making additional scientific observations. The most likely course to be pursued would be the subordination of both science and safety to Hall's dominant motive, — the desire to reach a high latitude. In the event of his death, the foregoing possibilities would become probabilities, if not actual certainties. It should never be forgotten, when attempting to determine the relative values of the organizations of the several polar expeditions, that the success of the Polaris was entirely due to unprecedented good fortune, and not at all to good management, or extraordinary judgment in encountering and overcoming obstacles. Had serious difficulties occurred at the outset, for instance such as the English expedition had to contend with, it is probable that geographical knowledge would not have been advanced to any important extent.

The principal defect to be noticed in Dr. Bessels' paper is a want of appreciation of the laws of literary and historical perspective. Quite unconsciously, perhaps, he exaggerates the importance of events with which he was personally associated. As an instance, the narrative of the Polaris' voyage is detailed at extraordinary length, occupying some thirty pages of the paper; while the history of the late English expedition, by far the most important of all, occupies but fourteen pages. In fact, an ice-hummock seen by the Polaris appears to be of more consequence than an iceberg seen from any one vessel; and an oath of Buddington's more worthy of chronicle than the most animated descriptions of Kane, Hayes, or Nares. This is a very serious fault in an historical writer, and cannot be too severely reprehended. Generally speaking, it tends to render the style of the publication undignified, and the substance trivial. But it is only fair to remember that Dr. Bessels is writing of circumstances of an exceptional nature; that he is relating much that is new, and which to most persons is rather secret than general history; that he was intimately and prominently connected with the events of which he writes; and that the facts have not, heretofore, been presented from his particular point of view. The faults of the paper are therefore excusable, while the merits would counterbalance them even were they not. The history of two hundred and sixty years of arctic exploration, so far as it relates to Smith Sound, has been condensed into a volume of a hundred and fifteen pages, accessible to any one. The voyages of the various discoverers, beginning with Baffin and Bylot, and ending with Garlington, have been analyzed with a care that indicates the expenditure of considerable labor. The result will be a better appreciation of the work of the older navigators, which Dr. Bessels shows to have been more accurate than was to be expected, and strongly contrasting with that of some of their successors, notably Dr. Hayes. Indeed, considering the light thrown on the geography of this region by the observations of the Polaris, Nares, and Proteus expeditions, it is very difficult to understand how Dr. Hayes could have asserted the existence of the open polar sea. But Dr. Bessels has shown how it was possible for the mistake to be made. In his opinion, and he brings strong evidence to support it, Hayes never reached a latitude above 80°. If this be true, then we can understand why Hayes, looking, as he must have done, across Kane's basin, should have imagined that he saw an open sea. No other plausible explanation can be given; for, had he been north of Cape Collinson with an atmosphere sufficiently clear for observations, he could not have failed to see the opposite coast of Greenland, only thirty miles distant.

In discussing the scientific results, Dr. Bessels might have gone more into detail without fear of incurring displeasure, for the scientific results are the most valuable products of the various arctic expeditions. He is of the opinion that the general set of the currents is to the southward, and that there are no data supporting the theory of an extension of the Gulf Stream to these high latitudes. He calls attention to the fact that the ice met by the Polaris was of a different character from that encountered by the English expedition, and points out the causes which would prevent the latter formation from being continuous. He says, "There is no reason to assume that the ice-cover of the sea in close vicinity to the north pole should be more dense and impenetrable than its lower latitudes." He is also of the opinion that land in some shape exists to the northward of Markham's highest position, basing his opinion upon the soundings and character of the ice in that latitude. This latter assumption may or may not be true; but it will not, in all probability, be removed from the domain of hypothesis for some time to come.

Finally, Dr. Bessels does not consider Greely's situation as dangerous, and is of the opinion that the party remained at Lady Franklin Bay during the past winter, and will be found in the vicinity of Littleton Island about the end of June. He adds some advice regarding the conduct of the relief expedition, which appears judicious; and, considering the experience of the author, it should have great weight.

The impression left after reading the paper, while not exactly prejudicial to arctic expeditions, is certainly opposed to them as some have been heretofore constituted. Their value really lies in the opportunity they afford scientific observers to study phenomena out of the usual range. Unfortunately this end has always been subordinated to a desire to reach the north pole, or an effort to rescue those who had gone forth on that rather barren quest. Without doubt, had not most arctic expeditions been animated by those dominant motives, the results would have been of far more consequence. Certainly future expeditions should be guarded against the operation of similar influences.

