

XIV. NOTES ON THE FAUNA OF THE MATLAH RIVER IN THE GANGETIC DELTA.

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In December 1915, thanks to the kindness of Mr. T. Southwell, Deputy Director of Fisheries, Bengal and Bihar, I was able to visit certain parts of the Gangetic delta in the S.L. "Kitty," a launch recently built by Government for fishery investigation. The area examined comprises the Matlah River and the channels in its vicinity, and extends from Port Canning in the north to the junction of the Matlah and Biddah rivers in the south, a distance of about 30 miles. The following note deals only with the bottom fauna of this area.

The Matlah river is one of the largest of the numerous waterways that traverse the Gangetic delta and is navigable for ships of large tonnage as far as Port Canning. It varies in depth, but in the main channel there is nowhere less than $4\frac{1}{2}$ fathoms at low spring tides; over considerable areas the water exceeds 8 fathoms and the chart published in 1855 shows that still deeper pockets exist, soundings at a point some $7\frac{1}{2}$ miles below Port Canning reaching a maximum of 27 fathoms.

The level of the water varies greatly according to tide; there is as a general rule a difference of about 10 feet between high and low water, a figure that may rise to as much as 15 feet at spring tides. Towards the close of the monsoon the average level is raised by floods and at such times the uncultivated islands (that is to say, those that are not surrounded by an embankment) are almost wholly submerged at high tide. The water is nearly always heavily laden with silt and doubtless shows great seasonal variation in salinity. On the occasion of my visit the specific gravity (corrected to a standard temperature of 15°C.) varied from 1.00375 to 1.01075.¹ Higher readings would almost certainly be found immediately prior to the monsoon, when the land drainage is at its minimum, and during the flood season the water at certain states of the tide is probably almost fresh.

In the area examined the river bottom appears to be composed of very finely divided mud, in character considerably softer than I have seen in any other locality. On the banks at low water a person of average weight will sometimes sink to a depth of two feet and, unless active, may require assistance to extricate himself.

¹ The specific gravity of the sea on the Orissa coast of the Bay of Bengal is much greater than the highest of these readings, varying from about 1.017 at the close of the monsoon to 1.0280 in early spring.

The mud of the river bed appears to be of a similar consistency, but in a few places near the junction of the Biddah river there is a small admixture of sand. The tidal currents run swiftly, with the result that the upper layers of mud on the river bed must always be kept in motion and partially in suspension, the actual bottom being perhaps almost impalpable.

The fauna of the river bed appears to be very limited ; but, though poor in species, it is abundant in individuals. The more characteristic of the species obtained in our small trawl¹ were the following:—

CRUSTACEA.	FISH.
Palaemonidae.	Sciaenidae.
* <i>Palaemon mirabilis</i> , Kemp.	<i>Sciaena corta</i> (Ham.-Buch.).
* <i>Leander styliiferus</i> , Milne-Edwards.	<i>Umbrina sinuata</i> , Day.
* „ <i>tenuipes</i> , Henderson.	Trichiuridae.
Penaeidae.	<i>Trichiurus haumela</i> (Forsk.).
<i>Penaeopsis monoceros</i> (Milne-Edwards).	Gobiidae.
„ <i>brevicornis</i> (Milne-Edwards).	<i>Glossogobius elegans</i> (Kuhl & Hass.).
* <i>Parapenaeopsis sculptilis</i> (Heller).	Siluridae.
FISH.	* <i>Macrones gulio</i> (Ham.-Buch.).
Kurtidae.	<i>Pangasius pangasius</i> (Ham.-Buch.).
<i>Kurtus indicus</i> , Bloch.	Scopelidae.
Polynemidae.	* <i>Harpodon nehereus</i> , (Ham.-Buch.).
* <i>Polydactylus paradiseus</i> (Linn.).	Clupeidae.
Sciaenidae.	* <i>Coilia dussumieri</i> , Cuv. & Val.
<i>Sciaena cuja</i> (Ham.-Buch.).	<i>Stolephorus indicus</i> (von Hasselt).

The names of the more abundant species are marked with an asterisk. For the identifications of the fish I am indebted to my colleague Dr. B. L. Chaudhuri.

