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TWO NEW GENERA AND SPECIES OF ACANTHOCEPHALA FROM FISHES OF INDIA.*

By H. J. VAN CLEAVE, *University of Illinois, Urbana, Illinois, U.S.A.*

From time to time, the late Doctor Annandale and Dr. B. Prashad have forwarded to me small consignments of Acanthocephala from the collections of the Indian Museum. This first report upon these specimens sets forth the descriptions of two new species from fishes, each of which becomes the type of a new genus. One of these genera departs so far from the general plan of organization in the recognized families of Acanthocephala that a new family is proposed to include it as type.

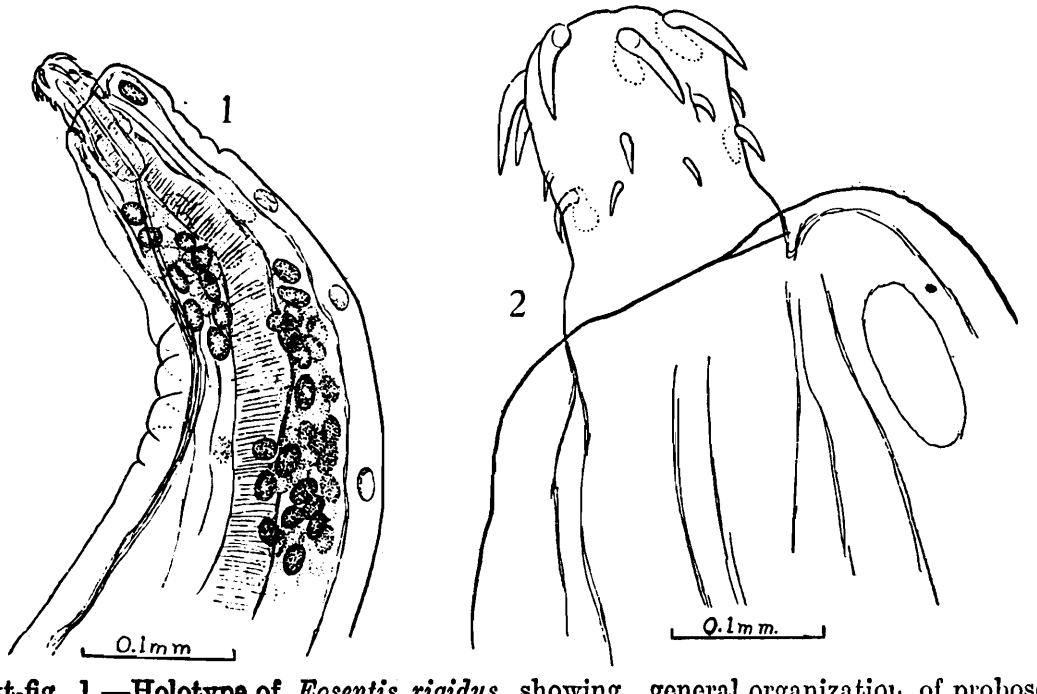
Eosentis, gen. nov.

This genus seems to belong to the family Neoechinorhynchidae but the subcuticular nuclei do not seem to conform exactly to the arrangement in this family. Body without spines, moderately long, tapering toward the posterior extremity. Proboscis short, globular, armed with a few circles of hooks. Proboscis receptacle with a single, very thick muscular wall. Lemnisci large, extending through the anterior fourth of the body cavity. Males not observed. Parasitic as adults in digestive tract of fishes.

Type species: *Eosentis rigidus*, sp. nov.

Eosentis rigidus, sp. nov.

Description based upon a single female which becomes the holotype. Body slightly crescentic in form, about 9 mm. long and 0·87 mm. in

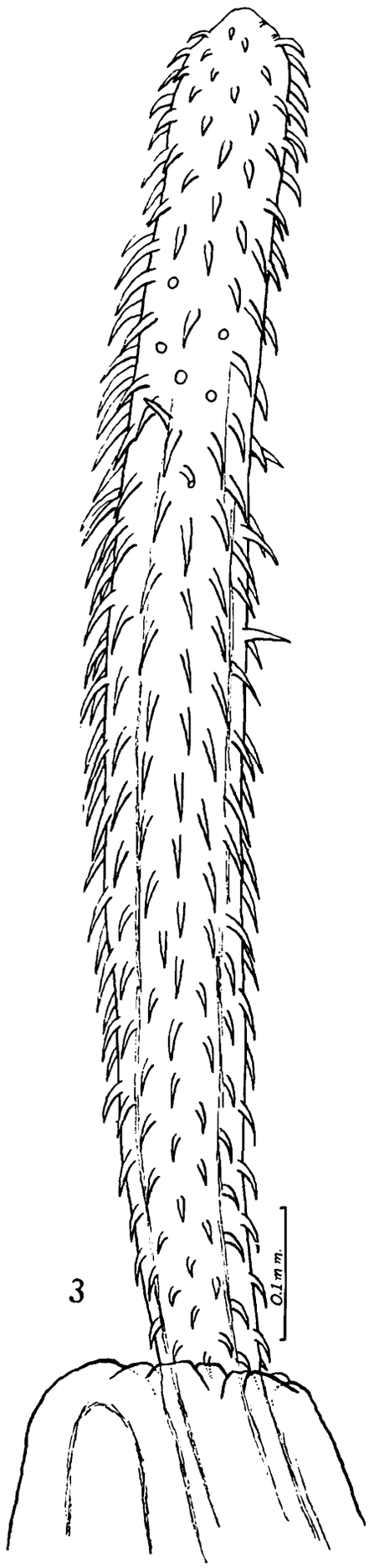


Text-fig. 1.—Holotype of *Eosentis rigidus*, showing general organization of proboscis and anterior region of body.

„ 2.—Proboscis of holotype of *Eosentis rigidus*, showing arrangement of hooks.

* Contributions from the Zoological Laboratory of the University of Illinois, No. 314.

maximum diameter. Proboscis globular, 0·192 mm. in length and 0·153 mm. in diameter; armed with three rings of six hooks each. Hooks of terminal circle 70μ long, of second circle 47μ, of basal circle 41μ. Embryos not present.



Text-fig. 3.—Proboscis of holotype (male) of *Filisoma indicum*, showing details of proboscis hooks and relation of proboscis to body proper.

Type host: *Schizothorax zarudnyi* taken at Seistan by Drs. N. Annandale and S. W Kemp.

Holotype deposited in the collections of the Zoological Survey of India (Indian Museum), Calcutta.

Filisomidae, fam. nov.

The extreme length of the body and of the proboscis in the genus *Filisoma*, the structure of the body-wall, the form of the cement glands of the male, the location of the brain and location of the genital orifice of the female are characters not paralleled in any other genus of acanthocephalans from fishes. The name Filisomidae is therefore recommended for a family to include *Filisoma* as type. The characters of the genus as enumerated above must suffice for the family until the group is more thoroughly understood.

Filisoma, gen. nov.

Body without spines, very long and very slender. Sub-cuticular nuclei small, numerous. Proboscis excessively long and slender, cylindrical, armed with about 14 longitudinal rows of more than 20 hooks each. Proboscis receptacle long, cylindrical, bluntly truncated at posterior extremity; with a double muscular wall. Brain near posterior extremity of receptacle. Lemnisci broad, about same length as receptacle. Reproductive organs of male restricted to posterior half of body cavity. Testes elliptical, length several times the diameter, slightly separated. Cement glands very long, individual glands not recognized in type material. Parasitic as adults in the digestive tract of fishes.

Type species: *Filisoma indicum*, sp. nov.

Filisoma indicum, sp. nov.

Body 20 to 30 mm. long, with a maximum diameter of 0·28 mm. in the male and 0·68 mm. in the female. No indication of body spines. Proboscis in type male 1·5 mm. long, almost perfectly cylindrical, 0·089 mm. in diameter; armed with about 14 longitudinal rows of 24 hooks each. Hooks near the middle of the proboscis 35μ long, gradually diminishing in length to about 24μ near base and 18μ to 30μ near tip. Proboscis receptacle about 1·3 mm. long. Embryos not fully formed in specimens under observation. Each testis about 1·2 mm. long with a diameter of 0·25 mm. Genital opening of female distinctly ventral at posterior extremity between a pair of blunt, ventrally produced papillae.

Type host: *Scatophagus argus* at Barkul, Chilka Lake, India. Specimens examined were taken from the intestine of the host on November 29, 1914.

This species, described from six individuals, was taken in the Chilka Lake Survey. The holotype is deposited in the collections of the Zoological Survey of India (Indian Museum), Calcutta. Paratypes are in the same collection and in the collection of H. J. Van Cleave at Urbana, Illinois, U. S. A.

THE EVOLUTION OF THE ORDER ODONATA.

PART I.—INTRODUCTION AND EARLY HISTORY OF THE ORDER.

By R. J. TILLYARD, *M.A., Sc.D. (Cantab.), D.Sc. (Sydney), F.R.S., F.L.S., F.G.S., F.E.S., C.M.Z.S., F.N.Z. Inst., Assistant Director and Chief of the Biological Department, Cawthron Institute, Nelson, N Z.*

Recent discoveries in fossil insects have to a large extent bridged the great gaps which once obscured our view of the evolution of the principal Orders of Insects. The history of the winged Insects previous to the Upper Carboniferous is still obscure, although some light is necessarily thrown upon it by the discovery of what appear to be undoubted remains of Collembola in the Rhynie Chert of Scotland [Devonian : Old Red Sandstone ; see Hirst and Maulik (1926) and Tillyard (1928*b*)]. It is logical to argue that if Collembola existed in the Old Red Sandstone so did Thysanura, which are in their morphological characters even more primitive. Indeed, a pair of insect mandibles preserved in these same beds may be placed with considerable probability as the mandibles of a young larval stage of some Thysanuran, probably belonging to the family Lepismatidae. If these fossils do really belong to the Apterygota, it gives much added weight to the theory that the Pterygota are descended from Apterygotan ancestors, and weighs equally strongly against Handlirsch's theory of the direct descent of Pterygota from Trilobites, with Apterygota as a debased side-branch.

But, however that may be, we are still faced with a complete gap in our knowledge as to how insect wings first arose. It is still quite legitimate to argue, purely on the evidence available from morphology and physiology of recent forms, that wings arose as specializations either from (*a*) paranotal expansions or (*b*) tracheal gills. All we can be certain of is that wings did arise, almost certainly by one or other of these methods, during the geological period between the Old Red Sandstone and the lower portion of the Upper Carboniferous. Judging by the wealth of forms and high comparative specializations displayed by the known Upper Carboniferous Insect Faunas, one would be inclined to expect the first winged Insecta at least as far back as the Lower Carboniferous.

The two great gaps in our knowledge of fossil insects which existed for so many years have now been almost completely filled by the discoveries made in the Permian and Trias. Before that, the Permian record was very poor indeed. Apart from a considerable number of Blattoids, Handlirsch in 1908 was only able to record one Protorthopteron, three Protoblattoidea, four Plectoptera, one Protodonaton, one Protohemipteron, two Homoptera and one doubtful member of the Perlaria. The discovery of a rich fauna in the Lower Permian of Kansas, and a more restricted though equally interesting fauna in the Upper Permian of Belmont and Newcastle, N. S. W., has changed the Permian from

one of the least known to almost the best known geological epoch as regards insect life. Much the same has been the case with the Trias. In 1908 Handlirsch listed only nineteen Triassic Coleoptera and two Neuroptera. Then came the discovery of the rich Upper Triassic fauna of Ipswich, Queensland, from which more than 120 species have already been described ; and, much more recently, an older Triassic bed is being explored near Sydney, N. S. W and has yielded a number of valuable discoveries not yet worked out or described.

Up to 1908, the oldest undoubted fossil Odonata belonged to the Lias, representing a period when the Suborder Anisozygoptera was dominant. At the present day, only a single genus (*Epiophlebia*) of that Suborder remains, with two species, one in Japan and one in the Himalayas. His analysis of the Liassic fossil record led Handlirsch to postulate the theory that the Anisozygoptera were the original stem of the Odonata, the Zygoptera being derived from them by reduction and the Anisoptera by amplification and addition.

The few Odonata discovered in the Upper Trias of Ipswich, Queensland, did not support this view, for they were all of simpler wing-structure than the Liassic Anisozygoptera, and the two forms in which the base of the wing was preserved (*Triassagrion* and *Triassolestes*) were both strongly petiolate. On Handlirsch's theory, these should have been later geologically, instead of earlier. It was still possible to argue, however, owing to the paucity of material, that these might have been very specializations, and that Anisozygopterous forms with non-petiolate wings existed in the Trias, though not yet discovered.

The next important discovery of fossil Odonata was made by myself when examining the great collection made by the Yale University Expedition, from the Kansas Lower Permian beds. Out of about two thousand specimens, two genera of undoubted Odonata were found. One of these, *Kennedya* Till. (1925), was represented by both basal and distal portions of wings, and proved to be an exceedingly simplified type with strongly petiolate base. The other, *Ditaxineura* Till. (1926*a*), was only represented by the apical portion of the wing, but is nearly enough allied to *Kennedya* to make it certain that it did not differ very greatly from it in the form of the basal portion of the wing. A third genus, *Opter* Sell., (poorly preserved), can be recognised as belonging to the same group, and is petiolate also.

With these discoveries, it seemed to me already clearly indicated that the original type of the Order Odonata was a very simple Zygopterous, or rather Protozygopterous, form in which the wings were definitely petiolate and the number of cross-veins was less than in any existing forms, however simple. This hypothesis forms the basis of the new classification of the Order which I have given in my " Insects of Australia and New Zealand " (1926*b*). The Lower Permian forms are definitely assigned to a new Suborder Protozygoptera, distinguished from true Zygoptera by the absence of any specialized discoidal cell, the absence of a subnodus, and the presence within the petiole of a remnant of the original convex vein Cu_1, which is entirely absent from all other Odonata. The Triassic forms were true Zygoptera, still with petiolate wings. The Liassic Anisozygoptera form a complete series leading from petiolate

Zygopterous forms right up to true Anisopterous forms with broadened hindwings; this is clearly shown in my study of the British Liassic species (1925).

In the very restricted Upper Permian fauna from Belmont and Newcastle, N. S. W., no sign of Odonata has yet been seen. But, since true Odonata were present in the Lower Permian of Kansas, it was evident that such must also have been present somewhere on the earth in Upper Permian times. Either they had not yet reached Australia at that period, or else they are present at Belmont but not yet discovered. From a comparison of *Kennedya* with the Triassic and Liassic forms, I concluded that one might expect the Upper Permian forms to be simple, true Zygoptera with petiolate wings and an open discoidal cell not unlike that of the existing Australian genera *Hemiphlebia* and *Chorismagrion;* one would also expect Cu_1 to have vanished and at least some formation of a subnodus to be present.

Such an Upper Permian type has recently been unearthed in the genus *Permagrion* (Tillyard, 1928*a*.) from the Gondwana-formation of the Falkland Islands. This fine wing has proved to be almost exactly what I had anticipated for an Upper Permian type on the working hypothesis laid down. With its discovery, the chain of evidence for the internal evolution of the Order Odonata is practically complete. In this paper, I propose to set out the whole evolutionary history of the Order from the earliest known period, as far as we can trace it from the available palaeontological evidence.

It should be clearly understood that the great majority of fossil insect remains are impressions of wings only. All the Permian and Triassic Odonata so far discovered are wings only; but in the Lias some bodies also are known and in the Upper Jurassic many complete specimens. The classification of the Order being based mainly upon the wing-venation, the main lines of evolution are best indicated by following the venational changes. In a discussion of the evolution of other parts of the imago, or of the larva, more recourse must be had to the methods of comparative morphology, which experience has shown to be much less reliable than the palaeontological evidence.

EVOLUTION OF EARLY TYPES ANCESTRAL TO THE ORDER.

It has been already stated that the earliest known Odonata occur in the Lower Permian of Kansas. In order to trace the history of the Order further back, we begin by examining these beds for traces of insects allied to the Odonata, and we are at once struck by the fairly abundant remains of the closely allied Order Protodonata, previously only known from the Upper Carboniferous. Our first problem is to attempt to decide whether the Odonata proper are direct descendants of the Protodonata, or whether both have come from some older and less specialized common ancestor. If we can show that the Odonata are types modified from known members of the Protodonata by definite venational or other specializations, then we must accept the former alternative, but if we find that the Odonata are themselves more primitive in certain important characters than are the Protodonata, then the latter alternative is the only acceptable one.

The Protodonata differ from the true Odonata, as regards their venation, chiefly in the absence of any true nodus and pterostigma. The presence of the nodus is associated with a greatly shortened Sc, which turns slightly upwards distally to meet the costa at a point where the continuity of the line of the latter is definitely broken. In the Protodonata, most of the known types have Sc very long, running close above and parallel to R_1 nearly to the apex of the wing (*Protagrion*, *Meganeura*, *Typus*, etc.). But in *Paralogus* Sc is greatly shortened, while in *Calvertiella* it is not only considerably shortened but ends on R_1! This last genus was easily the smallest known member of the Order Protodonata, the total length of the wing being only 26 mm., while *Paralogus* had a wing-length of 60 mm. The other members of the Order were all huge insects, ranging from a wing-length of about 90 mm. for *Protagrion* and *Typus*, up to the enormous *Megatypus* and *Meganeura*, the largest of all known insects, with a wing-length ranging up to as much as 300 mm.! The Permian Odonata are all comparatively small insects, the wing of *Kennedya* being about 33 mm. long and exceedingly narrow, while that of *Permagrion* is 34 mm. long. Thus we see that the shortened Sc is correlated, without exception, with the smaller-sized wings. It is not, therefore, a legitimate deduction to assume that the elongated Sc is primitive for Odonatoid insects. All we can say with certainty is that Sc was of a fixed, shortened form in the most primitive Odonata, while it remained in an unstable condition in the older Protodonata.

It is quite clear that the formation of a pterostigma was a specialization which followed the shortening of Sc and the development of a definite series of postnodal cross-veins. For the pterostigma, in Odonata, is a strongly chitinized cell lying towards the apex of the wing, between the costal margin and R_1, and bounded basally and distally by cross-veins. In a Protodonate type with long Sc, two longitudinal veins, running parallel and close together (Sc and R_1), form the main support of this portion of the wing. With the reduction of Sc, this support is reduced to one vein only, *viz.*, R_1; in spite of this, the smaller Protodonates, *Calvertiella* and *Protagrion*, remain without a pterostigma but all the early Odonata possess one. We may legitimately conclude, that, in this character, the Odonata are more specialized than the Protodonata and might have been derived from forms like *Protagrion*, though not from *Calvertiella* where Sc ends distally on R_1.

But we meet with a grave difficulty when we come to consider the problem of petiolation. Is the petiolate wing primitive, or is it derived from a broad-based type? If we turn to the Upper Carboniferous forms, we find two very prominent groups of aërial insects: the Palaeodictyoptera with the wings comparatively broad at the base, and the Megasecoptera with the wings basally narrowed and usually sub-petiolate. Further, while the Palaeodictyoptera proper have three or more anal veins, the Megasecoptera have only a single anal, 1A, with or without a series of short descending branches. A glance at the whole of the known genera of Protodonata will show that, although they have broad wings, they possess only one anal vein, and that the branch veins descending from it are all specialized arrangements from this very simple Megasecopteroid type. We can only conclude that they have been derived

from an ancestor having an anal area similar to that of the Carboniferous Megascoptera, and not from the true Palaeodictyoptera.

The Odonata proper, or rather their early fossil forms, are evidently not derivable from any of the Protodonata as regards the form of their anal area. They all have Cu_2 and 1A fused throughout the petiole, and then diverging from one another distally as the wing widens. The series of descending veins from 1A is confined to the free portion of that vein distally from the petiole. All the Protodonata except *Calvertiella* have Cu_2 and 1A separate throughout. *Calvertiella* itself has the most highly specialized anal area to be found within this Order, and cannot be taken as the starting point of the Odonata. The only possible conclusion to come to in this case is that Protodonata and Odonata have both become specialized in the form of their anal area, but *in opposite directions.* For a common ancestor, then, we have to postulate a form with a subpetiolate wing and a single anal vein with or without descending branches (these latter would depend to a large extent upon the actual amount of petiolation in the ancestral wing).

In the true Odonata, both the concave median vein (MP) and the convex first cubitus (Cu_1) are absent, except in the single case of *Kennedya*, where a weak remnant of Cu_1 is preserved in the petiole. In the Protodonata, the highest forms (Meganeuridae) possess only small remnants of these two veins close to the base of the wing ; but the older forms (Protagriidae) retain both MP and Cu_1 as complete veins. The common ancestor, therefore, must have agreed with the Protagriidae in this character.

Again, in the whole of the true Odonata, and also in the Meganeuridae within the Protodonata, Rs has been captured by MA, and the original basal piece of Rs has been lost. In Protagriidae Rs remains distinct from MA, but the latter arches up very close to it near its origin, and a short, strong cross-vein, uniting the two, shows clearly the method of capture in the higher forms. The common ancestor, therefore, must have had Rs distinct from MA.

There are two other characters common to the Protodonata and Odonata which need to be emphasized here. One is the character of the cross-vein system, which is, *in all parts of the wing including the costal areas*, at right angles to the veins which it connects. The only other insects with this very striking character are the May-flies (Plectoptera). The important point to notice is that, in those insects with true costal veinlets present, these are always *obliquely* placed. We may conclude that the cross-veins in the costal spaces of Odonata, Protodonata and Plectoptera are truly such, and not veinlets. Hence, in searching for a common ancestor, we should look for one *without costal veinlets.* The second point is of even greater importance, *viz.*, the extraordinary serrated condition of the very strongly formed costal margin of the wing. The larger forms, *i.e.*, all the Protodonata except perhaps *Calvertiella* (in which the extreme base of the costa is not well preserved) possess, in addition, a basal *precostal coriaceous area*, which must be regarded as a specialization due to size. In looking for a common ancestor, therefore, we should seek especially for some signs of this character, which is not to be found in any recent forms except Odonata.

Reviewing the above evidence, we conclude that the Protodonata cannot be the actual ancestors of the Odonata, as they are more specialized in the condition of their anal area and also in the possession of the precostal coriaceous area. But they agree so closely with them in other venational characters, that both must be considered as having arisen from a common ancestor at a time geologically not far back from the Upper Carboniferous. As we still have no records of winged insects earlier than this, the most we can do is to examine the lower or middle beds of the Upper Carboniferous for evidence of the existence of still more primitive types representing, or closely allied to, this common ancestor.

In this paper, I propose to analyse the characters common to the two Orders Protodonata and Odonata, and to attempt to deduce from them the common ancestral stock. From that stock we shall be able to follow the evolutionary stages of the Order Odonata right through to the present day. In this Part, the evolution will be followed up to the complete establishment of the most primitive existing Suborder, Zygoptera, in the Upper Permian, while the various lines of evolution from there onwards must be relegated to Part II.

In developping the argument set forth in this paper, the venational notation used must necessarily be that fully set forth in my recent work on the Insects of Australia and New Zealand (Tillyard, 1926). As far as the Odonata are concerned, this notation is the logical outcome of the evolutionary development indicated by the fossil history. One starts with the accepted notation for the Carboniferous Orders Palaeodictyoptera and Megasecoptera, with the recognized addition of a convex anterior median, MA, to the original Comstock-Needham system, as proposed by Lameere (1922). All the modifications in Odonate venational nomenclature necessarily follow from this.

The principal stages in the evolutionary history of the Order Odonata up to the formation of the true Zygoptera in the Upper Permian may be most clearly exhibited in four distinct stages, each dealt with in a separate Section. To these may conveniently be added, as a separate Section following on the first of the four dealing with Odonata, a short account of the evolution of the Order Protodonata. This gives us five Sections, as follows :—

Section 1.—Analysis of the Primitive Characters of the Common Ancestor of Protodonata and Odonata. (*Brodia* Stage : actual : Westphalian or middle part of Upper Carboniferous.)

Section 2.—Evolution of the Order Protodonata. (Upper Carboniferous and Lower Permian.)

Section 3.—Emergence of the Order Odonata from the ancestral stage. (*Protokennedya* Stage : hypothetical : Stephanian or upper part of Upper Carboniferous.)

Section 4.—The first true Odonata. Suborder Protozygoptera. (*Kennedya* Stage : actual : Lower Permian.)

Section 5.—Evolution of the Suborder Zygoptera. (*Permagrion* Stage : actual : Upper Permian.)

Section 1.—Analysis of the Primitive Characters of the Common Ancestor of Protodonata and Odonata. (*Brodia* Stage : actual : middle part of Upper Carboniferous.)

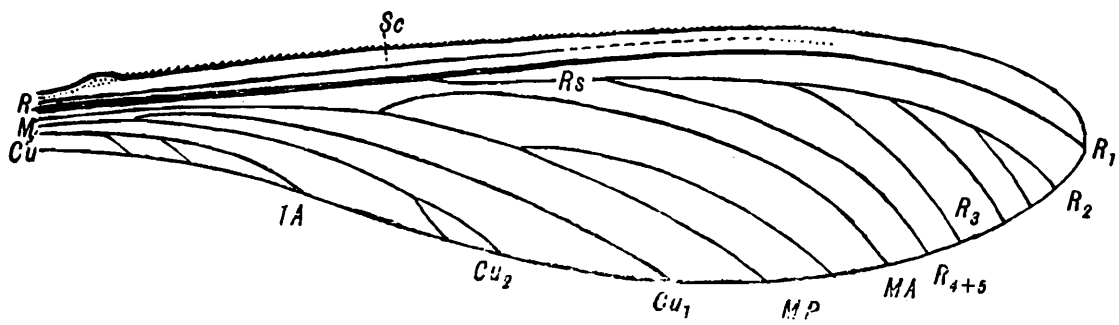


FIG. 1.—*Brodia priscotincta* Scudder, Order Megasecoptera. Upper Carboniferous of Europe. Wing. Length 58 mm. Cross-veins and transversely fasciated colour-pattern omitted.

The analysis of the ancestral characters common to both Protodonata and Odonata, already given above, supplies us with the following basis of venational requirements for the common ancenstor of the two Orders :—

(1) A hardened costal margin, with serrated edge.
(2) A simple, concave subcosta (Sc).
(3) A strong, convex radius (R), ending near apex of wing, and armed with reduced spines or serrations.
(4) A concave radial sector (Rs), having a pectinate series of descending branches, all concave, of the type found in Palaeodictyoptera and Megasecoptera.
(5) A simple or branched, concave, posterior median (MP), arising separately from the base of the wing, just below R.
(6) A simple, convex, upwardly arching, anterior median (MA), not arising from the base of the wing, but originating from MP at or near the level of the origin of Rs, so that the highest point of the arch of MP comes very close up to Rs.
(7) A concave second cubitus (Cu_2), with short descending branches distally, and ending up at about half-way along the posterior margin or less from the base of the wing.
(8) A simple, convex first cubitus (Cu_1), not arising from the base of the wing, but branching anteriorly from Cu_2 very close to the base, definitely within the area of the subpetiole.
(9) A single convex anal vein (1A), shorter than Cu_2, but extending slightly beyond the subpetiole, with or without short descending veinlets.
(10) An elongated, narrow form of wing, with the basal portion definitely compressed into a subpetiolate form.
(11) A weak, unfixed system of cross-veins, all at right angles to the main veins.
(12) Absence of costal veinlets, nodus and pterostigma.

When we compare these requirements with the venation exhibited by the Upper Carboniferous genus *Brodia* Scudder, (see Bolton, 1921, Handlirsch 1908, 1919), we find that they agree in all essential particulars. We do not require, in the ancestral form, the transversely fasciated colour-pattern of the wings of *Brodia priscotincta*, but all the other charac-

ters are needed. We may therefore speak of this earliest ancestral stage in the evolution of the two Orders Protodonata and Odonata as the *Brodia Stage.*

Age of the Brodia Stage.—It is interesting to note that, while the great majority of the Palaeodictyoptera and Megasecoptera occur in the Stephanian or upper division of the Upper Carboniferous, the genus *Brodia* occurs only in the Lower Coal Measures of England, *i.e.*, the Westphalian or middle division of the Upper Carboniferous, and possibly extends backwards even to the base of this division or beyond it. There is therefore no geological reason why this genus should not be regarded as the ancestor of both Protodonata and Odonata, since the former only appear in the Stephanian and the latter in the Lower Permian.

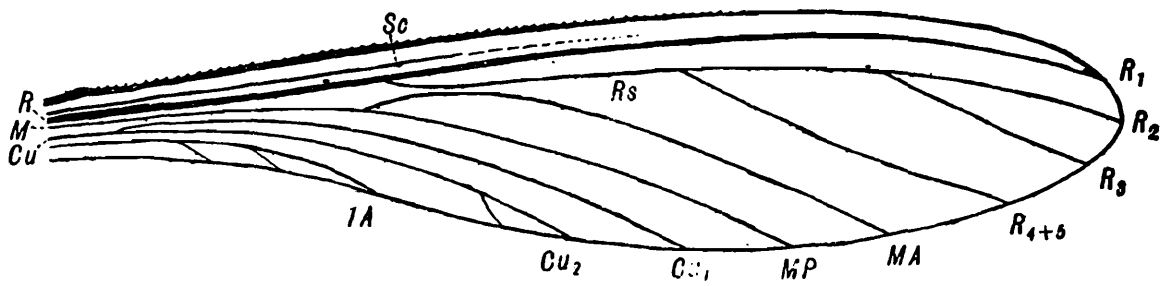


FIG. 2.—Hypothetical *Brodia* type of wing with the number of descending sectors of Rs reduced to two, MP unbranched, and no fasciated colour-pattern. Hypothetical ancestor of Odonata.

Classification of the Brodia Stage.—The genus *Brodia* will find its ordinal position according to the particular view-point of each author or student as to the limits and divisions of the great group Palaeodictyoptera. For the purposes of this paper, it does not seem necessary to discuss the proposals of Lameere for the sub-division of this Order. The only group which comes really into the question is that series of forms in which the anal area only carries a single vein, 1A. I consider this to be the diagnostic character of the Order Megasecoptera, irrespective of whether the wings carried nygmata or not. The genus *Brodia* will then be classified as an early and slightly specialized form within this Order, characterized by the very strongly formed and serrately ridged costal margin, the subpetiolate, narrow wings with evenly rounded apices, the absence of nygmata and of specialized cross-veins.

It is also important to note that larval forms of this genus are known, and that the larval wings were held more or less vertically above the thorax in the position characteristic of Mayflies. In the last larval stage the wings are about two-fifths the length of those of the imago.

We may note three tendencies in the genus *Brodia* which are of importance in the later evolution of the groups which we are studying :—

(*a*) The distal end of Sc is weakly formed and indeterminate.

(*b*) MA is already upwardly arched so much that it tends to become connected with Rs close to its origin.

(*c*) 1A and Cu_2 are already very close basally, owing to the subpetiolate condition of the wing, and are tending to unite.

Section 2.—Evolution of the Order Protodonata. (Upper Carboniferous and Lower Permian.)

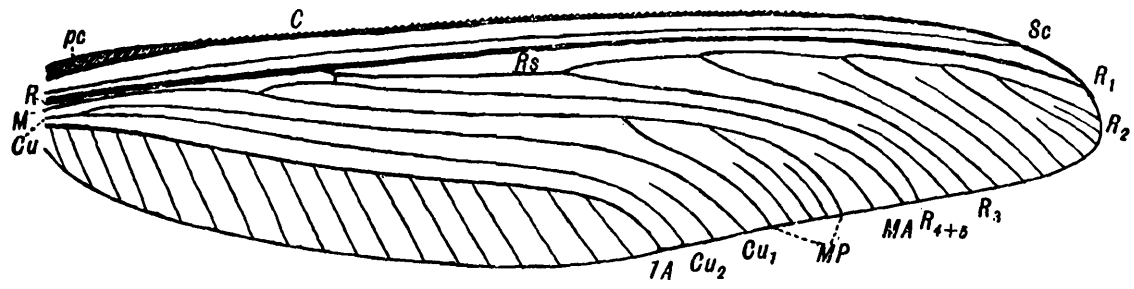


FIG. 3.—*Protagrion audouini* Brongn., Order Protodonata, family Protagriidae. Upper Carboniferous of Europe. Restoration of wing. Length about 90 mm. Cross-veins omitted, except the short one connecting Rs basally with MA.

