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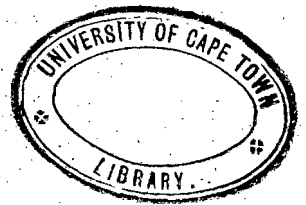
DOCTOR OF PHILOSOPHY

in

ZOOLOGY

by

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A TAXONOMIC AND LEPIDOLOGICAL STUDY  
OF THE  
SOUTH AFRICAN HETEROSOMATA  
WITH  
SPECIAL REFERENCE TO THE VALUE OF  
SCALE CHARACTERS  
IN  
IDENTIFICATION AND CLASSIFICATION.

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During the course of some years of research into growth-rate and age of South African fishes of commercial importance, amongst which are included various species of Heterosomata, the scales of such species received a great deal of attention. In a very short time the characteristics of the scales thus examined became so familiar, that it was found possible to identify any particular species solely from its scales.

In a great many instances scale-samples, labelled with the local common name of the fish from which they were taken, were received from interested persons engaged in the commercial fisheries in various ways. Very often in such cases, the actual species could not with certainty be ascertained from the local common name applied, as, along the 2000 miles of coastline of the Union, the same species may have a great variety of names, differing from place to place, or totally different species may have the same name at widely separated places. In such obscure cases, due to the familiarity acquired by experience, positive identifications were readily, rapidly and conveniently made by examination of the scale-samples.

It was considered, that if the diagnostics of scales could be of so much assistance in identifying the individual species of a heterogeneous collection of species, such as that composing the South African food-fishes, it would be of considerable interest and value to determine to what extent scale-characters could be utilised in identification and taxonomy, both independently and accessory to normal morphological diagnostics.

The desiderata of such a study was considered best fulfilled by a homogeneous group of fishes in which varying degrees of relationships between sub-groups and individual species were to be found. For the purposes of a South African study of this nature, the order Heterosomata, which is represented by all five of the recognised families and a goodly

number of subfamilies, genera and species in South African seas, was selected. A secondary but nevertheless important reason for tipping the balance in favour of this selection is to be attributed to the large amount of material available for study in the almost complete collections of Flat-fishes in the South African Museum, and the Fisheries and Marine Biological Survey Division of the Department of Commerce and Industries, both centred at Cape Town.

This paper, therefore, comprises a combined taxonomic and lepidological study of the South African Heterosomata with special reference to the question of the value of scale-character in identification and classification.

The first general revision of the South African Flat-fishes (Heterosomata) by Boulenger published in 1898 in the "Report of the Marine Biologist for 1897, Department of Agriculture, Cape of Good Hope", incorporated descriptions of six species. This review was subsequently republished in 1902 in "Marine Investigations in South Africa", Vol. I. In this volume a second paper, also by Boulenger and first published in 1900, included a description of a seventh species from South African seas.

As the marine survey, which commenced in 1896, proceeded, new species were recorded and described by Gilchrist in "Marine Investigations in South Africa" Vols. II, III, and IV, until by the end of 1908 the number of flatfish species recorded from South African waters stood at twenty-seven. During the years 1909 to 1918 no new species were recorded, but from 1919 to 1921 six additions to the list of species were made by Regan, five in "Annals of the Durban Museum" Vols. II and III, 1919 - 1921, and one in "Annals and Magazine of Natural History" Vol. VII(9), 1921, thus bringing the total number of species up to thirty-three. The next comprehensive survey of the South African flatfishes is that of Von Bonde published in 1922 in

Report No. 2 for 1921 of the "Fisheries and Marine Biological Survey, Department of Mines and Industries, Union of South Africa." In this review the author described thirteen species new to science and recorded four known species from South African waters for the first time, giving a total list of fifty species. In a subsequent paper by the same author, on a collection of flatfishes from Portuguese East Africa, published in 1925, in "Transactions of the Royal Society of South Africa" Vol. XII, three new species were recorded and described, two being new to science and one an established species recorded from South African seas for the first time. At this stage, therefore, the order Heterosomata was represented in South African waters by fifty-three species belonging to twenty-eight genera.

We now come to the last general account of the South African flatfishes, that of Barnard, published in 1925 as part of his "Monograph of the Marine Fishes of South Africa", in "Annals of the South African Museum" Vol. XXI. In this work the number of species recognised, was reduced to forty-five, divided amongst twenty-seven genera. Of the total number of species thirty-three were endemic.

In the present paper, forty-five species belonging to thirty genera are recognised, and, of this total, thirty-two are peculiar to South African waters.

The arrangement adopted in this paper of dividing the Heterosomata into five families, viz., Psettodidae, Bothidae, Pleuronectidae, Soleidae, and Cynoglossidae, proposed by Regan in 1929 as a modification of his earlier arrangement of 1910, is now generally recognised as being a perfectly natural one.

The subdivision of the five families into smaller groups, such as sub-families, parts (sections) or genera, adopted here, follows Norman (1934) as far as the Psettodidae, Bothidae and Pleuronectidae are concerned, Chabanaud (1930) with respect to

the Soleidae, and Barnard (1925) as regards the Cynoglossidae.

The zoo-geographical area designated "South African" in this study is that demarcated by Barnard (1925).

The paper is divided into four main parts. Part A. deals with general explanatory matter and comprises, a survey of the material studied, explanatory notes on the nomenclature and technique of lepidology, notes on measurements, etc., used in morphological diagnostics, and some few notes on the literature consulted. Part B. deals with the systematics of the recognised species. Part C. includes firstly, a review of the literature of fish-scales having special reference to the relation between scale-characters and taxonomic identification and secondly, a discussion on the application of lepidological diagnostics to the identification and classification of the South African Heterosomata, in the light of a detailed study of scale-characters in the group, as well as the statement of certain general conclusions arrived at as a result of the study as a whole.

A. GENERAL PART.

1. Material.

The material is derived from two main sources, viz., (i) the South African Museum Collection of Heterosomata, and (ii) the Government Marine Survey Collection, now held by the Fisheries Survey Division of the Department of Commerce and Industries.

The other sources are the following, (iii) a number of type and other specimens in the British Museum (Natural History), and (iv) one specimen in the Albany Museum, Grahamstown.

(i). The South African Museum Collection, access to which was kindly granted by Dr. K. H. Barnard, Assistant Director and Keeper of Fish and Marine Invertebrates, includes the following species: -

Psettodes erumei - a few specimens.

Pseudorhombus arsius - one specimen of P. andersoni, Gilchrist.

Pseudorhombus natalensis - type and other specimens.

Citharoides macrolepis - type and other specimens of Arnoglossus macrolepis, Gilchrist.

Arnoglossus capensis - topotype and other specimens.

Crossorhombus valde-rostratus - specimens of Platophrys dimorphus, Gilchrist; also nine specimens, largest 70 mm., of Platophrys grandisquama, Gilchrist.

Chascanopsetta lugubris - specimens of C. gilchristi, Von Bonde.

Paralichthodes algoensis - type specimen.

Synapturichthys kleini variolosa - type and one other specimen of Synaptura melanoptera, Gilchrist, and type and other specimens of Solea capensis, Gilchrist.

Austroglossus pectoralis - two sinistral specimens.

Austroglossus microlepis - a number of specimens, largest 750 mm. in length.

Barnardichthys fulvomarginata - type and other specimens of Solea fulvomarginata, Gilchrist.

- Dicologlossa cuneata - type specimen of Solea cleverleyi, Gilchrist.
- Solea bleekeri - type and other specimens of Solea turbynei, Gilchrist.
- Synaptura marginata - type and other specimens of S.ciliata, Gilchrist.
- Zebrias (Pseudaesopia) regani - type and other specimens of Synaptura regani, Gilchrist.
- Coryphaesopia cornuta barnardi - specimens of Synaptura cornuta, Gilchrist; and of Aesopia cornuta, Kaup.
- Heteromycteris capensis - specimens of Achirus capensis, Boulenger.
- Symphurus variegatus - type and one other specimen of Aphoristia variegata, Gilchrist.
- Cynoglossus gilchristi - type specimen of C.brachycephalus (nom. preocc.Bleeker), Gilchrist.
- Arelia attenuata - type and other specimens of Cynoglossus attenuatus, Gilchrist.
- Trulla capensis - specimens of Cynoglossus capensis, Boulenger.
- Trulla microphthalmus - specimens of Areliscus microphthalmus, Von Bonde.
- Areliscus marleyi - topotype and other specimens of Cynoglossus marleyi, Regan.
- Areliscus ecaudatus - type and other specimens of Cynoglossus acaudatus, Gilchrist.
- Paraplagusia marmorata - type and other specimens of Plagusia marmorata var. africana, Gilchrist.

(ii) The Fisheries Survey Division Collection includes the following species: -

- Pseudorhombus arsius - a number of specimens, largest 240 mm. in length, of P.russellii (Gray).
- Pseudorhombus natalensis - seven small specimens, largest 135 mm.

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Citharoides macrolepis - a large  
sizes of Arnoglossus macrol

Arnoglossus capensis - a large n  
Practically all the specimens  
scales rubbed off.

Enzyprosopeon grandisquama - two  
(Temminck and Schlegel), lar

Enzyprosopeon natalensis - a single

Crossorhombus valde-rostratus -  
155 mm., of C. dimorphus (

Bothus pantherinus - a number of  
pantherinus (Rüppell), var

Chaacnopsetta lugubris - a number  
Von Bonde and C. maculata,

Laeops nigromaculatus - type and

Laeops natalensis - a few specimens  
of Lambdopsetta kitscherae

Laeops pectoralis - type and other  
in length, of Lambdopsetta

Poecilopsetta natalensis - a few  
in length, of Limanda bean

Marlevella bicolorata - a large

setta bicolorata, Von Bonde, both males and females.

Largest male 170 mm., largest female 150 mm. in length.

Paralichthodes algoensis - two specimens, larger 420 mm.

Samaris delagoensis - type and two other specimens, largest 170  
mm. in length.

Synapturichthys kleini variolosa - a single specimen of Solea  
melanoptera (Gilchrist); numerous specimens of all sizes  
of Solea capensis, Gilchrist.

Austroglossus pectoralis - a very large range of specimens,  
including four sinistral ones, varying in length from

50-580 mm. A number of specimens labelled Synaptura pectoralis, Kaup.

Austroglossus microlepis - a very large range of specimens largest 1025 mm. in length. A number of specimens labelled Synaptura microlepis, Bleeker.

Barnardichthys fulvomarginata - a few specimens of Solea fulvomarginata, Gilchrist.

Quenselia ocellata - type specimen of Solea quadriocellata, Von Bonde, 108 mm. in length.

Solea bleekeri - numerous specimens of all sizes of S. turbynei, Gilchrist, largest 120 mm. in length; one specimen labelled Solea impar, Bennett, by Von Bonde, 160 mm. in length.

Synaptura marginata - two specimens of Synaptura ciliata, Gilchrist.

Zebrias (Pseudaesopia) regani - a number of specimens, largest 140 mm., of Zebrias regani (Gilchrist).

Coryphaesopia cornuta barnardi - a few specimens, largest 150 mm., of Aesopia cornuta, Kaup.

Achirus marmoratus - a single specimen of Pardachirus marmoratus, (Lacépède), 260 mm. in length.

Heteromycteris capensis - numerous specimens of all sizes; a few specimens of Achirus capensis, Boulenger.

Symphurus variegatus - a few specimens, largest 85 mm. in length.

Symphurus ocellatus - type and one other specimen, larger 105 mm. in length.

Cynoglossus durbanensis - two specimens, 125 mm. and 154 mm.

Cynoglossus gilchristi - numerous specimens, largest 155 mm. in length; a few specimens of C. brachycephalus (nom. preocc. Bleeker), Gilchrist.

Cynoglossus hunteri - type specimen, 78 mm. in length.

Arelia attenuata - numerous specimens of Cynoglossoides attenuatus (Gilchrist), largest 225 mm.

Trulla capensis - a great variety of specimens of all sizes up to 400 mm. Two specimens labelled Areliscus capensis, (Kaup).

Trulla microphthalmus - numerous specimens of all sizes, largest 350 mm. in length. Type and other specimens of Areliscus microphthalmus, Von Bonde.

Areliscus marleyi - a few specimens, largest 250 mm.

Areliscus ecaudatus - a few specimens, largest 140 mm. in length, of A. natalensis, Von Bonde.

(iii). Samples of scales were obtained from the following species in the British Museum: -

Arnoglossus dalgleishi - Trichopsetta dalgleishi, Von Bonde.

Paratype specimen, from which only a few lateral line scales from the ocular side were available.

Arnoglossus microphthalmus - Laeops microphthalmus, Von Bonde.

Type specimens, from which only a few scales from the ocular side were available.

Samaris ornatus - type specimen, from which scales from both sides were procured.

Symphurus strictus - scales from both sides were obtained.

Cynoglossus lida - scales from both sides were obtained.

(iv). A specimen, named Synaptura barnardi, was made available for examination through courtesy of Dr. J. L. B. Smith, Honorary Keeper of Fishes (and namer of the specimen) and Dr. Hewitt, Director of the Albany Museum, Grahamstown.

The great majority of the specimens composing the material were procured during the course of fisheries and marine biological survey investigations on the West, South, and East Coasts of the Union of South Africa (including Delagoa Bay) by the following survey vessels: 1887-1906, "Pieter Faure"; 1920-1929,

"Pickle", 1931 and subsequently, "Africana". No species new to science have been found during the "Africana" survey up to the present time, but large numbers of specimens of established species have been added to the Fisheries Survey Division Collection of Heterosomata.

Some few specimens have been added through the good offices of interested private donors, and the single specimen of Synaptura barnardi was procured from a rock-pool at Great Fish Point by Dr. J. L. B. Smith of Rhodes University College, Grahamstown.

## 2. Lepidological Terminology and Technique.

### (a) Terminology.

As great diversity of terminology exists with regard to the different structures of scales, this synonymy, with explanatory notes, is given to indicate the terms used in this paper.

The side of the scale nearest the body is called the inferior side. The exterior or superior side is the sculptured side. The exterior surface of scales is marked with numerous, more or less distinct, relieved lines, concentric, or nearly so in most cases, with the scale's margin. They are variously known as annuli (Esdaile), circuli (Cockerell), striae, fibrillae, concentric rings and growth-rings. Such lines are called circuli in this paper (Plate I, C.).

For the common centre of the circuli, usually rather posterior to the centre point of the scale, the term focus, adopted by Cockerell, is used here (Plate I, F.). It has also been called the centre, centrum, centre of growth, and nucleus.

Concentric with the circuli are bands or zones, which are here termed annuli (Plate I, A.). They are usually darker than the space between them and have been viewed as zones in which the circuli are closer together. They appear in numerous cases to be regions in which the regularity and continuity of the circuli have been interrupted. They are variously known as annuli, peronidia, annual-rings, winter-bands, and growth-rings.

Radii, as they are designated in this paper, are lines usually found on the anterior region of the scale, perpendicular to the circuli, directed from the focus to the scale's margin and usually increasing in number as the latter is approached. They have been known as grooves, radiating-grooves, striae or basal-striae, canaliculi, and radii (Plate I, R.).

The outer edge of the scale is called, in this and other papers, the periphery. It has been termed the margin, and this term is also utilised in this paper (Plate I, P.).

In the scales of many species the posterior part is found to be wholly or partly covered with spines, barbs or teeth. The term spines is used here. They have also been called denticles, spinules, and cilia. (Plate I, Sp.).

The scales of a great many fish species may be divided into four well-marked areas or fields. They are referred to in this paper as the anterior field (Plate I, AF.), or that portion covered in the scale pocket and directed towards the head of the fish; the posterior field (Plate I, PF.), or that part opposite the anterior field and in ctenoid scales wholly or partly covered with spines; and the lateral fields (Plate I, LF.), or those areas, usually triangular in shape, on either side of the scale. In connection with areas of the scale surface the terms apical and basal have been used for posterior and anterior respectively, hence the terms, basal striae (radii), apical denticles (spines).

In very many ctenoid scales and very commonly in the majority of ctenoid flatfish scales, the spines show a greater or less (sometimes obscure or absent) degree of regular alternation.

TEXT - FIG.1.

The spines may be differentiated into primary (major) and secondary (minor) series. The primary series of spines have their bases further marginal, i.e. more posterior, than the secondary spines. Each pair of primary spines has a secondary spine lying between them. The first, i.e. the marginal or most posterior, series of spines is the first primary or major series. Fig. 1 shows an ideal arrangement and the letters P and S represent primary (major) and secondary (minor). Thus:

(1)	P	a spine of the first major series,
(1)	S	" " " " " minor " ,
(2)	P	" " " " second major " ,

(2)  
 S a spine of the second minor series,  
 (3)  
 P " " " " third major " ,  
 (3)  
 S " " " " " minor " .

The spines of the major series therefore all lie in the same postero-anterior radial lines. The spines of the minor series also lie in the same postero-anterior radial lines but these are alternately intermediate to the major postero-anterior radial lines. In the posterior field shown in Fig. 1, there are therefore 3 major series and 3 minor series of spines. As the posterior field thins down towards its lateral margins the numbers of series of spines become reduced. In the example given the major and minor series are reduced to 2 at the lateral extremities of the field. In this paper the term major is used for primary and minor for secondary.

(b) Technique.

The methods of scale collection, preparation, examination and photomicrography employed in this study follow normal modern practice and the introduction of original technique at any point in the complete process was not found necessary.

The scales covering the body of a particular flatfish vary considerably in form in different regions of the body both ocular and blind sides, but a typical form for each particular area is readily recognisable. After considerable study of the scales from every part of the body both ocular and blind sides, in numerous specimens of many of the South African species, the following scales were finally selected as being adequately representative of the lepidology of a particular species: -

(i) Ocular side.

A scale away from the lateral line. The typical scales of this category are found about midway between the lateral line

be cleaned are placed in the ammonia or washing soda bath for about five minutes. Cycloid scales were quickly cleaned by placing one or two from the first bath on the ball of the index finger and rubbing this finger with the thumb. Ctenoid scales could not be treated in this way as the spines were mutilated. Practically all the adhering epithelial skin becomes detached in the first bath but stubbornly adhering scraps of skin have to be removed under the solution in the bath by using a dissecting microscope and a pair of dissecting needles. When clean the scales are transferred to the alcohol bath for about five minutes.

The scales are mounted dry between two thin glass-slides. Two glass slides are bound together at one end with a strip of gummed paper, opened out flat like a book, the clean scales from the alcohol bath placed in position on one slide, the other slide folded over on top, held firmly together and the other end bound with a strip of gummed paper. White gummed paper was used in order to provide the necessary inscription space without affixing a special label for this purpose.

Scales mounted in Canada Balsam are practically useless for lepidological examination since they become so transparent as to be almost invisible.

For each species two slides, one ocular side and one blind side, were made. On the ocular side slide the scales were arranged in three groups, viz., scales independent of the lateral line to the left, lateral line scales in the centre, and scales adjacent to the lateral line on the right.

Microscopic examination of the scales was mostly effected by means of the Edinger Microprojector manufactured by Leitz-Wetzlar. In the case of small scales a 16 mm. (x 12) objective in combination with eyepieces of various magnifications was used, and, if the scales were too large for the field of view available with this objective, a Summar lens (F/4.5, 100 mm. focus) was brought into use. Measurements, as a rule, were made directly on

the projected image but in some instances micrometer eyepieces (5 mm. divided into 50 parts and 5 mm. divided into 100 parts) were utilised. To procure most of the original drawings the projected images were traced.