The list may, I think, be taken as a fair sample of the bottom fauna of the area examined; but the larger and more active species of fish, such as *Lates calcarifer*, were not obtained in our nets. Apart from fish and Decapod Crustacea the fauna is excessively poor; it includes a Mysid, probably belonging to the genus *Gastrosaccus*, and occasional Isopods, Amphipods and Polychaetes, not more than one or two species of each. Young specimens of Portunid crabs, *Scylla serrata* and *Charybdis rostrata*, were found on a few occasions. A peculiar Medusa, *Asenathia piscatoris*, Annandale,² that appears to live at or near the bottom, was also obtained, but was extremely scarce.

¹ A beam trawl 6 feet in breadth.

² Annandale, *Mem. Asiat. Soc. Bengal*, VI, pp. 114-116, text-figs. 3-5 (1917).

The chief interest of this fauna, and the point with which this note is mainly concerned, is the extraordinary resemblance which the species bear to those inhabiting great depths of the sea. I am convinced that if anyone with experience of both deep-sea and shallow-water faunas were to have made a casual inspection of the contents of the nets we hauled in the Matlah River, he would have expressed the opinion that the catch came from water not less than 400 fathoms in depth. On closer inspection he would no doubt find reason to alter his opinion, for only one of the species is a member of a deep-sea genus and few belong even to families known from considerable depths. But in general facies the two faunas resemble one another so closely that he would almost certainly be deceived at first sight.

The bottom of the Matlah River, with its rapid currents and moving silt, affords an environment altogether unsuitable for sedentary or slow moving organisms, and it is to this feature that the predominance of Crustacea and fish must be ascribed. Conditions in the deep sea are evidently different, for fixed animals such as Hexactinellid sponges are often far from uncommon, while creatures of slow movement such as the leathery sea-urchins and Holothurians are often very abundant. It is in the fish and Decapods that the peculiar character of the Matlah fauna is exhibited and it is, moreover, in the most abundant species that the resemblance to deep-sea forms is most pronounced.

The modifications that give to the deep-sea fauna its peculiar facies may be discussed under two headings,—form and colour; and in view of what has already been said it will be sufficient to refer here only to the fish and Decapod Crustacea.

The colours of deep-sea fish are very limited. The great majority of the species are deep black, grey of varying intensity, silver, and semitranslucent or dead white. Two or more of these colours are frequently found in combination. Reddish and brownish tints are very rare and blues and yellows are almost non-existent. In the Matlah fish there are no black forms, the majority being grey, white or silver. The *Macrones* is very deep grey above and dull white below, with black fins; the *Pangasius*, *Sciaena* and *Umbrina* are grey and silvery and the *Trichiurus* and *Kurtus* altogether silvery. *Coilia dussumieri* is white with a lateral row of brilliant silver spots, while *Harpodon nehereus* is semitranslucent milky white with minute black dots. An exception is *Polynemus paradiseus*, which though greyish above has dull golden brown sides.

The range of colour in deep-sea Crustacea is even more limited than in the case of fish. A considerable number of the species are uniformly crimson, red or pink, while in a few cases purple tones are found. Other species are ivory or milky white, frequently semitranslucent, and these are sometimes blotched or streaked with red, orange or yellow. Forms which are uniformly orange or yellow also occur, but are less common. In the great majority of cases the eggs are yellow or yellowish green.

The Crustacea found in the Matlah River most strikingly resemble deep-sea forms in their colour. *Parapenaeopsis sculptilis* is uniformly deep red, while the Palaemonidae are of a milky semitranslucency¹ with red markings. In *Palaemon mirabilis* red flecks or suffusions are found on the abdominal somites; in *Leander styliferus* the tip of the rostrum and the extremities of the telson and uropods are red. In *L. tenuipes* the mandibular region is bright red and the rostrum dotted with carmine; the lower antennular flagellum is carmine at the base, changing to deep mauve nearer the tip; there are red flecks on the abdominal somites and the telson and uropods are deeply stained with bright red. The eggs are gamboge or greenish yellow.

