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XLVII.—*Memoir on the Hydrographical System and the Freshwater Fish of Algeria.* By Lieut.-Colonel R. L. PLAYFAIR, H.M. Consul General, and M. LETOURNEUX, Conseiller à la Cour d'Appel, in Algeria*.

I. HYDROGRAPHICAL SYSTEM.

In Europe an admirable system of circulation restores to the ocean the waters which the sun has taken from it, and which, having escaped from their aërial reservoirs in the clouds, are poured out on the surface of the earth. In every country a network of natural canals reunites into one central stream, and carries to the sea, the surplus of the rains and snows which have fertilized the soil, in the same manner that the venous system carries back the blood to the heart to be purified and to serve for the regeneration of the bodily organs.

In Algeria, on the contrary, the system is far from being so simple: a very small part of the country is subject to ordinary hydrographic laws; in the rest the waters either return to the clouds without passing through the sea or circulate in vast subterranean lakes.

A glance at the map of Algeria will suffice to show that the country consists of three regions, as distinct in their hydrographical features as in their climate and vegetation: these are the Tell, the High Plateaux, and the Sahara.

The first, occupying the littoral zone, with a breadth of from 50 to 70 miles, is for the most part mountainous, watered by copious rains, tempered by sea breezes, and possessing in a high degree the ordinary Mediterranean features.

The flora and fauna of the eastern portion do not differ essentially from those of Sicily and Sardinia, while in the west they resemble rather those of Spain†.

* Communicated by the Authors, having been read at the Meeting of the British Association in August 1871.

† The separation of Spain from Africa hardly goes beyond the limit of *Ann. & Mag. N. Hist.* Ser. 4. Vol. viii.

The watershed of the Tell is as regular as in other countries ; and its streams all reach the sea. Although the general direction of the mountain-range is from east to west, the configuration of the ground is very irregular ; and confused mountain masses frequently occur, throwing out lateral spurs or buttresses, which in many instances plunge abruptly into the sea. This has caused numerous basins, often narrow and tortuous, and has been the means of confining the watercourses between the perpendicular walls of narrow gorges.

The sources of the principal streams are situated high up, either on the southern border of the Tell, on the first terraces of the High Plateaux*, or on the flanks of the great isolated mountain masses†.

In spite of the meanderings often necessitated by the nature of the ground, the streams of the Tell are generally short : the Chelif alone has a length of 244 miles ; but a great part of its course is owing to exceptional causes in the regions of the High Plateaux. It follows that the rivers and streams flowing over a steep incline are, in the rainy season or after a storm, foaming torrents, carrying down in their troubled waters huge masses of stone broken from their beds and trees torn from their banks‡. During summer, on the other hand, the beds of these rivers are entirely dry in the mountains and in the plains, where their banks are sometimes half a mile distant from each other, inclosing a sandy bed invaded by vegetation ; all that remains is a tiny stream in the middle, and here and there a few pools of stagnant water.

The most considerable rivers in Algeria are, the Mafrag, the Seybouse, the Oued-el-Kebir, the Makta, &c., which during flood-time discolour the water for several miles at sea, and have not the strength in summer to force themselves a passage through the banks of sand accumulated in their estuaries by the currents along the coast.

Alluvial plains of any considerable extent are rare in Algeria ; they do not form, as elsewhere, in the estuary of a great river. Parallel to the sea they stretch between the foot of the mountains and the isolated groups of hills, once probably islands, such as those at La Calle, to the north of the plain of Tarf, El-Edough in the plain of Bône, the Sahel at Algiers,

history. DeCandolle affirms the existence of the ancient communication between Numidia and the Italian islands.

* From 2500 to 3000 feet above the sea.

† Jurjura, 7385 feet ; Ouarensis, 6425 feet ; Bators, 6336 feet.

‡ Freshets in the Seybouse have frequently been known to carry down several hundred trees to the sea, and even wild boar, surprised by the inundation and unable to contend against the strength of the current.

and the Mountain of Lions in the plain of Oran. Rivers traverse these without draining them, and any depressions in their surface are occupied by marshes and shallow lakes, either fresh or salt*.

The region of the High Plateaux extends longitudinally from the east to the west, south-west of Algeria, and is formed by vast plains separated by parallel ranges of mountains.

These terraces increase in height as they recede from the Tell, and again decrease as they approach the Sahara, thus forming a double series of gradients, of which the highest is 3000 or 3800 feet above the level of the sea, much higher, indeed, than the summits of the hills which bound it.

The spurs or projections from the mountains cut up each of these stages into a series of basins, more or less elongated, sometimes circular, like the Hodua, in which the depressions are occupied by lakes, generally salt, known by the name of *Chotts* or *Sebkhas*.

This region is subject to alternations of intense cold and extreme heat; rain waters it less copiously than the Tell; instead of sea-breezes it receives the hot blast of the desert-wind; and it is entirely devoid of trees, save on the southern side of the high mountain-ranges.

During seasons of abundant rain, however, and in places capable of irrigation, it produces abundant crops of cereals; but otherwise it presents to the weary eye of the traveller an unbroken stretch of stunted scrub and salsolaceous plants, on which browse the sheep and camel, the wealth of the wandering Arab.

Here and there a stream of water escapes from the mountains to be lost in the Chotts; sometimes, however, they are absorbed by irrigation in the upper part of their short course; so that for a considerable part of the year the lower part of the beds are entirely dry.

The disposition of the soil in enclosed basins, and the existence of veins of permeable rock of a concave form, gave rise to the supposition that there existed subterranean sheets of water in several parts of the High Plateaux. Acting on this theory, artesian wells were sunk; and in many instances these brought to the surface copious supplies of water, which here is verdure and life.

* The lakes of Houheira and Tonga, near La Calle, are sheets of fresh water, as were those of Oued-el-Maïz in the plain of Bône, and Lake Halloula in the Metidja, now dry. The lake of Mezerguin near Oran is salt, and that of Fezzura near Bône is brackish. The last, in the time of the Romans, poured the excess of its waters into the Seybouse by means of a canal, the remains of which still exist.