A very large amount of photographic work was necessary and involved several different types of technique.

In copying figures from published works and making duplicates of original drawings, two methods were employed: -

a. By the use of a Reflex Screen negatives were procured on Kodaline Slow Paper and contact prints taken from these.

b. By the use of the Leitz Universal Copying Apparatus, incorporating a Leica Miniature Camera, 24 x 36 mm. negatives were procured on Gevaert Positive Film (Speed 19 H. and D.) and enlargements made from these with the Leitz Focomat Enlarger.

Photomicrography was both speedy and simple by employing two methods: -

a. By the use of a 9 x 12 cm. Leitz "Makam" in conjunction with a Leitz Microscope and Leitz Carbon Arc-Lamp as source of illumination. Photographs taken on Agfa Extra-Rapid Plates (Speed 270 H. and D.) giving exposures of  $\frac{1}{4}$  to  $\frac{1}{10}$ th of a second.

b. By the use of the Leitz Microscope in combination with the above-mentioned copying equipment and a Leitz Micro Arc-Lamp (Pointolite) as source of illumination. Photographs on Gevaert Positive Film giving exposures of  $\frac{1}{8}$ th of a second.

All prints were made on Kodak Bromide Paper (B.G.4.)

### 3. Notes on Measurements, etc.

The diagnostic description of a fish includes the proportional comparison of certain body and parts of the body measurements. In the case of flatfishes the points between which the requisite measurements, which are always taken in a straight line as if with a pair of callipers and not round the curve of the body, are the following: -

(i) The distance between the tip of the lower jaw and the extremity of the longest caudal ray or rays, is the total length of the fish. In this paper, when the size of the fish is given in millimetres or inches, the total length is the measurement denoted.

(ii) The measurement between the tip of the lower jaw and the posterior extremity of the bony operculum or gill-cover, is the length of the head.

(iii) The depth of the body is the greatest depth without the marginal fins. Sometimes the bases of these fins are covered with scales on the ocular side, and in such instances the measurement is taken on the blind side.

(iv) The length of the fish, which is measured between the tip of the lower jaw and the base of the caudal fin, is compared with both the depth of the body and the length of the head.

(v) The distance between the tip of the snout and the vertical through the anterior border of the foremost eye, usually the upper eye, is the length of the snout.

(vi) The diameter of the eye refers to the horizontal or longitudinal measurement of the eyeball itself and not to that of the orbit.

(vii) The distance between the inner borders of the eyeballs is the interorbital width or interocular space. In some instances, the eyes are separated by a flat or concave space bounded by a

pair of sharp ridges forming the inner walls of the orbits. In such cases, the distance between these two ridges is measured.

(viii) The size of the mouth is denoted by giving the position of the posterior end of the maxillary in relation to the lower eye. The length of the maxillary is the total length of the upper jaw, measured on the ocular side normally unless stated otherwise, and is the distance between the anterior extremity of the snout and the posterior end of the maxillary. The premaxillary and maxillary are therefore both included.

(ix) The number of scales in the lateral line is counted, either in the lateral line itself or just above the lateral line, from a point opposite the upper angle of the gill-opening to the base of the caudal. In cases where the number of pores in the lateral line is less than the number of scales, this fact is stated as a general rule. The number of scales between the lateral line and the middle of the back, or between the median lateral line and the dorsal or ventral lateral lines, in transverse series, is counted in an oblique row.

(x) When it is stated that the caudal peduncle is twice as deep as long, this means that the least depth of the muscular part of the tail is twice as great as its length. The length is the distance between the line joining the last rays of the dorsal and anal fins and the posterior part of the peduncle. The length does not include the basal part of the caudal fin itself, as this may be covered with scales.

The diagnostic description of a scale includes the proportional measurements of its various parts. In order to clarify the terms and measurements used in this paper it is necessary to define the points between which the measurements are taken.

TEXT-FIG. 2.

In the above figure certain points are indicated, viz.,

anterior angle (aa.), posterior angle (pa.) and focus (f.).

The anterior breadth is measured between the anterior angles (from aa. to aa.), but when these are not well marked, the length of the anterior margin (ab) of the scale is taken.

The posterior breadth lies between the posterior angles (from pa. to pa.). The anterior length is measured along the median postero-anterior axis of the scale between the line joining the posterior angles and the line joining the anterior angles, or, when the anterior angles are very rounded and obscure, between the first-mentioned line and the most projecting point of the anterior margin. The total length of the scale is the distance along the line used for finding the anterior length, from the same anterior points mentioned above to the extremity of the longest spine in the median section of the posterior field, or, in cycloid scales, to the most projecting point of the posterior margin. The maximum breadth of the scale is the greatest distance between the lateral margins. The posterior field is referred to as deep or large, and the measurement is the distance from the extremity of the longest spine in the median section of the posterior field to the centre of the focus, or, in cycloid scales, the distance from the most projecting point of the posterior margin to the focus measured along the median axis. In this paper the measurements defined above are expressed as percentages of each other, usually the shorter as a percentage of the longer.

#### 4. Bibliographical Notes.

The publications listed in Part I of the Bibliography (vide Section D) for the most part comprise only those papers having special reference to the question of the taxonomic value and utilization of scale characters. The literature review incorporated in this study (vide Section C.1) deals exclusively with the papers listed in the above-mentioned part.

Some few of the papers listed in Part I have not been seen - these are marked with asterisks - but due to their importance have been included to assist future workers in lepidology.

Publications consulted as guides to the literature on flatfishes in general, fish scales and flatfish scales in particular, are the following: -

- a. Zoological Record. Pisces. Zoological Society of London, 1864 —→ up to date.
- b. A Bibliography of Fishes, by Dean. American Museum of Natural History, Vols. 1 - 3, 1916, 1917 and 1923.
- c. The Genera of Fishes, Parts I - IV, by Jordan. Leland Stanford Junior University Publications, University Series, 1917 - 1920.
- d. A Classification of Fishes, by Jordan. Stanford University Publications. Biological Sciences, Vol. 3, No. 2, 1923.
- e. Biological Abstracts, Vols. 1 —→ up to date, 1926 - 1936.

In Part II of the Bibliography is listed all the papers dealing with South African Heterosomata issued in South African scientific publications, since the inception of Government aided marine biological research in this country in 1895 up to the present day. The method of grouping the papers under the headings of the publications in which they appear is adopted in order to facilitate reference.

In compiling the synonymy of each species an attempt has been made throughout this study to make this as

complete as possible without including non-essential references. Particular care has been taken not to omit the papers on work done on South African Heterosomata by South African investigators.

the left eye in dextral forms and that of the right eye in sinistral forms, always dorsal; one or two post-cleithra on each side; ribs present.

(i). Eyes on the left side (except in reversed examples); nerve of the right eye always dorsal; egg with a single oil-globule in the yolk . . . II. BOTHIDAE.

(ii). Eyes on the right side (except in reversed examples); nerve of the left eye always dorsal; egg without oil-globules . . . III. PLEURONECTIDAE.

b. Preopercular margin not free, hidden by the skin and scales of the head; lower jaw never prominent; nasal organs symmetrical in position; optic chiasma dimorphic, the right or the left nerve dorsal without reference to dextrality or sinistrality; no post-cleithrum; no ribs.

(i). Eyes on the right side . . . IV. SOLEIDAE.

(ii). Eyes on the left side . . . V. CYNOGLOSSIDAE.

#### Family I. PSETTODIDAE.

Eyes on the right or left side; optic chiasma dimorphic. Dorsal fin not extending forward on the head, the anterior rays spinous. Pelvic fins nearly symmetrical, thoracic, each of a spine and 5 soft-rays. Mouth large, terminal, with straight cleft; lower jaw prominent; jaws and dentition equally developed on both sides; maxillary with a well-defined supplemental bone; teeth strong; palatines toothed. Urohyal normal, the lower edge scarcely curved. Preoperculum with free margin. Nasal organ of blind side scarcely higher than the other; olfactory laminae numerous, radiating from a rather short central rachis. Vertebrae 24 (10 + 14); precaudal parapophyses downwardly directed and united to form closed haemal arches. Two post-cleithra on each side; pectoral radials well developed.

A single genus from tropical seas.

(1) PSETTODES.

Psettodes, Bennett, 1831, Proc. Comm. Zool. Soc., (12), p. 147; Günther 1862, Cat. Fish. Brit. Mus., iv, p. 401; Barnard, 1925, Ann. S. Afr. Mus., xxi, p. 383; Norman, 1934, Monogr. Flatf. (Heterosomata), i, p. 57  
Sphagomorus, Cope, 1869, Trans. Amer. Phil. Soc. Philad., xiii, p. 407.

Body ovate or rather elongate, not greatly compressed. Eyes separated by a flat, scaled space of moderate width, the upper placed on the dorsal surface of the head. Mouth large, the length of the maxillary more than half that of head. Teeth straight or curved, pointed, some of them with barbed tips; in 2 or 3 series in both jaws, those of the inner row larger, depressible, those of the outer row fixed; a small patch of teeth on the vomer and a single row on each palatine; patches of teeth on tongue. No gill-rakers, but gill-arches with groups of teeth; lower pharyngeals very narrow, slender not united, each with 2 (or 3) rows of slender curved teeth, those of inner row larger. Most of the soft-rays of the dorsal fin and nearly all those of the anal branched, not scaled; a low scaled sheath at bases of dorsal and anal; tip of first interhaemal spine not projecting in front of anal. Pectoral fins subequal, middle rays branched. Scales rather small, adherent, with fine diverging radii and finely crenulated margins. Lateral line well developed on both sides of the body, with a low curve above the pectoral fin; no distinct supratemporal branch; tubules branched. Vent nearly median, just in front of anal fin; several pyloric appendages.

One species found in South African waters.

1. PSETTODES ERUMEI (Schneider).  
 (The Adalah).

Pleuronectes erumei, Schneider, 1801, in Bloch, Syst. Ichth., p. 150.  
Hippoglossus erumei, Cuvier, 1829, R. Anim., ed. 2, ii, p. 340; Rüppell, 1830, Fische Rothen Meeres, p. 121; Cantor, 1850, J. Asiat. Soc. Bengal, xviii (2), p. 1198; Bleeker, 1852, Verh. Batav. Gen., xxiv, Pleuron., p. 13.  
Pleuronectes nalaka, Cuvier, 1829, R. Anim., ed. 2, ii, p. 340.

- Hippoglossus dentex, Richardson, 1845, Zool. "Sulphur", p. 102; 1846, 15 Rept. Brit. Assoc. (Cambr., 1845), p. 278.
- Hippoglossus orthorhynchus, Richardson, 1846, 15 Rept. Brit. Assoc. Cambr., 1845), p. 278.
- Hippoglossus goniographicus, Richardson, 1846, tom. cit., p. 279.
- Psettodes erumei, Günther, 1862, Cat. Fish. Brit. Mus., iv, p. 402; Playfair and Günther, 1866, Fish. Zanzibar, p. 112; Bleeker, 1866-1872, Atlas Ichth., vi, p. 4; Pleuron. pl. 1, fig. 2; Kner, 1869, Reise "Novara", Zool., i, 5, Fische, p. 282; Klunzinger, 1870, Verh. zool.-bot. Ges. Wien, xxi, p. 570; Day, 1877, Fish. India, p. 422, pl. xci, fig. 4; Saviile-Kent, 1893, Great Barrier Reef, p. 297, pl. xlvi, fig. 5; Barnard, 1925, Ann. S. Afr. Mus., xxi, p. 383, pl. xvii, fig. 1; Norman, 1926, Biol. Res. "Endeavour", v, p. 221; Norman, 1927, Rec. Ind. Mus., xxix, p. 8, fig. 1; Oshima, 1927, Japan. J. Zool. Trans. Abstr., 1(5), p. 178; Weber and Beaufort, 1929, Fish. Indo-Austral. Arch., v, p. 97, fig. 24; McCulloch, 1929, Mem. Aust. Mus., v, p. 276; Wu, 1932, The. Facult. Sci. Univ. Paris, A. 244(268), p. 73.
- Spagomorus erumei, Cope, 1869, Trans. Amer. Phil. Soc. Philad., xiii, p. 407.
- Psettodes goniographicus, Bleeker, 1873, Ned. Tydschr. Dierk., iv, p. 130.

TEXT-FIG. 3.

D. 50-56; A. 34-43; P. 14-16; L. 1.68-76.

Depth of body  $2\frac{1}{5}$  to  $2\frac{1}{2}$  in the length, length of head  $3\frac{1}{6}$  to  $3\frac{2}{3}$ . Snout as long as or a little longer than eye, diameter of which is 5 (young) to 7 in length of head and greater than inter-orbital width. Maxillary extending to well beyond posterior edge of eye, length  $1\frac{1}{5}$  to  $1\frac{1}{2}$  in that of head; length of lower jaw  $3\frac{4}{5}$  to  $4\frac{1}{2}$  in that of fish (without caudal). 68 to 76 scales in a longitudinal series above lateral line, 22 to 28 between lateral line and middle of back, 32 to 38 round caudal peduncle. Origin of dorsal above or a little behind level of hinder edge of lower eye. Pectoral  $2\frac{1}{4}$  to  $2\frac{3}{4}$  in length of head. Caudal with 17 rays (15 branched), truncate or double-truncate; caudal peduncle deeper than long. Brownish or greyish, sometimes with four broad dark transverse bars; body sometimes with small scattered white spots; dorsal, anal and posterior part of caudal darker, the caudal sometimes with a distinct blackish band posteriorly; pectoral with small dark spots. Blind side whitish.

Length: Up to 600 mm.

Distribution: Delagoa Bay.

Lepidology. (Plate II, figs. 1, 2.).

Scales "primitively ctenoid" on both sides of the body, rather small, adherent, regular in arrangement; 68 - 76 scales

in the lateral line.

Ocular side - independent of the l.l.

Broadly oval, anterior angles very widely rounded, anterior margin markedly and evenly convex, finely scalloped, scallops numerous, 30 - 32, lateral margins markedly and evenly convex; anterior length 70 - 75% of the total length, anterior breadth 104 - 108% of the anterior length, posterior breadth 72 - 78% of the anterior breadth. Scales as a rule broader anteriorly than posteriorly. Focus very small but well-defined, posterior in position, about  $\frac{1}{3}$  of total length from posterior margin. Anterior field very large, radii rather widely divergent from the focus, continuous, fine, smooth, well-defined, rather numerous, increasing in number from about 6 - 8 near the focus to about 30 - 32 at the anterior margin. Interradial circuli close-set, straight or nearly so, continuous. Lateral fields small, roughly triangular, covered with close-set circuli. Posterior field of medium size, ornamented with 14 - 20 well-defined, slightly undulated and laterally crenulated ridges radiating from the focus. The posterior margin is finely crenulated or produced into a number of small projections. Each ridge extends to the tip of a projection or crenulation, thus giving 14 - 20 such projections or crenulations along the posterior margin. As no true spines are present and yet the posterior margin is not smooth, the scales have been termed "primitively ctenoid."

Adjacent to the l.l.

Similar in all respects to scales away from the lateral line as described above, except that the lateral margin adjacent to the lateral line is usually rather flattened and not so markedly convex.

Lateral line.

More or less pear-shaped, broad anteriorly with widely-rounded anterior angles, narrowed posteriorly. Muciferous canal medianly symmetrical, starting as a narrow gap in the posterior margin,

which continues narrowly for some distance towards the centre of the scale, and then swells out into an oval or circular form; beyond this the canal continues as a wide short depression in the scale surface; ridges absent.

Blind side - independent of the l.l.

Oval, slightly more elongated than typical ocular side scales. Lateral margins less convex than in ocular side scales. Anterior length 72 - 76% of the total length, anterior breadth 72 - 75% of the anterior length, posterior breadth 98 - 100% of the anterior breadth. Anterior field somewhat reduced in size, radii fewer, 18 - 22 at the anterior margin. Posterior field reduced in size, ridges and crenulations fewer, 10 - 14.

There are no signs of annuli.

Family II. BOTHIDAE.

Eyes on the left side, except in reversed examples in certain species; optic chiasma monomorphic, the nerve of the right eye always dorsal. Dorsal fin extending forward on the head at least to above the eye; all the fins articulated. Each pelvic fin of 6 or fewer rays. Mouth terminal, with the lower jaw more or less prominent; maxillary without a supplemental bone; palatines toothless. Lower edge of urohyal deeply emarginate, so that the bone appears forked. Preoperculum with free margin. Nasal organ of blind side near edge of head. Vertebrae never fewer than 30. On each side one or two post-cleithra; pectoral radials present. Ribs present. Egg with a single oil-globule in the yolk.

Two subfamilies represented in South African waters.

Synopsis of the South African Subfamilies.

- A. Pelvic fins generally short-based, but that of the eyed side, if somewhat extended, never with the anterior ray much in advance of the first ray of that of the blind side; pelvic fins supported by the pelvic bones and situated behind the cleithra, either symmetrical or with the fin of the eyed side nearly median in position; caudal vertebrae without transverse apophyses . . . . . A. PARALICHTINAE.
- B. Pelvic fin of the blind side short-based; that of ocular side elongate, extending forward to the urohyal, supported by a cartilaginous plate placed in advance of the cleithra, its anterior ray well in advance of the first ray of that of blind side; caudal vertebrae with well-developed apophyses . . . . . B. BOTHINAE.

Subfamily A. PARALICHTHINAE.

Characters as given in the above synopsis. Two genera found in South African waters.

Key to the South African Genera.

- a. Pelvics subequal and subasymmetrical . . . (ii). Pseudorhombus.
- b. Pelvics more or less subequal, that of eyed side median . . . . .  
 . . . . . (iii). Citharoides.

(ii). PSUDORHOMBUS.

Pseudorhombus, Bleeker, 1862, Versl. Akad. Wet. Amsterdam, xiii, p. 426; Day, 1877, Fish. India, p. 422; Gilchrist, 1904, Mar. Invest. S. Afr., iii, p. 8; Regan, 1920, Ann. Durban Mus., ii, p. 207; Barnard, 1925, Ann. S. Afr. Mus., xxi, p. 387; Weber and De Beaufort, 1929, Fish. Indo-Austral. Arch., v, p. 99; Norman, 1931, Ann. Mag. Nat. Hist., (10) viii, p. 597; Wu, 1932, Thés. Facult. Sci. Univ. Paris, A. 244 (268), p. 79; Norman, 1934, Monogr. Fauna (Heterosomata), i, p. 89.

Teratorhombus, Macleay, 1882, Proc. Linn. Soc. N.S.W., vi, p. 126.

Rhombiscus, Jordan and Snyder, 1901, Proc. U.S. Nat. Mus., xxiii, p. 379.

Spinirhombus, Oshima, 1927, Japan, J. Zool. Trans. Abstr., i (5), p. 187.

Istiorhombus, Whitley, 1931, Aust. Zool., vi, p. 322.