The peculiar character of the Matlah fauna is at first sight most forcefully brought to notice through the medium of colour, and it is unfortunate that it is not possible to do justice to this very striking feature by mere description. Several of the constituent species, however, show in their structure also a remarkable resemblance to deep-sea forms. The most notable instance is perhaps the "Bombay Duck," *Harpodon nehereus*,² which, with its gelatinous consistency and large mouth with the lower jaws loosely articulated and furnished with recurved teeth, exhibits every characteristic of a deep-sea species. *Harpodon nehereus* differs from all other forms found in the Matlah River in belonging to a family (the Scopelidae) the members of which are almost exclusively of abyssal or bathypelagic habitat; other species of the same genus are known only from considerable depths. The peculiarity of *H. nehereus* lies therefore not in its structure, but in the fact that a representative of such a typically deep-sea family should occur in shallow water. The resemblance to abyssal forms misled even so great an authority 'as Gunther; for, in reference to the two species of *Harpodon* known to him (one being *H. nehereus*), he remarks "both are evidently inhabitants of considerable depths, and periodically come nearer to the surface."³

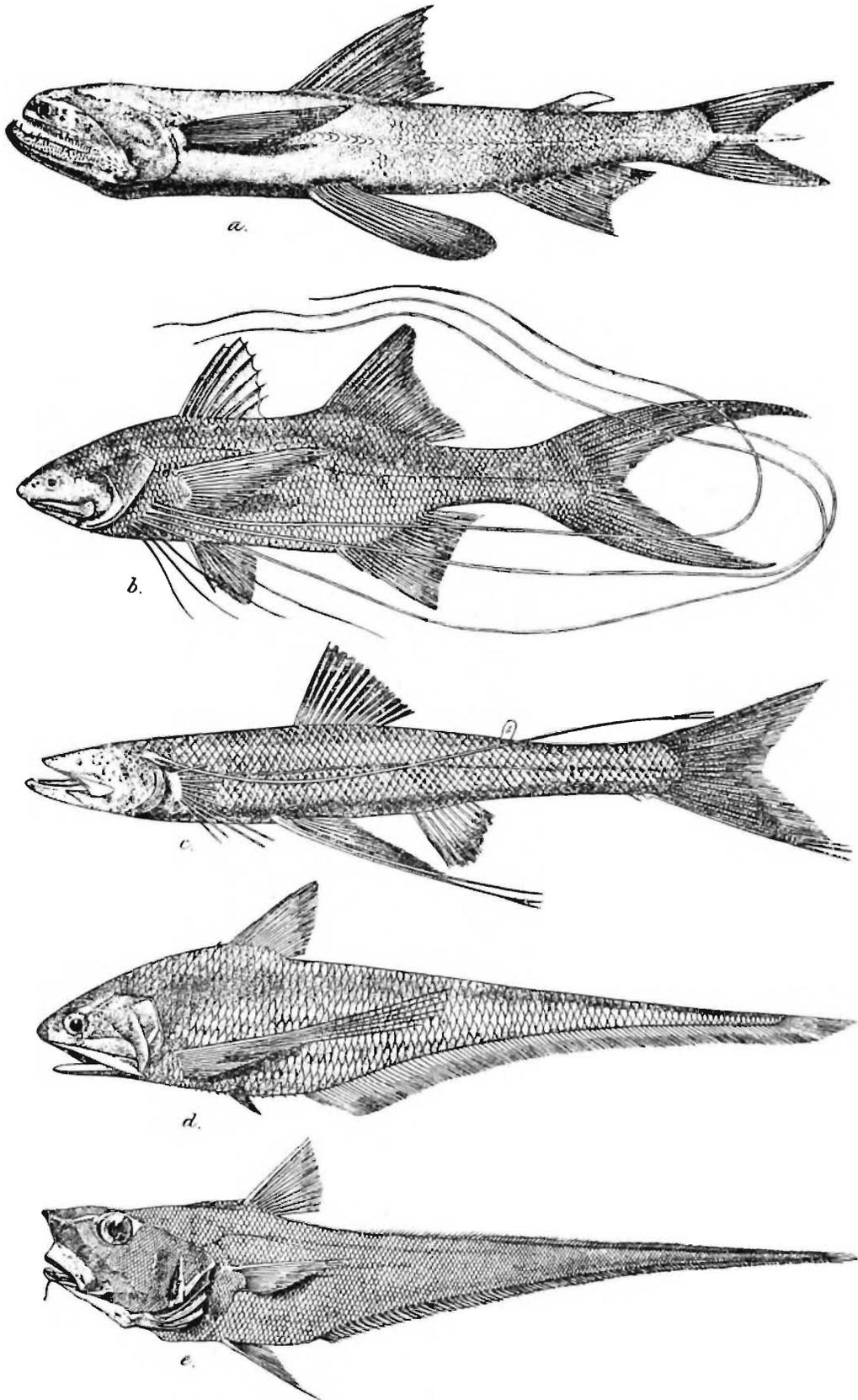
Polynemus paradiseus is remarkable for the extreme length of certain free pectoral rays and for the elongation of the upper and lower caudal rays. In general appearance it is not dissimilar to deep-sea Scopelids of the genus *Bathypterois*, in which both these modifications occur. The eyes in *Bathypterois* are small and some of the species are probably quite blind; in *P. paradiseus* the eyes are small and covered by skin.