Regular as is the general character of the High Plateaux, they still present several anomalies. On the southern border the lower terrace, instead of forming a basin, presents here and there slopes, down which the water flows to the north, and thus becomes the sources of several rivers in the Tell.

Towards the centre the basin of Sersous, filled of old by a vast lake, the traces of which are plainly visible, is now drained by the river Ouassel, which has forced itself a passage near Boghari, between the excavated plateau of Sersous and the foot of the last mountains of the Tell. On quitting the High Plateaux, this river becomes the Chelif, the most important in Algeria.

Towards the south-east the basin which ought to have existed is replaced by the immense mountain of Aurès, of which the central peak attains an altitude of 7800 feet. This protuberance takes the place of a depression; and instead of a salt lake, we find a mountain covered with cedars and alpine vegetation. On the north, Aurès has only moderate slopes, which convey its waters into Chotts of the neighbouring plateau. Towards the south it is prolonged almost in a straight line, and descends like a precipitous wall to the Sahara, which stretches at an immense distance below it.

In the west of Algeria the centre of the country bristles with mountains, which adjoin the great snowy range of Deren. The southern slopes give rise to immense rivers, amongst others the Oued Gheir, which the French expedition under General Wimpffen reached in the spring of 1870, and which, in their admiration, the soldiers compared to the Meuse.

Popular belief pictures the Sahara as an immense plain of moving sand, dotted here and there with fertile oases; and the old simile of the panther's skin is still with many an article of faith. A few details are necessary to dispel this poetical but false idea.

The desert in Algeria consists of two very distinct regions, which we shall call the lower and the upper Sahara:—this a vast depression of sand and clay, stretching on the east as far as the frontier of Tunis; that a rocky plateau, frequently attaining considerable elevation, extending on the west to the borders of Morocco.

The former comprises the Ziban, the Oued Ghir, the Souf, and the Choucha of Ouargla. On the north it is bounded by the mountain-range of Aurès and the foot of the mountains of Hodua and Bou-Kahil; on the east it penetrates into the Regency of Tunis; on the south it rises in a slight and almost insensible slope towards the country of the Touareys; and on the west it stretches in a point along the Oued Mia as

far as Golea, after which it turns towards the north along the plateau of the Beni M'Zab.

The Oued Ghir, the Souf, N'gouça, and the greater part of the Ziban have a less elevation than 100 metres; Biskra and Ouargla are hardly higher, while the Chott Melghir and part of the Oued Ghir are below the level of the sea.

The Chott Melghir, which occupies the bottom of the depression, is sunk in the gypseous soil, and forms a sheet of water salter than the sea. It is of no great depth, and in summer, owing to evaporation, it is partly covered with a thick and brilliant coating of crystals; so that the eye can scarcely distinguish where the salt terminates and the water begins. The bottom is an abyss of black and viscous mud, emitting an odour of garlic, due possibly to the presence of bromides. Nevertheless it is not without veins of more solid ground, forming natural causeways, on which the people of the country do not hesitate to trust themselves.

The rivers of the Aurasic system, essentially torrential in the mountains when confined within steep and narrow gorges, serve to irrigate the oases, where their waters are retained and absorbed by means of dams. That which percolates through these and forms streams lower down their courses is again absorbed by the Sakias or canals of irrigation. It is only after the copious rains of winter, and the melting of the snow in the mountains, that their beds are filled and their waters reach the Chott.

The smaller springs and streams which have their origin at the foot of the mountains are always absorbed by the oases or by the cereals which the inhabitants of the Ziban cultivate wherever a thread of the precious liquid is found.

On the west the Oued Djedi joins the Chott; it rises on the southern slopes of Jebel Amour, fertilizes the oasis of El-Aghouat, and, skirting the plateaux of the higher Sahara, traverses the lower Sahara from west to east. It is only in the upper part of its course that this Oued is a permanent stream; lower down its water is to a great extent dried up by the solar rays or absorbed by barrages; the rest disappears in the permeable strata, or filters through the sand and flows along the clayey bottom which underlies it. Like the rivers of the Aurès, but even more rarely than these, its course is only filled by the melting of the snows, or during the heavy rains on the High Plateaux.

The foregoing remarks apply equally to the other rivers which, rising in the eastern part of the higher Sahara, flow towards the region of N'gouça.

In the south the Oued Mia presents always the appearance of a dry watercourse, below the sand of which water flows

along an impermeable bed. The same may be said of the Oued Gghaghar, whose source, never yet visited by Europeans, is in the Touarey country.

These dry watercourses have all enormous beds with deeply worn banks, and they join the central depression by immense estuaries, which prove how great a volume of water they had once discharged as their tribute to the great Lake Tritonis, of which the Chott Melghir and the salt lakes of the Tunisian Sahara are the insignificant remains.

What has drained this great river, and transformed into a series of salt marshes the Lake Tritonis, which, if we can believe Lucan, communicated with the sea?

It is probable that this is mainly owing to a gentle and progressive upheaval of a great part of the Sahara, and partly perhaps to the disappearance of those great forests, once the home of the African elephant.

Whatever the cause, the eastern depression has now no running water except on its northern border. But sheets of water, driven from the surface, still exist, in the bowels of the earth, as a vast subterranean sea, the waters of which are strongly impregnated with saline matter.

From time immemorial artesian wells have existed here, and have everywhere spread with their waters life and wealth.

The water, which in the lowest part of the depression is found at a depth of 20 metres, is, at the edges of the basin, 50, 60, or 100 metres from the surface of the soil.

Its existence, however, is not only indicated by artesian wells: throughout the whole extent of the Oued Ghir, and even to the south of it, depressions are found full of water, which appear to be as it were the spiracles of the subterranean lake; they are styled by the natives *bahr* (sea); the French call them *gouffres*.

In the Souf the water circulates close to the surface of the soil, enclosed in a sandy substratum which is concealed by a bed, more or less thick, of sulphate of lime, crystallized on the upper surface and amorphous in the lower part. One has only to penetrate this layer of gypsum to create a well. When it is intended to plant a date-grove, the industrious *Souafa* remove the entire crust of gypsum and plant their palms in the aquiferous sand beneath. Their green summits rise above the plain around, thus forming orchards excavated like ants' nests, sometimes 8 metres below the level of the ground.

