

XXIX.--NATURAL AND ECONOMICAL HISTORY OF THE GOURAMI.*

BY THEODORE GILL.

OSPHROMENUS GORAMY.

Synonymy.

- Osphromenus goramy*, *Lacépède*, Hist. Nat. Poiss., III, 117, pl. 3, fig. 2, 1802; *Gill*, Am. Sportsman, IV, 66, 369, 1874.
- Trichopus goramy*, *Shaw*, Gen. Zool., IV, 388, pl. 55, 1803.
- Osphromenus olfax*, *Comm. in Lacépède* Hist. Nat. Poiss., III, 117, 1802; *Hardwicke*, Zool. Journ., IV, 309, pl. 36; *Cuv. & Val.*, Hist. Nat. Poiss., VII, 377, pl. 198, 1831; *Rich*, Brit. Ass. Rep. (Ich. China and Japan), 1846, 251; *Bleeker*, Vissch. Doolh. Kieuw., (Verhand. Batav. Genootschap, XXIII, p.) 10, 1850; *Cantor*, Cat. Malayan Fishes, 88, 1850; *Val.*, Règne An., par *Cuv.*, éd. par disciples, Poissons, pl. 73, figs. 1, 3; *Günther*, Cat. Acanth. Fishes B. M., III, 382, 1861; and various authors, Bull. Soc. Zool. d'Acclim., infra cit., 1860-74; Zool. Garten, etc.
- Trichopodus mentum*, *Lacépède*, Hist. Nat. Poiss., III, 125, pl. 3, fig. 2, 1802. (Based on a bad figure by M. Céré.)
- Trichopus satyrus*, *Shaw*, Gen. Zool., IV, 391, pl. 35, 1803. (A substitute for *Trichopodus mentum*.)
- Osphromenus satyrus*, *Bleeker*, Vissch. Doolh. Kieuw. (Verhand. Batav. Genootschap, XXIII), 10, 1850.
- Osphromenus notatus*, *Kuhl & Van Hassalt*, in *Cuv. & Val.* Hist. Nat. Poiss., VII, 386, 1831.
- Osphromenus vittatus*, *Kuhl & Van Hassalt*, in *Cuv. & Val.* Hist. Nat. Poiss., VII, 387, 1831.

The preceding are only the more important references to the species; others will be found in the foot-notes and in the subsequent text.

A—NATURAL HISTORY.

PREFATORY.

The great interest which has been excited by the gourami, and the numerous attempts to acclimatize or introduce it into distant countries will doubtless render welcome a somewhat elaborate article on the species, and a practical application of the lessons of experience in connection with it.

The literature on the fish is very voluminous, and numerous articles have been written upon it; in the Bulletin de la Société Impériale Zoologique d'Acclimatation alone, there are about one hundred references in the indices to articles and notices in the various volumes. These and many other papers have been consulted, and our readers are furnished with the results of experiments and observations to date. Especially

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are acknowledgments due to the articles cited in the foot-note;* to Colonel Nicolas Pike, our late very efficient consul to Mauritius, to whom the Smithsonian Institution is indebted for many specimens; and to extracts from an article of Mr. Clarke.

NAME.

Osphromenus goramy is the true and first-published scientific name given to the celebrated gourami, and was conferred by Lacépède, who accepted a manuscript-name devised by Commerson for the genus, and proposed a modification of the best-known vernacular name for the species. *Osphromenus olfax*, a name suggested in the manuscript of Commerson, was published by Lacépède as a synonym. The name *Osphromenus* was bestowed by Commerson by reason of an erroneous idea which he entertained, (that the labyrinthiform apparatus was an adaptation for smelling,) and was derived from the Greek *οσφρομαί*, to smell. Commerson's idea arose from his perception of some analogy in appearance between the labyrinthiform apparatus and the ethmoid bone of man.

FORM, ETC.

The gourami has an oblong-oval form. The snout is produced, and the forehead in front of the eyes concave but behind convex, and it becomes more and more so with advancing age, (as will be noticed by comparison of figures of young and old here given). The lateral line is continuous from the shoulder to the base of the caudal fin. The dorsal fin is considerably smaller than the anal; the former commencing far behind the head, ending some distance in advance of the caudal, and furnished with eleven to thirteen spines, and eleven or twelve articulated rays; the anal commencing near the base of the ventral, extending to and connected with the base of the caudal fin, and supplied with nine to

* RUFZ DE LAVISON. *Sur quelques tentatives d'acclimatation du gourami (Osphromenus olfax) dans divers pays.* <Bulletin Soc. Imp. Zool. d'Acclim. (Paris), viii, 1861, pp. 392-403.

VINSON (Dr. Auguste). *De l'acclimatation du gourami à l'île de la Réunion, et des moyens d'acclimater ce poisson en Algérie et dans le midi de la France.* <Bulletin Soc. Imp. Zool. d'Acclim. (Paris), viii, 1861, pp. 509-514, 541-546.

BARTHÉLEMY-LAPOMMERAYE. *Nouvelle tentative d'introduction du gourami d'île Maurice en France, entreprise par M. Liénard.* <Bulletin Soc. Imp. Zool. d'Acclim. (Paris), x, 1863, pp. 739-740.

COSYRÉ. *Instruction pour le transport des gouramis.* <Bulletin Soc. Imp. Zool. d'Acclim. (Paris), 2^e série, ii, 1865, pp. 76-80.

BARTHÉLEMY-LAPOMMERAYE. *Sur l'introduction récente du gourami en France, et instructions à cet sujet. Lettre adressée à M. le président de la Société Impériale d'Acclimatation.* <Bulletin Soc. Imp. Zool. d'Acclim. (Paris), 2^e série, ii, 1865, pp. 195-203.