Body ovate, compressed. Eyes large, separated by a bony ridge. Olfactory laminae somewhat variable in arrangement and number. Usually radiating from or arranged transversely to a fairly long central rachis. In some species the rachis is much reduced in length. Mouth large, the length of the maxillary  $\frac{1}{2}$  or nearly  $\frac{1}{2}$  that of head; jaws and dentition about equally developed on both sides; teeth moderately strong and of moderate size; rather slender and sharply pointed, more or less enlarged anteriorly, uniserial in both jaws; vomer toothless. Gill-rakers of moderate length or rather long, generally slender; lower pharyngeals each with numerous rows of minute pointed teeth. Dorsal fin commencing above or immediately behind posterior nostril of blind side and in front of or above anterior part of eye; most of the rays simple, scaled on both sides. Tip of first interhaemal spine feeble, not projecting in front of anal fin. Pectoral fins unequal, that of ocular side larger, middle rays branched, but not prolonged. Pelvic fins short-based. Scales ctenoid or cycloid. Lateral line equally developed on both sides of body, with a distinct curve above the pectoral fin, and with supratemporal branch running upwards towards the anterior (8th - 12th) dorsal rays. Vent on blind side, in advance of or above first ray of anal fin.

The genus is represented by two species in South African seas

Key to the South African Species.

- a. Teeth strong, rather widely set, canines large; 6 to 16 teeth on blind side of lower jaw . . 2. arsius.
- b. Teeth smaller, more or less close-set, not much enlarged anteriorly; usually more than 20 teeth on blind side of lower jaw . . . . . 3. natalensis.

2. PSEUDORHOMBUS ARSIUS (Hamilton).  
(Large-toothed Flounder).

Pleuronectes arsis, Hamilton, 1822, Fish. Ganges, p. 128; Hora, 1929, Mem. Ind. Mus., ix, p. 86, pl. xvii, figs. 1, 2.

Platessa russellii, Gray, 1834, Illust. Indian Zool., ii, pl. xciv, fig. 2; Cantor, 1850, J. Asiat. Soc. Beng., xviii (2), p. 1196.

Rhombus lentiginosus, Richardson, 1843, Ann. Mag. Nat. Hist., xi, p. 495; Bleeker, 1852, Verh. Batav. Gen., xxiv, Pleuron., p. 15.

Platessa balteata, Richardson, 1846, Rept. Brit. Assoc., (Cambr. 1845), p. 278.

Rhombus arsius, Bleeker, 1853, Verh. Batav. Gen. xxv, Bengal, p. 76.

Rhombus polyspilus, Bleeker, 1853, Nat. Tijdschr. Ned. Ind., iv, p. 503.

Pseudorhombus russellii (part), Günther, 1862, Cat. Fish. Brit. Mus., iv, p. 424; Barnard, 1925, Ann. S. Afr. Mus., xxi, p. 388.

Pseudorhombus lentiginosus, Bleeker, 1865, Ned. Tijdschr. Dierk., ii, p. 184.

Pseudorhombus russellii, Day, 1865, Fish. Malabar, p. 172; Bleeker, 1866-72, Atlas Ichth., vi, p. 6. Pleuron., pl. ii, fig. 2; Macleay, 1878, Proc. Linn. Soc. N.S.W., ii, p. 362; Sauvage, 1891, Hist. Nat. Madagascar, xvi, Poiss., p. 473; Gilchrist and Thompson, 1909, Ann. S. Afr. Mus., vi, p. 263; Gilchrist and Thompson, 1917, Ann. Durban Mus., i, p. 399; Regan, 1920, Ann. Durban Mus., ii, p. 208, fig. 1; Von Bonde, 1922, Rep. Fish. Mar. Biol. Surv. S. Afr., ii, (1921), Spec. Rep. i, p. 15; Von Bonde, 1925, Trans. Roy. Soc. S. Afr., xii, p. 290; Fowler, 1925, Proc. Acad. Nat. Sci. Philad., lxxvii, p. 204; Oshima, 1927, Japan. J. Zool. Trans. Abstr., i (5), p. 183.

Pseudorhombus arsius, Günther, 1862, Cat. Fish. Brit. Mus., iv, p. 426; Day, 1877, Fish. India, p. 423, pl. xci, fig. 5; Gilchrist, 1902, Mar. Invest. S. Afr., i, p. 145; Jordan & Seale, 1907, Bull. U.S. Bur. Fish., xxvi, (1906), p. 45; Snyder, 1912, Proc. U.S. Nat. Mus., xlii, p. 439; Hora, 1923, Mem. Ind. Mus., v, p. 758; Norman, 1926, Biol. Res. "Endeavour", v, p. 231; Norman, 1927, Rec. Ind. Mus. xxix, p. 13; Fowler, 1928, Mem. B.P. Bishop Mus., x, p. 93; Weber and De Beaufort, 1929, Fish. Indo-Austral. Arch., v, p. 105; McCulloch, 1929, Mem. Aust. Mus., v, p. 279; Wu, 1932, Thés. Facult. Sci. Univ. Paris, A. 244 (268), p. 86; Norman, 1934, Monogr. Flatf. (Heterosomata), i, p. 101, fig. 62; Fowler, 1934, Proc. Acad. Nat. Sci. Philad., lxxxvi, p. 434.

Pseudorhombus polyspilus, Bleeker, 1862, Versl. Akad. Wet. Amsterdam, xiii, p. 426; Bleeker, 1866-72, Atl. Ichth., vi, p. 7, Pleuron. pl. vi, fig. 3; Jordan & Seale, 1907, Bull. U.S. Bur. Fish., xxvi, (1906), p. 45; Weber and De Beaufort, 1929, Fish. Indo-Austral. Arch., v, p. 106, fig. 26; Schmidt, 1930, Trans. Pacif. Comm. Acad. Sci. U.S.S.R., i, p. 112.

Teratorhombus excisiceps, Macleay, 1882, Proc. Linn. Soc. N.S.W., vi, p. 126.

Pleuronectes mortoniensis, De Vis, 1883, Proc. Linn. Soc. N.S.W., vii, p. 370.

Pseudorhombus multimaculatus, Meyer, 1885, Anal. Soc. Esp. Hist. Nat., xiv, p. 40.

Neorhombus ocellatus, De Vis, 1886, Ann. Rept. Q'ld. Mus.

- Paralichthys arsius, Rutter, 1897, Proc. Acad. Nat. Sci. Philad., p. 87; Waite, 1899, Mem. Aust. Mus., iv, p. 120, fig. 8; Stead, 1906, Fish. Austral., p. 178; Stead, 1908, Edible Fish, N.S. Wales, p. 103.
- Paralichthys polyspilus, Fowler, 1904, J. Acad. Nat. Sci. Philad., (2) xii, p. 555.
- Pseudorhombus andersoni, Gilchrist, 1905, Mar. Invest. S. Afr., iii, p. 9, pl. xxvi.
- Platophrys russellii, Evermann & Seale, 1907, Bull. U.S. Bur. Fish. xxvi, (1906), p. 105.
- Pseudorhombus arsius (part), Jenkins, 1910, Mem. Ind. Mus., iii, p. 24.

TEXT-FIG. 4.

D. 72-80; A. 54-62; P. 11-13; L. 1. 69-80.

Depth  $1\frac{3}{4}$  to  $2\frac{1}{4}$  in the length, length of head  $3\frac{1}{3}$  to  $3\frac{3}{4}$ . Upper profile of head straight or a little notched in front of eyes. Snout (in adults) longer than eye, diameter of which  $4\frac{2}{3}$  to 7 in length of head; anterior margins of eyes level or upper a little in advance of lower; upper eye separated from edge of head by a space equal to  $\frac{1}{3}$  to  $\frac{2}{3}$  its diameter. Maxillary extending to below posterior edge or hinder part of eye (middle of eye in young), length  $2\frac{1}{5}$  to  $2\frac{2}{3}$  in that of head; lower jaw not projecting,  $1\frac{3}{4}$  to 2 in head. Lateral teeth of upper jaw small, and rather close-set; 2 to 4 pairs of rather large canines anteriorly; lateral teeth of lower jaw much stronger and wider apart than those of upper jaw; 6 to 13 teeth on blind side of jaw, and one or two pairs of strong canines anteriorly; none of the teeth with barbed tips. Gill-rakers of moderate length or rather short; 8 to 15 on lower part of anterior arch. Scales ctenoid on ocular side, cycloid on blind side. Supratemporal branch of lateral line reaching eighth to twelfth ray of dorsal fin. Pectoral of eyed side  $1\frac{1}{3}$  to 2 in length of head; that of blind side 2 to  $2\frac{2}{5}$  in head. Caudal double-truncate; caudal peduncle  $2\frac{1}{4}$  to  $3\frac{1}{2}$  times as deep as long. Brown, with darker more or less ocellate spots and markings on body, smaller spots on fins, a large dark spot at beginning of straight part of lateral line; all the spots more prominent in the young than in the adult. Blind side whitish.

Length: Up to 365 mm.

Distribution: Durban, Natal and Delagoa Bay, shallow water.

Lepidology. (Plate II, figs, 3, 4.)

Scales ctenoid on ocular side and cycloid on blind side, moderate in size, larger in posterior regions of the body than anteriorly, those of ocular side slightly larger than those of blind side, adherent, regular in arrangement; 69 - 80 scales in the lateral line.

Ocular side - independent of the l.l.

Broadly oval or subcircular, anterior and lateral margins convex in continuation, no anterior angles therefore discernible as such, anterior margin scalloped, scallops fairly numerous, about 20; anterior length 85-88% of the total length, anterior breadth 60 - 65% of the anterior length, posterior breadth 105-110% of the anterior breadth; most scales slightly broader posteriorly than anteriorly. Focus minute but well-defined, circular, very posterior in position, about 1/8th of total length from posterior margin. Anterior field very large, radii divergent from the focus, lateral spread great, continuous, smooth, practically straight, well-defined, relatively widely spaced, fairly numerous, 6 - 8 near the focus, increasing to 20 - 22 at the anterior margin. Interradial circuli very close-set, entire, slightly curved towards the anterior margin. Lateral fields of medium size, circuli very close-set. Posterior field small, triangular, anterior apex a large obtuse angle, entirely covered with spines. Spines short, longest 5 - 6% of total length of scale, rather blunt-pointed, strong, lateral margins very slightly curved. Spines of two marginal series homogeneous, of nearly equal length, the others decreasing in length towards the focus. Alternate arrangement into major and minor series distinct but not always regular; 4 major and 4 minor in the median section of the posterior field, reduced to 1 laterally. First major series of 10 - 12 spines and first minor series of 14 - 16 spines (2 spines of the first minor

series are sometimes placed between a successive pair of spines of the first major series, instead of the normal 1, usual in regular alternation), giving a marginal projecting series of 24 -28 spines. Spines of the other major and minor series fall wholly within the confines of the posterior field.

Adjacent to the l.l.

A little longer than those away from the lateral line. Lateral margin adjacent to the lateral line somewhat flattened and nearly straight.

Lateral line.

Subcircular, in other respects similar to scales away from the lateral line. Muciferous canal medianly symmetrical, fairly long, of even width throughout. Posterior field without spines, posterior margin convex and smooth.

Blind side - independent of the l.l.

Subcircular or circular, anterior and lateral margins convex in continuation, no anterior angles discernible as such, anterior margin scalloped, scallops fairly numerous, about 20; anterior length 70 - 75% of the total length, anterior breadth 95 - 100% of the anterior length, posterior breadth 100 - 105% of the anterior breadth. Posterior field somewhat larger than in ocular side scales (focus about 1/4 of total length of scale from posterior margin), ornamented with close-set, somewhat faint, rather interrupted circuli. In certain parts of this field irregularly-shaped and coalescing unornamented patches occur, especially along the posterior margin, which is evenly convex and smooth. Total length of blind side scale 84 - 86% of total length of corresponding scale of ocular side.

There are no signs of annuli.

3. PSEUDORHOMBUS NATALENSIS, Gilchrist.

Pseudorhombus natalensis, Gilchrist, 1905, Mar. Invest. S. Afr., iii, p.8, pl. xxv; Gilchrist and Thompson, 1917, Ann. Durban Mus., i,

p.399; Regan, 1920, Ann. Durban Mus., ii, p.209; Von Bonde, 1922, Rep. Fish. Mar. Biol. Surv. S. Afr., ii, (1921), Spec. Rep., i, p.15; Von Bonde, 1925, Trans. Roy. Soc. S. Afr., xii, p.290; Fowler, 1925, Proc. Acad. Nat. Sci. Philad., lxxvii, p.203; Norman, 1931, Ann. Mag. Nat. Hist., (10) viii, p.508; Norman, 1934, Monogr. Flatf. (Heterosomata), i, p.104, fig.63. Pseudorhombus russellii (part), Barnard, 1925, Ann. S. Afr. Mus., xxi, p.388, pl. xvii, fig.2.

TEXT-FIG.5.

D.70; A.52; P.11; L.1.58.

Close to P. argius. Depth of body twice in the length, length of head  $3\frac{3}{5}$ . Snout shorter than eye, diameter of which is  $3\frac{1}{2}$  in length of head; lower eye a little in advance of upper, which is separated from edge of head by a space equal to about  $\frac{1}{4}$  its diameter. Maxillary extending to below anterior  $\frac{1}{3}$  of eye, length  $2\frac{1}{2}$  in that of head; lower jaw not projecting,  $1\frac{5}{6}$  in head. Teeth small and close-set, scarcely enlarged anteriorly. Gill-rakers rather short, 11 on lower part of anterior arch. Scales ctenoid on ocular side, cycloid on blind side. Dorsal commencing above posterior nostril of blind side and at a distance in front of eye equal to  $\frac{1}{3}$  its diameter. Tip of first interhaemal spine feeble, just projecting. Pectoral of ocular side about  $1\frac{2}{5}$  in length of head. Caudal double-truncate; caudal peduncle more than twice as deep as long. Brownish, with a number of distinct dark rings arranged symmetrically on body; a series of conspicuous brown spots on dorsal and anal fins; tip of pelvic of ocular side with a dark spot. Blind side whitish.

Length: Up to 135 mm.

Distribution: Natal and Zululand Coasts, 25-230 fathoms.

Lepidology. (Plate II, figs, 5, 6).

Scales ctenoid on ocular side, cycloid on blind side, moderate in size, larger in posterior regions of body than anteriorly, those of ocular side a little larger than those of blind side, adherent, regular in arrangement; 58 scales in the lateral line.

Ocular side - independent of the l.l.

Broadly oval or subcircular, anterior and lateral margins convex in continuation, no anterior angles therefore discernible as such, anterior margin prominently scalloped, scallops fairly numerous, about 16; anterior length 85 - 90% of total length, anterior breadth 70 - 75% of anterior length, posterior breadth 102 - 105% of anterior breadth; most scales a little broader posteriorly than anteriorly. Focus minute but well-defined, circular, very posterior in position, about 1/9th of total length of scale from posterior margin. Anterior field very large, radii divergent from focus, lateral spread great, continuous, smooth practically straight, well-defined, relatively widely-spaced, spacing unequal, fairly numerous, 6 - 8 near the focus, increasing to 14 - 16 at the anterior margin; interradii very close-set, entire, slightly curved towards the anterior margin. Lateral fields rather small, triangular, radii very close-set. Posterior field small, in the form of a narrow, curved marginal band, entirely covered with spines. Spines short, longest 6 - 7% of total length of scale, sharp-pointed, strong, lateral margins straight or very slightly convex. Spines of two marginal series homogeneous, of nearly equal length, others very much shorter and decreasing in length towards the focus. Alternate arrangement distinct and regular, 4 major and 4 minor series medianly, reduced to 2 laterally. First major series of 11 - 13 spines and first minor series of 11 - 13 spines, giving a marginal projecting series of 22 - 26 spines. Spines of the other major and minor series fall wholly within the confines of the posterior field.

Adjacent to the l.l.

A little longer and larger than those away from the lateral line. Lateral margin adjacent to the lateral line straight or slightly concave.

Lateral line.

Subcircular, in other respects similar to scales away from the lateral line. Muciferous anal medianly symmetrical, fairly

long, slightly dumb-bell shaped. Posterior field minus spines, posterior margin convex and smooth.

Blind side - independent of the l.l.

Subcircular or circular, a little smaller than ocular side scales. Scallops of anterior margin fewer in number than in ocular side scales, about 12; radii of anterior field also fewer, about 3 near the focus, increasing to about 12 at anterior margin. In other respects similar to ocular side scales, except that posterior field is larger, triangular in shape, without spines, but ornamented with close-set, somewhat faint circuli. Posterior margin convex and smooth.

There are no signs of annuli.

(iii) CITHAROIDES.

Citharoides, Hubbs, 1915, Proc. U. S. Nat. Mus., xlviii, p. 453; Norman, 1934, Monogr. Flatf. (Heterosomata), i, p. 170.  
Paracitharus, Regan, 1920, Ann. Durban Mus., ii, p. 209; Barnard, 1925, Ann. S. Afr. Mus., xxi, p. 389.

Body rather elongate, compressed. Eyes on the left side, separated by a low bony ridge. Olfactory laminae rather numerous, arranged transversely to a long central rachis. Mouth large, maxillary about  $\frac{1}{2}$  as long as head; lower jaw strongly projecting, anterior end of each mandible flat or with a very shallow emargination; jaws and dentition about equally developed on both sides, teeth all small, pointed, in bands in jaws (at least in adults); vomer toothless. Gill-rakers of moderate length, rather slender. Dorsal fin commencing immediately above posterior nostril of blind side; nearly all the rays branched, not scaled; hinder rays of fin highest, slightly deflected on to blind side of caudal peduncle. Tip of first interhaemal spine feeble, just projecting in front of anal fin. Pectoral fins unequal, that of ocular side larger; middle rays branched. Pelvic fins short-based, subequal, that of ocular side on median line. Scales large, deciduous, ctenoid on the ocular side, cycloid

on the blind side. Lateral line equally developed on both sides of the body, continued posteriorly to margin of caudal fin; a distinct curve above the pectoral fin; no supratemporal branch; tubules of lateral line forked, Y - or T-shaped. Vent on ocular side, above first ray of anal fin.

A single South African species.

4. CITHAROIDES MACROLEPIS (Gilchrist).  
(Large-scaled Flounder.)

Arnoglossus macrolepis, Gilchrist, 1905, Mar. Invest. S. Afr., iii, p.12, pl. xxxi; Gilchrist & Thompson, 1917, Ann. Durban Mus., i, p.398; Von Bonde, 1922, Rep. Fish. Mar. Biol. Surv. S. Afr., ii, (1921), Spec. Rep. i, p.6; Von Bonde, 1925, Trans. R. Soc. S. Afr., xii, p.288.  
Citharoides macrolepidotus, Hubbs, 1915, Proc. U.S. Nat. Mus., xlviii, p.453, pl. xxv, fig. 1.  
Paracitharus macrolepis, Regen, 1920, Ann. Durban Mus., ii, p.210, fig. 2; Barnard, 1925, Ann. S. Afr. Mus., xxi, p.389; Fowler, 1925, Proc. Acad. Nat. Sci. Philad., lxxvii, p.203.  
Citharoides macrolepis, Norman, 1934, Monogr. Flatf. (Heterosomata), i, p.170, fig. 122.

TEXT-FIG. 6.

D.66-72; A.43-50; P.10; L.1.40-46.