In a number of the fish found in the Matlah River the body tends to become attenuated posteriorly. This feature, which is also found in abyssal forms, reaches an extreme development in *Coilia dussumieri*, a species which bears a strange resemblance to deep-sea fish of the genus *Macrurus*.

¹ This milky tint is also found in the bottom-living Medusa, *Asenathia piscatoris*.

² Dr. Chaudhuri informs me that Hamilton-Buchanan must have adopted the specific name of this fish from the Bengali term *nihādē*, meaning "boneless."

³ Gunther, *Study of Fishes*, p. 584 (1880).



- a. Harpodon nehereus* (Ham.-Buch.) [Matlah River].
b. Polydactylus paradiseus (Linn.) [Matlah River].
c. Bathypterois dubius, Vaillant [Deep-sea].
d. Coilia dussumieri, Cuv. & Val. [Mutlah River].
e. Macrurus wood-masoni, Alcock [Deep-sea].

FIGS. *a, b, d*, after Day, fig. *c* after Vaillant, fig. *e* after Alcock.

Among the Decapoda Macrura characteristic differences between abyssal and shallow-water forms are less evident, but in a number of species belonging to several different families the walking legs tend to become extremely long and slender. This tendency reaches its maximum development in the very peculiar forms belonging to the Nematocarcinidae, a family known only from great depths of the ocean.