DABRY (P. Thiersant). *Note sur le transport des gouramis.* <Bulletin Soc. Imp. Zool. d'Acclim. (Paris), 2^e série, v, 1868, pp. 591-592.

— *Histoire naturelle du gourami.* <Bulletin Soc. Imp. Zool. d'Acclim. (Paris), 2^e série, viii, 1870, pp. 671-688.

twelve spines and nineteen to twenty-one branched rays; the caudal fin is rounded behind; the ventrals have five rays, (besides the spine,) and the one next to the spine is much prolonged, especially in the young. The opercular bones are unarmed, having neither spines nor serratures. The color is brownish, with faint oblique bands in the young, but unicolor in the adult, with a blackish spot at the base of the pectoral fin.

GEOGRAPHICAL RANGE.

The gourami has been an inhabitant from time immemorial of the fresh waters of Cochin China, on the mainland of Farther India, as well as the islands of Java, Madura, Sumatra, and Borneo, and may, therefore, be presumed to be indigenous to all those localities. It is also found in Malacca and the adjoining small island Penang, or Prince of Wales Island, but is said to have been introduced into those places from Cochin China. The history of its successful introduction into the islands of Mauritius and Bourbon (or Réunion) is a matter of record and well known. Attempts have likewise been made to introduce it into the West Indian island Martinique, the French South-American colony Cayenne, the Cape of Good Hope, Australia, Egypt, and France, but hitherto without satisfactory results. Details respecting these attempts will hereafter be given.

SIZE.

The gourami is potentially almost one of the largest fresh-water fishes found in any part of the world, if we may credit the statements of certain authors; for it has been reported (by Baron de Roujoux) that in their original habitat they sometimes attain the length of 5 or 6 feet and a weight of 50 kilograms, that is, somewhat more than 110 pounds. It must be remembered, too, (and will be recognized by reference to the illustrations,) that they have bodies deep and stout in proportion to their length. While it is barely possible that they may occasionally, under exceptional conditions, attain such a size, they generally fall far short of it; and at the islands of Bourbon and Mauritius, they have never been found even approximating that size; according to Dr. Vinson, at Bourbon they rarely exceed 8 to 10 kilograms, (*i. e.*, 17.63 to 22.04 pounds,) although they occasionally attain a weight of 16 kilograms, (*i. e.*, 35.27 pounds.) The largest that Dr. Vinson had seen measured 92 centimeters (*i. e.*, about three feet) long, and 38 centimeters (*i. e.*, 15 inches) in depth. They are even considered very large if they weigh 12 to 14 pounds and measure about 2 feet in length. They probably continue to grow indefinitely to some extent under favorable conditions, and hence, if they have really been seen of the size claimed, they may have been of great age.

GROWTH AND AGE.

The fry, or newly-hatched, is, of course, very small, and proportioned

to the size of the egg (about half an inch, more or less);* at the end of the first year, it has grown to a length of about 4 inches; in the second, to about 7 or 8; and in the third, to about 10 or 11. In the third year, it is sexually developed and commences to spawn. Their growth, however, continues indefinitely, conditioned by the nature of their home. If their quarters are confined and the water cold, they increase slowly and do not thrive; but if the water is warm, well aerated, and extensive, and otherwise appropriate, they flourish and increase rapidly. They continue to grow for years, and attain a very considerable age; and in the island of Martinique, the last introduced therein was killed for the table twenty-seven years after its arrival, and at the time of its capture measured about a meter (or 39 inches) in length.

STATION AND TEMPERATURE.

The gourami, in its native country, (Anam or Cochin China,) is found in brackish as well as fresh waters, and even prefers the former, according to M. Pierre, the director of the Zoological and Botanical Garden of Saigon, (see Bulletin Imp. Zool. Soc. d'Acclim., 1869, p. 45). According to other authors, it is found in running streams, lakes, and ponds, but flourishes best in the last, especially when they are stocked with aquatic plants and have deep and sheltered holes to which the fishes can retreat, and which they especially avail themselves of in cold weather. The countries in which it thrives are in the intertropical belt, with an annual mean temperature, says M. Dabry, of about 24° to 26° centigrade, (*i. e.*, $75^{\circ}.20$ to $78^{\circ}.80$ Fahrenheit,) and with the mean of the winter not much less than 19° centigrade, ($66^{\circ}.20$ Fahrenheit,) while the coldest weather is rarely below 14° or 15° centigrade ($57^{\circ}.20$ to 59° Fahrenheit) above freezing. As the temperature of a country is an all-important element to be taken into consideration in estimating the probabilities of success in attempts to introduce this fish, the following table of the temperatures of the year and its several seasons in the countries in which the gourami is now found is reproduced from Mr. Dabry's article on that fish. (Bulletin Imp. Zool. Soc. d'Acclim., 1870, p. 676.) The first column of figures in each double column represents the temperature in degrees centigrade, as given by Mr. Dabry, and the second the equivalents in degrees of the Fahrenheit thermometer.

*According to Mr. Clark, the newly-hatched are less than half an inch, and according to Mr. Dabry 2 to 4 centimeters, (*i. e.*, about an inch, more or less,) long; the former statement appears to be the most probable.

TABLE OF ATMOSPHERIC TEMPERATURES OF NATIVE AND FOSTER COUNTRIES OF THE GOURAMI.