THE DEEP-SEA FISHES COLLECTED BY THE TALISMAN.[1]

IN the cruises made by the Travailleur, the exploring-instruments left much to desire, and the taking of fish was so rare, that, as Mr. Milne-Edwards said

[1] Translated from an article by H. FILHOL in *La Nature*.

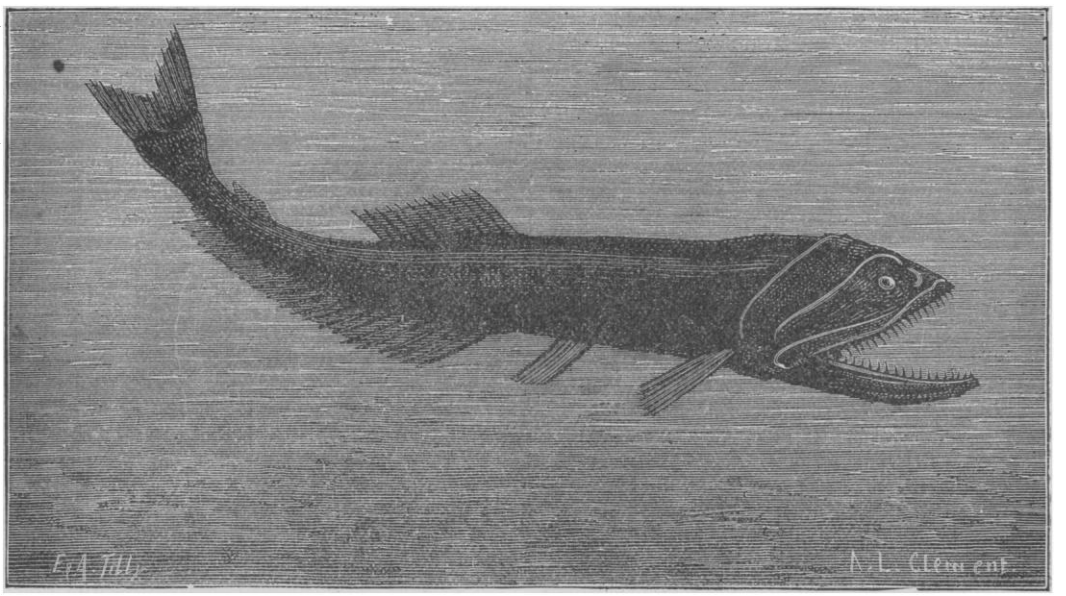

Fig. 1.—Neostoma bathyphilum.

in his report, the capture of one of these creatures 'was considered really an event.' During the cruise of the Talisman, thanks to that new invention, the trawl, they were taken more frequently. Almost all the dredgings resulted in the capture of some fish, and sometimes the number brought up was surprising. For instance: on the 29th of July, in latitude 16° 52′, longitude 27° 30′, in one drag of the trawl, 1,031 fishes were taken, at a depth of 450 metres.

The most interesting surface fishes taken were a large shark, and a fish of small size peculiar to the Sargasso Sea, Antennarius marmoratus Bl. Sch. Sharks (Carcharias glaucus) were found especially between Senegal and the Cape Verde Islands. They followed our ship in schools, and we often saw them accompanied by their 'pilots,'—fishes known among the ancients as Pompilius, and, by naturalists of the present time, as Naucrates ductor. It seems that Naucrates acts as a guide for the sharks, and that the latter, in recognition of its services, never pursue it. It is certain that the Naucrates which we saw lived in perfect harmony with the sharks. They swam around them, and sometimes leaned against them, within the pectoral fin. These fishes, which much resemble mackerel, are bluish gray, darkening toward the back; broad vertical stripes of a beautiful blue encircle their bodies; the pectoral fins are white, the ventral ones black, while the tail is of a blue shade. We found this species of shark in the Sargasso Sea.