Depth of body  $2\frac{1}{2}$  to  $2\frac{3}{4}$  in the length, length of head  $3\frac{1}{2}$  to nearly  $3\frac{1}{2}$ . Upper profile of head a little concave in front of eyes. Snout as long as or shorter than eye, diameter of which is  $3\frac{1}{3}$  (young) to nearly 5 in length of head. Maxillary extending to below posterior part of eye, length twice or a little more than twice in head; lower jaw  $1\frac{2}{3}$  to  $1\frac{3}{4}$  in head. 9 to 11 gill-rakers on lower part of anterior arch. Pectoral of ocular side a little more than  $\frac{1}{2}$  length of head. Caudal rounded or double-truncate; caudal peduncle (in adults) about twice as deep as long. Pale brownish; a dark spot at base of last rays of dorsal fin and a similar spot above end of anal; a row of round, black or brown spots on dorsal and anal. Blind side whitish.

Length: Up to 215 mm.

Distribution: Natal and Zululand Coasts, Delagoa Bay, 50 - 190 fathoms.

Lepidology. (Plate III, figs. 7, 8.)

Scales mostly ctenoid on ocular side, many cycloid scales

interspersed, patch of cycloid scales covered by the pectoral fin; cycloid on the blind side; large, very deciduous, more or less regular in arrangement; 40 - 46 scales in the lateral line. Tubules of lateral line scales bifurcate, Y- or T-shaped. As the scales are so deciduous and are continually being lost and regenerated during life, original scales are very difficult to find, and in fact most specimens captured are almost devoid of scales.

Ocular side - independent of the l.l.

Broadly oval or subcircular, anterior angles very largely rounded, anterior margin convex, faintly scalloped, scallops fairly numerous, 18 - 22 (more numerous in regenerated scales, 25-40), lateral margins slightly convex; anterior length 88-92% of the total length, anterior breadth 75-80% of the anterior length, posterior breadth 95-105% of anterior breadth. Focus small, ill-defined, more or less circular, very posterior in position, about 1/8th of total length from posterior margin. In regenerated scales the larger or smaller central area has a pitted appearance. Anterior field of medium size, radii subparallel in the median section of the field but widely divergent laterally, closer together medianly than laterally, well-defined, continuous, more or less straight, fairly numerous, 5 - 10 near the focus, increasing to 18-22 at the anterior margin (25-40 in regenerated scales). Lateral fields of moderate size, circuli wider spaced, better defined and fewer in number than in the anterior field; branching of the circuli occurs at the junctions of the lateral and anterior fields. Posterior field small, in the form of a relatively narrow band along the posterior margin in ctenoid scales; larger in cycloid scales, roughly triangular. In ctenoid scales the band-like posterior field is entirely covered with numerous spines. Spines short, 3% of the total length of the scale, broad-based, sharp-pointed, strong but slender, lateral margins slightly curved.

Alternate arrangement into major and minor series absent or obscure; occasionally in certain parts of the posterior field of a few scales 3 major and 3 minor series may be recognised; spines all homogeneous, more or less of the same length, regular reduction in length anteriorly and laterally more or less absent. About 40 - 60 spines project for about half their length beyond the posterior margin. In cycloid scales the posterior field is ornamented with a moderate number of moderately-spaced, rather discontinuous circuli. Posterior margin evenly convex and smooth.  
Adjacent to the l.l.

Lateral margin adjacent to the lateral line somewhat flattened and nearly straight.

Lateral line.

Similar to non-lateral line scales, but a little smaller. Muciferous canal bifurcate, Y) or T-shaped; basal limb (i.e. the anterior limb ) of canal medianly symmetrical; forking takes place at the median anterior part of the posterior field and the two lateral limbs run obliquely towards the lateral extremities of the posterior field where they cut the posterior margin; canal rather wide and of even width throughout; spines persistent except where canal cuts posterior field; posterior margin of scale concave, maximum concavity median.

Blind side - independent of the l.l.

Similar in all respects to ocular side cycloid scales. There are no signs of annuli.

Subfamily B. BOTHINAE.

Characters as given in the synopsis on page 35 . Six genera found in South African waters.

Key to the South African Genera.

- I. Dentition more or less developed on both sides of jaws; mouth a little protractile.



(iv). ARNOGLOSSUS.

- Arnoglossus, Bleeker, 1862, Versl. Akad. Wet. Amsterd., xiii, p. 427; Günther 1862, Cat. Fish Brit. Mus., iv, p. 415; Barnard, 1925, Ann. S. Afr. Mus., xxi, p. 391; Norman, 1931, Ann. Mag. Nat. Hist., (10) viii, p. 599; Chabanaud, 1931, Les Poiss. Pleuron. de la Méditerran. (Reviere Scientifique, Memoire II), p. 18; Chabanaud, 1933, Mem. Soc. Sci. Natur. du Maroc, xxxv, p. 28; Norman, 1934, Monogr. Flatf. (Heterosomata), i, p. 173.
- Boscanius, Schiödt, 1868, Natur. Tidsskrift, (3) v, p. 275.
- Anticitharus, Günther, 1880, Shore Fishes "Challenger", p. 47.
- Charybdia, Facciola, 1885, Nat. Sicil., iv, p. 265.
- Caulopsetta, Gill, 1893, Mem. Nat. Acad. Sci. Washington, vi, p. 124.
- Kyleia, Chabanaud, 1931, Bull. Soc. Zool. Fr., lvi, p. 393; Chabanaud, 1933, Mem. Soc. Sci. Natur. du Maroc, xxxv, p. 49.
- Dollfusina, Chabanaud, 1933, Mem. Soc. Sci. Natur. du Maroc, xxxv, pp. 31, 44.

Body ovate or rather elongate, compressed. Eyes on the left side, separated by a bony ridge or narrow concave space, the inter-orbital region similar in both sexes. No rostral or orbital spines. Olfactory laminae few or in moderate number, arranged transversely to or radiating from a central rachis of varying length. Mouth of moderate size or rather small, the length of the maxillary 2 to  $3\frac{1}{2}$  in that of head; jaws and dentition about equally developed on both sides; teeth small or of moderate size, slender, sharply pointed, sometimes enlarged and canine-like anteriorly, uniserial in both jaws; vomer toothless. Gill-rakers comparatively few in number, generally rather slender and of moderate length; lower pharyngeals each with a single series of sharply-pointed teeth. Dorsal fin commencing above nostrils of blind side and well in front of eye; all the rays simple, generally scaled (at least on ocular side). Tip of first interhaemal spine not projecting in front of anal fin. Pectoral fins unequal, that of ocular side larger; all the rays simple. Tip of pelvic bone projecting downwards and backwards between the pelvic fins. Scales small or of moderate size, feebly ctenoid or cycloid on ocular side, generally cycloid on blind side; no supplementary scales. Lateral line developed only on ocular side of body, with a distinct curve above the pectoral fin; no supratemporal branch. Vent on blind side above anterior ray of anal fin.

Represented by three species in South African waters.

Key to the South African Species.

- a. Eyes separated by a concave scaled space; anterior rays of dorsal fin somewhat prolonged in both sexes . . . . .  
 . . . . . 5. capensis.
- b. Eyes separated by a bony ridge; none of the anterior rays of the dorsal fin prolonged.
- (i) Dorsal 99; anal 77; about 70 scales in lateral line  
 . . . . . 6. dalglishi.
- (ii) Dorsal 106; anal 84; about 110 scales in lateral line.  
 . . . . . 7. microphthalmus.

5. ARNOGLOSSUS CAPENSIS, Boulenger.  
 (Cape Scald-fish).

Arnoglossus capensis, Boulenger, 1898, Mar., Invest. S. Afr., i, p. 1; Gilchrist, 1902, Mar. Invest. S. Afr., i, p. 145; Gilchrist, 1904, Mar. Invest. S. Afr., iii, p. 133, pl. v. fig. 36; Lampe, 1913, Denkschr. med.-naturw. Ges. Jena, xvii, p. 156; Gilchrist, 1916; Mar. Biol. Rep. S. Afr., iii, p. 16, fig. 12; Thompson, 1918, Mar. Biol. Rep. S. Afr., iv, p. 125; Von Bonde, 1922, Rep. Fish. Mar. Biol. Surv. S. Afr., ii, (1921), Spec. Rep., i, p. 6; Barnard, 1925, Ann. S. Afr., Mus., xxi, p. 391; Norman, 1934, Monogr. Flatf. (Heterosomata), i, p. 183, fig. 129.

TEXT-FIG. 7.

D. 96-100; A. 76-80; P. 11-12; L. 1.62-66.

Depth of body  $2\frac{1}{4}$  to  $2\frac{2}{5}$  in the length, length of head  $3\frac{2}{5}$  to  $4\frac{1}{2}$ . Snout shorter than eye, diameter of which is  $3\frac{1}{3}$  to 4 in length of head; eyes separated by a concave scaled space, its width  $2\frac{1}{2}$  to  $3\frac{1}{3}$  in diameter of eye; lower eye a little in advance of upper. Maxillary extending to below anterior edge of anterior part of eye, length 3 to  $3\frac{1}{4}$  in that of head; lower jaw  $1\frac{5}{6}$  to  $2\frac{1}{3}$  in head. Teeth all small, scarcely enlarged anteriorly. 10 to 13 gill-rakers of moderate length on lower part of anterior arch. Scales feebly ctenoid on ocular side, mostly cycloid on blind side. Anterior rays of dorsal more or less free from membrane and somewhat prolonged in both sexes, highest ray  $1\frac{3}{5}$  (male) or more than twice (female) in head. Pectoral of ocular side  $\frac{2}{3}$  to  $\frac{3}{4}$  in length of head. Caudal rounded. Brownish, with traces of darker markings; a series of indistinct dark spots on dorsal and anal fins. Blind side whitish.

Length: Up to 180 mm.

Distribution: False Bay to East London, 20 -60 fathoms.

Occasionally found on the West side of the Cape Peninsula.

Lepidology. (Plate III, figs. 9, 10.)

Scales weakly ctenoid on ocular side, mostly cycloid on blind side (rarely an isolated, very feebly ctenoid scale may be found on blind side), of moderate size, very deciduous, thin, more or less regular in arrangement; 62 - 66 scales in the lateral line.

Ocular side - independent of the l.l.

Elongate pentagonal, posterior margin has a median apex, apical angle  $120^{\circ}$  or more, and thus forms two sides of the rough pentagon, lateral margins straight or nearly so, anterior margin in general convex but irregularly undulate, anterior angles rounded but obvious, nearly  $90^{\circ}$ . Anterior margin very finely scalloped, scallops very numerous, 40 - 45; anterior length 90 - 92% of the total length, anterior breadth 48 - 52% of the anterior length, posterior breadth 115-120% of the anterior breadth. Scales mostly broader posteriorly than anteriorly. Focus small but well-defined, circular, very posterior in position, close to apex of posterior margin, about  $1/9$ th of total length from posterior margin. Anterior field very large, radii practically parallel medianly and slightly divergent laterally; the central parallel radii are long and mostly run from the anterior margin to end near the focus, whereas the lateral diverging radii are short and end against the outermost radii of the central parallel series, approaching these at acute angles. All the radii continuous, nearly straight, or slightly undulate, well-defined, smooth, fine, close-set, rather numerous increasing in number from 12 - 15 near the focus to about 40-45 at the anterior margin. Interradial circuli moderately close-set, entire, slightly curved towards the posterior aspect of the scale. Lateral fields moderate in size, more or less triangular, covered with a mosaic-like ornamentation due to interconnected close-set circuli. Posterior field very small, in the form of a very narrow marginal band, along which is placed a single

marginal series of 30 - 40 short (5% of total length of scale), slender, narrow-based, sharp-pointed spines. The posterior margin is incised between adjacent spines which project for about 1/3rd. their length beyond the posterior margin.

Adjacent to the l.l.

Lateral margin adjacent to the lateral line usually slightly concave.

Lateral line.

Quadrangular, nearly as wide as long. Muciferous canal medianly symmetrical, short, very wide. Spines persistent except where canal cuts posterior margin.

Blind side- independent of the l.l.

Broadly oval, broadly pentagonal or sub-circular, anterior angles much rounded, anterior margin usually as in ocular side scales but occasionally having a rather flat median apex, posterior margin evenly convex, smooth, lateral margins slightly convex. Focus sub-central in position, in conformity with this position the anterior, lateral and posterior fields are more or less of equal size. Anterior and lateral fields ornamented as in ocular side scales. Posterior field ornamented with a mosaic-like pattern in the same manner as the lateral fields of ocular side scales. The mosaic-like pattern of the lateral and posterior fields of blind side scales is more obvious than that found in the lateral fields of ocular side scales.

There are no signs of annuli.

6. ARNOGLOSSUS DALGLEISHI (Von Bonde).  
(Dalgleish's Flounder).

Trichopsetta dalgleishi, Von Bonde, 1922, Rep. Fish. Mar. Biol. Surv. S. Afr., ii, (1921), Spec. Rep., i, p. 6, pl. i, fig. 1; Barnard, 1925, Ann. S. Afr. Mus., xxi, p. 391.

Arnoglossus dalgleishi, Norman, 1934, Monogr. Flatf. (Heterosomata), 1, p. 193, fig. 141.

TEXT-FIG. 8.

D. 99; A. 77; P. 14; L. l. ca. 70.

Depth of body  $2\frac{1}{2}$  in the length, length of head nearly 4. Upper profile of head only moderately concave above and behind eyes. Snout about as long as eye, diameter of which is a little more than 4 in length of head; eyes separated by a sharp ridge, the lower very little in advance of upper. Maxillary extending to below posterior half of eye, length about twice in head; lower jaw  $1\frac{2}{3}$  in head. Teeth of upper jaw small and rather closely set laterally, some curved canines anteriorly; lateral teeth of lower jaw stronger and wider apart than those of upper, somewhat enlarged anteriorly.

Nine rather slender, pointed gill-rakers on lower part of anterior arch. Scales feebly ctenoid on ocular side, apparently cycloid on blind side. None of rays of dorsal fin prolonged. Pectoral of ocular side more than  $\frac{1}{2}$  length of head. Caudal rounded Greyish; dorsal and anal each with a number of dark blotches; first two rays of dorsal black. Blind side whitish.

Length: Up to 155 mm.

Distribution: Natal Coast 29 fathoms.

Lepidology. (Plate III, figs. 11, 12).

The paratype in the British Museum is the only specimen available, as the type specimen originally included in the Fisheries Survey Division Collection has been lost. Only a few lateral line scales from the ocular side of the British Museum specimen were available and procured for examination. Scales feebly ctenoid on ocular side, apparently cycloid on blind side, of moderate size, rather deciduous, more or less regular in arrangement; about 70 scales in the lateral line.

Ocular side- lateral line.

Subtrapezoidal, anterior angles widely rounded, anterior margin in general convex but irregularly undulate, finely scalloped scallops very numerous, 50 - 55, lateral margins slightly convex, posterior angles well-defined, nearly  $90^\circ$ , posterior margin slightly concave from the posterior angles towards the median section, where it suddenly falls away into a U-shaped indentation, which is moderately deep, 10% of total length of scale, and wide, 10% of posterior breadth of scale, narrowing

slightly and evenly towards its anterior end. Scales wider anteriorly than posteriorly, maximum breadth of scale along line joining anterior angles, maximum breadth 84 - 88% of total length. Focus fairly large, nearly covered by muciferous canal of scale which runs through it and ends a distance of less than  $\frac{1}{2}$  total length of scale from anterior margin. Anterior field very large, radii very slightly divergent or subparallel in a small median section of the field, more markedly but not widely divergent laterally, degree of divergence tending to increase as the lateral margins are approached. Radii close-set, well defined, straight or slightly curved towards the lateral margins, undulating slightly, rather numerous, increasing in number from about 25 - 28 near the focus to about 55-60 at the anterior margin. Interradial circuli close-set, entire, slightly curved towards the posterior aspect of the scale. Lateral fields of moderate size, circuli close-set, no mosaic-like pattern. Posterior field small, anterior boundary along lines running from posterior angles to base of U-shaped indentation in posterior margin. Of all the scales available and examined, only one shows a remnant of spiny ctenoid elements. From the position of this remnant, which is nearly completely detached from the posterior margin of the scale, the ctenoid elements in scales of this species take the form of a single series of marginally projecting, short, slender, sharp-pointed, narrow-based spines, similar in most respects to those found in ocular side scales of Arnoglossus capensis. Only the tips of the spines project beyond the posterior margin. The muciferous canal is wider posteriorly than anteriorly, symmetrical running along the postero-anterior median axis of the scale.

There are no signs of annuli.

#### 7. ARNOGLOSSUS MICROPHthalmus. (Von Bonde).

Laeops microphthalmus, Von Bonde, 1922, Rep. Fish. Mar. Biol. Surv. S. Afr., ii, (1921), Spec. Rep., i, p. 11, pl. iv, fig. 1; Barnard, 1925, Ann. S. Afr. Mus., xxi, p. 392.  
Arnoglossus microphthalmus, Norman, 1931, Ann. Mag. Nat. Hist., (10) viii, p. 508; Norman, 1934, Monogr. Flatf. (Heterosomata), i, p. 197, fig. 145.

D.106; A.84; P.14; L.l.ca. 110.

Depth of body  $2\frac{2}{3}$ , in the length, length of head  $4\frac{3}{5}$ . Upper profile of head markedly concave above and behind eyes. Snout as long as eye, diameter of which is about  $4\frac{3}{4}$  in length of head; eyes separated by a low ridge, the lower a very little in advance of upper. Maxillary extending to below anterior part of eye, length nearly  $2\frac{1}{2}$  in that of head; lower jaw nearly twice in head. Teeth of upper jaw small and rather close-set laterally, some enlarged canines anteriorly; lateral teeth of lower jaw stronger and wider apart than those of upper. 8 or 9 rather short, pointed gill-rakers on lower part of anterior arch. Scales cycloid on both sides of the body. Width of curve of lateral line  $2\frac{4}{5}$  in length of head. None of rays of dorsal fin prolonged. Pectoral of ocular side  $\frac{1}{2}$  length of head. Caudal rounded. Pale brownish; median fins darker. Blind side whitish.

Length: Up to 135 mm.

Distribution: Natal Coast, 150 fathoms.

Lepidology. (Plate IV, fig. 13).

Only a few ocular side scales from the type specimen in the British Museum were available and procured for examination.

Scales cycloid on both sides of the body, rather small, somewhat deciduous, more or less regular in arrangement; about 110 scales in the lateral line.

Ocular side.

Oval or subcircular, anterior angles widely rounded, anterior margin evenly convex, very faintly scalloped, almost smooth, scallops fairly numerous, 25 - 30, lateral margins convex to a greater or less degree, posterior margin evenly convex, smooth. Anterior length (measured from anterior margin along median axis to centre of focus) 50 - 54% of total length, maximum breadth 68 - 72% of the total length; scales broader posteriorly than anteriorly, maximum breadth along line passing a little posterior of posterior margin of focus. Focus relatively large, oval, central (in subcircular scales) or subcentral (in oval scales) in position,

surrounded by a number, 3 - 5, rather widely-spaced, continuous, well-defined circuli. Anterior field of moderate size, radii slightly divergent from focus, slightly undulating, rather faint near focus becoming better defined as the anterior margin is approached, close-set, fairly numerous, increasing in number from about 10 - 14 near the focus to about 28 - 34 at the anterior margin; interradi al circuli fairly close-set (except the few near the focus), entire, slightly curved towards the posterior aspect of the scale. Lateral fields of moderate size, circuli close-set towards the lateral margins, rather widely-spaced towards the focus. Posterior field of moderate size, ornamented with circuli which are widely-spaced and continuous towards the focus but closely-set and rather discontinuous towards the posterior margin.