Cities and countries.	Annual mean.		Winter mean.		Spring mean.		Summer mean.		Autumn mean.		Mean of coldest month.		Mean of warmest month.		Greatest cold.		Greatest heat.		Authorities.
Port Louis (Mauritius).....	24.9	76.82	21.6	70.88	23.2	74.84	28.1	82.38	26.0	78.80	21.1	69.92	22.4	85.12	19.4	66.92	32.7	90.88	Martins, in Kempfz.
St. Denis (Réunion).....	25	77	22.6	72.68	24.9	76.82	26.7	80.06	25.6	78.08	22.1	71.78	27.1	80.72	15.1	59.1			Martins, Vinson.
Batavia.....	26.8	80.4	26.2	79.16	26.8	80.24	27.2	80.96	27.1	84.32	27.9	82.92	27.8	82.04					Martins, Bergham.
Trincomalee (Ceylon).....	27.4	81.32	25.7	78.26	23.4	82.12	22.9	84.02	22.2	84.56	25.4	77.72	22.2	84.56					Martins, Bergham.
Penang.....	23.3	82.94																	Bergham.
Malacca.....	30.2	86.36																	Bergham.
Sumatra.....	29.5	85.10																	Bescherelle.
Borneo.....	28	82.40															35	95	
Havana.....	25	77	22.6	72.68	24.6	76.28	29.4	84.92	25.6	78.08	21.2	71.42	27.5	81.50					Bescherelle.
Cayenne.....	25	77					30	86			20	68	32	80.60			35	95	Martins.
Martinique.....	25	77													17	62.60	35	95	Charvallon.
Surinam.....	25	77											32	80.60					Bescherelle.

Such are the temperatures of the regions where (and where only) the gourami flourishes; the table may be allowed, in the main, to speak for itself, but a slight commentary may serve to enforce its significance. The island of Bourbon, (or Réunion,) in the coldest months of the year, (June, July, and August,) near St. Denis, has a temperature not lower than 57° to 59° , (Fahrenheit,) and in the warmest months (January and February) the thermometer indicates a temperature of about 80° near the level of the sea, and at the heights in the vicinity more than 62° . And yet gouramis kept at such elevations, although they lived, and for about thirty years, never propagated, but when transported to the streams of the lowlands soon increased and multiplied; and as there was no other apparent cause, the barrenness in the elevated regions was attributed, and apparently with justness, to the insufficient warmth. Let it then be borne in mind that a temperature of not less than 57° retarded the growth and prohibited the multiplication of the gourami.*

Such, at least, was the general inference from the observed facts and experience respecting the fish in the isle of Bourbon. So sensitive, too, are they to cold, that during the cold spells in Bourbon and Mauritius, they bury themselves in the mud or take shelter in the weeds. So fond, on the other hand, are they of heat and sun-light, that in the hottest days of summer they bask in the sun, and, ascending to the surface, protrude their mouths and swallow atmospheric air. The last characteristic, however, is doubtless a concomitant of their organization, in common with the other members of the family.

FOOD.

The gourami is omnivorous in its appetite, taking at times flesh, fish, frogs, insects, worms, and many kinds of vegetable; and on account of its omnivorous habit, it has been called by the French colonists of Mauritius *porc des rivières*, or "water-pig;" it is, however, essentially a vegetarian, and its adaptation for this diet is indicated by the extremely elongate intestinal canal, which is many times folded upon itself. It is said to be especially fond of the leaves of several araceous plants belonging to the genera *Caladium*, *Arum*, and *Pistia*; but it also devours, with not much inferior relish, cabbage, radish, carrot, turnip, and beet leaves, lettuce, and most of the wild plants which grow in the water, and it can secure for its use the leaves of plants that grow on the banks and a slight distance out of the water. It also takes wild rice, maize, potatoes, arrow-root, manioc, bread, and analogous articles.

* It has even been asserted that a fall of the temperature to 66° (Fahrenheit) caused death on the way from Mauritius to Australia; and in the Museum of Natural History of Paris, in a decrease to 59° , death commenced. Even if some other conditions concurred to produce death, the circumstances of their death without any other assignable cause show how delicate they are.

MOVEMENTS.

In its movements the gourami is slow, and is said to swim along with a certain "majesty of demeanor," (majesty probably being associated with slowness); it rarely hastens toward a meal, but proceeds slowly and leisurely onward. If, however, aught frightens the fishes, or they are disturbed, they at once show that swiftness is not incompatible with their organization, and they dart away with great velocity. They are also possessed of great saltatorial agility, and if confined in narrow quarters are prone to leap out, and when pursued they will also attempt to escape by leaping out of the water. This is manifested when they are fished for with nets, and, according to Colonel Pike, unless the net is held a foot or two above the water, they will leap over it to a distance of several feet outside, and even when caught and laid on the ground, unless attended to, they will repeatedly leap upward and "batter themselves to pieces," for they are very tenacious of life.

SPAWNING AND NESTING.

In the sexual relations, and the care which it takes of its eggs, the gourami resembles the sunfishes of temperate North America and the cichlids of tropical America and Africa. The spawning-season falls in the autumn (March and April) and spring (September and October) of the transequatorial islands of Mauritius and Bourbon. When that time has come, the males and females pair off, and each pair select a suitable place wherein they construct a rude nest. "Like all intelligent animals, they will only propagate when insured a suitable temperature for the eggs and young, a fit retreat for the building of the nest, with plants and mud for its construction, and aquatic plants suitable for the food of the young." The bottom selected is muddy, the depth variable within a narrow area; that is, in one place about a yard, and near by several yards deep. They prefer to use for the nest tufts of a peculiar grass, (*Panicum jumentorum*,) which grows on the surface of the water, and whose floating roots, which rise and fall with the movements of the waters, form natural galleries, under which the fish can conceal themselves. In one of the corners of the pond, among the plants which grow there, the gouramis attach their nest, which is of a nearly spherical form, and composed of plants and mud, and considerably resembles in form those of some birds.