This complicated distribution of water in the lower Sahara gives rise to the different kinds of oases.

Running streams, dammed by barrages and distributed in canals, make the river oases (Ziban).

Water absorbed by permeable strata constitutes (1) the oases with ordinary wells (Oulad Djellal &c.), (2) oases with artesian wells (Tuggart, N'gouça, Ouargla, &c.), (3) the excavated oases (Souf).

Sometimes two systems are found united in the same place.

The higher Sahara extends from the western limits of the lower one to within the frontiers of Morocco; to the south it reaches beyond Goleah, and on the north it is bounded by the last chains of the High Plateaux.

It is principally composed of rocky steppes, only the depressions between which are filled with sand.

Towards the east descends almost perpendicularly from north to south a large promontory which rises below El-Aghouat to nearly 9000 metres, and sinks gradually towards Goleah, separated from the plateau of Tademait by a sort of isthmus 400 metres high. It is in this plateau that the Oued Mia and its affluents arise, which, in French territory at least, contain only slight infiltrations of water under a sandy bed.

In the centre the rocky plateaux fall rather abruptly as far as the zone of the *Areg*, or country of sand-hills, occupying a depression the bottom of which is about 400 metres above the sea.

Finally, towards the extreme west, where the chains of the High Plateaux descend lower, the Saharan plateaux also descend further south, leaving between them numerous valleys.

In each of these three divisions the water-system is different. The eastern promontory, the crests of which are directed towards the west, sends out no spurs towards the zone of the *Areg*; but it is furrowed towards the east by immense ravines, of which the principal bear the names of Oued Ensa and Oued M'Zab. Rain seldom falls in the lower part; and the southern *crevasses* are almost all deep ravines, without water or vegetation. Even in the upper part it is only during severe storms, and when more than usually abundant snow has melted on the High Plateaux, that the waters pouring on the Sahara unite in the deep defiles, forming a mighty wave, which during twenty-four or forty-eight hours precipitates itself into the estuaries of the lower Sahara. When this torrent has passed, nothing remains in its dry bed save a few pools where the gazelle drinks, and a slight subterranean percolation which serves to supply the few wells at which the caravans draw water.

These periodical inundations are quite inadequate to supply the Beni M'Zab, who have established gardens in the very beds of the great ravines which dominate their seven cities. In vain they treasure up a store in their reservoirs; they are

obliged to have recourse to deep wells cut in the rock, which collect the infiltration of water in the calcareous strata.

Above the promontory it is only El-Aghouat and Ain Madhi, situated in a depression at the foot of the mountains, that can utilize almost at all seasons of the year, by means of barrages, the upper waters of the Oued Djedi, which flow from east to west.

In the middle, Brezina and several oases placed at the very foot of the mountain-range can also irrigate their date-groves with running water; but further south the water flowing along the rocky plateaux encounters the moving sands of the Areg, which arrest its course and cause pools or marshes (Dhaya), neither usually very large or very deep. These little Chotts present the same phenomena as the greater depressions in the lower Sahara, their ancient banks, now quite dry, attesting a very marked decrease in the volume of their waters.

Towards the east, on the other hand, where the mountains in the plateaux rise to a greater height than 900 metres, and present a vast surface, the ravines are the bed of veritable rivers, which render abundant irrigation possible, and, uniting in two principal streams, form the Oued Mersaoud, which descends southwards to an unknown distance.

Such is the upper Algerian Sahara, of which the greatest depression does not descend to within 400 metres of the sea, while in the lower one there is not a single point attaining that altitude. In the one the plateau is the prevailing feature, in the other the depression; here rocks abound, there they are entirely absent. As to moving sand, which the Arabs compare to a net, it occupies a sufficiently extensive zone in both regions; but still it does not cover one third part of the Algerian Sahara.

II. DISTRIBUTION OF SPECIES.

The ichthyology of Algeria is yet imperfectly known; and future discoveries will probably augment the comparatively small number of twenty-one species, which our researches have established in the fresh and brackish waters of the colony.

The Tell, as might be imagined, is the richest region: there sixteen species, or three fourths of the total number, are found. Of this number only two are common to the three regions, *Barbus callensis* and *Anguilla vulgaris*. The *Leuciscus callensis* is common to the Tell and the High Plateaux; and the *Cyprinodon calaritanus* inhabits equally the brackish

waters of Lake Bou-Kamira in the Tell and the salter waters of the Oued Ghir.

There remain, therefore, eleven species peculiar to the littoral, of which the majority occur both in the sea and in fresh water, namely *Gobius rhodopterus*, *G. paganellus*, *Blennius vulgaris*, *Atherina Rissoi*, *Mugil cephalus*, *M. capito*, and *Clupea finta*.

The species found only in the fresh waters of the Tell are *Gasterosteus brachycentrus*, *Salmo macrostigma*, *Carassius auratus*, and *Syngnathus algeriensis*.

Carassius auratus, the common goldfish, is not a native of Algeria, although it abounds in the western rivers on the frontier of Morocco. It is probable that its introduction was due to the caprice of one of the sultans of the Tlemcen dynasty; but, whatever the cause, the fact is that it has been so long and is so widely naturalized, that we have not thought it proper to exclude it from our list, like the carp and tench, which have been in course of naturalization for about twelve years, but which have not yet left the reservoirs where they have been reared for the freer life of the streams or rivers.

We include also amongst the fish of the Tell the *Syngnathus algeriensis*, one of the few species of that genus not found in the sea. It has never been observed within 80 kilometres of the coast; and we therefore consider it purely fluviatile.

The High Plateaux have hitherto afforded only seven species, three of which have been previously cited as common to the other regions; the remaining four are *Cyprinodon iberus*, *Cristiceps argentatus*, *Tellia apoda*, and *Leuciscus callensis*, which last is also found in the Tell; *Cristiceps argentatus* occurs also on the coasts of the Mediterranean; so that two species only are peculiar to this region; and of these, one has been found in Spain. The *Tellia apoda* is a genus and species not represented elsewhere than in Algeria.