In the midst of the floating vegetation of the Sargasso Sea, the second species peculiar to the surface-water, noticed at the beginning of this article, Antennarius marmoratus, is one of the strangest animals we observed. Its back is furnished with long appendages; and its fins, elongated and broadened at the ends, and digitated, form a sort of feet by means of which it circulates among the seaweed which shelters it. It builds a nest, joining, by means of strong mucous threads, balls of the seaweed on which it deposits its eggs. These balls float, tossed about by the waves; and, when the young are born, they probably find a safe home within. This fish, like all the animals of the Sargasso Sea, crustaceans and mollusks, is of the same color as the Algae: it has, as it were, assumed their livery. The color of the body, spotted with brown and yellow and white, harmonizes perfectly with the surroundings; and it is only by careful scrutiny that it is discovered. It is evident that this similarity in color is to allow the animals easily to conceal themselves, and thus escape their enemies. But, as Mr. Milne Edwards observes, if this livery is a protection to the animals possessing it, it becomes in certain cases a danger for them; for, owing to it, the carnivorous species which have assumed it can very easily approach their prey without fear of being seen.

The fishes from the deep sea taken on board of the Talisman include a considerable number of genera and species. An examination of them discloses a series of general facts of great interest. The first question which is suggested to one who studies them is this: are there genera and species of fishes characteristic of bottoms of certain depths? that is, are different faunas found at one, two, three, four, and five thousand metres? This question may be answered in the affirmative, for the dredgings show that the distribution of certain forms is limited. Many examinations were necessary to reach this conclusion, on account of the strange circumstance that certain species are found at a depth of from 600 to

almost 3,000 metres. Thus a fish showing the same organic structure is capable of living under pressures varying from a half-ton to one and two tons, and even more. It may be asked how it is that there are forms characteristic of certain depths; for, with zones of distribution of so great extent, it would seem that abyssal faunas should remain the same. The explanation of this singular fact is, that fishes which are found at a depth of from 600 to 3,600 metres do not dwell continuously in the same locality: they are travellers, rising and descending in turns into the abysses of the sea; and, when they make these journeys, they go slowly, so that they can endure the slow expansion and contraction. I will notice a few species which have made known to us these wonderful voyages. We found Alepocephalus rostratus between 868 and 3,650 metres, Scopelus maderensis between 1,090 and 3,655 metres, Lepioderma macrops between 1,153 and 3,655 metres, Macrurus affinis between 590 and 2,220 metres; the depth of distribution for these four species varying by 2,782, 2,561, 2,502, and 2,000 metres. I could mention other cases, but those cited will suffice to show that the organization of fishes of certain depths is such that it is capable of sustaining enormous weights without suffering. The structures of the fishes just mentioned have nothing special which attracts attention, and distinguishes them from fishes living near the surface. Their teeth are well developed, this peculiarity showing that they are carnivorous (fig. 1). All fishes which live continuously at a depth greater than 600 metres are carnivorous. This results from the fact, that, with the absence of light, vegetation quickly disappears at the bottom, and consequently all the species which do not rise to within 150 metres of the surface, the point where the last Algae are found, are obliged to hunt for food. Fig. 2 shows a cut of one of these fishes, Macrurus globiceps, whose depth of distribution is between 1,400 and 3,000 metres.

If the fishes which transiently visit great depths do not show peculiarities in form, this is not the case with those which continuously inhabit deep waters. This ought not to surprise us, for the structure of these animals must suffer important modifications before being adapted to these peculiar conditions of life. Various influences act upon these fishes. Light and vegetation are wanting. Beyond a certain depth the temperature of the surrounding water tends to become equalized, and the water in which they live is always calm. The modifications due to these circumstances affect the structure of the tissues, the size of the eyes, the development of the sense of touch, and the color. Moreover, these fishes possess organs which ordinary fishes do not possess. Their function is to emit phosphorescent light, and thus to supply the light which is lacking.