The nests, of course, vary in size in proportion to the fishes, but the usual size is somewhat less than a man's hand in length, (about 5 or 6 inches). The fishes are employed some five or six days or a week in building, and their task is rendered easier, when the pairing-season has arrived, by placing in the water, almost at the surface, branches of bamboo, (*Bambusa arundinacea*), to which are attached bundles of fine dog's-tooth grass. The gouramis take this grass, and with it form their nests in the branches of the submerged bamboo, in a manner analogous to

that with which the common silk-worm avails itself of the branch which is presented for it to make its nest on. When the nest is completed, the female deposits her eggs, which in a moderate-sized individual amount to about 800 to 1,000. After the eggs have been deposited and fecundated, and while they are hatching, the parents remain near, jealously guarding them, and rushing with vehement fury at any ordinary intruder near their domains, and thus they continue to guard the young for a time after they are hatched.

YOUNG.

The eggs are soon hatched, (within a fortnight, according to Mr. Clark,) and in the nest the young find (1) a refuge where they are free from a thousand dangers by which they would be otherwise threatened during the first days of their life; and (2) in the macerated vegetable matter of which their nest is partly composed, they obtain their earliest food, and that which is most suitable to them in their most delicate condition. Soon, however, they make short excursions from the nest, but under the guidance of the parent-fish, who is prepared to give them aid in case of need. They do not soon disperse, but keep together in shoals. The young, it is said, for some time retain the yelk-bag, and the ventral fins are very conspicuous, much exceeding in length the fish; and as they grow only to a limited extent *pari passu* with the fish, they gradually lose their relative length, and the difference between even the adolescent fish and those of a more advanced age is considerable, as will be perceived by reference to the illustrations.

FLESH.

The gourami has always been held in high esteem for the excellence of its flesh, at least among the Europeans and colonists. Commerson, to whom we are indebted for our first acquaintance with the fish, in rapture declared that he had never tasted among either salt or fresh-water fishes any more delicious, ("*nihil inter pisces tum marinos tum fluviatiles exquisitius unquam degustavi*,") and subsequent gourmands have echoed the sentiment. Its flesh is, according to several authors, of a light-yellow straw-color, firm, and easy of digestion. They vary in value according to the nature of the waters inhabited; those taken from a rocky river being much superior to those from muddy ponds, but those dwelling at the mouths of rivers, where the water is to some extent brackish, are the best of all. Again, they vary with age, and the large overgrown fishes are much less esteemed than the small ones; they are in their prime when three years old. Dr. Vinson says the flavor is somewhat like that of the carp, and, if this is so, we may entertain some skepticism as to its superiority; but the unanimous testimony in favor of its excellence naturally leads to the belief that the comparison is unfair to the gourami.

B—THE INTRODUCTION AND ATTEMPTS TO INTRODUCE THE GOURAMI INTO FOREIGN COUNTRIES.

AUTHORITIES.

In this chapter are given, in more or less detail, accounts of the attempts to introduce the gourami into various countries. These have been chiefly compiled, as before indicated, from the "*Bulletin de la Société Zoologique d'Acclimatation*," and to enable ready reference to be made for verification or further details of the facts here mentioned, references are added in parentheses, the larger numbers (e. g., 1870) indicating the year of publication in the Bulletin, and the smaller numbers the pages of the annual volumes.

EAST INDIAN ISLANDS.

No other fish has been the subject of such earnest and oft-repeated attempts to introduce and acclimatize in foreign countries as the gourami. Originally, it is claimed, (by Mr. Dabry,) peculiar to Cochin China and the neighboring countries, it is said to have been introduced at the commencement of the last century in Java, and thence into the neighboring islands Madura, Penang, Borneo, Sumatra, and Molucca. No positive data, however, have been published—or, at least, are known to the writer—of the details of those efforts, and the accounts are therefore somewhat apocryphal.

ISLAND OF MAURITIUS.

The first well-authenticated transportation and introduction of the fish into a foreign country were into the island of Mauritius, (then called "Isle of France,") in 1761, at that time under the dominion of the French.

In that year, several naval officers—chief of whom were Captains De Surville, Joannis, and De Maguy—took some fishes to the island, but, it is said, rather for the gratification of the sight and for exhibition in vases than with reference to its eventual naturalization in the island; these were confided to Céré, (who has been accredited with the introduction of the goldfish into France,) who was at the time mentioned commander of the French troops in the island, and he especially interested himself in the introduction of the species. The fish placed in the ponds propagated; some escaped into the contiguous streams, and the species had become already domiciliated in the island when Comber-son, the naturalist-traveler, visited it in 1770. According to Comber-son, the fishes introduced had been brought from China; but according to others, and especially M. Carpentier-Cossigny, (and with greater probability,) they were carried from Batavia.

ISLAND OF BOURBON OR RÉUNION.

The gourami was next introduced into the neighboring island of Bourbon or Réunion in 1795, through the efforts of M. Desmanières,^a

resident of the island, and who imported specimens from Mauritius. His experience has been given by M. Vinson, and, on account of its important bearing on the subject of its acclimatization in other lands, is repeated in his own words. M. Desmanières had "on his estate of Bellevue, situated on the upland of the quarter Sainte-Suzanne, a magnificent natural body of water, with two islets abounding in aquatic plants. Everything appeared to be favorable for the raising of the gourami, but the low temperature at this part of the island had not been taken into consideration. The fishes lived, but did not propagate. M. Desmanières at first thought that the large size of the pond might be the cause of this, and he caused to be made two vivaria, which may yet be seen, and which were supplied by the large pond. In these vivaria, the gouramis were placed; but the result was still unsatisfactory. He received from the isle of France additional fishes, but even then had no success. Finally, having transferred his fishes into a vivarium near the sea-shore, he succeeded in inducing propagation. This experiment had, however, taken thirty years; and during this time success in propagating the species in the island had become despaired of. As has been seen, acclimatization often depends on causes very simple in appearance, but which are only discovered after a long time."

