beyond vertical from front margin of eye . . . *Hampala*
— Maxillary not reaching beyond vertical from front margin of eye 4
4. Groove running posterior and parallel to lower lip interrupted in middle . *Puntius*
— Groove running posterior and parallel to lower lip not interrupted 5
5. Dorsal spine denticulated. Head with numerous parallel lines of pores . . . . *Cyclocheilichthys*
— Dorsal spine non-denticulated. Head without parallel lines of pores . . . *Tor*

Cyclocheilichthys Bleeker, 1860b

Cyclocheilichthys apogon (Valenciennes) (pl. 3 fig. 1)

Barbus apogon Valenciennes, in: Cuvier & Valenciennes, 1842: 392 — Java.
Cyclocheilichthys apogon Weber & De Beaufort, 1916: 156.

Material examined: ML.24992, MacRitchie Reservoir, E. Alfred, April 1962, four; NMS.1220, west of MacRitchie Reservoir, S. Sarmani, 23.1.1963, two.

Dorsal rays IV. 8; anal III. 5; pectoral i. 14-15; ventral i. 8. Lateral line 31-33; transverse scales 6½/1/6½; predorsals 14-17; circumpeduncular scales 3½/1/3½. Standard length 50.0-110.0 mm. The species is herein formally recorded for the first time from Singapore. Dr. D. S. Johnson of the University of Singapore informs me (personal communication) that he has also obtained this fish from the same locality.

Labiobarbus Van Hasselt, 1823

Although Weber & De Beaufort (1916: 112) have used *Dangila* Cuvier & Valenciennes (1842) for the fishes of this genus, and Inger & Chin (1962: 94) have given reasons for the continued usage of the name, I follow Smith (1945: 221) in accepting the earlier available name, *Labiobarbus* Van Hasselt (1823). Van Hasselt's description, which I have translated into English (Alfred, 1962a), reads in full, "Het genus *Labiobarbus,* Mihi bestaat uit Labiones met 4 barbillons, met eene dorsaal vin, waarvan de 2de straal niet getand is, vereenigt dus de karakteren van *Labio,* en *barbus,* waarom ik den naam *Labiobarbus* heb aangenomen. De namen *L. Leptocheilus* M. en *Lipocheilus* M. onderscheiden de twee species, die beide bij Batavia in de rivier gevonden worden, en onder mij afgebeeld zijn".

Using Van Hasselt's specimen, Valenciennes (1842: 234) provided a fuller description of *L. leptocheila* under the generic name *Dangila,* and later Bleeker (1863: 24) designated the species as the type of that genus. I have examined a specimen from the Van Hasselt collection labelled "*Dangila leptocheila* C.V." in the Leiden Museum (No. 2109) measuring about 115 mm total length, and I agree with Bleeker (1863) and Weber & De Beaufort (1916: 115) that *D. leptocheila* Valenciennes is a synonym of *D. cuvieri* Valenciennes (1842: 230).

*Labiobarbus festivus (Heckel)

Cyrene festiva Heckel, 1843: 1025 — not seen.
Dangila burmanica (nec Day) Hanitsch, 1904: 10; Maxwell, 1922: 242, 264; Fowler, 1938: 64.
Dangila festiva Herre & Myers, 1937: 59.

Material examined. — NMS.101 Singapore, T. I. Rowell, 1883-1887, one.

Previously known locally from only 5 specimens 128 to 152 mm in length, collected by A. W. Herre in March 1934 (Herre & Myers, 1937). The present specimen is a stuffed skin of about 275 mm total length.

Hampala Van Hasselt, 1823

As pointed out by Smith (1945: 132) we may more appropriately follow Bleeker (1860b) in crediting the generic name to Van Hasselt, rather than to Bleeker as is done by Weber & De Beaufort (1916: 143). Van Hasselt's description reads in full "Het genus *Hampala* Nob., komt het naast aan *Leuciscus* Cuv., onderscheidt zich echter door 2 filamenten aan iederen mondhoek; de species is afgebeeld onder den naam *Macrolepidota* Nob. en leeft bij Buitenzorg".

*Hampala macrolepidota Van Hasselt

Hampala macrolepidota Van Hasselt, 1823: 132 — Buitenzorg, Java.
Capoeta macrolepidota Valenciennes, in: Cuvier & Valenciennes, 1842: 280, pl. 477 — Java.
Barbus jerdoni (nec Day) Hanitsch, 1904: 11; Maxwell, 1922: 246, 265; Fowler, 1938: 61.
Hampala macrolepidota Herre & Myers, 1937: 60.

Material examined. — NMS. 109, Singapore, T. I. Rowell, 1883-1887, one.

The species is known locally from 5 specimens collected by A. W. Herre in March 1934 (Herre & Myers, 1937) and from the present stuffed skin measuring 295 mm total length.

Osteochilus Günther, 1868

The genus is represented by 2 species, *O. melanopleura* (Bleeker) and *O. spilurus* (Bleeker). The former is characterised by the absence of pores on the snout and having 45 to 54 lateral line scales. In *O. spilurus* there are numerous small pores on the snout and the lateral line scales are relatively fewer, being 29 or 30.

*Osteochilus melanopleura (Bleeker)

Rohita melanoplcura Bleeker, 1852b: 430 — Banjermassin, Borneo and Palembang, Sumatra.

Osteochilus melanoplcurus Karoli, 1882: 179; Fowler, 1938: 67.

Osteochilus melanopleura Weber & De Beaufort, 1916: 127.

The species is known from only the original Singapore record given by Karoli (1882). Weber & De Beaufort (1916) and Fowler (1938) have accepted this record without comment but I am accepting it with reservations since Karoli made several errors in his localities.

*Osteochilus spilurus (Bleeker)

Dangila spilurus Bleeker, 1851a: 272 — Banjermassin, Borneo.

Labeo caeruleus (nec Day) Hanitsch, 1904: 10; Maxwell, 1922: 253, 265; Fowler, 1938: 66.

Osteochilus spilurus Herre, 1940: 29 (Mandai Road).

Material examined. — NMS.102, Singapore, T. I. Rowell, 1883-1887, one.

The first Singapore record of the species is of 2 specimens of 20 and 25 mm in standard length, collected from the Mandai Road area in 1936 (Herre, 1940). I now refer here one stuffed skin of about 170 mm standard length.

Puntius Hamilton, 1822

The puntiid fishes are represented by 6 species of which only 3 are known as currently occurring in Singapore. In addition, I have for convenience included in this group a seventh species, *Barbus semifasciolatus* Günther, which has been introduced from China. They may be identified as follows: —

1. 7½ scales between origin of dorsal fin and lateral line . . *P. schwanenfeldii*
— 6½ scales between origin of dorsal fin and lateral line 2
2. 16 scales around narrowest part of caudal peduncle . . . . . *P. halei*
— 12 scales around narrowest part of caudal peduncle 3
3. A single pair of barbels. Lateral line incomplete, complete or interrupted . . . . . *P. semifasciolatus*
— Two pairs of barbels. Lateral line complete 4
4. Markings consisting of 6 transverse stripes. No spots, blotches or longitudinal stripes. Total length not exceeding 60 mm. . . . . *P. pentazona johorensis*
— Markings not consisting of 6 transverse stripes. Spots, blotches or longitudinal

stripes present. Total length exceeding 60 mm. 5
5. Body markings consisting of two transverse bands anteriorly, one across nape and the other between base of ventrals and anterior dorsal base. A mid-lateral longitudinal stripe posteriorly . . . . . *P. lateristriga*
— Body markings not so but consisting mainly of spots and blotches 6
6. A transverse band across nape followed by two transverse blotches, one above ventrals and the other above anal, and a precaudal spot . . . . . *P. dunckeri*
— Markings not so. A transverse blotch or spot at anterior dorsal base. A row of mid-lateral spots posteriorly or a precaudal spot with or without a faint longitudinal stripe. Sometimes no markings discernible . . . . . *P. binotatus*

Puntius binotatus (Valenciennes)

Barbus binotatus Valenciennes, in: Cuvier & Valenciennes, 1842: 168 — Java.

Systomus (Barbodes) maculatus Bleeker, 1860a: 217; Bleeker, 1860c: 450; Bleeker, 1860f: 34, 346.

Puntius (Barbodes) maculatus Bleeker, 1864-1865: 36, 104, pl. 141 fig. 1, pl. 144 fig. 6.

Barbus (Puntius) maculatus Martens, 1876: 402.

Barbus maculatus Hanitsch, 1901: 4; Hanitsch, 1904: 11; Duncker, 1904: 177 (Botanic Gardens).

Puntius binotatus Weber & De Beaufort, 1916: 186; Tweedie, 1936: 20; Herre & Myers, 1937: 63; Fowler, 1938: 59, 252; Menon, 1954: 15; Alfred, 1961a: 11, pl. 3 fig. 17a, 17b (north shore of Seletar Reservoir and Nee Soon swamp forest).

Puntius binotatus banksi Herre, 1940: 31 (Botanic Gardens).

Material examined. — NMS.521, Botanic Gardens, F. N. Chasen, February 1923, eleven; NMS. 522, Punggol, V. Knight, 9.2.1913, two; NMS.524, Mandai, N. Smedley, 1927, four; NMS. 526, Singapore, R. Hanitsch, 1913, one; NMS.528, Singapore, A. W. Herre, March 1934, two; NMS.547, Singapore, R. Hanitsch, 1912, one; NMS. 550, Botanic Gardens, no other data, thirty-seven; NMS.554, Botanic Gardens, P. H. de Fontaine, September 1930, four; ZMA.103210, Mandai, M. Tweedie, 1927, six; NMS.1024, Sungei Ayer Tawar, near Huat Choe, E. Alfred, 19.3.1958, six; NMS.1036, Sungei Seletar, Nee Soon Rifle Range, E. Alfred, 17.2.1958, three; NMS.1048, MacRitchie Reservoir, S. Sarmani, 25.3.1962, twenty-one; NMS.1134, MacRitchie Reservoir, E. Alfred, 3.3.1963, twelve; NMS.1149, Sungei Tengeh, E. Alfred, 21.3.1963, fifty-four; NMS.1169, Sungei Seletar, north of Seletar Reservoir, E. Alfred, 4.4.1963, nine; ML. 24975, Sungei Seletar, west of Seletar Reservoir, E. Alfred, 8.4.1963, fifteen; NMS.1212, Sungei Whompoe, west of MacRitchie Reservoir, S. Sarmani, 23.1.1964, eight; NMS. 1222, Sungei Whompoe, outlet from MacRitchie Reservoir, T. Oates, 2.1.1964, ten; NMS.1232, Sungei Kangkar, 16th mile Lim Chu Kang Road, M. Dali, 14.3.1963, eight; NMS.1242, Botanic Gardens Lake, T. Oates, 20.1.1964, thirty-three; NMS.1250, Sungei Bajau, Pasir Laba Road, E. Alfred, 21.3.1963, twelve; NMS.1267, Sungei Kallang, outlet from Peirce Reservoir, E. Alfred, 3.1.1964, fourteen.

Dorsal rays IV. 7-8; anal iii. 5; pectoral i. 13-15; ventral i. 8. Lateral line 21-23; predorsal scales 10-11.

This is by far the most common and widely distributed cyprinid in Singapore. It is generally a species of slow, forest streams. The specimens in hand show all stages of development of the colour pattern which is described by Menon (1954: 15, fig. 4). In the largest specimens, the markings are entirely obscured.

*Puntius dunckeri (Ahl)

Barbus dunckeri Ahl, 1929: 165, 1 fig. — Bukit Timah, Singapore.
? Barbus tetrazona Karoli, 1882: 179 (Seletar); Fowler, 1938: 63.
Puntius everetti (p.p., nec Boulenger) Weber & De Beaufort, 1916: 180.
Puntius tetrazona (p.p., nec Bleeker) Weber & De Beaufort, 1916: 183.
Puntius tetrazona (nec Bleeker) Herre & Myers, 1937: 64.
Barbus everetti (nec Boulenger) Fowler, 1938: 60.
Barbus dunckeri Ahl, 1939: 243 (Bukit Timah, Singapore).
Puntius dunckeri Herre, 1940: 30 (Mandai Road).

Material examined. — Zoologisches Museum der Humboldt-Universität, Berlin, No. 20876, Bukit Timah, B. Kuhnt, November 1922, four syntypes; ZMA.103188, Singapore, ex Raffles Museum, 1913, two; ZMA.103190, Singapore, ex Zoologisch Museum Hamburg, No. 10006, no date, one; BM. 1913 10.30.29, Singapore, A. Rachow, no date, one.

Dorsal rays iii-iv. 8; anal iii. 5; pectoral i. 13-15; ventral i. 8. Lateral line scales 22-24; transverse scales 4½/1/4½; predorsals 8-9; circumpeduncular scales 2½/1/2½. Depth 2.7-2.9; head 3.6-3.9; eye 4.0-4.3; snout 3.0-3.4; standard length 33.3-64.4 mm; total length 45.5-86.2 mm. Dorsal origin opposite origin of ventrals and opposite 7th scale of lateral line. Origin of ventrals separated from lateral line by 3 scales. Anal origin opposite 13th or 14th lateral line scale and separated from it by 3 or 4 scales. Maxillary barbels slightly longer than rostrals and equal to 1.05 to 1.55 times eye diameter.

Colouration (in preserved specimens). A black band across the nape (sometimes narrowly interrupted mid-dorsally) passing immediately behind the opercle and almost reaching the base of the pectoral fin. A black blotch on the anterior two-thirds of the base of the dorsal fin. Below this a black transverse bar almost meeting the base of the ventral fin. A black spot or blotch at the anterior half of the anal base. A black transverse bar above this which is sometimes extended both dorsally and ventrally to form a continuous band encircling the body behind the dorsal fin. A precaudal spot, sometimes extended to form a dark band encircling the caudal base. A vague, darkish, lateral stripe running mainly along the scale row immediately dorsal to the lateral line and extending from the anterior band behind the opercle to the third transverse bar above the anal fin. Dorsal and caudal fins dusky, anal with a dark margin.

The species was first described briefly in an aquarium publication by Ahl (1929) who stated that he had already described it elsewhere and added "Betreffs der Beschreibung verweise ich Interessenten auf meine diesbezugliche Abhandlung im Zoolog. Anzeiger". Unfortunately, it was not until 10 years later (Ahl, 1939) that the formal description was published and this

too, not in the publication he mentioned. Not unexpectedly, this led to some confusion and Herre (1940: 56), for example, stated "*Barbus dunckeri* was described in an article in the Zoologisches Anzeiger, but I have been unable to get hold of the paper or to learn its exact title, 1922".

Herre (1940) also pointed out that the species is easily confused with *P. everetti* (Boulenger) and Weber & De Beaufort (1916) erroneously listed Singapore as a locality for the latter on the basis of the single specimen (BM. 1913.10.30.29) identified as that species in the collection of the British Museum. However, Ahl (1939) pointed out that the species differs from *P. everetti* mainly because it has more scales in the upper half of the body, a slightly greater body depth and shorter barbels. Comparison of the 6 syntypes (BM. 1893.3.6.213-218, Sarawak, Everett) and 3 other specimens of *P. everetti* in the Muséum National d'Histoire Naturelle, Paris (Nos. 91.352 & 91.353, Sebroeang, Borneo, M. Chaper) with 4 syntypes and 4 topotypes of *P. dunckeri* (listed above) reveal that there are two small but distinct differences between the two species. The scales above the lateral line are fewer in *P. everetti,* being 3½ as against 4½ in *P. dunckeri.* Secondly, while the colouration in both the species is identical *P. everetti* has an additional small dark spot at the base of the hindmost dorsal rays.

Examination of 18 specimens (NMS. 516) collected from 8 miles north of Kota Tinggi, Johore, the remainder of the series reported by Menon (1954: 20, fig. 6) as *P. everetti,* reveal that they are not identifiable as *P. everetti* but are *P. dunckeri.* It is probable that the former is restricted to Borneo and *P. dunckeri* to Malaya.

*Puntius halei** Duncker

Puntius halei Duncker, 1904: 178 — Pahang River, Kuala Tembeling, Malaya.
Puntius halei Herre & Myers, 1937: 63.

Of this little known species, Herre & Myers (1937) record a single specimen, 89 mm in standard length. It is otherwise known from the Pahang River near Kuala Tembeling.

Puntius lateristriga (Valenciennes) (pl. 3 fig. 2)

Barbus lateristriga Valenciennes, in: Cuvier & Valenciennes, 1842: 161 — Java.
Systomus (Barbodes) lateristriga Bleeker, 1860d: 334; Bleeker, 1860e: 101; Bleeker, 1860f: 34, 342.
Barbus lateristriga Karoli, 1882: 180; Fowler, 1938: 61.
Puntius lateristriga Weber & De Beaufort, 1916: 179; Herre & Myers, 1937: 64; Alfred, 1961a: 10, pl. 3 fig. 16 (north shore of MacRitchie Reservoir).

Material examined. — BM.1913.10.30.24-26, Singapore, A. Rachow, three; NMS.1045, MacRitchie Reservoir, S. Sarmani, 25.3.1962, twelve; ML.24976, same locality, E. Alfred.

3.3.1963, five; NMS.1287, Sungei Kallang, west of Peirce Reservoir, B. A. Abel, 9.1.1964, three; NMS.1219, Sungei Whompoe, west of MacRitchie Reservoir, S. Sarmani, 23.1.1964, two.

Dorsal rays IV. 8; anal iii. 5-6; pectoral i. 12-13; ventral i. 8. Lateral line 22-23; transverse scales 3½/1/3½; predorsals 8; circumpeduncular scales 2½/1/2½.

In his studies on regional variation in the colour pattern of the species, Tweedie (1961) showed the presence of 6 colour forms in Malaya. The pattern on the adult and juvenile Singapore specimens now available, agrees closely with his specimens from the Mawai District, Johore (Tweedie, 1961: 178, pl. 22 fig. 2, pl. 23 fig. 11). A re-examination of the entire series of specimens now in the National Museum collection shows that in addition to the basic markings described by Tweedie, there is a dark basal spot on the hindmost dorsal rays. I am also taking this opportunity to point out that in my previous illustration of the species (Alfred, 1961a, pl. 3 fig. 16) the markings are erroneously shown in that the anterior horizontal bar between the 2 vertical bars is absent.

This distinctively marked cyprinid was collected locally for the first time a century ago, by the Count Francis de Castelnau (Bleeker, 1860d). Subsequently, additional specimens were reported by Karoli (1882), Herre & Myers (1937), and Alfred (1961a).

Puntius pentazona johorensis Duncker

Barbus tetrazona var. *johorensis* Duncker, 1904: 178, pl. 1 fig. 3 — Muar River, Tebing Tinggi.

Barbus (Barbodes) hexazona Weber & De Beaufort, 1912: 527, pl. 11 fig. 2 — Taluk and Gunung Sahilan, Sumatra.

Puntius pentazona (p.p.) Weber & De Beaufort, 1916: 182; Fowler, 1938: 62.

Puntius hexazona Tweedie, 1936: 20 (Woodlands); Fowler, 1938: 252; Alfred, 1961a: 10, pl. 3 fig. 15 (Nee Soon swamp forest); Alfred, 1962b: 150.

Puntius pentazona johorensis Alfred, 1964e: 139 (various localities).

Material examined. — BM.1912.2.2.19-20, J. P. Arnold, two; BM.1913.10.30.27-28, A. Rachow, two; ZMA.103202, Woodlands, Tan Teck Swee, 28.1.1913, two; NMS.507, same data, three; ML.20912, A. Werner, 10.7.1956, six; NMS.1189, Sungei Seletar, west of Seletar Reservoir, E. Alfred, 8.4.1963, eleven. Also, 1 paratype of *B. tetrazona* var. *johorensis* Duncker, BM.1905.5.6.6., Muar River, Tebing Tinggi, Negri Sembilan, G. Duncker, 1901, and 14 syntypes of *B. hexazona* Weber & De Beaufort, ZMA.103200, Gunung Sahilan, Sumatra, and ZMA.100253, Taluk, Sumatra, J. P. Kleiweg de Zwaan, 1907.

Dorsal rays IV. 8-9; anal iii. 5; pectoral i. 12-14; ventral i. 8. Lateral line 19-23; transverse scales 4½/1/4½; predorsals 8-10; circumpeduncular scales 2½/1/2½.

I have recently shown (Alfred, 1964e) that the Singapore form which is most commonly referred to as *P. hexazona* (Weber & De Beaufort),

should be considered as no more than a subspecies of *P. pentazona* (Boulenger).

*Puntius schwanenfeldii (Bleeker)

Barbus Schwanenfeldii Bleeker, 1853b: 517 — Lake Singkara, Moarakompeh, Palembang and Pangabuang, Sumatra.

Barbus neilli (nec Day) Hanitsch, 1904: 11; Maxwell, 1922: 244, 265; Fowler, 1938: 61.

Puntius schwanefeldi Weber & De Beaufort, 1916: 178.