When we come to analyse the known genera of Protodonata, we find that they fall conveniently into two distinct families, as follows :—

FAMILY PROTAGRIIDAE.—Posterior median (MP) and first cubitus (Cu_1) still existing as distinct veins running to the posterior margin of the wing. 1A with pectinate series of descending branches.

FAMILY MEGANEURIDAE.—Posterior median and first cubitus either entirely absent, or else only existing as short vestiges attached closely to MA and Cu_2 respectively near the base of the wing. 1A with a specialized concave sector (SA) as well as numerous convex descending branches.

On all points the family Protagriidae is seen to be the more primitive of these two groups. In looking, then, for the ancestral connecting link between Protodonata and the older *Brodia* Stage, we must first of all analyse the known genera of this family.

The fossil *Protagrion audouini* Brongn., from the Stephanian of Commentry, France (fig. 3) appears to be the oldest known type of Protodonate yet discovered. The actual specimen is not very well preserved, but I venture to give a restoration of the wing from a study of the fossil and a good photograph of it. This should be carefully compared with *Brodia* (fig. 1), when it will be seen to agree pretty closely with it in a number of important points :—

(1) The radial sector (Rs) has a series of five or six descending, concave branches, pectinately arranged. But *Protagrion* has, in addition, somewhat irregular convex interpolated veins between these.

(2) The anterior median (MA) is a simple convex vein, arching up so as nearly to meet the radial sector close to its origin. In *Protagrion*, however, it appears to be definitely connected by a short, strong cross-vein to Rs, whereas in *Brodia* it remains unconnected.

(3) The posterior median (MP) is complete and is distally branched.

(4) The first cubitus is a complete, simple, convex vein, arising from the stem of Cu not far from base.

Protagrion differs rom *Brodia* as follows :—

(1) Instead of a costal hump, there is a well developed precostal coriaceous area (*pc*).

(2) The general shape of the wing is very different, and petiolation is absent.

(3) The first anal (1A) is a much longer vein, reaching almost as far as the end of Cu_2, and having a very complete series of descending branches, pectinately arranged.

In searching for a type which would connect *Protagrion* with *Brodia*, we should naturally look for one which included all four characters on which these two are agreed, but which also should show (*a*) a weak development of a precostal area, (*b*) some amount of petiolation of the wing, and (*c*) a shorter and less well developed anal vein than that of *Protagrion*.

The fossil genus *Campyloptera* Brongn., from the Stephanian of Commentry, agrees with these requirements in all respects except one, *viz.*, that the anterior median appears to be already fused with Rs for a short distance. As I have not studied the fossil, which appears to have been only moderately well preserved, I do not attempt to figure it here, but would simply refer to Handlirsch's figure (1908, Atlas, pl. xxxii, fig. 15). The general shape of the wing is that of *Kennedya* (fig. 6), but the basal portion is only subpetiolate and the apex is somewhat nodding, like that of *Permagrion* (fig. 8). The anal vein (1A) reaches to about two-fifths of the posterior margin from the base, and has a series of short, descending, pectinate branchlets. Rs appears to have had only two concave descending branches, separated by two interpolated convex veins, as in *Calvertiella* and all true Odonata. MP is distally forked much as in *Brodia*. There is a short but quite definite precostal area, and a poorly developed system of cross-veins at right-angles to the main veins. The total length of the wing was 65 mm. as against 58 mm. for *Brodia priscotincta* and about 90 mm. for *Protagrion audouini*.

Brongniart (1893, p. 527) placed the genus *Campyloptera* within the Order Protodonata, next to the genus *Brodia*, which he also included within that Order. Handlirsch (1908, p. 316) removed *Campyloptera* to the Megasecoptera, though his remarks on the point show that he was in considerable doubt about it. At the same time, he placed *Brodia* in the Order Palaeodictyoptera (1908, p. 113); but, in his more recent work (1919, p. 73) he again moves this genus to the Megasecoptera, where it clearly belongs.

Handlirsch placed considerable weight on the presence of "Schaltsectoren" or "intercalated sectors" as an ordinal character for the Protodonata, and he says of *Campyloptera* (l.c., p. 316) "Sollten die Adern, wie es auf dem Bilde den Anschein hat, wirklich den Character von Schaltsectoren haben, so durfte die Form wohl eher zu den Protodonaten gehören" Brongniart's original figure of the genus (1893, pl. 40, fig. 3) shows undoubted intercalated sectors present, and, if there were any doubt on the question, it seems to me that the presence of the precostal area clearly indicates the true Protodonate character of the genus.

It seems clear to me that the original ancestor of the Protodonata must have been the Westphalian form (not yet discovered) from which *Campyloptera* was directly descended, and that it only differed from that genus in having MA still unfused with Rs. Such a form, to which the name *Procampyloptera* might be provisionally given, would connect *Brodia* quite naturally with the family Protagriidae, and would allow us to envisage the change from Megasecoptera to Protodonata as having taken place through a subpetiolate form, which began to develop intercalated sectors a little prior to the first connection between Rs and MA by means of a cross-vein.

We may now indicate the general lines of evolution of the genera of Protodonata as follows :—

Family PROTAGRIIDAE.—Starting with the hypothetical *Procampyloptera* as the ancestral type, there are two lines of evolution :—

(Sub-family Campylopterinae.)

(A) The *subpetiolate line* of descent, which ran to *Campyloptera* and then, as far as we know, died out in the Stephanian.

Sub-family Protagriinae.

(B) The *non-petiolate line* of descent, which gave origin in the Stephanian to *Protagrion* through strong development of the anal area, with a cross-vein connection between Rs and MA and a fairly strong development of intercalated sectors between the branches of Rs, M and Cu. This line carried on into the Lower Permian in North America, where we find the very highly specialized genus *Calvertiella* (Tillyard, 1925, pp. 43-48, figs. 1,2A) with the anal area still more highly specialized, 1A partially fused with Cu_2 and all its descending branches strongly curved, MP still branched and with intercalated sectors, and Rs with only two concave descending branches, but with the intercalated sectors already taking on very strongly the form of the two interpolated convex veins IR_2, IR_3, characteristic of the true Odonata.

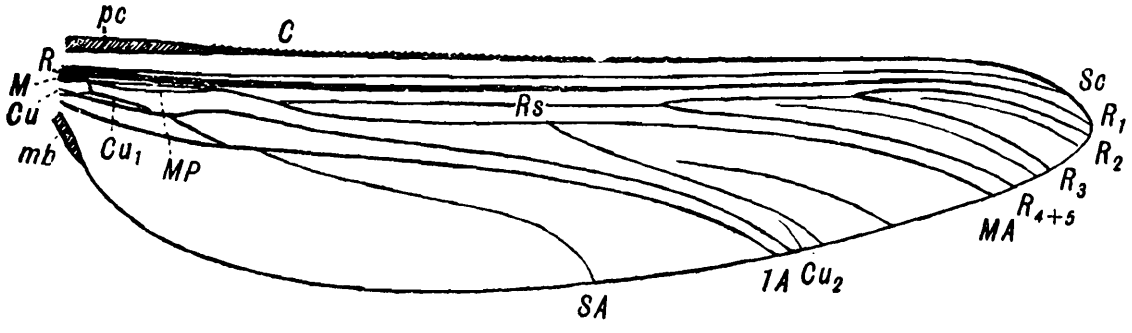


FIG. 4.—*Megatypus schucherti* Till., Order Protodonata, family Meganeuridae. Lower Permian of North America. Length about 250 mm. Cross-veins and intercalated Sectors omitted. Note the remnants of MP and Cu_1 near base of wing.

Family MEGANEURIDAE.—This was the most highly successful specialization within the Order, and gave rise, in both Stephanian and Lower

Permian times, to the largest insects ever evolved. Three main lines of descent can be distinguished :—

(A) Sub-family Paraloginae, of moderate size (wings about 60 mm. long), with the bases somewhat narrowed, Sc shortened, and the precostal area very slightly formed. (Genera *Paralogus* Scudder and *Paralogopsis* Handl., both from the Upper Carboniferous of North America).

(B) Subfamily Meganeurinae, of large to very large size (wings from 120 up to 300 mm. in length), with the bases not narrowed, Sc very long, and R_4+_5 arising close to origin of MA, and the precostal area well developed. (Genera *Meganeura* Brongn., *Meganeurula* Handl., *Meganeurella* Handl., *Meganeurina* Handl., *Meganeurites* Handl., *Boltonites* Handl. and *Gilsonia* Meun., all from the Upper Carboniferous of Europe.)

(C) Sub-family Typinae, differing only from (B) in having R_4+_5 arising far distad from origin of MA. (Genera *Typus* Sell. and *Megatypus* Till., both from the Lower Permian of North America.)

Section 3.—Emergence of the Order Odonata from the ancestral stage. (*Protokennedya* Stage : hypothetical : Upper Carboniferous.)

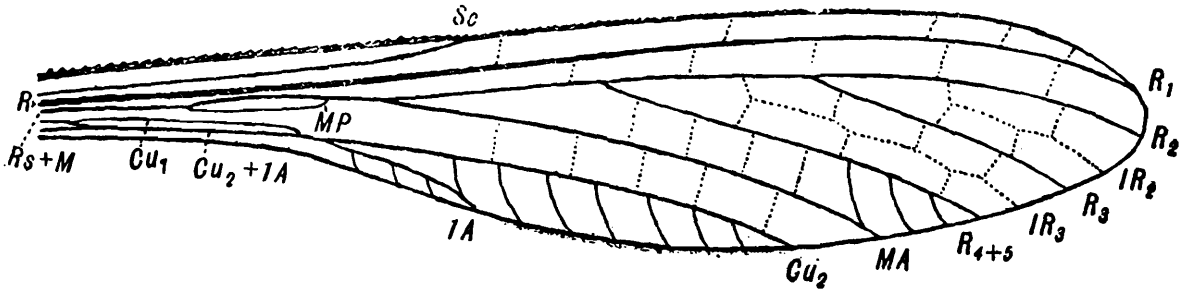


Fig. 5.—Wing of *Protokennedya*, a hypothetical type intermediate between the *Brodia* Stage (Order Megasecoptera) and the *Kennedya* Stage (Order Odonata, suborder Protozygoptera). Note the beginnings of the two interpolated convex veins IR_2 and IR_3, formed from the alignment between two sets of cross-vens.

While the Protodonata reached the sumit of their short but glorious evolutionary career in the Stephanian or upper division of the Upper Carboniferous, and died out in the Permian, we now have to indicate the hypothetical connecting link which serves to bring *Kennedya* and its allies into evolutionary connection with *Brodia*. This stage, which may conveniently be termed the *Protokennedya Stage*, is reached from *Brodia* by the following specializations :—

(1) Sc becomes much shortened, ending on costa.

(2) R and M approach very close basally.

(3) MA captures Rs close to its origin, and the original basal piece of Rs becomes aborted.

(4) Rs becomes fixed with two descending concave branches in addition to its apical portion, and the beginnings of interpolated convex veins appear between them.

(5) Vein MP becomes reduced to a short basal portion lying close below MA and attached again to it distally.

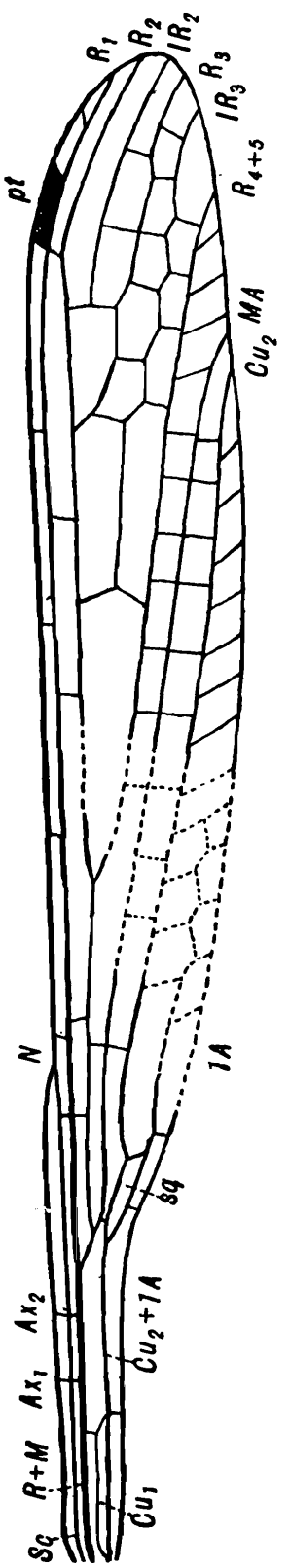


FIG. 6.—*Kennedya mirabilis* Till., Order Odonata, suborder Protozygoptera. Lower Permian of North America. Wing, with missing parts restored by dotted lines. Length 44 mm.

(6) Vein Cu_1 likewise becomes reduced to a short basal portion lying close above Cu_2 and attached again to it distally.

(7) Cu_2 and 1A become fused for a short distance close to the base, within the subpetiole.

(8) The cross-vein system becomes more definite, consisting of a fair number of cross-veins at right angles to the main veins and fairly evenly spaced; in particular, double series of cross-veins develop between R_2, R_3 and R_4+_5, forming the beginning of interpolated longitudinal veins.

(9) The subpetiolate form of wing becomes more marked, tending to complete petiolation; at the same time, the wing is becoming excessively narrowed, this condition being correlated with (5), (6) and (7).

This stage may be taken as the *annectent* stage between the two Orders Megasecoptera and Odonata. The actual fossil form which seems to lie closest to it appears to me to be *Camplyoptera eatoni* Brongn., from the Stephanian of Commentry, but I have not been able to study this fossil in detail.

Section 4.—The first true Odonata. Suborder Protozygoptera. (*Kennedya* Stage: actual: Lower Permian.)

The first true Odonata recognizable in the fossil record belong to the Lowe Permian of Kansas, and consist of the three genera *Kennedya* Till., *Opter* Sell. and *Ditaxineura* Till. Of these, the only one that is approximately complete is *Kennedya* (fig. 6). The *Kennedya Stage*, representing the Suborder Protozygoptera, is reached from the *Protokennedya* Stage by certain very definite specializations, as follows:—

(1) Fixation of a *primitive nodus* through the upturning end of Sc meeting the costal margin at a point not far distad from the end of the level of petiolation, in such a way that a definite *bend* of the costa is produced.

(2) Fixation of two specialized cross-veins connecting C, Sc and R well basad from the nodus, so as to form the two original *anteṅodals*, Ax_1 and Ax_2.
(3) Development of a series of evenly spaced *postnodals*, probably originally six or seven in number only.
(4) Chitinization of the cell between C, R_1 and two of these postnodals at the point of greatest wing-impact during flight, *viz.*, somewhat before the apex. This chitinized cell is called the *pterostigma* (*pt*).
(5) Complete formation of a petiolate base or stalk to the wing.
(6) Almost complete fusion of R and M basally within petiole, and, consequently.—
(7) Formation of a true *arculus*, (*anterior arculus* of Comstock only).
(8) Complete loss of remnant of MP.
(9) Complete formation of the interpolated convex veins, IR_2 and IR_3.
(10) Last stage of reduction of remnant of Cu_1, which becomes very weakly chitinized and only about half the length of the petiole.
(11) Complete fusion of Cu_2 and 1A throughout whole length of petiole.
(12) Fixation of the cross-vein *dv* (discoidal cross-vein) between MA and Cu_2 in region of arculus.
(13) Fixation of the cross-vein *Sdv* (subdiscoidal cross-vein) between Cu_2 and 1A distally from arculus, with upward arching of Cu_2 from that point.
(14) First formation of the *subdiscoidal cell* (*sq*) by strengthening and obliquity of *Sdv*.
(15) Increase in number of cross-veins so that the total number of closed cells in the wing now numbers somewhere about one hundred, but without any very definite transverse alignments of such cross-veins.

Of the above characters, I would single out as diagnostic for the Order Odonata the *nodus*, the *pterostigma* and the *arculus-formation*. The first and third of these are never again lost. The pterostigma is almost as constant, but we must remember that the males of certain highly specialized genera of Agrioidea lose it entirely, while other forms may have it hypertrophied.

With the emergence of the group into a recognizable Odonate stage, we now have to consider certain specializations in the larval wing which must of necessity have taken place concurrently with those of the imago.

The first of these is the evolution of the peculiar condition found in all Odonate larvae, in which the hind wing-sheaths come to overlie the fore. This is, of course, correlated with the adoption of the obliquely placed thorax in the imago. Let us study the two together.

If we consider the Mayfly larva and imago, we find that the thorax remains normal in form, and the fore wing-sheaths of the larva overlie the hind. It seems mainifestly impossible for such a larval form as this to have been the ancestor of one in which the positions of the wing-sheaths are reversed.

But we know that, in the *Brodia* stage, the wing-sheaths did *not* lie flatly down upon the thorax of the larva at all ; instead, they stood out more or less vertically from it, much as the imaginal wings of Mayflies do to-day. Now let us try to conceive the effect of a gradually increasing petiolation on such a type, with correlated increase in the obliquity of the thorax. It seems logical to suppose that, as the wings narrowed basally, the notal areas also narrowed, thus allowing for the expansion of the pleural areas in front of them. As this progresses, the wings of the imago and the wing-sheaths of the larva would both tend to project backwards at a steadily decreasing angle to the abdomen. It is a verifiable fact that most Zygopterous Odonata rest with the anterior portions of their hindwings more or less enveloping the posterior portions of the fore, and it seems logical to assume that this position was also a primitive one in the arrangement of the larval wing-sheaths. Once this slight envelopment is attained, it will easily be seen that, as flattening of the sheaths is attained, it is inevitable that the hind wing-sheath must come to overlie the fore, and not *viceversâ*.

The second point of importance is the consideration of the primitive condition of the tracheal system of the larval wing. We have to start with the Megasecopterous condition, which we may provisionally assume had, in the larval wing, a complete series of main tracheae along the courses of the main veins, and therefore must have had tracheae MP, Cu_1 and 1A complete, but no tracheae IR_2 or IR_3, since these veins had not then been formed.

When Rs was captured by MA, trachea Rs might have retained its primitive connection with R, or it might have become aborted basally, leaving trachea M in possession of the whole tracheal system supplying Rs. We know, from actual study of Odonate larval wings, that the later is the universal condition throughout the Order.

With the loss of vein MP, and, a little later, of vein Cu_1, it might be expected that the tracheae belonging to these veins would also abort. This also we know has actually happened.

We know also that no existing Odonate larva has a trachea along the course of IR_2. IR_3, on the other hand, has secondary tracheal

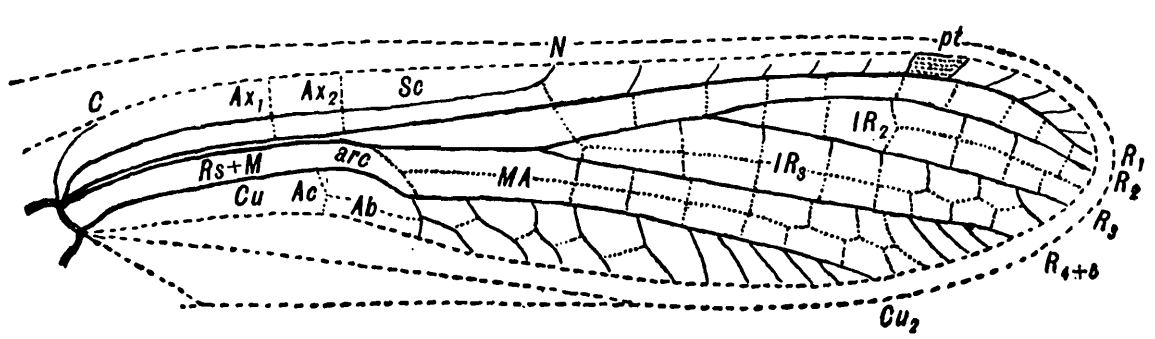


FIG. 7.—*Hemiphlebia mirabilis* Sel., Order Odonata, suorder Zygoptera, family Hemiphlebiidae. Recent. Wing of last larval instar, showing tracheation (complete lines) and pigment-bands of veins and cross-veins of imaginal wing (dotted lines).

supplies of varying types. Only in the very archaic genus *Hemiphlebia* does it possess no tracheal supply at all, and this genus also has a larval

wing without any tracheal supply to either MA or 1A. MA we know must have been an interpolated vein at one stage of its development, since a very large number of insects never possessed it. It would appear, therefore, as if its trachea did not develop until the Order Odonata was well under way, and the primitive genus *Hemiphlebia* must have been evolved before this happened. The original trachea 1A was almost certainly suppressed during the process of petiolation and of fusion of 1A with Cu_2. A new secondary anal trachea appears to have developed again very slowly in the Odonata as the anal area also developed, but its tortuous course betrays its secondary origin. Many primitive Zygoptera show little or no signs of such a trachea.

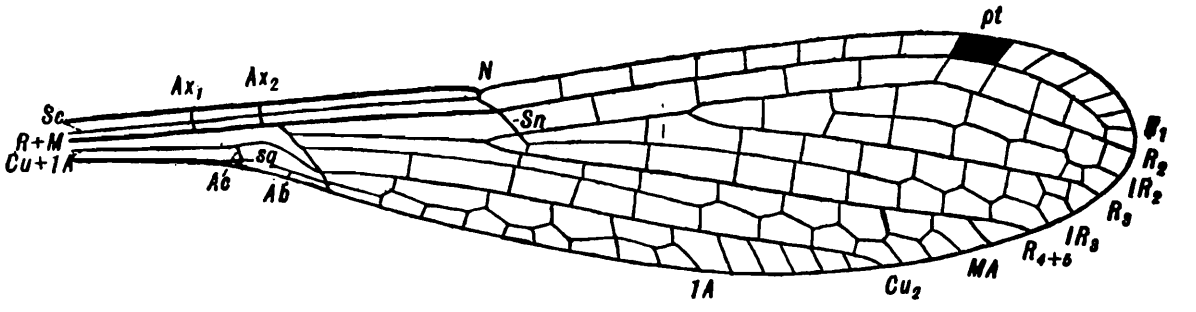


FIG. 7*a*.—Forewing of imago of *Hemiphlebia mirabilis* Selys.

The larval tracheation of *Hemiphlebia mirabilis* Sel. is shown in fig. 7 to illustrate the most archaic condition still extant within the Order Odonata. In tracing the evolution of the chief existing groups, the additions made to this simple type will also be figured.

Section 5.—Evolution of the Suborder Zygoptera. (*Permagrion* Stage: actual: Upper Permian).

Very few additional specializations are required to change the Protozygopterous *Kennedya*-type into a true Zygopteron. This change took place during the Permian. The Lower Permian Odonata were all Protozygoptera. The only Upper Permian (Gondwanan) form yet discovered is *Permagrion* from the Falkland Islands, and this is a true Zygopteron. The evolution of the *Permagrion* Stage (most primitive Zygopteron) from the *Kennedya* Stage was brought about as follows :—

(1) Complete loss of Cu_1.

(2) Completion of nodus and formation of subnodus by alignment and obliquity of two cross-veins, that between Sc and R_1 completing the nodus and that between R_1 and Rs forming the subnodus (Sn).

(3) Completion of basal fusion of R and M (these are still slightly separated basally in *Kennedya*).

(4) Specialization of the discoidal cross-vein *dv* as an oblique vein continuing the line of the arculus above it, and hence.—

(5) First formation of a recognisable open discoidal cell or quadrilateral (*q*) with more or less acute distal angle.

(6) Fixation of subdiscoidal cross-vein *Sdv* obliquely in line with and immediately below *dv*.

(7) Differentiation of the original free basal portion of 1A, after its fusion with Cu_2, into the anal crossing (Ac) and anal bridge (Ab) with supporting cross-veins.

(8) Extension of 1A distally by alignment of portions of the descending branches of Cu_2 and their connecting cross-veins.

(9) Increase in the number of postnodals and cross-veins generally, with beginnings of tendency to transverse alignment of cross-veins, and with zigzagging of distal portions of the convex veins IR_3, MA and 1A.

(10) Precession of branches of Rs basad; in particular, the origin of R_{4+5} moves close to Sn though still distad from it.

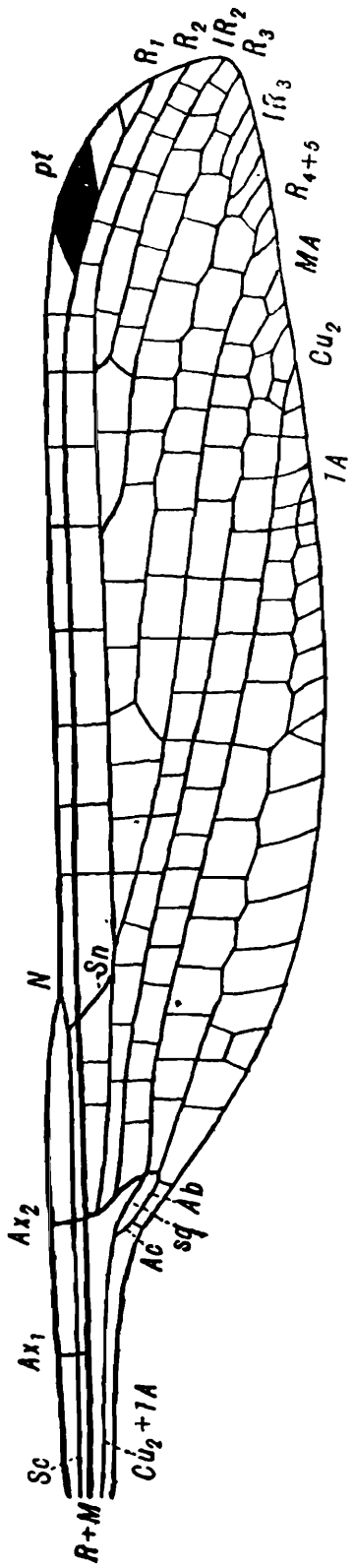


FIG. 8.—*Permagrion falklandicum* Till., Order Odonata, suborder Zygoptera, family Permagriidae. Upper Permian (Gondwanan) of the Falkland Islands. Wing Length 34 mm.

In comparing the Protozygopterous type with the Zygopterous, we may with advantage concentrate on the important changes which took place in two special regions of the wing :—

(A) *The Nodus* (fig. 9). The Protozygopterous nodus, as already pointed out, was incomplete, being merely the point at which a definite bend in the costal margin had been formed by the fusion with it of the slightly upturned end of Sc (fig. 9, A). In *Kennedya* we note the presence of an unspecialized cross-vein basad from the nodus between Sc and R_1 and another unspecialized cross-vein below this, between R_1 and Rs. It seems clear that the Zygopterous nodus was first completed by the movement distad of these two cross-veins, which, at the same time, became somewhat oblique in position. The term nodus in the Odonata is generally used to include the whole formation at and below the costal break or bend, from C down to R_1; that is to say, it consists of three parts (*a*) the costal break or bend, (*b*) the small distal piece of Sc from this bend back to the origin of the cross-vein, and (*c*) the *nodal cross-vein* (*nv*) itself. As the nodal cross-vein is placed at a more or less marked angle to Sc, the typical form

of Odonate nodus is V-shaped, tending to become more and more obtuse as evolution progresses and finally blending

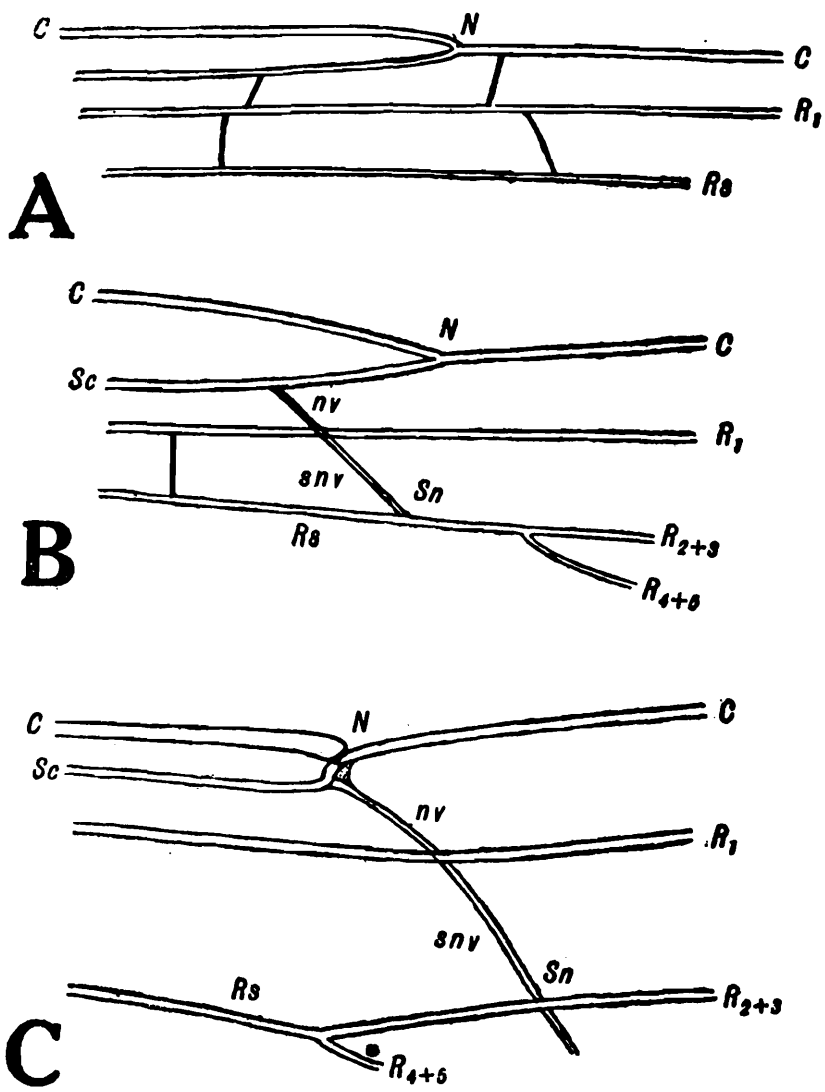


FIG. 9.—Evolution of the Nodus in Odonata. A. Primitive formation of end of subcosta in *Kennedya mirabilis* Till., suborder Protozygoptera. B. Formation of the nodal area in *Permagrion falklandicum* Till., suborder Zygoptera, showing completion of subnodus (Sn) by alignment of the nodal (*nv*) and subnodal (*snv*) cross-veins. C. Complete nodal formation in a recent Zygopteron, *Hemiphlebia mirabilis* Sel., with flexible joint on costa at nodus (N).

into a sort of arch concave to the base of the wing (fig. 9). The *Subnodus* (Sn) continues this formation directly downwards by means of the second or subnodal cross-vein (*snv*) between R_1 and Rs. This fixed area of nodus plus subnodus is one around which important evolutionary changes later on took place, helping to differentiate the main groups within the Order.