There are no signs of true annuli, but in the anterior field the interradi al circuli tend to be more closely-set in certain zones, which alternate with zones in which the spacing of the circuli is somewhat greater.

(v) ENGYPROSOPON.

Engyprosopon, Günther, 1862, Cat. Fish. Brit. Mus., iv, p. 431; Norman, 1934, Monogr. Flatf. (Heterosomata), i, p. 203.  
Scaeops, Jordan & Starks, 1904, Bull. U.S. Comm. Fish., xxii, (1902), p. 627; Jordan & Starks, 1906, Proc. U.S. Nat. Mus., xxxi, p. 168; Barnard, 1925, Ann. S. Afr. Mus., xxi, p. 387.

Body ovate or rather deep, strongly compressed. Eyes on the left side, separated by a flat or concave space of varying width, which is generally broader in the male; eyes sometimes separated by a bony ridge in young. Male usually with one or more spines on the snout and on the orbital margins. Olfactory laminae as in Arnoglossus. Mouth rather small, the length of the maxillary  $2\frac{1}{5}$  to  $3\frac{1}{2}$  in that of head; jaws and dentition about equally developed on both sides, teeth small, sometimes uniserial, but generally with an outer series of larger teeth anteriorly in upper jaw, no distinct canines; vomer toothless. Gill-opening extending upwards to lateral line or ending a short distance

above pectoral fin, in which case the scaling of the head and body is continuous below lateral line; gill-rakers comparatively few in number, short or of moderate length. Dorsal fin commencing above or a little in advance of nostrils of blind side, and well in front of eye; all the rays simple, scaled (at least on ocular side). Tip of first interhaemal spine not projecting in front of anal fin. Pectoral fins unequal, that of ocular side larger, all the rays simple; upper ray sometimes prolonged in the mature male. Tip of pelvic bone projecting downwards and backwards between pelvic fins. Scales of moderate size or rather large, somewhat feebly ctenoid on ocular side, cycloid on blind side; no supplementary scales. Lateral line developed only on ocular side of body, with a distinct curve above the pectoral fin; no supratemporal branch. Vent on blind side, above first ray of anal fin.

Represented by two species in South African seas.

Key to the South African Species.

- a. Caudal fin with a pair of large, dark spots . . . . .  
 . . . . . 8. grandisquama.
- b. Caudal fin without large dark spots . . . . .  
 . . . . . 9. natalensis.

8. ENGYPROSOPON GRANDISQUAMA (Temminck & Schlegel.)

- Rhombus grandisquama, Temminck & Schlegel, 1846, Faun. Japon. (Pisces), p. 183, pl. xcii, figs. 3, 4.  
Rhombus poecilurus, Bleeker, 1852, Nat. Tijdschr. Ned. Ind., iii, p. 293; Bleeker, 1852, Verh. Batav. Gen., xxiv, Pleuron., p. 29.  
Rhomboidichthys grandisquama (part), Günther, 1862, Cat. Fish. Brit. Mus., iv, p. 437.  
Pseudorhombus poecilurus, Bleeker, 1865, Ned. Tijdschr. Dierk., ii, p. 274.  
Platophrys (Arnoglossus) poecilurus, Bleeker, 1866-72, Atl. Ichth., vi, p. 13, Pleuron., pl. v, fig. 1.  
Rhomboidichthys spilurus, Günther, 1880, Shore Fishes "Challenger", pp. 47, 53, pl. xvi, fig. A.  
Rhomboidichthys spiniceps, Macleay, 1882, Proc. Linn. Soc. N.S.W., vi, p. 127; Ogilby, 1887, Cat. Fish. N.S.W., p. 32.  
Rhomboidichthys poecilurus, Regan, 1902, in Gardiner, Faun. Maldive Laccadive. Arch., i, p. 277; Regan, 1905, J. Bombay Nat. Hist. Soc., xvi, p. 332.  
Arnoglossus spilurus, Johnstone, 1904, Ceylon Pearl Oyster Fish., Suppl. Rep., xv, p. 211.

Scaeops grandisquama, Jordan & Starks, 1904, Bull. U.S. Comm. Fish.,  
 xxii, (1902), p. 627, pl. viii, fig. 2; Jordan & Starks, 1906,  
 Proc. U.S. Nat. Mus., xxxi, p. 168, fig. 1.; Fowler and Bean, 1922,  
 Proc. U.S. Nat. Mus., lxi(2), p. 67; Von Bonde, 1922, Rep. Fish. Mar.  
 Biol. Surv. S. Afr., ii, (1921), Spec. Rep., i, p. 6; Von Bonde, 1925,  
 Trans. Roy. Soc. S. Afr., xii, p. 287; Bernard, 1925, Ann. S. Afr. Mus.,  
 xxi, p. 387.

Scaeops poecilurus, Jordan & Starks, 1905, Proc. U.S. Nat. Mus., xxviii,  
 p. 803; Regan, 1908, Trans. Linn. Soc. London, Zool., xii, p. 233;  
 Weber, 1913, "Siboga" - Exped., Fische, p. 429; Fowler, 1928,  
 Mem. B.P. Bishop Mus., x, p. 92.

Scaeops spilura, Jordan & Seale, 1906, Bull. U.S. Bur. Fish., xxv, (1905),  
 p. 412; Fowler, 1928, Mem. B.P. Bishop Mus., x, p. 92.

Scaeops orbicularis, Jordan & Seale, 1907, Bull. U.S. Bur. Fish.,  
 xxvi, (1906), p. 45; Jordan & Richardson, 1909, Mem. Carnegie Mus.,  
 iv, p. 201; Oshima, 1927, Japan. J. Zool. Tokyo, Trans. Abstr., i(5), p.  
 179; Wu, 1932, Thés. Facult. Sci. Univ. Paris, A. 244(268), p. 91.

Rhomboidichthys valderostratus, Jenkins, 1910, Mem. Ind. Mus., iii, p. 26.

Platophrys grandisquama, Gilchrist & Thompson, 1917, Ann. Durban Mus.,  
 i, p. 400.

Platophrys spiniceps, McCulloch, 1921, Aust. Zool., ii, p. 46.

Engyprosoon (Scaeops) grandisquama, McCulloch & Whitley, 1925, Rec.  
 Aust. Mus., xiv, p. 343, fig. 1.

Engyprosoon grandisquama, Norman, 1926, Biol. Res. "Endeavour", v,  
 p. 250; Norman, 1927, Rec. Ind. Mus., xxix, p. 25, fig. 5; McCulloch,  
 1929, Mem. Aust. Mus., v, p. 276; Norman, 1934, Monogr. Flatf. (Heterosoma  
 ta), i, p. 209, fig. 156; Fowler, 1934, Proc. Acad. Nat. Sci. Philad.,  
 lxxxvi, p. 434.

Bothus (Arnoglossus) poecilurus, Weber and De Beaufort, 1929, Fish.  
 Indo-Austral. Arch., v, p. 131, fig. 31.

TEXT-FIG. 10.

D.79-89; A.59-68; P.10-12; L.1.36-45.

Depth of body  $1\frac{2}{3}$  to  $2\frac{1}{8}$  in the length, length of head  $3\frac{3}{5}$   
 to  $4\frac{1}{5}$ . Snout shorter than eye, diameter of which is  $2\frac{2}{3}$  to nearly  
 4 in length of head; interorbital space concave, width  $\frac{2}{3}$  to  $1\frac{3}{4}$   
 times (male) or  $\frac{1}{3}$  to  $\frac{7}{8}$  (female) diameter of eye; anterior edge  
 of upper eye above middle or posterior part of lower. Rostral and  
 orbital spines present in the male, very small or absent in female.  
 Maxillary extending to, nearly to, or beyond anterior edge of eye,  
 length 3 to  $3\frac{1}{2}$  in that of head. Teeth of upper jaw biserial  
 anteriorly (at least in adults), uniserial laterally; those of  
 lower jaw uniserial, sometimes in two rows posteriorly. 5 to 7  
 short gill-rakers on lower part of anterior arch. Pectoral of  
 ocular side equal to or less than length of head, the upper ray  
 sometimes a little prolonged in the male. Brownish, generally  
 with some darker spots and other markings; median fins usually

fields relatively small, roughly triangular, covered with a faint mosaic-like ornamentation due to interconnected close-set circuli. Posterior field very small, in the form of a very narrow marginal band along which is placed a single marginal series of 40 - 50 short (4% of total length of scale), slender, narrow-based, sharp-pointed spines. Posterior margin incised between adjacent spines, which project for about  $\frac{1}{2}$  their length beyond the posterior margin.  
Adjacent to the l.l.

Similar in all respects to scales away from the lateral line, except that the lateral margin adjacent to the lateral line is usually quite definitely concave.

Lateral line.

Semicircular or semi-ovoid, anterior and lateral margins form the major arc of a circle with the posterior margin as a flat base. Scale broader than long, maximum breadth 112-116% of total length. Muciferous canal unsymmetrical - in a correctly orientated scale the canal starts from adjacent to the ventral posterior angle and runs very obliquely, making an acute angle with the posterior margin, towards the dorsal lateral field and margin. Canal of about equal width throughout its length, moderately wide. That part of the posterior margin interrupted by the canal is devoid of spines, the remaining portion has a single marginal series identical to that found in other ocular side scales.

Blind side - independent of the l.l.

Broadly oval or sub-circular, anterior angles very widely rounded, anterior margin markedly convex, lateral margins moderately convex, posterior margin markedly convex but the arc is wider than that of the anterior margin; maximum breadth 75 - 80% of total length of scale. Focus small but well-defined, circular, subcentral in position. Anterior and lateral fields with ornamentations identical to those found in ocular side scales. The mosaic-like pattern of the lateral fields more marked than in ocular side scales. Posterior field of moderate size, roughly triangular, posterior margin smooth, ornamented with moderately-

spaced, interconnected, well-defined circuli, thus producing a very well-marked mosaic-like pattern over the whole field.

There are no signs of true annuli, but the majority of the scales, both ocular and blind sides, show a single well-marked break in the continuity of growth. The break is usually most distinct in the lateral fields of ocular side scales and in the lateral and posterior fields of blind side scales; takes the form of either a very narrow band of rather irregular and discontinuous circuli, or a line of growth-arrest with a small amount of absorption; always placed nearer to periphery of scale than to focus.

#### 9. ENGYPROSOPON NATALENSIS, Regan.

Engyprosopon natalensis, Regan, 1920, Ann. Durban Mus., i, p. 211; Von Bonde, 1922, Rep. Fish. Mar. Biol. Surv. S. Afr., ii, (1921), Spec. Rep., i, p. 6; Von Bonde, 1925, Trans. Roy. Soc. S. Afr., xii, p. 288; Norman, 1934, Monogr. Flatf. (Heterosomata), i, p. 213, fig. 161.

#### TEXT-FIG. 11.

D. 85; A. 64; P. 11; L. 1.40.

Close to E. latifrons, also from the Indian Ocean. Depth of body twice in length, length of head  $3\frac{3}{4}$ . Diameter of eye  $3\frac{1}{5}$  to  $3\frac{1}{2}$  in length of head, twice (male) or 3 times (female) inter-orbital width; anterior edge of upper eye above anterior part of lower. Rostral spine present in the male. Maxillary extending to below anterior  $\frac{1}{3}$  of eye, length  $2\frac{3}{5}$  to  $2\frac{2}{3}$  in that of head. 6 gill-rakers on lower part of anterior arch. Pectoral of ocular side  $\frac{3}{5}$  length of head; upper ray scarcely prolonged in male. Brown, traces of small dark spots on the fins. Blind side whitish.

Length: Up to 76 mm.

Distribution: Natal Coast, 26 - 27 fathoms.

Lepidology. (Plate IV, figs. 16, 17.)

Scales rather feebly ctenoid on ocular side, cycloid on blind side, moderate to large in size, a little larger on the blind side than on the ocular side, somewhat deciduous, regular in arrangement 40 scales in the lateral line.

Ocular side - independent of the l.l.

Elongate pentagonal, posterior margin with a median apex, apical angle more than  $120^{\circ}$ , anterior angles rounded but distinct, nearly  $90^{\circ}$ , anterior margin in general convex but undulate, very finely scalloped, scallops not very well-defined, very numerous, 40 - 50, lateral margins slightly convex, undulose; anterior length 80 - 85% of total length, anterior breadth 48 - 52% of anterior length, posterior breadth 110-116% of anterior breadth. Scales usually a little broader posteriorly than anteriorly. Focus small but well-defined, circular, very posterior in position, occupying the apical angle, about 1/10th of total length of scale from posterior margin. Anterior field very large and wide, radii parallel practically throughout the field, about 6 - 8 of the most lateral ones on both sides of the field divergent to a small extent, only the median 6 - 8 radii are long and stretch from near the focus to the anterior margin, others on both sides of this median group successively shorter as the lateral margins are approached, lateral groups of divergent radii very short, ending against outermost radii of parallel series at acute angles. All radii continuous, nearly straight or slightly undulate, well-defined, smooth, fine, very close-set, very numerous, 6 - 8 near the focus increasing to 40 - 50 at the anterior margin; interradii circuli very close-set, entire, straight. Lateral fields relatively small, roughly triangular, covered with a faint mosaic-like ornamentation due to interconnected close-set circuli. Posterior field very small, in the form of a very narrow marginal band along which is placed a single marginal series of 25 - 30 short (6 - 8% of total length of scale), slender, narrow-based, sharp-pointed spines. Posterior margin incised between adjacent spines, which project for about half their length beyond the posterior margin.

Adjacent to the l.l.

Similar to scales away from the lateral line. Lateral margin

adjacent to the lateral line concave.

Lateral Line.

Semi-ovoid or semi-circular, anterior and lateral margins form the major arc of a circle with the posterior margin as a flat base. Scale often broader than long, maximum breadth 95-104% of total length. Muciferous canal medianly symmetrical, rather short and of even width, narrow. Spines of posterior field persistent to greater or less degree, absent where canal cuts posterior margin.

Blind side - independent of the l.l.

Broadly oval, anterior angles widely rounded, anterior margin markedly convex, lateral margins moderately convex, posterior margin markedly convex but the arc is wider than that of the anterior margin; maximum breadth 65-70% of total length of scale. Focus of moderate size, well-defined, circular, posterior in position, about  $\frac{1}{3}$  of total length of scale from posterior margin, not a clear area, ornamented with very convoluted lines forming a mosaic-like pattern. Posterior field of moderate size, triangular, posterior margin smooth, ornamented with very close-set circuli. Anterior and lateral fields ornamented as in ocular side scales.

There are no signs of true annuli, but both ocular and blind side scales show a single line of growth-arrest near the periphery of the scale, similar to that found in E.grandisquama.

(vi). CROSSORHOMBUS.

Crossorhombus, Regan, 1920, Ann.Durban Mus., i, p.211; Barnard, 1925, Ann.S.Afr.Mus., xxi, p.385; Norman, 1934, Monogr.Flatf. (Heterosomata), i, p.217.

Close to Enzyprosoxon, but mouth smaller, the length of the maxillary  $3\frac{3}{5}$  to nearly 4 in that of head; teeth uniserial in both jaws. Upper angle of gill-opening a short distance above pectoral fin; scaling of head and body continuous below lateral line; gill-rakers short, few in number. Scales of moderate size,

strongly ctenoid on ocular side, feebly ctenoid or cycloid on blind side.

Represented by one species in South African seas.

10. CROSSORHOMBUS VALDE-ROSTRATUS (Alcock).  
(Broad-forehead Flounder.)

- Rhomboidichthys valde-rostratus, Alcock, 1820, Ann. Mag. Nat. Hist. (6)vi, p.435; Alcock, 1898, Illust. Zool. "Investigator", Fishes, pl.xxiv, fig.2.
- Platophrys dimorphus, Gilchrist, 1905, Mar. Invest. S. Afr., iii, p.10, pl.xxvii; Gilchrist & Thompson, 1917, Ann. Durban Mus., i, p.400.
- Scaeops kobensis, Jordan & Starks, 1906, Proc. U.S. Nat. Mus., xxxi, p.170, fig.2; Franz, 1910, Abh. Bayer. Akad. Wiss., Suppl. iv, Abh. i, p.61, pl.vii, fig.55, pl.viii, fig.61; Jordan & Thompson, 1914, Mem. Carnegie Mus., vi, p.308, fig.80.
- Platophrys grandisquama (Part), Gilchrist, 1908, Mar. Invest. S. Afr., iv, p.161.
- Engyproson kobensis, Hubbs, 1915, Proc. U.S. Nat. Mus., xlviii, p.458.
- Crossorhombus dimorphus, Regan, 1920, Ann. Durban Mus., ii, p.212; Von Bonde, 1922, Rep. Fish. Mar. Biol. Surv. S. Afr., ii, (1921), Spec. Rep., i, p.6; Von Bonde, 1925, Trans. Roy. Soc. S. Afr., xii, p.287; Barnard, 1925, Ann. S. Afr. Mus., xxi, p.386.
- Crossorhombus valde-rostratus, Norman, 1927, Rec. Ind. Mus., xxix, p.28, fig.6; Norman, 1934, Monogr. Flatf. (Heterosomata), i, p.217, fig.166; Fowler, 1934, Proc. Acad. Nat. Sci. Philad., lxxxvi, p.434.

TEXT-FIG. 12.

D.79-89; A.(61) 63-74; P.10-11; L.1.48-61.

Depth of body  $1\frac{4}{5}$  to twice in the length, length of head  $3\frac{2}{3}$  to a little more than 4. Snout shorter than eye, diameter of which is  $3\frac{1}{3}$  to  $3\frac{3}{5}$  in length of head; each eye with a broad membranous flap in the male; interorbital width  $1\frac{1}{3}$  to  $1\frac{2}{5}$  times (male) or  $\frac{3}{5}$  to  $1\frac{1}{6}$  times (female) diameter of eye; anterior edge of upper eye above middle or posterior part of lower. Male with a strong spine on the snout and some smaller spines on orbital margins. Maxillary extending to below anterior edge of eye, length  $3\frac{2}{3}$  to nearly 4 in that of head. 5 to 7 gill-rakers on lower part of anterior arch. Pectoral of ocular side with upper ray prolonged and filamentous in the mature male; length  $1\frac{1}{4}$  to  $1\frac{3}{4}$  times (male) or  $\frac{3}{4}$  to  $\frac{7}{8}$  (female) that of head. Greyish brown, with darker spots and blotches of which a row near upper and lower edges of body and 2 or 3 larger ones on lateral line are

usually more prominent; male sometimes with small dark or bluish spots on head in front of interorbital space; median fins spotted with darker; hinder part of caudal with a broad blackish band. Blind side whitish.

Length: Up to 155 mm.

Distribution: Natal and Zululand Coasts, 3 - 30 fathoms, Delagoa Bay.

Lepidology. (Plate V, figs. 18, 19).