Material examined. — NMS.108, Singapore, T. I. Rowell, 1883-1887, one; NMS.592, Jurong, M. Tweedie, 14.5.1937, six. Also, 5 syntypes, ML.7013 (one), ML.10322 (three) and BM.1866.5.2.178 (one), Lake Singkara, Moarakompeh, Palembang and Pangabuang, Sumatra, H. W. Schwanefeld, J. M. van Leer, J. J. Adriaans and J. Schwarz.

Dorsal rays IV. 8; anal iii. 5; pectoral i. 13-15; ventral i. 8. Lateral line 32-34; transverse scales 7½/1/5½; predorsals 11-13; circumpeduncular scales 3½/1/3½.

Herein reported for the first time from Singapore from 6 specimens 62-67 mm total length, collected from Jurong in 1937, and from a seventh specimen, a stuffed skin, of about 350 mm total length.

Puntius semifasciolatus (Günther) (pl. 3 fig. 3)

Barbus semifasciolatus Günther, 1868: 140, 484 — China.

Puntius sachsi (nec Ahl) De Beaufort, 1933: 33 (Serangoon); Tweedie, 1936: 21 (Serangoon).

Barbus sachsii (nec Ahl) Fowler, 1938: 62, 252.

Material examined. — NMS.1025, University of Singapore pond, Bukit Timah Road, E. Alfred, 13.5.1958, twelve; NMS.1175, Alkaff Gardens, Serangoon Road, T. Oates, 15.1.1964, one hundred and twelve; NMS.1215, MacRitchie Reservoir, S. Sarmani, 23.1.1963, one; NMS.1268, Sungei Kallang, outlet from Peirce Reservoir, E. Alfred, 3.1.1964, two; ML.24977, Sungei Seletar, outlet from Seletar Reservoir, E. Alfred, 4.1.1964, seventy; ZMA.103211, pond at Serangoon, 16.5.1912, two. Also, holotype, BM.1851.12.27.165, China, Warwick.

Dorsal rays III. 8-9; anal iii. 5; pectoral i. 11-13; ventral i. 7-8. Lateral line complete, incomplete, or interrupted. Lateral line scales 21-23; transverse scales 3½/1/4½; predorsals 8-10; circumpeduncular scales 2½/1/2½. Depth 2.7-3.1; head 2.8-3.4; predorsal length 1.7-1.9; eye 2.9-3.6; snout 3.1-4.0; interorbital width 2.5-3.1; standard length 17.7-40.0 mm; total length 23.5-52.8 mm. Dorsal origin slightly behind that of ventrals and opposite 8th scale of lateral line. Origin of ventrals opposite 7th lateral line scale and separated from it by 3 scales. Anal origin opposite 13th or 14th lateral line scale and separated from it by 3 scales. A pair of maxillary barbels, equal to 0.3 to 0.4 times eye diameter.

Colouration (in preserved specimens). Dusky above whitish below, with a variable number of spots, blotches and bars on the side. In all the specimens

there is a black, vertical bar behind the head opposite the pectorals, followed by a second bar opposite the dorsal, behind which is a third bar or spot opposite the anal and finally a precaudal spot. Additional spots, blotches or bars may be present between these markings. A dark spot at the base of the dorsal spines, and a supra-anal spot present. Dorsal, anal, and caudal fins slightly dusky, other fins hyaline. In life, the colouration is as described but the body is silvery yellow.

De Beaufort (1933), who first reported specimens from Singapore under the name of *Puntius sachsi* (Ahl), has already pointed out the peculiarity of the lateral line being complete, incomplete, or interrupted. This is also evident in my specimens. I have examined the holotype of *Barbus sachsii* Ahl (Zoologisches Museum der Humboldt-Universität, Berlin, No. 20670, coll. Bade) and now find that it differs from the present species only in having no barbels.

Tor Gray, 1833

***Tor tambroides** (Bleeker)

Labeobarbus tambroides Bleeker, 1854a: 92 — Padang, Pajakombo, Solok, Lacus Meninju, Sumatra; Tjampea, Buitenzorg, Tjipanas, Java.
Tor tambroides Herre & Myers 1937: 60.

The only Singapore record is of a single specimen measuring 85 mm in standard length collectd by A. W. Herre in March 1934 (Herre & Myers, 1937).

COBITIDAE

The loaches of the family Cobitidae are characteristic of forest streams where they usually occur, often in great numbers, among aquatic vegetation or under deposits of dead leaves or loose stones and gravel. Two genera are represented, *Acantophthalmus* Van Hasselt, and *Noemacheilus* Van Hasselt. The former is distinguished by the origin of the dorsal fin being behind the ventrals, the subcutaneous eyes, and the presence of a small suborbital spine. In *Noemacheilus* the dorsal origin is before the ventrals, the eyes have a free orbital margin, and a suborbital spine is absent.

Acantophthalmus Van Hasselt, 1823

The generic name *Acanthophthalmus* was first used by Van Hasselt (1824). This is antedated by *Acantophthalmus* Van Hasselt (1823). However, in neither of these publications did the author adequately describe the three species he mentioned, viz., *A. octocirrhus, A. fasciatus* and *A. javanicus*.

Using Van Hasselt's specimens and manuscript drawings, Valenciennes (in Cuvier & Valenciennes, 1846) described the three species, re-naming them respectively, *Cobitis hasselti, C. kuhlii* and *C. oblonga.* Later, Bleeker (1859a) accepted *Acanthophthalmus* Van Hasselt and provided a fuller description of the genus. He however assigned *C. hasselti* to the genus *Lepidocephalus* Bleeker but retained *C. kuhlii* and *C. oblonga* as species of *Acanthophthalmus.*

The genus is represented locally by two species which may be distinguished as follows: —

1. Labial barbels absent. Head with two transverse markings. A series of broad, transverse markings across the dorsum and sides of the body. Dorsal and caudal fins without stripes . . . . . *A. kuhlii*
— A pair of labial barbels present. Head with three transverse markings. A longitudinal row of irregular blotches along the dorsum with a similar mid-lateral row and sometimes a second lateral row of blotches below this. Distal half of dorsal and caudal fins with irregular stripes . . . . . *A. muraeniformis*

Acantophthalmus kuhlii (Valenciennes) (pl. 5 fig. 1-6)

Acantophthalmus fasciatus Van Hasselt, 1823: 133 — Java. (nomen nudum).
Cobitis kuhlii Valenciennes, in: Cuvier & Valenciennes, 1846: 77 — Batavia, Java.
Acantophthalmus kuhlii Karoli, 1882: 181 (Seletar River); Weber & De Beaufort, 1916: 33; Fowler, 1938: 53.

Material examined. — ML.24993, Sungei Seletar, north of Seletar Reservoir, E. Alfred, 4.4.1963, two; NMS.1187, Sungei Seletar, west of Seletar Reservoir, E. Alfred, 8.4.1963, nine.

Dorsal rays iii. 6; anal iii. 5; pectoral i. 8-9; ventral i. 5. A pair of rostral, maxillary, and mandibular barbels. Anterior nostril tubular, with the posterior rim drawn out, and resembling a barbel. Base of dorsal fin completely in front of anal fin. In full-grown males the second pectoral ray is 2 to 3 times thicker than the third. The pectoral fins are also slightly longer in males than in females.

Colouration in life. Pinkish, with reddish-brown markings as described in the key, and as illustrated in the accompanying plate.

Since Karoli (1882) first reported the species locally from the Seletar River, it has been collected twice, only recently, from the same river drainage. The specimens were taken from leaf-beds and from among other submerged debris.

The species was originally described by Valenciennes from a manuscript drawing prepared by Van Hasselt who labelled it *A. fasciatus.* I have not been able to locate this illustration or the original specimen and I believe that they have been lost. However, I have examined the Bleeker collection of 16 specimens (ML. 7054) from Batavia, Buitenzorg and Penawangan, Java, and Lahat, Sumatra, in addition to 4 specimens (ML. 2688) collected

by S. Müller from Krawang, Java. My series agrees closely with these specimens.

A critical examination of the Bleeker specimen (BM. 1866.5.2.41), which Fraser-Brunner describes (1940: 174, fig. 4B) as *A. kuhlii sumatranus*, reveals that there are no appreciable differences between this specimen and the other Bleeker and the Müller specimens. Neither do any of the latter (which include Javan specimens) agree with his aquarium specimen of *A. kuhlii kuhlii* (1940: 174, fig. 4A) which is supposedly from Java. Furthermore, his drawing of the type of *A. k. sumatranus* (fig. 4B) shows only the faded markings, but when the specimen is seen under ultra-violet light (pl. 5 fig. 1), it agrees with my Singapore series (pl. 5 fig. 2-6). The specimen besides, is incorrectly labelled by him as originating from Lahat, Sumatra; there is no indication in the British Museum fish register that this is so and it may very well have been collected from any of the localities from which Bleeker described the species. Accordingly, I do not consider subspecific distinctions valid in this species.

Acantophthalmus muraeniformis De Beaufort (pl. 4)

Acanthophthalmus (Cobitophis) muraeniformis De Beaufort, 1933: 32 — Thomson Road, Singapore Island.

Acanthophthalmus (Cobitophis) muraeniformis Tweedie, 1936: 19.

Acanthophthalmus muraeniformis Fowler, 1938: 53, 250; Alfred, 1961a: 7, pl. 1 fig. 8 (north shore of Seletar Reservoir and Nee Soon swamp forest).

Material examined. — ZMA.103185, 3 syntypes, and NMS.1052, 2 syntypes, 3rd mile Thomson Road, Singapore, R. Hanitsch, 16.5.1912; NMS.1031, Sungei Seletar, Nee Soon Rifle Range, E. Alfred, 17.2.1958, eighteen; NMS.1051, stream near Seletar Reservoir, M. Tweedie, January 1951, three; ML.24994, Sungei Seletar north of Seletar Reservoir, E. Alfred, 4.4.1963, nineteen; NMS.1168, Sungei Seletar, west of Seletar Reservoir, E. Alfred, 8.4.1963, one hundred and seventy-one.

Dorsal rays iii. 5-6; anal iii. 5; pectoral i. 7; ventral i. 6. Depth 8.8-12.1, head 6.0-7.9; eye 7.6-9.5; snout 2.3-3.0; interorbital width 6.4-8.4.

A pair of rostral, maxillary, mandibular, and, on the lower lip, labial barbels. Anterior nostril tubular, with the posterior rim drawn out, and resembling a barbel. Base of dorsal fin completely in front of anal fin. In full-grown males the second pectoral ray is 2 to 3 times thicker than the third ray. The pectoral fin is also longer in males than in females; in 7 of the largest males it was 1.4 to 1.5, while in 7 of the largest females it was 1.7 to 2.1 in the head.

Colouration in life. Pinkish with dark-brown markings as described in the key (above) and as shown in the accompanying plate. In addition, the males have irregular, brown blotches on the pectoral fins. In preserved specimens the pinkish ground colour is faded white.

In the original description, De Beaufort (1933) mistakenly placed the species under the sub-genus *Cobitophis* Myers (1927). This was probably due to the fact that he placed complete reliance on only the first of the two characters that Myers gave to define the sub-genus, viz., "the extremely attenuated, anguilliform body, and in having some part of the anal fin under the dorsal".

There is also some confusion regarding the colouration. Hora (1941: 51, pl. 5 figs. 1, 3) described two colour forms from Johore and Pahang. I have examined duplicates of the series which Hora (fig. 3) described as having lighter markings and tentatively identify them as *A. mariae* Inger & Chin.

Noemacheilus Van Hasselt, 1823

Schultz (in Smith, 1945: 302) and Briggs (1961: 163) have pointed out that the original spelling used by Van Hasselt is *Noemacheilus,* which has been erroneously rendered *Nemachilus* or *Nemacheilus* by several authors. Of the latter, *Nemachilus* dates back to Bleeker (1863) and not to Günther (1868: 11, 347). The earliest usage of *Nemacheilus* appears to be that of Bleeker (1864-1865).

Weber & De Beaufort credit the original generic description to Bleeker (1863) but there are no grounds for ignoring Van Hasselt's description which reads, "*Noemacheilus* Nob. nadert door platte maxillen het genus Poecilia Schn., de Zundanezen noemen hem *Jelaer,* hij leeft bij Buitenzorg en de species heeft in onze teekening den naam *fasciatus* Nob.".

Noemacheilus selangoricus Duncker (pl. 5 fig. 7)

Nemachilus selangoricus Duncker, 1904: 175 — Kuala Lumpur, Malaya.

Nemacheilus selangoricus Herre & Myers, 1937: 65; Herre, 1940: 34 (Mandai Road).

Nemachilus selangoricus Tweedie, 1940: 73; Hora, 1941: 57; Alfred, 1961a: 8, pl. 2 fig. 9 (north shore of Seletar Reservoir and Nee Soon swamp forest).

Material examined. — NMS.1030, Sungei Seletar, Nee Soon Rifle Range, E. Alfred, 17.2.1958, two; ML.24995, Sungei Seletar, north of Seletar Reservoir, E. Alfred 4.4.1963, two; NMS.1188, Sungei Seletar, west of Seletar Reservoir, E. Alfred, 8.4.1963, twenty; NMS.1050, Singapore, M. A. W. Davies, 1951, four. Also one paratype, BM.1905.5.6.16, Kuala Lumpur, Selangor, G. Duncker, 1901.

The specimens in hand agree well with the description of the Bornean material reported by Inger & Chin (1962: 123), except that I find dorsal rays iv. 9, anal iii. 5, and pectoral i. 11-12. I too find the presence of pre-orbital hooks in males (including the paratype), and the specialized peduncular scales.

The species was first recorded locally by Herre & Myers (1937) who reported it as "Common on Singapore Island". Subsequent records (Herre, 1940; Tweedie, 1940; Hora, 1941; Alfred, 1961a) and recent collecting have revealed, however, that the species occurs only in the upper reaches of the Seletar drainage where it is common.

Suborder Siluroidea

SILURIDAE

The catfishes of the family Siluridae have been recently studied by Haig (1952), who recorded 4 genera representing 5 species. These records were based mainly on the collections made by A. W. Herre in 1934 and 1937. However, recent collecting reveals the presence of only 1 species; the other 4 are believed to have been exterminated. The following key, which is modified from Haig (1952: 61-62), will distinguish the 5 species known from Singapore:

1. Longest anal rays longer than depth of body at their base. Anal completely confluent with caudal. Head 6 or more in standard length. Gillrakers all rudimentary *Silurichthys hasseltii*
— Longest anal rays shorter than depth of body at their base. Anal free from or only partly confluent with caudal. Head less than 6 in standard length. Gillrakers never all rudimentary 2
2. Eyes with free orbital margin, situated above level of corner of mouth. Dorsal with 5 rays . . . . . *Wallago miostoma*
— Eyes subcutaneous, situated opposite level of corner of mouth. Dorsal with 4 or less rays 3
3. Dorsal rays 1 or 2. Gillrakers 15 or more on longer limb of gill arch and as long as branchial filaments . . . . . *Kryptopterus micronema*
— Dorsal rays 3 or 4. Gillrakers 15 or less on longer limb of gill arch and shorter than branchial filaments 4
4. Anal connected with caudal base. Mandibular barbels almost as long as head . . *Ompok leiacanthus*
— Anal free from caudal. Mandibular barbels much shorter than head, not much longer than eye . . . . . *Ompok bimaculatus*

Kryptopterus Bleeker, 1858

***Kryptopterus micronema** (Bleeker)

Silurus micronemus Bleeker, 1846: 289 — Batavia.
Kryptopterus micronema Herre & Myers, 1937: 67; Haig, 1952: 109.

Reported from Singapore by Herre & Myers (1937) who unfortunately did not give any details of their specimens. There are no other records.

Ompok Lacépède, 1803

*Ompok bimaculatus (Bloch)

Silurus bimaculatus Bloch, 1794: 24, pl. 364 — Malabar.
Ompok bimaculatus Herre & Myers, 1937: 67; Haig, 1952: 90, 103.
Callichrous bimaculatus Hora & Gupta, 1941: 14.

Material examined. — NMS.1803, Singapore Island, A. W. Herre, March 1934, one.

The species is known locally from only the 4 specimens, 133 to 305 mm in standard length, collected by A. W. Herre in March 1934 (Herre & Myers, 1937). One of these (the present specimen), measuring 160 mm in standard length, was also examined and recorded by Hora & Gupta (1941).

*Ompok leiacanthus (Bleeker)

Wallago leiacanthus Bleeker, 1853a: 189 — Marawang, Banka.
Ompok leiacanthus Herre, 1940: 35; Haig, 1952: 105 (Mandai Road).

The only Singapore record is of a single specimen measuring 88 mm in standard length, collected by A. W. Herre from the Mandai Road area in 1937 (Herre, 1940). This same specimen (St. 32702) is mentioned by Haig (1952).

Silurichthys Bleeker, 1858

Three species have been reported from Singapore viz., *S. hasseltii* Bleeker, *S. indragiriensis* Volz and *S. phaiosoma* Bleeker. However, the status of these species and consequently the validity of the Singapore records, have not been very clear.

Bleeker (1863-64: 81) distinguished *S. hasseltii* as having the dorsal fin in front of the ventrals and having a mottled colouration while *S. phaiosoma* was shown to have the dorsal opposite the ventrals with the colouration uniform brown. However, Weber & De Beaufort (1916: 198) dismissed *S. hasseltii* as a doubtful species on the grounds that the differences were too slight. Comparison of the holotype of *S. phaiosoma* (ML. 6831, collected from Sambas, Borneo, by Einthoven) and the 6 other specimens from the Bleeker collection in Leiden, with the holotype of *S. hasseltii* (ML. 2992) and 3 other specimens (ML. 1808-09, collected by J. Büttikofer in 1894 from the Mandai River, Nanga Raoen, Borneo) reveals that the distinguishing features given by Bleeker (1863-64) are quite valid. Haig (1952: 71) has also shown that the characteristic of the dorsal being in advance of the ventrals holds good for the 42 mottled specimens she examined and I have also found this to be true for my 18 specimens (below). I therefore conclude that *S. hasseltii* and *S. phaiosoma* are distinct species.

In regard to the third Singapore species, viz., *S. indragiriensis* Volz, I follow Haig (1952) in considering it as a probable synonym of *S. hasseltii.*

Silurichthys hasseltii Bleeker (pl. 6 fig. 1)

Silurichthys Hasseltii Bleeker, 1858: 270 — Tjisekat, Java.
Silurichthys phaiosoma (nec Bleeker) Hanitsch, 1901: 4; Duncker, 1904: 172 (Botanic Gardens); Weber & De Beaufort, 1913: 197; Tweedie, 1936: 18 (Mandai Road and Botanic Gardens); Herre & Myers, 1937: 66; Fowler, 1938: 46, 248; Hora & Gupta, 1941: 16.
? Silurichthys indragiriensis Herre, 1940: 35.
Silurichthys hasseltii Haig, 1952: 96 (Jurong, Mandai Road and Singapore); Alfred, 1961a: 6, pl. 2 fig. 5 (Seletar River and north shore of Seletar Reservoir).

Material examined. — NMS.1804, Botanic Gardens Lake, H. N. Ridley, January 1901, one; NMS.1805, Mandai Road, collected by Fisheries Department, 15.7.1927, one; NMS.1806, Mandai Road, no other data, three; NMS.1163, Sungei Seletar, north of Seletar Reservoir, E. Alfred, 4.4.1963, eight; ML.24996, Sungei Seletar, west of Seletar Reservoir, E. Alfred, 8.4.1963, four; NMS.1218, Sungei Whompoe, west of MacRitchie Reservoir, S. Sarmani, 29.1.1964, one. Also, holotype, ML.2992, Tjisekat, Java, Kuhl and van Hasselt.

The following data are from the 18 specimens listed above with the details of the holotype in parentheses: Dorsal rays i. 3 (i. 3); anal ii. 48-54 (ii. 52); pectoral I. 9-10 (I. 9); ventral i. 6 (i. 6). Depth 4.7-5.6; head 4.7-5.4; caudal length 2.9-3.7; standard length 51.4-67.5 mm (92.3 mm); total length 67.5-124.0 mm.

Colouration (in life and when freshly preserved). Light brown above, lighter towards the undersurface. Entire body surface, including fins and barbels, with irregular, dark and light brown patches.

All earlier Singapore records of the species are given as *S. phaiosoma.* However, my re-examination of the material on which these records are based reveals that the specimens are actually *S. hasseltii.*

Wallago Bleeker, 1851c

***Wallago miostoma** Vaillant

Wallago miostoma Vaillant, 1902: 44 — Topoe, Borneo.
Wallago miostoma Haig, 1952: 80, 102.

Known locally from the single specimen reported by Haig (1952). Since this is a large-sized fish which is known from the larger rivers in Malaya, I had expressed doubts about the accuracy of the locality (in litt.) pointing out that there are no sufficiently large rivers in Singapore. However, Dr. A. W. Herre, who collected the specimen, confirmed (in litt.) that is was definitely collected in Singapore. Inger & Chin (1959: 281) who examined the specimen, state that the standard length in 308 mm and the gillrakers are 5 + 11.