The Sahara is not more rich*; and it is only in the upper part, in the rivers which descend from the High Plateaux, that the two species of barbel are found. In the greater part of this vast region the waters are only inhabited by *Anguilla vulgaris* (found everywhere in Algeria), the *Cyprinodon calaritanus* (also found near Bône), and the two species of *Chromis*, *C. nilotica* and *C. Tristrami*.

These last three species have been frequently ejected by artesian wells; and this has formed the subject of numerous

* It is to be regretted that no ichthyologist accompanied General de Wimpffen's expedition, in the summer of 1870, to the south-west of Algeria. It is probable that the abundant waters of the Oued Gheir would have contributed to swell our list.

speculations. It has been concluded that these fish inhabited the vast subterranean sea which occupies the bottom of the Saharan depression; and it has been asked how, if they were destined to live in perpetual obscurity, they were not destitute of eyes like the Sirens of the grottoes of Carniola or the Crustacea of the Mammoth Cave in the United States?

We have already noticed the existence, from Biskrah as far as Temacin, of *bahrs* or *gouffres*, which communicate with the underground sheet of water, and occupy too great a surface to be regarded as the enlarged apertures of fallen-in wells. All these apertures are inhabited by considerable numbers of Cyprinodons and *Chromis*. There they live freely, exposed to air and light, and breed under normal conditions. Their underground life is merely an episode, and as it were an incident in the voyages which they undertake between one *bahr* and another. When they reach the neighbourhood of a well, they are either forced up with the water, or obey an instinct to mount to the surface.

It is less easy to explain the appearance of *Barbus setifensis* in the basin of an artesian well near Miserguin (region of the Tell), and of *Cristiceps argentatus* in the "rigoles d'écoulement" of the Fontaine Malakoff (in the region of the High Plateaux). The former fact is vouched for by the engineers of the Ponts et Chaussées, and the latter by the naturalist Fanton.

Do these barbel come by some concealed communication from the subterranean depths into which the Tafna is engulfed and in which it disappears during a part of its course? The fact is doubtful, but by no means impossible. As to the *Cristiceps*, it appears to us probable that it may inhabit some of the brackish springs at the foot of the mountains round the basin of Zahrez, which doubtless communicate with the artesian water-supply.

If we examine the distribution of Algerian fish with reference to longitude, we observe that the richness of the fish-fauna diminishes sensibly from east to west. The province of Constantine possesses sixteen species, of which five are common to Algiers, Oran, and itself (namely, *Mugil cephalus*, *Clupea finta*, *Barbus callensis*, *B. setifensis*, and *Anguilla vulgaris*), and a sixth (*Blennius vulgaris*) common to Algiers and Constantine; the other ten (*Gobius rhodopterus*, *G. pagannellus*, *Mugil capito*, *Salmo macrostigma*, *Leuciscus callensis*, *Cyprinodon calaritanus*, *Syngnathus algeriensis*, *Tellia apoda*, *Chromis nilotica*, and *Ch. Tristrami*) are not found in the other provinces.

This is easily explained by the extent of the zone of the

Tell in this province, the geological variety in its mountains, the abundance of forests producing shade and coolness on its littoral, and, above all, because the whole of the Saharan depression with its *bahrs* is comprised within its limits.

The province of Algiers has only six species, of which four are special to it—*Cristiceps argentatus*, *Gasterosteus brachycentrus*, *Atherina Rissoi*, and *Cyprinodon iberus*.

In the province of Oran an equal number is found; but of these only one, and that the common goldfish, does not occur in the others.

It now only remains to make a few remarks on the area which these twenty-one Algerian species occupy elsewhere in the world.

Amongst those with an extensive geographical distribution, besides the common eel, there is the *Cristiceps*, which inhabits the Mediterranean, the Atlantic, the Cape of Good Hope, and extends as far as Australia; the *Mugil capito*, which frequents the coasts of Europe and Western Africa; the *Clupea finta*, which is found in the Mediterranean, on the west coasts of Europe, and in the Nile; and the two Gobies, common to the Mediterranean and the North Atlantic Ocean.

The *Mugil cephalus* is caught on all the coasts of Africa.

The *Blennius vulgaris*, a Mediterranean sea-fish, is sold as a freshwater one on the banks of the Italian lakes and at Aix-les-Bains.

The *Atherina Rissoi* appears peculiar to the Mediterranean.

The other species, which do not exist out of fresh or brackish water, have a less extended distribution; nevertheless *Cyprinodon calaritanus* inhabits both the north of Africa and the south of Europe. The *Chromis nilotica* extends from Algeria to Mozambique; and the *C. Tristrami* has been found also in the kingdom of the Ashantees.

The *Cyprinodon iberus*, as its name indicates, is of Spanish origin; the *Barbus callensis* has been found in the Tagus; and the *Gasterosteus brachycentrus* is an Italian species.

It is commonly known that China is the home of the *Carassius auratus*.

Algeria possesses five species peculiar to itself:—the *Salmo macrostigma*, which loves the cool and limpid waters of the Oued Z'hour and its affluents, which flow over beds of granite and gneiss, through shady cool forests (this is the most southern species of all the Salmon family); the *Tellia apoda*, which has no known habitat save the spring of Bou-Merzook, from which it never strays more than half a mile; the *Leuciscus callensis*, which peoples all the lakes and springs, both

of fresh and brackish water, in the east of Algeria, from La Calle to Philippeville and from Constantine to Tebessa; the *Barbus setifensis*, which is found all over Algeria; the *Syngnathus algeriensis*, peculiar to the Seybouse and the two streams which unite to form it, the Oued Cherf and the Bou-Hamdan.

From the foregoing it is evident that the fish-fauna of the Tell and of the High Plateaux belongs exclusively to the European or Mediterranean system, and that the Sahara alone is linked to the African system by its Chromidæ—conclusions amply borne out by the flora and entomology of those regions.

III. ACCLIMATIZATION.

Except those which enter the rivers from the sea, the only fish which constitute an appreciable article of food are the eel and the two barbels.