Scales strongly ctenoid ("ciliate") on ocular side, cycloid on blind side, moderate to large in size, slightly deciduous, regular in arrangement; 48 - 61 scales in the lateral line.

Ocular side - independent of the l.l.

Ovoid-pentagonal, a little longer than broad, posterior margin with a median rounded apex, apical angle more than  $120^{\circ}$ , anterior angles widely rounded, anterior margin in general markedly convex but prominently undulate, minutely scalloped, scallops very numerous, 50 - 60, lateral margins moderately convex; anterior length 55 - 60% of total length, anterior breadth 75 - 80% of anterior length, posterior breadth 130 - 135% of anterior breadth. Scales broader posteriorly than anteriorly, broadest part of scale along line joining posterior angles. Focus small but well-defined, circular, very posterior in position, occupying the apical angle, about  $1/12$ th of total length of scale from posterior margin. Anterior field fairly large, radii parallel or subparallel for the most part, at both lateral borders of the field a few radii, 6 - 8, diverge slightly, only the median 8 - 10 are long and stretch from near the focus to the anterior margin, others on both sides of this median group successively shorter as the lateral margins are approached, lateral groups of divergent radii short, ending against outermost radii of parallel series at acute angles. Radii for the most part continuous.

occasionally interrupted, branched to a limited extent, especially in the lateral divergent groups, straight or very slightly curved towards the lateral margins, slightly undulate, well-defined, smooth, fine, very close-set, very numerous, increasing in number from about 8 - 10 near the focus to about 50 - 60 at the anterior margin. Interradial circuli very close-set, entire straight or very slightly curved towards the anterior margin. Lateral fields of moderate size, roughly triangular, covered with a quite definite mosaic-like ornamentation due to interconnected, close-set circuli. Posterior field very small, in the form of a narrow marginal band along which is placed a single marginal series of about 40 very close-set, narrow-based, sharp-pointed, slender and tapering, very long (25% of total length of scale), almost filamentous spines, which project for practically their entire length beyond the posterior margin.

Adjacent to the l.l.

Similar in all respects to scales away from the lateral line except that the lateral margin adjacent to the lateral line is flattened and straight.

Lateral line.

Semi-ovoid, posterior margin forming a flat base. Muciferous canal medianly symmetrical, short. Spines persistent along posterior margin, except where canal cuts it. Spines much shorter than those on scales away from the lateral line.

Blind side - independent of the l.l.

Broadly oval or subcircular, anterior angles widely rounded, anterior margin convex in general but slightly undulate, minutely scalloped, scallops very numerous, 55 - 65, lateral margins convex, posterior margin convex and smooth. Focus small but well-defined, circular, subcentral in position. Ornamentation of anterior and lateral fields similar to that found in ocular side scales, mosaic-like pattern of lateral

fields more marked than in ocular side scales, posterior field of moderate size, roughly triangular, ornamented with a rather faint, mosaic-like pattern due to a few rather irregular, discontinuous, interconnected circuli. Maximum breadth of scale 68-76% of total length.

There are no signs of annuli.

I am unable to find a single blind side scale showing any evidences of even "weakly ciliate" character (vide Regan).

(vii). BOTHUS.

Bothus, Rafinesque, 1810, Car. n. gen., p. 23; Bonaparte, 1833, Icon. Faun. Ital., fasc. iv, (24); Bonaparte, 1846, Cat. Metod. Pesci Europ., p. 49; Kyle, 1913, Rep. Danish Ocean. Exped. 1908-1910, ii, A. 1, p. 94; Barnard, 1925, Ann. S. Afr. Mus., xxi, p. 385; Norman, 1934, Monogr. Flatf. (Heterosomata), i, p. 220.

Solea, (non Quensel, 1806), Rafinesque, 1810, Ind. Itt. Sicil., pp. 14, 52.

Platophrys, Swainson, 1839, N. H. Fishes, etc., ii, pp. 187, 302; Jordan & Evermann, 1898, Bull. U. S. Nat. Mus., xlvii (3), p. 2660; Chabanaud, 1931, Les Poiss. Fleuron. de la Mediterr. (Reviere Scientifique, Memoire II), p. 20; Chabanaud, 1933, Mem. Soc. Sci. Natur. du Maroc, xxxv, p. 55.

Rhomboidichthys, Bleeker, 1856, Act. Soc. Sci. Indo-Neerl., i, Manado etc., p. 67.

Psettylis, Alcock, 1890, Ann. Mag. Nat. Hist., (6) vi, p. 436; Johnstone, 1904, Ceylon Pearl Oyster Fish., Suppl. Rep., xv, p. 207.

Platotichthys, Nichols, 1921, Bull. Amer. Mus. Nat. Hist., xlv, p. 21.

Symboulchthys, Chabanaud, 1927, Bull. Soc. Zool. Fr., lxi, p. 76.

Body ovate or rather deep, strongly compressed. Eyes on the left side, separated by a flat or concave space of varying width, sometimes broader in the male; lower eye well in advance of upper. Male generally with spines on the snout and sometimes on the orbital margins. Olfactory laminae rather feebly developed, few in number, slightly radiating or sometimes nearly parallel to one another and to the axis of the body, without central rachis. Mouth of moderate size or rather small, the length of the maxillary  $2\frac{4}{5}$  <sup>to 4</sup> in that of head; jaws and dentition about equally developed on both sides or stronger on blind side; teeth small, pointed, without distinct canines, in two or more series in both jaws, at least anteriorly (except in young); vomer toothless. Upper angle of gill-opening a short distance above pectoral fin, the membrane joining the operculum to the pectoral arch scaleless; gill-rakers

few in number, short or of moderate length; lower pharyngeals very narrow, each with an inner row of rather strong pointed teeth, and generally one or two outer rows of smaller teeth. Dorsal fin commencing above or just in advance of nostrils of blind side and well in front of eye; all the rays simple, scaled (at least on ocular side). Tip of first interhaemal spine not projecting in front of anal fin. Pectoral fins unequal, that of ocular side larger; all the rays simple; upper rays sometimes prolonged. Tip of pelvic bone projecting downwards and backwards between the pelvic fins, sometimes blunt and inconspicuous externally. Scales small, ctenoid or cycloid on ocular side, cycloid on blind side; no supplementary scales. Lateral line developed only on ocular side of body, with a distinct curve above the pectoral fin; a bifurcated supratemporal branch behind upper eye. Vent on blind side, above or a little in front of anterior ray of anal fin. Vertebrae 38 to 40.

Represented by one species in South African waters.

11. BOTHUS PANTHERINUS (Rüppell).  
(Mottled Flounder).

Rhombus pantherinus, Rüppell, 1830-31, in Atlas zu Rüppell, Reise (Senckenb. Nat. Ges.) Fische, p. 121.

Rhombus parvimanus, Bennett, 1832, Proc. Comm. Sci. Zool. Soc., (14), March, p. 168.

Rhombus sumatranus, Bleeker, 1851, Nat. Tijdschr. Ned. Ind., i, p. 409.

Psetta pantherina, Rüppell, 1852, Verzeichn. Samml. Senckenb. Mus., iv, Fische, p. 19.

Pleuronectes lunulatus, Jouan, 1861, Mem. Soc. Cherbourg, viii, p. 256.

Rhomboidichthys pantherinus, Günther, 1862, Cat. Fish. Brit. Mus., iv, p. 436; Playfair and Günther, 1866, Fish. Zanzibar, p. 112; Klunzinger, 1871, Verh. zool.-bot. Ges. Wien, xxi, p. 571; Günther, 1909, Fische Südsee, viii, p. 342.

Pseudorhombus pantherinus, Bleeker, 1862, Versl. Akad. Wet. Amsterdam, xiv, p. 103.

Platophrys (Platophrys) pantherinus, Bleeker, 1866-72, Atl. Ichth., vi, p. 11. Pleuron., pl. ii, fig. 3.

Platophrys pantherinus, Day, 1877, Fish. India, p. 425, pl. xcii, figs. 3, 4; Steindachner, 1901, Denkschr. Akad. Wiss. Wien, lxx, p. 511; Jordan and Evermann, 1905, Bull. U.S. Comm. Fish. xxiii, (1903), p. 512; Jordan and Seale, 1906, Bull. U.S. Bur. Fish., xxv, (1905), p. 412; Kendall and Goldsborough, 1911, Mem. Mus. Comp. Zool.,

xxvi, p. 332; Weber, 1913, "Siboga" - Exped., Fische, p. 427; Ogilby, 1913, Mem. Qd. Mus., ii, p. 90; Gilchrist and Thompson, 1917, Ann. Durban Mus., i, p. 400; McCulloch, 1922, Mem. Qd. Mus., vii, p. 244; Von Bonde, 1922, Rep. Fish. Mar. Biol. Surv. S. Afr., ii, (1921), Spec. Rep., i, p. 6; Von Bonde, 1925, Trans. Roy. Soc. S. Afr., xii, p. 287; Fowler, 1925, Proc. Acad. Nat. Sci. Philad., lxxvii, p. 204; Fowler, 1928, Mem. B. P. Bishop Mus., x, p. 91; Schmidt, 1930, Trans. Pacif. Comm. Acad. Sci. U. S. S. R., i, p. 111; Fowler, 1931, Mem. B. P. Bishop Mus., xi, p. 320.

Platophrys mancus, Jordan & Snyder, 1904, Proc. U. S. Nat. Mus., xxvii, p. 946.

Bothus pantherinus, Regan, 1920, Ann. Durban Mus., ii, p. 212, fig. 3; Barnard, 1925, Ann. S. Afr. Mus., xxi, p. 385; Norman, 1926, Biol. Res. "Endeavour", v, p. 252; Norman, 1927, Rec. Ind. Mus., xxix, p. 33; McCulloch, 1929, Mem. Aust. Mus., x, p. 276; Norman, 1934, Monogr. Flat (Heterosomata), i, p. 233, fig. 177; Fowler, 1934, Proc. Acad. Nat. Sci. Philad., lxxxvi, p. 434.

TEXT-FIG. 13.

D. 85-95; A. 64-71; P. 9-11; L. 1.80-92.

Depth of body  $1\frac{2}{3}$  to twice in the length, length of head  $3\frac{1}{3}$  to 4. Upper profile of head convex, or with a slight notch in front of lower eye. Diameter of eye  $3\frac{1}{2}$  to nearly 5 in length of head; interorbital width equal to or a little less than diameter of eye in the male, rather narrower in the female; anterior edge of upper eye above, or a little behind middle of lower; male generally with a dermal tentacle on hinder part of each eye. Mature male with one or more irregular bony tubercles on the snout, in front of lower eye, and often one or two in front of upper eye; except for a blunt knob on the snout, these are wanting in the female. Maxillary extending to below anterior edge or anterior half of eye, length about 3 in that of head. About 6 to 8 very short gill-rakers on lower part of anterior arch. Scales ctenoid on ocular side, cycloid on blind side. Pectoral of ocular side with upper rays greatly prolonged in the mature male, sometimes reaching base of caudal. Caudal obtusely pointed. Vertebrae 10 + 29. Brownish, covered with paler and darker spots, blotches, rings or ocelli; generally a large dark blotch on middle of straight portion of lateral line; median fins similarly coloured and marked pectoral spotted with brown, with or without irregular dark cross-bars. Blind side whitish.

Length: Up to 450 mm.

Distribution: Natal Coast, Kosi Bay, Delagoa Bay, 2-60 fathoms

Lepidology. (Plate V, figs.20, 21).

Scales ctenoid on ocular side, cycloid on blind side, small, adherent, regular in arrangement; 80 - 92 scales in the lateral line.

Ocular side - independent of the l.l.

Ovoid-hexagonal, anterior angles widely rounded, anterior margin markedly convex in general and slightly undulate, finely and very faintly scalloped, scallops very numerous, 45-50, lateral margins moderately convex; anterior length 75-78% of total length, anterior breadth 85-90% of anterior length, posterior breadth 110-115% of anterior breadth. Scales broader posteriorly than anteriorly, broadest part of scale along line joining posterior angles. Focus small but well-defined, circular, very posterior in position, about  $\frac{1}{6}$  of total length of scale from posterior margin. Anterior field very large, radii moderately divergent from focus, slightly curved towards lateral margins, close-set, well-defined, continuous, unbranched, very slightly undulate, very numerous, increasing in number from about 8 - 10 near the focus to about 45 - 50 at the anterior margin. Interradial circuli very close-set, entire, nearly straight or very slightly curved towards the anterior margin. Lateral fields small, roughly triangular, covered with a rather faint mosaic-like ornamentation due to interconnected close-set circuli. Posterior field very small, in the form of a narrow, curved, marginal band, along which is placed a single marginal series of 16 - 20 fairly short (10-12% of total length of scale), rather stout, somewhat blunt-pointed, narrow-based, tapered, peg-like spines. A variable but small number of very short accessory or supplementary spines, rather irregularly disposed near the bases of the marginal spines, are usually present. About  $\frac{1}{2}$  the length of the marginal series of spines project beyond the posterior margin, which is slightly concave.

between adjacent spines. The accessory spines do not even reach the posterior margin.

Adjacent to the l.l.

Similar in all respects to scales away from the lateral line except that the lateral margin adjacent to the lateral line is flattened.

Lateral line.

Elongate oval, much narrowed posteriorly. Muciferous canal medianly symmetrical, fairly long, not very wide, but occupies whole of posterior margin. Spines absent.

Blind side - independent of the l.l.

Elongate oval, more elongate than ocular side scales. Scales broader anteriorly than posteriorly, broadest part of scale along line joining anterior angles, which are much rounded; anterior length 86 - 90% of total length, anterior breadth 80-84% of anterior length, posterior breadth 65 - 68% of anterior breadth. In other respects similar to ocular side scales, except that the posterior field is larger, roughly triangular in shape, ornamented with a few rather irregular, discontinuous, moderately-spaced circuli. Posterior margin evenly and slightly convex, smooth.

Many ocular side scales show 2 or 3 breaks in the continuity of growth (absent or very obscure in blind side scales). These breaks are always much nearer to the periphery of the scale than to the focus, and take the form of either very narrow bands in which the circuli are rather irregular, and discontinuous, or lines of growth-arrest with fair amounts of absorption.

(viii). CHASCANOPSETTA.

Chascanopsetta, Alcock, 1894, J. Asiat. Soc. Beng., lxiii(2), p.128; Alcock, 1899, Cat. Indian Deep-Sea Fishes, p.125; Barnard, 1925, Ann. S. Afr. Mus., xxi, p.389; Norman, 1934, Monogr. Flatf. (Heterosomata), i, p.249.  
Trachypterophrys, Franz, 1910, Abh. Bayer Akad. Wiss., Suppl. iv, Abh. 1, p.60.

Body elongate, tapering posteriorly, strongly compressed. Eyes on the left side, separated by a rather narrow and

slightly concave space; interorbital region similar in both sexes. No rostral or orbital spines. Olfactory laminae rather numerous, arranged transversely to a long central rachis. Mouth very large, the length of the maxillary more than  $\frac{1}{2}$  that of head; tip of lower jaw projecting in front of upper; mandibular membranes not forming a distinct pouch; jaws and dentition about equally developed on both sides; teeth small, slender, curved, pointed, those of the lower jaw depressible; uniserial in both jaws; no distinct canines; vomer toothless. Gill-openings wide; gill-rakers absent or represented by one or two rudiments. Dorsal fin commencing above anterior nostril of blind side and well in front of eye; anterior rays connected by membrane only at their bases; all the rays simple, not scaled. Tip of first interhaemal spine not projecting in front of anal fin. Pectoral fins unequal, that of ocular side larger; all the rays simple. Anterior ray of left pelvic well in advance of that of right. Scales very small, cycloid on both sides of the body; no supplementary scales. Lateral line equally developed on both sides of the body, with a low, flat-topped curve above the pectoral fin; no supratemporal branch. Vent on blind side, just in front of anal fin.

Represented by one species in South African seas.

12. CHASCANOPSETTA LUGUBRIS, Alcock.

Chascanopsetta luzubris, Alcock, 1894, J. Asiat. Soc. Beng., lxxiii (2), p. 129, pl. vi, fig. 4; Alcock, 1895, Illust. Zool. "Investigator", Fishes, pl. xv, fig. 3; Alcock, 1899, Cat. Indian Deep-Sea Fishes, p. 125; Brauer, 1906, "Valdivia" Tiefsee-Fische, p. 295; Norman, 1927, Rec. Ind. Mus., xxix, p. 35, fig. 9; Norman, 1931, Ann. Mag. Nat. Hist., (10) viii, p. 601; Norman, 1934, Monogr. Flatf. (Heterosomata), i, p. 250, fig. 191.

Trachypterophrys raptator, Franz, 1910, Abh. Bayer. Akad. Wiss., Suppl. iv, p. 60, pl. vii, fig. 54; Hubbs, 1915, Proc. U.S. Nat. Mus., xlvi, p. 452.

Chascanopsetta gilchristi, Von Bonde, 1922, Rep. Fish. Mar. Biol. Surv. S. Afr., ii, (1921), Spec. Rep., i, p. 7, pl. ii, fig. 2; Barnard 1925, Ann. S. Afr. Mus., xxi, p. 390.

Chascanopsetta maculata, Von Bonde, 1922, tom. cit., p. 8; Von Bonde, 1925, Trans. Roy. Soc. S. Afr., xii, p. 288.

TEXT-FIG. 14.

Depth of body  $3\frac{1}{4}$  to nearly 4 in length, length of head 4 to  $5\frac{1}{4}$ . Diameter of upper eye  $3\frac{2}{3}$  to 4 in length of head, 3 to 5 in interorbital width. Cleft of mouth generally oblique, but sometimes nearly vertical or horizontal; maxillary extending to well beyond eye, length  $1\frac{1}{4}$  to  $1\frac{2}{5}$  in that of head. Width of curve of lateral line 5 to  $5\frac{3}{4}$  in straight part. Pectoral of ocular side  $1\frac{3}{4}$  to  $2\frac{1}{5}$  in length of head. Caudal abtusely pointed; caudal peduncle deeper than long. Greyish or yellowish-brown, with or without numerous small dark spots; fins dusky. Blind side whitish.

Length: Up to 245 mm.

Distribution: Off Natal and Delagoa Bay, 174-275 fathoms.

Lepidology. (Plate VI, fig.22).

Cycloid on both sides of the body, very small, smaller on blind side than on ocular side, very thin, adherent, regular in arrangement; about 145 scales in the lateral line.

Ocular side - independent of the l.l.

Oval, anterior angles largely rounded, anterior margin convex, faintly scalloped, scallops fairly numerous, about 20, lateral margins moderately convex, posterior margin evenly convex; anterior length 50-55% of total length, anterior breadth 95-100% of anterior length, posterior breadth 100% of anterior breadth. Focus large, elongate oval in shape, more or less central in position, well-defined. The scale may be divided into the usual four fields but such division is rather arbitrary, as sharply defined limits cannot be recognised. The least difficult field to demarcate is the posterior field and then only when the covering epithelial skin adheres to the scale.

The scale generally is ornamented with rather few, widely-spaced circuli interrupted at right angles by a number of rather indistinct, widely-spaced, divergent, undulose radii. The radii are to be found in the anterior field and in the major portions

of the lateral fields. In the lateral fields they are usually very short and somewhat discontinuous, starting some distance from the focus and not reaching as far as the lateral margins of the scale. There are about 6 radii near the focus and about 20 at the scale's margin. The interradii are straight or slightly curved towards the periphery of the scale and entire.