BAGRIDAE

Mystus Scopoli, 1777

The bagrid catfishes are represented by the single genus *Mystus* Scopoli. Three species are recorded, viz. *M. elongatus* (Günther) which is known from the unique holotype, *M. nemurus* (Valenciennes) of which there are two reliable records, and *M. gulio* (Hamilton) which is a new record for Singapore. The following key will differentiate the 3 species: —

1. Base of adipose fin more than twice longer than base of anal. Median fontanel reaching base of occipital process. Occipital process well separated from dorsal fin base . . . . . *M. elongatus*
— Base of adipose fin shorter than or about equal to base of anal. Median fontanel not reaching base of occipital process. Occipital process reaching or almost reaching basal element of dorsal fin 2
2. Adipose base shorter than anal base. Body depth less than 5 in standard length . . *M. gulio*
— Adipose base about equal to anal base. Body depth 5 or more in standard length . . *M. nemurus*

*Mystus elongatus (Günther)

Macrones elongatus Gunther, 1864: 77 — Singapore.
Mystus elongatus Fowler, 1938: 52.

Material examined. — BM.1855.9.19.1099, holotype, Singapore, Haslar collection.

Dorsal rays II. 7; anal v. 10; pectoral I. 10; ventral i. 5; caudal i. 15. i; gillrakers 5 + 16; branchiostegals 12; standard length 239 mm; total length 276 mm.

Dorsal profile rising evenly but not steeply from tip of snout to dorsal origin, then sloping gradually to narrow part of caudal peduncle; ventral profile almost horizontal to origin of anal, then rising to narrow part of caudal peduncle; body depth 6.1. Dorsal surface of head smooth; head length 4.1; depth of head 8.5; head width 5.4; tip of occipital process separated from basal element of dorsal spine by its own length, which is 6.2 times in the head length; median fontanel reaching base of occipital process; anterior nostril tubular, situated about midway between tip of snout and posterior nostril; eye 6.9; snout 2.7; interorbital width 3.1; postorbital length 2.0; nasal barbel shortest, reaching about centre of eye; mental barbel reaching about 0.5 eye diameter beyond nasal, mandibular barbel reaching to slightly beyond base of pectoral spine, and maxillary barbel reaching beyond dorsal fin base to approximately opposite the ventrals; maxillary bone with a curved band of small pointed teeth, its width 5.8 in its own length, and its length 2.6 in the head length.

Predorsal length 2.8; dorsal spine 1.7 in head; dorsal base 2.9; anal base 3.3 in adipose base; dorsal-adipose distance 2.5 in dorsal base; least height of caudal peduncle 2.7 in its length.

Colouration (in alcohol). The specimen is much faded and is uniform dirty white. Dorsal and caudal fins with black tips.

Unless it is because they have synonymised the present species with *M. nemurus* (Valenciennes) without comment, Weber & De Beaufort (1913) make no mention of this species.

Mystus gulio (Hamilton) (pl. 6 fig. 2)

Pimelodus gulio Hamilton, 1822: 201, pl. 23 fig. 66 — Higher parts of the Gangetic estuaries.
Macrones gulio Weber & De Beaufort, 1913: 344.

Material examined. — NMS.1152, Sungei Tengeh, Pasir Laba Road, E. Alfred, 20.3.1963, one.

Dorsal rays II. 6; anal iv. 9; pectoral I. 9; ventral i. 5; standard length 100 mm; total length 130 mm.

Ventral profile of body not horizontal, curved outwards from tip of snout to base of ventrals, thence rising evenly to narrow part of caudal peduncle; body depth 3.6. Dorsal surface of head smooth; head length 3.3; length of occipital process 3.6 in head, its tip touching basal element of dorsal fin; median fontanel not reaching and well separated from base of occipital process. Eye 5.3; snout 2.8; interorbital width 2.3; postorbital length 1.9; nasal barbel shortest, reaching beyond eye but not to edge of opercle; mental barbel slightly longer, reaching to base of pectoral spine; mandibular barbel reaching beyond pectoral base but not reaching ventrals; maxillary barbel reaching to slightly beyond adipose base.

Predorsal length 2.4; dorsal spine 1.8 in head; adipose base 1.2 in dorsal base and 1.6 in anal base; dorsal base 1.8 in dorsal-adipose distance; least height of caudal peduncle 1.2 in its length.

Colouration (freshly preserved in alcohol). Dorsum and sides dusky-brown, undersurface yellowish-white. Fins and barbels all dusky.

Herein recorded for the first time from Singapore from a single specimen. Despite repeated collecting from the same locality, no other specimens were obtained.

*Mystus nemurus** (Valenciennes)

Bagrus nemurus Valenciennes, in: Cuvier & Valenciennes, 1839: 423 — Java.
Macrones nemurus Weber & De Beaufort, 1913: 341.
Mystus nemurus Herre & Myers, 1937: 69; Hora & Gupta, 1941: 26.

Although Weber & De Beaufort (1913) included Singapore as a locality for this species they did not indicate that they saw any specimens. Unfortunately, there are no published records prior to theirs and neither have I been able to locate any museum specimens from which their record may have been given. It seems likely that they mis-read Duncker's record (1904: 172) from Ulu Jelai, Pahang.

Herre & Myers (1937) report 5 specimens and Hora & Gupta (1941) include Singapore as one of the localities for 6 specimens they examined. There are no other records from the island.

CLARIIDAE

Clarias Scopoli, 1777

These stout-bodied, eel-like catfishes occur in a variety of habitats and live in ponds, streams, and roadside ditches, and even in concreted canals. They are generally nocturnal in their habits and usually hide under debris or burrow superficially in the mud during daylight. Like the snake-head fishes (family Ophicephalidae), they constitute a pest to fish culturists. Large-sized fishes are sometimes caught for food. Three species are represented. They may be distinguished as follows: —

1. Occipital process separated from basal element of first dorsal ray by an interval contained less than 3 times in the mid dorsal length of the head . . *C. teijsmanni*
— Occipital process separated from basal element of first dorsal ray by an interval contained more than 3 times in the mid dorsal length of the head 2
2. Anterior border of pectoral spine strongly denticulated . . . *C. meladerma*
— Anterior border of pectoral spine smooth or weakly denticulated . . *C. batrachus*

Clarias batrachus (Linnaeus)

Silurus batrachus Linnaeus, 1758: 305 — Asia, Africa.

Clarias batrachus Bleeker, 1860a: 216; Bleeker, 1860c: 450; Bleeker, 1863-1864: 23, 103, pl. 98 fig. 2; Weber & De Beaufort, 1913: 190; Tweedie, 1936: 18 (Botanic Gardens); Herre & Myers, 1937: 65; Fowler, 1938: 43, 247; Hora & Gupta, 1941: 40; Alfred, 1961a: 5, pl. 2 fig. 3 (various localities).

Clarias magur Hanitsch, 1901: 4; Duncker, 1904: 171; Hanitsch, 1912: 28 (various localities).

Material examined. — NMS.1069, Singapore, no exact locality, R. Hanitsch, 28.8.1898, six; NMS.1070, Singapore, no other data, one; NMS.1071, Botanic Gardens Lake, F. N. Chasen, February 1923, one; NMS. 1072, Singapore, 14.8.1930, no other data, one; NMS.1073, Singapore, no exact locality, purchased from fishmarket, 1935, two; NMS.1074, Jurong, A. W. Herre, May 1937, one; NMS.1153, Sungei Tengeh, 1 mile north-east of Tuas, E. Alfred, 21.3.1963, four; NMS.1087, Kampong Beremban, M. Dali, 11.3.1963, one; NMS.1248, Sungei Bajau, E. Alfred, 21.3.1963, one; NMS.1245, Sungei Kangkar, 17th mile Lim Chu Kang Road, M. Dali, 14.5.1963, seventeen; ML.24978, Sungei Tengeh, E. Alfred, 21.3.1963, thirty-seven; NMS.1228, Sungei Whompoe, outlet from MacRitchie Reservoir, T. Oates, 2.1.1964, four; NMS.1272, Sungei Kallang, outlet from Peirce Reservoir, E. Alfred, 31.1.1964, three; NMS.1281, Sungei Seletar, outlet from Seletar Reservoir, E. Alfred, 4.1.1964, one.

This species is known from a wide range of habitats and it is probably the hardiest and most widely distributed fresh-water fish in Singapore. It is often collected for food and its ability to remain alive for considerable lengths of time out of water, is of distinct advantage in the local fishmarkets, since no elaborate preparations for refrigeration are required.

In his publication on dangerous marine animals, Halstead (1959: 67, fig. 37) considers the present species as venomous. I have not been able to verify this from my observations.

*Clarias meladerma Bleeker

Clarias meladerma Bleeker, 1847: 54 — Batavia.
Clarias melanoderma Herre & Myers, 1937: 66.

Known from the single specimen collected by A. W. Herre in March 1934, measuring 197 mm standard length (Herre & Myers, 1937).

Clarias teijsmanni Bleeker

Clarias Teijsmanni Bleeker, 1857: 344 — Tjikoppo, Buitenzorg Province, Java.
Clarias teysmanni Tweedie, 1936: 18 (Mandai Road); Herre & Myers, 1937: 66; Alfred, 1961a: 5, pl. 2 fig. 4 (Seletar River and north shore of Seletar Reservoir).
Clarias teijsmanni Fowler, 1938: 247.

Material examined. — NMS.1067, Mandai Road, collected by Fisheries Dept., 15.7.1921, one; NMS.1068, same locality, February 1938, no other data, one; NMS.1037, Sungei Seletar, Nee Soon Rifle Range, E. Alfred, 17.2.1958, one; ML.24997, Sungei Seletar, north of Seletar Reservoir, E. Alfred, 4.4.1963, two. Also, holotype, ML.6803, Tjikoppo, Buitenzorg Province, Java, 900 m above sea level, J. E. Teijsmann.

The following details are with the data on the holotype in parentheses: — Dorsal rays 62-74 (74); anal 53-60 (59); pectoral I. 7-8 (I. 7); ventral i. 5 (i. 5). Depth 5.7-6.7 (8.5); head 3.8-4.0 (4.9); eye 13.1-17.3 (16.2); snout 2.9 (3.3); interorbital width 2.0-2.1 (2.3); standard length 67.8-130.0 mm (95.0 mm); total length 80.3-157.0 mm (110.0 mm). Distance between basal element of first dorsal ray and tip of occipital process 2.3-2.8 (2.1) times in the mid-dorsal length of the head. Occipital process semicircular, its base slightly more than 2 times its length.

Colouration. Brownish-grey, pale on the belly and undersurface of the head. A number of small white spots on the sides arranged in irregular transverse rows. Fins and barbels all dusky.

Unlike *C. batrachus*, the present species appears to have a habitat preference for well-shaded, forest streams.

SISORIDAE

The Sisoridae are represented by the genera *Bagarius* Bleeker and *Glypto-*

thorax Blyth. The latter is immediately distinguished by the presence of a circular area of radiating folds of skin on the thorax, a feature that is absent in *Bagarius*. In addition, the fishes of the genus *Glyptothorax* are much smaller in size and hardly attain 20 cm total length.

Hora & Gupta's reference (1941: 33) to these fishes as "characteristic mountain catfishes" is misleading. The species *Bagarius bagarius* (Hamilton), which is the only known member of the genus *Bagarius*, is a large fish which attains more than 2 metres in length (Smith, 1945: 394) and, from my observations, occurs mainly in large lowland streams. The fishes of the genus *Glyptothorax* are, from my experience in Malaya, characteristic of lowland rapids and riffles and they do not extend their range above the foothills into the mountain torrents. Apart from being adapted for life in these rapids and riffles which are a permanent feature of many large rivers in Malaya, the adaptive features of *Glyptothorax* are undoubtedly also of importance for life in small lowland streams which are subject to periodic flooding from heavy rainfall. Small streams, such as those where *Glyptothorax* occurs in Singapore, may often be converted into raging torrents after sudden spells of rain.

Bagarius Bleeker, 1853c

***Bagarius bagarius** (Hamilton)

Pimelodus bagarius Hamilton, 1822: 186, 378, pl. 7 fig. 62 — locality not given (= River Ganges).
Bagarius bagarius Tweedie, 1936: 18; Hora & Gupta, 1941: 34.

This species is as yet known from Singapore from the single specimen collected by N. Smedley in 1927, and which is mentioned by Tweedie (1936), and Hora & Gupta (1941).

Glyptothorax Blyth, 1860

Glyptothorax major (Boulenger) (pl. 6 fig. 3)

Akysis major Boulenger, 1894: 246 — Sarawak, Borneo.
Glyptothorax majus Herre, 1940: 35.
Glyptothorax major Alfred, 1961a: 6, pl. 2 fig. 6 (north shore of Seletar Reservoir).

Material examined. — NMS.1041, Seletar Reservoir, E. Alfred, 17.2.1958, three; ML.24998, Sungei Seletar, north of Seletar Reservoir, E. Alfred, 4.4.1963, one; NMS.1196, Sungei Seletar, west of Seletar Reservoir, E. Alfred, 8.4.1963, one.

Dorsal rays II.5; anal iv-v.10; pectoral i.8-9; ventral i.5. Depth 3.9-4.5; depth of caudal peduncle 1.5-1.8 in its length; standard length 25.6-42.6 mm; total length 35.1-58.7 mm.

Of particular interest was the re-discovery of this fish in 1958, some 20 years after a single specimen was collected in 1937 (Herre, 1940).

AKYSIDAE

Parakysis Herre, 1940

The catfishes of the family Akysidae are represented by the single genus *Parakysis* Herre. As has been pointed out by Hora & Gupta (1941: 32), Herre characterised the genus by its absence of an adipose dorsal fin and, it is mainly on this character that he separated it from *Akysis* Bleeker. Hora & Gupta (1941), however, claim of the 4 specimens they examined, that "they possess a long, low and thick adipose fin which owing to tubercles on the body, is not distinct unless the specimen is held against the light." After critically examining the specimens in hand, I disagree that the fold of skin which Herre himself has described as "a low ridge or keel on the dorsal side of the caudal peduncle", is significant enough to be considered as an adipose fin.

Parakysis verrucosa Herre (pl. 6 fig. 4)

Parakysis verrucosa Herre, 1940: 12, pl. 6 — Mawai District, Johore.
Parakysis verrucosa Alfred, 1961a: 7, pl. 1 fig. 7 (Nee Soon swamp forest).

Material examined. — NMS.1161, Sungei Seletar, north of Seletar Reservoir, E. Alfred, 4.4.1963, two. Also 5 paratypes, NMS.1066, Mawai District, Johore, M. Tweedie and A. W. Herre, February 1937.

The following details are with the data on the paratypes in parentheses: Dorsal rays II.iv (II.iv), all soft rays unbranched and last two rays counted separately; anal iv.4-5 (iii-iv.4-5); pectoral I.6 (I.6); ventral i.5 (i.5). Depth 4.8-5.2 (6.2-6.9); standard length 18.3-29.5 mm (15.5-24.7 mm); total length 26.3-38.3 mm (22.9-32.3 mm).

I had previously and for the first time (Alfred, 1961a) reported the species from a single specimen collected by me in 1956 and deposited in the fish collection of the Department of Zoology, University of Singapore. Unfortunately, that particular specimen is now missing and is probably lost.

Order Synentognathi

HEMIRAMPHIDAE

The fresh-water halfbeaks of the family Hemiramphidae are represented by two small fishes, *Dermogenys pusillus* Van Hasselt, and *Hemiramphodon pogonognathus* (Bleeker). Both species are viviparous and sexually dimorphic. The males are much smaller and more colourful than females. In addition the anal fin in males is modified to form an intromittant organ. Mohr (1936) has described these features in detail. The following key will distinguish the two species:

1. Origin of dorsal fin before origin of anal. Ventral fins larger than pectorals. Lower jaw toothed beyond upper jaw. Restricted to fresh water . . . . . *Hemiramphodon pogonognathus*

— Origin of dorsal fin behind origin of anal. Ventral fins smaller than pectorals. Lower jaw toothless beyond upper jaw. Occurring in fresh and brackish water . . *Dermogenys pusillus*

Dermogenys Van Hasselt, 1823

Dermogenys pusillus Van Hasselt

Dermogenys pusillus Van Hasselt, 1823: 131 — Java.
Hemiramphus sumatranus Karoli, 1882: 182 (Changi).
Hemiramphus fluviatilis Hanitsch, 1901: 4; Hanitsch, 1904: 11; Duncker, 1904: 170 (Botanic Gardens); Hanitsch, 1912: 27 (various localities).
Dermogenys sumatranus Weber & De Beaufort, 1922: 139; Fowler, 1938: 74.
Dermogenys pusillus Weber & De Beaufort, 1922: 140; Mohr, 1936: 41; Tweedie, 1936: 22; Fowler, 1938: 74, 254; Herre, 1944: 43; Alfred, 1961a: 12, pl. 3 fig. 19 (Jurong, Kranji and Seletar Rivers).

Material examined. — NMS.1023, Sungei Ayer Tawar, Huat Choe, E. Alfred, 19.3.1958, five; NMS.1026, Sungei Tengeh, Tuas Road, E. Alfred, 19.3.1958, nine; NMS.1130, Kampong Pinang, Sungei Serangoon, E. Alfred, 7.3.1963, eleven; NMS.1148, Sungei Tengeh, E. Alfred, 21.3.1963, one hundred and seventy-one; NMS.1172, Alkaff Gardens, Serangoon Road, T. Oates, 15.1. 1964, nine; NMS.1180, Singapore, G. Duncker, 5.1.1901, twelve; ZMA.103186, same data, twelve; NMS.1181, Orange Grove Road, R. Hanitsch, 9.5.1912, four; NMS.1182, St. George's Road, 10.4.1927, four; NMS.1233, Sungei Kangkar, 16th mile Lim Chu Kang Road, M. Dali, 14.3.1963, one hundred and seven; NMS.1247, Sungei Bajau, Pasir Laba Road, E. Alfred, 21.3.1963, twenty-two; NMS.1257, Kampong Punggol, E. Alfred, 8.3.1963, forty; NMS.1271, Sungei Kallang, outlet from Peirce Reservoir, E. Alfred, 3.1.1964, four; ML.24979, Sungei Seletar, outlet from Seletar Reservoir, E. Alfred, 4.1.1964, forty-five.

Dorsal rays (last 2 counted separately) iii-iv.6-7; anal (last 2 counted separately) ii-iii.11-12; pectoral i.9-10; ventral i.5. Maximum standard length (including beak) of females 47.1 mm, of males 35.0 mm.

Weber & De Beaufort (1922) reported the two species *D. sumatranus* Bleeker and *D. pusillus* Van Hasselt, which are distinguished from each other by the position of the base of the ventral fins in relation to the head and the caudal. Mohr (1936) has however shown that this is a variable character and the two forms are conspecific.

The species is common in brackish localities where it occurs in vast numbers.

Hemiramphodon Bleeker, 1866

Hemiramphodon pogonognathus (Bleeker)

Hemiramphus pogonognathus Bleeker, 1853a: 193 — Marawang, Banka.
Hemiramphodon pogonognathus Mohr, 1936: 60; Tweedie, 1936: 22 (Mandai); Herre

& Myers, in: Herre, 1937: 17; Fowler, 1938: 254; Alfred, 1961a: 11, pl. 3 fig. 18 (Seletar River, Nee Soon swamp forest and north shore of Seletar Reservoir).

Material examined. — NMS.1141, MacRitchie Reservoir, E. Alfred, 3.3.1963, one; ML.24980, Sungei Seletar, north of Seletar Reservoir, E. Alfred, 4.4.1963, twenty-nine; NMS.1183, Mandai Road, N. Smedley, 1927, eight; NMS.1184, Mandai Road, collected by Fisheries Dept., 15.7.1927, five; NMS.1185, Mandai Road, M. Tweedie, February 1937, sixty-five; NMS.1197, Sungei Seletar, west of Seletar Reservoir, E. Alfred, 8.4.1963, thirty-three; NMS.1216, Sungei Whompoe, west of MacRitchie Reservoir, S. Sarmani, 23.1.1964, one.

Dorsal rays (last 2 counted separately) xii-xiii.2-5; anal (last 2 counted separately) ii.6-7; pectoral i.7-8; ventral i.5. Maximum standard length (including beak) of females 80.0 mm, of males 56.1 mm.

This is characteristically a species of shaded, forest streams and it does not occur in brackish water. Neither does it occur in such large numbers as the preceding species.

Order Microcyprini

CYPRINODONTIDAE

The cyprinodonts are represented by the two species *Aplocheilus panchax* (Hamilton) and *Oryzias javanicus* (Bleeker). While both are fairly common, the former has a wider range of habitats and occurs in both fresh and brackish water. The two species may be distinguished as follows:

1. Gill membranes united. Upper jaw not protractile. Pectorals inserted at about middle of height. In life, body not hyaline, with a silvery spot on top of head . . *Aplocheilus panchax*

— Gill membranes not united. Upper jaw protractile. Pectorals inserted below middle of height. In life, body partly hyaline with no silvery spot on top of head . . . *Oryzias javanicus*

Aplocheilus McClelland, 1839

Aplocheilus panchax (Hamilton)

Esox panchax Hamilton, 1822: 211, 380, pl. 3 fig. 69 — ditches and ponds of Bengal.