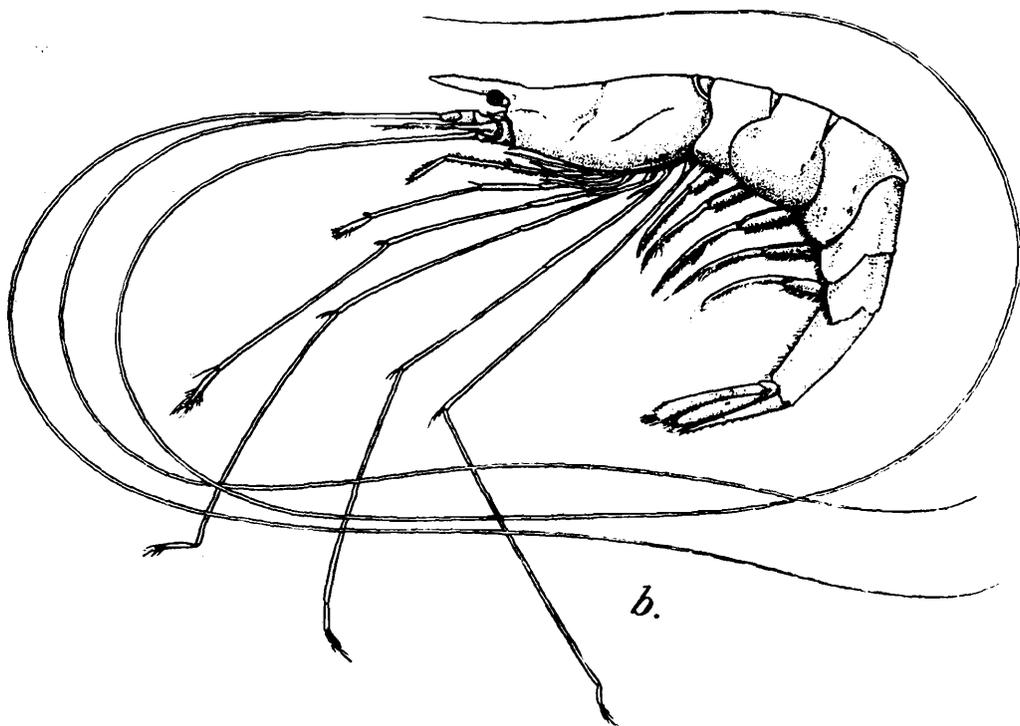
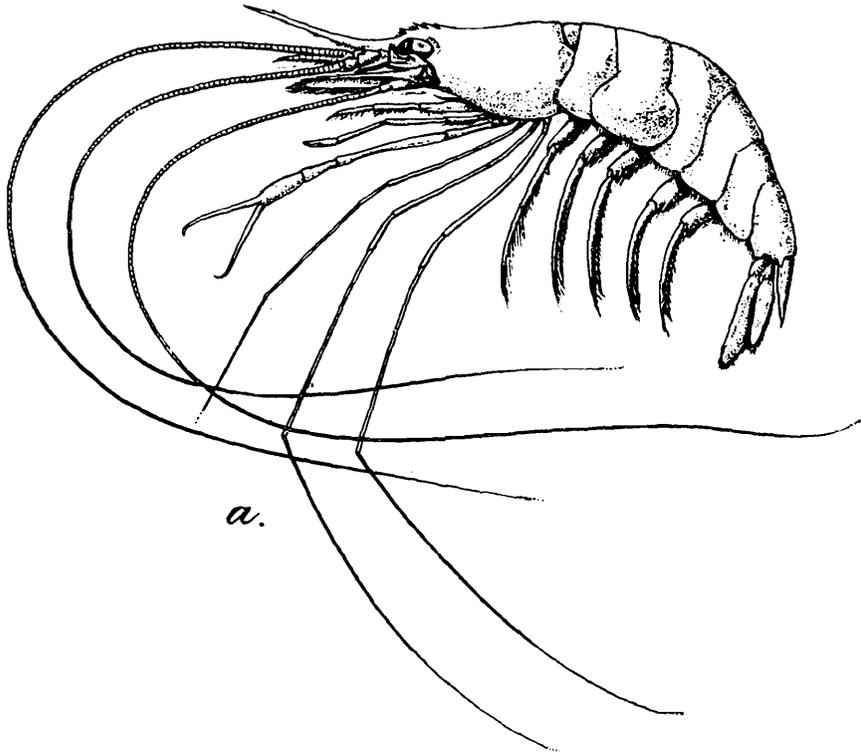
Only a few species of Macrura inhabit the bed of the Matlah River. The Penaeids do not show any special structural modifications, but in all the Carids the legs are noticeably longer and very much more slender than is customary. The most remarkable form is unquestionably *Leander tenuipes*, in which the legs are of the most extreme length and tenuity. I do not know of any shallow-water Carid¹ that is in the least degree comparable with this peculiar species; to find analogous cases we must turn to deep-sea forms and in particular to the genus *Nematocarcinus*. The modification is not effected in the same way in both cases. In *L. tenuipes* it is in the main brought about by the extreme attenuation of the propodus and dactylus; in *Nematocarcinus* these two segments are short, the great length of the leg being due to an elongation of the ischium, merus and carpus.

There are two characteristic features of a deep-sea fish and Crustacean fauna that are not met with in the Matlah River,—(i) the eyes are about normal in size and no species, except perhaps *P. paradiseus*, is even partially blind, (ii) none of the species possess luminous organs. In many deep-sea forms, however, the eyes show but little modification, and it now seems probable that all abyssal animals that possess definite luminous organs or photophores (as opposed to glands excreting a luminous fluid) are meso- or bathypelagic in habit and do not live on the bottom. *Harpodon nehereus* is said to be brilliantly luminous over its whole surface, but this is a statement that I am not able to corroborate by observation.

Summarising what has already been said, it may be stated that the comparatively small number of animals living on the bed of the Matlah River present modifications similar to those found in a deep-sea fauna. The resemblance is due largely to colour—the similarity in this respect being almost exact—, while it is enhanced in a number of instances by the presence of structural peculiarities rarely met with except in abyssal forms.