(B) *The Arculus and Discoidal Cell* (fig. 10). In the Protozygoptera (fig. 10,A) there was merely a gentle divergence of Rs + MA from its common stalk with R_1; this formed the *anterior arculus* of Comstock. Except for a greater degree of divergence, this incomplete arculus formation remained throughout the Permian, and is still to be seen in the forewings of *Hemiphlebia* (fig. 10, C) and *Chorismagrion*. But, while little change was going on in this area, a most interesting series of changes was taking place in the region just pos-

terior to it. Here, as we can see from *Kennedya* (fig.10,A) the early development of a specialized cross-vein, the subdiscoidal cross-vein, *sdv*, formed a closed triangular cell, the subdiscoidal cell, or subquadrangle (*sq*), long before the more typi-

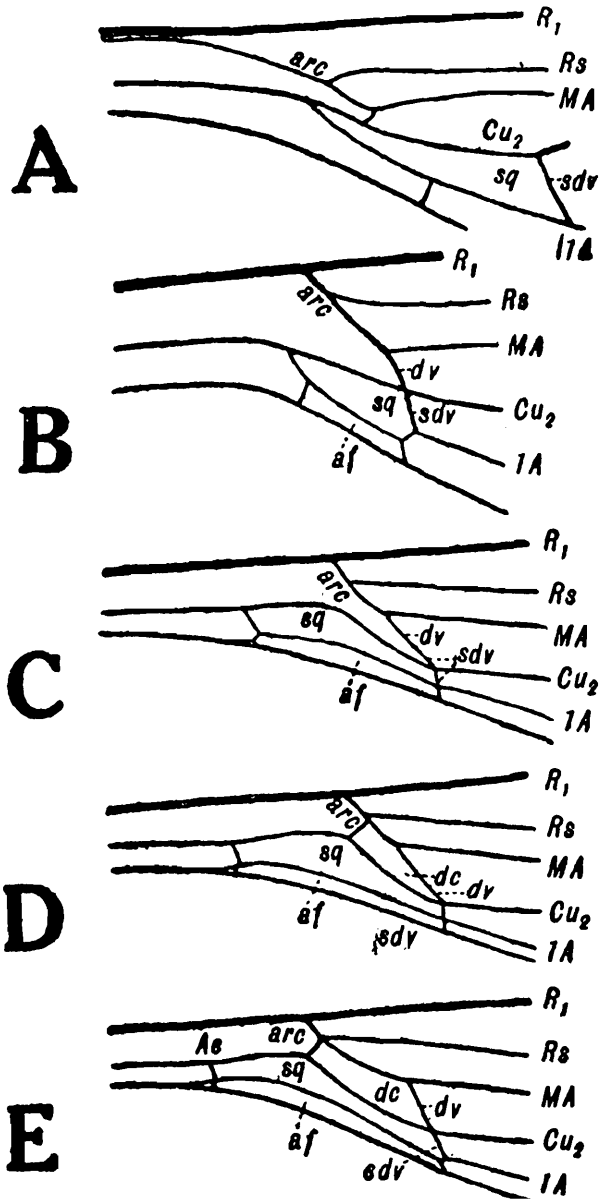


FIG. 10.—Evolution of the Arculus, Discoidal Cell, Subdiscoidal Cell and Anal Field in Odonata. A. Primitive condition in *Kennedya mirabilis* Till. B. First alignment of discoidal (*dv*) and subdiscoidal (*sdv*) cross-veins in *Permagrion falklandicum* Till. C. Normal formation of open discoidal cell in *Hemiphlebia mirabilis* Sel., forewing. D. Abnormal closure of discoidal cell from the other forewing of same specimen as C. E. Closed discoidal cell of hindwing of same specimen as C.

cal discoidal cell, or quadrangle, *dc*, became differentiated. The later history of this sub-discoidal cell is very interesting, particularly as it lays an important part in the evolution of the Anisoptera. In *Kennedya* (fig. 10,A) we see it in its most primitive form, *viz.*, as a closed triangular cell formed by closure of the space between the two diverging veins Cu_2 and 1A ; at this stage, the cross-veins below *sq* are unspecialized. In the *Permagrion* Stage, (fig. 10, B), these two cross-veins have moved up to positions of greater advantage, strutting the cell on to the posterior margin and making

it more of an elongate pentagonal form than a triangle. As we shall see later, *all Anisopterous anal areas have arisen as specializations from this basic type.* As soon as this flattened pentagonal form is reached, we are able to divide the basal piece of 1A, which formed the original posterior side of *sdc*, into two parts separated by an angle, *viz.*, the short basal portion from Cu_2 to the first cross-vein, which we can now recognize as the primitive *anal crossing* (Ac), and the rest of 1A as far as *sdv*, which is the primitive *anal bridge* (Ab). Without the fossil record, it would have been impossible to discover that these two formations were originally parts of the same longitudinal vein; but such was undoubtedly the case. It is of special importance that we should now recognize that those forms of Zygoptera in which Ac tends to be obliquely placed to Cu_2, while the cross-vein below it remains still at right-angles to the posterior margin, are more archaic than those in which Ac takes on the appearance of a cross-vein, while the original cross-vein below it tends to become longitudinally placed, as if it were the true extension of Ab basad.

We now need a name for this important cross-vein below Ac, and we need not look far for one, for a little thought will show us that it is the first beginnings of the formation called the *secondary anal* or A^1(fig. 10,C) in more highly evolved forms, both Zygoptera and Anisoptera! The various lines of evolution of Ac, A^1 and Ab will be followed out in detail in a subsequent Part of this work.

Having now completed our survey of the subdiscoidal cell and its supporting cross-veins, let us return to the discoidal cell, which, as we have already seen, lags behind the subdiscoidal in evolutionary development. We can start with the very primitive position which we find in *Kennedya* (fig. 10, A), when the discoidal vein, *dv*, is merely an ordinary cross-vein, and not even in line with the subdiscoidal vein *sdv*. By the time the *Permagrion* Stage is reached (fig. 10, B), the two crossviens *dv* and *sdv* are practically in line with one another, and this alignment is retained *without a single exception* throughout the whole of the three Suborders, Zygoptera, Anisozygoptera and Anisoptera, into which the Order Odonata subsequently became divided. Once this stabilized position is reached, it is easy to recognize the existence of a specialized *discoidal cell* (*dc*), even though that cell remained open basally for a very long period of geological time.

At first sight, it would seem only necessary to add here that the evolution of the discoidal cell into a complete quadrilateral was brought about (as it clearly was) by the development of an additional cross-vein below the anterior arculus, forming the *posterior arculus* of Comstock (fig. 10, D, E). This bare statement, however, does not suffice to set out the evolutionary history of this area. If we examine the existing archaic Zygopterous genera *Hemiphlebia* (fig. 10, C-E) and *Chorismagrion*, we note that *the discoidal cell of the forewing remains open, while that of the hindwing is already closed,* whereas, in all other known Zygoptera, the discoidal cells of both fore and hind wings are closed quadrilaterals. This differentiation between fore and hind wings in *Hemiphle-*

bia and *Chorismagrion* was, in actual fact, *the first step towards anisoptery;* it persisted (with increasing divergence in form) in all the Liassic members of the derived Suborder Anisozygoptera, and may be recognised throughout all its stages as *a strong tendency for the development of the hindwing to outrun that of the fore.* In the Zygoptera, this tendency was checked before it had acquired momentum; after a long evolutionary interval, the discoidal cell of the forewing became closed like that of the hind, and from that point onwards the two wings developed at equal rates.

We still have one other important change to follow up in the region below the arculus, *viz.*, the fate of the *distal* portion of 1A. Most unfortunately, this has been almost wholly lost in *Kennedya.* In my original restoration (1925, p. 64, fig. 10) I carried 1A distally almost to the limit of the gap between the two fossilized portions of the wing. This may, or may not, be correct. There is, on the one hand, the evidence of *Permagrion* (fig. 8) in favour of it; but, on the other hand, the formation shown in the larval wing-tracheation of *Hemiphebia* (fig. 7) points much more strongly to the existence of *an originally very short 1A, followed by a much longer Cu_2 with numerous descending branchlets.* This may, of course, have been due entirely to the loss of the original tracheation of 1A, and the zig-zagging of that vein distally may be due to its receiving a whole series of secondary tracheae as descending branchlets from Cu_2. To me, however, the previous supposition appears the more likely, and also it agrees most closely with our knowledge of the basic form *Brodia*, in which 1A was always very short, not extending very far beyond the subpetiole. The point must be left unsettled, pending the discovery of further fossil evidence; but, in the meanwhile, fig. 7 is given as indicating the probable course of evolution of the distal parts of Cu_2 and 1A.

We have now carried the account of the evolution of the Odonata as far as the Upper Permian, by which time true Zygoptera had appeared (*Permagrion* Stage). In Part II, we shall endeavour to trace the main lines of evolution within the Order subsequently to this.

SUMMARY.

In this paper the basic characters of the two related Orders Protodonata and Odonata are analysed and the conclusion is reached that the common ancestor is to be found in the Westphalian genus *Brodia* of the Order Megasecoptera. The Evolution of the group from this starting point is divided into five sections, *viz.*, (1) Analysis of the Primitive Characters of the common Ancestor of the Orders Protodonata and Odonata. (2) Evolution of the Order Protodonata. (3) Emergence of the Order Odonata from the ancestral stage. (4) The first true Odonata; Suborder Protozygoptera, and (5) Evolution of the Suborder Zygoptera. The stages corresponding to (1), (3), (4) and (5) respectively in the evolution of the Odonata are called the *Brodia*, *Protokennedya*, *Kennedya* and *Permagrion* Stages, the second of these being hypothetical but the other three based on actual fossil genera. The paper brings the evolution of the Order down to the formation of true Zygoptera in the Upper Permian, leaving the evolution throughout Mesozoic and Tertiary times to be dealt with in Part II.

Bibliography.

Bolton, H.—
1921. "A Monograph of the Fossil Insects of the British Coal Measures." Part I. Palæontological Society, 1919, pp. 1-80, pls. i-iv. (*Brodia*, pp. 58-70.)

Brongniart, C.—
1893. "Etudes sur le terrain houillier de Commentry, Livre 3me. Faune Entomologique." St.-Etienne. (*Campyloptera*, p. 527; *Brodia*, p. 528.)

Handlirsch, A.—
1908. "Die Fossilen Insekten." Leipzig. (*Brodia*, p. 113; *Campyloptera*, p. 316; Order Protodonata, pp. 304-311.)
1919. "Revision der Palæozoischen Insekten." Vienna. (Order Protodonata, pp. 56-63; *Brodia*, pp. 73-76.)

Hirst, S. & Maulik, S.—
1926. "On some Arthropod Remains from the Rhynie Chert (Old Red Sandstone)." *Geol. Mag.*, LXIII, No. 740, pp. 69-71, pl. vii.

Lameere, A.—
1922. "Sur la nervation alaire des insectes." *Bull. Acad. Roy. Belg.*, pp. 138-149. (English Translation in *Psyche*, 1923, XXX, Nos. 3-4, pp. 123-132.)

Tillyard, R. J.—
1925. "Kansas Permian Insects, Part 5. The Orders Protodonata and Odonata." *Amer. Journ. Sci.* X, pp. 41-73. (*Kennedya*, pp. 62-72.)
1926. "Kansas Permian Insects. Part 6. Additions to the Protohymenoptera and Odonata." *Amer. Journ. Sci.*, XI, pp. 69-73.
1926*b*. "The Insects of Australia and New Zealand." Sydney, Angus & Robertson, Ltd. (*Hemiphlebia*, p. 70, fig. F4, C. and p. 76; *Kennedya*, p. 69; table of venational notations, p. 68.)
1928*a*. "A Permian Fossil Damselfly Wing from the Falkland Islands." *Trans. Ent. Soc. London*, 1928.
1928*b*. "Some Remarks on the Devonian Fossil Insects from the Rhynie Chert Beds, Old Red Sandstone." *Trans. Ent. Soc. London*, 1928.

Venational notation of figures.

1A, anal vein. Ab, anal bridge. Ac, anal crossing. *af*, anal field. *arc*, arculus. Ax_1, Ax_2, the two antenodals. C, costa. Cu, cubitus. Cu_1, first cubitus. Cu_2, second cubitus. *dc*, discoidal cell. *dv*, discoidal cross-vein. IR_2, IR_3, the two interpolated convex branches of Rs. MA, anterior median. MP, posterior median. *mb*, membranule. N, nodus. *nv*, nodal cross-vein. *pc*, coriaceous precostal area. *pt*, pterostigma. R, radius. R_1, its main stem. Rs, radial sector, with its branches R_2, R_3, R_4+_5. Sc, subcosta. *sdv*, subdiscoidal cross-vein. Sn, subnodus. *snv*, subnodal cross-vein. *sq*, subquadrangle.

Cawthron Institute, Nelson, N.Z. 30. xii. 1927.

THE FLATFISHES (HETEROSOMATA) OF INDIA, WITH A LIST OF THE SPECIMENS IN THE INDIAN MUSEUM.

PART II.*

By J. R. NORMAN.

(Plates IV—VII.)

INTRODUCTION.

In this, the second and concluding part of my report on the Indian Heterosomata I have dealt with the families Soleidae and Cynoglossidae, which together constitute the division Solaeiformes of Regan's classification of the order.[1] The sub-division into genera of the Flatfishes related to *Solea* and *Synaptura* is a matter of some difficulty, and, pending the examination of further material and a complete revision of the whole family, the arrangement adopted in this paper must be regarded as tentative.

The illustrations accompanying both parts of this report are the work of Major W. P. C. Tenison, D.S.O.

Family 4. **Soleidae.**

Eight genera represented in Indian Waters.

Synopsis of the Indian Genera.

I. Pelvic fins symmetrical or subsymmetrical, that of the right side free from the anal or joined by a low membrane to the base of the first anal ray; snout not prolonged into a hook, the dorsal rays not extending to its tip; interbranchial septum entire.

A. Both pectoral fins developed.

1. Gill-opening on ocular side ending opposite lower edge or lower part of pectoral base; pectoral fin on both sides generally well developed, rounded or obtusely pointed, not connected with opercular membrane.

a. Posterior rays of dorsal and anal fins short, not connected with caudal fin; urinogenital papilla situated on the right side of the body at some distance from the anus — 1. *Solea.*

b. Posterior rays of dorsal and anal fins more or less elongate and united with the rays of the caudal fin; urinogenital papilla situated between the pelvic fins and close to the anus .. — 2. *Brachirus.*

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* The first part appeared in the *Records of the Indian Museum*, XXIX, part 1, p. 7 (April, 1927).

[1] *Ann. Mag. Nat. Hist.* (8) VI, p. 484 (1910).

2. Gill-opening on ocular side ending opposite upper part of pectoral base; pectoral fins small, especially on blind side; opercular membrane joined to upper portion of the pectoral fin; posterior rays of dorsal and anal fins rather long.

a. Posterior rays of dorsal and anal fins connected only with the base of the caudal fin; anterior nasal tube of ocular side elongate; only the hinder parts of dorsal and anal fins scaly on blind side; anal with 78 to 82 rays .. .. 3. *Soleichthys.*

b. Posterior rays of dorsal and anal fins connected with at least the basal third of the caudal fin; anterior nasal tube of ocular side short or of moderate length; dorsal and anal fins entirely scaly on blind side; anal with 56 to 71 rays.

Scales ctenoid; first dorsal ray not enlarged .. .. .. 4. *Zebrias.*

Scales cycloid; first dorsal ray enlarged, free .. .. 5. *Aesopia.*

B. Pectoral fins absent; lateral line with a more or less distinct accessory dorsal branch on blind side.

1. Each ray of dorsal and anal fin with an open pore near its base .. .. .. 6. *Pardachirus.*

2. Rays of dorsal and anal fins without pores .. 7. *Aseraggodes.*

II. Pelvic fins markedly asymmetrical, that of the right side median, elongate and joined to the anal; snout prolonged into a hook, the dorsal rays extending to its extremity; interbranchial septum perforated; anterior nostril of blind side dilated and fringed .. .. 8. *Heteromycteris.*

1. Solea Quensel.

Solea, Quensel, *Vet. Acad. Handl.*, XXVII, pp. 53, 229 (1806).
Solea (part), Günther, *Cat. Fish.*, IV, p. 462 (1862); Day, *Fish. India*, p. 425 (1877).

Several species from the Eastern Atlantic, Mediterranean and Indo-Pacific; three known from India.

Synopsis of the Indian Species.

I. Depth $2\frac{1}{2}$ to 3 in length; head 4 to $4\frac{3}{4}$; dorsal with 67 to 77 rays; anal with 52 to 63 rays.

A. Depth $2\frac{3}{5}$ to 3 in length; maxillary reaching middle of eye; distance from angle of mouth to tip of lower jaw 3 to $3\frac{1}{2}$ in head; dorsal with 72 to 77 rays; anal with 59 to 63 rays; barbel-like processes on blind side of head well developed (fig. 1a) .. .. .. 1. *elongata.*

B. Depth $2\frac{1}{2}$ to $2\frac{2}{3}$ in length; maxillary hardly reaching middle of eye; distance from angle of mouth to tip of lower jaw $3\frac{1}{2}$ to $3\frac{2}{3}$ in head; dorsal with 68 to 71 rays; anal with 54 to 58 rays; barbel-like processes on blind side of head moderately developed (fig. 1b) .. 2. *heinii.*

II. Depth 2 to $2\frac{1}{6}$ in length; head $3\frac{1}{2}$ to $4\frac{1}{6}$; dorsal with 58 to 67 rays; anal with 41 to 51 rays 3. *ovata.*

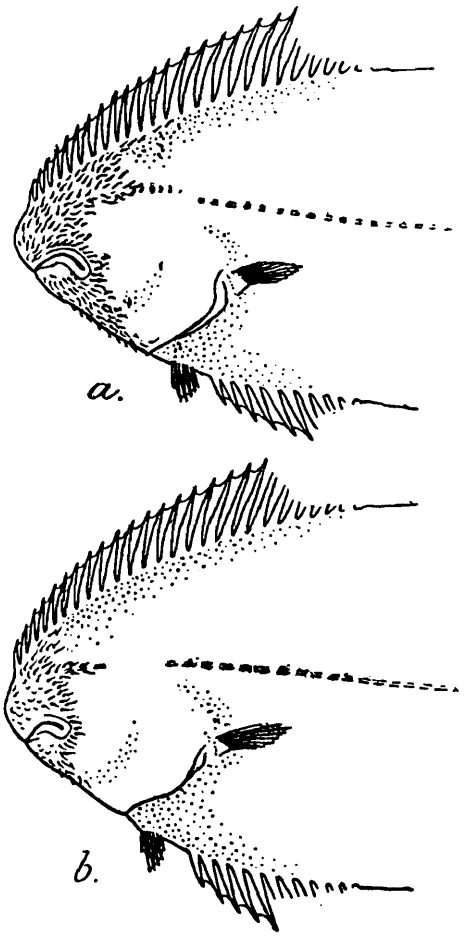
Solea indica was described by Günther [Cat. Fish., IV, p. 474 (1862)] from a single example, 46 mm. in total length said to have been collected

at Madras by Mr. T. C. Jerdon. Examination of the type shows this to be an example of *Achirus lineatus*, Linn., an American species, and there is little doubt that the type locality is incorrect.

1. Solea elongata Day.

Solea elongata, Day, *Fish. India*, p. 426, pl. xc, fig. 4 (1877).

Depth of body $2\frac{3}{5}$ to 3 in the length, length of head 4 to $4\frac{3}{4}$. Snout rather obtusely pointed, length (measured from anterior margin of lower eye) $3\frac{1}{3}$ to 4 in head. Eyes separated by a narrow scaly interspace, the upper in advance of the lower ; diameter $3\frac{1}{2}$ to 4 in length of head. Maxillary extending to below middle of eye ; distance from angle of mouth



TEXT-FIG. 1.—Blind side of head of (*a*) *Solea elongata* Day ; (*b*) *Solea heinii* Steind. Nat. size.

to tip of lower jaw 3 to $3\frac{1}{2}$ in length of head. No dilated nostril on blind side. Dorsal (70) 72-77. Anal 59-63. Right pectoral 2 to $2\frac{1}{2}$, left $2\frac{2}{5}$ to 3 in length of head. About 110 scales in a longitudinal series[1] ; those on anterior part of blind side of head produced into barbel-like processes (text-fig. 1a). Brownish or greyish, spotted or blotched with darker ; the markings are more distinct near the edges of the body, and often tend to form irregular vertical bands ; a black blotch on distal part of pectoral.

Described from several specimens, 60 to 115 mm. in total length.

[1] Counted above the lateral line from the level of the upper angle of the gill-opening to the base of the caudal.

Hab.—From the Persian Gulf to Madras; Ceylon.

106-120	North End of Persian Gulf, 15 fms.	"Investigator."
157-8	Stn. 352; Persian Gulf, 13 fms.	,,
14324-5	Trincomali, Ceylon.	,,

A specimen in the British Museum from Karachi.

2. **Solea heinii** Steind.

Solea heinii,[1] Steindachner, *Denkschr. K. Ak. Wiss. Wien*, LXXI, p. 153, pl. i, fig. 3 (1902).
Solea sindensis, Jenkins, *Rec. Ind. Mus.*, V, p. 133 (1910); *Mem. Ind. Mus.*, VII, pl. iii, fig. 2 (1910).

Close to the preceding species. Body (generally) somewhat broader, the depth $2\frac{1}{2}$ to $2\frac{2}{3}$ in the length. Snout somewhat broader, the anterior margin more rounded, length (measured from anterior edge of lower eye) $3\frac{1}{4}$ to $3\frac{4}{5}$ in head. Maxillary hardly extending to below middle of lower eye; distance from angle of mouth to tip of lower jaw $3\frac{1}{2}$ to $3\frac{2}{3}$ in length of head. Dorsal (67) 68-71. Anal (52) 54-58. Barbel-like processes on blind side of head less developed. Brownish or greyish, more or less densely spotted and blotched with darker; some dark streaks and spots on the vertical fins; a black blotch on distal part of pectoral.

Described from several specimens, 60 to 102 mm. in total length, including the type of *Solea sindensis*.

Hab.—Southern Arabia and Mekran Coast.

14303-4	.. Mekran Coast, Arabian Sea.	Townsend.
1846	(Type of *Solea sindensis*). Karachi.	
———.	??	

Several specimens in the British Museum from Karachi.

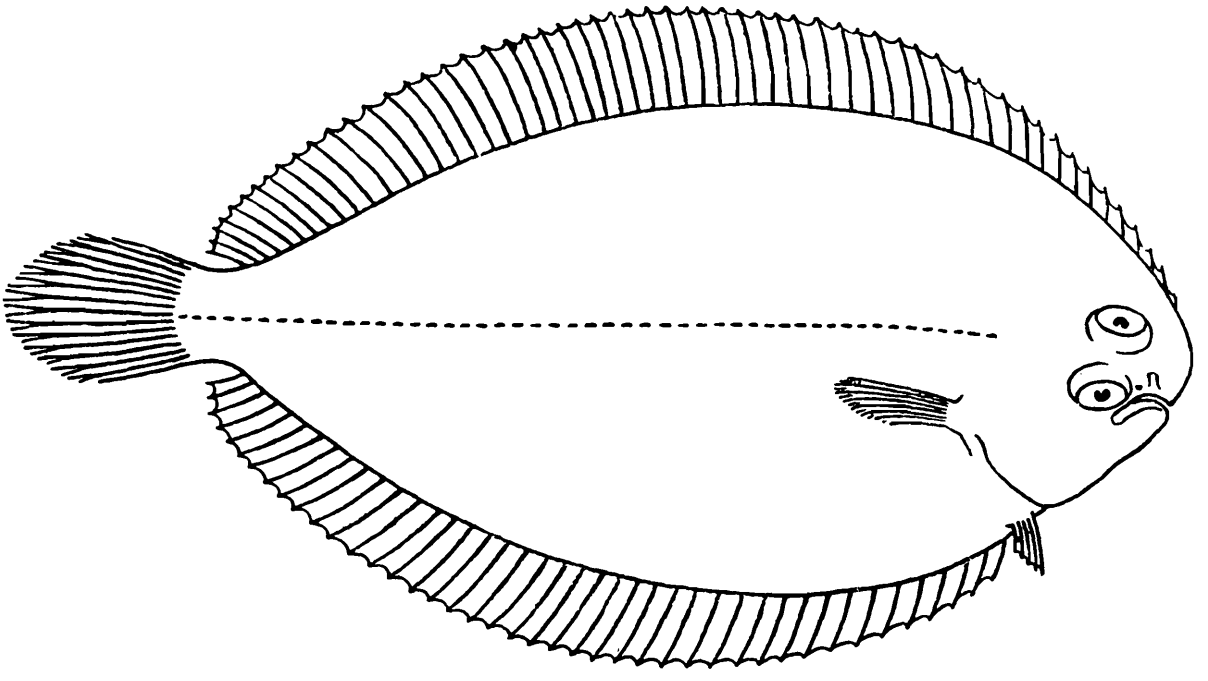
3. **Solea ovata** Richardson.

Solea ovata, Richardson, *Rep. Brit. Assoc. Adv. Sci.*, 1845 (1846), p. 279; Günther, *Cat. Fish.*, IV, p. 472 (1862); Day, *Fish. India*, p. 426, pl. xciii, fig. 1 (1877); Alcock, *J. Asiat. Soc. Bengal*, LVIII, pt. 2, p. 285 (1889).
Solea humilis, Cantor, *J. Asiat. Soc. Bengal*, XVIII, pt. 2, p. 1201 (1850); Günther, *Cat. Fish.*, IV, p. 471 (1862); Bleeker, *Atl. Ichth.*, VI, p. 16, Pleuron, pl. vi, fig. 1 (1866).
Solea maculata (Cuvier) Bleeker, *Verh. Bat. Gen.*, XXIV, Pleuron, p. 17 (1852).

Depth of body 2 to $2\frac{1}{5}$ in the length, length of head $3\frac{1}{2}$ to $4\frac{1}{6}$. Eyes separated by a scaly interspace of moderate width, the upper in advance of the lower; diameter 4 to $4\frac{3}{5}$ in length of head. Maxillary extending to below middle of eye or not quite as far. No dilated nostril on blind side. Dorsal 58-67. Anal 41-51. Right pectoral $1\frac{2}{3}$ to $2\frac{2}{5}$, left $2\frac{1}{2}$ to 3 in length of head. 100 to 108 scales in a longitudinal series; those on anterior part of blind side of head produced into barbel-like processes. Brownish or greyish, spotted and blotched with darker; sometimes a series of white blotches along upper and lower edges of body, and one or two whitish spots in the region of the lateral line; a black blotch on distal part of pectoral.

[1] This name was provisionally suggested by Steindachner for certain specimens from Gischin, S. Arabia, as he was doubtful whether they were really examples of *Solea elongata*, Day.

Described from several specimens, 60 to 105 mm. in total length, including the type of *Solea humilis*.



TEXT-FIG. 2.—Outline drawing of *Solea ovata* Richardson. × 1¾.

Hab.—Coasts of India, through the Malay Peninsula and Archipelago to China.

153-5	..	Vasco Bay, Portuguese India, 2 to 3½ fms.	Kemp.
——	..	Sandy Bay, N. W. of Nazareth Point, Mormugao Bay, Portuguese India.	„
183-4	.	Ditto	„
1091, 1094	..	Madras. ..	
12178-80	..	Orissa Coast, 7 to 10 fms. ..	"Investigator."
12243-4, 12258		„ „ ..	„

Specimens in the British Museum from Madras.

The specimens examined exhibited considerable variation in the length of the pectoral fins, but I am unable to recognize more than one species.

2. **Brachirus** Swainson.

Brachirus, Swainson, *Nat. Hist. Fish.*, II, pp. 187, 303 (1839).
Synaptura, Cantor, *J. Asiat. Soc. Bengal*, XVIII, pt. 2, p. 1204 (1850).
Euryglossa, Kaup, *Arch. Naturg.*, 1858, p. 99.

Several species from the Eastern Atlantic and Indo-Pacific; five known from India.

Synopsis of the Indian Species.

I. Form elongate; depth 3⅓ to 4⅓ in length; a bony prominence on the snout; 155 to 160 scales in a longitudial series .. .. (*Synaptura.*)
  A. Depth 3¾ to 4⅓ in length; no barbel between the nostrils; right pectoral 5 to 6 in head; body without white spots . .. .. 1. *commersoni.*
  B. Depth 3⅓ to 3½ in length; a barbel between the nostrils; right pectoral 2½ to 3¼ in head; body with 2 to 5 series of small white spots .. 2. *albomaculata.*
II. Form ovate; depth of body 2 to 2⅔ in length; no bony prominence on the snout; 63 to 74 scales in a longitudinal series .. .. .. (*Brachirus.*)

A. Eyes separated by a scaly interspace, diameter 5 to 8 in head; depth 2 to 2¼ in length; right pectoral with more than 4 rays, length much greater than diameter of eye.
   1. Dorsal with 62 to 72 rays; anal with 47 to 57 rays; none of the scales enlarged .. 3. *orientalis.*
   2. Dorsal with 57 to 61 rays; anal with 43 to 46 rays; scales of nape and upper part of head enlarged .. .. .. 4. *pan.*

B. Eyes contiguous, diameter about 11 in head; depth 2⅔ in length; right pectoral with 3 or 4 rays, length about equal to diameter of eye .. 5. *macrolepis.*

Euryglossa was said to differ from *Brachirus* in having the nasal tube bifid. Mr. Chabanaud has examined Kaup's type in the Paris Museum, and kindly informs me that this condition is clearly abnormal, and that the specimen is in all other respects a typical *Brachirus orientalis.*

1. Brachirus commersoni (Lacep.)

? *Pleuronecte Commersonien,* Lacepède, *Hist. Nat. Poiss.*, III, pl. 12, fig. 2 (1802).[1]
Brachirus commersoni, Swainson, *Nat. Hist. Fish.*, II, p. 303 (1839).
Synaptura commersoniana, Cantor, *J. Asiat. Soc. Bengal,* XVIII, pt. 2, p. 1204 (1850); Bleeker, *Verh. Bat. Gen.*, XXV, Bengal p. 76 (1853); Günther, *Cat. Fish.*, IV, p. 483 (1862); Bleeker, *Atl. Ichth.*, VI, p. 18, Pleuron, pl. iv, fig. 3 (1866); Day, *Fish. India,* p. 428, pl. xciv, fig. 1 (1877); Jenkins, *Mem. Ind. Mus.*, III, p. 29 (1910).
Solea russellii, Bleeker, *Nat. Tijdschr. Ned. Ind.*, I, p. 401 (1851); *Verh. Bat. Gen.*, XXIV, Pleuron, p. 15 (1852).
Synaptura commersoni, Jerdon, *Madras J. Lit. Sci.*, XVII, No. 39, p. 148 (1851) 1853.
Synaptura russellii, Bleeker, *Verh. Bat. Gen.*, XXV, Bengal, p. 76 (1853).
"*Jerree Potoo*" A, Russell, *Descr. Fish. Vizag.*, I, p. 55, pl. lxx (1803).

Depth of body 3¾ to 4⅓ in the length, length of head 5⅓ to 5½. A bony prominence on the anterior part of the snout. Eyes separated by a rather narrow scaly interspace, the upper almost entirely in advance of the lower; diameter 6 to 8 in length of head. Cleft of mouth extending to below middle of eye; lower lip distinctly fringed. Two tubular nostrils on ocular side, in front of lower eye. Dorsal 70-81. Anal 58-66. Caudal 12. Posterior rays of dorsal and anal completely joined to the caudal, which is obtusely pointed. Right pectoral rounded, 5 to 6 in length of head; left pectoral equal to or somewhat larger than the right. Scales of ocular side ctenoid, those of blind side cycloid; about 160 in a longitudinal series; those on upper part of head and nape enlarged; many of those on blind side of head produced into barbel-like processes. Greyish brown; vertical fins blackish towards their edges on both sides, and with a conspicuous white margin; right pectoral dusky, with a pale margin posteriorly.

Described from 8 specimens, 160 to 320 mm. in total length, including an example of *B. russellii* from Dr. Bleeker's collection.

Hab.—Seas of India to the Malay Archipelago.

1150 ..	S. Canara.		
259 ..	.. Madras: near mouth of harbour.		Kemp.
795 ..	.. Madras. ..	..	Day.
F. 2328/1. ..	.. Akyab Coast, Burma.	..	"Golden Crown."

Specimens in the British Museum from Karachi, Canara, and Madras.

[1] Not *Pleuronectes commersonii,* Lacepède, *Hist. Nat. Poiss.*, IV, pp. 599, 654 (1802).