Haplochilus panchax Von Martens, 1876: 401; Garman, 1895: 124; Hanitsch, 1904: 11; Duncker, 1904: 171 (Botanic Gardens); Hanitsch, 1912: 27 (various localities).

Haplochisus panchar Karoli, 1882: 181 (Serangoon; Changi).

Panchax panchax Weber & De Beaufort, 1922: 374; Tweedie, 1936: 23; Herre & Myers, 1937: 69; Fowler, 1938: 71, 354.

Aplocheilus panchax Alfred, 1961a: 13, pl. 3 fig. 20 (various localities).

Material examined. — NMS.1078, Orange Grove Road, R. Hanitsch, 9.5.1912, four; NMS.1079, Syed Ali Road, R. Hanitsch, 9.5.1912, six; NMS.1080, Singapore, no other data, thirteen; NMS.1082, Serangoon, M. Tweedie, February 1938, thirty-one; NMS.1140, MacRitchie Reservoir, E. Alfred, 3.3.1963, one; NMS.1143, Sungei Tengeh, E. Alfred, 21.3.1963, twelve; ML.24981, Sungei Seletar, north of Seletar Reservoir,

E. Alfred, 4.4.1963, sixty-one; NMS.1198, Sungei Seletar, west of Seletar Reservoir, E. Alfred, 8.4.1963, thirty-eight; NMS.1231, Sungei Kangkar, 16th mile Thong Hoe Road, M. Dali, 14.3.1963, five; NMS.1240, Botanic Gardens Lake, T. Oates, 20.1.1964, nine; NMS.1251, Sungei Simpang Kiri, Sungei Simpang, M. Dali, 30.10.1963, seventeen; NMS.1280, Sungei Seletar, outlet from Seletar Reservoir, E. Alfred, 4.1.1964, fifteen.

Dorsal rays ii-iii.4-6; anal iii.12-14; pectoral i.12-13; ventral i.5. Lateral scales 26-30; transverse scales ½8½; predorsals 23-25; circumpeduncular scales 15-17. Depth 4.3-5.2; head 2.8-3.5; standard length 17.8-42.4 mm; total length 26.4-56.2 mm.

This is a common and widely distributed fish which sometimes occurs in brackish localities. In Singapore it is represented by land-locked populations, such as those in the Seletar and MacRitchie Reservoirs, as well as by populations that are constantly subject to tidal and brackish influence. Specimens from the latter localities are generally larger and have more vividly coloured fins.

As a result of an inquiry by the government on the possible usefulness of *A. panchax* as a mosquito larvivore, Hanitsch (1912) gave an interesting account of the species as well as of a few other fishes, which were apparently common within the present city area of Singapore. Of the many localities from which he recorded the species, it is now known from only the lake in the Botanic Gardens.

Oryzias Jordan & Snyder, 1907

Oryzias javanicus (Bleeker)

Aplocheilus javanicus Bleeker, 1854b: 323 — Perdana, Penimbang River, Java.
Haplochisus javanicus Karoli, 1882: 181 (Serangoon).
Aplocheilus javanicus Weber & De Beaufort, 1922: 372; Tweedie, 1936: 23 (Geylang); Herre & Myers, 1937: 69.
Panchax javanicus Fowler, 1938: 71, 254.
Oryzias javanicus Alfred, 1961a: 13, pl. 3 fig. 21 (Seletar and Serangoon Rivers).

Material examined. — NMS.1075, Geylang, R. Hanitsch, 8.5.1912, fourteen; NMS.1076, Singapore, A. W. Herre, March 1934, four; NMS.1077, Serangoon, M. Tweedie, February 1938, thirty; NMS.1128, Kampong Pinang, Sungei Serangoon, E. Alfred, 7.3.1963, forty-five; NMS.1146, Sungei Tengeh, E. Alfred, 21.3.1963, sixty-seven; NMS. 1229, Sungei Kangkar, 16th mile Thong Hoe Road, M. Dali, 14.3.1963, ten; NMS.1256, Punggol, E. Alfred, 8.3.1963, eight; ML.24982, Sungei Punggol, 9th mile. Yio Chu Kang Road, E. Alfred, 12.3.1963, thirty. Also, 15 syntypes, ML.6979, Perdana, Penimbang River, Java, Bleeker collection.

The following details are with the data on the syntypes in parentheses: — Dorsal rays i.5-6 (i.5-6); anal ii.19-20 (ii.16-22); pectoral i.9-10 (i.9-11); ventral i.5 (i.5). Lateral scales 28-31; transverse scales ½9½; predorsals

26-28; circumpeduncular scales 13-14. Depth 3.2-3.9; head 3.3-3.5; standard length 17.5-29.0 mm; total length 22.3-37.9 mm.

This species is restricted to brackish localities where it usually occurs in vast numbers like the halfbeak, *Dermogenys pusillus* Van Hasselt.

POECILIIDAE

The poeciliid fishes include a number of species which have been introduced by human agency well beyond their natural geographic range. Two species, viz., *Lebistes reticulatus* (Peters) and *Mollienisia sphenops* (Valenciennes), occur in Singapore and both are well established. In addition Johnson & Soong (1963) report that *Gambusia affinis* (Baird & Girard) is "possibly locally established" and that "a small population is surviving in a polluted stream, the S. Whampoa". As I have never collected this fish from that locality or anywhere else in Singapore I do not believe that it has succeeded in establishing itself. I have accordingly ignored it in my account. The two species may be distinguished as follows:

1. First prolonged ray of anal fin of male without antrorse spine. Male brightly coloured and with one or more black spots on the body. Maximum size of female not exceeding 50 mm total length . . . . . *Lebistes reticulatus*
— First prolonged ray of anal fin of male with antrorse spine near the tip. Male not brightly coloured and without black spots. Maximum size of female exceeding 50 mm total length . . . . . *Mollienisia sphenops*

Lebistes de Filippi, 1861

Lebistes reticulatus (Peters)

Poecilia reticulata Peters, 1859: 412 — Guaira River, Caracas.

Lebistes reticulatus Herre, 1940: 37; Alfred, 1961a: 13, pl. 3 fig. 22a, 22b (various localities).

Material examined. — NMS.1226, Sungei Whompoe, outlet from MacRitchie Reservoir, E. Alfred, 2.1.1964, seventy-eight; NMS.1258, Sungei Punggol, 9th mile Yio Chu Kang Road, E. Alfred, 12.3.1963, forty; NMS.1279, Sungei Seletar, outlet from Seletar Reservoir, E. Alfred, 4.1.1964, thirty-seven.

The exact date of introduction of this South American fish is not known but it is certainly much before 1937 when Herre first collected the species (Herre, 1940). It is now well established especially in highly polluted localities which are unsuitable, and probably toxic, to the indigenous species. Johnson & Soong (1963) have given a good account of its habitat.

Mollienisia Le Sueur, 1821

Mollienisia sphenops (Valenciennes)

Poecilia sphenops Valenciennes, in: Cuvier & Valenciennes, 1846: 130, pl. 526 — Vera Cruz.

Mollienisia sphenops Regan, 1913b: 1012, fig. 173 F.

Material examined. — NMS.1127, Kampong Pinang, Sungei Serangoon, E. Alfred, December 1961, one hundred and eighty-two; NMS.1131, same locality, 7.3.1963, ninety-four; NMS.1221, Sungei Whompoe, outlet from MacRitchie Reservoir, E. Alfred, 2.1.1964, one; NMS.1255, Punggol, E. Alfred, 8.3.1963, four.

This species is well established in the brackish zone of the Serangoon River where it occurs in association with *Tilapia mossambica* Peters and *Oryzias javanicus* (Bleeker). It appears to be spreading into the Punggol River and there is also a record from the Whompoe.

When the species was first collected in December 1961, many specimens bore black spots and blotches, suggesting that the Singapore population probably originated from aquarium specimens of the so-called "Black Mollies". More recent collecting reveals fewer specimens with these black markings (pl. 7 fig. 1-4) as compared with the normal form (pl. 7 fig. 5-6).

I am grateful to Dr M. Boeseman of the Rijksmuseum van Natuurlijke Historie, Leiden, for his comments on and confirmation of my identification of some of the specimens sent to him (ML. 24649).

Order Percomorphi

NANDIDAE

The nandid fishes are represented by two genera, each by a single species. They may be distinguished as follows:

1. Maxillary reaching vertical through posterior margin of eye. Gill-membranes not united. Opercle with a single spine. Body markings comprising an irregular reticulate pattern . . . . . *Nandus nebulosus*
— Maxillary not reaching vertical through posterior margin of eye. Gill-membranes united. Opercle with two spines. Body markings, if present, comprising darkish crossbands . . . . . *Pristolepis fasciatus*

Nandus Valenciennes, 1831a

Nandus nebulosus (Gray) (pl. 7 fig. 7)

Bedula Nebulosus Gray, 1833-1835: pl. 55 fig. 2 — locality not given.
Nandus nebulosus Bleeker, 1860e: 101; Fowler, 1938: 120.
Nandus marmoratus Hanitsch, 1901: 4.

Material examined. — ML.24999, MacRitchie Reservoir, S. Sarmani, 25.3.1962, two; NMS.1137, same locality, E. Alfred, 3.3.1963, two.

Dorsal rays XV. 11-12; anal III. 5-6; pectoral i. 16; ventral I. 5. Lateral line 25-29 + 5-7; transverse scales 4½/1/11½-12; predorsals 12 (up to tip

of occipital process); circumpeduncular scales 5-5½/1/5-5½. Depth 2.3-2.4; head 2.2-2.4; standard length 40.6-57.9 mm; total length 58.2-74.4 mm.

The species was recorded for the first time by Bleeker (1860e) on the basis of a drawing submitted to him by the Count Francis De Castelnau who was residing in Singapore. Later, Hanitsch (1901) recorded *N. marmoratus* (Valenciennes) but it seems more likely that his specimens were the present species. Unfortunately his specimens are lost and I am unable to verify their identity.

Of great interest was the re-discovery of the species in 1962, thereby verifying Bleeker's 100-year old record. The specimens were collected from among leaf-beds and weeds. They agree well with the description in Weber & De Beaufort (1936: 477).

Pristolepis Jerdon, 1848

***Pristolepis fasciatus** (Bleeker)

Catopra fasciata Bleeker, 1851b: 65 — Bandjermassing, Borneo.
Pristolepis fasciatus Herre & Myers, 1937: 74 (Mandai Road).

Known from only 2 specimens each of 95 mm standard length, collected by A. W. Herre in March 1934 from the Mandai Road area (Herre & Myers, 1937).

CICHLIDAE

Tilapia Smith, 1840

Tilapia mossambica Peters

Chromis (Tilapia) mossambicus Peters, 1852: 681 — Tette, Sena, Quellimano, Lumbo, Inhambe and Querimba.
Tilapia mossambica Alfred, 1961a: 18, pl. 4 fig. 32 (Seletar River and Botanic Gardens pond).

Material examined. — NMS.1089, Kampong Beremban, M. Dali, 11.1.1963, twenty-one; NMS.1129, Kampong Pinang, Sungei Serangoon, E. Alfred, 7.3.1963, one; NMS.1136, MacRitchie Reservoir, E. Alfred, 3.3.1963, one; NMS.1174, Alkaff Gardens, Serangoon Road, T. Oates, 5.1.1964, thirty-five; NMS.1235, Sungei Kranji, near Thong Hoe, M. Dali, 13.5.1963, sixty-six; NMS.1273, Sungei Kallang, outlet from Peirce Reservoir, E. Alfred, 3.1.1964, forty-five; NMS.1282, Sungei Seletar, outlet from Seletar Reservoir, E. Alfred, 4.1.1964, three; NMS.1297, Botanic Gardens Lake, E. Alfred, 24.5.1960, seven.

Most of the feral specimens I have collected are small in size and do not exceed 150 mm total length. The population in the Botanic Gardens Lake was therefore interesting since the specimens grew much larger. A series collected in 1960 measured 220 to 283 mm total length. In 1961 a supply of *T. zilli* (Gerv.) fingerlings was introduced into the lake on the advice of

the Tropical Fish Culture Research Institute, Malacca (Burkill, 1963). The results of this experiment are not known.

I am unable to verify the exact date of introduction of this species which is generally presumed to have been introduced by the Japanese from Java sometime during the period 1942-45. According to Le Mare (1949: 15) this took place sometime towards the end of 1944. Atz (1954) suggests the year 1943.

Although Le Mare (1949, 1951) reports highly satisfactory results at rearing this fish under brackish conditions, it is not seriously cultivated by Singapore fish culturists presumably because of the low price it fetches. I have seen a few specimens being sold from time to time in the local fish-markets.

Order Gobioidea

GOBIIDAE

Stigmatogobius Bleeker, 1874

Stigmatogobius poicilosoma (Bleeker)

Gobius poicilosoma Bleeker, 1849: 31 — Pasuruan, Java.
Vaimosa serangoonensis Herre, 1937: 40, pl. 2 (Serangoon); Koumans, 1940: 153.
Stigmatogobius poicilosoma Koumans, 1953: 119 (Serangoon).

Material examined. — NMS.1049, MacRitchie Reservoir, S. H. Chuang, 4.11.1959, seven; NMS.1225, Sungei Whompoe, outlet from MacRitchie Reservoir, T. Oates, 2.1.1964, sixteen; NMS.1274, Sungei Kallang, outlet from Peirce Reservoir, E. Alfred, 3.1.1964, nine; NMS.1298, MacRitchie Reservoir, 1939, two. Also, ML.4488, Java, Bleeker collection, seven.

The following details are with the data on the Bleeker specimens in parentheses: First dorsal vi (vi); second dorsal i. 6-7 (i. 6-7); anal i. 6-7 (i. 6-7); pectoral i. 15-16 (i. 13-14); ventral i. 5 (i. 5). Standard length 16.4-34.4 mm; total length 19.8-43.5 mm. In males the first ray of the first dorsal is filamentous.

Of the many sporadic and diadromous fresh-water fishes that are known, this is the only species that is represented by a population which is completely adapted to fresh water. It occurs in the MacRitchie Reservoir where, following the construction of the dam in 1902, there has been no possibility of the locality being re-invaded from the sea.

Order Labyrinthici

Suborder Anabantoidea

ANABANTIDAE

The anabantids are economically an important group and include both food fishes and aquarium-worthy species. Their air-breathing and nest-

building habits are well known. The family is represented by 6 genera and 8 species as follows:

1. Dorsal fin longer than anal, its origin opposite to or before pectoral base . . 2
— Dorsal fin shorter than anal, its origin well behind pectoral base 3
2. Margin of opercle and preopercle serrated. Cleft of mouth reaching beyond vertical through front margin of eye . . . . . *Anabas testudineus*
— Margin of opercle an preopercle smooth. Cleft of mouth not reaching vertical through front margin of eye . . . . . *Belontia hasselti*
3. Ventral fins with a vestigial spine. Scales on body irregularly arranged . . . 4
— Ventral fins with a well-developed spine. Scales on body regularly arranged . . 5
4. Dorsal fin with 8 or 9 soft rays. Two black spots on each side. Size not exceeding 12 cm . . . . . *Trichogaster trichopterus*
— Dorsal fin with 10 or 11 soft rays. No black spots on sides. Size exceeding 20 cm *Trichogaster pectoralis*
5. Lateral line complete. Filament of ventrals reaching beyond caudal fin. Size exceeding 30 cm . . . . . *Osphronemus goramy*
— Lateral line vestigial or absent. Filament of ventrals not reaching beyond caudal fin. Size not exceeding 15 cm 6
6. Preorbital serrated. Filament of ventrals longer than head . . *Trichopsis vittatus*
— Preorbital smooth. Filament of ventrals shorter than head 7
7. Interorbital space flat, its width 2.5 to 3.0 in head. Size exceeding 8 cm . . . . *Betta pugnax*
— Interorbital space convex, its width 2.9 to 3.9 in head. Size not exceeding 5 cm . . *Betta splendens*

Anabas Cuvier & Cloquet, 1816

Anabas testudineus (Bloch)

Anthias testudineus Bloch, 1792: 121, pl. 322 — Japan.

Anabas scandens Cantor, 1849: 1064; Bleeker, 1860a: 334; Bleeker, 1860b: 101; Bleeker, 1879: 7; Hanitsch, 1901: 4; Hanitsch, 1904: 14; Duncker 1904: 162 (Botanic Gardens); Hanitsch, 1912: 28 (Geylang Road and Telok Blangah).

Anabas macrocephalus Karoli, 1882: 172 (Serangoon).

Anabas testudineus Weber & De Beaufort, 1922: 334; Tweedie, 1936: 22; Herre & Myers, 1937: 72; Fowler, 1938: 120, 259; Alfred, 1961a: 16, pl. 4 fig. 26 (various localities).

Material examined. — ZMA.103184, Singapore, E. Jacobson, November 1912, one; NMS.1090, Singapore, R. Hanitsch, 28.8.1898, two; NMS.1091, Geylang, R. Hanitsch, 18.5.1912, six; NMS.1092, ponds at Serangoon, N. Smedley, 1927, one; NMS.1093, Botanic Gardens, no other data, one; NMS.1033, Sungei Seletar, Nee Soon Rifle Range, E. Alfred, 17.2.1958, two; NMS.1088, Kampong Beremban, M. Dali, 11.3.1963, twenty-seven; NMS.1261, Sungei Kallang, outlet from Peirce Reservoir, E. Alfred, 3.1.1964, one; NMS.1275, Sungei Seletar, outlet from Seletar Reservoir, E. Alfred, 4.1.1964, one.

Dorsal rays XVII-XVIII. 8-9; anal IX-X. 8-10; pectoral i. 13-15; ventral I. 5; lateral line 15-19 + 10-13; standard length 9.4-100 mm; total length 12.9-127 mm.

The so-called Climbing Perch occurs in sufficiently large numbers in certain localities to be collected for food. It is more tolerant of pollution than any of the other anabantids and it occurs in a variety of habitats. Smith (1945: 447-450) has given an interesting account of its habits.

Belontia Myers, 1923

***Belontia hasselti** (Cuvier)

Polyacanthus hasselti Cuvier, in: Cuvier & Valenciennes, 1831a: 353, pl. 195 — Java.
Polyacanthus hasselti Duncker, 1904: 162; Weber & De Beaufort, 1922: 338; Fowler, 1938: 260.
Belontia hasselti Herre & Myers, 1937: 71; Fowler, 1938: 123.

The only satisfactory Singapore record of this little-known species is given by Herre & Myers (1937) who mention 2 specimens of 90 and 103 mm standard length, which were collected by A. W. Herre in March 1934. Duncker's record (1904) should be accepted with reservations since his specimens were obtained from a Singapore fishmarket and may not have originated from Singapore.

Betta Bleeker, 1850

No less than 8 species have been reported, viz., *B. pugnax* Cantor, *B. trifasciata* Bleeker, *B. anabatoides* Bleeker, *B. fusca* Regan, *B. macrophthalma* Regan, *B. taeniata* Regan, *B. splendens* Regan, and *B. rubra* Perugia. In his review of the Malayan species Herre (1940: 40) suggested that a revision based on a very large amount of material would show that several of the species should be relegated to synonymy. After examining all the Malayan material available to him Tweedie (1952: 71-75) came to the conclusion that all the specimens recorded from Malaya could be referred to only 2 species, viz., *B. pugnax* (Cantor) and *B. splendens* Regan. For the present I follow Tweedie in recognising only these 2 species from Singapore.

Betta pugnax (Cantor)

Macropodus pugnax Cantor, 1849: 1066, pl. 2 fig. 1-3 — Pinang, Malayan Peninsula.
Betta anabatoides Bleeker, 1860d: 334; Weber & De Beaufort, 1922: 357; Herre & Myers, 1937: 72; Fowler, 1938: 121; Herre, 1940: 46.
Betta trifasciata Karoli, 1882: 172.
Betta pugnax Hanitsch, 1901: 4; Duncker, 1904: 164 (Bukit Timah); Hanitsch, 1912: 27 (various localities); Tweedie, 1952: 73; Alfred, 1958: 162; Alfred, 1961a: 18, pl. 4 fig. 31 (Nee Soon swamp forest and north shore of Seletar Reservoir).
Betta macrophthalma Regan, 1910: 781.
Betta picta (nec Valenciennes) Bleeker, 1879: 26; Weber & De Beaufort, 1922:

360; Fowler, 1938: 121; Herre, 1940: 44 (Mandai Road).

Betta fusca Tweedie, 1936: 22 (Mandai); Fowler, 1938: 259 (Mandai); Herre, 1940: 46.

Betta taeniata Tweedie, 1936: 22 (Botanic Gardens); Herre & Myers, 1937: 72; Herre, 1940: 45 (Botanic Gardens).

Betta rubra Herre, 1940: 45.