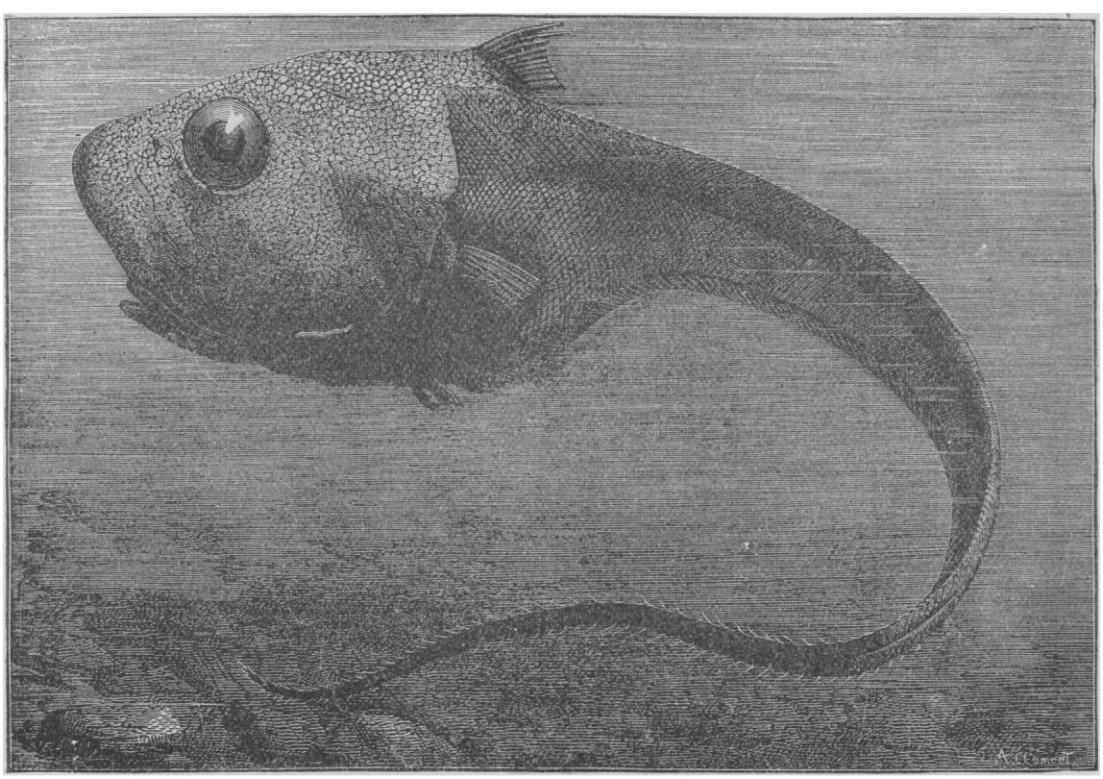

FIG. 2. — MACRURUS GLOBICEPS.

The changes undergone by the tissues are seen in the structure of the skin, muscles, and bones. The skin is thin, and destitute of bright colors, the shades varying from grayish to velvet black (fig. 3). The scales, often much reduced in size, are weakly attached, and the friction which they experience during the ascent of the trawl removes almost all of them. The muscles have little resistance, and, being without flavor, the fish are not edible. The bones are friable, and spongy inside.

In fishes living continuously at a depth to which a little light penetrates, the eyes are quite large in order to present a larger sensitive surface. This fact recalls what we notice in crepuscular birds, whose visual organs are also much developed. Among fishes at a great depth, this increase of the size of the eye is not observed. These organs are of normal size, and possess nothing peculiar, either in their position or structure. Their function in absolute darkness seems at first almost incomprehensible. When, however, one recognizes the fact that these animals possess phosphorescent plates, or, rather, that they are covered by a luminous mucous coating capable of lighting a considerable space, the explanation is found. This phosphorescence serves partly to guide them, and partly to attract prey. It serves, in the latter case, the same purpose as a torch in the hand of a fisherman. This fact has been verified, long since, in the case of surface fishes which hunt at night. Thus Bennett describes a species of shark remarkable for a bright green phosphorescence, which is emitted from the whole lower portion of its body. This learned zoölogist one day brought one of these fishes into a dark room, which was immediately illuminated by its body. The light is increased neither by motion nor by rubbing. After the shark's death, the light from the stomach first disappeared. The jaws and the fins were the last to retain the phosphorescence. The various sharks found only at a depth of two thousand metres, of which several specimens were taken by the Talisman off the coast of Portugal, must, like the fish of which Bennett spoke, use the light which they emit to attract the fishes on which they feed. What is the origin of this mucous coating, which is thus able to shed so bright light? It must be due to the existence of glandular organs, scattered along the sides and the tail, near the eyes on the head, and sometimes more sparsely on the back. But, besides these glandular follicles, certain fishes have apparatus of a quite different kind, which emits light. These organs consist of a sort of biconvex transparent lens, closing externally a chamber filled with transparent liquid. This chamber is furnished with a membrane of black color, formed of