In other words, in a place where in the coldest months the temperature does not ordinarily fall below 67° Fahrenheit, the species did not thrive and propagate. In the warmer waters of the lowland, however, it immediately began to multiply, and is now abundant; it is the object of regular care and cultivation in vivaria or ponds, and the source of a regular income; the wealthy proprietors or planters of some districts have, too, each their own private ponds.

WEST INDIES.

The next earnest attempt to introduce the species into a distant country was made at the instance of M. Moreau de Jonnes, who, in 1818, induced the "minister of marine" of France to order the transportation of specimens to the French possessions in the West Indies. Accordingly, in April, 1819, a hundred small fishes were intrusted to the care of M. de Mackau, captain of a storeship, *Le Golo*, and the interest and zealous care manifested by that officer were rewarded by the comparatively slight loss of only twenty-three fishes during the entire voyage to the West Indies; and when it is recalled that a slight blow, an abrasion of the sides, or loss of a scale, may cause death, and the difficulty of adjusting the supply of fresh water, &c., to their necessities is taken into consideration, the small percentage of the loss must be considered as remarkable. Of the seventy-seven which remained alive, twenty-six were distributed to the islands of Martinique and Guadeloupe each, and twenty-five to the colony of Cayenne. The fortunes of the strangers in their new places of abode were various. Cuvier and

Valenciennes, in the seventh volume of their "*Histoire Naturelle des Poissons*," published in 1831, acknowledge the reception of one of the fishes originally taken from Isle-de-France to Cayenne. The belief that their acclimatization in America had succeeded has even found utterance in the statement as a fact which has obtained currency in several publications. Although the fishes introduced continued to live, none seemed to be fruitful in their new quarters, and there is no published evidence that any individuals of the species are now living in America. We have the fullest and most authentic details concerning its fate in Martinique.

The little fishes, on their arrival at Martinique, were placed in a large basin of fresh water; the largest of them was only about three French inches long. Some months after, they were transferred to a small pond in the botanic garden of Saint Pierre; all were still alive and healthy, and had attained a length of from 10 to 12 inches. Their subsequent increase was, however, much less rapid, and after six years, they had little more than doubled that length, for in 1827 the largest had only gained a length of from 24 to 27 inches. The subsequent rate of increase was still less rapid, as might naturally be supposed; and the last survivor of the original twenty-six, which was served on the table in 1846, twenty-seven years after its arrival at Martinique, measured about a meter, or somewhat more than 39 inches in length. None of these fishes had been able to propagate their race in the island during all this time. Five years after their introduction, a formal announcement was indeed made that numerous young gouramis had made their appearance in two broods, at intervals of only six months; but it was soon discovered that the supposed young gouramis were native fishes that had gained entrance into the preserves of the gouramis. The sudden revulsion from the hope and high expectations to which the apparent success had given rise, to chagrin and despair, unhappily reacted on the poor fishes, and was doubtless enhanced by the ridicule which the exposure of the nature of the discovery entailed on the historian of that discovery, and which engendered a proverbial expression in the island. The prospect of propagating the gouramis appearing hopeless, one after another was caught and served up on the table of the governor when a distinguished guest was to be entertained, and thus was the last disposed of in 1846. Although equally full details have not been published concerning those introduced into Guadeloupe and Cayenne, no greater success appears to have rewarded the attempts to propagate the species.

As it has repeatedly been affirmed (1867, 551) that the gourami has been acclimatized in, or is a native of, South-American waters, it may be well to state here that there is no other foundation for such statements than the existence in those waters of fishes belonging to the family of icthlids, which have some superficial resemblance to the gourami.

FRANCE.

The most careful and persevering attempts have been made to introduce the gourami into France, and it was the subject of the most zealous efforts for a number of years on the part of the Acclimatization Society of Paris. In 1862 and 1867, prizes were offered (for the introduction and acclimatization of a new food-fish into the fresh waters of France, from Algeria, Martinique, or Guadeloupe) of five hundred francs for any fish except the gourami, and double the amount in case of that species, the competition being open under the last offer until the 1st of December, 1870. From the numerous references in the bulletin of that society, (*Bulletin de la Société Impériale Zoologique d'Acclimatation*,) the following account is drawn up, the authorities therein for the statements of facts being inclosed in parentheses.

As early as 1804, it seems an attempt had been made to introduce the fish into France. In that year the celebrated Peron, on his return from the voyage of circumnavigation in the corvette *Le Géographe*, stopped at the island of Mauritius, and there took on board a hundred gouramis, but these all died in the Mozambique Channel, partly in consequence of the bad quality of the water with which the receptacle containing them was renewed and partly on account of the fall in the temperature, (1859, p. 339; 1861, pp. 25-26*).

Nearly at the same time another unsuccessful attempt was made by Bailli de Suffren, (1861, 545,) and he also recommended that it should be attempted by stages, that is, by acclimatizing them in, and then transferring them from, intermediate places. In 1820, another consignment of fish was taken on the corvette *Le Relief*; but notwithstanding the care taken by the commander, Baron Melius, no better luck attended the attempt (1870, 686).