Material examined. — NMS.1038, Sungei Seletar, Nee Soon Rifle Range, E. Alfred, 17.2.1958, six; NMS.1159, Sungei Seletar, north of Seletar Reservoir, E. Alfred, 4.4.1963, twenty-two; NMS.1138, MacRitchie Reservoir, E. Alfred, 3.3.1963, one; NMS.1094, Mandai Road, collected by Fisheries Dept., no other data, three; NMS.1095, Botanic Gardens, H. N. Ridley, 16.1.1901, six; NMS.1096, Singapore, no exact locality, A. W. Herre, March 1934, two; NMS.1097, Mandai Road, 1937, no other data, fourteen; NMS.1098, Mandai Road, February 1938, no other data, one; NMS.1206, Sungei Seletar, west of Seletar Reservoir, E. Alfred, 8.4.1963, one adult and brood of seventy-four; NMS.1230, Sungei Kangkar, 16th mile Lim Chu Kang Road, M. Dali, 14.3.1963, thirty-six; ML.24983, Sungei Seletar, west of Seletar Reservoir, E. Alfred, 8.4.1963, ninety-three; NMS.1246, Sungei Bajau, Pasir Laba Road, E. Alfred, 21.3.1963, one hundred and thirty-six.

I have recently provided a description of the species which was based exclusively on the types and a series of topotypes (Alfred, 1964a: 147). The Singapore series differs from those specimens as follows: Dorsal rays I-II. 8-9 instead of I. 7-9, anal rays II-III. 22-26 instead of II. 24-27, lateral line 28-31 instead of 28-30, transverse scales 9-10 against 10-12, and predorsals 25-31 as against 25-29. Variation in the colouration of live and preserved specimens is similar to that described for the topotypes (Alfred, 1964a). The habitat in Singapore is usually slow-flowing, well-shaded, forest streams.

Of particular interest is the fact that the species is a mouth-breeder. An individual collected near the Seletar Reservoir, measuring 72.5 mm total length and 51.5 mm standard length, voided 74 juveniles when it was placed in formalin. The juveniles measure about 0.7 mm total length.

Betta splendens Regan (pl. 8 fig. 1)

Betta splendens Regan, 1910: 782 — Bangkok, Menam River, Siam and Pinang, Malay Peninsula.

Betta splendens Herre, 1940: 46 (Mandai Road); Tweedie, 1952: 75 (Naval Base).

Material examined. — NMS.1262, Sungei Kallang, outlet from Peirce Reservoir, E. Alfred, 3.1.1964, two. Also, BM.1897.1.28.6-8, Penang, S. S. Flower, 21.11.1896, three syntypes; and BM.1898.11.8.95-97, Bangkok, Menam River, Thailand, S S. Flower, August 1898, three syntypes.

The following details are with the data on the syntypes in parentheses: Dorsal rays (last 2 rays counted separately) I. 8-10 (I. 9-10); anal (last 2 rays counted separately) IV. 22-25 (III-IV. 24-25); pectoral i. 10-12 (i. 11-12); ventral I. 5 (I. 5). Lateral line 29 (29-31); transverse scales 9½ (9½) plus 2 on anal base; predorsals 24-25 (26-30). Standard length

25.8-27.4 mm (27.0-31.0 mm for Penang syntypes); total length 34.3-36.1 mm (37.0-40.0 mm for Penang syntypes).

The well-known Siamese Fighting-fish has been widely introduced in Malaya by fish fanciers who keep it mainly for its fighting prowess. It is also an aquarium fish. Herre (1940) reports taking 2 specimens of 33 and 37 mm standard length from a brook along the Mandai Road in 1937. Tweedie (1952) states that "it is found here and there on Singapore Island" and adds that he has seen examples taken at the Naval Base (Woodlands). More recent collecting reveals that it is by no means well established.

Osphronemus Lacépède, 1802

Osphronemus goramy Lacépède

Osphronemus goramy Lacépède, 1802: 116 — France.
Osphronemus goramy Herre & Myers, 1937: 71; Tweedie, 1940: 69 (MacRitchie Reservoir); Alfred, 1961a: 17, pl. 4 fig. 29 (MacRitchie Reservoir and Jurong River).

Material examined. — NMS.1288, MacRitchie Reservoir, S. N. Crosswell, 1939, one (plaster cast).

The Giant Goramy has been so widely distributed as a pond culture fish that it is difficult to state whether it is indigenous to Singapore. Herre & Myers (1937) report that 2 specimens of 166 and 169 mm standard length, were taken from a pond by A. W. Herre in March 1934. Tweedie (1940) gave MacRitchie Reservoir as a locality on the basis of a specimen of about 360 mm total length, which now exists as a plaster model in the Fish Gallery of the National Museum, Singapore.

The species has not found favour among local fish culturists who prefer the species of Chinese Carps. However, Le Mare (1949: 15) mentions that when the supply of carp fry from China ceased during the Japanese occupation from 1941 to 1945, the local fish culturists turned to this species.

Trichogaster Bloch & Schneider, 1801

Trichogaster pectoralis (Regan)

Trichopodus pectoralis Regan, 1910: 784, pl. 79 fig. 1 — Siam and Singapore.
Trichopodus pectoralis Fowler, 1938: 123.
Trichogaster pectoralis Smith, 1933: 259; Herre & Myers, 1937: 73; Tweedie, 1952: 76; Alfred, 1961a: 17, pl. 4 fig. 28 (Jurong and Kranji Rivers).

Material examined. — BM.1862.11.1.232, Thailand, Jamrach, lectotype; BM.1862.11.1.233, Thailand, Jamrach, paratype; BM 1903.3.9.1-2, Singapore, J. A. M. Vipan, two paratypes; NMS.1099, Singapore, A. W. Herre, March 1934, one; NMS.1100, Woodleigh, no other data, one; NMS.1101, Singapore, no other data, one; NMS.1104, ditch draining into Rochore River, Moulmein Road, R. Hanitsch, 16.5.1912, one; NMS.1264, Sungei Kallang, outlet from Peirce Reservoir, E. Alfred, 3.1.1964, fourteen.

Total length 22.3-180.0 mm. Standard length 17.3-135.0 mm. Depth at origin of anal fin 2.1-2.9. Head 2.8-3.4. Eye 3.6-4.8. Snout 2.4-4.0. Interorbital width 2.4-2.7. Dorsal rays (last 2 rays counted separately) VII. 10-12. First soft ray of dorsal fin always unbranched; remaining soft rays unbranched in juveniles smaller than about 75.2 mm total length and 58.5 mm standard length, but branched in larger specimens. Dorsal origin opposite 15th-16th lateral line scale. Anal rays (last 2 rays counted separately) X-XI. 35-38. All soft rays of anal fin unbranched. Pectorals 11-12. Ventral I. 4. First soft ray of ventrals long and filamentous and reaching beyond caudal fin. Lateral line 48-55. Transverse scales between dorsal origin and anal origin 8½-9½/1/17½-18½. Predorsals 43-53.

Colouration (in alcohol). Dusky above, white on the sides. A series of 10 to 16 dark, oblique, irregular cross-bands. A darker (sometimes black) interrupted longitudinal stripe from the tip of the snout to the caudal base where it ends in a dark spot. In the largest specimens, the fins are dusky and without markings. In juveniles, the caudal and the posterior half of the dorsal and anal have irregular white spots. In life, these spots are distinctly yellowish while the colouration of the body is as described for alcohol specimens except that the sides are silvery.

According to Smith (1933) who quotes a statement dated June 27, 1933, from the Director of the Raffles Museum, Singapore, the species was introduced from Thailand to Singapore in 1898 and to the Krian District of Perak in 1913. Although Tweedie (1952: 76) states that the "fish is now established in Singapore", more recent collecting in 1963 and 1964 has shown that the species is by no means well established. However, the species is well established elsewhere in Malaya.

The type series originated from both Singapore and Thailand. I hereby select one of the two syntypes from Thailand of 150 mm total length and 118 mm standard length, BM. 1862.11.1.232, as the lectotype. I also hereby restrict the type locality to Bangkok, Thailand.

Trichogaster trichopterus (Pallas)

Labrus trichopterus Pallas, 1770: 45 — East Indies.

Osphromenus siamensis Hanitsch, 1901: 4; Hanitsch, 1904: 14.

Osphromenus trichopterus Duncker, 1904: 164 (Rochor River); Hanitsch, 1912: 27 (various localities).

Trichopodus trichopterus Weber & De Beaufort, 1922: 366; Tweedie, 1936: 23; Fowler, 1938: 123, 360.

Trichogaster trichopterus Hanitsch, 1901: 4; Hanitsch, 1904: 14; Herre & Myers, 1937: 73; Alfred, 1961a: 17, pl. 4 fig. 17 (various localities); Alfred, 1962b: 151.

Material examined. — BM.1897.5.31.1, Singapore, J. A. M. Vipan, one; NMS.1021,

Sungei Ayer Tawar, Huat Choe, E Alfred, 19.3.1958, four; NMS.1035, Sungei Seletar, Nee Soon Rifle Range, E. Alfred, 17.2.1958, one; NMS.1040, Sungei Ayer Tawar, Huat Choe, S. Forselius, 13.5.1958, three; NMS.1102, Serangoon, R. Hanitsch, 21.8.1898, five; NMS.1103, Jervoise Road, R. Hanitsch, 9.5.1912, two; NMS.1105, ponds at Serangoon, N. Smedley, 1927, fifteen; NMS.1106, Woodleigh, no other data, six; NMS.1107, Singapore, A. W. Herre, March 1934, two; ML.24984 Sungei Tengeh, E. Alfred, 21.3.1963, thirty-five; NMS.1179, Alkaff Gardens, Serangoon Road, T. Oates, 15.1.1964, three; NMS.1243, Sungei Kangkar, 17th mile Lim Chu Kang Road, M. Dali, 13.5.1963, forty; Sungei Kallang, outlet from Peirce Reservoir, E. Alfred, 3.1.1964, twenty-nine; NMS.1277, Sungei Seletar, outlet from Seletar Reservoir, E. Alfred, 4.1.1964, seven; NMS.1289, Somerset Road, R. Hanitsch, 7.5.1912, four.

The Two-spot Gouramy is common and widely distributed. It is considered a food fish in the rice-growing areas of Malaya, but does not appear to be popular locally. Hanitsch (1912) has given a good idea of its former range within what is now the city area of Singapore.

Trichopsis Canestrini, 1860

Trichopsis vittata (Cuvier) (pl. 8 fig. 3)

Osphromenus vittatus Cuvier, in: Cuvier & Valenciennes, 1831a: 387 — Java.
Ctenops vittatus Tweedie, 1936: 22.
Trichopsis vittatus Herre & Myers, 1937: 72; Fowler, 1938: 260; Tweedie 1952: 71; Alfred, 1961a: 17, pl. 4 fig. 30 (various localities).

Material examined. — NMS.1022, Sungei Ayer Tawar, Huat Choe, E. Alfred, 19.3.1958, thirty; NMS.1028, Sungei Tengeh, Tuas Road, E. Alfred, 19.3.1958, seven; NMS.1139, MacRitchie Reservoir, E. Alfred, 3.3.1963, two; NMS.1142, Sungei Tengeh, E. Alfred, 21.3.1963, fifty-two; NMS.1178, Alkaff Gardens, Serangoon Road, T. Oates, 5.1.1964, sixty-seven; ML.24985, Sungei Seletar, west of Seletar Reservoir, E. Alfred, 8.4.1963, eighty-six; NMS.1213, Sungei Whompoe, west of MacRitchie Reservoir, S. Sarmani, 23.1.1963, one; NMS.1244, Sungei Kangkar, 17th mile Lim Chu Kang Road, M. Dali, 13.5.1963, twenty-one; NMS.1252, Sungei Simpang Kiri, Sungei Simpang, M. Dali, 30.10.1963, four; NMS.1266, Sungei Kallang, outlet from Peirce Reservoir, E. Alfred, 3.1.1964, twelve; NMS.1278, Sungei Seletar, outlet from Seletar Reservoir, E. Alfred, 4.1.1964, ten; NMS.1108, Serangoon Road, R. Hanitsch, 16.5.1912, two; NMS.1109, Bukit Arang, R. Hanitsch, 16.5.1912, two; NMS.1110, Syed Ali Road, R. Hanitsch, 9.5.1912, twelve; NMS.1111, Somerset Road, R. Hanitsch, 7.5.1912, one; NMS.1112, Botanic Gardens Lake, F. N. Chasen, February 1923, nine; NMS.1113, St. George's Road, 10.4.1927, three; NMS.1114, Jurong, M. Tweedie, May 1937, seven.

The Croaking Gouramy is also widely distributed but it is far less tolerant of pollution than the preceding species. As in Thailand (Smith, 1945: 452) the species is subject to considerable variation in colour. Usually there are 4 longitudinal stripes. The dark spot near the shoulder on the second stripe is usually absent. The anal spines are VII-IX.

LUCIOCEPHALIDAE

Luciocephalus Bleeker, 1851a

Luciocephalus pulcher (Gray)

Diplopterus pulcher Gray, 1830-1832: 87, fig. 1 — locality not given.
Luciocephalus pulcher Karoli, 1882: 172 (Seletar); Weber & De Beaufort, 1922: 369; Herre & Myers, 1937: 70; Fowler, 1938: 124; Tweedie, 1952: 65; Alfred, 1961a: 15, pl. 3 fig. 25 (Seletar River system).

Material examined. — NMS.1160, Sungei Seletar, north of Seletar Reservoir, E. Alfred, 4.4.1963, eighteen; ML.24986, Sungei Seletar, west of Seletar Reservoir, E. Alfred, 8.4.1963, thirty-nine; NMS.1207, same data, 1 adult + 91 embryos; NMS. 1208, same data, 1 adult + 90 embryos; NMS.1209, same data, 1 adult + 40 young; NMS.1210, same data, 1 adult + 33 young; NMS.1253, Singapore, A. W. Herre, March 1934, one; NMS.1254, Mandai Road, no other data, one.

The species appears to be restricted to the Seletar drainage where it is particularly abundant in the streams draining into the Seletar Reservoir. Its carnivorous habits are well-known. Tweedie (1952) records the observations of Mr W. H. Marsack who discovered that the species is a mouth breeder. I have observed 3 separate adults with disgorged embryos in an aquarium and on each occasion the embryos once disgorged, were never taken in again.

Out of a total of 43 specimens taken recently from a stream west of the Seletar Reservoir, 4 had young. Details of these 4 specimens are given in the accompanying table.

TABLE 1

Details of 4 brooding adults of *Luciocephalus pulcher* (Gray) and their young

Catalogue No.	1210	1207	1208	1209
Total length (mm)	97.0	118	121	136
Standard length (mm)	78.8	96.0	98.4	110
No. of embryos (E) or juveniles (J)	33 (J)	91 (E)	90 (E)	40 (J)
Total length of embryos and juveniles (mm)	14.3-15.0	13.4-14.7	9.2-12.2	14.8-15.5

Suborder Ophicephaloidea

OPHICEPHALIDAE

Channa Scopoli, 1777

I follow Myers & Shapovalov (1931) in considering *Ophicephalus* Bloch

a synonym of *Channa* Scopoli. The 4 species which are known from Singapore may be distinguished as follows:

1. Vomer and palatines with a pluriserial band of teeth which are small and not caniniform . . . . . *C. striata*
— Vomer and palatines with one or two rows of teeth which are mostly large and caniniform 2
2. 3½ scales in transverse series between anterior part of dorsal fin and lateral line. Lateral line scales less than 50. Juveniles without 2 black lateral stripes . . . . *C. orientalis*
— More than 3½ scales in transverse series between anterior part of dorsal fin and lateral line. Lateral line scales more than 50. Juveniles with 2 black lateral stripes 3
3. 5½ scales in transverse series between anterior part of dorsal fin and lateral line. Lateral line scales less than 75. Juveniles with lower lateral stripe passing through eye. Maximum size not exceeding 400 mm total length . . . . . *C. lucius*
— 6½ scales in transverse series between anterior part of dorsal fin and lateral line. Lateral line scales more than 75. Juveniles with upper lateral stripe passing through eye. Maximum size exceeding 600 mm total length . . . *C. micropeltes*

Channa lucius (Cuvier)

Ophicephalus lucius Cuvier, in: Cuvier & Valenciennes, 1831a: 416 — Java.
Ophiocephalus bistriatus Weber & De Beaufort, 1922: 322 — Sungei Manggar, Balikpapan, Borneo.
Ophicephalus bistriatus Herre & Myers, 1937: 70.
Channa bistriata Tweedie, 1950: 104.
Channa lucius Alfred, 1961a: 15, pl. 4 fig. 24a, 24b (MacRitchie and Seletar Reservoirs and Nee Soon swamp forest); Alfred, 1964c: 156, fig. 1a-1d.

Material examined. — NMS.1115, Singapore, A. W. Herre, March 1934, two; NMS.1125, Sungei Seletar, Nee Soon Rifle Range, J. R. Hendrickson and E. Alfred, April 1958, 1 adult and 29 young; ML.24987, Sungei Seletar, west of Seletar Reservoir, E. Alfred, 8.4.1963, twenty-eight.

Dorsal rays i. 38-39; anal i. 26-27; pectoral i. 16-17; ventral i. 5. Lateral line 59-63; transverse scales 5½/1/13½-14½. Standard length 49.0-185 mm; total length 59.0-226 mm.

Although this species is fairly common in certain localities it was not until recently (Alfred, 1961a) that it was reported for the first time from Singapore. However, Dr A. W. Herre collected 26 juveniles in March 1934 and these were subsequently reported as *C. bistriata* (Weber & De Beaufort) by Herre & Myers (1937) and by Tweedie (1950). I have recently shown (Alfred, 1964c) that *C. bistriata* represents the juvenile stage of *C. lucius*.

Channa micropeltes (Cuvier) (pl. 8 fig. 4)

Ophicephalus micropeltes Cuvier, in: Cuvier & Valenciennes, 1831a: 427 — Java.
Chana micropeltes Burkill, 1961: 163 (Botanic Gardens Lake).
Chanos micropeltes Burkill, 1963: 9, pl. 6 (Botanic Gardens Lake).

Material examined. — NMS.1042, Botanic Gardens Lake, E. Alfred, 24.5.1960, six; ML.24988, same data, 25.5.1960, five; NMS.1290-1294, same data, June 1961, five.

Dorsal rays i. 42-45; anal i. 27-29; pectoral i. 17; ventral i. 5. Lateral line 85-88; transverse scales 6½/1/17½. Standard length 115-725 mm; total length 140-880 mm.

It is unlikely that such a large-sized fish as this species could have remained undetected until only recently and there is little doubt that it is a recent introduction to Singapore. It is known from the Botanic Gardens Lake and nowhere else. Weber & De Beaufort (1922: 328) give the maximum size as 640 mm total length. My 5 largest specimens which were collected in 1961, measure 600 to 800 mm total length.

*Channa orientalis Bloch & Schneider

Channa orientalis Bloch & Schneider, 1801: 496, pl. 90 fig. 2 — India orientali.

Ophiocephalus gachua Hamilton, 1822: 67, 367, pl. 21 fig. 21 — ponds and ditches of Bengal.

Ophiocephalus gachua var. *malaccensis* Peters, 1868: 262 (Kranji River).

Ophiocephalus gachua Bleeker, 1879: 38; Hanitsch, 1901: 4; Hanitsch, 1904: 14; Duncker, 1904: 165 (Bukit Timah); Weber & De Beaufort, 1922: 321; Tweedie, 1936: 22 (Bukit Timah); Herre & Myers, 1937: 71 (Mandai Road).

Channa gachua Fowler, 1938: 124, 260; Tweedie, 1950: 102 (Bukit Timah).

Material examined. — NMS. 1116, Bukit Timah, R. Hanitsch, 6.1.1901, two.

Dorsal rays i. 33-35; anal i. 22; pectoral i. 14-15; ventral i. 5. Lateral line 40-42; transverse scales 3½/1/7½. Standard length 80.2-83.4 mm; total length 105-106 mm.

According to Myers & Shapovalov (1931), the species *O. gachua* Hamilton is conspecific with *C. orientalis* Bloch & Schneider.

Tweedie (1950) has pointed out that the species is found in hill-streams. My observations in Malaya, are that the species is characteristic of small, slow-flowing, forest streams and their associated pools, close to hills. The first specimens taken locally were collected in 1861 from the Kranji River (Peters, 1868). Additional specimens are recorded by Hanitsch (1901), Duncker (1904) and Herre & Myers (1937).

Channa striata (Bloch)

Ophicephalus striatus Bloch, 1793: 141, pl. 359 — Malabar.

Ophiocephalus striatus Cantor, 1849: 1074; Bleeker, 1860a: 216; Bleeker, 1860c: 449; Bleeker, 1879: 42; Hanitsch, 1901: 4; Duncker, 1904: 165 (Botanic Gardens); Hanitsch, 1904: 14; Hanitsch, 1912: 28 (Syed Ali Road); Weber & De Beaufort, 1922: 317; Tweedie, 1936: 22 (Botanic Gardens).