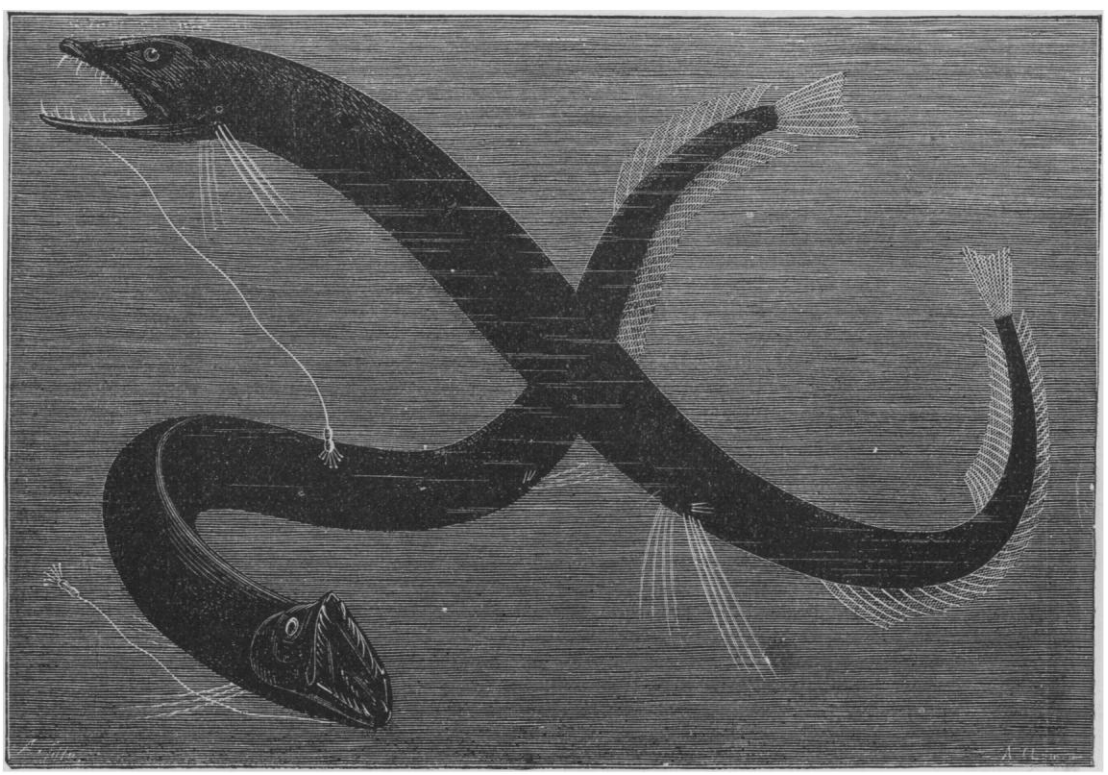

Fig. 3. — Eustomias obscurus.

little hexagonal cells, much resembling the retina: it is connected with the nerves. These phosphorescent plates are placed either below the eyes, or on the sides of the body. In the Talisman exhibition-rooms, Malacosteus niger (fig. 4) may be seen, caught 1,500 and 2,000 metres below the surface, with enormous plates below the eyes, and Stomias, found at the same depth, with side-plates. Several zoölogists have considered the last-mentioned organs as secondary eyes, in consequence of the retina-like membrane which covers them, and on account of its connection with the nerves. This view is difficult to admit, when the normal development of the eyes is taken into account; and it seems much more reasonable to suppose that they serve simply to produce light, which, owing to the lens in front, may be brought to a focus at a certain point.

The tentacle, which is in continual motion, serves as bait to attract fishes on which it springs. Other very peculiar transformations of the rays of the fins into organs of touch may be seen in various fishes taken on board the Talisman. Bathypterois is especially worthy of mention. Among the most singular tactile organs we noticed in these fishes, that of Eustomias obscurus, immediately below the mouth, is to be mentioned. This new genus is shown in fig. 3. One of the most remarkable peculiarities of fishes living in very deep water is the great development of the mouth and the stomach. In Melanocetus and Chiasmodus, the capacity of the latter organ is such that it can contain prey whose size is double that of the body of the fish. As to the proportions assumed by the mouth, the greatest development is shown by Eurypharynx pelecanoides (see figure, p. 620).