2. **Brachirus albomaculatus** (Kaup).

Synaptura albomaculata, Kaup, *Arch. Naturg.*, 1858, p. 96 ; Günther, *Cat. Fish.*, IV, p. 483 (1862) ; Day, *Fish. India*, p. 429, pl. xciii, fig. 5 (1877).

Depth of body $3\frac{1}{3}$ to $3\frac{1}{2}$ in the length, length of head $5\frac{1}{4}$ to $5\frac{4}{5}$. A bony prominence on the anterior part of the snout. Eyes separated by a rather narrow scaly interspace, the upper almost entirely in advance of the lower ; diameter about 6 in length of head. Cleft of mouth extending to a little beyond middle of eye ; lower lip distinctly fringed. Two tubular nostrils on ocular side in front of lower eye ; a small barbel between the nostrils. Dorsal 70-75. Anal 56-61. Caudal 16. Posterior rays of dorsal and anal completely joined to the caudal, which is obtusely pointed. Right pectoral rounded, $2\frac{1}{2}$ to $3\frac{1}{4}$ in length of head ; left pectoral about equal to right. Scales of ocular side ctenoid, those of blind side cycloid ; about 155 in a longitudinal series ; those on upper side of head somewhat enlarged ; many of those on blind side of head produced into barbel-like processes. Brownish, with 2 to 5 rows of widely separated white spots ; vertical fins blackish towards their edges on both sides, and with a narrow white margin ; right pectoral blackish, with a pale margin posteriorly.

Described from 7 specimens, 135 to 235 mm. in total length.

Hab.—Seas of India.

1149	.. ..	Madras.	.. Day.
1498	.. ..	Canara.	
—— (2 spec.)	..	Puri, Orissa Coast.	
12703-4	.. ..	Ganjam Coast, 7 to 10 fms.	.. "Investigator."
——	.. ..	Sundarbans, mouth of R. Hughli.	Kemp.
9297	.. ..	Akyab, Burma. ..	.. Ireland.

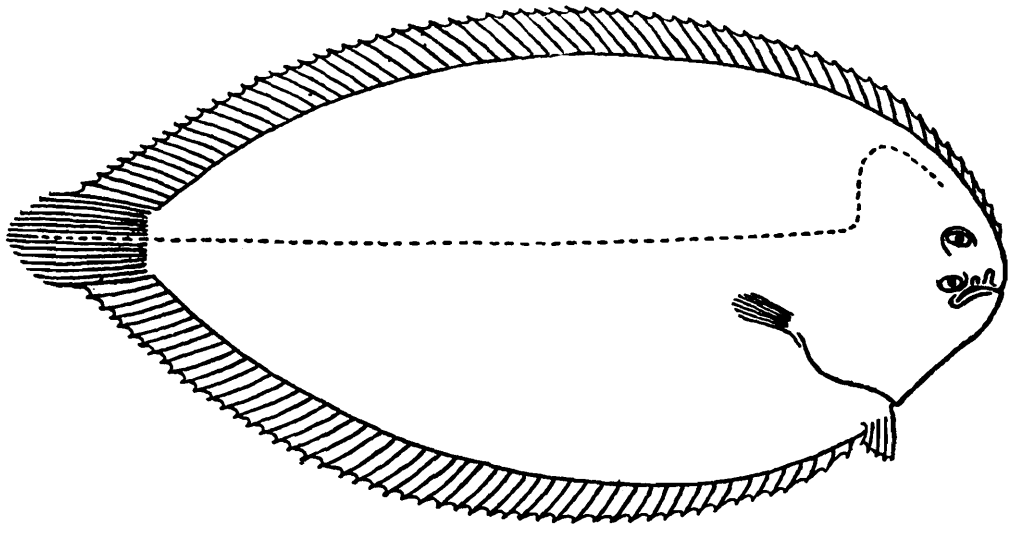
Specimens in the British Museum from Canara ; Coramandel Coast, Vizagapatam.

3. **Brachirus orientalis** (Bloch, Schneider).

Pleuronectes orientalis, Bloch, Schneider, *Syst. Ichth.*, p. 157 (1801).
Brachirus orientalis, Swainson, *Nat. Hist. Fish.*, II, p. 303 (1839).
Solea foliacea, Richardson, *Rep. Brit. Assoc. Adv. Sci.*, 1845 (1846), p. 279.
Solea pan, Bleeker, *Nat. Tijdschr. Ned. Ind.*, I, p. 410 (1851).
Synaptura pan, Bleeker, *Verh. Bat. Gen.*, XXIV, Pleuron, p. 30 (1852).
? *Solea trichodactylus*, Kaup. *Arch. Naturg.*, 1858, p. 95.
Euryglossa orientalis, Kaup, *t. c.* p. 99.
Synaptura foliacea, Günther, *Cat. Fish.*, IV, p. 481 (1862 ; Day, *Fish. Malabar*, p. 173 (1865).
Synaptura cinerascens, Günther, *t. c.* p. 482.
Synaptura orientalis, Günther, *t. c.* p. 484 (1862) ; Day, *Fish. India*, p. 429, pl. xciii, fig. 4, pl. xciv, fig. 2 (1877); Jenkins, *Mem. Ind. Mus.*, III, p. 29 (1910) ; Hora, *Mem. Ind. Mus.*, V, p. 759 (1923).
Brachirus sundaicus, Bleeker, *Atl. Ichth.*, VI, p. 20, Pleuron, pl. v, fig. 4, pl. viii, fig. 2 (1866).
Synaptura nigra, Macleay, *Proc. Linn. Soc. N. S. Wales*, V, p. 49 (1881) ; VI, p. 137 (1882).

Depth of body 2 to $2\frac{1}{4}$ in the length, length of head $4\frac{1}{4}$ to $5\frac{1}{3}$. Eyes separated by a rather wide scaly interspace, the upper in advance of the lower ; diameter $1\frac{1}{2}$ to $2\frac{1}{2}$ in length of snout, 5 to 8 in length of head. Cleft of mouth extending to below middle of eye or not quite as far ;

lower lip feebly fringed. Two tubular nostrils on ocular side in front of lower eye. Dorsal 62-72. Anal 47-57. Caudal 16. Posterior rays of dorsal and anal completely joined to the caudal, which is rounded. Right pectoral with 8 or 9 rays, rounded or obtusely pointed, length $2\frac{1}{3}$ to $3\frac{1}{2}$ in head ; left pectoral somewhat smaller. Scales ctenoid on both sides of body ; each scale on ocular side with a series of 12 or 13 spinules on the posterior edge ; scales on upper part of head and nape not enlarged ; some of those on blind side of head produced into barbel-like processes ; 63 to 74 scales in a longitudinal series. Ocular side of body with a number of strong filamentous processes, which tend to form irregular groups. Greyish or brownish, generally blotched or irregularly spotted with darker ; a number of short dark vertical streaks crossing the lateral line ; groups of dermal filaments blackish ; right pectoral dusky.



Text-fig. 3.—Outline drawing of *Brachirus orientalis* (Bloch, Schneider). $\frac{3}{4}$ Nat. size.

Described from numerous specimens, 75 to 240 mm. in total length, including the type of *B. cinerascens.*

Hab.—From the Persian Gulf, through the Malay Peninsula and Archipelago to China and Australia.

F. 1841/1, F. 1830/1	.. Karachi.	..	.. Cumming.
457 (cat.), 1151-2	.. S. Canara.	..	.. Day.
1155 ..	.. Canara.	..	..
F. 4179/1 ..	.. Quilon, Travancore,		.. Trivandrum Mus.
F. 4186/1 ..	.. Trivandrum, Travancore.		.. „ „
1156 ..	.. Malabar.		
796 ..	.. Madras.		
1154 ..	.. „ ..	..	.. Day.
162 ..	.. Ennur Backwater, Madras.		.. Annandale.
264 ..	.. Chilka Lake.	..	.. Chilka Survey.
1153 ..	.. Cochin. ..	..	.. Day.

Specimens in the British Museum from the Persian Gulf; Sind; Calicut ; Madras ; Travancore ; Ceylon ; Malabar ; Cochin.

This species may be distinguished from *B. aspilos*, Bleeker, (=*B. heterolepis*, Bleeker) by the ctenoid scales on the blind side.

4. **Brachirus pan** (Ham. Buch.).

Pleuronectes pan, Hamilton (Buchanan), *Fish. Ganges*, pp. 130, 373, pl. xxiv, fig. 42 (1822).
Brachirus pan, Swainson, *Nat. Hist. Fish.*, II, p. 303 (1839); Bleeker, *Atl. Ichth.*, VI, p. 21, Pleuron, pl. ix, fig. 1 (1866).
Pleuronectes canus, Gray, *Cat. Fish. Gronow*, p. 91 (1854).
Synaptura pan, Günther, *Cat. Fish.*, IV, p. 481 (1862); Day, *Fish. India*, p. 429, pl. xciii, fig. 3 (1877).

Depth of body 2 to $2\frac{1}{4}$ in the length, length of head $4\frac{1}{5}$ to 5. Eyes separated by a scaly interspace of moderate width, the upper in advance of the lower; diameter 5 to 6 in length of head. Cleft of mouth extending to below anterior part of eye; lower lip feebly fringed. Two tubular nostrils on ocular side in front of lower eye. Dorsal 57-61. Anal 43-46. Caudal 14. Posterior rays of dorsal and anal more or less completely joined to the caudal, which is obtusely pointed. Right pectoral with 7 or 8 rays, pointed, length 3 to $3\frac{1}{3}$ in head; left pectoral somewhat smaller. Scales ctenoid on both sides of body, those on upper part of head and nape distinctly enlarged; some of those on blind of head produced into barbel-like processes; 66 to 72 scales in a longitudinal series. A few dermal filaments on ocular side of body. Greyish or brownish, spotted and blotched with darker; generally some short dark vertical streaks crossing the lateral line; margin of right pectoral blackish.

Described from several specimens, 50 to 165 mm. in total length.

Hab.—Estuaries and tidal rivers of Orissa; Ganges delta; rivers of Burma; Malay Peninsula and Archipelago.

456 (Cat.) (5 spec.)	.. Calcutta Bazaar.	
1496 ..	R. Hughli. ..	.. Day.
13829-42	.. Santipur Marshes, R. Hughli. ..	Alcock.
——. (9 spec.)	.. Sundarbans, mouth of R. Hughli.	Kemp.
148 ..	.. Sittang River, Burma. ..	Day.

5. **Brachirus macrolepis** (Bleeker).

(Plate IV.)

Synaptura macrolepis, Bleeker, *Act. Soc. Sci. Indo-Neerl.*, V, p. 7 (1858-9); Günther, *Cat. Fish.*, IV, p. 486 (1862).
Brachirus macrolepis, Bleeker, *Atl. Ichth.*, p. 20, Pleuron, pl. v, fig. 3 (1866).

Depth of body $2\frac{2}{3}$ in the length, length of head a little more than 4. Eyes very small, contiguous, the upper a little in advance of the lower; diameter about 11 in length of head. Cleft of mouth extending to below anterior part of eye; lower lip feebly fringed. Both nostrils on ocular side close together in front of eyes; the anterior nostril tubular, the posterior with a membranous flap. Dorsal (68) 69-70. Anal (51) 52. Caudal 16. Posterior rays of dorsal and anal completely joined to the caudal, which is pointed. Right pectoral with 3 or 4 rays, length about equal to diameter of eye; left pectoral a little larger. Scales ctenoid on both sides of body, those on upper part of head and nape enlarged; 63 scales in a longitudinal series. Uniform pale brownish.

Described from a single specimen, 135 mm. in total length.

Hab.—Coast of Orissa; Borneo.

——. .. .. Balasore Bay, Orissa.

3. **Soleichthys** Bleeker.

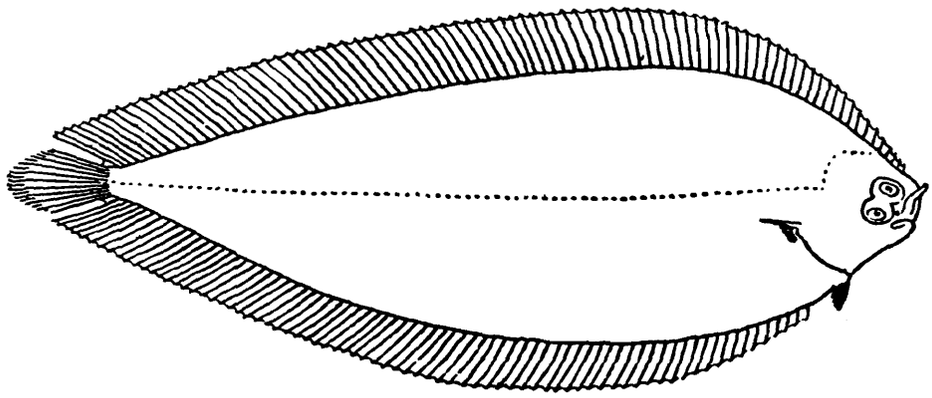
Soleichthys, Bleeker, *Act. Soc. Sci. Indo-Neerl.*, VI, p. 183 (1859); McCulloch, *Austral. Zool.*, I, p. 90 (1917).

Several species from the Indo-Pacific; one known from India.

1. **Soleichthys heterorhinos** (Bleeker).

Solea heterorhinos, Bleeker, *Act. Soc. Sci. Indo-Neerl.*, I, Amboina, p. 64 (1856); *Atl. Ichth.*, VI, p. 17, Pleuron, pl. ix, fig. 2 (1866).
? *Aesopia multifasciata*, Kaup, *Arch. Naturg.*, p. 97 (1858).
Soleichthys heterorhinos, Bleeker, *Act. Soc. Sci. Indo-Neerl.*, VIII, Amboina, p. 14 (1860); Norman, *Biol. Res.* "*Endeavour*," V, p. 286 (1926).
Solea heterorhina, Günther, *Cat. Fish.*, IV, p. 466 (1862); Kner, *Denkschr. K. Ak. Wiss. Wien.*, XXIV, p. 8, pl. iii, fig. 2 (1865); Day, *Fish. India*, p. 426, pl. xcii, fig. 5 (1877); Günther, *Fische Sudsee*, VIII, p. 345 (1909).
Solea nigrostriolata, Steindachner and Kner, *Sitzber. K. Ak. Wiss. Wien*, LXI, Abt. 1, p. 427, pl. i, fig. 2 (1870).
? *Solea lineata*, Ramsay, *Proc. Linn. Soc. N. S. Wales*, VII, p. 406 (1883).
? *Synaptura multifasciata*, Günther, *Cat. Fish.*, IV, p. 485 (1862); Day, *Fish. India*, p. 430 (1877).

Depth of body 3 to $3\frac{1}{2}$ in the length, length of head $5\frac{2}{3}$ to $6\frac{2}{3}$. Eyes contiguous, diameter greater than snout and $3\frac{1}{2}$ to 4 in length of head. Dorsal 87-98. Anal 78-85. Right pectoral with the upper rays produced, length $1\frac{3}{5}$ to $2\frac{3}{5}$ in head; left pectoral very short. About 110 scales in a longitudinal series.



Text-fig. 4.—Outline drawing of *Soleichthys heterorhinos* (Bleeker). $\frac{3}{4}$ Nat. size.

Described from 7 specimens, 80 to 130 mm. in total length.

Hab.—From the Andaman Islands, through the Indo-Australian Archipelago to Australia and the Pacific.

1444 .. .. Andamans.

Soleichthys tubifera, Peters, from Mauritius, is very close to this species, but has fewer anal rays and a different colouration. *S. microcephalus*, Günther, from Australia, may be distinguished from *S. heterorhinos* by the larger head, larger scales, fewer anal rays, and by the different colouration.

4. **Zebrias** Jordan and Snyder.

Zebias, Jordan and Snyder, *Proc. U. S. Nat. Mus.*, XXIII, p. 380 (1900); Jordan. & Starks, *ibid*, XXXI, p. 232 (1906).

Several species from the Indo-Pacific; three known from India.

Synopsis of the Indian Species.

I Scales strongly ctenoid, each with a single series of strong spinules on the posterior edge; 66 to 71 scales in a longitudinal series; dorsal with 69 to 74 rays: anal with 59 to 63 rays; posterior rays of dorsal and anal joined to basal half of caudal .. 1. *synapturoides.*

II. Scales moderately ctenoid, the marginal spinules much shorer; posterior rays of dorsal and anal fins more or less completely joined to caudal.

A. Eyes with tentacles; dorsal with 67 to 73 rays; anal with 56 to 61 rays; right pectoral 2½ to 3¼ in head; 92 to 99 scales in a longitudinal series; each scale with several series of spinules posteriorly. .. .. .. 2. *quagga.*

B. Eyes without tentacles; dorsal with 79 to 83 rays; anal with 65 to 71 rays; right pectoral 6 to 8 in head; 105 to 112 scales in a longitudinal series; each scale with one (or two) series of spinules posteriorly.. .. .. 3. *altipinnis.*

1. **Zebrias synapturoides** (Jenkins).

(Plate V.)

? *Solea jerreus*, Cuvier, *Régne Anim.*, ed. 2, II, p. 343 (1829).
? *Brachirus jerreus*, Swainson, *Nat. Hist. Fish.*, II, p. 303 (1839).
Synaptura quagga (part), Günther, *Cat. Fish.*, IV, p. 485 (1862).
Synaptura synapturoides, Jenkins, *Mem. Ind., Mus.*, III, p. 28, pl. iii, fig. 4 (1910).
? "*Jerre Potoo*" B, Russell, *Descr. Fish. Vizag.*, I, p. 56, pl. lxxi (1803).

Depth of body 2⅔ to 2⅘ in the length, length of head 4⅕ to 5. Eyes nearly contiguous, the upper a little in advance of the lower; diameter a little greater than length of snout and 4½ to 5 in length of head; eyes without tentacles. Mouth extending to below middle of eye or not quite as far. Nasal tube rather short. Dorsal 69-76. Anal 59-63. Caudal 18. Posterior rays of dorsal and anal joined to the basal half of the caudal, which is quite distinct and rounded. Right pectoral shorter than eye, the upper rays not produced; left pectoral rather smaller. Scales strongly ctenoid on both sides of body; each scale with a single series of 10 to 12 strong spinules on the posterior margin; some of those on blind side of head produced into barbel-like processes; 66 to 71 scales in a longitudinal series. Greyish, with a number of dark brown cross-bands arranged as in the accompanying figure and extending on to the vertical fins; posterior part of caudal with a circular area of dark brown, margined with yellowish white, and with a number of yellowish white spots and blotches in the centre.

Described from 8 specimens, 90 to 130 mm. in total length.

Hab.—Madras and Ganjam Coasts.

F. 3430/1 (One of the types)	Ganjam Coast, 24 to 30 fms. ..	"Investigator."
12911-6	,, ,, 30 to 35 fms. ..	,,
F. 826/1 ..	Off Malabar Coast, 68 fms.	,,

Solea jerreus, Cuvier, was based on the fish described and figured by Russell as "Jerree Potoo" B, which may be this species. Russell describes the dorsal and anal fins as being continued to the caudal but not coalescing with it.

2. **Zebrias quagga** (Kaup).

(Plate VI.)

Aesopia quagga, Kaup. *Arch. Naturg.*, 1858, p. 98.
Synaptura quagga (part), Günther, *Cat. Fish.*, IV, p. 485 (1862).
Synaptura zebra, Day, *Fish. India*, p. 430, pl. xciv, fig. 3 (1877).
Synaptura quagga, Alcock, *Ann. Mag. Nat. Hist.*, (6) VI, p. 440 (1890); *J. Asiat. Soc. Bengal*, LXV, pt. 2, p. 329 (1896).
? *Synaptura zebra*, Regan, *J. Bombay N. H. Soc.*, XVI, p. 330 (1905).

Depth of body $2\frac{1}{2}$ to $2\frac{3}{4}$ in the length, length of head $4\frac{4}{5}$ to $5\frac{1}{5}$. Eyes practically contiguous, the upper a little in advance of the lower; diameter a little greater than length of snout and 4 to 5 in length of head; each eye with a small membranous tentacle. Mouth extending to below anterior part of eye. Nasal tube short. Dorsal 66-73. Anal 56-61. Caudal 16-18. Posterior rays of dorsal and anal more or less completely joined to the caudal, which is scarcely distinct and rounded posteriorly. The upper rays of the right pectoral produced, $2\frac{1}{2}$ to $3\frac{1}{4}$ in length of head; left pectoral rather smaller. Scales moderately ctenoid on both sides of body; each scale with several series of small spinules posteriorly; some of those on blind side of head produced into barbel-like processes; 92 to 99 scales in a longitudinal series. Pale brownish or greyish, with a number of dark brown cross-bands arranged as in the accompanying figure and extending on to the vertical fins; caudal fin irregularly marked with yellowish white and black.

Described from 9 specimens, 80 to 135 mm. in total length.

Hab.—Persian Gulf (?); Seas of India, through the Malay Peninsula and Archipelago to China.

1497	.. .. Madras.	
12234, 12312, 12315-7	.. Orissa Coast, 7 to 10 fms.	.. "Investigator."

Specimens in the British Museum from the Persian Gulf; Bombay; Madras.

The specimens from the Persian Gulf agree closely with those described above, but the orbital tentacles are absent, and the form and arrangement of the cross-bands is different. They may represent a new species, but as all my examples are immature I do not feel justified in describing them as such.

3. **Zebrias altipinnis** (Alcock).

(Plate VII.)

Synaptura altipinnis, Alcock, Ann. Mag. Nat. Hist., (6) VI, p. 441 (1890); Jenkins, *Mem. Ind. Mus.*, III, p. 29 (1910).

Depth of body $2\frac{2}{5}$ to $2\frac{2}{3}$ in the length, length of head $4\frac{3}{5}$ to 5. Eyes nearly contiguous, the upper a little in advance of the lower; diameter equal to or less than length of snout and 5 to $6\frac{1}{4}$ in length of head; eyes without tentacles. Mouth extending to below middle or anterior part of eye. Nasal tube rather short. Dorsal 79-83. Anal 64-71. Caudal 18. Posterior rays of dorsal and anal completely joined to the caudal, which is not distinct and obtusely pointed posteriorly. The upper rays of the right pectoral not produced, 6 to 8 in length of head; left pectoral about the same size. Scales moderately ctenoid on both sides of body;

each scale with one (sometimes two) series of small spinules posteriorly some of those on blind side of head produced into barbel-like processes 105 to 112 scales in a longitudinal series. Pale brownish or greyish, with a number of dark brown cross-bands arranged as in the accompanying figure and extending on to the vertical fins; caudal fin dark brown, with 2 or 3 large yellowish white spots.

Described from 9 specimens, 80 to 245 mm. in total length.

Hab.—East coast of India to the Malay Peninsula and Archipelago.

12177	Orissa Coast, 7 to 10 fms. ..	" Investigator."
224	Ganjam Coast, 25 to 35 fms.	,,
F. 2472/1 ..	,, ,, 24 to 30 fms. ..	" Golden Crown."
254 ..	Sandheads, mouth of R. Hughli ..	P. V. " Lady Fraser."
——. (2 spec).	,, ,, ,, ,, ..	,,
——. ..	Bay of Bengal, between Pilot Ridge Light Vessel and Eastern Channel.	,,
256	Stn. 395; off Tenasserim Coast, Burma.	"Investigator."
F. 5804-1 ..	Off Arakan Coast, Burma. ..	" Golden Crown."
——. ..	??	

This species may be distinguished from *Z. zebra*, Bloch, by the deeper body, larger head, short sub-equal pectorals, and by the form and arrangement of the cross-bands.

5. **Aesopia** Kaup.

Aesopia, Kaup, *Arch. Naturg.*, 1858, p. 97 ; Günther, *Cat. Fish.*, IV, p. 487 (1862).

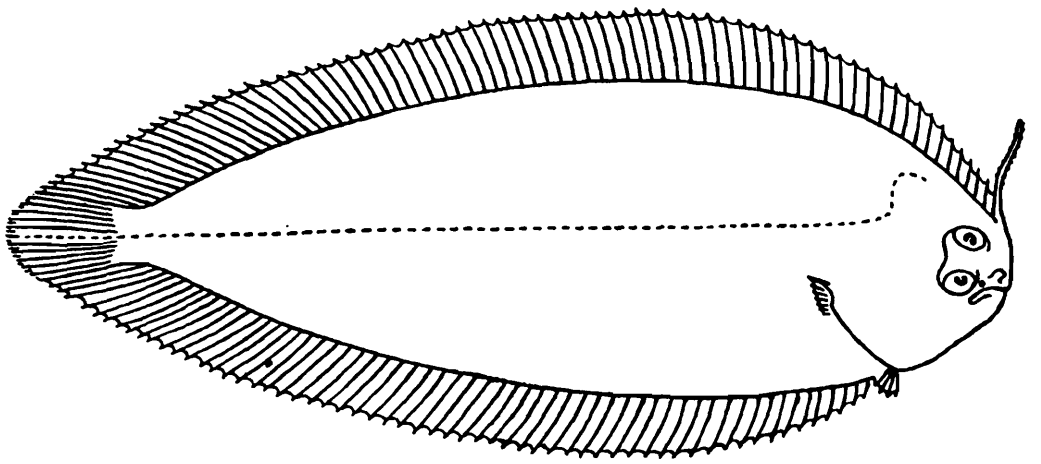
A single species.

1. **Aesopia cornuta** Kaup.

Synaptura potoo, Bleeker, *Verh. Bat. Gen.*, XXV, Bengal, p. 76 (1853).
Aesopia cornuta, (Cuvier) Kaup, *Arch. Naturg.*, 1858, p. 98 ; Günther, *Cat. Fish.*, IV, p. 487 (1862) ; Day, *Proc. Zool. Soc.*, 1873, p. 238 ; Jordan & Starks, *Proc. U. S. Nat. Mus.*, XXXI, p. 235, fig. 27 (1906) ; Regan, *Ann. Durban Mus.*, II, p. 218 (1920) ; Barnard, *Ann. S. Afric. Mus.*, XXI, p. 409 (1925).
Synaptura cornuta, Day, *Fish. India*, p. 430, pl. xciv, fig. 4 (1877) ; Alcock, *J. Asiat. Soc. Bengal*, LVIII, pt. 2, p. 287 (1889) ; Johnstone, *Ceylon Pearl Oyster Fish.*, Supp. Rep. XV, p. 206 (1904) ; Jenkins, *Mem. Ind. Mus.*, III, p. 29 (1910).
" *Jerree Potoo* " C. Russell, *Descr. Fish. Vizag*, I, p. 56, pl. lxxii (1803).

Depth of body about 3 in the length, length of head 5 to 5¼. Eyes contiguous, the upper scarcely in advance of the lower ; diameter greater than length of snout and about 4 in length of head. Mouth extending to below anterior part of eye. Nasal tube rather short. Dorsal 69-79. Anal 61-66. Caudal 15-17. Posterior rays of dorsal and anal completely joined to the caudal. Right pectoral shorter than eye, the upper rays not produced ; left pectoral about the same size. Scales cycloid on both sides of body ; some of those on blind side of head produced into barbel-like processes ; 87 to 98 scales in a longitudinal series. Greyish or brownish, with 13 dark brown cross-bands extending on to the vertica

fins, the anterior band being on the snout ; caudal dark brown posteriorly, with some oblong white spots.



TEXT-FIG. 5.—Outline drawing of *Aesopia cornuta* Kaup. ¾ Nat. size.

Described from 10 specimens, 55 to 130 mm. in total length.

Hab.—South Africa to Japan.

798	Madras.		
12707, 12710 ..	Ganjam Coast, 9 to 10 fms.	..	"Investigator."
12233 ..	Orissa Coast, 7 to 8 fms.	..	,,
F. 825/1 ..	Off Martaban Coast, 68 fms.	..	,,

Specimens in the British Museum from Madras, and the Ganjam Coast ; in the Herdman Collection from Galle, Ceylon.

I have been unable to find any trace of the " *Solea cornuta* " attributed to Cuvier. In the second edition of the Règne Animalium Vol. II he lists " la sole cornue " in a footnote on page 343, and refers to Russell's figure, but does not give a specific name. The name *Solea cornuta*, Cuvier, is not to be found in Sherborn's " Index Animalium," and probably does not exist.

6. **Pardachirus** Günther.

Pardachirus, Günther, *Cat. Fish.*, IV, p. 478 (1862).

Four species from the Indo-Pacific ; two known from India.[1]

1. **Pardachirus marmoratus** (Lacep.).

? *Achirus barbatus*, Lacepède, *Hist. Nat. Poiss.*, IV, pp. 658, 660 (1802).
Achirus marmoratus, Lacepède, *t. c.*, pp. 658, 660.
Achirus barbatus, Geoffroy, *Ann. Mus. H. N. Paris*, I, p. 152, pl. xi (1802) ; Rüppell, *Fische roth. Meeres*, p. 122, pl. 31, fig. 2 (1828).
Pardachirus marmoratus, Günther, *Cat. Fish.*, IV, p. 478 (1862) ; Sauvage, *H. Nat. Poiss. Madagascar*, p. 472 (1891) ; Barnard, *Ann. S. Afric. Mus.*, XXI, p. 405 (1925).

Depth of body 2¼ to 2½ in the length, length of head 4¼ to 4⅔. Dorsal 66-70. Anal 52-55. About 95 scales in a longitudinal series ; each scale on ocular side of head with a roughened patch posteriorly, but without marginal spinules. Brownish, with a number of rather indistinct rounded or irregular pale, dark-edged areas, with or without a dark central spot ;

[1] I am unable to recognise *Pleuronectes maculatus*, Bloch, the type of which was re-examined by Day (*Fish. India*, p. 427), who regarded it as congeneric with *Pardachirus pavoninus*. It is doubtful whether this is a true *Pardachirus*. The type, a skin preserved in the Berlin Museum, was said to come from Tranquebar.

head, body and fins with numerous small dark spots in addition to the other markings; sometimes a few large black and white ocelli on the body.

Described from 8 specimens, 85 to 215 mm. in total length.

Hab.—Red Sea; East coast of Africa southwards to Madagascar; Persian Gulf; Gulf of Oman.

265. (2 spec.) Persian Gulf "Palinurus."

A specimen in the British Museum from Muscat, Arabia.

2. **Pardachirus pavoninus** (Lacep.).

Achirus pavoninus, Lacepède, *Hist. Nat. Poiss.*, IV, pp. 658, 660 (1802); Cantor, *J. Asiat. Soc. Bengal*, XVIII, pt. 2, p. 1207 (1850); Bleeker, *Atl. Ichth.*, VI, p. 24, Pleuron, pl. x, fig. 1 (1866); Day, *Fish. India*, p. 427, pl. xciii, fig. 2 (1877).