The posterior field, when the covering epithelial skin is absent, may be recognised by the absence of radii and the fewer, more widely-spaced and more definitely-marked circuli.

Adjacent to the l.l.

Similar in all respects to scales away from the lateral line, except that the lateral margin adjacent to the lateral line is flattened.

Lateral line.

Oval, a little narrower than scales away from the lateral line. Muciferous canal medianly symmetrical, wide, short.

Blind side - independent of the l.l.

Smaller replicas of ocular side scales. Circuli and radii fewer.

There are no signs of annuli.

Shifting of the scales in the scale pockets seems to be a common occurrence in this species. The scale illustrated is a typical example and shows the change in the axis of growth due to such movement very plainly.

(ix). LAEOPS.

Laeops, Günther, 1880, Shore Fishes "Challenger", p.29; Barnard, 1925, Ann.S.Afr.Mus., xxi, p.392; Norman 1931, Ann.Mag.Nat.Hist., (10) viii, p.601; Norman, 1934, Monogr.Flatf. (Heterosomata), i, p.252.

Scianectes, Alcock, 1889, J.Asiat.Soc.Beng., lviii(2), p.284; Alcock, 1890, Ann.Mag.Nat.Hist., (6)vi, p.216.

Lambdopsetta, Smith and Pope, 1906, Proc.U.S.Nat.Mus., xxi, p.496; Barnard, 1925, Ann.S.Afr.Mus., xxi, p.393.

Laeoptichthys, Hubbs, 1915, Proc.U.S.Nat.Mus., xlviii, p.460.

Body ovate or rather elongate, broad in front, tapering behind, compressed. Eyes on the left side, separated by a bony ridge or very narrow concave space; interorbital region similar

in both sexes. No rostral or orbital spines. Olfactory laminae in moderate number, arranged transversely to or radiating from a fairly long central rachis. Mouth small, protractile, the length of the maxillary  $3\frac{3}{5}$  to  $4\frac{3}{5}$  in that of head. Jaws about equally developed on both sides, but dentition almost entirely confined to blind side; teeth all very small, pointed, more or less uniserial or in narrow bands in both jaws; vomer toothless. Gill-rakers few in number, very short, sometimes rudimentary. Dorsal fin commencing above nostrils of blind side and in front of or above anterior edge of eye; all the rays simple, scaled (at least on ocular side); first two rays generally separated by an interspace from rest of fin. Tip of first interhaemal spine not projecting in front of anal fin. Pectoral fins unequal, that of ocular side larger. Scales very small, all cycloid; no supplementary scales. Lateral line developed only on ocular side of body, with a distinct curve above the pectoral fin; without or with a very short supratemporal branch. Vent on blind side, above first ray of anal fin.

Represented by three species in South African seas.

Key to the South African Species.

- a. Origin of dorsal above anterior nostril of blind side; first two rays not detached from remainder of fin, second and third a little prolonged . . . . . 13. nigromaculatus.
- b. Origin of dorsal above posterior nostril of blind side; first two rays detached from remainder of fin, but none of the rays prolonged (except in very young).
- (i) Pectoral shorter than head . . . . . 14. natalensis.
- (ii) Pectoral nearly twice as long as head. 15. pectoralis.

13. LAEOPS NIGROMACULATUS, Von Bonde.

Laeops nigromaculatus. Von Bonde, 1922, Rep. Fish. Mar. Biol. Surv. S. Afr., ii, (1921), Spec. Rep., i, p. 10, pl. iii; Von Bonde, 1925, Trans. Roy. Soc. S. Afr., xii, p. 289; Barnard, 1925, Ann. S. Afr. Mus., xxi, p. 392; Norman, 1931, Ann. Mag. Nat. Hist., (10) viii,

p.510; Norman, 1934, Monogr. Flatf. (Heterosomata), i,  
p.254, fig.194.

TEXT-FIG.15.

D.103-106; A.83-85; P.14; L.1.102.

Depth of body  $2\frac{2}{3}$  to  $2\frac{4}{5}$  in the length, length of head 5 to  $5\frac{1}{3}$ . Upper profile of head and body markedly convex above and behind eyes. Diameter of eye  $3\frac{2}{3}$  to  $3\frac{3}{4}$  in length of head; lower eye scarcely in advance of upper, which is separated from edge of head by a space equal to  $\frac{1}{4}$  or  $\frac{1}{3}$  its diameter. Maxillary scarcely reaching anterior edge of eye, length  $3\frac{3}{4}$  to 4 in head; teeth uniserial, almost entirely confined to blind side of jaws. 6 or 7 gill-rakers on lower part of anterior arch. Origin of dorsal above anterior nostril of blind side; first two rays not detached from remainder of fin; second and third rays a little prolonged. Pectoral of ocular side  $1\frac{1}{4}$  to  $1\frac{1}{3}$  in length of head. Caudal obtusely pointed. Brownish, with small black spots scattered irregularly over the body; outer parts of dorsal and anal fins black; caudal blackish. Blind side whitish.

Length: Up to 178 mm.

Distribution: Natal Coast and Delagoa Bay, 55-160 fathoms.

Lepidology. (Plate VI, fig.23.)

Scales cycloid on both sides of body, small, adherent, regular in arrangement; 102 scales in the lateral line.

Ocular side - independent of the l.l.

Broadly oval, anterior angles widely rounded, anterior margin evenly convex, very faintly scalloped, nearly smooth, scallops fairly numerous, 16 - 20, lateral margins slightly convex, posterior margin evenly convex, smooth. Anterior length (measured from anterior margin along median axis to centre of focus) 65-68% of total length, anterior breadth 100-115% of anterior length, posterior breadth 82-92% of anterior breadth. Focus large, oval in shape, boundaries somewhat indefinite, somewhat posterior in position, about  $\frac{1}{3}$  of total length of scale

from posterior margin, surrounded by a few, 3 - 4, rather widely-spaced circuli. Anterior field of fair size, radii slightly divergent from focus, lateral spread not great; slightly undulose, moderately spaced, fairly numerous, increasing in number from about 10-12 near the focus to about 16-20 at the anterior margin; interradii circuli moderately close-set (except the few near the focus), entire (for the most part), straight or nearly so. Lateral fields of moderate size, roughly triangular, circuli fairly close-set except the few near the focus. Posterior field somewhat small, triangular, ornamented with a few widely-spaced, somewhat discontinuous circuli.

Adjacent to the l.l.

Similar in all respects to scales away from the lateral line, except that the lateral margin adjacent to the lateral line is flattened or slightly concave.

Lateral line.

Squarish oval, narrowed posteriorly. Muciferous canal medianly symmetrical. Maximum breadth 85-90% of total length.

Blind side - independent of the l.l.

Identical in every way to ocular side scales.

There are no signs of annuli.

14. LAEOPS NATALENSIS, Norman.

Lambdopsetta kitaharae, (non Smith & Pope), Von Bonde, 1922, Rep. Fish. Mar. Biol. Surv. S. Afr., 11, (1921) Spec. Rep., 1, p. 9; Barnard, 1925, Ann. S. Afr., Mus., xxi, p. 393.

Laeps natalensis, Norman, 1931, Ann. Mag. Nat. Hist., (10) viii, p. 510; Norman, 1934, Monogr. Flatf. (Heterosomata), 1, p. 258, fig. 199.

TEXT-FIG. 16.

D. 97-99; A. 75-77; P. 14; L.l. ca. 100.

Depth of body  $2\frac{1}{5}$  to  $2\frac{1}{4}$  in the length, length of head 5 to  $5\frac{1}{3}$ . Upper profile of head and body markedly convex above and

behind eyes. Diameter of eye about 3 in length of head; lower eye a little in advance of upper, which almost touches edge of head. Maxillary extending to below anterior edge of eye, length a little more than 4 in that of head; teeth in narrow bands, mostly confined to blind side of jaws. 5 or 6 gill-rakers on lower part of anterior arch. Origin of dorsal above posterior nostril of blind side; first two rays detached from remainder of fin; none of the rays prolonged. Pectoral of ocular side about  $1\frac{1}{2}$  in length of head. Caudal rounded. Yellowish brown; median fins dusky towards their margins. Blind side whitish.

Length: Up to 135 mm.

Distribution: Natal Coast, 180-230 fathoms.

Lepidology. (Plate VI, fig. 24.)

Scales cycloid on both sides of body, small, adherent, regular in arrangement; about 100 scales in the lateral line.

Ocular side - independent of the l.l.

Squarish-oval, anterior angle widely rounded (not so widely as in L. nigromaculatus), anterior margin evenly convex, very faintly scalloped, nearly smooth, scallops numerous, 22-24, lateral margins very slightly convex or straight, posterior margin evenly convex, smooth. Anterior length (measured from anterior margin along median axis to centre of focus) 58-60% of total length, anterior breadth 114 - 118% of anterior length, posterior breadth 92-96% of anterior breadth. Focus of moderate size, well-defined, circular, slightly posterior or subcentral in position, surrounded by a few, 3 - 4, rather widely-spaced circuli. Anterior field fairly large, radii sub-parallel, very slightly divergent from focus, lateral spread very small, close-set, slightly undulose numerous, increasing in number from about 10 - 12 near the focus to about 22 - 24 at the anterior margin; interradii circuli close-set (except the few near the focus), entire, straight. Lateral fields of moderate size, roughly triangular, circuli close-set, except the few near the focus. Posterior field not large, triangular, ornamented with a small number of rather widely-spaced,

somewhat discontinuous circuli.

Adjacent to the l.l.

Similar in all respects to scales away from the lateral line, except that the lateral margin adjacent to the lateral line is definitely concave.

Lateral line.

Squarish oval, narrowed posteriorly. Muciferous canal medianly symmetrical. Maximum breadth 80 - 85% of total length. Blind side - independent of the l.l.

Identical in practically every way to ocular side scales. The general form is somewhat more rounded oval than is the case with ocular side scales, the lateral margins being a little more convex.

There are no signs of annuli.

15. LAEOPS PECTORALIS (Von Bonde).

Lambdopsetta pectoralis, Von Bonde, 1922, Rep. Fish. Mar. Biol. Surv. S. Afr., ii, (1921), Spec. Rep., i, p. 10, pl. i, fig. 3; Von Bonde, 1925, Trans. Roy. Soc. S. Afr., xii, p. 289; Barnard, 1925, Ann. S. Afr. Mus., xxi, p. 393.

Laeops pectoralis, Norman, 1934, Monogr. Flatf. (Heterosomata), i, p. 261, fig. 203.

TEXT-FIG. 17.

D. 108-113; A. 91-94; P. 12; L. 1. 105-110.

Depth of body  $2\frac{4}{5}$  to nearly 3 in the length, length of head  $5\frac{2}{3}$  to  $6\frac{1}{4}$ . Upper profile of head and body moderately convex above and behind eyes. Diameter of eye  $2\frac{1}{2}$  to  $2\frac{3}{4}$  in length of head; lower eye a little in advance of upper, which is close to edge of head. Maxillary extending to anterior edge of eye, length about  $4\frac{1}{2}$  in that of head; teeth apparently in one or two series, mostly confined to blind side of jaws. 7 or 8 gill-rakers on lower part of anterior arch. Origin of dorsal above posterior nostril of blind side; first two rays detached from remainder of fin; none of the rays prolonged. Pectoral of ocular side nearly twice as long as head. Caudal obtusely pointed. Brownish; fins dusky.

Blind side whitish.

Length: Up to 190 mm.

Distribution: Natal Coast and Delagoa Bay, 150 -170 fathoms.

Lepidology. (Plate VI, fig.25).

Scales cycloid on both sides of body, small, rather thin, adherent, regular in arrangement; 105-110 scales in the lateral line.

Ocular side - independent of the l.l.

Broadly oval, anterior angles widely rounded (as in L.nigromaculatus), anterior margin convex but usually slightly undulose, very faintly scalloped, scallops numerous, 24-26, lateral margins convex (sometimes a little irregularly undulose), posterior margin convex, smooth. Anterior length (measured from anterior margin along median axis to centre of focus) 70-75% of total length, anterior breadth 80-85% of anterior length, posterior breadth 98-100% of anterior breadth. Focus relatively large, rather elongate, oval, somewhat ill-defined, rather posterior in position, about  $\frac{1}{4}$  of total length from posterior margin, surrounded by a few, 2 - 4, rather widely-spaced, often discontinuous circuli. Anterior field large, radii moderately divergent from the focus, tending to curve slightly towards the lateral margins, close-set, slightly undulose, numerous, increasing in number from about 12 - 14 near the focus to about 24 - 28 at the anterior margin. A few of the most lateral radii on both sides of the field start near the focus but do not reach the periphery of the scale; interradii close-set (except the few near the focus), entire, straight or very slightly curved towards the posterior aspect of the scale. Lateral fields of moderate size, triangular, circuli close-set, except the few near the focus. Posterior field not large, triangular, ornamented with close-set, somewhat discontinuous circuli.

Adjacent to the l.l.

Similar in all respects to scales away from the lateral line, except that the lateral margin adjacent to the lateral line is flattened.

Lateral line.

Squarish oval, narrowed posteriorly, anterior angles not so widely rounded, anterior margin flattened or concave. Muciferous canal broad and symmetrically median. Maximum breadth 85-90% of total length.

Blind side - independent of the l.l.

Identical in practically every way to ocular side scales. General form somewhat more rounded oval than is the case with ocular side scales.

There are no signs of annuli.

Family III. PLEURONECTIDAE.

Eyes on the right side, except in reversed examples in certain species; optic chiasma monomorphic, the nerve of the left eye always dorsal. Dorsal fin extending forward on the head at least to above the eye; all the fin-rays articulated. Each pelvic fin of from 3 to 13 rays. Mouth usually terminal, with the lower jaw more or less prominent; maxillary without a supplemental bone; palatines toothless. Lower edge of urohyal deeply emarginate, so that the bone appears forked. Preoperculum with free margin. Nasal organ of blind side usually near edge of head, but sometimes nearly opposite that of ocular side. Vertebrae never fewer than 30. On each side a single post-cleithrum. Ribs present. Egg without an oil-globule in the yolk.

Three subfamilies represented in South African waters.

Synopsis of the South African Subfamilies.

Pelvic fins generally short-based, symmetrical, or that of ventral side median and somewhat advanced, the fins supported by the pelvic bones behind or below the cleithra; pectoral radials present.

- A. Origin of dorsal fin above the eyes, behind nasal organ of blind side; precaudal parapophyses separate, divergent; hypocoracoids narrowed forward below. Lateral line rudimentary and scarcely apparent on blind side of body; olfactory laminae radiating from a short central rachis . . . A. POECILOPSETTINAE
- B. Origin of dorsal in front of eyes, the fin extending forward on snout either above or below nasal organ of blind side.
  - 1. Dorsal fin extending forward on snout above nasal organ of blind side; last 5 precaudal vertebrae with parapophyses, of which the last pair are connected by a bridge; hypocoracoids

narrowed forward below; olfactory laminae arranged transversely to or radiating from a central rachis; lateral line well developed on both sides of the body. . . . .

. . . . . B. PARALICHTHODINAE.

2. Dorsal fin extending forward on snout below nasal organ of blind side; parapophyses of precaudal vertebrae united to form closed haemal arches, bearing the slender ribs at their extremities; hypocoracoids expanded; olfactory laminae parallel, without rachis; lateral line rudimentary and scarcely apparent on blind side

. . . . . C. SAMARINAE.

Subfamily A. POECILOPSETTINAE.

Characters as given in the above synopsis. Two genera found in South African seas.

Key to the South African Genera.

- a. None of the anterior rays of dorsal or pelvics prolonged; male similar to female. No orbital tentacles . . . . . (x) Poecilopsetta.
- b. Anterior rays of dorsal and of pelvic of ocular side more or less prolonged in both sexes, very long in male; male with strong rostral spines, and with the teeth on ocular side of upper jaw extending on to outer surface of jaw . . . (xi) Marlevella.

(x). POECILOPSETTA.

Poecilopsetta, Günther, 1880, Shore Fishes "Challenger", p. 48; Hubbs, 1919, Proc. Biol. Soc. Washington, xxi, p. 163; Norman, 1931, Treubia, xiii, p. 423; Norman, 1934, Monogr. Flatf. (Heterosomata), i, p. 387.

Boopsetta, Alcock, 1896, J. Asiat. Soc. Bengal, lxxv (2), p. 305; Alcock, 1899, Cat. Indian Deep-Sea Fish., p. 126.

Alaeops, Jordan & Starks, 1904, Bull. U.S. Comm. Fish., xxii, (1902), p. 623, Jordan & Starks, 1906, Proc. U.S. Nat. Mus., xxxi, p. 198.

Paralimanda, Breder, 1927, Bull. Bingham Ocean. Coll., 1 (1), p.86.

Male similar to female. Body ovate or rather elongate, strongly compressed, often fragile. Eyes on the right side, contiguous or separated by a very narrow space. Male without rostral spines. Mouth rather small, nearly symmetrical, the length of the maxillary less than  $\frac{1}{2}$  that of head; teeth small, villiform, in one or two rows or in narrow bands in the jaws; dentition better developed on blind side of jaws; vomer toothless. Gill-rakers rather short, pointed, few in number; lower pharyngeals rather narrow, separated for the greater part of their length, each with 2 or 3 rows of sharply pointed teeth. Dorsal fin with 56 or 68 rays, commencing well behind nostrils of blind side and above eye; nearly all the rays simple, not scaled; anterior rays not prolonged; a low scaly sheath covering basal part of fin on ocular side. Anal with 45 to 58 rays; similar to dorsal; tip of first interhaemal spine not projecting in front of fin. Pectoral fins unequal, that of ocular side larger, with 7 to 12 rays. Pelvic fins with 6 rays, short-based, subequal, but somewhat asymmetrical, that of ocular side further forward and closer to median line than that of blind side; none of the rays prolonged. Scales of moderate or small size, rather feebly ctenoid or cycloid on ocular side, cycloid on blind side. Lateral line on ocular side well developed, extending on to the caudal fin, with a large flat-topped curve above the pectoral fin; no supratemporal or suborbital branches; lateral line of blind side rudimentary or absent. Vent nearly median.

Only one species found in South African waters.

16. POECILOPSETTA NATALENSIS, Norman.

Limanda beanii (non Goode), Von Bonde, 1922, Rep. Fish. Mar. Biol. Surv. S.Afr., (1921), Spec. Rep., 1, p. 16; Barnard, 1925, Ann. S.Afr. Mus., xxi, p. 395.

Poecilopsetta natalensis, Norman, 1931, Treubia, xii, p. 426;  
 Norman, 1934, Monogr. Flatf. (Heterosomata), i, p. 292,  
 fig. 283.

TEXT-FIG. 18.