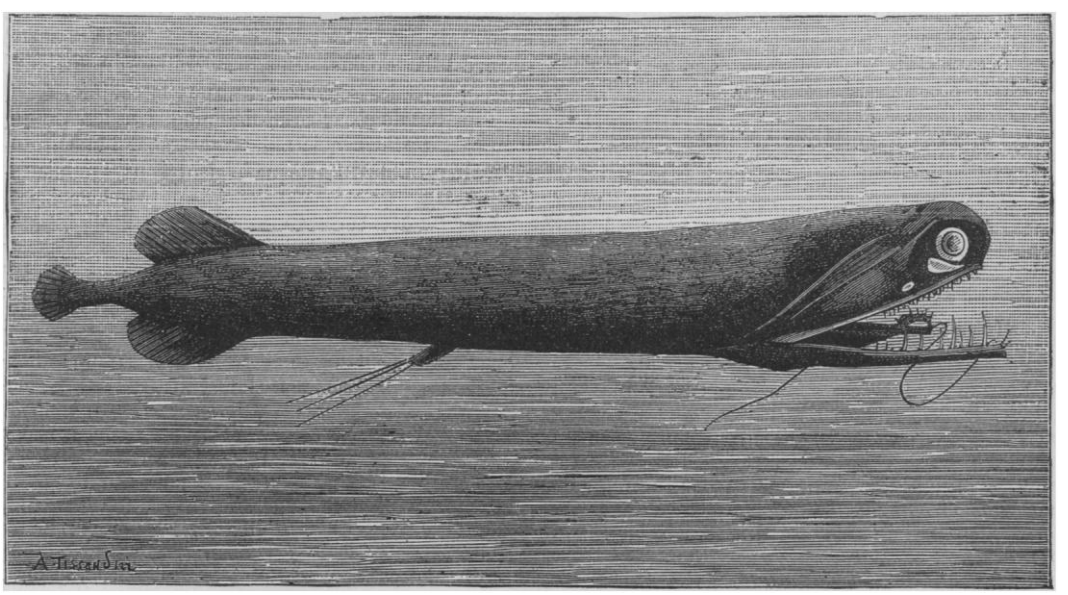

FIG. 4. — MALACOSTEUS NIGER.

Fishes at a great depth seem to move very little. They evidently live buried in the ooze, for one invariably notices bits of lime on their bodies. Often several fin-rays, instead of performing their usual duty, become organs of touch. One of the most remarkable examples of this is shown by a fish caught on the coast of Africa, the Melanocetus Johnsoni (see figure, p. 621). In this animal, which was known only by a single specimen found dead on the surface near Madeira, the first ray of the dorsal fin was developed, and formed a forward projecting true organ of touch, serving the same purpose as that of the goose-fish. In the latter fish there also exists a tentacle at the extremity of the first ray of the dorsal fin. The goose-fish lives in the sand, or ooze, where, by means of its fins, it makes a cavity in which it entombs itself, thrusting out only the upper part of its body.

One of the most interesting questions concerning the distribution of fish relates to the maximum depth at which these animals are met. On the Talisman, the fish caught at the greatest depth was Bythites crassus: it was brought up from a depth of 4,255 metres. The Challenger obtained a fish, Bathyophis ferox, at 5,019 metres.

[Mr. T. H. Bean, curator of fishes in the U. S. national museum, has furnished the following notes on the fishes obtained at the greatest depth by the Albatross, in a letter addressed to Professor Baird, and kindly placed by him at our disposal.— ED.]

The greatest depth explored by the Albatross was 2,949 fathoms (5,394 metres), which was found Oct. 2, 1883, in north latitude 37° 12′ 20″, and west longitude 69° 39′. Five species of fishes, representing

as many distinct families, were obtained in this haul. They are the following: Cyclothone lusca Goode and Bean, Scopelus Mülleri Gmel., ? Aleposomus Copei Gill, an undescribed alepocephalid with scaleless body and head, Mancalias uranoscopus Murray, and Plectropomus crassiceps Goode and Bean MS.

The species obtained at the greatest depth by the Challenger was Gonostoma microdon Günther, which was obtained by the trawl from 2,900 fathoms (5,304 metres), in north latitude 35° 22′, and east longitude 169° 53′.

There may be reason to doubt, with Dr. Günther, the pertinence of Gonostoma microdon to this extreme depth; and the same may be said of our very closely related Cyclothone lusca (a species which is at least congeneric with G. microdon), especially as we have it from depths varying between 552 and 5,394 metres; and it is abundant and widely distributed in the lesser depths. Scopelus Mülleri, also, has been obtained in 556 metres. As for ? Aleposomus and Mancalias (and perhaps, also, Plectropomus), there can be no doubt that they are true deep-sea fishes; and we may expect to find them frequently at the great depth of 5,400 metres. Mancalias uranoscopus Murray was taken at a depth of 4,390 metres by the Challenger, in the Atlantic, between Canary and Cape Verde Islands. The Albatross specimen of this species is the type of Dr. Gill's supposed new blind ceratiid genus, Typhlopsaras.