Ophicephalus striatus Herre & Myers, 1937: 71.

Channa striata Fowler, 1938: 125, 261; Alfred, 1961a: 14, pl. 3 fig. 23a, 23b (various localities).

Material examined. — NMS.1034, Sungei Seletar, Nee Soon Rifle Range, E. Alfred, 17.2.1958, two; NMS.1039, Sungei Tengeh, Tuas Road, S. Forselius, 13.5.1958, one

hundred and forty; NMS.1117, Singapore, R. Hanitsch, 28.8.1898, five; NMS.1118, Botanic Gardens Lake, R. Hanitsch, 23.8.1898, two; NMS.1119, Syed Ali Road, R. Hanitsch, 9.5.1912, five; NMS.1120, same data, 13.9.1912, three; NMS.1121, Botanic Gardens Lake, F. N. Chasen, February 1923, one; NMS.1122, from fishmarket, Singapore, no other data, one; NMS. 1123, Singapore, A. W. Herre, March 1934, one; NMS.1124, Singapore, M. Tweedie, 1952, one. NMS.1147, Sungei Tengeh, E. Alfred, 21.3.1963, one; NMS.1158, Sungei Seletar, north of Seletar Reservoir, E. Alfred, 4.4.1963, one; NMS.1177, Alkaff Gardens, Serangoon Road, T. Oates, 5.1.1964, nine; NMS.1204, Sungei Seletar, west of Seletar Reservoir, E. Alfred, 8.4.1963, three; NMS.1296, same data, one; NMS.1227, Sungei Whompoe, outlet from MacRitchie Reservoir, T. Oates, 2.1.1964, one; NMS.1241, Botanic Gardens Lake, T. Oates, 20.1.1964, ninety-two; NMS.1295, same locality, E. Alfred, 24.5.1960, one; NMS.1260, Sungei Punggol, 9th mile Yio Chu Kang Road, E. Alfred, 12.3.1963, two; NMS.1263, Sungei Kallang, outlet from Peirce Reservoir, E. Alfred, 3.1.1964, three; ML.24989, Sungei Seletar, outlet from Seletar Reservoir, E. Alfred, 4.1.1964, two.

This is by far the most common and widely distributed species of *Channa* in Singapore. According to Schuster (1952: 187) the species is "often kept alive for a considerable time by Javanese fishermen and transported over long distances" and "it is even shipped alive in sailboats from Bandjermasin in South Borneo to the markets in Singapore". Although such introductions of the species may have taken place from time to time, there is no reason to suppose that the species is not indigenous to Singapore.

Order Opisthomi

MASTACEMBELIDAE

In his studies of the family Mastacembelidae, Sufi (1956) recognised 4 species from Singapore. His specimens were however collected more than 25 years ago and recent collecting has revealed only a single species. The following key which will identify the 4 species is adapted from De Beaufort (1962):

1. Snout much elongated beyond lower jaw and transversely grooved underneath . . *Macrognathus aculeatus*
— Snout not much elongated beyond lower jaw and not transversely grooved underneath 2
2. Preopercular spines present 3
— Preopercular spines absent 4
3. Dorsal spines XXVI-XXXI . . . . . *Mastacembelus maculatus* (part)
— Dorsal spines XXXII-XXXV . . . . . *Mastacembelus armatus*
4. Preorbital spine present . . . . . *Mastacembelus maculatus* (part)
— Preorbital spine absent . . . . . *Mastacembelus perakensis*

Macrognathus Lacépède, 1800

***Macrognathus aculeatus** (Bloch)

Ophidium aculeatum Bloch, 1786: 72, fig. 2 — East Indies.
Macrognathus aculeatus Herre & Myers, 1937: 74; Sufi, 1956: 101.

There is a specimen from Singapore measuring 245.0 mm standard length which was registered in 1883 in the British Museum (Sufi, 1956: 104). In addition, A. W. Herre collected 2 specimens of 97 and 168 mm standard length, in March 1934 (Herre & Myers, 1937).

Mastacembelus Scopoli, 1777

*__Mastacembelus perakensis__ Herre & Myers

Mastacembelus perakensis Herre & Myers, 1937: 74 — Bukit Merah Reservoir, Krian District, Perak and Singapore.
Mastacembelus perakensis Sufi, 1956: 117; De Beaufort, 1962: 429.

The species is as yet known from the holotype and paratype which were obtained respectively in Perak and Singapore and from a third specimen from Johore (Herre, 1940: 55). Sufi (1956) considers it a doubtful species which is closely related to *M. maculatus* Cuvier. It appears to resemble that species in all respects except for the absence of the preorbital spine. However, as Sufi points out, this character is variable in some other species.

Mastacembelus maculatus Cuvier

Mastacembelus maculatus Cuvier, in: Cuvier & Valenciennes, 1831b: 461 — Moluccas.
Mastacembelus guentheri Herre, 1940: 55 (Mandai Road).
Mastacembelus maculatus Herre, 1940: 55 (Mandai Road); Sufi, 1956: 113; Alfred, 1961a: 4, pl. 2 fig. 1 (Seletar Reservoir and Nee Soon swamp forest); De Beaufort, 1962: 428.

Material examined. — NMS.1029, Sungei Seletar, Nee Soon Rifle Range, J. R. Hendrickson, 17.2.1958, two; ML.24990, Sungei Seletar, north of Seletar Reservoir, E. Alfred, 4.4.1963, four; NMS.1199, Sungei Seletar, west of Seletar Reservoir, E. Alfred, 8.4.1963, fourteen; NMS.1217, Sungei Whompoe, west of MacRitchie Reservoir, S. Sarmani, 23.1.1964, one.

First recorded from Singapore by Herre (1940) from 5 specimens taken from the Mandai Road area, Sufi (1956) pointed out that the 2 specimens of *M. guentheri* reported by Herre (1940) from the same locality should also be referred to this species. In doing so Sufi considers the presence or absence of preopercular spines as a variable character in the present species. My series are all without preopercular spines.

*__Mastacembelus armatus__ (Lacépède)

Macrognathus armatus Lacépède, 1800: 286 — locality not known.
Mastacembelus armatus Sufi, 1956: 134; De Beaufort, 1962: 433.

Known locally from only a single specimen of 439 mm standard length which was registered in the British Museum collection in 1883 (Sufi, 1956: 139).

Order Synbranchia

FLUTIDAE

Fluta Bloch & Schneider, 1801

Fluta alba (Zuiew)

Muraena alba Zuiew, 1793: 299, pl. 7 fig. 2 — not seen.
Fluta alba Herre, 1937: 14.
Monopterus albus Alfred, 1961a: 4, pl. 2 fig. 2 (various localities).

Material examined. — NMS.1145, Sungei Tengeh, E. Alfred, 21.3.1963, three; NMS.1173, Alkaff Gardens, Serangoon Road, T. Oates, 15.1.1964, two; NMS.1205, Sungei Seletar, west of Seletar Reservoir, E. Alfred, 8.4.1963, two; NMS.1234, Sungei Kangkar, 16th mile Lim Chu Kang Road, M. Dali, 14.3.1963, one; NMS.1249, Sungei Bajau, Pasir Laba Road, E. Alfred, 21.3.1963, one; ML.24991, Sungei Kallang, outlet from Peirce Reservoir, E. Alfred, 3.1.1964, nine; NMS.1299, Singapore, R. Hanitsch, 23.12.1898, six.

Although the earliest published Singapore record is of 2 specimens measuring 210 and 244 mm in length, collected in March 1934 (Herre, 1937), there are 6 specimens in hand which were obtained in 1898. As Herre has pointed out, the species is common in fresh-water ponds and ditches. Large specimens are collected for food.

DOUBTFUL AND ERRONEOUS RECORDS

I have earlier (p. 10) dismissed as erroneous, the Singapore records which are given by Boeseman (1957). These are *Kryptopterus bicirrhus* (Valenciennes), *Botia macracanthus* (Bleeker), *Acanthophthalmus semicinctus* Fraser-Brunner, *Rasbora pauciperforata* Weber & De Beaufort, *R. taeniata* Ahl, *Puntius partipentazona* Fowler, *Gymnochanda filamentosa* Fraser-Brunner, and *Sphaerichthys osphromenoides* Canestrini. Ignoring aquarium publications, the following are other records, mainly Karoli's (1882), which require specific comment.

Esomus danrica (Hamilton)

Cyprinus danrica Hamilton, 1822: 325, 390, pl. 16 fig. 88 — ponds and ditches of Bengal.
Nuria Danrica Karoli, 1882: 34.
Esomus danrica Weber & De Beaufort, 1916: 83.

Although Weber & De Beaufort (1916) expressed doubts about Karoli's (1882) record of this Indian species from Singapore, they painstakingly provided a detailed description of the genus and the species (including a figure), presumably as an aid to its possible re-discovery. There are no records since then of the species being collected from Singapore or anywhere

else in the Malay Peninsula, and I have little doubt that Karoli's record is erroneous.

Rasbora argyrotaenia (Bleeker)

Leuciscus argyrotaenia Bleeker, 1850: 21 — Banjumas, Gombong, Purworedjo and Surabaya.
Rasbora argyrotaenia Karoli, 1882: 180 (Selita); Fowler, 1938: 56.

This is one of the two species of *Rasbora* which is erroneously reported (Karoli, 1882) from Singapore. It is not known in the Malay Peninsula, its recorded distribution (Brittan, 1954a) being Java, Sumatra, Borneo and southern Philippines.

Rasbora daniconius (Hamilton)

Cyprinus daniconius Hamilton, 1822: 327, pl. 15 fig. 89 — Rivers of southern Bengal.
Rasbora daniconius Karoli, 1882: 180; Duncker, 1904: 181; Fowler, 1938: 57.

This is an Indian species whose range is not known to extend into the Malay Peninsula (Brittan, 1954a). Karoli's and Duncker's record would refer to some other species, probably *R. einthovenii* (Bleeker).

Botia hymenophysa (Bleeker)

Cobitis hymenophysa Bleeker, 1852c: 602 — Palembang, Sumatra.
Botia hymenophysa Weber & De Beaufort, 1916: 24; Fowler, 1938: 54.

I am unable to find the published records that Weber & De Beaufort (1916) apparently refer to. They probably mis-read Duncker (1904: 174) who, referring to specimens from Ulu Jelai, Pahang in the collection of Raffles Museum (now, National Museum), Singapore, gave the locality as "Raffles Mus. (Singapore): Ulu Jelai (Pahang)". These same specimens are listed by Hanitsch (1904).

Hemiramphodon phaiosoma (Bleeker)

Hemiramphus phaiosoma Bleeker, 1852a: 99 — Tjirutjup River, Bilitong, Java.
Hemiramphus phaiosoma Karoli, 1882: 181 (Serangoon).
Hemiramphodon phaiosoma Weber & De Beaufort, 1922: 143; Mohr, 1936: 59; Fowler, 1938: 74.

In addition to Banka, Biliton and Borneo, Weber & De Beaufort (1922) include Singapore as a locality for the species, and this locality is cited after them by Mohr (1936) and Fowler (1938). Since Weber & De Beaufort

do not state that they have actually seen any specimens from Singapore, it is presumed that they quoted Karoli's record (1882) of the species from Serangoon. However, Karoli's record is suspect since the species has never been reported since from Singapore or Malaya.

Colisa fasciata (Bloch & Schneider)

Trichogaster fasciatus Bloch & Schneider, 1801: 164 — Tranquebar.
Trichogaster fasciatus Weber & De Beaufort, 1922: 341.

Referring to a specimen from Singapore in the British Museum, Weber & De Beaufort (1922) expressed doubts about the exact locality since the specimen originated from an aquarium. I have examined this specimen (BM. 1898.3.4.1) and there is no doubt of its identity. The locality is however certainly incorrect since the species is not known south of Assam and northern Burma.

Channa punctata (Bloch)

Ophicephalus punctatus Bloch, 1793: 139, pl. 358 — Malabar coast.
Ophiocephalus affinis Karoli, 1882: 25.
Channa punctata Fowler, 1938: 125.

Weber & De Beaufort (1922) have expressed strong doubts about Karoli's record of this Indian species from Singapore. I fully agree with them that the species ought to be omitted from the Indo-Australian list.

REFERENCES

AHL, E., 1929. Übersicht über die lebend eingeführten Asiatischen Arten der Gattung Barbus. Teil 3. — Das Aquarium **1929**: 165-169, fig. 1-8.

——, 1939. Ueber eine neue Barbenart aus Singapore. — SitzBer. Ges. naturf. Freunde Berlin **1939**: 243-245.

ALEXANDER, F. E. S., 1950. Report on the availability of granite on Singapore and the surrounding islands: i-ii, 1-24, text-fig. 1-5, pl. 1-5, map 1-3.

ALFRED, E. R., 1958. The food and habitat of the Fighting-fish Betta pugnax. — Malayan Nat. Journ. **12** (4): 161-163.

——, 1961a. Singapore fresh-water fishes. — Malayan Nat. Journ. **15** (1, 2): 1-19, pl. 1-4.

——, 1961b. The Cantor Collection of Malayan fresh-water fishes. — Bull. Raffles Mus. Singapore **26**: 183-186.

——, 1962a. The Javanese fishes described by Kuhl and van Hasselt. — Bull. Nat. Mus. Singapore **30**: 80-88, pl. 3-8.

——, 1962b. Definitive issue of Singapore postage stamps. — Malayan Nat. Journ. **16** (3): 150-151.

——, 1964a. Notes on a collection of fresh-water fishes from Penang. — Bull. Nat. Mus. Singapore **32**: 143-154, pl. 3, 4.

——, 1964b. Notes on a re-examination of some Bleeker type specimens of Indo-Malayan fresh-water fishes. Part 2. Abramidinae and Rasborinae. — Bull. Nat. Mus. Singapore **32**: 128-134.
——, 1964c. Channa bistriata (Weber and de Beaufort), the young of the Snake-head fish Channa lucius (Cuvier). — Bull. Nat. Mus. Singapore **32**: 156-157.
——, 1964d. Some comments on the type specimens of Malayan fishes described by Georg Duncker. — Bull. Nat. Mus. Singapore **32**: 165-166.
——, 1964e. Some colourful fishes of the genus Puntius Hamilton. — Bull. Nat. Mus. Singapore **32**: 135-142, fig. 1.
ATZ, J. W., 1954. The peregrinating Tilapia. — Animal Kingdom **50** (5): 148-155.
BEAUFORT, L. F. DE, 1933. On some new or rare species of Ostariophysi from the Malay Peninsula and a new species of Betta from Borneo. — Bull. Raffles Mus. Singapore **8**: 31-36.
——, 1962. The fishes of the Indo-Australian Archipelago **11**: i-xi, 1-481, fig. 1-100.
BIRTWISTLE, W., 1931a. Rearing of carp in ponds. — Malayan Agric. Journ. **19** (8): 372-383, text-fig. 1-5, pl. 1.
——, 1931b. Transport of carp fry from China. — Malayan Agric. Journ. **19** (10): 490-493, pl. 1, 2.
BLEEKER, P., 1846. Siluroideorum bataviensium species nuperrime detectae. — Nat. Geneesk. Arch. Ned. Ind. **3** (2): 284-293.
——, 1847. Siluroideorum bataviensium conspectus diagnosticus. — Verh. Bat. Gen. **21**: 1-60.
——, 1849. Bijdrage tot de kennis der Blennioiden en Gobioiden van den Soenda-Molukschen Archipel, met beschrijving van 42 nieuwe soorten. — Verh. Bat. Gen. **22**: 1-40. (not seen).
——, 1850. Bijdrage tot de kennis der ichthyologische fauna van Midden- en Oost-Java met beschrijving van eenige nieuwe species. — Verh. Bat. Gen. **23**: 1-23.
——, 1851a. Nieuwe bijdrage tot de kennis der ichthyologische fauna van Borneo, met beschrijving van eenige nieuwe soorten van zoetwatervisschen. — Nat. Tijdschr. Ned. Indie **1**: 259-275.
——, 1851b. Derde bijdrage tot de kennis der ichthyologische fauna van Borneo, met beschrijving van eenige nieuwe soorten van zoetwatervisschen. — Nat. Tijdschr. Ned. Indie **2**: 57-70.
——,1851c. Vierde bijdrage tot de kennis der ichthyologische fauna van Borneo, met beschrijving van eenige nieuwe soorten van zoetwatervisschen. — Nat. Tijdschr. Ned. Indie **2**: 193-208.
——, 1851d. Vijfde bijdrage tot de kennis der ichthyologische fauna van Borneo, met beschrijving van eenige nieuwe soorten van zoetwatervisschen. — Nat. Tijdschr. Ned. Indie **2**: 415-442.
——, 1852a. Bijdrage tot de kennis der ichthyologische fauna van Blitong (Billiton), met beschrijving van eenige nieuwe soorten van zoetwatervisschen. — Nat. Tijdschr. Ned. Indie **3**: 87-100.
——, 1852b. Zesde bijdrage tot de kennis der ichthyologische fauna van Borneo. Vischen van Pamangkat, Bandjermassing, Braboekarta en Sumpit. — Nat. Tijdschr. Ned. Indie **3**: 407-442.
——, 1852c. Diagnostische beschrijvingen van nieuwe of weinig bekende vischsoorten van Sumatra. Tiental I-IV. — Nat. Tijdschr. Ned. Indie **3**: 569-608.
——, 1853a. Nalezingen op de ichthyologische fauna van het eiland Banka. — Nat. Tijdschr. Ned. Indie **5**: 175-194.
——, 1853b. Nieuwe tientallen diagnostische beschrijvingen van nieuwe of weinig bekende vischsoorten van Sumatra. — Nat. Tijdschr. Ned. Indie **5**: 495-534.
——, 1853c. Nalezingen op de ichthyologische fauna van Bengalen en Hindostan. — Verh. Bat. Gen. **25**: 1-165.

——, 1854a. Overzicht der ichthyologische fauna van Sumatra, met beschrijving van eenige nieuwe soorten. — Nat. Tijdschr. Ned. Indie **7**: 49-108.
——, 1854b. Ichthyologische waarnemingen gedaan op verschillende reizen in de residentie Bantam. — Nat. Tijdschr. Ned. Indie **7**: 309-326.
——, 1857. Descriptiones specierum piscium javanensium novarum vel minus cognitatum diagnosticae. — Nat. Tijdschr. Ned. Indie **13**: 323-368.
——, 1858. De visschen van den Indischen Archipel. Deel 1. Siluri. — Act. Soc. Sci. Indo-Neerl. **4**: i-xii, 1-370.
——, 1859a. Over de geslachten der Cobitinen. — Nat. Tijdschr. Ned. Indie **16**: 302-304.
——, 1859b. Enumeratio specierum piscium hucusqce in Archipelago Indico observatarum. — Act. Soc. Sci. Indo-Neerl. **6**: i-xxxvi, 1-276.
——, 1860a. Vischsoorten van Singapore, verzameld door Fr. Graaf de Castelnau. — Nat. Tijdschr. Ned. Indie, **20**: 216-217.
——, 1860b. Conspectus systematis cyprinorum. — Nat. Tijdschr. Ned. Indie **20**: 421-441.
——, 1860c. Derde bijdrage tot de kennis der vischfauna van Singapoera. — Nat. Tijdschr. Ned. Indie **20**: 446-456.
——, 1860d. Zoetwatervisschen van Singapoera. — Nat. Tijdschr. Ned. Indie **21**: 334.
——, 1860e. Vischsoorten nieuw voor de kennis der fauna van Singapoera. — Nat. Tijdschr. Ned. Indie **22**: 101-102.
——, 1860f. Ordo Cyprini, Karpers. — Act. Soc. Sci. Indo-Neerl. **7**: 1-492.
——, 1863. Sur les genres de la famille des Cobitioides. — Versl. Akad. Amsterdam **15**: 32-44.
——, 1863-1864. Atlas ichthyologique des Indes Orientales Neerlandaises **2**: 1-112, pl. 49-101.
——, 1864-1865. Atlas ichthyologique des Indes Orientales Neerlandaises **3**: 1-150, pl. 102-144.
——, 1866. Revision des Hemirhamphes de l'Inde archipelagique. — Ned. Tijdschr. Dierk. **3**: 136-170.
——, 1874. Esquisse d'un système naturel des Gobioides. — Arch. Néerl. Sci. nat. **9**: 289-331.
——, 1879. Mémoire sur les poissons à pharyngiens labyrinthiformes de l'Inde archipélagique. — Verh. Akad. Amsterdam **19**: 1-56.
Bloch, M. E., 1786. Naturgeschichte der ausländischen Fische **2**: i-viii, 1-160, 36 pls.
——, 1792. Naturgeschichte der ausländischen Fische **6**: i-vi, 1-126, 36 pls.
——, 1793. Naturgeschichte der ausländischen Fische **7**: i-xiv, 1-144, 36 pls.
——, 1794. Naturgeschichte der ausländischen Fische **8**: i-vi, 1-174, 36 pls.
Bloch, M. E. & J. G. Schneider, 1801. Systema Ichthyologiae Iconibus CX illustratum: i-lx, 1-584, pl. 1-110.
Blythe, W. L., 1951. Fauna and Flora. — Ann. Rep. Colony Singapore **1950**: 177-185.
Boeseman, M., 1957. On a collection of East Asian Fishes. — Zool. Meded. Leiden **35** (7): 69-78, pl. 3.
Boulenger, G. A., 1894. Descriptions of new freshwater fishes from Borneo. — Ann. Mag. nat. Hist. (6) **13**: 245-251.
Briggs, J. C., 1961. Emendated generic names in Berg's Classification of Fishes. — Copeia **1961** (2): 161-166.
Brittan, M. R., 1954a. A revision of the Indo-Malayan fresh-water fish genus Rasbora. — Monogr. Inst. Sci. Tech. Manila **3**: 1-224, map 1-3, fig. 1-52.
——, 1954b. The Cyprinid fish genus Rasbora in Malaya. — Bull. Raffles Mus. Singapore **25**: 129-156, fig. 1, 2.
Burdon, T. W., 1950. The pond cultivation of fish in the Colony of Singapore. In: D. W. Le Mare, 1950, Report of the Fisheries Department, Malaya **1949**: 130-142.
Burkill, H. M., 1961. Protection of wild life on Singapore Island. In: J. Wyatt-Smith

& P. R. WYCHERLEY, Nature conservation in western Malaysia: 152-164, 1 map, pl. 29.