Not for many years were any further endeavors made to introduce the gourami into France. In 1856, however, the Messieurs Lienard, (father and son,) planters of the island of Mauritius, wrote to the Acclimatization Society of Paris, announcing their intention to send, when the opportunity offered, living individuals of "the fish known under the name of gourami" (1856, 204; 1857, xlv). Hopeful anticipations were entertained that these attempts would, at no distant day, be successful (1860, i). No consignments by the Lienards were made, however, till 1861, when a number (50) were confided to the care of Dr. Perrot de Chamarel, who went by the way of Suez to Marseilles, and arrived early in July at the latter city, with only five of the lot (1861, 367, 422, 473). These, apparently, were subsequently given to M. Paul Gervais, then of Montpellier, as he, in 1867, recalled that he had received from Dr. Perrot de Chamarel five fishes, the survivors of a lot of twenty-five, with which Dr. Perrot started from Mauritius. These five were

* See, also, GIRARD, *Vie et travaux de François Peron*.

intrusted by Professor Gervais to the superintendent of pisciculture of the department of Herault, but lived only a few weeks (1867, 551).*

Monographs on the habits and best means of caring for the gourami were now presented by Messrs. Rutz de Lavison, Roujoux, and Viuson, and published in the Bulletin of the Acclimatization Society, (1861, 290, 355, 392, 403, 509, 514, 541, 546); and the success in bringing the five specimens as far as Marseilles encouraged the friends of the fish. A fresh consignment was made by M. Lienard to M. Barthélemy-Lapommeraye, at Alexandria, in February, 1862, (1862, 135, 150); but at the same time the news of their death after their arrival in Egypt was received from M. Lienard, (1862, 142, 150).

Another volunteer (M. Manés, of the island of Réunion) soon after tendered his services, (1862, 798, 898, 917,) and several attempts were actually made by him; a first early failed (1862, 917; 1863, 120). He, however, had greater hopes of success in transportation of the fecundated ova than of the developed fish.

Soon after (in March) a number of fish were sent by M. Manés, of the island of Réunion, in care of M. Rignolet (1863, 307,) and some arrived living at Cairo, but all succumbed on the way from that place to Algeria (1863, 627). M. Manés then, despairing of sending them alive to France, proposed to consign some to the care of the Khedive of Egypt, by whom they could be ultimately forwarded to France (1863, 627). This intention he carried out in the following year (October, 1864).

But early in November of this year, M. Lienard left Mauritius with ten fishes, and leaving five of them in Egypt in care of M. Coulon, at a country-house near Cairo, he arrived at Marseilles with the rest; but four of the five died soon after his arrival, on account of the changes in the wind and temperature. The sole survivor was confided to the care of M. Barthélemy-Lapommeraye (1863, 738, 764). Again, in October, 1864, M. Barthélemy-Lapommeraye was intrusted with the care of a lot of seven gouramis, which had arrived in Marseilles, and had been sent by M. Autard de Bragard to M. Lienard for the French Society of Acclimatization, through the intervention of M. Georges Aubin (1865, 615).

M. Manés subsequently sent nests of the gouramis, containing their eggs, one in January, 1865, (1865, 52,) and a second in May, (1865, 356); but no records of their fate were published by the society. A second time, however, after all these trials, a lot of living fishes were received in France. M. Autard de Bragard, of the island of Mauritius, and ex-president of the Acclimatization Society of that island, took with him nineteen fishes from the island in a large glass vase, and arrived at Marseilles with eleven of the lot on the 15th of April, (1865, 195-313); but they all died very soon after their arrival (1865, 199-358). Another lot of about two hundred fishes, sent at nearly the same time, was still less

* Notwithstanding the discrepancies noted, the two accounts have reference apparently to the same lot.

fortunate, all having died at Suez (1865, 357, 425, 549); equally unsuccessful were consignments made by M. Autard de Bragard (1865, 488; 1866, 485-487). In the last case, we are told by M. Berthelin, who took charge of them, twenty had been selected the evening before the departure of the vessel, those selected being about three inches; these were placed in the vessel in a zinc vase, in a dark place, and the water was renewed every day with river-water; but, in spite of all, the fishes soon died, two on the day after leaving port, twelve in the night of the second or third day, and two on the next succeeding one, while the four remaining were transferred into a porcelain vase and lived a number of days, (from the 18th to the 30th of May,) but finally succumbed (to the excessive heat, it was supposed) in the harbor of Aden (1866, 485, 487, 493, 569). M. Berthelin added suggestions for future guidance, and recommended Egypt as an intermediate station for the acclimatization of the gourami (1866, 598).

Again, in 1867, gouramis were brought living into France. First, M. Berthelin and M. Grandidier, in May, arrived at Marseilles with sixteen fishes out of an original lot of one hundred; six, however, soon died, and the rest followed some time after (1867, 441); and again M. Autard de Bragard was successful, reaching Marseilles (near the end of July) with five fishes out of twelve with which he embarked at Mauritius, and these were even received in Paris, and confided (July 17) to the care of M. Duméril in order to be kept in the reptile-house of the Museum of Natural History (1867, 550-552). These thrived for some time (1867, 640), and until October, when on account of the fall of the temperature, they suddenly succumbed—one on the 4th, two on the 5th, and the last two on the 6th. The temperature of the water, nevertheless, had not declined lower than 13° centigrade (55.40 Fahrenheit); and that cold was the cause of death was rendered evident by the sluggishness of the fishes near this temperature, and their revival when warmer water was injected, to be again succeeded by depression when the temperature again fell (1868, 352).

An attempt was also made from another quarter to give France the coveted fish. M. Henry Rozy sent from Bantam, in the island of Java, fifteen gouramis, and also the branchlets of a tree containing nests of the fish; eleven of the fishes were received at Marseilles alive, having made the long voyage without apparent detriment, but on the night of their arrival, the cold being too great for them, they died; nothing has been recorded as to the fate of the eggs (1871, 646).