JOURNEY OF LESSAR TO SERAKS.

THE military railway from Michel Bay, on the Caspian, to Kisil Arvat, was finished in September, 1882. It was afterward decided to make a preliminary survey, having in view the extension of this road to Seraks. The expedition comprised twenty Cossacks, ten sappers, two surveyors, two interpreters, and a guide, who set out from Askabad, a newly established station. In October they reached Annan, after crossing a flat country broken here and there by sandy hills some two thousand feet in height. Annan contains an immense mosque in a half-ruined condition, but with its principal façade intact, and of remarkable elegance. It is the finest of the few monuments of art in the Tekke country. The people live mostly in khibitkas: the site of the town is surrounded with ruined fortifications. Thence the route passed between the dunes twenty versts, to Gwiwars, which has three series of dilapidated fortifications inhabited by a few Kirgis and Tekkes. Several caravans of Tekkes were met with on their way from Merv to Akhala. Having taken refuge in the Merv oasis during the war, they were now expelled by the Mervli, who feared famine from the presence of too many people. The distance from Gwiwars to Baba Durmaz was found to be thirty-six versts, over an undulating country. Water is conveyed to Durmaz by a canal, and, though a little salt, is used by men and beasts without inconvenience. The chiefs of Khorassan, enraged by the conquest of Akhala, and discontented at the reign of order established by Russia on the steppes, are in general unfriendly. The population, however, are well satisfied, and enjoy a peace which they have never known. They are no longer raided by the Mervli, and many men formerly enslaved at Khiva or Akhala have returned to their villages in freedom due to the Russian conquest. From Durmaz to Liutfabad the forests have been cut away, and the soil is riddled so by the burrows of porcupines, that men and horses stumble at every step. Here and there are hillocks surmounted by ruins of towers or ramparts. Very lately each village or farm of this country possessed a round tower, with a single entrance closed by an enormous stone, to which the inhabitants retired at a moment's notice of the approach of one of the robber-bands who infested the region. The robbers did not attack the tower, but stole or destroyed every thing outside of it. At present a watch is rarely kept, and the towers are falling into decay. Liutfabad has a bazaar, reputed the best in all that country, where, however, the only goods were sugar, dry raisins, rice, nuts, bad tea, and henna. The inhabitants held the kindest relations with the Russian explorers. Thence to Kaakha the country for thirty versts is fertile, well watered, with a numerous population; but the streams are destitute of bridges. Woods were observed toward the mountains north of the route.

Near Kaakha the uniformity of the plain is broken by villages, fortifications, and numerous tumuli generally on the banks of streams. These last were said by Vambéry to be erected by the Tekkes over the graves of their chiefs; but the people deny this, and there is little doubt that they are prehistoric. They are circular or elliptical, and reach fifteen or twenty metres in height. Along the route the people worked in the fields with horses or camels, and did not avoid the Russians, but met them on friendly terms. The approach of the party constantly started up pheasants, partridges, and other game from the fields. The Tekke *cuisine*, observed by the explorers, did not comprise the revolting dishes reported by Vambéry, but included pilau, game, camel's milk, melons, and pastry. The people eat with their fingers, but have wooden spoons. On all the steppes many termite-hills were visible, hemispherical, a foot and a half high, and two feet in diameter. These insects are amber-colored, and half an inch long: they form a covered way to any object which they desire to consume, especially wood or cloth. Though destructive to wooden buildings along the line, they have not injured the sleepers of the railway, which is ascribed to the jarring motion produced by the passage of trains, which is supposed to destroy their mud-tunnels, outside of which they will not work.

Seraks is a rather large fortress occupied by a battalion of Persian infantry. The outer line of works is extended to include farms and vineyards. The environs are habitually pillaged by Tekke robbers, who inspire such fear that the garrison never ventures on a *sortie*, and dares not attempt to succor a caravan attacked within a mile or two of the ramparts; and at night the patrol always carry torches. The fortress is armed with six old useless cannon. The River