The *Salmo macrostigma*, of which the flesh equals in delicacy that of its European congeners, is only found in a few rivers far from the centres of population, and cannot be easily transported. The Chromidæ, of which the flesh resembles that of the perch, never attain a great size, and are confined to the Sahara, whence it is impossible to convey them to our markets. The others are too small or too rare to be of use as an article of food.

The eel and the barbels are sold in large quantities; but the latter are detestable, and suited only to the accommodating stomach of the hungry soldier, especially when they have attained a considerable size, or have lived in water with a muddy bottom.

It is therefore a great desideratum to substitute or, rather, to add other species more valuable as articles of food.

The Arabs have never shown a very great liking for fish, and have never attempted to naturalize them, except in the case of the goldfish, which was prized rather for its beauty than for its economic value.

The first attempt to introduce European species since the French conquest was made in 1858 by MM. Kralik and Cosson, who brought to Constantine a barrel of young carp and the ova of various Salmonidæ. The latter were successfully hatched; and the young fish developed rapidly in the pure water of the cistern in which they were placed; but no sooner were they launched into the water of the river Rummel than their bodies and eyes seemed to get covered with a sort of calcareous film, and they speedily died. The carp, on the contrary, have suc-

ceeded admirably in the basin of Djebel Ouah, and have multiplied amazingly. Some were put into the Rummel; but the Zouaves, informed of their translation, immediately set to work to catch them, and soon destroyed these new denizens of the river.

Attempts at pisciculture have also been made in the province of Algiers, where carp and, more recently, tench have succeeded perfectly in reservoirs.

At this point, however, the experiment has remained stationary, and no effort to naturalize the fish thus bred has been made. The question, as far as relates to the Salmonidæ, appears to us easy to resolve, after the experience gained at Constantine. Fish of this family require fresh and clear water not charged with calcareous deposits. These conditions are only possible on certain points of the littoral, particularly in eastern Kabylia, and partly in that of Babor, where the streams rise on the sides of high mountains, preserving a temperature nearly constant, flowing on a bed of gneiss, granite, or schist, and protected from the rays of the sun by shady forests.

Unfortunately, on the whole of the littoral of the provinces of Constantine and Algiers the mountain-range is broken up into an infinite variety of little basins, very steep, which only supply running water from autumn till June. An extensive zone of acclimatization cannot, therefore, be anticipated for the salmon family; and the small volume of water in those waters will not permit the introduction of the larger species; but the Algerian trout may well be employed to people the few suitable rivers, where it does not already exist.

In this zone also an attempt might advantageously be made to introduce fish of other families, especially of the Percidæ, which delight in clear and limpid water. In the province of Oran these might succeed in the upper part of the Tafna, which flows over a bed of rocks and gravel.

In other parts of the country, where even the most important streams sink, during the hot season, to a mere series of pools connected by shallow rills thoroughly heated by the sun's rays, the carp and tench offer the best chances of success. The latter (which, in Europe, inhabits muddy marshes almost dry in summer, without detriment to the quality of its flesh) might support as well as the barbel the calcareous salts which the majority of rivers in Algeria hold in solution, the rather that they would be free from its natural enemies the larger crustaceans and voracious fishes.

IV. ICHTHYOLOGY.

1. *Gobius rhodopterus*.

Gobius reticulatus, Cuv. & Val. xii. p. 50; M'Coy in Ann. & Mag. Nat. Hist. 1841, vol. vi. p. 403 (not *Eichw.*).

— *rhodopterus*, Günth. Fish. iii. p. 16.

D. 6 | 9-10; A. 9-10; L. lat. ca. 38.

Snout rather rounded, with the lower jaw longer than the upper; head longer and broader than high; eyes close together on the top of the head; sides of head naked; teeth of the outer series enlarged; no canines. Height of body from 6 to 7 times and length of head $4\frac{1}{2}$ times in the total length. Scales in about nine longitudinal series; those of the anterior part of the body are imbedded in the skin, those on the tail are much the largest; and the nape is naked. Dorsal fins rather close together, and lower than the body; none of the rays of the pectoral silk-like; ventrals extend nearly as far as the vent; caudal rounded. *Coloration*: brownish olive, irregularly spotted and reticulated with darker, and with an interrupted brown longitudinal band; first dorsal with a large black spot posteriorly; second dorsal and caudal with minute brown spots arranged in lines parallel to their bases; anal immaculate.

Length 1.8 inch.

Hab. The Seybouse, and Oued-el-Cherif, near Guelma. *Mediterranean, Dublin Bay.*

2. *Gobius paganellus*, L.

Hab. The Seybouse near Guelma and the rivers of Eastern Kabylia. *Mediterranean and coasts of Great Britain.*

3. *Blennius vulgaris*, Poll.

Hab. Oued-el-Harach and rivers of Eastern Kabylia. *Mediterranean, lakes of Italy.*

4. *Cristiceps argentatus*.

Blennius argentatus, Risso, Ichth. Nice, p. 140.

— *Audifredi*, idem, p. 139.

Clinus argentatus, Risso, Eur. Mérid. iii. p. 238.

— *testudinarius*, idem, p. 239.

— *virescens*, idem, p. 239.

— *Audifredi*, idem, p. 240.

— *mutabilis*, Cocco, Giorn. Sc. Lett. ed Arti Sicil., April 1833, xlii. p. 9, t. 42. f. 2.

— *argentatus*, Cuv. & Val. xi. p. 354; Guich. Expl. Sc. Alg. Poiss. p. 74.

Cristiceps argentatus, Günth. Fish. iii. p. 272.

Perhaps the most interesting discovery that has yet been

made in connexion with the freshwater-fish fauna of Algeria is the occurrence of a well-known Mediterranean Blennioïd in an artesian well on the high plateaux of the province of Algiers. M. Fanton, a naturalist of Algiers, has presented us with a specimen of the common *Cristiceps argentatus*, Risso, which he assures us he caught in one of the "rigoles d'écoulement" of the Fontaine Malakoff, an artesian well excavated in the vast depression which traverses the route between Algiers and El-Aghouat, known as the Basin of Zahrez.