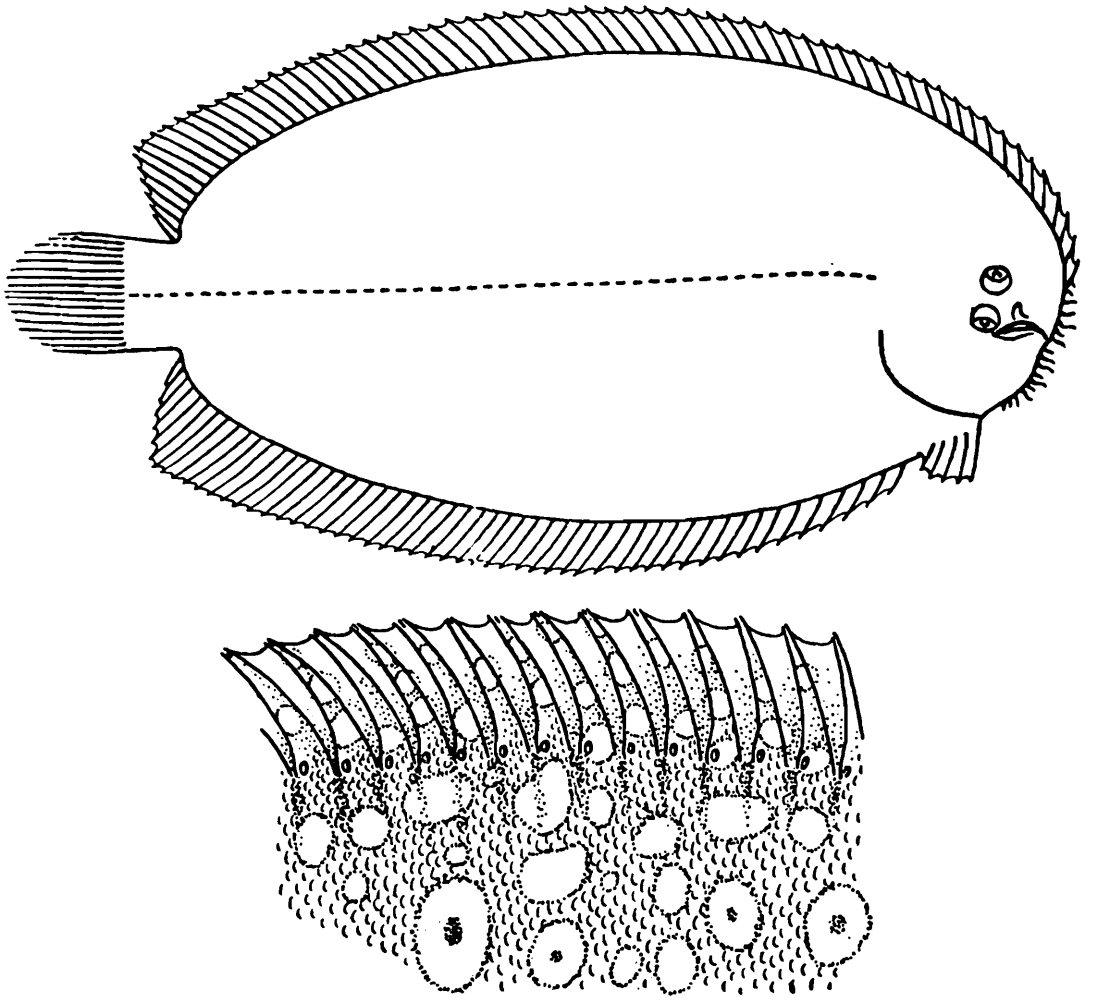
Achirus maculatus, Bleeker, *Nat. & Geneesk. Arch. Ned. Ind.*, II, p. 509 (1845).

Pardachirus pavoninus, Günther, *Cat. Fish.*, IV, p. 479 (1862); *Fische Sudsee*, VIII, p. 347 (1909); Weber, "*Siboga*"-*Exped.* Monogr. 57, p. 439 (1913); Ogilby, *Mem. Queensland Mus.*, V, p. 142, pl. xvi (1916),; Norman, *Biol. Res.* "*Endeavour*," V, p. 288 (1926).

? *Pardachirus marmoratus*, Kner, *Reise* "*Novara*," Zool. I, 5, Fische, p. 290 (1869).

Solea persimilis, Günther, *Fische Sudsee*, VIII, p. 346 (1909).

Depth of body $2\frac{1}{8}$ to $2\frac{1}{3}$ in the length, length of head $4\frac{1}{2}$ to nearly 5. Dorsal 64-71. Anal 50-56. 78 to 85 scales in a longitudinal series; each



a.

TEXT-FIG. 6.—Outline drawing of *Pardachirus pavoninus* (Lacep.). $\frac{2}{3}$ Nat. size. (*a*) Portion of dorsal fin of same, showing the pores near the bases of the rays.

scale on ocular side of head with a roughened patch posteriorly and with a series of marginal spinules. Greyish brown, with a number of rounded

or irregular milk-white blotches and spots, margined with dark brown or black and with or without a dark central spot; these markings extend on to the fins.

Described from several specimens, 105 to 195 mm. in total length, including the type of *Solea persimilis*.

Hab.—Andaman Islands, through the Malay Peninsula and Archipelago to Japan, Australia and the Pacific.

455 (Cat.)	.. ..	??	
1259	.. ..	Andaman Is.	
9490	.. ..	„ ..	.. Homfrey.

The four species of *Pardachirus* may be distinguished as follows :—

I. Anal with 50 to 56 rays; 80 to 100 scales in a longitudinal series.	
A. Scales on ocular side of head without marginal spinules	1. *marmoratus*, Lacep.
B. Scales on ocular side of head with marginal spinules.	
1. Scales on body with the marginal spinules feebly developed or absent; right pelvic fin separated from anal by a narrow space which is less than diameter of eye, joined by a membrane to the urino-genital papilla; body without dark blotches ..	2. *pavoninus*, Lacep.
2. Scales on body with the marginal spinules well developed; right pelvic fin separated from anal by a space which is greater than diameter of eye, not joined to the urino-genital papilla; 3 series of black blotches on body in addition to the usual ocelli ..	3. *hedleyi*, Ogilby.
II. Anal with 44 to 47 rays; 60 to 70 scales in a longitudinal series	4. *poropterus*, Bleeker. [=*thepassii*, Bleeker].

7. Aseraggodes Kaup.

Aseraggodes, Kaup, *Arch. Naturg.*, 1858, p. 103.
Liachirus, Günther, *Cat. Fish.*, IV, p. 479 (1862).

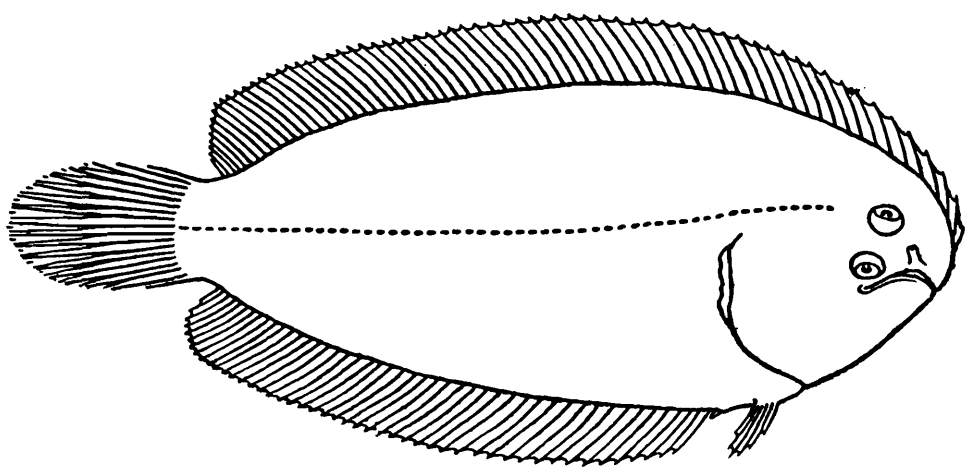
Several species from the Indo-Pacific; one known from India.

1. Aseraggodes cyaneus (Alcock).

Solea cyanea, Alcock, *Ann. Mag. Nat. Hist.* (6) VI, p. 439 (1890).
Solea umbralitis, Alcock, *J. Asiat. Soc. Bengal*, LXIII, pt. 2, p. 131, pl. vii, fig. 3 (1894).
Solea umbratilis, Alcock, *Illust. Zool.* "*Investigator*," Fishes pl. xv, fig. 4 (1895); *Cat. Indian Deep-Sea Fishes*, p. 129 (1899); Regan, *J. Bombay Nat. Hist. Soc.*, XVI, p. 329 (1905).
Solea (Achirus) cyanea, Alcock, *J. Asiat. Soc. Bengal*, LXV, pt. 2, p. 329 (1896).
Solea (Achirus) umbratilis, Alcock, *t. c.* p. 329.
? *Achirus poropterus*, Regan, *Trans. Linn. Soc.*, Zool., XII, p. 235 (1908).
Aseraggodes cyaneus, Weber, "*Siboga*"-*Exped.* Monogr. 57, p. 435, pl. xi, fig. 3 (1913).

Depth of body $2\frac{1}{4}$ to $2\frac{3}{5}$ in the length, length of head $2\frac{3}{4}$ to $4\frac{2}{5}$. Upper eye in advance of lower, its diameter $\frac{1}{2}$ or more than $\frac{1}{2}$ length of snout, greater than interorbital width, and 6 to 8 in length of head. Mouth extending to below middle of eye or beyond; distance from angle of mouth

to tip of lower jaw 3 to 3½ in length of head. Dorsal 67-77. Anal 46-54. Scales ctenoid on both sides of body; 58 to 66 in a longitudinal series. Greyish or brownish, with some large darker blotches arranged in four or five irregular transverse series and in three irregular longitudinal series; dorsal and anal fins generally with dark brown or blackish punctulations on the membrane between the rays.



TEXT-FIG. 7.—Outline drawing of *Aseraggodes cyaneus* (Alcock). Nat. size.

Described from numerous examples, 60 to 100 mm. in total length, including paratypes of the species and of *A. umbratilis*.

Hab.—From the Persian Gulf, through the Indian Ocean and Archipelago to the Timor Sea.

F. 1006-9/1	Stn. 292 : Persian Gulf, 53 fms. ..	"Investigator."
F. 1152-4/1	„ 346 : „ 47 fms. ..	„
F. 1017-8/1	„ 294 : „ 40 fms. ..	„
9401	Persian Gulf.	Blanford.
F. 1297-9/1 ..	Stn. 360 : Arabian Sea, 130 fms.	"Investigator."
F. 50-54/1	Off Kathiawar Coast, 82 fms. ..	„
F. 631-42/1	Stn. 246 : Laccadive Sea, 68 to 148 fms.	„
F. 595-630/1	N. W. of Calicut, 100 fms. ..	„
F. 6834-6/1 (6 spec.) ..	Stn. 389 : off Travancore Coast, 81 fms.	„
12919 (Paratypes of *A. cyaneus*).	Stn. 79 : Ganjam Coast, 33 fms. ..	„
12920 (Paratypes of *A. cyaneus*).	Stn. 93 : Vizagapatam Coast, 25 fms.	„
12921 (Paratypes of *A. cyaneus*).	Stn. 98, Vizagapatam Coast, 20 fms.	„
13615, 13617, 13621-2 ..	Stn. 170 : Bay of Bengal, 107 fms.	„
13623, 13625-8 ..	Stn. 169 : Bay of Bengal, 91 fms.	„

Specimens in the British Museum from Gulf of Oman, 98 fms.; off Muscat, 220 fms.; Bay of Bengal, 107 fms. A young example collected by Gardiner in the Maldives may belong to this species.

After examining and tabulating a large series of specimens from various localities, I conclude that *A. umbratilis* is synonymous with *A. cyaneus*, or, at the most, only a variety. It is said to differ in the larger head and mouth, larger and more widely separated eyes, and in the smaller number of dorsal and anal rays: none of these characters, however, appear to be constant.

8. **Heteromycteris** Kaup.

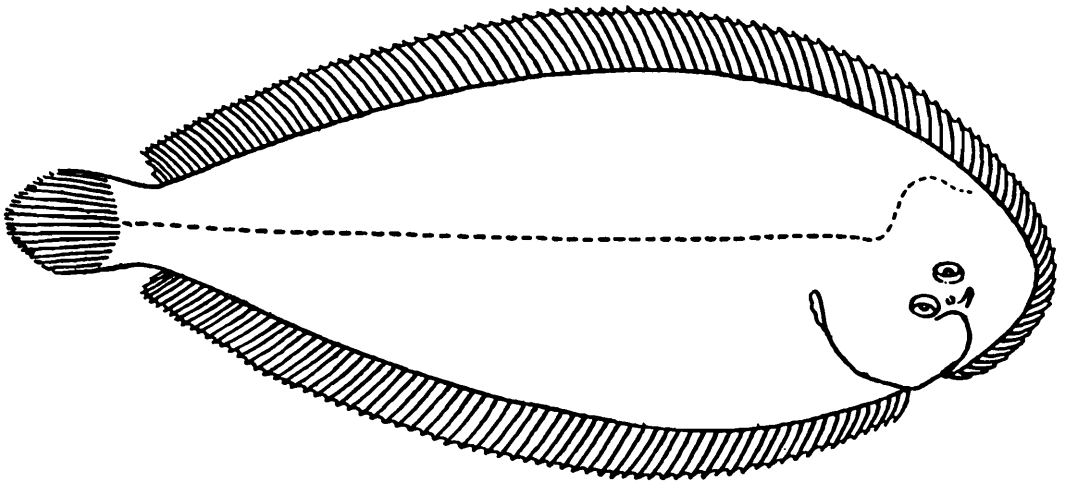
Heteromycteris, Kaup, *Arch. Naturg.*, 1858, p. 103; Jordan, *Copeia*, No. 136, p. 99 (1924); Chabanaud, *Ann. Mag. Nat. Hist.* (9) XX, p. 523 (1927).
Amate, Jordan & Starks, *Proc. U. S. Nat. Mus.*, XXXI, p. 228 (1906); Jordan, *Univ. Calif. Publ. Zool.*, XXVI, No. 1, p. 11 (1923).
Monodichthys, Chabanaud, *Bull. Mus. Nat. Hist. Paris*, 1925, p. 356.

Four species from the Indo-Pacific; one known from India.

1. **Heteromycteris oculus** (Alcock).

Solea oculus, Alcock, *J. Asiat. Soc. Bengal*, LVIII, pt. 2, p. 285, pl. xviii, fig. 3 (1889); Johnstone, *Ceylon Pearl Oyster Fish.*, Supp. Rep. XV, p. 206 (1904).
Solea (Achirus) oculus, Alcock, *J. Asiat. Soc. Bengal*, LXV, pt. 2, p. 329 (1896).
Heteromycteris oculus, Chabanaud, *Ann. Mag. Nat. Hist.* (9) XX, p. 526 (1927).

Depth of body $2\frac{3}{5}$ to nearly 3 in the length, length of head $3\frac{3}{4}$ to $4\frac{1}{4}$. Dorsal 90-103. Anal 60-67. 86 to 91 scales in a longitudinal series.



TEXT-FIG. 8.—Outline drawing of *Heteromycteris oculus* (Alcock). $\frac{3}{4}$ Nat. size.

Described from several specimens, 64 to 145 mm. in total length.
Hab.—Mekran, Ganjam and Orissa Coasts; Ceylon.

14274-8 ..	Mekran Coast. ..	.. Townsend.
12591-3, 12595, 12597, 12599, 12601-12, 12705-6.	Ganjam Coast, 9 to 14 fms.	.. "Investigator."
F. 2688/1	Puri Coast, Orissa. ..	Annandale.
——	Sundarbans, mouth of R. Hughli.	Kemp.

This species is very close to *H. hartzfeldii*, Bleeker, but appears to differ in the absence of scales on the rays of the dorsal and anal fins, on the ocular side, and in the colouration.

Family 5. **Cynoglossidae.**

Three genera represented in Indian waters.

Synopsis of the Indian Genera.

I. Two or three lateral lines on ocular side.
  A. Lips fringed .. .. 1. *Paraplagusia.*
  B. Lips not fringed. 2. *Cynoglossus.*
II. No lateral lines on ocular side .. .. 3. *Symphurus.*

1. Paraplagusia Bleeker.

Paraplagusia, Bleeker, *Nat. Tijdschr. Dierk.*, II, p. 274 (1865); *Atl. Ichth.*, VI, p. 26 (1866).

Several species from the Indo-Pacific; two known from India.

Synopsis of the Indian Species.

I. Posterior edge of rostral hook $2\frac{1}{4}$ to $2\frac{2}{3}$ in head; dorsal with 106 to 118 rays; anal with 86 to 93 rays; 98 to 114 scales in a longitudinal series, 16 to 19 between lateral lines .. .. 1. *bilineata.*

II. Posterior edge of rostral hook 3 to $3\frac{1}{2}$ in head; dorsal with 99 to 104 rays; anal with 76 to 82 rays; 75 to 83 scales in a longitudinal series, 13 to 16 between lateral lines .. .. 2. *blochii.*

1. Paraplagusia bilineata (Bloch).

Pleuronectes bilineatus, Bloch, *Nat. Ausland. Fische*, III, p. 29 (1785); Bloch, Schneider, *Syst. Ichth.*, p. 158 (1801); Cuvier, *Règne Anim.*, ed. 1, II, p. 224 (1817).

? *Plagusia dipterygia*, Rüppell, *Fische roth. Meeres*, p. 123, pl. 31, fig. 3 (1828).

Plagusia marmorata, Bleeker, *Nat. Tijdschr. Ned. Ind.*, I, p. 411 (1851); *Verh. Bat. Gen.*, XXIV, Pleuron, p. 20 (1852): Günther, *Cat. Fish.*, IV, p. 491 (1862); Day, *Fish. India*, p. 431, pl. xcv, fig. 1 (1877); Jenkins, *Mem. Ind. Mus.*, III, p. 29 (1910).

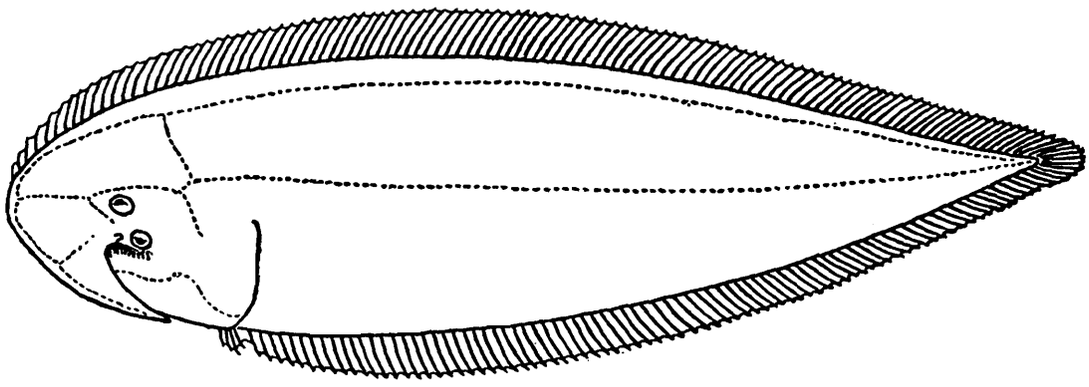
Paraplagusia marmorata, Bleeker, *Atl. Ichth*, VI, p. 28, Pleuron, pl. xv, fig. 5 (1866); *Verh. Akad. Amsterdam*, XVIII, p. 22 (1879); Regan, *Ann. Durban Mus.*, II, p. 219 (1920); Barnard, *Ann. S. Afric. Mus.*, XXI, p. 410 (1925).

Plagusia bilineata, Klunzinger, *Verh. zool.-bot. Ges. Wien*, XXI, p. 573 (1871).

Paraplagusia dipterygia, Jordan & Starks, *Proc. U. S. Nat. Mus.*, XXXI, p. 236 (1906).

Plagusia marmorata var. *africana*, Gilchrist, *Mar. Invest. S. Afric.*, IV, p. 163 pl. xlvii (1908).

Depth of body $3\frac{4}{5}$ to 4 in the length, length of head 4 to $4\frac{1}{3}$. Snout rounded or obtusely pointed, equal to or a little longer than head behind lower eye; rostral hook rather long, its posterior edge $2\frac{1}{4}$ to $2\frac{2}{3}$ in length of head, ending behind lower eye; interorbital width equal to or less than diameter of eye, which is 9 to 11 in length of head; upper eye in advance of lower; angle of mouth below or a little behind posterior part of lower eye, much nearer gill-opening than end of snout. Fringes on lower lip generally strongly arborescent. Dorsal 106-118. Anal 86-93. Scales



TEXT-FIG. 9.—Outline drawing of *Paraplagusia bilineata* (Bloch). $\frac{3}{4}$ Nat. size.

ctenoid, those of ocular side more strongly denticulated than those of blind side; 98 to 114 in a longitudinal series; two lateral lines on ocular

side, separated by 16 to 19 series of scales; no distinct lateral line on blind side. Brownish, spotted and marbled with darker.

Described from several specimens, 80 to 190 mm. in total length.

Hab.—From East Africa, through the Indian Ocean and Archipelago to China and Japan.

F. 3432/1 (8 spec.) ..	Puri, Orissa Coast. ..	Jenkins.
F. 4177/1, F. 2687/1 (pt.)	Puri, Orissa Coast.	Annandale.
F. 2104/1	Puri, Orissa.	Paiva.
12676-7, 12679 ..	Stn. 67 : 19 miles S. W. of Gopalpur, 9 to 10 fms.	"Investigator."
15561-2	Gangaram, Gangetic Delta.	
——. (2 spec.) ..	Sundarbans, mouth of R. Hughli.	Kemp.
7999	Akyab, Burma. ..	Dodgson.
10600 ..	Akyab Bazaar, Burma. ..	Yunnan Exped. (Anderson).
459 (Cat.)	??	

Specimens in the British Museum from Malabar; Ceylon; Ganjam; Batjan.

This species is very close to *P. unicolor*, Macleay, from Australia, but differs in having a larger head, rather longer rostral hook, a greater number of anal rays and smaller scales.

Klunzinger, who has examined the type of *Pleuronectes bilineatus*, states that it is identical with the species described by Bleeker and Günther as *P. marmoratus*.

2. **Paraplagusia blochii** (Bleeker).

Plagusia bilineata (*non* Bloch), Cantor, *J. Asiat. Soc. Bengal*, XVIII, pt. 2, p. 1209 (1850); Jerdon, *Madras J. Lit. Sci.*, XVII, No. 39, p. 148 (1851), 1853; Günther, *Cat. Fish.*, IV, p. 492 (1862); Day, *Fish. Malabar*, p. 174 (1865); *Fish. India*, p. 431 (1877); Alcock, *J. Asiat. Soc. Bengal*, LVIII, pt. 2, p. 290 (1889); Jenkins, *Mem. Ind. Mus.*, III, p. 29 (1910).

Plagusia blochii, Bleeker, *Nat. Tijdschr. Ned. Ind.*, I, p. 411 (1851); *Verh. Bat. Gen.*, XXIV, Pleuron, p. 21 (1852); von Martens, *Exp. nach Ost. Asien*, I, p. 398 (1876).

Paraplagusia bilineata, Bleeker, *Atl. Ichth.*, VI, p. 47, Pleuron, pl. xiii, fig. 5 (1866).

Plagusia obscura, Jenkins, *Rec. Ind. Mus.*, V, p. 134 (1910).

"*Jerree Potoo*" E, Russell, *Descr. Fish. Vizag.*, I, p. 58, pl. lxxiv (1803).

Depth of body $3\frac{3}{5}$ to $3\frac{3}{4}$ in the length, length of head $3\frac{2}{3}$ to $4\frac{1}{6}$. Snout obtusely pointed, about equal to head behind lower eye; rostral hook of moderate length, its posterior edge 3 to $3\frac{1}{2}$ in length of head, ending below middle or posterior part of lower eye; interorbital width equal to or greater than diameter of eye in adults, which is 10 to 12 in length of head; upper eye in advance of lower; angle of mouth below posterior part of lower eye, nearer gill-opening than end of snout. Fringes on lower lip generally strongly arborescent. Dorsal 99-104. Anal 76-82. Scales ctenoid, those of ocular side rather more strongly denticulated than those of blind side; 75 to 83 in a longitudinal series; two lateral lines on ocular side, separated by 13 to 16 series of scales; no distinct lateral line on blind side. More or less uniformly brownish.

Described from 13 specimens, 110 to 240 mm. in total length, including the type of *P. obscura*.

Hab.—East Africa, through the Indian Ocean and Archipelago to Formosa.

F. 1845/1 (Type of *P. obscura*)	Karachi.	
2359 ..	Madras.	
[1]2389	Godaveri Coast, 4 to 5 fms. ..	"Investigator."
F. 3431/1	Ganjam Coast, 24 to 30 fms. ..	"Golden Crown."
F. 3446/1, F. 2687/1(pt.) ..	Puri, Orissa Coast.	Annandale.
F. 3447/1 ..	„ „	Jenkins.
F. 1680-1/1, 1698/1 ..	„ „	Annandale & Lloyd.
F. 2100-3/1 ..	„ „	Paiva.
—— ..	Sundarbans, mouth of R. Hughli.	Settlement Officer, Khulna.
—— ..	Sandheads, mouth of R. Hughli.	P. V. "Lady Fraser."
11591 ..	Sandheads, R. Hughli. ..	Daly.
11558-60	Gangaram, Vizagapatam.	
138, ——. ..	Rangabali, nr. Raymangal, Khulna, Sundarbans.	Rahim.
—— ..	??	
——	??	

A specimen in the British Museum from Orissa.

2. Cynoglossus (Ham. Buch.)

Cynoglossus, Hamilton (Buchanan), *Fish. Ganges*, p. 32 (1822).

Numerous species from west Africa and the Indo-Pacific; twenty-one known from India.

Synopsis of the Indian Species.

A. Three lateral lines on ocular side.
- **B.** No distinct lateral line on blind side.
  - **C.** Depth $3\frac{4}{5}$ to $4\frac{1}{4}$ in length, head $4\frac{2}{3}$ to $5\frac{1}{5}$; maxillary extending to below middle or hinder part of eye; 10 to 12 scales between upper and middle lateral lines.
    - **D.** A single nostril on ocular side; snout 3 in head .. .. .. 1. *sealarki.*
    - **DD.** Two nostrils on ocular side; snout $3\frac{2}{3}$ in head .. .. .. 2. *versicolor.*
  - **CC.** Depth $3\frac{1}{2}$ to $3\frac{4}{5}$ in length, head about $3\frac{1}{2}$; maxillary extending to well beyond eye; 15 to 17 scales between upper and middle lateral lines .. .. .. 3. *carpenteri.*
- **BB.** Two lateral lines on blind side .. .. 4. *qiunquelineatus.*

AA. Two lateral lines on ocular side.
- **B.** Two lateral lines on blind side.
  - **C.** Head $4\frac{2}{5}$ to 5 in length; snout $2\frac{1}{2}$ to $2\frac{4}{5}$ in head; angle of mouth equidistant from end of snout and gill-opening or nearer the latter; 15 to 18 scales between lateral lines on blind side .. 5. *bilineatus.*
  - **CC.** Head about $5\frac{1}{3}$ in length; snout $3\frac{1}{5}$ to $3\frac{2}{5}$ in head; angle of mouth nearer end of snout than gill-opening; 22 to 25 scales between lateral lines on blind side .. .. .. 6. *dispar.*
- **BB.** Never more than one lateral line on blind side.
  - **C.** Scales cycloid on ocular side; a distinct lateral line on blind side .. .. .. 7. *dubius.*
  - **CC.** Scales ctenoid on ocular side; no distinct lateral line on blind side.

D. Scales cycloid on blind side; 7 to 14 between lateral lines.
E. 12 to 14 scales between lateral lines; depth $5\frac{3}{5}$ to $6\frac{1}{2}$ in length .. 8. *lingua.*
EE. 7 to 10 scales between lateral lines.
F. Depth $4\frac{7}{8}$ to $5\frac{1}{4}$ in length; snout $2\frac{1}{3}$ to $2\frac{1}{4}$ in head; eye 15 to 17 in head .. .. 9. *arel.*
FF. Depth $3\frac{4}{5}$ to $4\frac{2}{3}$ in length; snout $2\frac{2}{5}$ to $2\frac{2}{3}$ in head; eye $8\frac{1}{4}$ to 12 in head .. 10 *macrolepidotus.*

DD. Scales ctenoid on blind side.
E. 16 to 21 scales between lateral lines.
F. Eyes very small, prominent, subcontiguous, diameter 15 to 16 in head; both nostrils close together in front of eyes; 116 to 126 scales in a longitudinal series .. .. 11. *monopus.*
FF. Eyes moderate or small, not prominent, more or less separated from each other; diameter 8 to 14 in head; anterior nostril in front of lower eye, posterior in interorbital space or between anterior part of eyes; 80 to 110 scales in a longitudinal series.
G. Maxillary extending to well beyond eye; head $3\frac{3}{5}$ to $3\frac{5}{6}$ in length; snout $3\frac{2}{3}$ to $3\frac{5}{6}$ in head; eye 13 to 14 in head; about 95 scales in a longitudinal series .. .. 12. *macrostomus.*
GG. Maxillary extending to below posterior part of eye or a little beyond; head $4\frac{1}{2}$ to $5\frac{1}{5}$ in length; snout $2\frac{7}{8}$ to $3\frac{1}{5}$ in head; eye 8 to 10 in head; 91 to 110 scales in a longitudinal series .. 13. *puncticeps.*
GGG. Maxillary extending to below posterior part of eye; head 5 to $5\frac{3}{5}$ in length; snout 3 to $3\frac{2}{3}$ in head; eye 8 to 10 in head; 80 to 98 scales in a longitudinal series 14. *brevis.*

EE. 12 to 15 scales between lateral lines.
F. Angle of mouth nearer to end of snout than gill-opening or midway between them; snout $2\frac{3}{5}$ to $3\frac{1}{2}$ in head; rostral hook not extending to below eye.
G. Snout rounded or obtusely pointed, about $3\frac{1}{2}$ in head; depth $3\frac{3}{5}$ to 4, head $4\frac{1}{2}$ to 5 in length; body with irregular and incomplete cross-bands 15. *semifasciatus.*
GG. Snout pointed, $2\frac{3}{5}$ to $2\frac{2}{3}$ in head; depth $3\frac{1}{2}$ to $3\frac{3}{4}$, head $4\frac{2}{3}$ to nearly 5 in length; body uniform or vaguely marbled with darker markings .. 16. *cynoglossus.*

GGG. Snout pointed, $2\frac{2}{3}$ to $2\frac{3}{4}$ in head; depth $4\frac{1}{4}$ to $4\frac{2}{3}$, head $4\frac{1}{2}$ to $4\frac{3}{5}$ in length; body with traces of darker markings .. 17. *sumatranus.*

FF. Angle of mouth nearer to gill-opening than end of snout; rostral hook extending to below lower eye; snout $2\frac{1}{3}$ to $2\frac{1}{2}$ in head 18. *lida.*

EEE. 9 to 11 scales between lateral lines.

F. Depth $3\frac{1}{2}$ to 4, head $4\frac{2}{3}$ to $5\frac{1}{4}$ in length; snout $3\frac{1}{4}$ to $3\frac{1}{2}$, eye 6 to $7\frac{1}{2}$ in head; dorsal with 102 to 112 rays; anal with 84 to 88 rays .. .. 19. *brachycephalus.*

FF. Depth $3\frac{2}{3}$ to 4, head about 4 in length; snout $2\frac{2}{5}$ to $2\frac{2}{3}$, eye 15 to 18 in head; dorsal with about 95 rays; anal with about 70 rays .. .. 20. *deltae.*

FFF. Depth $4\frac{1}{4}$, head $5\frac{1}{4}$ in length; snout $3\frac{3}{5}$, eye about 11 in head; dorsal with about 91 rays; anal with about 76 rays 21. *brevirostris.*

This genus has been further sub-divided into several genera, based on the form of the nostrils and the number of lateral lines. Pending a complete revision of the whole family, I have retained the genus *Cynoglossus* in the unrestricted sense of Günther and Bleeker.

1. **Cynoglossus sealarki** Regan.

Cynoglossus sealarki, Regan, *Trans. Linn. Soc.*, Zool., XII, p. 235, pl. 26 fig. 1 (1908).

Depth of body 4 to $4\frac{1}{4}$ in the length, length of head $4\frac{2}{3}$ to 5. Snout rounded, length 3 in head; rostral hook short, extending to below mandibulary symphysis; diameter of eye 7 to 8 in length of head and 2 to 3 times the interorbital width; upper eye a little in advance of lower; maxillary extending to below middle of eye, posterior edge nearer end of snout than gill-opening. A single tubular nostril on ocular side in front of lower eye. Dorsal 108-116. Anal 90-95. Scales ctenoid on ocular side, cycloid on blind side; 65 to 70 in a longitudinal series[1]; three lateral lines on ocular side, the upper and middle separated by 10 to 12 series of scales; no distinct lateral line on blind side. Uniformly brownish.