——, 1963. Annual Report of the Botanic Gardens Department, Singapore, for 1961: 1-27, pl. 1-8, 1 map.

CANESTRINI, J., 1860. Zur Systematik und Charakteristik der Anabatinen. — Verh. zool.-bot. Ges. Wien **10**: 697-712.

CANTOR, T., 1849. Catalogue of Malayan fishes. — Journ. Asiat. Soc. Bengal **18** (2): i-xii, 983-1426, pl. 1-14.

CUVIER, G. & H. CLOQUET, 1816. Anabas. Dictionaire des sciences naturelles (ed. 2) **2** (suppl.): 35 (not seen).

CUVIER, G. L. C. F. D. & A. VALENCIENNES, 1831a. Histoire naturelle des poissons **7**: i-xxxvi, 1-531, pl. 170-208.

—— & ——, 1831b. Histoire naturelle des poissons **8**: i-xxiv, 1-509, pl. 209-245.

—— & ——, 1839. Histoire naturelle des poissons **14**: i-xxiv, 1-468, pl. 389-420.

—— & ——, 1842. Histoire naturelle des poissons **16**: i-xxii, 1-472, pl. 456-487.

—— & ——, 1844. Histoire naturelle des poissons **17**: i-xxvi, 1-497, pl. 487-519.

—— & ——, 1846. Histoire naturelle des poissons **18**: i-xxii, 1-509, pl. 520-553.

DUNCKER, G., 1904. Die Fische der malayischen Halbinsel. — Mitt. naturh. Mus. Hamburg **21**: 133-207, map 1, text-fig. 1, pl. 1, 2.

FILIPPI, F. DE, 1861. Lebistes, nuovo genere di pesce della famiglia dei Ciprinodonti. — Arch. Zool. Anat. Fisiol. **1**: 69-70.

FOWLER, H. W., 1938. A list of the fishes known from Malaya. — Fish. Bull. Singapore **1**: 1-268, i-lvi.

FRASER-BRUNNER, A., 1940. On some fishes of the genus Acanthophthalmus, with a description of a new species. — Ann. Mag. nat. Hist. (11) **6**: 170-175, fig. 1-4.

GARMAN, S., 1895. The cyprinodonts. — Mem. Harvard Mus. comp. Zoöl. **19** (1): 1-179.

GRAY, J. E., 1830-1832. Illustrations of Indian zoology; chiefly selected from the collection of Major-General Hardwicke, F.R.S. **1**: pl. 1-100.

——, 1833-1835. Illustrations of Indian zoology; chiefly selected from the collection of Major-General Hardwicke, F.R.S. **2**: pl. 1-102.

GREEN, C. F., 1928. Fish culture. — Ann. Rep. Fisher. Dept. Straits Settlem. Fed. Malay States **1927**: 12.

GÜNTHER, A., 1864. Catalogue of the fishes in the British Museum **5**: i-xxii, 1-455.

——, 1868. Catalogue of the fishes in the British Museum **7**: i-xx, 1-512.

HAIG, J., 1952. Studies on the classification of the catfishes of the oriental and palaearctic family Siluridae. — Rec. Indian Mus. **48** (3, 4): 59-116, fig. 1.

HALSTEAD, B. W., 1959. Dangerous marine animals: i-xiv, 1-146, fig. 1-86.

HAMILTON, F., 1822. An account of the fishes found in the river Ganges and its branches: i-vii, 1-405, pl. 1-39.

HANITSCH, R., 1901. Fishes. — Report Raffles Lib. Mus. **1900**: 3-4.

——, 1904. Catalogue of the fishes in the Raffles Museum. — Report Raffles Lib. Mus. **1903**: 9-15.

——, 1912. Mosquito larvae and freshwater fish. — Journ. Straits Br. Roy. Asiat. Soc. **62**: 26-30.

——, 1914. Mosquito enquiry. — Report Raffles Mus. Lib. **1913**: 4.

HASSELT, J. C. VAN, 1823. Uittreksel uit een' brief van den Heer J. C. van Hasselt, aan den Heer C. J. Temminck, geschreven uit Tjecande, Residentie Bantam, den 29sten December 1822. — Algem. Konst. Letter-Bode **2** (35): 130-133.

——, 1824. Extrait d'une seconde lettre sur les poissons de Java, écrite par M. van Hasselt à M. C. J. Temminck, datée de Tjecande, résidence de Bantam, 29 decembre 1822. (Alg. Konst en Letter bode, 1823, aout, no. 35). Suite de la dernière,

écrite en octobre 1822. (Voyez l'extrait de la première, dans le Bulletin de mai, no. 73). — Bull. Sci. nat. Geol. **2** (Zoologie) (306): 374-377.

HECKEL, J. J., 1843. Ichthyologie. In: J. VON RUSSEGGER, Reisen in Europa, Asien und Afrika, mit besonderer Rücksicht auf die naturwissenschaftlichen Verhältnisse der betreffende Länder unternommen in den Jahren 1835 bis 1841, etc. **1** (2): 991-1099, pl. 1-12.

HERRE, A. W. C. T., 1937. A contribution to the ichthyology of the Malay Peninsula. Part I. Marine Fishes. — Bull. Raffles Mus. Singapore **13**: 5-53, pl. 1-4.

——, 1940. Additions to the fish fauna of Malaya and notes on rare or little known Malayan and Bornean fishes. — Bull. Raffles Mus. Singapore **16**: 27-61.

——, 1944. A review of the halfbeaks or Hemiramphidae of the Philippines and adjacent waters. — Stanford Univ. Pub. (biol. ser.) **9** (2): 41-86, 1 map.

HERRE, A. W. C. T. & G. S. MYERS, 1937. A contribution to the ichthyology of the Malay Peninsula. Part II. Fresh-water fishes. — Bull. Raffles Mus. Singapore **13**: 53-74, pl. 5-7.

HOEDEMAN, J. J., 1959. Aquariumvissen encyclopaedie: 1-728, fig. 1-477.

HORA, S. L., 1941. Notes on Malayan fishes in the collection of the Raffles Museum, Singapore. Parts 2 and 3. — Bull. Raffles Mus. Singapore **17**: 44-64, fig. 1-6, pl. 5, 6.

HORA, S. L. & J. C. GUPTA, 1941. Notes on Malayan fishes in the collection of the Raffles Museum, Singapore. Part 1. — Bull. Raffles Mus. Singapore **17**: 12-43, pl. 2.

HUBBS, C. L. & K. F. LAGLER, 1958. Fishes of the Great Lakes Region. — Bull. Cranbrook Inst. Sci. **26** 1-213, text-fig. 1-251, pl. 1-44.

INGER, R. F. & P. K. CHIN, 1959. New species of fresh-water catfishes from North Borneo. — Fieldiana (Zool.) **39** (27): 279-296, fig. 46-48.

—— & ——, 1962. The fresh-water fishes of North Borneo. — Fieldiana (Zool.) **45**: 1-268, fig. 1-120.

JERDON, T. C., 1848. On the freshwater fishes of southern India. — Madras Journ. Lit. Sci. **15** (1): 139-149.

JOHNSON, D. S. & M. H. H. Soong, 1963. The fate of introduced freshwater fish in Malaya. — Proc. XVI Int. Congr. Zool. **1**: 246-247.

JORDAN, D. S. & J. O. SNYDER, 1906. A review of the Poeciliidae or Killifishes of Japan. — Proc. U.S. Nat. Mus. **31** (1486): 287-290, 1 fig.

KAROLI, J., 1882. Prodromus piscium Asiae orientalis a domine Joanne Xanthus annis 1868 — 70 collectorum. — Termesz. Fuzetek Budapest **5**: 147-187.

KOUMANS, F. P., 1940. Results of a reexamination of types and specimens of gobioid fishes, with notes on the fish fauna of the surroundings of Batavia. — Zool. Meded. Leiden **22**: 121-210.

——, 1953. The fishes of the Indo-Australian Archipelago **10**: i-xiii, 1-423, fig. 1-95.

LACÉPÈDE, B. G. E., 1800. Histoire naturelle des poissons **2**: i-lxiv, 1-632, pl. 1-20.

——, 1802. Histoire naturelle des poissons **3**: i-lxvi, 1-558, pl. 1-34.

——, 1803. Histoire naturelle des poissons **5** (not seen).

LESUEUR, C. A., 1821. Description of a new genus, and of several new species of fresh-water fish, indigenous to the United States. — Journ. Acad. Nat. Sci. Philadelphia **2**: 2-8, pl. 1-3.

LINNAEUS, C., 1758. Systema naturae per regna tria naturae, secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis (ed. 10) **1**: 1-824, i-iii.

McClelland, J., 1839. Indian Cyprinidae. — Asiatic Researches **19** (2): 217-471, pl.37-61.

MARE, D. W. LE, 1949. Annual report of the Fisheries Department, Federation of Malaya and Singapore **1948**: 1-72.

——, 1951. Application of the principles of fish culture to estuarine conditions in Singapore. — Proc. Indo-Pac. Fish. Counc. **2** (= for 1950): 180-183.

MARTENS, E. VON, 1876. Die Preussische Expedition nach Ost-Asien. Zoologischer Theil **1**: i-xii, 1-412, pl. 1-15.

MAXWELL, C. N., 1922. Malayan fishes. — Journ. Straits Br. Roy. Asiat. Soc. **84**: 175-280, i, ii, pl. 1-72.

MENON, A. G. K., 1954. Notes on Malayan fishes in the collection of the Raffles Museum, Singapore. Part 4. — Bull. Raffles Mus. Singapore **25**: 5-26, fig. 1-9.

MOHR, E., 1936. Hemiramphiden Studien IV-VI. — Mitt. zool. Mus. Berlin **21** (1): 34-64, fig. 1-14.

MYERS, G. S., 1923. Further notes on anabantids. — Copeia **1923** (124): 111-112.

——, 1927. Puntius streeteri, a new cyprinoid fish from Borneo, and Cobitophis, a new genus of Bornean Cobitidae. — Amer. Mus. Novit. **265**: 1-4, fig. 1.

——, 1949. Salt-tolerance of fresh-water fish groups in relation to zoogeographical problems. — Bijdr. Dierk. Amsterdam **28**: 315-322.

MYERS, G. S. & L. SHAPOVALOV, 1931. On the identity of Ophicephalus and Channa, two genera of labyrinth fishes. — Peking nat. Hist. Bull. **6**: 33-37.

PALLAS, P. S., 1770. Spicilegia zoologica **8**: 1-54, pl. 1-5.

PETERS, W. C. H., 1852. Diagnosen van neuen Flussfischen aus Mossambique. — Monatsber. Akad. Wiss. Berlin. **1852**: 275-276, 681-685.

——, 1859. Eine neue vom Herrn Jagor im Atlantischen Meere gefangene Art der Gattung Leptocephalus, und über einige andere neue Fische des Zoologischen Museums. — Monatsber. Akad. Wiss. Berlin **1859**: 411-413.

——, 1868. Über die von Herrn Dr. F. Jagor in dem ostindischen Archipel gesammelten Fische. — Monatsber. Akad. Wiss. Berlin **1868**: 254-281, 460-461.

REGAN, C. T., 1910. The Asiatic fishes of the family Anabantidae. — Proc. zool. Soc. London **1909**: 767-787, pl. 77-79.

——, 1913a. Description of a new Cyprinid fish from Singapore. — Ann. Mag. nat. Hist. (8) **11**: 394.

——, 1913b. A revision of the Cyprinodont fishes of the subfamily Poeciliinae. — Proc. zool. Soc. London **1913**: 977-1018, text-fig. 167-176, pl. 99-101.

SCHUSTER, W. H., 1952. A provisional survey of the introduction and transplantation of fish throughout the Indo-Pacific Region. — Proc. Indo-Pac. Fish. Counc. **3** (= for 1951): 187-196.

SCOPOLI, J. A., 1777. Introductio ad historiam naturalem: i-x, 1-506.

SILAS, E. G., 1958. Studies on Cyprinid fishes of the oriental genus Chela Hamilton. — Journ. Bombay nat. Hist. Soc. **55** (1): 54-99, text-fig. 1-6, pl. 1, 2.

SMITH, A., 1849. Illustrations of the zoology of South Africa **4** (not seen).

SMITH, H. M., 1933. Pla Salid in the Malay Peninsula. — Journ. Siam. Soc. (Nat. Hist. Suppl.) **9** (2): 259-260.

——, 1945. The fresh-water fishes of Siam, or Thailand. — Bull. U.S. Nat. Mus. **188**: i-xi, 1-622, text-figs. 1-107, pl. 1-9.

SOONG, M. K., 1963. A note on the pond-culture of Puntius javanicus Blkr. in the Federation of Malaya. — Proc. Indo-Pacific Fish. Counc. **10** (= for 1962): 170-173.

SUFI, S. M. K., 1956. Revision of the oriental fishes of the family Mastacembelidae. — Bull. Raffles Mus. Singapore **27**: 93-146, pl. 13-26.

TWEEDIE, M. W. F., 1936. A list of the fishes in the collection of the Raffles Museum. — Bull. Raffles Mus. Singapore **12**: 16-28.

——, 1940. Additions to the collection of fishes in the Raffles Museum. — Bull. Raffles Mus. Singapore **16**: 68-82.

——, 1950. Notes on Malayan fresh water fishes. No. 1 & 2. — Bull. Raffles Mus. Singapore **21**: 97-105, fig. 1, 2.

——, 1952. Notes on Malayan fresh-water fishes. No. 3-5. — Bull. Raffles Mus. Singapore **24**: 63-95, fig. 1-4.
——, 1961. Notes on Malayan fresh-water fishes. No. 9. — Bull. Raffles Mus. Singapore **26**: 178-182, pl. 22, 23.
VAILLANT, L. L., 1902. Poissons. Résultats zoologiques de l'expédition scientifique néerlandaise au Bornéo Central. — Notes Leyden Mus. **24**: 1-166, fig. 1-47, pl. 1, 2.
VOLZ, W., 1903. Neue Fische aus Sumatra. Reise von Dr. W. Volz. Vorläufige Mittheilung. — Zool. Anz. Leipzig **26** (703): 553-559.
WATTS, I. E. M., 1955. Rainfall of Singapore Island. — Malayan Journ. trop. Geogr. **7**: 1-71, fig. 1-37.
WEBER, M. & L. F. DE BEAUFORT, 1912. Fische. In: A. MAASS, Durch Zentral Sumatra **2**: 525-536, pl. 9.
—— & ——, 1913. The fishes of the Indo-Australian Archipelago **2**: i-xx, 1-404, figs. 1-151.
—— & ——, 1916. The fishes of the Indo-Australian Archipelago **3**: i-xv, 1-455, figs. 1-214.
—— & ——, 1922. The fishes of the Indo-Australian Archipelago **4**: i-xii, 1-410, fig. 1-103.
—— & ——, 1936. The fishes of the Indo-Australian Archipelago **7**: i-xvi, 1-607, fig. 1-106.
WEE, Y. C., 1964. A note on the vegetation of Singapore Island. — Malayan Forester **27** (3): 257-266.
ZUIEW, B., 1793. Bigarum muraenarum, novae species descriptae. — Nov. Act. Acad. Sci. Petropolitanae **7**: 296-391.

EXPLANATION OF PLATES

Plate 1

1, The Seletar Reservoir, viewed from the north. 2, The Sungei Seletar, west of and draining into the Seletar Reservoir.

Plate 2

1, *Rasborichthys altior* Regan, 67.5 (51.5) mm, Sungei Seletar, west of Seletar Reservoir, 8.4.1963; 2, *Rasbora bankanensis* (Bleeker), 44.7 (37.5) mm, same data; 3, *R. einthovenii* (Bleeker), 55.8 (42.3) mm, Sungei Tengeh, 20.3.1963; 4, *R. elegans* Volz, 115 (84.2) mm, Sungei Seletar, west of Seletar Reservoir, 8.4.1963.

Plate 3

1, *Cyclocheilichthys apogon* (Valenciennes), 75.8 (52.5) mm, MacRitchie Reservoir, 23.2.1963; 2, *Puntius lateristriga* (Valenciennes), 89.1 (68.2) mm, MacRitchie Reservoir, 3.3.1963; 3, *P. semifasciolatus* (Günther), 50.0 (38.0) mm, Sungei Seletar, outlet from Seletar Reservoir, 4.1.1964.

Plate 4

Acantophthalmus muraeniformis De Beaufort, Sungei Seletar, west of Seletar Reservoir, 8.4.1963, showing variation in colour pattern.

Plate 5

1, *Acantophthalmus kuhlii* (Valenciennes), 70 (63) mm, Bleeker collection, photographed under ultra-violet light to show up faded markings; 2-6, *A. kuhlii* (Valenciennes), Sungei Seletar, west of Seletar Reservoir, 8.4.1963; 7, *Noemacheilus selangoricus* Duncker, 71.5 (51.8) mm, same data.

Plate 6

1, *Silurichthys hasseltii* Bleeker, 100 (75.4) mm, Sungei Seletar, west of Seletar Reservoir, 8.4.1963; 2, *Mystus gulio* (Hamilton), 130 (100) mm, Sungei Tengeh, 20.3.1963; 3, *Glyptothorax major* (Boulenger), 58.0 (43.2) mm, Sungei Seletar, west of Seletar Reservoir, 3.1.1964; 3, *Trichopsis vittatus* (Cuvier), 52.5 (34.1) mm, Sungei Seletar, north of Seletar Reservoir, 4.4.1963.

Plate 7

1-6, *Mollienisia sphenops* (Valenciennes), Kampong Pinang, Sungei Serangoon, 7.3.1963; 7, *Nandus nebulosus* (Gray), 62.5 (47.0) mm, MacRitchie Reservoir, 3.3.1963.

Plate 8

1, *Betta pugnax* (Cantor), 91.8 (64.9) mm, Sungei Seletar, north of Seletar Reservoir, 4.4.63; 2, *Betta splendens* Regan, 36.4 (27.7) mm, Sungei Kallang, outlet from Peirce Reservoir, 3.1.1964; 3, *Trichopsis vittata* (Cuvier), 52.5 (34.1) mm, Sungei Seletar, west of Seletar Reservoir, 8.4.1963; 4, *Channa micropeltes* (Cuvier), juvenile, 192 (157) mm, Botanic Gardens Lake, 25.5.1960.