The following is a description of the specimen in question, which differs in some respects from the diagnoses of other specimens with which we have compared it:—

B. 6; D. 3 | $\frac{27}{3}$; A. $\frac{2}{17}$; V. $\frac{1}{2}$.

Height of body about 5 times in total length; head 4 times in the same; snout of moderate extent, subconical, with the lower jaw somewhat prominent; no palatine teeth. The width of the interorbital space is half the diameter of the eye; a small but rather broad fringed tentacle above orbit.

Scales rather large and very conspicuous. A well-developed separate dorsal fin on the nape of the neck, supported by three rather stout spines, the middle of which is nearly equal in length to the last of the second dorsal, which latter is united with the base of the caudal.

Colour, after maceration in spirit, olive; two longitudinal rows of large brown blotches, about eight or nine in number, along the base of the dorsal and above the lateral line; a series of white spots below the lateral line; a narrow band from the origin of the first dorsal, through eye, across cheek, behind mouth; fins immaculate.

Length $5\frac{1}{2}$ centimetres.

Hab. Ain Malakoff. *Mediterranean, Cape of Good Hope, coast of Australia.*

5. *Atherina Rissoi*.

?*Atherina Rissoi*, Cuv. & Val. x. p. 435.

We think we have recognized in a small *Atherina* from the Metidja a species very imperfectly described by Valenciennes under the above name, and which does not seem to have been recorded since. If it is not identical with that species, it is certainly a new one.

D. 6–8 | $\frac{1}{11-12}$; A. $\frac{1}{13-14}$; L. lat. 48; L. transv. 11.

The root of the ventral falls below the origin of the dorsal. Height of body $\frac{1}{6}$ of the total length; length of head $4\frac{1}{2}$ times

in the same. Diameter of eye about $\frac{1}{3}$ of the length of the head; it is greater than the length of the snout or interorbital space. Cleft of mouth oblique; maxillary extends beyond the anterior margin of eye; teeth very minute on the jaws, none on the vomer or palatine bones. Depth of extremity of tail rather less than diameter of eye. Distance from extremity of second dorsal to root of caudal less than length of head. From fifty-five to sixty series of scales from occiput to base of caudal; forty-eight only from superior angle of operculum.

A longitudinal silvery band on the fifth series of scales. Upper part of body minutely punctulated with black, generally with larger black spots scattered irregularly over the body.

Length 6 centimetres.

Hab. Streams and ditches of the Metidja; Maison Carrée, Mazafran, Oued-el-Alleng. ? Nice.

6. *Mugil cephalus*, Cuv.

Hab. Rivers of Algeria. Freshwater lakes of Tunis, Nile, Mediterranean, coast of Madeira, West Coast of Africa.

7. *Mugil capito*, Cuv.

Hab. River Bondjemat, near Bône; Lake Bou-Kamira. Lakes of Tunis, Nile, coasts of Europe, Cape of Good Hope.

8. *Gasterosteus brachycentrus*.

Gasterosteus brachycentrus, Cuv. & Val. iv. p. 499, pl. 98. f. 2; Günth. Fish. i. p. 5.

D. $1 \mid 1 \mid \frac{1}{12-13}$; A. $\frac{1}{8-10}$; P. 10; V. $1/1$.

Differing from *G. argyropomus*, Cuv. & Val., in having shorter dorsal spines, the length of which is about $\frac{1}{3}$ of the height of the body. There is sometimes the rudiment of a third dorsal spine concealed in the skin. The ventral cuirass reaches to the superior edge of the pectoral fins. From 0 to 4 scaly plates on the sides of the body above that fin; the rest of the body naked. In the adult the ventral spine does not reach much beyond the middle of the distance from its base to the extremity of the pubic bone.

These fish are minutely punctulated with black to a greater or less degree; and some have large black blotches, which are most numerous on the ventral fins.

Length 2 inches.

Hab. Ditches in the Metidja. Italy.

Since this description was written we have had the opportunity of perusing the latest paper published by M. Paul

Gervais on the freshwater fish of Algeria*. He there alludes to the discovery of a species of *Gasterosteus* (made, in fact, by us). This he imagines, despite of several secondary differences, to be referable to the variety common in the neighbourhood of Paris, of which Cuvier has made his species *G. leiurus*, and which is undoubtedly only a variety of the common European species *G. aculeatus*.

We have again carefully examined our numerous specimens, and we are convinced that it bears a much closer resemblance to the Italian species to which we have referred it.

Our endeavours to obtain specimens of the Chromidæ found in the salt and brackish waters, and even in the artesian wells of the eastern Sahara, have hitherto been without success; but an examination of the literature of the subject leaves little doubt on our minds that they are the *Chromis nilotica* and *Chromis Tristrami*.

9. *Chromis nilotica*.

Chromis niloticus, Cuv. Règne Anim. &c. &c.

Acerina Zillii, Gervais, Acad. Sc. et Let. Montp. 1848, and Ann. Sc. Nat. 3^e sér. x. p. 203.

Coptodus Zillii, idem, Bull. Soc. Cent. Agr. de l'Hérault, 1853, p. 80, pl. 4. f. 5-7, and Zool. et Pal. Gén. p. 204, pl. xlv. f. 3.

This fish has a very wide geographical range, being found from Algeria (if our supposition is correct), certainly from the Nile, to the coast of Mozambique.

10. *Chromis Tristrami*.

Haligenes Tristrami, Günth. Proc. Zool. Soc. 1859, p. 471, pl. 9. f. B; Gervais, Comptes Rend. Acad. Sc. 1866, t. lxiii. p. 7, and Zool. et Pal. Gén. 1869, p. 207.

Chromis Tristrami, Günth. Fish. iv. p. 269.

M. Paul Gervais, writing as late as 1869, persists in quoting Dr. Günther's nomenclature and remarks as contained in the 'Proceedings of the Zoological Society' ten years ago, and completely ignores the corrections which that naturalist has made in his important work, 'Catalogue of Fishes,' vol. iv. p. 269, of the existence of which M. Gervais does not seem aware.