Described from 4 specimens, 172 to 190 mm. in total length; types of the species (B. M. Reg. No. 1908. 3. 23. 153-6).

Hab.—Saya de Malha Bank, over 123 fms.

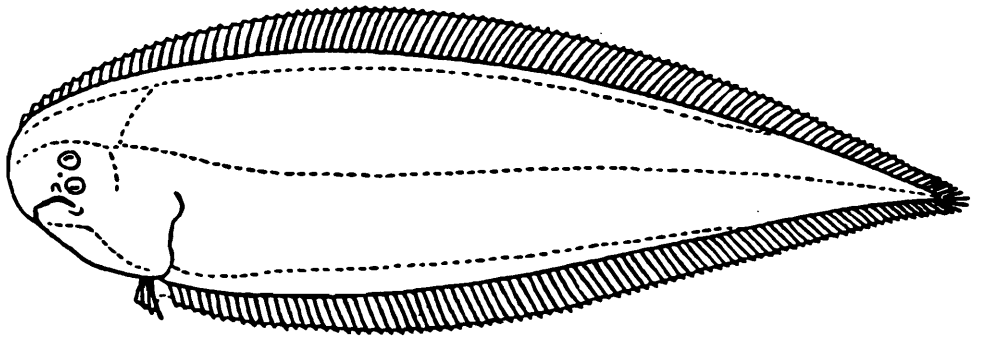
2. **Cynoglossus versicolor** Alcock.

Cynoglossus versicolor, Alcock, *Ann. Mag. Nat. Hist.* (6) VI, p. 442 (1890); *J. Asiat. Soc. Bengal*, LXV, pt. 2, p. 330 (1896).

Depth of body $3\frac{4}{5}$ in the length, length of head $5\frac{1}{5}$. Snout rounded, length $3\frac{2}{3}$ in head; rostral hook short, scarcely extending beyond mandibulary symphysis; diameter of eye $6\frac{3}{5}$ in length of head and about

[1] Counted from above gill-opening to base of caudal.

twice the interorbital width; upper eye a little in advance of lower; maxillary extending to below hinder part of eye, posterior edge nearer



TEXT-FIG. 10.—Outline drawing of *Cynoglossus versicolor* Alcock. ¾ Nat. size.

end of snout than gill-opening. Two nostrils on ocular side, a simple one between the anterior parts of the eyes and a tubular one in front of lower eye. Dorsal 114. Anal 89. Scales ctenoid on both sides of body; about 74 in a longitudinal series; three lateral lines on ocular side, the upper and lower incomplete posteriorly; 12 series of scales between the upper and middle lateral lines; no distinct lateral line on blind side. Uniformly brownish.

Described from a single specimen, 120 mm. in total length; type of the species.

Hab.—Orissa Coast.

12895 (type) .. .. Orissa Coast, 11 fms. Townsend.

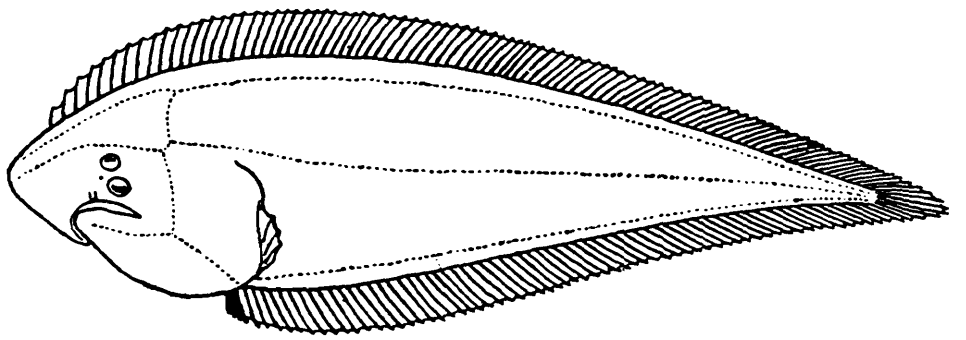
Close to *C. kopsii*, Bleeker, differing in the smaller scales and in the greater number of dorsal and anal rays. In his description of this species, Alcock states that there is only one nostril on the coloured side, and two lateral lines. Re-examination of the type shows a distinct, although incomplete lower lateral line, and an opening which appears to be the posterior nostril between the anterior parts of the eyes.

3. **Cynoglossus carpenteri** Alcock.

Cynoglossus carpenteri, Alcock, *J. Asiat. Soc. Bengal*, LVIII, pt. 2, p. 287, pl. xviii, fig. 1 (1889); *Ann. Mag. Nat. Hist.* (6) VI, p. 217 (1890); *J. Asiat. Soc. Bengal*, LXV, pt. 2, p. 330 (1896); *Illust. Zool.* "*Investigator*," Fishes, pl. xxii, fig. 5 (1898); *Cat. Indian Deep-Sea Fishes*, p. 133 (1899); Boulenger, *Ann. Mag. Nat. Hist.* (7) VII, p. 263 (1901); Regan, *J. Bombay Nat. Hist. Soc.*, XVI, p. 329 (1905).

Depth of body $3\frac{1}{2}$ to $3\frac{4}{5}$ in the length, length of head about $3\frac{1}{2}$. Snout obtusely pointed, length about 3 in head; rostral hook short, not extending to below eye; diameter of eye 9 to 12 in length of head, and 2 or 3 times the interorbital width; upper eye a little smaller and in advance of the lower; maxillary extending to well beyond eye, posterior edge equidistant from end of snout and gill-opening or a little nearer the latter. Two nostrils on ocular side, a simple one between the anterior parts of the eyes, a tubular one in front of lower eye. Dorsal 93-108. Anal 80-88. Scales cycloid on ocular side, except on posterior part of body where they are armed with a few strong spinules; those on blind side all cycloid; 83 to 91 scales in a longitudinal series; three lateral lines on ocular side, the upper and middle separated by 15 to 17 series

of scales; no distinct lateral line on blind side. Brownish; opercular region blackish; caudal and often the greater part of the dorsal and anal fins blackish.



TEXT-FIG. 11.—Outline drawing of *Cynoglossus carpenteri* Alcock. ½ Nat. size.

Described from numerous specimens, up to 200 mm. in total length.

Hab.—Persian Gulf; Gulf of Oman; Arabian Sea; Bay of Bengal; in deep water.

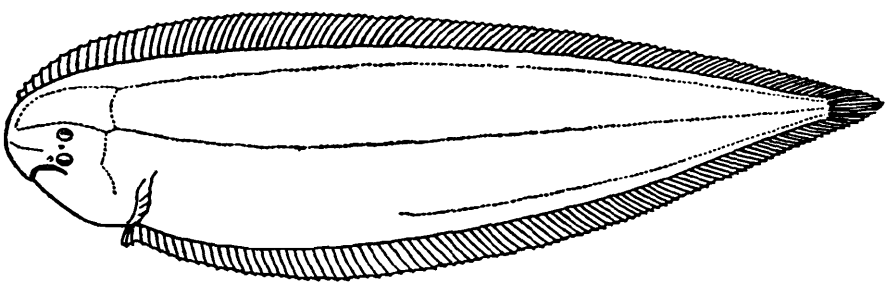
F. 1160-2/1 ..	..	Stn. 341; Gulf of Oman, 230 fms.	"Investigator,"
F. 1275-80/1 ..	..	„ 356: Arabian Sea, 156 to 200 fms.	„
F. 647-59/1 ..	..	Off Calicut, 100 fms... ..	„
12726-8. (25 spec.)	..	Stn. 96; Bay of Bengal, 98 to 102 fms.	„
13589-94 ..	..	Stn. 170; Bay of Bengal, 107 fms.	„

Specimens in the British Museum from the Persian Gulf; Gulf of Oman; Arabian Sea; Bay of Bengal.

4. **Cynoglossus quinquelineatus** Day.

Cynoglossus quinquelineatus, Day, *Fish. India*, p. 432, pl. xcviii, fig. 1 (1877).

Depth of body about 4 in the length, length of head $5\frac{1}{5}$. Snout rounded, length $2\frac{3}{4}$ in head; rostral hook very short, scarcely extending to below mandibulary symphysis; diameter of eye $9\frac{1}{2}$ in length of head and about equal to interorbital width; upper eye slightly in advance of lower; maxillry extending to below posterior edge of eye, posterior edge nearer end of snout than gill-opening. Two nostrils on ocular side, a simple one between the eyes, a tubular one in front of lower eye. Dorsal 109. Anal 91. Scales ctenoid on ocular side, cycloid on blind side;



TEXT-FIG. 12.—Outline drawing of *Cynoglossus quinquelineatus* Day. ½ Nat. size.

about 95 in a longitudinal series; three lateral lines on ocular side, the lower incomplete and extending from the middle of the body to the base

of the caudal; upper and middle lateral lines separated by 17 series of scales; two distinct lateral lines on the blind side. Brownish; an irregular dark patch on the opercular region.

Described from a single specimen, 250 mm. in total length, believed to be the type of the species.

Hab.—Madras.

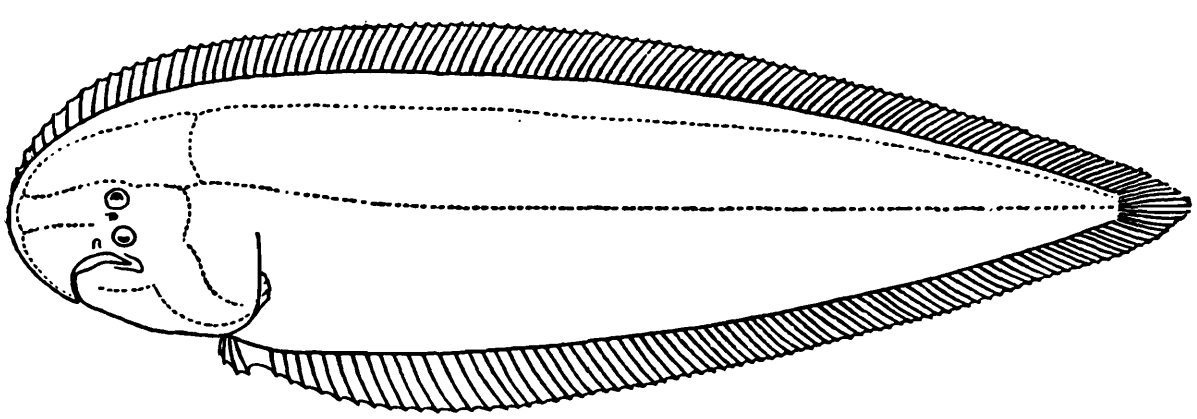
1265. (? type) Madras.

This species is known only from this single specimen, which may prove to be an abnormal example of *C. bilineatus*, in which an incomplete lateral line has developed on the lower part of the body on the ocular side. It seems to differ from that species, however, in having a somewhat smaller eye, a shorter rostral hook, and in the position of the angle of the mouth.

5. **Cynoglossus bilineatus** (Lacep.).

Achirus bilineatus, Lacepède, *Hist. Nat. Poiss.*, IV, pp. 659, 663 (1802).
Plagusia quadrilineata, Bleeker, *Nat. Tijdschr. Ned. Ind.*, I, p. 412 (1850); *Verh. Bat. Gen.*, XXIV, Pleuron, p. 21 (1852).
Arelia quadrilineata, Kaup, *Arch. Naturg.*, 1858, p. 107.
Cynoglossus quadrilineatus, Günther, *Cat. Fish.*, IV, p. 497 (1862); Bleeker, *Atl. Ichth.*, VI, p. 32, Pleuron. pl. xiv, fig. 3 (1866); Klunzinger, *Verh. zool.-bot. Ges. Wien*, XXI, p. 573 (1871); Day, *Fish. India*, p. 435 (1877); Klunzinger, *Sitzber. K. Ak. Wiss. Wien.* LXXX, Abt. 1, p. 409 (1880); Alcock, *J. Asiat. Soc. Bengal*, LVIII, pt. 2, p. 288 (1889); Steindachner, *Denkschr. Ak. Wiss. Wien*, LXXI, p. 154 (1902); Smith & Pope, *Proc. U. S. Nat. Mus.*, XXXI, p. 498 (1906); Jenkins, *Mem. Ind. Mus.*, III, p. 30 (1910).
Cynoglossus sindensis, Day, *Fish. India*, p. 434, pl. xc, fig. 6 (1877); Ogilby, *Proc. R. Soc. Queensland*, XXIII, p. 37 (1910).
Cynoglossus bilineatus, Weber, "*Siboga*"-*Exped.*, Monogr. 57, p. 443 (1913); Norman, *Biol. Res.* "*Endeavour*," V, p. 301 (1926).

Depth of body $3\frac{3}{4}$ to $4\frac{1}{3}$ in the length, length of head $4\frac{2}{5}$ to 5. Snout rounded, length $2\frac{1}{2}$ to $2\frac{4}{5}$ in head; rostral hook short, extending a little beyond mandibulary symphysis; diameter of eye $8\frac{1}{2}$ to 11 in length of head, a little greater than interorbital width; upper eye in advance of lower, maxillary extending to below posterior edge of eye or beyond, posterior edge equidistant from end of snout and gill-opening or a little nearer the latter. Two nostrils on ocular side, a simple one between the eyes, a tubular one in front of lower eye. Dorsal 104-114. Anal



TEXT-FIG. 13.—Outline drawing of *Cynoglossus bilineatus* (Lacep.). $\frac{1}{2}$ Nat. size.

84-95. Scales ctenoid on ocular side, cycloid on blind side; 84 to 96 in a longitudinal series; two lateral lines on ocular side, separated by 14 to 19 series of scales; two on blind side, separated by 15 to 18 series

of scales. Brownish ; generally an irregular dark patch on the opercular region.

Described from 25 specimens, 90 to 305 mm. in total length.

Hab.—From the Red Sea, through the Indian Ocean and Archipelago to Australia and Japan.

2715	.. ..	Sind.	
1145-6	.. ..	Madras.	
258	.. ..	Near mouth of harbour, Madras.	Kemp.
12702	.. ..	Ganjam Coast, 9 to 10 fms. ..	" Investigator."
F. 2627/1	.. ..	Orissa Coast.	Annandale.
12318, 12324, 12263, 12319-23.		„ 7 to 8 fms. ..	" Investigator."
F. 3444/1	.. ..	Elephant Pt., Arakan Coast, Burma.	" Golden Crown."
——	.. ..	??	

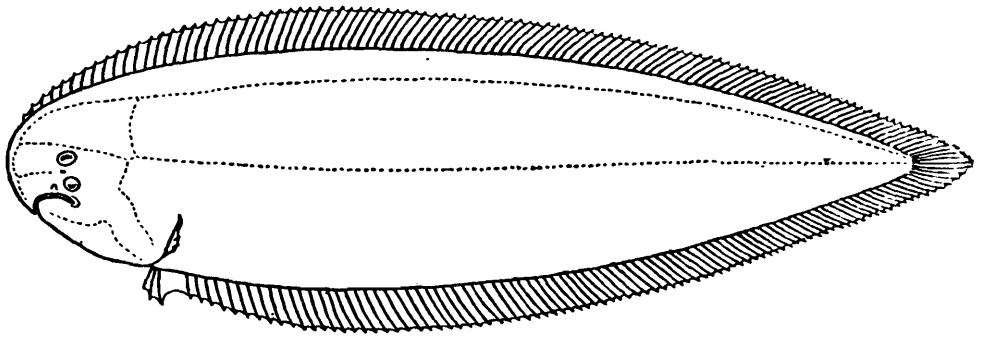
Specimens in the British Museum from Karachi ; Sind ; Seychelles.

The types of *C. sindensis* appear to have been lost, but I have little doubt that it is this species.

6. **Cynoglossus dispar** Day.

Cynoglossus dispar, Day, *Fish. India*, p. 434, pl. xcvi, fig. 2 (1877).

Depth of body $3\frac{3}{5}$ to $3\frac{3}{4}$ in the length, length of head about $5\frac{1}{3}$. Snout rounded, length $3\frac{1}{5}$ to $3\frac{2}{5}$ in head ; rostral hook short, extending a little beyond mandibulary symphysis ; diameter of eye $9\frac{1}{2}$ to $10\frac{1}{2}$ in length of head, somewhat greater than interorbital width ; upper eye a little in advance of lower ; maxillary extending to below posterior edge of eye or a little beyond, posterior edge nearer end of snout than gill-opening. Two nostrils on ocular side, a simple one between the eyes, a tubular one in front of lower eye. Dorsal 108-114. Anal 88-95. Scales ctenoid



TEXT-FIG. 14.—Outline drawing of *Cynoglossus dispar* Day. ½ Nat. size.

on ocular side, cycloid on blind side ; 105 to 109 in a longitudinal series ; two lateral lines on ocular side, separated by 18 or 19 series of scales ; two on blind side, separated by 22 to 25 series of scales ; upper lateral line on blind side ending in posterior ¼ of body. Brownish, more or less irregularly blotched with darker ; fins blackish, or with numerous black spots.

Described from 4 specimens, 95 to 350 mm. in total length, including examples believed to be the types of the species.

Hab.—Bombay ; Madras.

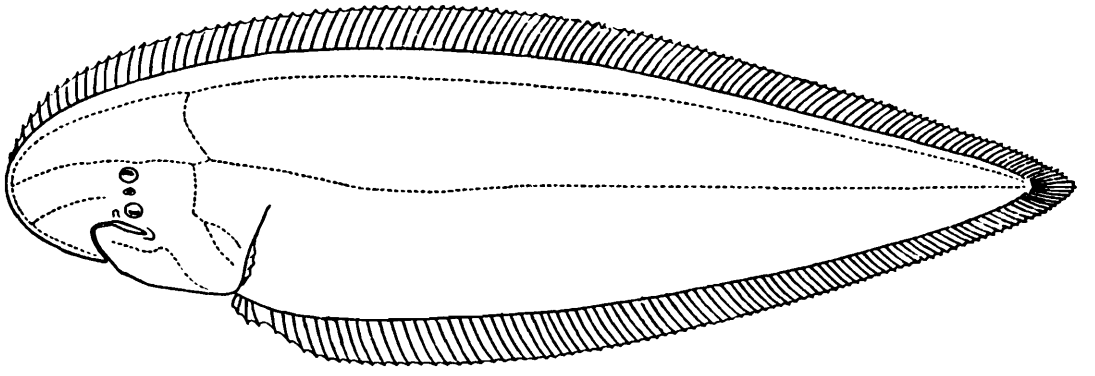
1141, 1144 (? types) .. Bombay.

Specimens in the British Museum from Madras.

7. **Cynoglossus dubius** Day.

Cynoglossus dubius, Day, *J. Linn. Soc.*, Zool., XI, p. 525 (1873); ***Fish. India***, p. 435, pl. xcv, fig. 2 (1877).

Depth of body $3\frac{4}{5}$ to $4\frac{1}{6}$ in the length, length of head about 4. Snout rounded or obtusely pointed, length $2\frac{1}{3}$ in head; rostral hook short, extending a little beyond mandibulary symphysis; diameter of eye 13 to 16 in length of head, $1\frac{1}{5}$ to $1\frac{1}{2}$ in interorbital width; upper eye in advance of lower; maxillary extending to beyond eye, posterior edge nearer to gill-opening than end of snout. Two nostrils on ocular side, a simple



TEXT-FIG. 15.—Outline drawing of *Cynoglossus dubius* Day. $\frac{1}{3}$ Nat. size.

one between the eyes, a tubular one in front of lower eye. Dorsal 108-112. Anal 85-89. Scales cycloid on both sides; about 95 in a longitudinal series; two lateral lines on ocular side, separated by 19 to 21 series of scales; a distinct lateral line in the middle of the blind side.[1] Uniformly brownish.

Described from 4 specimens, 220 to 460 mm. in total length, including an example believed to be the type of the species.

Hab.—Sind and Baluchistan; Travancore.

F. 1812/1 ..	.. Karachi.	..	.. Cumming.
1142 (? type) ..	.. Bombay.		

Specimens in the British Museum from Karachi and Travancore.

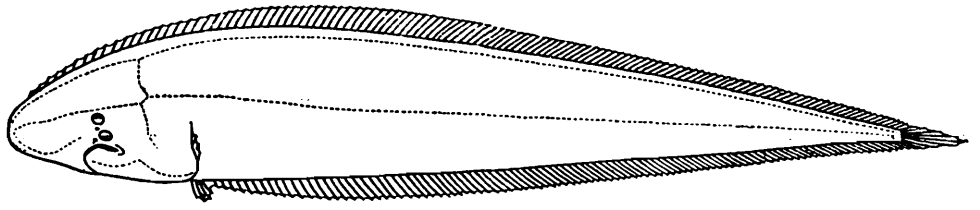
8. **Cynoglossus lingua** Ham. Buch.

Cynoglossus lingua, Hamilton (Buchanan), *Fish. Ganges*, pp. 32, 365 (1822); Günther, *Cat. Fish.*, IV, p. 501 (1862); Day, *Fish. India*, p. 433, pl. xcvi, fig. 1 (1877).
Pleuronectes potous, Cuvier, *Règne Anim.*, ed. 2, II, p. 344 (1829).
Plagusia lingua, Jerdon, *Madras. J. Lit. Sci.*, XVII, No. 39, p. 148 (1851) **1853.**
Plagusia potous, Bleeker, *Verh. Bat. Gen.*, XXIV, Pleuron, p. 23 (1852); Jerdon, *t.c.* p. 148.
? *Arelia lingua*, Kaup, *Arch. Naturg.*, 1858, p. 107.
Arelia potous, Bleeker, *Act. Soc. Sci. Indo-Neerl.*, VI, Enum. Spec., p. 185 (**1859**).
Cynoglossus potous, Bleeker, *Atl. Ichth.*, VI, p. 33, Pleuron, pl. x, fig. 4 (**1866**).
Cynoglossus macrorhynchus, Kner, *Reise "Novara,"* Zool., I, 5, Fische, p. 295 (1869).
Cynoglossus elongatus, Day, *Fish. India*, p. 433, pl. xc, fig. 5 (1877).
Cynoglossus acinaces, Jenkins, *Rec. Ind. Mus.*, V, p. 130 (1910).
"*Jerree Potoo*", D. Russell, *Descr. Fish. Vizag.*, I, p. 57, pl. lxxiii (1803).

Depth of body $5\frac{3}{5}$ to $6\frac{1}{2}$ in the length, length of head $4\frac{1}{2}$ to $4\frac{7}{8}$. Snout obtusely pointed, length $2\frac{1}{6}$ to $2\frac{1}{4}$ in head; rostral hook rather

[1] Day's statement that this species possesses two lateral lines on the blind side is probably incorrect. In all other characters the examples described above agree closely with his original description. I have little doubt that number 1142 is the specimen figured in the "*Fishes of India.*"

short, extending a little beyond mandibulary symphysis; diameter of eye 11 to 14 in length of head, equal to or greater than interorbital width; upper eye in advance of lower; maxillary extending to beyond eye; posterior edge much nearer gill-opening than end of snout. Two nostrils on ocular side, a simple one between the eyes, a tubular one in front of lower eye. Dorsal 130-175. Anal 101-124. Scales ctenoid on ocular side,[1] cycloid on blind side; 93 to 104 in a longitudinal series; two



TEXT-FIG. 16.—Outline drawing of *Cynoglossus lingua*, Ham. Buch. ⅓ Nat. size.

lateral lines on ocular side, separated by 12 or 13 (occasionally 14) series of scales; no distinct lateral line on blind side. Brownish or greyish, with or without indistinct darker patches; opercular region generally blackish, fins darker posteriorly.

Described from numerous specimens, up to 420 mm. in total length, including a dried skin, said to be the type of the species, and the types of *C. acinaces*.

Hab.—Coasts of India to the Malay Peninsula and Archipelago.

2716	Madras.		
1208, 1461 ..	Calcutta.		
F. 3940/1	Kan Kondiggee, 24 Perg., Bengal.	"Golden Crown."	
160	Sallermukai R., 24 Perg., Bengal.	Jenkins.	
F. 5849/1 ..	Kushtia, E. Bengal	,,	
137	Rangabali, nr. Raymangal, Khulna, Sundarbans.	Rahim.	
4149 (5 spec.) .. (Types of *C. acinaces*).	Morrelganj, Khulna, Sundarbans.	Bengal Fisheries.	
——	Sundarbans, mouth of R. Hughli.	Settlement Officer, Khulna.	
——. (8 spec.) ..	,, ,, ,,	Kemp.	
F. 5987/1	Nabaspur, Gangetic Delta. ..	Jenkins.	
255	Morrison Bay, Mergui Archipelago.	"Investigator."	
464-5 (Cat.) (8 spec.) ..	??		

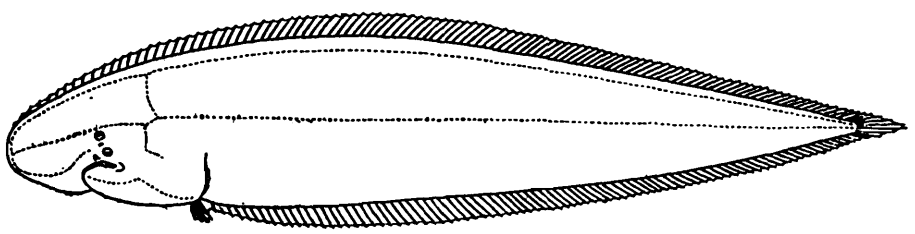
Specimens in the British Museum from Madras; Orissa; Calcutta; N. E. Bengal; Ganges; Moulmein, Burma.

9. **Cynoglossus arel** (Bloch, Schneider).

Pleuronectes arel, Bloch, Schneider, *Syst. Ichth.*, p. 159 (1801).
Plagusia lingua, Cantor, *J. Asiat. Soc. Bengal*, XVIII, pt. 2, p. 1215 (1850).
Cynoglossus elongatus, Günther, *Cat. Fish.*, IV, p. 501 (1862); Bleeker, *Atl. Ichth.* VI, p. 34 (1866).

[1] The spinules are inclined to wear off in preserved specimens, so that the scales may appear to be cycloid.

Depth of body $4\frac{7}{8}$ to $5\frac{1}{4}$ in the length, length of head 4 to $4\frac{1}{3}$. Snout rounded or obtusely pointed, length $2\frac{1}{5}$ to $2\frac{1}{4}$ in head; rostral hook rather short, extending a little beyond mandibulary symphysis; diameter of eye 15 to 17 in length of head, equal to or a little greater than interorbital width; upper eye a little in advance of lower; maxillary extending to beyond eye, much nearer gill-opening than end of snout. Two nostrils on ocular side, a simple one between the eyes, a tubular one in



TEXT-FIG. 17.—Outline drawing of *Cynoglossus arel* (Bloch, Schneider). $\frac{1}{3}$ Nat. size.

front of lower eye. Dorsal 122-138. Anal 90-109. Scales ctenoid on ocular side, cycloid on blind side; 60 to 65 in a longitudinal series; two lateral lines on ocular side, separated by 8 to 10 series of scales; no distinct lateral line on blind side. Brownish, with or without irregular blackish blotches.

Described from 5 specimens, 190 to 270 mm. in total length, including the type of the species,[1] and the type of *C. elongatus*.

Hab.—East coast of India; Penang.

13215 ..	.. Orissa Coast, 7 fms.	..	"Investigator."
——. (2 spec.)	Sandheads, mouth of R. Hughli.		"Lady Fraser."

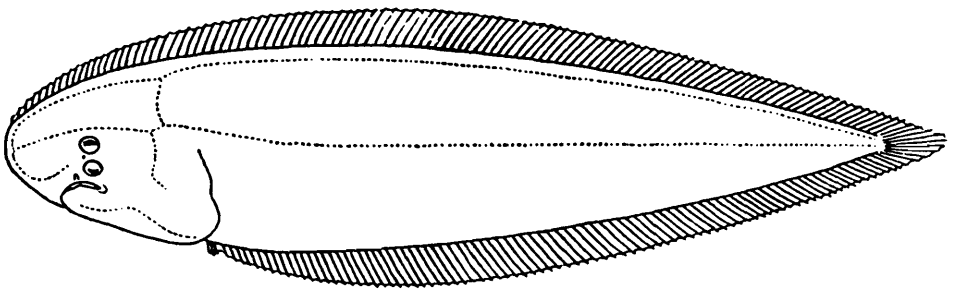
10. **Cynoglossus macrolepidotus** (Bleeker).

Plagusia macrolepidota, Bleeker, *Nat. Tijdschr. Ned. Ind.*, I, p. 415 (1850); *Verh. Bat. Gen.*, XXIV, Pleuron, p. 25 (1852).
Plagusia oligolepis, Bleeker, *Nat. Tijdschr. Ned. Ind.*, VII, p. 445 (1854).
Arelia macrolepidota, Bleeker, *Act. Soc. Sci. Indo-Neerl.*, VI, Enum. Spec. p. 184 (1859).
Arelia oligolepis, Bleeker, *t. c.*, p. 185.
Cynoglossus macrolepidotus, Günther, *Cat. Fish.*, IV, p. 496 (1862); Bleeker, *Atl. Ichth.*, VI, p. 34, Pleuron, pl. xi, fig. 2 (1866); Day, *Fish. India*, p. 434, pl. xcvi, fig. 3 (1877); Alcock, *J. Asiat. Soc. Bengal*, LVIII, pt. 2, p. 288 (1889); Jenkins, *Mem. Ind. Mus.*, III, p. 30 (1910).
Cynoglossus oligolepis, Günther, *Cat. Fish.*, IV, p. 496 (1862); Bleeker, *Atl. Ichth.* VI, p. 34, Pleuron, pl. xi, fig. 3 (1866); Day, *Fish. India*, p. 433, pl. xcv, fig. 4 (1877); Alcock, *J. Asiat. Soc. Bengal*, LVIII, pt. 2, p. 280 (1889), Johnston, *Ceylon Pearl Oyster Fish*, Supp. Rep. XV, p. 209 (1904); Weber, "*Siboga*"-*Exped.*, Monogr. 57, p. 441 (1913).
? *Cynoglossus arel*, Day, *Fish. India*, p. 434, pl. xcviii, fig. 2 (1877).

Depth of body $3\frac{4}{5}$ to $4\frac{2}{3}$ in the length, length of head 4 to $4\frac{2}{5}$. Snout rounded or obtusely pointed, length $2\frac{2}{5}$ to $2\frac{2}{3}$ in head; rostral hook short, extending a little beyond mandibulary symphysis; diameter of eye $8\frac{1}{4}$ to 12 in length of head, equal to or greater than interorbital width; upper eye in advance of lower; maxillary extending to below posterior

[1] I am greatly indebted to Dr. P. Pappenheim, for his kindness in lending me the type-specimen of this species, which is preserved in the Zoologisches Museum, Berlin.

margin of eye or beyond, posterior edge equidistant from gill-opening and end of snout or nearer the former. Two nostrils on ocular side, a simple one between the eyes, a tubular one in front of lower eye. Dorsal 105-130. Anal 80-96. Scales ctenoid on ocular side, cycloid on blind side; 56 to 66 in a longitudinal series; two lateral lines on ocular side, separated by 7 to 9 series of scales; no distinct lateral line on blind



TEXT-FIG. 18.—Outline drawing of *Cynoglossus macrolepidotus* (Bleeker). ¼ Nat. size.

side. More or less uniformly brownish; fins sometimes darker posteriorly.

Described from numerous examples, 100 to 350 mm. in total length.

Hab.—Persian Gulf; Seas of India; Malay Peninsula and Archipelago; China.