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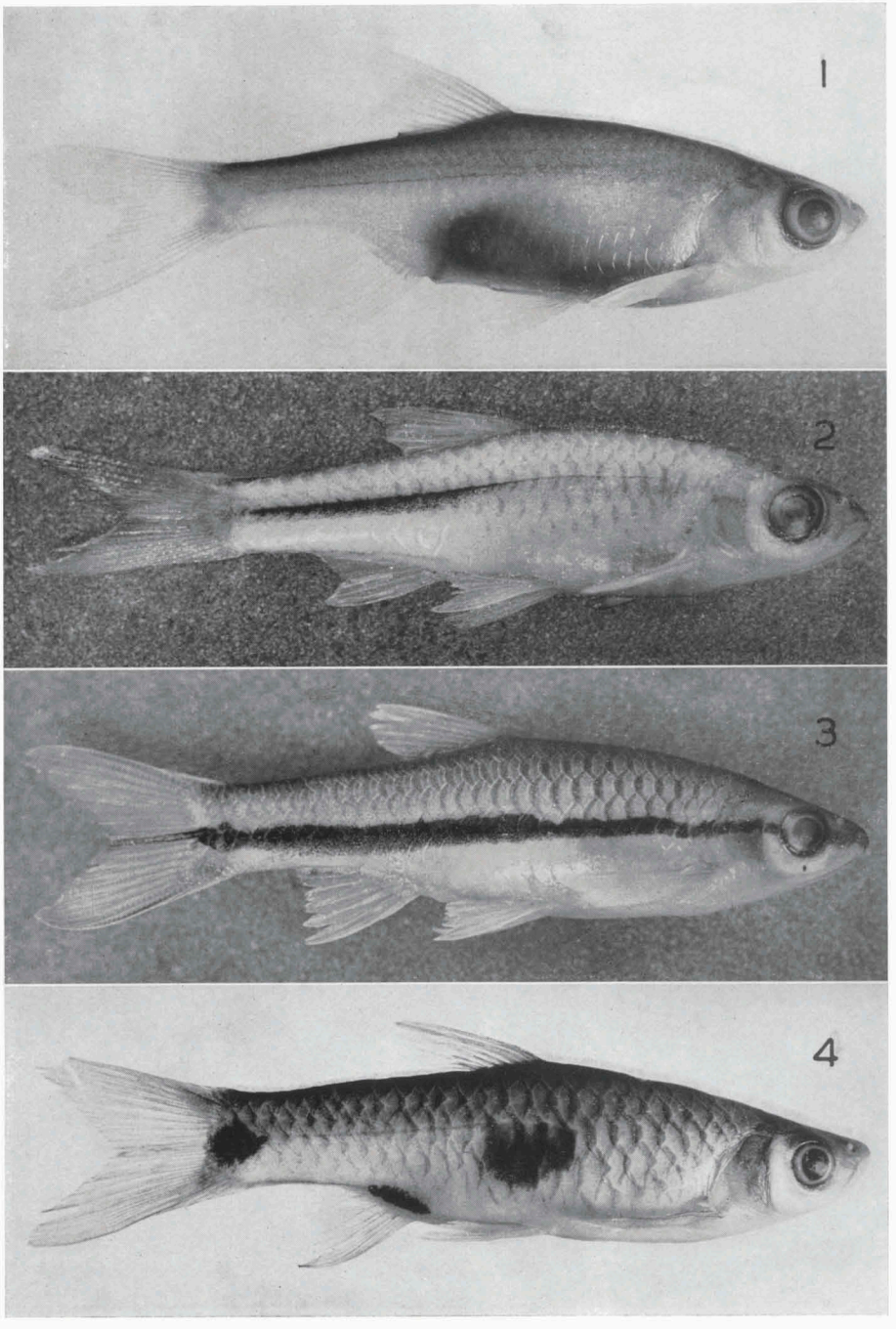
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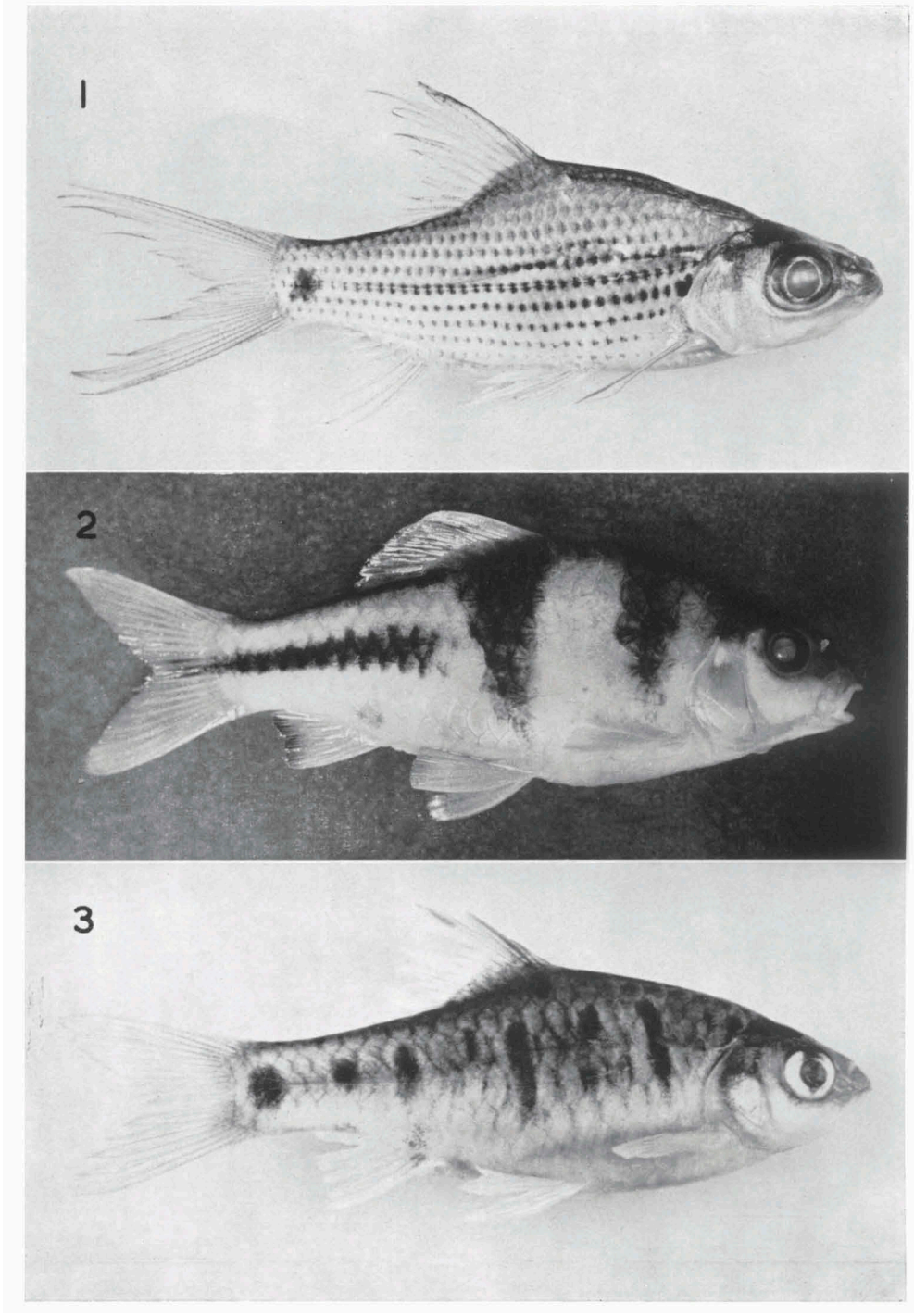
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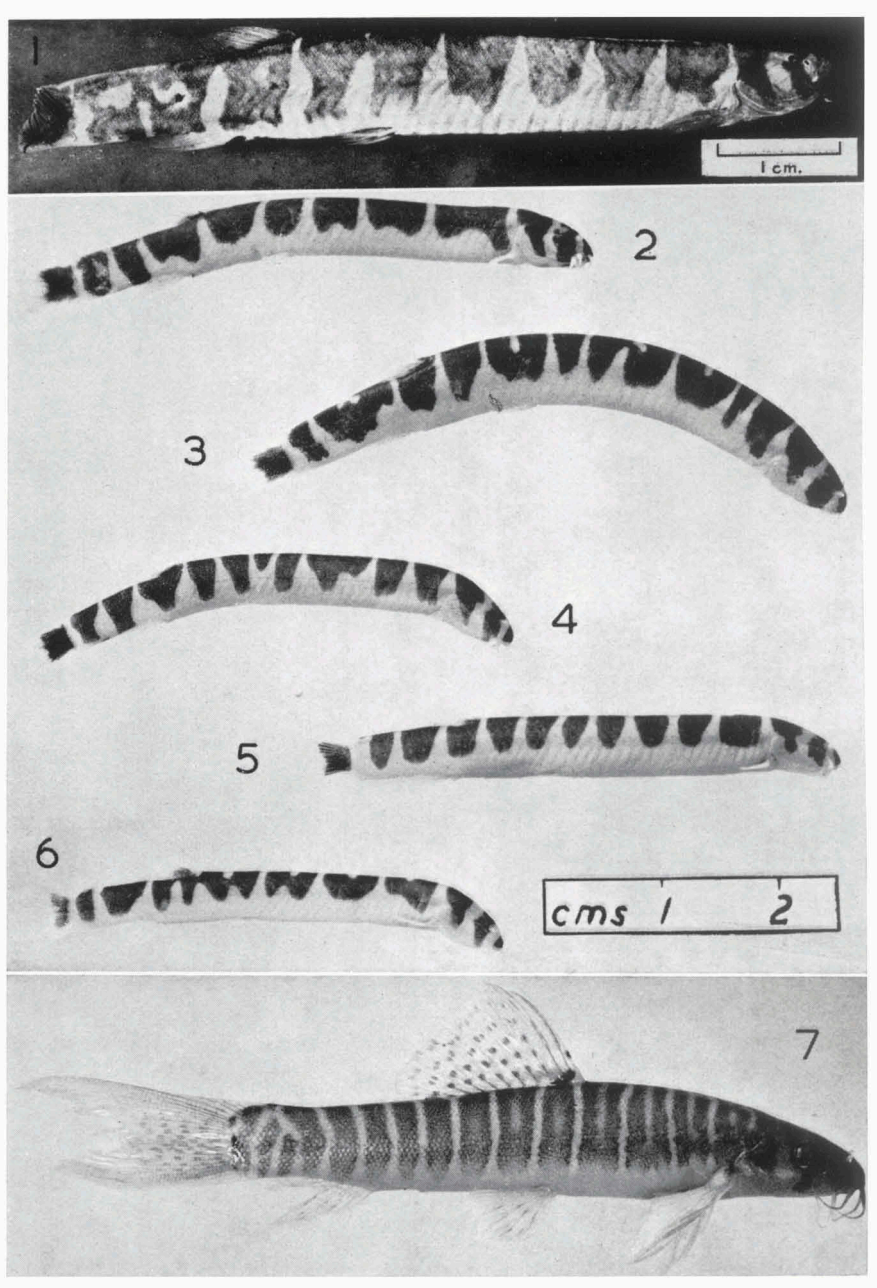
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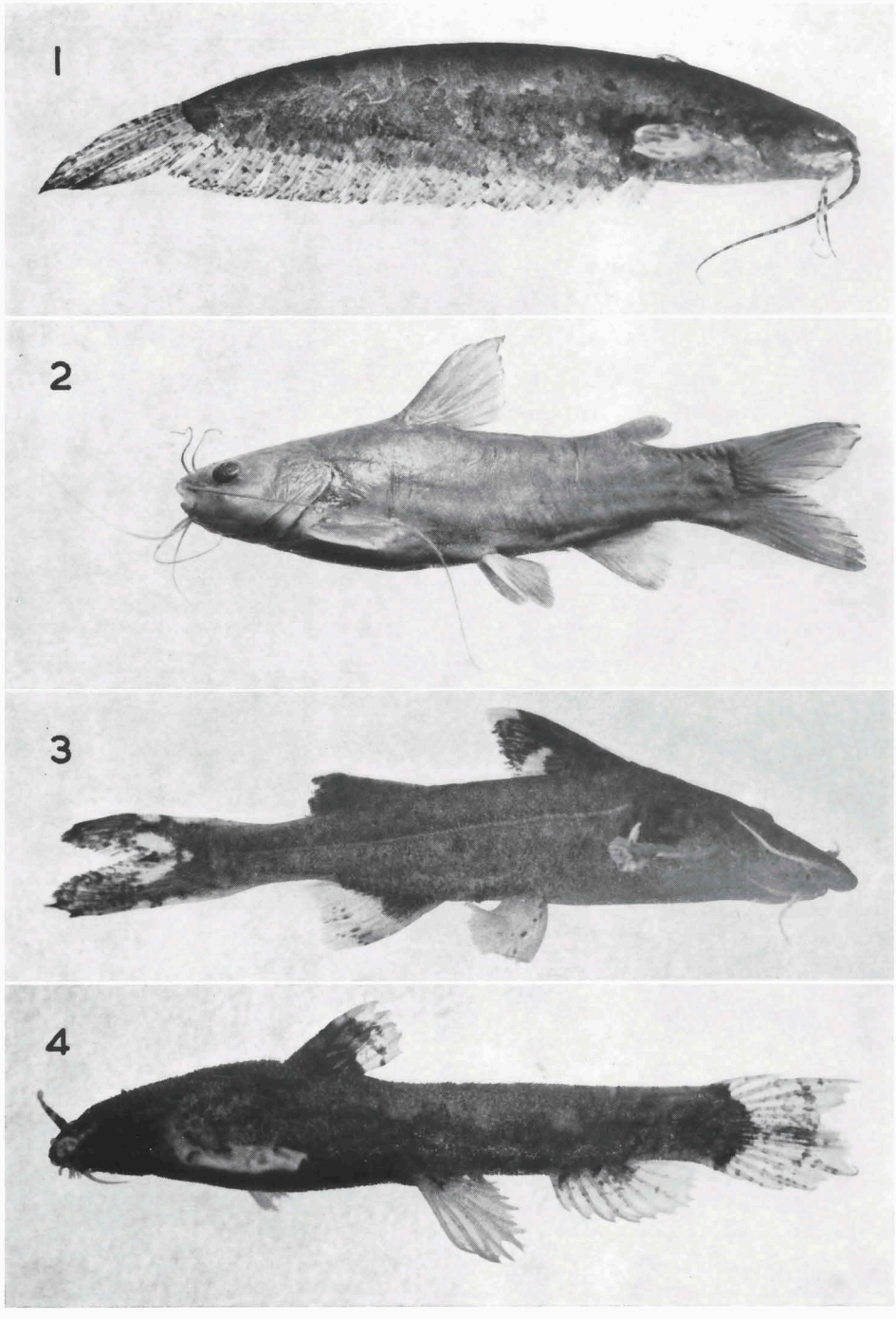
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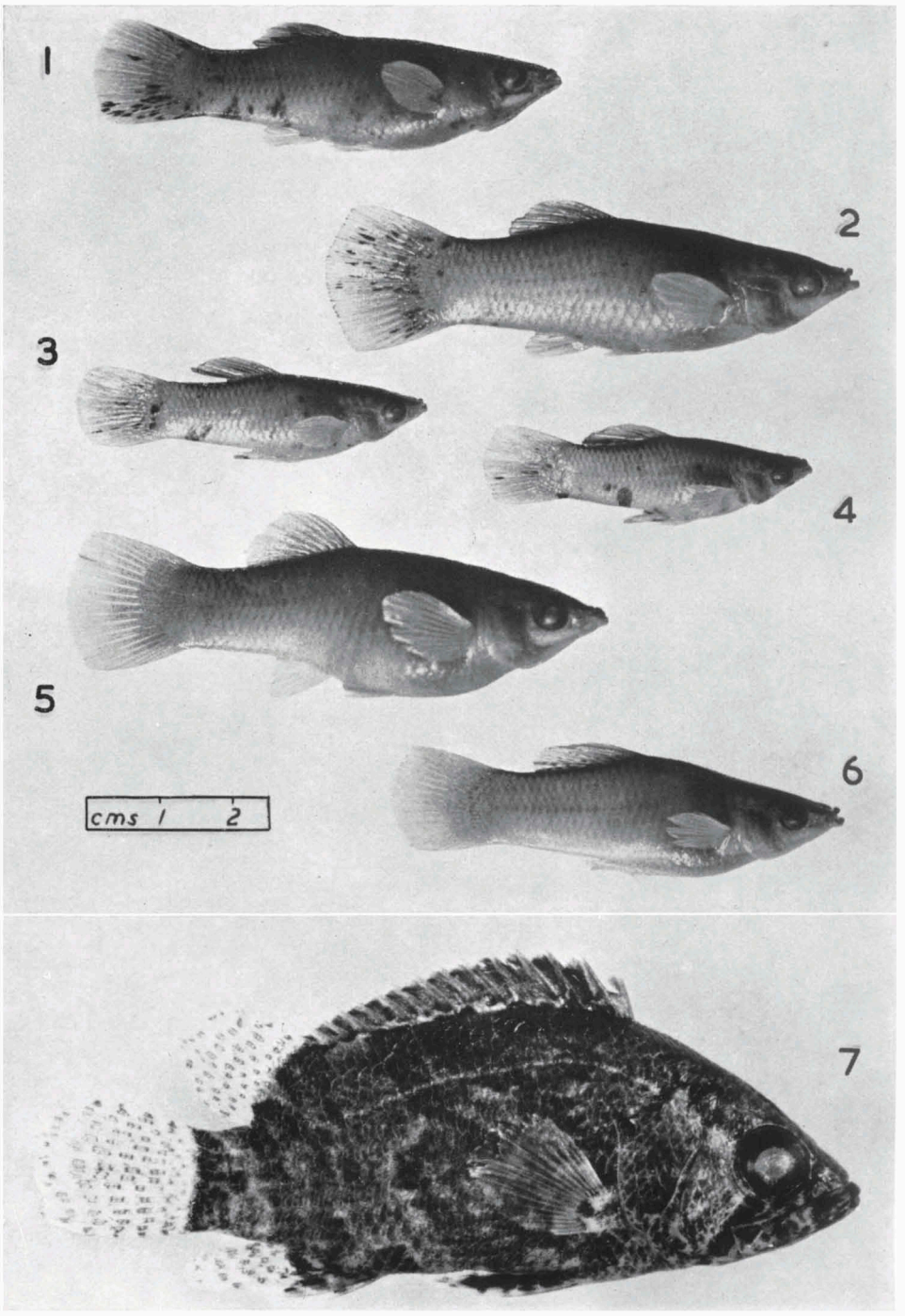
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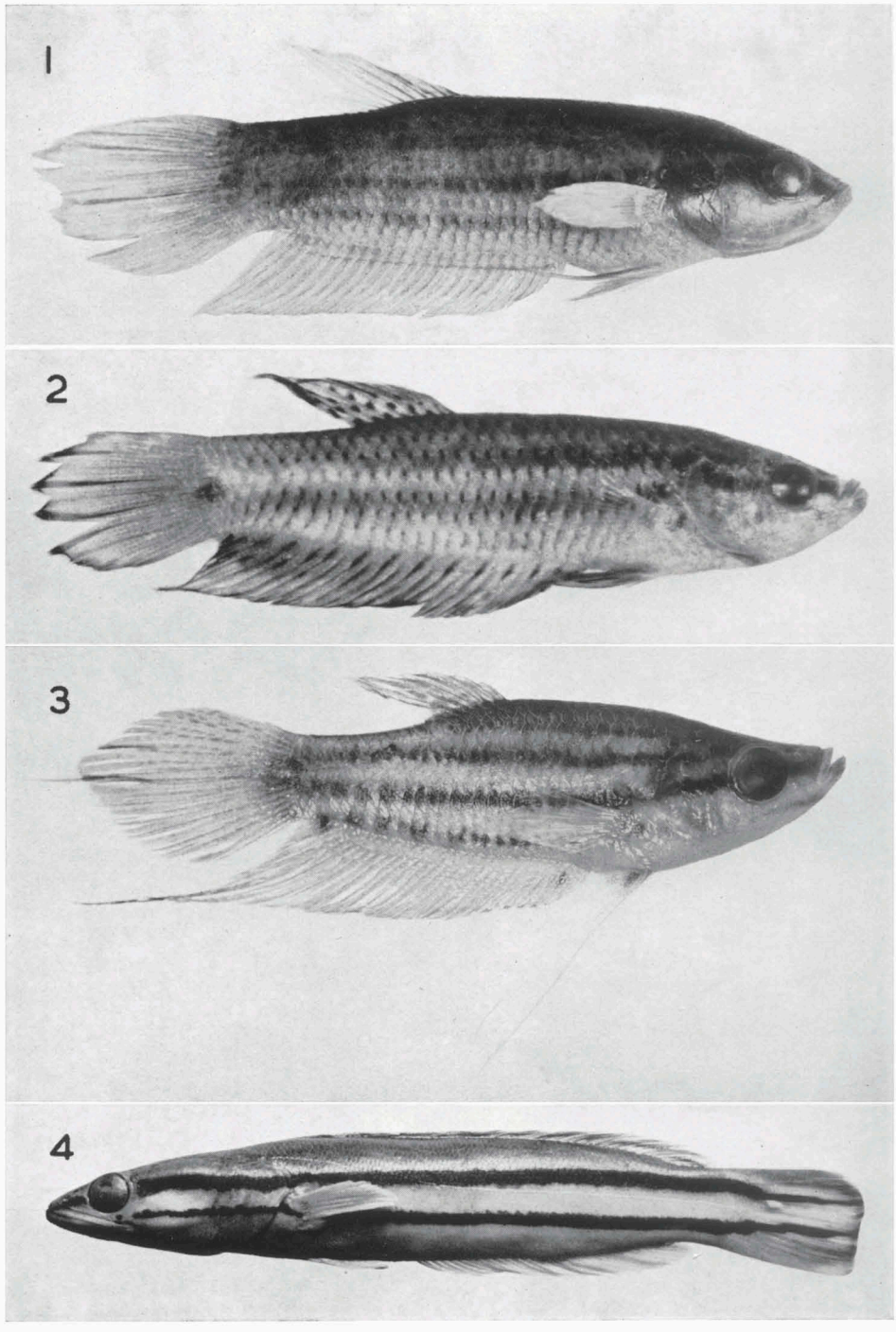
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