11. *Salmo macrostigma*, Dum.

Hab. Oued Z'hour and its affluents in Kabylia, near Callo.

12. *Cyprinodon calaritanus*, Bonelli.

C. calaritanus, Bonelli, = *C. cyanogaster*, Guich., female, + *C. doliatus*, Guich., male.

Hab. Lake Bou-Kamira, near Bône; Oued Gheir; artesian wells. Nile; south of Europe.

* Zoologie et Paléontologie Générales, 1869, p. 202, pl. xlv.

13. *Cyprinodon iberus*.

Cyprinodon iberus, Cuv. & Val. xviii. p. 160, pl. 528; Steind. Sitzgsber. Akad. Wiss. Wien, lii. 1865, f. 1-3; Günth. Fish. vi. p. 302.

D. 9; A. 9; L. lat. 30; L. transv. 9/10.

We cannot hesitate to separate this species from the foregoing. Of *C. calaritanus* we have examined several hundred specimens without discovering any appreciable difference from the description of Dr. Günther. But we have received from the spring of Taguin two males, the lengths of which are $2\frac{1}{2}$ and $3\frac{1}{2}$ centimetres respectively, which correspond with Valenciennes's description and figure quite sufficiently for identification with them.

In general appearance they resemble more nearly the female than the male of *C. calaritanus*; but they differ from both sexes of that fish in the number of scales on the lateral line, which are in 30 series.

The height of the body is $\frac{1}{3}$ of the total length without caudal; the length of the head is contained $3\frac{1}{2}$ times in the same. Diameter of eye rather more than length of snout, and equal to half the breadth of the interorbital space; it is one-third of the length of the head. Dorsal and anal as much elevated as in the female of *C. calaritanus*, but less than in the male of that species.

The first dorsal ray is inserted midway between the root of the caudal and the gill-opening, and corresponds to the twelfth scale of the lateral line. The first anal ray is below the second or third of the dorsal. Caudal truncated.

Colour: greenish-olive, minutely spotted with black; about eighteen narrow silvery cross bands on the sides; dorsal, anal, and caudal with very distinct black cross bands.

Hab. Taguin, in the High Plateaux of the province of Algiers. *Spain*.

14. *Tellia apoda*.

Tellia apoda, Gervais, Ann. Sc. Nat. 1853, t. xix. p. 15, and Zool. et Pal. Gén. pl. xlv. f. 6; Val. Compt. Rend. 1858, xlv. p. 715; Günth. Fish. vi. p. 309.

D. 13-15; A. 13-14, L. lat. 26-28; L. transv. 11.

The genus *Tellia** is very similar to *Cyprinodon*, but has no ventral fins; the mouth is protractile, the lower jaw projects beyond the upper, the teeth are tricuspid in a single series in each jaw.

The height of the body in females is about $\frac{1}{3}$, and in males somewhat less than $\frac{1}{3}$ of the total length; the length of the head is contained about $3\frac{1}{2}$ times in the same. The diameter

* So called, perhaps, because it has *never* been found in the Tell, but only on the High Plateaux.

of the eye equals the length of the snout, and is considerably more than half the interorbital space; it is contained from 3 to $3\frac{2}{3}$ times in the length of the head. Origin of dorsal midway between base of caudal and posterior margin of præoperculum; it corresponds to the eleventh scale on the lateral line.

Female. Body greenish olive, with from nine to twelve darker cross bands more irregular than in males.

Male. Greenish olive, with about eleven distinct lighter cross bars. A black ocellated spot posteriorly on both dorsal and anal fins. Caudal with several indistinct interrupted transverse bands, and a broad whitish margin.

Length 3 to 6 centimetres.

Hab. High Plateaux of Algeria.

15. *Carassius auratus*.

The common goldfish, originally a native of China and Japan, has been everywhere domesticated, and is found in great numbers in the Oued Malouïa, near the confines of Morocco. We have observed nearly every known variety of it: in some the fins are normal; in others the caudal is three- or four-lobed; sometimes the dorsal is reduced to a few rays, and sometimes it is entirely wanting; while every colour, from bright golden to uniform blackish, and every combination of those colours, has been observed. This fish was, no doubt, introduced by the Moors long before the French occupation of Algeria.

16. *Leuciscus callensis*.

Leuciscus callensis, Guich. Expl. Sc. Alg. Poiss. p. 94, pl. 7. f. 2.

D. 10; A. 12; V. 8; L. lat. 45; L. transv. $10\frac{1}{2}$.

Body elongated, compressed, its greatest height being contained $3\frac{1}{2}$ times in the total length, without caudal. The head is 4 times in the same. Cleft of mouth oblique, lower jaw slightly prominent, intermaxillary reaching to anterior margin of orbit. The attachment of the branchial membrane takes place behind the posterior margin of orbit. Pharyngeal teeth in a single series on each side, slightly hooked, 5.5. Belly behind ventrals compressed, *covered with scales*. Three series of scales between the lateral line and the root of the ventrals. Dorsal above the space between ventrals and anal. Lateral line complete, considerably below the middle of tail during the greater part of its course, but rising to the middle at the root of the caudal. *Colour*: blackish above, minutely punctulated with black; a broad blackish band along the sides above the lateral line.

Length 3 inches.

Hab. All the streams in the east of Algeria.

17. *Barbus callensis*.

Barbus callensis, Cuv. & Val. xvi. p. 147; Guich. Expl. Sc. Alg. Poiss. p. 93; Günth. Fish. vii. p. 92.

D. $\frac{3}{8-9}$; A. $\frac{3}{5}$; L. lat. 42-48; L. transv. $\frac{8-9}{10-11}$.

Four barbels; no pores or tubercles on snout. *Third dorsal ray very strong and deeply serrated*, much shorter than length of head. *Six* longitudinal series of scales between the lateral line and root of ventral. Height of body nearly equal to length of head, and rather more than a quarter of the total length without caudal. Eye considerably in advance of middle of head; cleft of mouth subterminal; upper jaw slightly the longer; lips thin; anal twice as high as broad.