Invoices of gouramis appear to have been also received, within the last year or two, by M. Pierre Carbonnier; but a failure of reception of the numbers of the "*Bulletin de la Société d'acclimatation*," containing the accounts, prevents us from giving full information at this time. Mr. Carbonnier, however, seems to have had unusual success in keeping his fishes alive. In August, twenty-two specimens of anabas and six gouramis were brought from Calcutta to Galle by M. Paul Carbonnier, and

were sent to the father in a glass vessel. The water was not changed on the route, and no one took special care of it. Ten anabas and three gouramis arrived, living, at Marseilles on the first of August. In the same vessel were found the skeletons of those which had died on the way. This success, says M. Carbonnier, is of importance, as it furnishes proof that all fishes with labyrinthiform pharyngeals can dispense with taking oxygen through the medium of water, and are able to avail themselves of the atmospheric air directly. Those that died on the way from Marseilles probably died from hunger rather than from insufficient aeration or other active malady (1874, 526-527).

A very recent record of unexpected success in the preservation of the gourami in the open air, during the winter, may seem to almost nullify the experience of others, and the inferences recorded in the preceding chapter. The account referred to has been published in the "*Bulletin de la Société d'acclimatation*" for March, 1874, and the following is almost a literal translation of the passages.

"M. Turrel writes from Toulon: The water-basin of our garden is enriched with two gouramis, which have for two years supported the climate of our Provence under conditions which appear to me to deserve to be mentioned. But before entering upon the details of this introduction, I ask myself if the fishes in question are truly gouramis. In form, they resemble carps; in dimension, they are nearly fifteen centimeters in length; their color is a very brilliant bronze copper. The following is the history of their introduction as it has been furnished to myself:

"In 1872, M. Daniels, second captain of the mail-steamer, took from Singapore for Ciotat (Bouches-du-Rhône) nearly two hundred young gouramis, of which only four survived the passage. These four were placed in an unwallled basin, having a depth of about two meters, and on the bottom of which aquatic plants were growing. In this body of water, the four fishes have passed two winters; in that season plunging into the bottom to avoid the attacks of cold, and supporting under these conditions 4° (39°.20 Fahrenheit) of temperature.

"Two of these fishes were given to me by a friend of M. Dauveld, who had obtained them to place in the basin. I received them the 13th of February, and placed them immediately in the basin of our garden, which has little depth and little extent, but is provided with a southern exposure, and protected against radiation by rock-work in the form of a grotto" (1874, 225-226).

The doubt involved in this case is as to the species of fish experimented with, and the doubt apparently conceived by M. Turrel may be pardoned in others until the fishes have been examined by an experienced ichthyologist.

While the French Society of Acclimatization was year after year attempting to introduce the gourami into France, frequent tenders of service were made by affiliated societies or individuals. Among others, the Baron Dunast suggested to the society a small rivulet in Sicily—the Anapo, or, as it was anciently called, the Anapus—as one which ap-

peared to him to combine all the most favorable conditions for such attempts (1864, 215; 1866, 680; 1867, 228); and ultimately, in response to a letter from the president of the Paris society, the Society of Acclimatization and Agriculture of Sicily, through its president, Baron Anca, appointed a commission to report on the subject, (1867, 282,) which confirmed the favorable opinion entertained by Baron Dunast, (1867, 552, 753.) An elaborate report was published by the Italian society on the subject, but their recommendations appear never to have been carried into effect.

All the attempts to acclimatize the gourami in France have thus far proved to be failures; and (if the physiological data obtained from a wide experience are any guide) are likely to be equally so in the future; and the Acclimatization Society has recognized this truth in the discontinuance of offers of specific prizes for the introduction or acclimatization into its waters of the gourami. The society, however, evidently still entertains hope of success for several French provinces; as, in 1873, it renewed its offers of prizes (which have been repeated several times) relative to this species. The premiums offered are, severally: (1) 500 francs for the *introduction* into the fresh waters of Algeria of a new food-fish; (2) 1,000 francs for the *acclimatization* in the fresh waters of Algeria of a new food-fish; (3) 500 francs for the *introduction* into the fresh waters of Guadeloupe and Martinique of a new food-fish; and, (4) 1,000 francs for the *acclimatization* in the fresh waters of Guadeloupe and Martinique of a new food-fish. The time for competition is in each case open till December, 1880; and the amounts offered are in each case doubled, in case the fish *introduced* or *acclimatized* is the gourami.

ALGERIA.

Efforts to introduce the fish into the French colony of Algeria were initiated in 1863 by a letter from M. Tourniol, of Melianah, (repeated in 1865, 489,) who offered to the French Acclimatization Society the use of his fish-basins to receive any specimens that could be sent to the colony, (1863, 131,) and by another from M. Hardy, the director of the Garden of Acclimatization of Algiers, who also announced his readiness to receive any (1863, 226). One lot sent in 1863 died on the way from Cairo to Algeria, (1863, 627); a second, sent in 1864, were more fortunate, as eleven were received (on October 31) by M. Hardy from M. Perrot de Chamarelle of Mauritius; these were placed in pendant vases, in which the water was often renewed, and the fishes were fed with flies (1864, 697, 701); most of them, however, died before the 19th of May, 1875, (1865, 358,) and the "depôt" (1865, 194) was thus exhausted. The same want of success that attended the attempts at introduction in the other countries awaited those made for Algeria.

AUSTRALIA.