It should be noted that no single member of the Matlah fauna is restricted to the Gangetic delta; some of the species have a wide distribution and several are known to occur in the open sea. It is, moreover, probable that a number are migratory forms, visiting the Bay of Bengal during the flood season; there is, at any rate, evidence that this is the case with the two species of *Leander*.

¹ Except *Leander hastatus*, Aurivillius, from the W. African coast, a species having an extremely close affinity with *L. tenuipes*.



a. Leander tenuipes, Henderson [Matlah River].
b. Nematocarcinus exilis (Bate) [Deep-sea].

Notwithstanding these facts I am strongly of the opinion that the resemblances between the two faunas are not fortuitous; some underlying cause must be at work and there can be no reasonable doubt that this cause is to be sought in the environment. So far as I can understand, the environment appears to have exercised a selective influence on the Matlah fauna, and has in some way permitted the existence only of those species that conform to certain definite rules. That this has resulted in the existence of a fauna resembling that of the deep sea is exceedingly curious, but it affords, I think, a clue as to the factors involved.

There are few points of similarity between the environment of the species found in the Matlah River and that of those found in the ocean depths. Complete absence of light, great pressure, low temperatures, high salinities and still water characterise the latter, whereas in the former the temperatures are high, the salinities very low and the tidal currents swift. I have no precise information as to the amount of light on the bed of the Matlah River. It is no doubt greatly diminished, for the water is heavily laden with silt and, as has already been pointed out, the upper layers of mud are probably always kept in motion by the tidal currents. There can, however, be little doubt that some light penetrates to the bottom.

But there is another factor, which may or may not be dependent on the amount of light, that appears to be of considerable importance; to this factor the term visibility may be applied. Dr. Annandale and I noticed that the Palaemonidae found in the Matlah River, when placed in an aquarium with the cleanest river water we could procure, were quite invisible unless they approached within an inch or so of the glass. The lack of visibility was brought about in the main by the colour of the animals, the milky translucency of their bodies seeming to correspond precisely with the turbidity of the water. Transparency is quite ineffectual in rendering animals invisible in muddy water; I have frequently noticed that such planctonic forms as *Pleurobrachia* and the Penaeid *Acetes* are extremely conspicuous in silt-laden water, forming as it were hyaline spaces in an otherwise merely translucent medium. In aquatic forms, then, the factor of visibility seems to depend, when light is present, on a relation between the opacity of the animal compared with that of the water in which it lives. In the Matlah River visibility, in the case of a considerable part of the bottom fauna, is evidently very low and in the deep sea, unless animal or bacterial luminosity is strong, it is practically absent.

Thus in the matter of visibility there is perhaps some slight similarity between the two environments and other factors common to both are the absence of vegetation and the nature of the bottom. But weeds are in many places absent without producing the curious effects seen in the Matlah fauna, and it is probable that the character of the bottom is much the more important. The mud of the Matlah River bed is of a peculiarly soft consistency

and is perhaps the nearest approach to the deep-sea oozes that is to be found in shallow water.

A diminished supply of light, low visibility and the very soft nature of the bottom appear to me to have been the principal factors that have determined the character of the Matlah fauna. The colour phenomena seem for the most part to be controlled by the first two of these factors. The presence of red pigmentation in deep-sea Crustacea is probably brought about in some way not yet fully understood in response to a diminished supply of light and, if this is so, there is every reason to think that the red colouration so commonly met with in the Matlah prawns is precisely similar in origin. In these cases there is no evidence that the colour has any protective significance. It is otherwise, however, with the peculiar translucency of the tissues that may exist either in combination with, or in absence of red pigment. This feature is clearly of protective value in the Matlah fauna; whether it is more than fortuitous in deep-sea forms we have at present no means of ascertaining.

The structural modifications, on the other hand, more particularly the elongation and attenuation of fin-rays and appendages, appear to be correlated with the nature of the bottom, and the evidence afforded by the inhabitants of the Matlah River suggests that this factor has had a greater influence than has generally been supposed in moulding the character of many deep-sea species.