156	Stn. 352; Persian Gulf, 13 fms. ..	"Investigator."
283-7 ..	North end of Persian Gulf, 15 fms.	,,
F. 4660-1 ..	? Travancore. ..	Trivandrum Mus.
1143, 1190, 1458 ..	Madras.	
12111-4, 12125-6	Orissa Coast, 10 fms.	"Investigator."
F. 2101/1	Puri, Orissa Coast. ..	Paiva.
F. 2626/1, 3433/1	,, ,, ,,	Annandale.
F. 6177/1 ..	Pratabnagore, Lower Bengal. ..	Mus. Coll. (Hodgart).
11497-500 ..	Sandheads, mouth of R. Hughli.	Lash.
11528-30, 11613 ..	,, ,, ,,	Daly.
——. (5 spec.) ..	,, ,, ,, ..	"Lady Fraser."
F. 3648/1 ..	Eastern Channel, mouth of R. Hughli.	"Golden Crown."
F. 3445/1, 8760/1	Bay of Bengal. ..	
F. 3572/1	? Bay of Bengal. ..	,,
13631	Stn. 154; Bay of Bengal, 80 to 110 fms.	"Investigator."
10383-5 ..	Andamans.	Dobson.
F. 1170-1/1	Stn. 329; Gulf of Martaban, 46 fms.	"Investigator."
279	Morrison Bay, Mergui Archipelago.	,,
277 ..	Stn. 548; 12° 49′ 23″ N., 98° 23′ 30″ E., 23 fms.	,,
F. 2156/1	Stn. 378: off Akyab, Burma, 34 fms.	,,

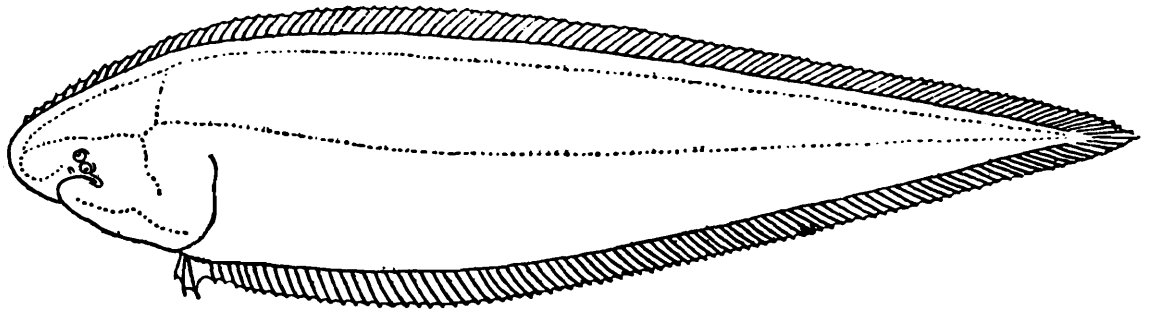
Specimens in the British Museum from Madras.

After examining a large number of specimens of all sizes, including examples of both species from Bleeker's collection, I am unable to separate *C. oligolepis* from *C. macrolepidotus*. The size of the eye seems to be very variable in this species.

11. **Cynoglossus monopus** (Bleeker).

Plagusia monopus, Bleeker, *Verh. Bat. Gen.*, XXII, Bijdr. Ichth. Bali, p. 11 (1848) 1849.
Plagusia melanopetrus, Bleeker, *Nat. Tijdschr. Ned. Ind.*, I, p. 415 (1850); *Verh. Bat. Gen.*, XXIV, Pleuron, p. 25 (1852).
Arelia ceratophrys, Kaup, *Arch. Naturg.*, 1858, p. 108.
Arelia melanopterus, Bleeker, *Act. Soc. Sci. Indo-Neerl.*, VI, Enum. Spec. p. 184 (1859).
Cynoglossus melanopterus, Günther, *Cat. Fish.*, IV, p. 502 (1862); Alcock, *J. Asiat. Soc. Bengal*, LVIII, pt. 2, p. 289 (1889).
Cynoglossus monopus, Bleeker, *Atl. Ichth.*, VI, p. 38, Pleuron, pl. xiv, fig. 4 (1866) Alcock, *J. Asiat. Soc. Bengal*, LXV, pt. 2, p. 330 (1896).

Depth of body $4\frac{1}{5}$ to $4\frac{3}{5}$ in the length, length of head $4\frac{2}{3}$ to 5. Snout obtusely pointed, length about 3 in head; rostral hook short, extending a little beyond mandibulary symphysis; eyes very small, prominent, subcontiugous, diameter 15 to 16 in length of head; upper eye in advance of lower; maxillary extending to beyond eye, posterior edge a little nearer end of snout than gill-opening. Two nostrils on ocular side, situated close together in front of eyes; anterior nostril tubular, posterior simple. Dorsal 110-119. Anal 85-98. Scales ctenoid on both sides;



TEXT-FIG. 19.—Outline drawing of *Cynoglossus monopus* (Bleeker). $\frac{2}{3}$ Nat. size.

116 to 126 in a longitudinal series; two lateral lines on ocular side, separated by 17 to 21 series of scales; no distinct lateral line on blind side. Pale brownish; fins darker.

Described from 11 specimens, 90 to 155 mm. in total length, including one from Bleeker's collection.

Hab.—Coasts of Ganjam and Orissa; Malay Archipelago; China

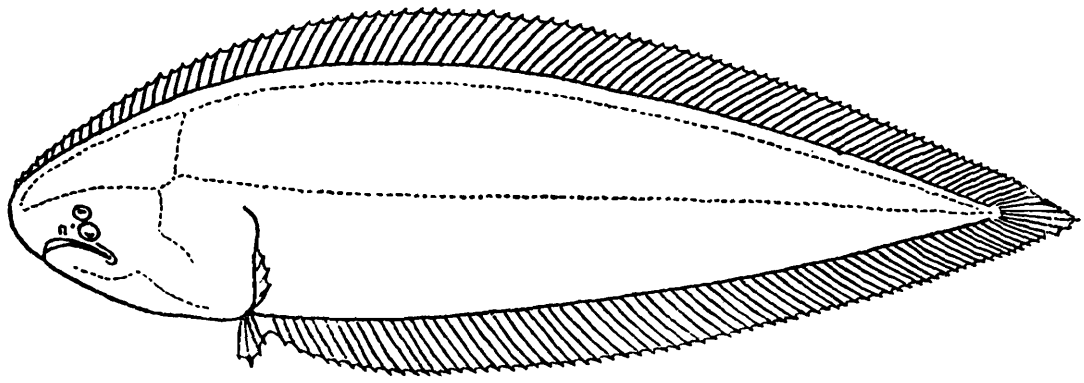
12420-5	..	..	Puri, Orissa Coast, 7 to 10 fms. "Investigator."
12617	..	..	Ganjam Coast, 7 to 10 fms. .. „

12. **Cynoglossus macrostomus**, sp. n.

Cynoglossus hamiltonii (*non* Günther), Day, *Fish. India*, p. 436, pl. xcv, fig. 3 (1877).

Depth of body $3\frac{3}{4}$ to $3\frac{4}{5}$ in the length, length of head $3\frac{3}{5}$ to nearly 4. Snout obtusely pointed, length $3\frac{2}{3}$ to $3\frac{5}{6}$ in head; rostral hook very short, scarcely extending beyond mandibulary symphysis; eyes close together, diameter 13 to 14 in length of head; upper eye slightly in advance of lower; maxillary extending to well beyond eye, posterior edge nearer snout than gill-opening. Two nostrils on ocular side, a simple one between the anterior parts of the eyes, a tubular one in front of lower eye. Dorsal 100-104. Anal 76-80. Scales ctenoid on both sides; about 95 in a longitudinal series; two lateral lines on ocular side,

separated by 16 series of scales; no distinct lateral line on blind side. Brownish, with traces of darker blotches and cross-bars; fins darker.



TEXT-FIG. 20.—Outline drawing of *Cynoglossus macrostomus*, sp. n. ¾ Nat. size.

Described from two specimens, 135 and 140 mm. in total length.

Hab.—Portuguese India (?); Orissa; Calcutta.

1460 (Holotype)	..	Calcutta.
?——	..	Mormugao Bay, Portuguese India. Kemp.

A specimen in the British Museum from Orissa.

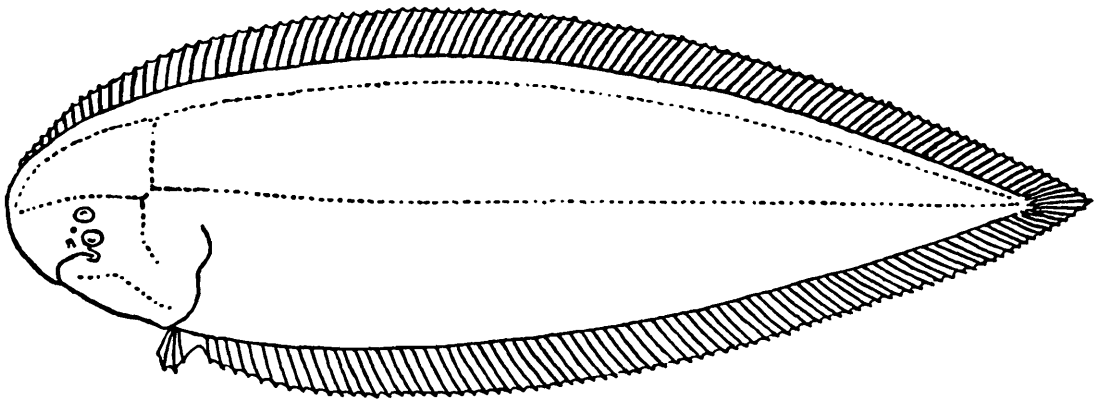
This species differs from *C. hamiltonii*, Günther, from Penang, in the larger head and in the greater number of scales between the lateral lines.

13. **Cynoglossus puncticeps** (Richardson).

Plagusia puncticeps, Richardson, *Rept. Brit. Assoc. Adv. Sci.*, (1845) 1846, p. 280.
Plagusia javanica, Bleeker, *Nat. Tijdschr. Ned. Ind.*, I, p. 414 (1851); *Verh. Bat. Gen.*, XXIV, Pleuron, p. 24 (1852).
Plagusia brachyrhynchos, Bleeker, *Nat. Tijdschr. Ned. Ind.*, I, p. 414 (1851); *Verh. Bat. Gen.*, XXIV, Pleuron, p. 24 (1852).
Arelia javanica, Bleeker, *Act. Soc. Sci. Indo-Neerl.*, VI, Enum. Spec. p. 184 (1859).
Arelia brachyrhynchos, Bleeker, *t. c.* p. 184.
Cynoglossus bengalensis (part), Günther, *Cat. Fish.*, IV, p. 499 (1862).
Cynoglossus brachyrhynchus, Günther, *Cat. Fish.*, IV, p. 499 (1862); Bleeker, *Atl. Ichth.*, VI, p. 37, Pleuron, pl. xii, fig. 4 (1866); Day, *Fish India*, p. 435, pl. xcvi, fig. 4 (1877); Johnstone, *Ceylon Pearl Oyster Fish.*, Supp. Rep., XV, p. 209 (1904); Weber, "*Siboga*"-*Exped.*, Monogr. 57, p. 443 (1913).
Cynoglossus puncticeps, Günther, *Cat. Fish.*, IV, p. 500 (1862); Bleeker, *Atl. Ichth.*, VI, p. 37, Pleuron, pl. xv, fig. 7 (1866); Day, *Fish. India*, p. 437 pl. xcvii, fig. 1 (1877); Alcock, *J. Asiat. Soc. Bengal*, LVIII, pt. 2, p. 289 (1889); Jenkins, *Mem. Ind. Mus.*, III, p. 30 (1910).
Cynoglossus lida, Jenkins, *Mem. Ind. Mus.*, III, p. 30 (1910).
Cynoglossus lida var. *punctatus*, Jenkins, *t. c.* p. 31.

Depth of body $3\frac{1}{3}$ to 4 in the length, length of head $4\frac{1}{2}$ to $5\frac{1}{5}$. Snout rounded or obtusely pointed, length $2\frac{7}{8}$ to $3\frac{1}{5}$ in head; rostral hook rather short, extending beyond mandibulary symphysis; eyes close together, diameter 8 to 10 in length of head; upper eye a little in advance of lower; maxillary extending to below posterior part of eye or a little beyond, posterior edge a little nearer end of snout than gill-opening (sometimes midway between them). Two nostrils on ocular side, a simple one between the anterior parts of the eyes, a tubular one in front of lower eye. Dorsal 92-107 Anal 70-83. Scales ctenoid on both sides; 91 to 110 in a longitudinal series; two lateral lines on ocular side, separated by 16 to 21 series of scales; no distinct lateral line on blind

side. Brownish; large darker blotches on head and body, which are often united to form irregular cross-bands; longitudinal series of scales



TEXT-FIG. 21.—Outline drawing of *Cynoglossus puncticeps* (Rich.). $\frac{2}{3}$ Nat. size.

frequently with fine dark stripes; most of the markings disappearing with age; some of the rays of the vertical fins marked with dark brown.

Described from numerous specimens, up to 165 mm. in total length.

Hab.—From Sind, through the Indian Ocean and Archipelago to China.

1148	Bombay.	
161, 282	Mormugao Bay, Portuguese India.	Kemp.
F. 4178/1, 4185-1, 4187-8/1	Trivandrum, Travancore. ..	Trivandrum Mus.
139	Stn. 467; off Travancore Coast, 42 to 75 fms.	"Investigator."
2693	Madras.	
180	Ennur Backwater, Madras. ..	Annandale.
1147	Calicut, Madras. ..	
144-8 ..	Near Ernakulam, Cochin Backwater.	Gravely.
12658-70, 12892 ..	Ganajm Coast, 7 to 14 fms. ..	"Investigator".
12107	Orissa Coast, 8 fms.	„
1462	Moulmein, Burma.	

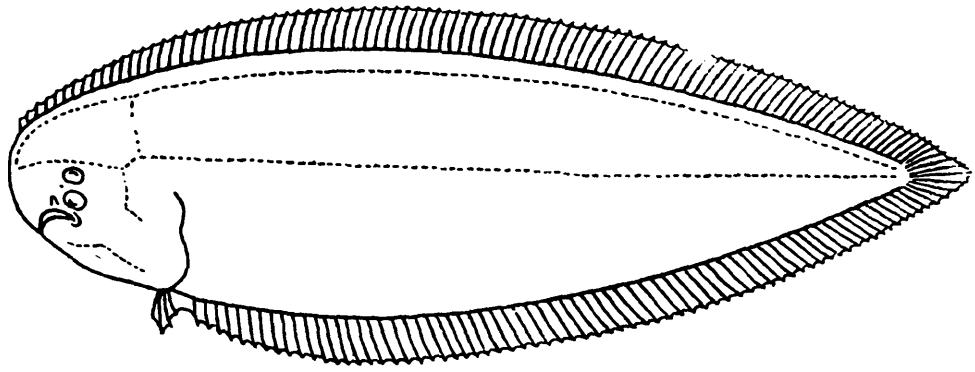
Specimens in the British Museum from Karachi; Sind; Bombay; Andamans.

14. **Cynoglossus brevis** Günther.

Cynoglossus brevis, Günther, *Cat. Fish.*, IV, p. 500 (1862); Day, *Fish. India*, p. 437, pl. xcvii, fig. 2 (1877); Alcock, *J. Asiat. Soc. Bengal*, LVIII, pt. 2, p. 289 (1889); Hora, *Mem. Ind. Mus.*, V, p. 760 (1923).
Cynoglossus buchanani (part), Day, *Proc. Zool. Soc.*, 1869, p. 522.
Cynoglossus durbanensis, Regan, *Ann. Durban Mus.*, III, p. 2 (1921).

Very close to the preceding species, but depth of body $3\frac{1}{6}$ to $3\frac{2}{3}$ in the length, length of head 5 to $5\frac{3}{5}$. Snout rounded or obtusely pointed, length 3 to $3\frac{2}{3}$ in head. Dorsal 93-100. Anal 70-78. 80 to 98 scales in a longitudinal series, 16 to 21 between the lateral lines. Brownish, with darker spots and patches, which tend to form irregular transverse bands, which are more distinct in the young; some of the rays of the vertical fins marked with dark brown or blackish.

Described from numerous examples, up to 160 mm. in total length, including the type of the species and the type of *C. durbanensis*.



TEXT-FIG. 22.—Outline drawing of *Cynoglossus brevis* Günther. ¾ Nat. size.

Hab.—East Coast of India.

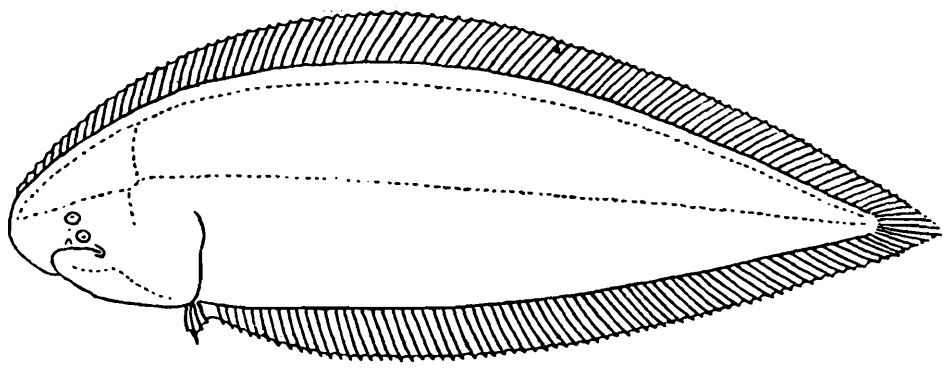
12671-4	Ganjam Coast, 7 to 14 fms.	..	"Investigator."
12235	Orissa Coast, 7 to 8 fms.	..	"
185-206, 210-216, 220-3, 225-249.	Chilka Lake.[1]		Chilka Survey.
1459, 2691 ..	Calcutta.		
F. 8579/1, 8581/1 ..	Calcutta Bazaar. ..	..	Asiat. Soc. Bengal.
463 (cat.) (? type of C. *buchanani*).	??		

Specimens in the British Museum from the Ganges (type), and Calcutta.

15. **Cynoglossus semifasciatus** Day.

Cynoglossus semifasciatus, Day, *Fish. India*, p. 436, pl. xcvii, fig. 5 (1877); Alcock, *J. Asiat. Soc. Bengal.* LVIII, pt. 2, p. 289 (1889); Jenkins, *Mem. Ind. Mus.*, III, p. 30 (1910).

Depth of body $3\frac{3}{5}$ to 4 in the length, length of head $4\frac{1}{2}$ to 5. Snout rounded or obtusely pointed, length about $3\frac{1}{2}$ in head; rostral hook rather short, extending a little beyond mandibulary symphysis; diameter of eye 11 to 12 in length of head, greater than interorbital width; upper



TEXT-FIG. 23.—Outline drawing of *Cynoglossus semifasciatus* Day. ¾ Nat. size.

eye in advance of lower; maxillary extending to beyond eye, posterior edge nearer to snout than gill-opening. Two nostrils on ocular side, a

[1] The exact localities in the Chilka Lake have been listed by Hora;—*Mem. Ind. Mus.*, V, p. 760 (1923).

simple one between the anterior parts of the eyes, a tubular one in front of lower eye. Dorsal 97-105. Anal 74-81. Scales ctenoid on both sides ; 75 to 84 in a longitudinal series ; two lateral lines on ocular side, separated by 12 to 14 series of scales ; no distinct lateral line on blind side. Brownish, with a number of irregular and incomplete darker cross-bands, extending on to the vertical fins.

Described from 6 specimens, 115 to 120 mm. in total length.

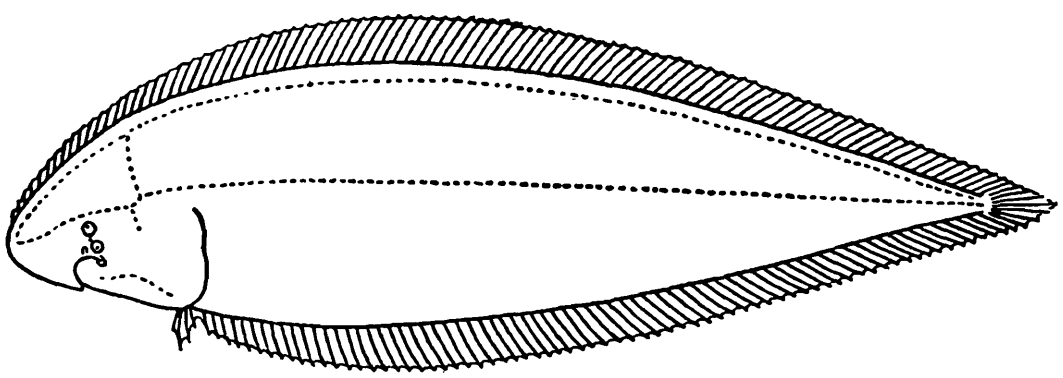
Hab.—East Coast of India.

12680-2 ..	.. Ganjam Coast, 8 to 9 fms.	..	" Investigator".
F. 3437/1	Puri Coast, Orissa.		" Golden Crown".
12159 ..	Orissa Coast, 7 to 10 fms.		" Investigator".
F. 6178/1	Pratabnagore, Lower Bengal.		Mus. Coll. (Hodgart).

16. **Cynoglossus cynoglossus** (Ham. Buch).

Achirus cynoglossus, Hamilton (Buchanan), *Fish. Ganges*, pp. 132, 373 (1822).
Plagusia bengalensis, Bleeker, *Verh. Bat. Gen*, XXV, Bengal, p. 152, pl. vi, fig. 3 (1853).
Cynoglossus bengalensis (part), Günther, *Cat. Fish.*, IV, p. 499 (1862).
Cynoglossus buchanani (part), Day, *Proc. Zool. Soc.*, 1869, p. 522.
Cynoglossus bengalensis, Day, *Fish. India*, p. 435, pl. xcvii, fig. 4 (1877) ; Johnstone, *Ceylon Pearl Oyster Fish.*, Supp. Rep. XV, p. 209 (1904).

Depth of body $3\frac{1}{2}$ to $3\frac{3}{4}$ in the length, length of head $4\frac{2}{5}$ to nearly 5. Snout pointed, length $2\frac{3}{5}$ to $2\frac{2}{3}$ in head ; rostral hook rather short, extending a little beyond mandibulary symphysis ; diameter of eye 10 to 12 in length of head, greater than interorbital width ; upper eye a little in advance of lower ; maxillary extending to below posterior edge of eye or a little beyond, posterior edge equidistant from end of snout and gill-opening or a little nearer the former. Two nostrils on ocular side, a simple one between the eyes, a tubular one in front of lower eye. Dorsal 98-106. Anal 78-83. Scales ctenoid on both sides ; 80 to 89 in a longitudinal series ; two lateral lines on ocular side, separated by 13 to 15



TEXT-FIG. 24.—Outline drawing of *Cynoglossus cynoglossus* (Ham. Buch.). $\frac{2}{3}$ Nat. size.

series of scales ; no distinct lateral line on blind side. Brownish or greyish ; sometimes vaguely marbled with darker.

Described from 15 specimens, up to 155 mm. in total length, including one believed to be the type of the species.

Hab.—Bengal.

1499, 2689 ..	Calcutta.		
F. 8580/1, 8581/2	Calcutta Bazaar.		Asiat. Soc., Bengal.
461 (cat.)	Salt water lakes near Calcutta.		Anderson.
166 .	.. Passar R., Khulna, Bengal.	..	Southwell.

F. 6775/1 ..	Near Shela, Khulna district, Bengal.	Jenkins.
——. (8 spec.)	Sundarbans. ..	Kemp.
178	Rangamati, Chittagong Hill Tracts, Kornafuli River.	Mus. Coll. (Hodgart).
9011 ..	Moisrakha. ..	Wood-Mason.
463 (cat.) (? type of *C. buchanani*).	??	

Specimens in the British Museum from the Ganges, and from Calcutta.

Examination of Hamilton's figure, which is preserved among a collection of drawings in the British Museum, leaves little doubt that he depicted the same species as that described by Bleeker as *C. bengalensis*. This figure is labelled "Acheirus kukur jibha." There is a specimen of *C. bengalensis* in the British Museum collection (Reg. No. 58, 8, 15, 55), which was received from Mr. G. R. Waterhouse, and entered in the museum register as *Achirus gibba*. The Waterhouse collection was believed to contain many of Buchanan's types, and I think that the specimen in question was, in all probability, the type of his *Achirus cynoglossus*.

17. **Cynoglossus sumatranus** (Bleeker).

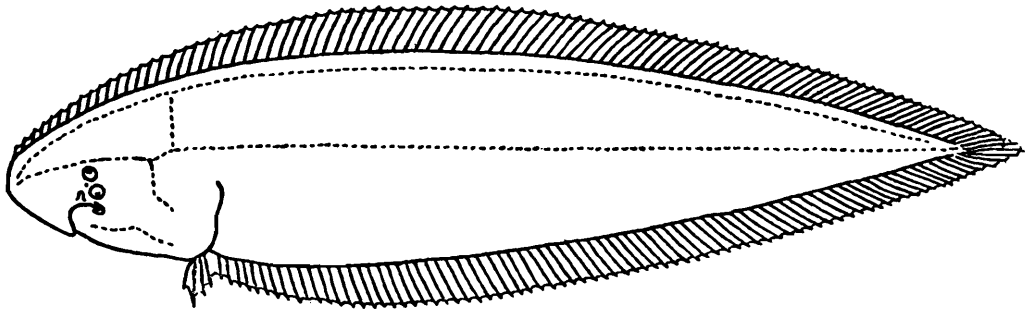
Plagusia sumatrana, Bleeker, *Nat. Tijdschr. Ned. Ind.*, V, p. 529 (1853).

Arelia sumatrensis, Bleeker, *Act. Soc. Sci. Indo-Neerl.*, VI, Enum. Spec. p. 185 (1859).

Cynoglossus sumatrensis, Günther, *Cat. Fish.*, IV, p. 497 (1862); Bleeker, *Atl. Ichth.*, VI, p. 35, Pleuron, pl. xii, fig. 1 (1866).

Cynoglossus bengalensis (part), Day, *Fish. India*, p. 436 (1877).

Depth of body $4\frac{1}{4}$ to $4\frac{2}{3}$ in the length, length of head $4\frac{1}{2}$ to $4\frac{3}{5}$. Snout pointed, length $2\frac{2}{3}$ to $2\frac{3}{4}$ in head; rostral hook short, extending a little beyond mandibulary symphysis; diameter of eye $10\frac{1}{2}$ to 11 in length of head, greater than interorbital width; upper eye a little in advance of lower; maxillary extending to below posterior edge of eye, posterior edge a little nearer to snout than gill-opening. Two nostrils on ocular side, a simple one between the eyes, a tubular one in front of lower eye. Dorsal 101-105. Anal 73-80. Scales ctenoid on both sides; about 85 in a longitudinal series; two lateral lines on ocular side,



TEXT-FIG. 25.—Outline drawing of *Cynoglossus sumatranus* (Bleeker). $\frac{3}{4}$ Nat. size.

separated by 13 series of scales; no distinct lateral line on blind side. Pale brownish, with traces of darker markings.

Described from two specimens, 120 and 130 mm. in total length.

Hab.—Burma; Mergui Archipelago; Singapore; Sumatra; Philippines.

2688	Burma. [1]	
152	Mergui.	Day.

I have identified these examples as *C. sumatranus* with a certain amount of doubt, as the specimen of that species in the British Museum collection, which was received from Dr. Bleeker, is in a very poor state of preservation.

18. **Cynoglossus lida** (Bleeker).

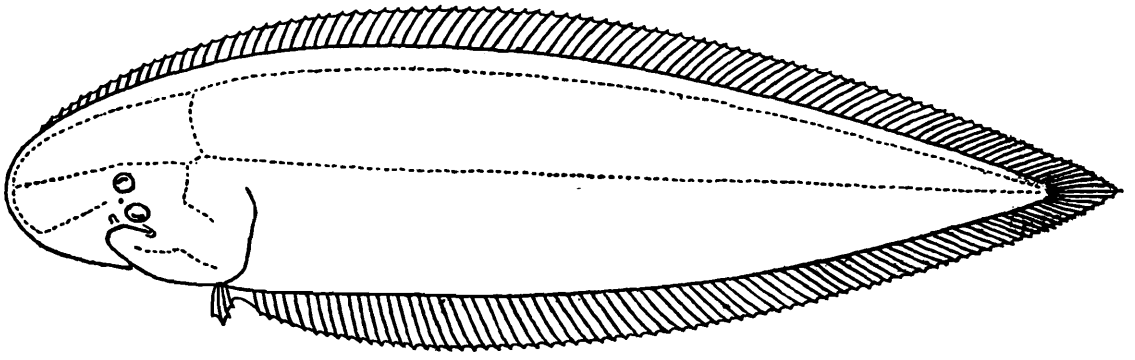
Plagusia lida, Bleeker, *Nat. Tijdschr. Ned. Ind.*, I, p. 413 (1851); *Verh. Bat. Gen.* XXIV, Pleuron, p. 23 (1852).

Arelia lida, Bleeker, *Act, Soc. Sci. Indo-Neerl.*, VI, Enum. Spec. p. 184 (1859).

Cynoglossus lida, Günther, *Cat. Fish.*, IV, p. 498 (1862); Bleeker, *Atl. Ichth.*, VI, p. 36, Pleuron, pl. xii, fig. 2 (1866); Day, *Fish. India*, p. 436, pl. xcvii, fig. 3 (1877); Alcock, *J. Asiat. Soc. Bengal*, LVIII, pt. 2, p. 288 (1889); Regan, *Ann. Durban Mus.*, II, p. 221 (1920); Barnard, *Ann. S. Afric. Mus.*, XXI, p. 411 (1925).

Cynoglossus intermedius Alcock, *J. Asiat. Soc. Bengal*, LVIII, pt. 2, p. 288 (1889).

Depth of body 4 to 4$\frac{1}{5}$ in the length, length of head 4 to 4$\frac{3}{5}$. Snout rounded, length 2$\frac{1}{3}$ to 2$\frac{1}{2}$ in head; rostral hook of moderate length, extending to below lower eye; diameter of eye 9 to 10$\frac{1}{2}$ in length of head, much greater than interorbital width; upper eye a little in advance of lower; maxillary extending to below posterior edge of eye or beyond, posterior edge much nearer gill-opening than end of snout. Two nostrils on ocular side, a simple one between the anterior parts of the eyes, a tubular one in front of lower eye. Dorsal 99-112. Anal 75-87. Scales



TEXT-FIG. 26.—Outline drawing of *Cynoglossus lida* (Bleeker). $\frac{2}{3}$ Nat. size.

ctenoid on both sides; 82 to 95 in a longitudinal series; two lateral lines on ocular side, separated by 13 to 15 series of scales; no distinct lateral line on blind side. Brownish or greyish; sometimes a dark patch on the opercular region.

Described from 12 specimens, 100 to 189 mm. in total length, including the type of *C. intermedius*.

Hab.—East Africa; Indian Ocean and Archipelago.

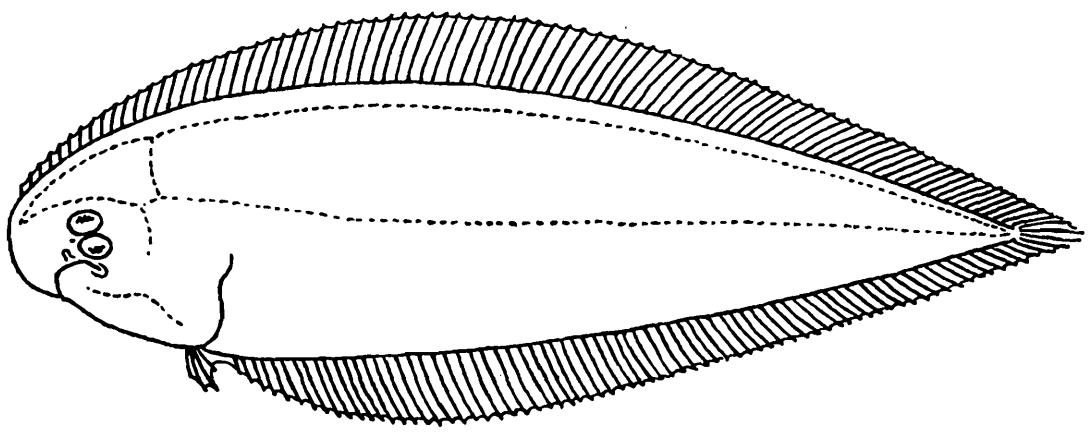
8905	Madras.	Day.
260-1	Near mouth of harbour, Madras.	Kemp.
12683-5	Stn. 67 : Ganjam Coast, 8 to 9 fms.	"Investigator".
12259-62	Orissa Coast, 7 fms.	,,
12264 (type of *C. intermedius*).	,, ,,	,,
F. 3434/1 (2 spec.)	Puri, Orissa Coast	Paiva.