Hab. Throughout Algeria. *River Tajo, Spain.*

18. *Barbus setifensis*.

Barbus setivimensis, Cuv. & Val. xvi. p. 149; Guich. Expl. Sc. Alg. Poiss. p. 93; Günth. Fish. vii. p. 99.

D. $\frac{3}{8}$; A. $\frac{3}{5}$; L. lat. 42; L. transv. $\frac{8-9}{10-12}$.

Four barbels; no pores or tubercles on snout. *Third spinous ray feeble and much less strongly serrated than in B. callensis*. *Five* longitudinal series of scales between lateral line and ventral. Height of body equals length of head, and is contained $3\frac{2}{3}$ times in the total length, without caudal. Eye much in advance of the middle of the head. Lips thick; upper jaw prominent. Caudal forked, lobes rounded; anal twice as high as broad. Entire body and fins generally covered with a thick mucus.

Hab. Setif; artesian wells near the salt lake of Miserguin; Oued Tafna; Bou Farik, near Algiers.

M. Guichenot* has noted a third barbel (*B. longiceps*) as existing in Algeria. This species was named by M. Valenciennes from a specimen brought from the Jordan; and several examples from the Lake of Galilee exist in the British Museum.

M. Guichenot asserts that it is found in the thermal spring of Hamam Meskoutin, where it lives with the *Barbus callensis*. We have examined a large series of specimens from that locality, but we have found none which can be identified with the species from Palestine. We have noticed considerable variations in both the Algerian species, especially in the strength and serrature of the third dorsal ray, but we have found one character invariable in each. In *B. callensis* there are always *six* longitudinal series of scales between the lateral

* Explor. Scien. de l'Alg. Poiss. p. 94.

line and the root of the ventral, and in *B. setifensis* five; whereas in the specimens of *B. longiceps* in the British Museum the number is eight.

This led us to doubt the fact of the last-mentioned being an African species at all; and we begged M. Guichenot to inform us as to the source whence the specimen in the Paris Museum was obtained, and the number of transverse scales. He states in reply:—"J'ai examiné avec beaucoup de soin les deux individus secs du *B. longiceps*, les seuls que possède notre musée, et sur lesquels j'ai compté les écailles qui se trouvent entre la ligne latérale et l'insertion des nageoires ventrales; elles sont au nombre de 7 ou de 8. Ces deux exemplaires proviennent du Jourdain, et non d'Algérie. Je doute beaucoup de l'existence de *B. longiceps* en Algérie, indiquée d'après une tête en très-mauvais état de conservation que j'ai trouvée dans un des lacs de la Calle lors de mon séjour en Afrique, et que je crois avoir rapportée, mais à tort, à ce poisson."

This proves beyond doubt that *B. longiceps* is not an African species.

19. *Clupea finta*, Cuv.

Hab. Nearly all the rivers of Algeria. Nile; coasts of Europe.

20. *Anguilla vulgaris*, Turton.

It is certain that the African eel described as a new species by Guichenot under the name of *A. callensis** is identical with the common European species. It is found everywhere in Algeria.

21. *Syngnathus algeriensis*, n. sp.

The last fish on our list is the only new species which we have observed; and it is interesting, as it is rare to find Syngnathidæ in water entirely fresh and beyond tidal influences†.

Head $\frac{1}{3}$ of the total length; snout half the length of the head, and scarcely compressed. Diameter of orbit $\frac{1}{6}$ of the length of the head; space between eyes concave, and less than the diameter of orbit; occiput slightly elevated and raised in a crest, which extends from the first body-ring to the extremity of the snout. Opercles swollen, finely striated, with a small ridge on the anterior portion only. Trunk heptagonal, rather slender, twice and a quarter as long as the head, and, measured from extremity of snout to vent, once and a half in the length of the tail. There are fifteen pairs

* Explor. Scien. de l'Alg. Poiss. p. 111, pl. 7. f. 1.

† Since this was written we have seen the eighth volume of Dr. Günther's Catalogue, at p. 164 of which he describes this species from the specimens sent by us to the British Museum.

of shields from head to dorsal. Tail tetrahedral, tapering, terminating in a moderately large caudal fin. The top surface is considerably broader than the lower one; it has about thirty-four rings, of which about sixteen are occupied by the egg-pouch in males. The dorsal stands on seven tail-rings, and equals the length from extremity of snout to anterior of opercles, measured on the lower surface of the head; it has twenty-six rays. The lateral line joins the upper surface of the tail at the end of the dorsal fin. *Colour*: blackish, with more or less regular series of white points, brown spots, and irregular patches.

Length $4\frac{1}{2}$ inches.

Numerous specimens were found at the confluence of the Oued Cherif and the Oued Bou-Hamdan, in the province of Constantine (twelve miles above Guelma, and sixty miles from the sea).

XLVIII.—*Notes on Holopus and Pentacrinus.*

By Dr. J. E. GRAY, F.R.S.

MR. RAWSON W. RAWSON, C.B., the Governor of Barbadoes, has kindly sent me the following observation:—"I have procured a specimen of a *Pentacrinus* from the north of the Island of Barbadoes, dredged or, rather, picked up in about 5 fathoms water. I enclose a sketch (see figure). It is ink-black, a portion broken so as to show the interior of the contracted armlets and the Pentacrinal formation of the mouth or entrance of the central canals. Do you know what it is? I am under the impression of having seen an engraving of such a zoophyte, but cannot find it."

There can be no doubt that the animal here referred to is very similar to the crinoid described by M. d'Orbigny at the Académie des Sciences, Feb. 27, 1837. The paper is printed at length in the 'Magasin de Zoologie' for the same year, with a plate, under the name of *Holopus Rangii*.

There is a short notice of the characters of the genus in the 'Annales des Sciences Naturelles,' vol. viii. p. 123, and in Wiegmann's 'Archiv' for 1839.

Playfair, R L and Letourneux, M. 1871. "XLVII.—Memoir on the hydrographical system and the freshwater fish of Algeria." *The Annals and magazine of natural history; zoology, botany, and geology* 8, 373–394.

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