Frequent attempts have also been made to introduce the gourami into Australia, especially the colony of Victoria. These were continued

from 1859 to at least 1864, (see Bulletin de la Société Impériale Zoologique d'Acclimatation, 1860, 98, 432; 1863, 153; 1864, 217, 305; 380; 1865, xxxvi,) but none were attended with eventual success.

CAPE OF GOOD HOPE.

Efforts appear to have been also made to introduce the species into the waters of the Cape Colony, (*op. cit.*, 1865, xxxvi,) but no documents are at present available giving detailed information.

EGYPT.

As already indicated, Egypt is on the highway from Mauritius to France; and, having a far more favorable climate, it was proposed to acclimatize them in that country, and thence introduce them into France. Koenig-Bey, the secretary to the Khedive, signified the desire of his government to be instrumental in such a work, (1864, 288, 314,) and agreed to work on shares with the society, keeping one-half and promising to send the other when the weather became favorable (1864, 696). Specimens were accordingly sent from Réunion by Messrs. Berg and Manés to the Egyptian functionary, (1864, 539, 696,) but were all lost on the way (1864, 539; 1865, 356); measures, however, were taken by the committee of the Acclimatization Society at Mauritius to send a consignment of fishes by every mail-steamer till success had crowned their efforts (1864, 539). Although partial success seems to have attended the endeavors to introduce them,* it seems to have been ephemeral; at least, no accessible data give any positive information respecting essential success (1866, 598; 1869, 242).

The recommendation has been made by the eminent ichthyologist, Dr. Günther, to attempt the introduction of the gourami (as well as the European cat-fish and the Australian *Oligorus*) into England, (Rep. Acclimatization Society of London; Bulletins de la Société d'Acclimatation de Paris, 1861, 98,) and others, too, have been sanguine in the belief that the acclimatization could be effected in England as well as in Germany; but the attempt has never been made, and we may certainly be easily convinced that if the climate of Marseilles and Southern France is too cold to enable them to survive through the year, more northern and colder countries would be still more incompetent to harbor them.

CONCLUSIONS.

Referring to the first part of this article on the gourami for information respecting the climate of the countries in which it thrives, and for the results of repeated experience of the limit of low temperature which it can withstand, and availing ourselves of the experience of the French, we must be convinced that the fish cannot be acclimatized, at least directly,

* "Pres. de S. A. Halim, Pacha au Caire, chez lequel on m'a assuré que ces poissons étaient acclimatés," 1866, 598.

in any country where at any time the temperature descends nearly to the freezing-point. What subtle influences have prevented propagation in the West Indies are unknown; the climate, so far as can be judged from thermometrical indications, can scarcely be an obstacle, and the cause of failure will probably be found in some unknown conditions. Of course, the experience in the case of the countries where attempts to acclimatize have been made equally teaches us that there is no hope for success in attempts to introduce it directly into any of the United States north of Florida or Lower California. And yet it is not utterly impossible that, starting from a tropical country, individuals might gradually be introduced northward; and while many would succumb to the cooler climate, (which, perhaps, would only be too cool once in a cycle of years,) a few would survive, and the descendants of such—themselves weeded out little by little—eventually leave a stronger race, which might in time be domiciliated in temperate climates. It may be, indeed, that (as in very many species of animals) there is already a difference in the susceptibility to cold of the several races of the gourami now acclimated in different countries, and that, in an Indian race, we have a more hardy form; such, at least, would seem to be the case if the fish referred to by M. Turrel was really the gourami; and, if it is so, that race would be the most suitable to experiment with. It must be remembered, however, that even M. Turrel's fishes were not claimed to have been subjected to a temperature lower than 39° Fahrenheit; and consequently the results of his experience (admitting that the fishes were gouramis) do not militate against the inferences here enunciated. None of the present generation could reasonably effect acclimatization of the species in northern waters; but, if any individual has no regard for a return for money expended, enthusiasm might be gratified by commencing with importation of specimens into our southern waters.

For the benefit of such, we refer to the articles teaching how to transport them,* and close with briefs of their instructions, and extracts from them by M. Coste.

C—RULES FOR TRANSPORTATION AND INTRODUCTION.

As to the introduction, it would, probably, be more readily effected by the transportation of nests with the ova than that by the fishes themselves; and such a course would, at least, require less care and attention, and would have the additional advantage of furnishing so many more individuals to select from. If, for any reasons, it is preferred to experiment with the young, the smallest should be chosen, and they should be placed in wooden or earthen ware vessels: the latter would be preferable, and those having a capacity of from ten to fifteen gallons would, perhaps, be best; but tubs or casks when perfectly clean

* COSTE. *Instruction pour le transport des gouramis*. <Bull. Soc. Imp. Zool. d'Acclim., 1865, pp. 76-80.

DABRY (P. Thiersant). *Note sur le transport des gouramis*. <Op. cit., 1868, pp. 591-592.

may be used. The receptacle, whatever it may be, should be suspended, in order to avoid the disturbance of its contents by the incessant rolling of the vessel; such motion being prejudicial to the welfare of the fishes. The fishes should also be fed, and a supply of suitable plants should therefore accompany them. We append a translation of the specific instructions of M. Coste, from whom, indeed, have been derived the hints above offered.

"1. Very young fishes should be selected.

"2. These fishes should be distributed among several receptacles.

"3. Care should be taken not to crowd too many together in one receptacle.

"4. The water should be renewed partially or entirely whenever it becomes necessary.

"5. It should also be aerated from time to time.

"6. The fishes should be fed whenever they shall seem to require it.

"7. The remains from the food which has been given to the fishes should be carefully taken up from the bottom of the receptacle, and removed within eight hours after feeding; the dejections and other impurities which would injure the water should be removed.

"8. Finally, the several receptacles should be kept in different places and under various conditions."