[1] This is probably the fish mentioned by Day (*Fish. India*, p. 436).

19. **Cynoglossus brachycephalus** Bleeker.

Cynoglossus brachycephalus, Bleeker, *Atl. Ichth.* VI, p. 38, Pleuron, pl. xiii, fig. 6 (1866) ; Regan, *Trans. Linn. Soc.*, Zool., XII, p. 235 (1908) ; Weber, "*Siboga*"-*Exped.*, Monogr. 57, p. 441 (1913).
Cynoglossus praecisus, Alcock, *Ann. Mag. Nat. Hist.*, (6) VI, p. 442 (1890).
Cynoglossus brevirostris, Johnstone, *Ceylon Pearl Oyster, Fish.*, Supp. Rep. XV, p. 209 (1904).
Cynoglossus kopsii, Regan, *t. c.* p. 235.
? *Cynoglossus sibogae*, Weber, "*Siboga*"-*Exped.*, Monogr. 57, p. 442, fig. (1913).
Areliscus natalensis, Von Bonde, *Rep. Fish. Mar. Biol. Survey S. Afric.*, 2, Spec. Rep. I, p. 23, pl. iv, fig. 2 (1922).

Depth of body $3\frac{1}{2}$ to 4 in the length, length of head $4\frac{2}{3}$ to $5\frac{1}{4}$. Snout rounded or obtusely pointed, length $3\frac{1}{4}$ to $3\frac{1}{2}$ in head ; rostral hook rather short, extending a little beyond mandibulary symphysis ; eyes narrowly separated or subcontiguous, diameter 6 to $7\frac{1}{2}$ in length of head ; upper eye a little in advance of lower ; maxillary extending to below posterior part of eye, posterior edge nearer to snout than gill-opening. Two nostrils on ocular side ; a simple one between the anterior parts of the eyes, often hidden by scales and difficult to see without microscopic examination ; a tubular one in front of lower eye. Dorsal 102-112. Anal 84-88. Scales ctenoid on both sides ; 58 to 66 in a longitudinal series ; two lateral lines on ocular side, separated by 9 or 10 series of scales ; no distinct lateral line on blind side. Brownish ; generally with some irregularly arranged darker spots and blotches.



TEXT-FIG. 27.—Outline drawing of *Cynoglossus brachycephalus* Bleeker. Nat. size.

Described from several specimens, 60 to 120 mm. in total length, including the types of *C. praecisus* and *C. natalensis*.

Hab.—From East Africa, through the Indian Ocean to the Malay Peninsula and Archipelago.

F. 999/1	Stn. 291 : Persian Gulf, 48 to 49 fms.	"Investigator".
177	Stn. 352 ; Persian Gulf, 13 fms.	,,
14285	Mekran Coast, Arabian Sea.	Townsend.
12893. (type of *C. praecisus*)	Stn. 33 : Ganjam Coast, 33 fms..	,,
12894	,, ,, ,,	,,
14021-34 ..	Madras Coast, 20 fms.	,,
281	Stn. 552 : 3 miles N. N. W. of Brown Rocks (12° 44′ 00″ N., 98° 8′ 30″ E.), 25 fms.	"Investigator".

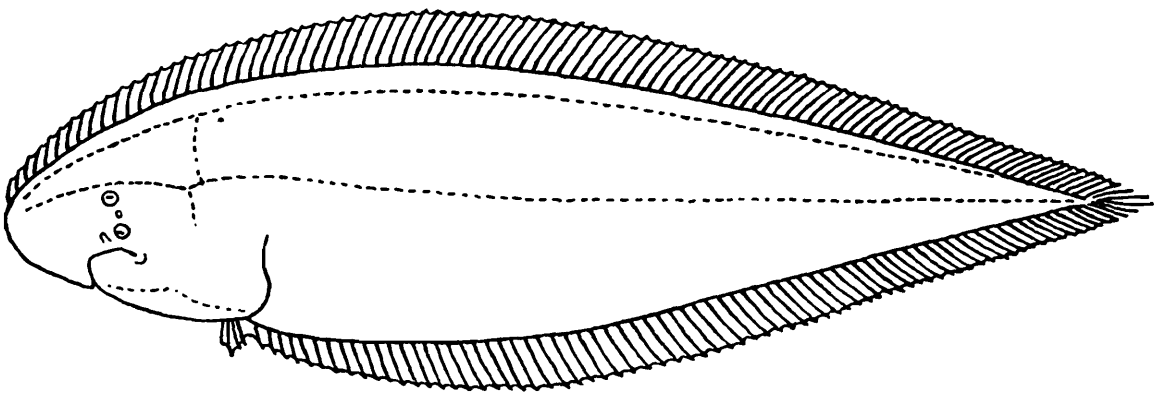
Specimens in the British Museum from Amirantes ; Cargados Carajos ; Seychelles ; Maldives ; and in the Herdman Collection from off the pearl banks, Aripu, Ceylon.

This species is very closely related to *C. kopsii*, Bleeker, with which it may prove to be identical. There is no trace, however, of a lower lateral line on the ocular side in any of the specimens described above.

20. **Cynoglossus deltae** Jenkins.

Cynoglossus deltae, Jenkins, *Rec. Ind. Mus.*, V. p. 130 (1910).

Depth of body $3\frac{2}{3}$ to 4 in the length, length of head about 4. Snout pointed, length $2\frac{2}{5}$ to $2\frac{2}{3}$ in head ; rostral hook rather short, extending a little beyond mandibulary symphysis ; diameter of eye 15 to 18 in length of head, equal to or less than interorbital width ; upper eye in advance of lower ; maxillary extending a little beyond eye, posterior edge equidistant from end of snout and gill-opening. Two nostrils on ocular side, a simple one between the eyes, a tubular one in front of lower eye. Dorsal about 95. Anal about 70. Scales ctenoid on both sides ; 65 to 75 in a longitudinal series ; two lateral lines on ocular side, separated by



TEXT-FIG. 28.—Outline drawing of *Cynoglossus deltae* Jenkins. $\times 1\frac{3}{4}$.

10 or 11 (occasionally 12) series of scales ; no distinct lateral line on blind side. Uniformly pale brownish.

Described from 12 specimens, 65 to 70 mm. in total length ; types of the species.

Hab.—Sundarbans, Bengal.

4150. (12 spec., types of the species). Morrelganj, Khulna, Sundarbans. Bengal Fisheries.

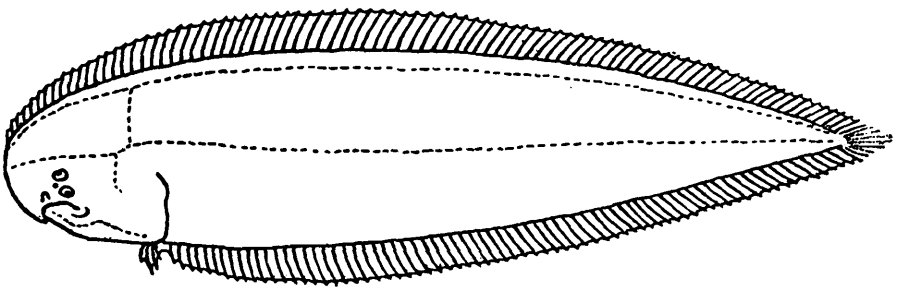
This species is perhaps identical with *C. cynoglossus*, but appears to differ in the larger head, smaller eye and larger scales.

21. **Cynoglossus brevirostris** Day.

Cynoglossus brevirostris, Day, *Fish. India*, p. 437, pl. xcvii, fig. 6 (1877).

Depth of body $4\frac{1}{4}$ in the length, length of head $5\frac{1}{4}$. Snout rounded, length $3\frac{3}{5}$ in head ; rostral hook rather short, extending a little beyond mandibulary symphysis ; diameter of eye about 11 in length of head, much greater than interorbital width ; upper eye a little in advance of lower ; maxillary extending to a little beyond eye, posterior edge a little nearer to end of snout than gill-opening. Two nostrils on ocular side, a simple one between the anterior parts of the eyes, a tubular one in

front of lower eye. Dorsal 91. Anal 76. Scales ctenoid on both sides ; about 70 in a longitudinal series ; two lateral lines on ocular side, separated by 11 series of scales ; no distinct lateral line on blind side. Uniformly brownish.



TEXT-FIG 29.—Outline drawing of *Cynoglossus brevirostris* Day. ¾ Nat. size.

Described from a single specimen, 110 mm. in total length ; type of the species.

Hab.—Madras.

2690. (type) .. Madras.

Cynoglossus sp.

The following specimens are either very young, or are badly preserved, so that the species cannot be determined.

164-5	Mutlah River.	" Golden Crown ".
143, 173-6, 181-2——	Mormugao Bay, Portuguese India.	Kemp.
252	Off Puri, Orissa Coast, 4 to 4½ fms.	,,
——.	Stn. 567 : Mergui Archipelago, 6 fms.	" Investigator".

3. **Symphurus** Rafinesque.

Symphurus, Rafinesque, *Indice Ittiol. Sicil.*, p. 52 (1810).
Aphoristia, Kaup, *Arch. Naturg.*, 1858, p. 106.
Ammopleurops, Günther, *Cat. Fish.*, IV, p. 490 (1862).

Several species from both coasts of America ; Mediterranean ; Indo-Pacific : four known from India.

Synopsis of the Indian Species.

I. Depth 3¾ to 4 in length ; ocular side of body with numerous fine dark longitudinal lines, but without cross-bars ; blind side more or less coloured.
  A. Angle of mouth below middle of eye ; pelvic separated from origin of anal by little more than an eye-length .. .. .. 1. *gilesii.*
  B. Angle of mouth in front of middle of eye ; pelvic separated from origin of anal by at least two eye-lengths .. .. 2. *wood-masoni.*

II. Depth 4 to 4¼ in length ; ocular side of body with dark cross-bars, but without longitudinal lines ; blind side colourless.
  A. Head 3⅔ to 4 in length ; 3 (or 4) cross-bars 3. *trifasciatus.*
  B. Head 4½ to 5 in length ; 7 (or 6) cross-bars .. 4. *septemstriatus.*

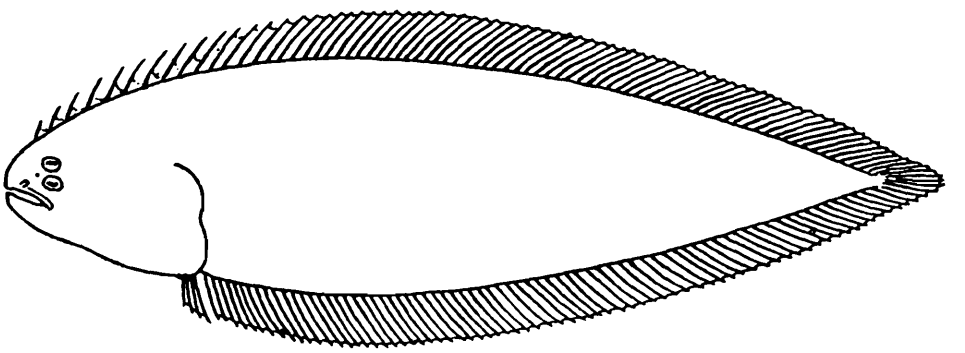
1. Symphurus gilesii (Alcock).

Aphoristia gilesii, Alcock, *J. Asiat. Soc. Bengal*, LVIII, pt. 2, p. 293, pl. xvii, fig. 2 (1889); *Ann. Mag. Nat. Hist.*, (6) IV, p. 398 (1889); *Illust. Zool.* "*Investigator*," Fishes pl. xiv, fig. 4 (1895); *J. Asiat. Soc. Bengal*, LXV, pt. 2, p. 330 (1896); *Cat. Indian Deep-Sea Fish.*, p. 131 (1899).

? Aphoristia gilesi, Weber, "*Siboga*"-*Exped.*, Monogr. 57, p. 445 (1913).

Hab.—Bay of Bengal; Kei Isds.

11684	.. Bay of Bengal, 193 fms.	"Investigator".



TEXT-FIG 30.—Outline drawing of *Symphurus gilesii* (Alcock). ¾ Nat. size.

2. Symphurus wood-masoni (Alcock).

Aphoristia wood-masoni, Alcock, *J. Asiat. Soc. Bengal*, LVIII, pt. 2, p. 294, pl. xvii, fig. 1 (1889); *Ann. Mag. Nat. Hist.*, (6) X, p. 354 (1892); *Illust. Zool.* "*Investigator*," Fishes pl. xvi, fig. 4 (1895); *J. Asiat. Soc. Bengal*, LXV, pt. 2, p. 330 (1896); *Cat. Ind. Deep-Sea Fish.*, p. 131 (1899); Regan, *Trans. Linn. Soc.*, Zool., XII, p. 235 (1908); Jenkins, *Mem. Ind. Mus.*, III, p. 30 (1910).

Aphoristia masoni, Alcock, *Ann. Mag. Nat. Hist.*, (6) IV, p. 398 (1889).

Hab.—Saya de Malha Bank; Laccadive Sea; Bay of Bengal; Andaman Sea.

F. 1015/1 ..	Stn. 295; Persian Gulf, 37 to 40 fms.	"Investigator".
F. 986/1	Stn. 231: Laccadive Sea, 300 fms.	„
11767	Bay of Bengal, 490 fms. ..	„
12466 ..	„ 265 fms. ..	„
13180 ..	.. Stn. 132: Bay of Bengal, 475 fms.	„
F. 1138/1 ..	„ 327: „ 419 fms.	„

Specimens in the British Museum from the Saya de Malha Bank, over 123 fms.

3. Symphurus trifasciatus (Alcock).

Aphoristia trifasciata, Alcock, *J. Asiat. Soc. Bengal*, LXIII, pt. 2, p. 132, pl. vii, fig. 4 (1894); *Illust. Zool.* "*Investigator*," Fishes pl. xv, fig. 5 (1895); *J. Asiat. Soc. Bengal*, LXV, pt. 2, p. 330 (1896); *Cat. Indian Deep.-Sea Fish.*, p. 133 (1899).

Hab.—Bay of Bengal—off Madras Coast; Gulf of Manaár.

251 ..	Stn. 151: 13½ miles N. 64° W. of Colombo Lt., 142 to 400 fms.	"Investigator".
13595-6, 13598-602. 13604-6, 13608-10.	Stn. 162: Bay of Bengal (off Madras Coast), 145 to 250 fms.	„

4. **Symphurus septemstriatus** (Alcock).

Aphoristia septemstriata, Alcock, *Ann. Mag. Nat. Hist.*, (6) VIII, p. 125 (1891); *Illust. Zool.* "*Investigator*," Fishes pl. ii, fig. 1 (1892); *J. Asiat. Soc. Bengal*, LXV, pt. 2, p. 330 (1896); *Cat. Indian Deep-Sea Fish.*, p. 132 (1899).

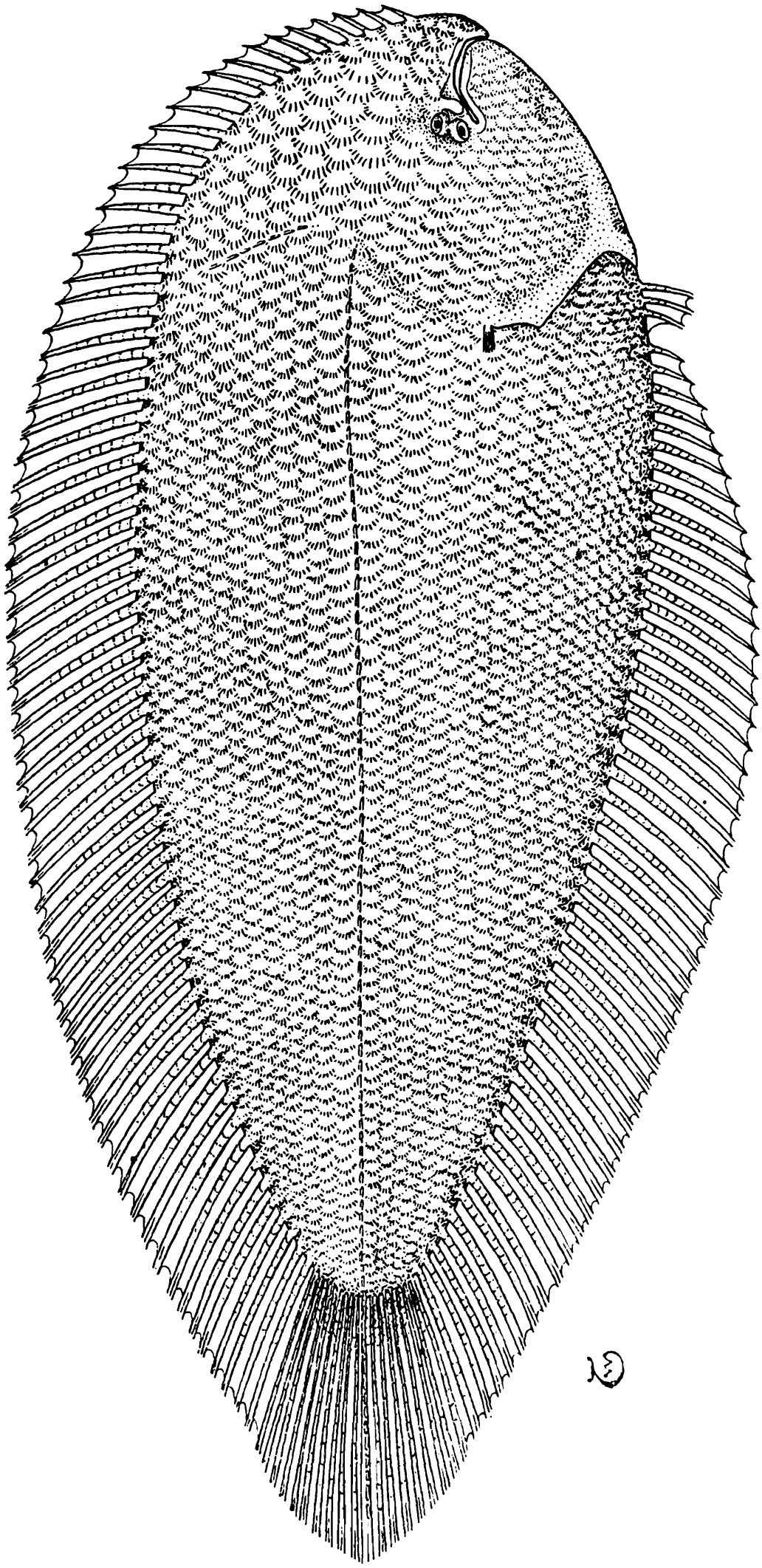
Hab.—Gulf of Manaár; Andaman Sea.

13110	Stn. 151 : 13½ miles N. 64° W. of Colombo Lt., 142 to 200 fms.	"Investigator."
13613-4 ..	Stn. 115 : Andaman Sea, 118 to 220 fms.	,,

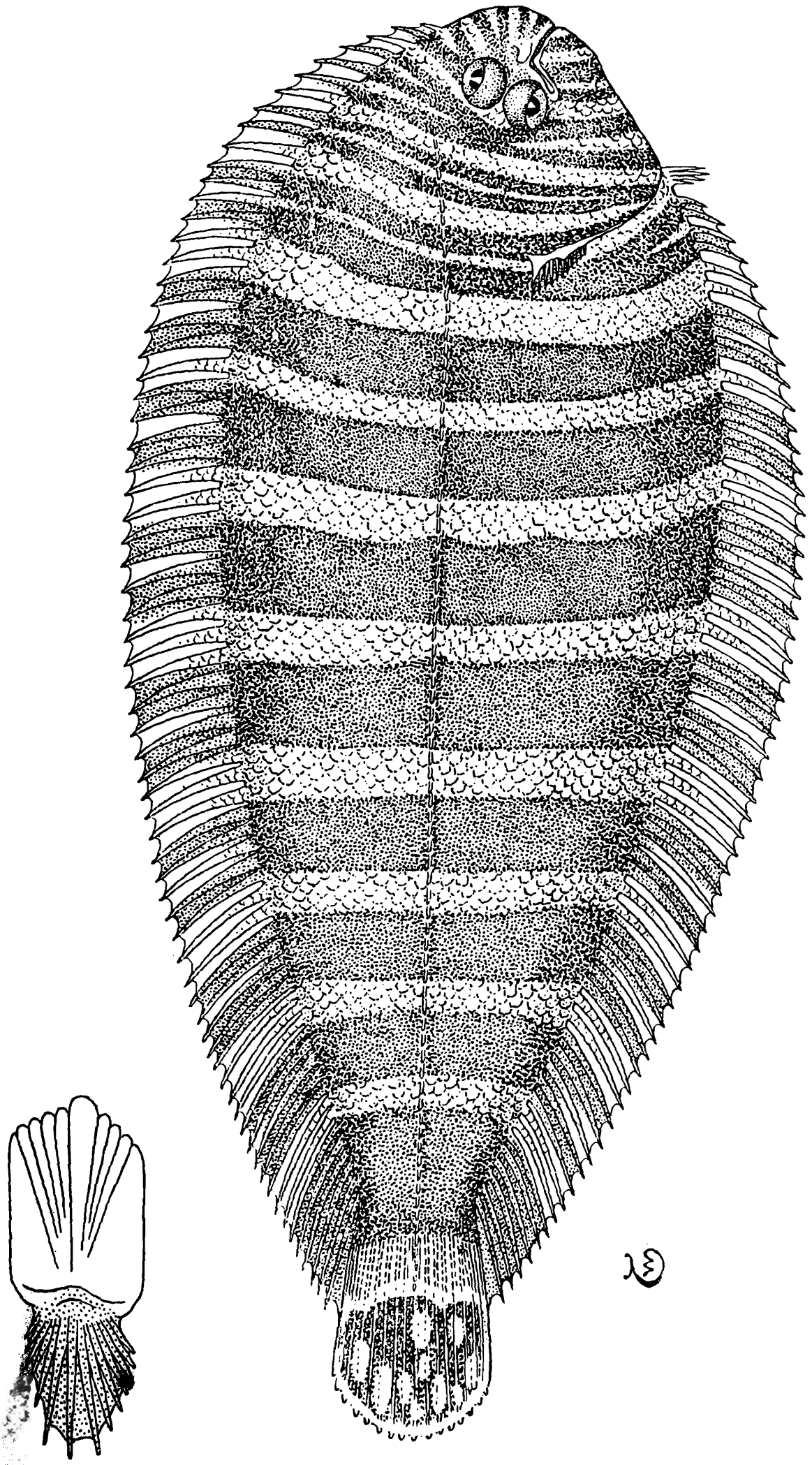
ADDENDA TO PART I.

Pseudorhombus triocellatus.		
——. (2 spec.)	Sundarbans, mouth of R. Hughli.	Kemp.
—— ..	Puri, Orissa Coast.	
Pseudorhombus arsius.		
——. (2 spec.)	Sundarbans, mouth of R. Hughli.	Kemp.
12115	Orissa Coast. ..	Marine Survey.
Pseudorhombus elevatus.		
——. (2 spec.)	Gulf of Cambay, 25 to 30 fms.	"William Carrick".
Engyprosopon grandisquama.		
——	Sundarbans, mouth of R. Hughli.	Kemp.
Bothus ovalis.		
—— ..	???	
Brachypleura novae-zeelandiae.		
F. 6709/1 ..	??? ..	"Golden Crown".

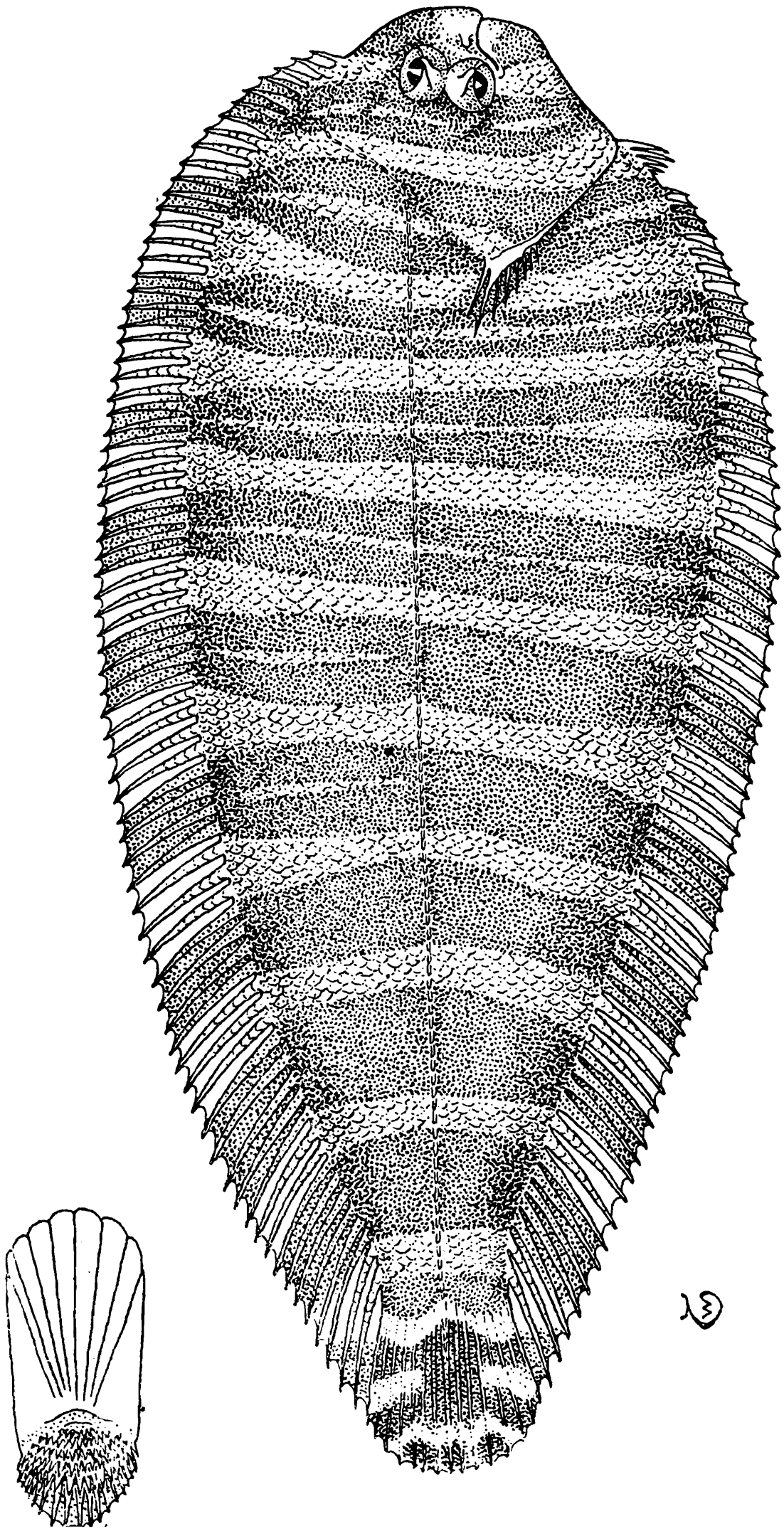
MGIPC—M—III-1-181—6-7-28—440.



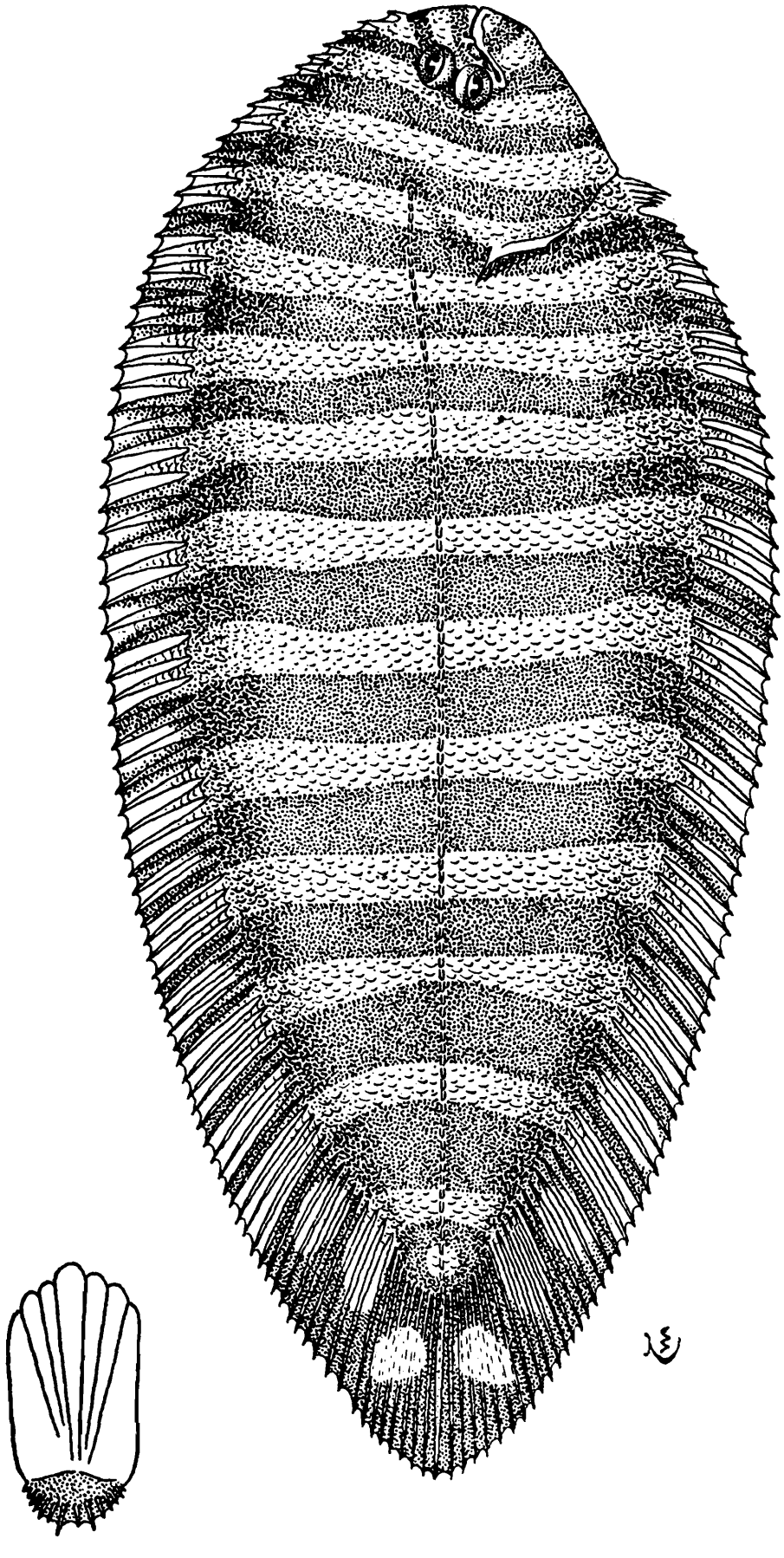
BRACHIRUS MACROLEPIS (BLEEKER) × $1\frac{3}{4}$.



ZEBRIAS SYNAPTUROIDES (JENKINS) × 2.



ZEBRIAS QUAGGA (KAUP) × 2.



ZEBRIAS ALTIPINNIS (ALCOCK) × 1¾.