D. 62; A. 54; P. 10; L. 1. ca 70.

Depth of body  $2\frac{3}{5}$  in the length, length of head  $4\frac{2}{5}$ . Snout much shorter than eye, diameter of which is  $2\frac{1}{3}$  in length of head; eyes nearly contiguous, the lower scarcely in advance of upper, which enters dorsal profile of head. Maxillary extending to a little beyond anterior margin of eye, length about  $3\frac{1}{2}$  in that of head; lower jaw  $2\frac{3}{5}$  in head. Teeth in narrow bands. 11 gill-rakers on lower part of anterior arch. Scales ctenoid on ocular side, cycloid on blind side. Pectoral of ocular side twice in length of head, all the rays simple. Caudal pointed; caudal peduncle more than 3 times as deep as long. Greyish brown, with darker patches; dorsal and anal fins with irregular black markings; a pair of conspicuous black blotches at middle of upper and lower margins of caudal; pectoral blackish distally. Blind side whitish.

Length: Up to 145 mm.

Distribution: Natal Coast and Delagoa Bay, 180-230 fathoms

Lepidology. (Plate VI, figs. 26, 27).

Scales somewhat feebly ctenoid on the ocular side, cycloid on the blind side, moderate or small in size, a little deciduous, regular in arrangement; about 70 scales in the lateral line.

Ocular side - independent of the l.l.

Broadly oval, anterior angles widely rounded, anterior margin markedly convex, prominently scalloped, scallops not very numerous, 6 - 12, lateral margins slightly convex or nearly straight anterior length 78 - 82% of total length, anterior breadth 60 - 65% of anterior length, posterior breadth 124 - 128% of anterior breadth. Most of the scales broader posteriorly than anteriorly.

Focus usually rather large, well-defined, oval or circular, rather posterior in position, about  $\frac{1}{5}$  of total length from posterior margin, surrounded by a few, 4 - 8, widely-spaced circuli. The focus is never a completely clear area but is usually ornamented with very convoluted lines forming an irregular mosaic-like pattern. Anterior field of moderate size, radii divergent from the focus, lateral spread fairly large, moderately widely-spaced, well defined, continuous, more or less straight or slightly undulose, not very numerous, increasing in number from about 6 - 8 near the focus to about 8 - 12 at the anterior margin; interradii circuli close-set (except the few near the focus), entire, sharply bent towards the anterior aspect of the scale in the form of "average curves", well-defined. Lateral fields of moderate size, triangular, circuli close-set (except the few near the focus), fewer in number than in the anterior field, branching occurs at the junctions of the lateral and anterior fields. Posterior field small, triangular, entirely covered with spines. Spines short, longest 4 - 6% of total length of scale, strong, slightly blunt-pointed, with curved lateral margins and fairly broad bases. Spines of two marginal series homogeneous, of about equal length, the others decreasing in length as the focus is approached. Alternate arrangement of spines fairly regular, 4 major and 4 minor series medianly, reduced to 2 or 3 laterally, in a few scales, majority with 3 major and 3 minor series medianly reduced to 1 or 2 laterally. First major series of 6 - 12 spines and first minor series of 6 - 12 spines, giving a marginal projecting series of 12 - 24 spines. Spines project for about  $\frac{1}{2}$  to  $\frac{2}{3}$  their length beyond posterior margin, which is incised between adjacent spines. Spines of other major and minor series fall wholly within the confines of the posterior field.

Adjacent to the l.l.

A little longer and narrower than those away from the lateral line. Lateral margin adjacent to the lateral line usually slightly concave.

Lateral line.

Similar to scales away from the lateral line, not quite so long and a little broader anteriorly than posteriorly. Muciferous canal medianly symmetrical, rather short. Spines of posterior field persistent except medianly where field is cut by canal.

Blind side- independent of l.l.

Similar to ocular side scales. Focus usually circular. Posterior field larger than its counterpart in ocular side scales, triangular, ornamented with fairly close-set, entire, well-defined circuli. Posterior margin convex, slightly undulose, smooth.

There are no signs of annuli.

It is noteworthy that large numbers of both ocular and blind side scales possess very large, rather indefinite central areas which obviously are not normal foci. Such scales are regenerated scales, and the lost scale in the regenerated scale is represented by the central area, which is slightly smaller than the original scale.

(xi). MARLEYELLA.

Marleyella, Fowler, 1925, Proc. Acad. Nat. Sci. Philad., lxxvii, p. 203; Norman, 1934, Monogr. Flatf. (Heterosomata), i, p. 396.

Close to Poecilopsetta, but male with strong rostral spines, and with the teeth on the ocular side of the upper jaw extending on to the outer surface of the jaw; anterior rays of dorsal and of pelvic of ocular side more or less prolonged in both sexes, very long in the male.

A single South African species.

17. MARLEYELLA BICOLORATA. (Von Bonde.)

(Blue-green Flounder.)

Poecilopsetta bicolorata, Von Bonde, 1922, Rep. Fish. Mar. Biol. Surv. S.Afr., (1921), Spec. Rep., i, p. 14, pl. v, fig. 2; Barnard, 1925, Ann. S.Afr. Mus., xxi, p. 396.

Poecilopsetta (Marleyella) bicolorata, Fowler, 1925, Proc. Acad. Nat. Sci. Philad., lxxvii, p. 203.

Marleyella bicolorata, Norman, 1931, Treubia, xiii, p. 423; Norman, 1934, Monogr. Flatf. (Heterosomata), i, p. 396, fig. 287; Fowler, 1934, Proc. Acad. Nat. Sci. Philad., lxxxvi, p. 435.

## TEXT-FIG. 19.

D.55-57; A. 46-47; P.11; L.1.70 - 75.

Body ovate. Depth of body about twice in the length, length of head about 4. Snout shorter than eye, diameter of which is nearly 4 in length of head; eyes separated by a low scaled ridge, its width less than  $\frac{1}{2}$  diameter of eye; anterior margins of eyes about level, the upper entering dorsal profile of head. A strong rostral spine overhanging the upper jaw of the ocular side in the male, and a similar but rather smaller spine on the blind side; in the female the spine on the ocular side is represented by a small prominence, and that of the blind side is absent. Maxillary extending nearly to below middle of eye, length  $2\frac{1}{4}$  to  $2\frac{1}{2}$  in that of head; lower jaw about twice in head. Teeth irregularly biserial or in narrow bands, extending on to outer surface of upper jaw on ocular side in the male. 12 gill-rakers on lower part of anterior arch. Scales ctenoid on ocular side, cycloid on blind side. Origin of dorsal above middle of eye; second to eighth rays greatly prolonged in the male, highest nearly twice length of head; second to fourth or fifth rays a little longer than those which follow in the female. Pectoral of ocular side with 9 or 10 of the 11 rays branched, length  $1\frac{2}{5}$  to  $1\frac{3}{5}$  in that of head. Pelvics with first three rays prolonged in both sexes, longest rays  $\frac{4}{5}$  (female) or about twice (male) length of head. Caudal obtusely pointed; caudal peduncle short. Bluish black (dark brownish in preserved specimens), tinted with green, spotted and blotched with black, the dark blotches tending to form irregular cross-bars; branchiostegal membranes azure blue below; median fins with smaller and larger black spots; caudal with a dark vertical bar near its base; pectoral and pelvic spotted with darker; blind side similar to ocular side but cross-bars indistinct pectoral lighter in colour; head with small round black spots.

Length: Up to 185 mm.

Distribution: Natal Coast, 70 -250 fathoms.

Lepidology. (Plate VII, figs. 28, 29).

Scales ctenoid on ocular side, cycloid on blind side, moderate to small in size, much smaller on blind side than on ocular side, a little deciduous, regular in arrangement; 70-75 scales in the lateral line.

Ocular side - independent of the l.l.

Broadly oval, anterior angles widely rounded, anterior margin convex, very prominently scalloped, scallops rather few, 6 - 8, lateral margins convex as a rule, sometimes a little concave in part of their lengths; anterior length 72 - 75% of total length, anterior breadth 75 - 80% of anterior length, posterior breadth 110 - 115% of anterior breadth; most of scales a little broader posteriorly than anteriorly. Focus very small, circular, well-defined, rather posterior in position, about  $\frac{1}{4}$  of total length of scale from posterior margin. Anterior field of moderate size, radii divergent from focus, lateral spread fairly large, rather widely-spaced, spacing unequal, well-defined, continuous, slightly undulose, rather few, increasing in number from about 4 - 5 near the focus to about 6 - 8 at the anterior margin; interradii circuli close-set, entire, markedly bent towards the anterior aspect of the scale in the form of "average curves", well defined. Lateral fields of moderate size, triangular, circuli close-set. Posterior field somewhat small, roughly triangular, entirely covered with spines. Spines short, longest 6 - 8% of total length of scale, strong, slightly blunt-pointed, with very slightly curved lateral margins and fairly broad bases. Spines of two marginal series homogeneous, of about equal length, others decreasing in length towards the focus. Alternate arrangement of spines regular, 5 major and 5 minor series medianly, reduced to 2 laterally. First major series of 8 - 11 spines and first minor series of 8 - 11 spines, giving a marginal projecting series of 16 - 22 spines. Spines project for about  $\frac{1}{3}$  their length beyond posterior margin, which is

incised between adjacent spines. Spines of other major and minor series fall wholly within the confines of the posterior field.

Adjacent to the 1.1.

Similar to scales away from the lateral line. Lateral margin adjacent to the lateral line usually definitely concave.

Lateral line.

Similar to scales away from the lateral line. Lateral margins concave, scales slightly narrowed posteriorly. Muciferous canal medianly symmetrical, not long. Spines of posterior field persistent except medianly where field is cut by canal.

Blind side - independent of 1.1.

Smaller but similar to ocular side scales. Posterior field about same size as its counterpart in ocular side scales, triangular, ornamented with close-set, entire, well-defined circuli. Posterior margin evenly convex, smooth.

There are no signs of annuli.

#### Subfamily B. PARALICHTHODINAE.

Characters as in synopsis on pages 81-82. The pelvic fins supported by the pelvic bones behind the cleithra. A single South African genus.

#### (xii). PARALICHTHODES.

Paralichthodes, Gilchrist, 1902, Mar. Invest. S.Afr., ii, p. 108; Regan, 1920, Ann. Durban Mus., ii, p. 213; Barnard, 1925, Ann. S. Afr. Mus., xxi, p. 398; Norman, 1934, Monogr. Platf. (Heterosomata), i, p. 398.

Body rather elongate, compressed. Eyes on the right side, separated by a flat space of moderate width. Mouth rather large, the length of the maxillary nearly  $\frac{1}{2}$  that of head; jaws and dentition about equally developed on both sides; teeth small, pointed, in 2 or 3 series in both jaws; vomer toothless. Gill-membranes separate; gill-rakers of moderate length, rather close-set, not numerous; lower pharyngeals very narrow and slender, not

approximated, each with 3 or 4 rows of pointed teeth. Dorsal fin commencing in front of nostrils of blind side and well in advance of eye; most of the rays forked distally, scaled at their bases. Anal similar to dorsal; tip of first interhaemal spine not projecting in front of fin. Pectoral fins unequal, that of ocular side larger; middle rays branched. Pelvic fins with 6 rays. Caudal peduncle very short. Scales small, adherent, imbricated; all cycloid. Lateral line with a distinct curve above the pectoral fin; a supratemporal branch. Vertebrae 31 (10 + 21). Vent on blind side, above first ray of anal fin; intestine with 2 or 3 coils; 2 + 2 pyloric appendages of moderate length.

A single South African species.

18. PARALICHTHODES ALGOENSIS, Gilchrist.

Paralichthodes algoensis, Gilchrist, 1902, Mar. Invest. S.Afr., ii, p. 108, pl. viii; Gilchrist and Thompson, 1909, Ann. S.Afr. Mus., vi, p. 262; Gilchrist and Thompson, 1917, Ann. Durban Mus., i, p. 397; Thompson, 1918, Mar. Biol. Rept., iv, p. 125; Regan, 1920, Ann. Durban Mus., ii, p. 214; Von Bonde, 1922, Rep. Fish. Mar. Biol. Surv. S. Afr., (1921), Spec. Rep., i, p. 12; Barnard, 1925, Ann. S. Afr. Mus., xxi, p. 398; Norman, 1934, Monogr. Flatf. (Heterosomata), i, p. 398, fig. 288; Fowler, 1934, Proc. Acad. Nat. Sci. Philad., lxxxvi, p. 435.

TEXT-FIG. 20.

D. (67) 72 - 74; A. (47) 61 - 54; P.12; L.1.110-125.

Depth of body about  $2\frac{1}{2}$  in the length, length of head 4 to  $4\frac{1}{2}$ . Snout about as long as eye, diameter of which is  $4\frac{3}{5}$  to nearly 5 in length of head and more than twice the interorbital width; anterior margins of eyes about level or upper a little in advance of lower. Maxillary extending to below middle or posterior part of eye, length nearly  $\frac{1}{2}$  that of head; lower jaw projecting. 19 - 21 gill-rakers on lower part of anterior arch. Anterior rays of dorsal fin much branched and more or less free from membrane. Pectoral of ocular side with 9 or 10 of the 12 rays branched, length  $1\frac{2}{3}$  to  $1\frac{3}{4}$  in that of head. Caudal with 16 rays (12 branched), rounded or obtusely pointed. Brownish or greyish, with small dark spots on head and on anterior part of body. Blind side whitish.

Length: Up to 450 mm.

Distribution: South Coast (Algoa Bay), East Coast (East London and Natal), shallow water.

Lepidology. (Plate VII, fig. 30.)

Scales cycloid on both sides of the body, small, adherent, imbricated, regular in arrangement; 110 - 125 scales in the lateral line.

Ocular side - independent of the l.l.

Oval, anterior angles largely rounded, anterior margin convex, faintly scalloped, scallops fairly numerous, 25 - 30, lateral margins convex, posterior margin convex, smooth; anterior length 80 - 82% of total length, anterior breadth 70 - 75% of anterior length, posterior breadth 100% of anterior breadth. Focus minute but well-defined, circular, posterior in position, about  $\frac{1}{6}$  of total length of scale from posterior margin. Anterior field of moderate size, radii divergent from focus, lateral spread not great, moderately-spaced, well-defined, continuous, nearly straight or slightly undulose, tending to curve slightly towards the lateral margins, fairly numerous, 6 - 8 near the focus, increasing to 25 - 30 at the anterior margin; interradii circuli very close-set, somewhat discontinuous, straight or finely undulose. Lateral fields of moderate size, triangular, circuli very close-set. Posterior field rather small, roughly triangular, ornamented with very discontinuous circuli and irregularly-shaped, coalescing clear areas, more especially along the margin.

Adjacent to the l.l.

Similar to scales away from the lateral line. Lateral margin adjacent to the lateral line flattened with a rather sharp concavity in the centre of its length.

Lateral line.

Elongate oval, somewhat smaller than scales away from the lateral line. Posterior margin concave but undulose. Muciferous canal medianly symmetrical, long, stretching nearly the full

length of the scale, of fairly wide even width throughout. Maximum breadth 50% of total length. In other respects similar to scales away from the lateral line.

Blind side - independent of the l.l.

A little smaller and narrower than ocular side scales, but in other respects identical.

There are no signs of annuli.

Subfamily C. SAMARINAE.

Characters as given in the synopsis on pages 81-82.

Represented by one genus in South African waters.

(xiii) SAMARIS.

Samaris, Gray, 1831, Zool. Miscell. (Gray), (I), p. 4; Günther, 1862, Cat. Fish. Brit. Mus., iv, p. 419; Barnard, 1925, Ann. S. Afr. Mus., xxi, p. 396; Norman, 1934, Monogr. Platf. (Heterosomata), 1, p. 402.

Body elliptical, compressed. Eyes on the right side, nearly contiguous or separated by a very narrow, scaled ridge; snout, jaws and upper parts of eye-balls not scaled; nasal organ of blind side above first ray of dorsal fin. Mouth small, the length of the maxillary not much more than  $\frac{1}{3}$  that of head; jaws and dentition about equally developed on both sides; teeth small, villiform, in narrow bands; teeth not enlarged anteriorly; vomer toothless. Gill membranes broadly united below the throat; gill-rakers rudimentary. Dorsal fin commencing on blind side, in front of eye; anterior rays greatly prolonged and filamentous; all the rays simple, not scaled; no sheath covering basal part of fin. Anal similar to dorsal; tip of first interhaemal spine not projecting in front of fin. Only the pectoral fin of ocular side developed; all the rays simple. Pelvic fins with 5 rays, bases rather elongate; that of ocular side placed a little further forward than that of blind side, and with the rays prolonged. Caudal fin with the rays all simple; caudal peduncle very short. Scales rather small, adherent, imbricated, strongly ctenoid on ocular side, cycloid or moderately ctenoid on blind side; more than

50 scales in lateral line. Lateral line nearly straight, bifurcated behind upper eye; no supratemporal branch. Vent nearly median.

Represented by two species in South African seas.

Key to the South African Species.

- a. Dorsal 86, anal 57; 80 scales in lateral line . . . . .  
 . . . . . 19. ornatus.
- b. Dorsal 78, anal 55; 94 scales in lateral line . . . . .  
 . . . . . 20. delagoensis.

19. SAMARIS ORNATUS, Von Bonde.

(Crested Flounder.)

Samaris ornatus, Von Bonde, 1922, Rep. Fish. Mar. Biol. Surv. S.Afr., (1921), Spec. Rep. i, p. 13, pl. vi; Barnard, 1925, Ann.S. Afr., Mus., xxi, p. 396; Norman, 1934, Monogr. Flatf. (Heterosomata), i, p. 404, fig. 292.

TEXT-FIG. 21.

D. 86; A. 57; P. 4; L.l. ca. 80.

Very close to S. cristatus, a deep-water species from the Indian Ocean and Chinese seas. Depth of body  $2\frac{4}{5}$  in the length, length of head  $4\frac{1}{2}$ . Snout shorter than eye, diameter of which is 3 in length of head; anterior margins of eyes level. Maxillary extending to below anterior edge of pupil of eye, length  $3\frac{2}{5}$  in that of head; lower jaw a little projecting,  $1\frac{3}{4}$  to 2 in head. Scales ctenoid on both sides of the body, spines much stronger and very much more numerous on scales from the ocular side. First 14 rays of dorsal fin prolonged, filamentous, longest rays 4 or 5 times length of head. Pectoral a little shorter than head. Caudal bluntly pointed, with 16 rays. Pelvic of ocular side much longer than that of blind side, with first ray filamentous and free. Deep brown, with irregularly scattered black spots; a row of 5 large blotches along upper edge, 4 along lower edge of body, and 2 on lateral line; dorsal and anal fins dusky, darker towards their edges; anterior rays of dorsal white distally; caudal with small pale spots; pectoral blackish; both pelvics dusky, darker distally. Blind side whitish.

Length: Up to 103 mm.

Distribution: Natal Coast, 30 fathoms.

Lepidology. (Plate VII, figs. 31, 32).

Scales ctenoid on both sides of body, much more strongly ctenoid on ocular side than on blind side, small, adherent, imbricated regular in arrangement; about 80 scales in the lateral line.

Scales from both ocular and blind sides of the type specimen in the British Museum were obtained for examination, but their exact location on the body is unknown, and lateral line scales were not included in the sample.

Ocular side.

Oval, anterior angles widely rounded, anterior margin convex, scalloped, scallops rather large and not numerous, 8 - 10, lateral margins convex; anterior length 70 - 75% of total length, anterior breadth 84 - 88% of anterior length, posterior breadth 78 - 82% of anterior breadth. Focus small but well-defined, circular, rather posterior in position, about  $\frac{1}{4}$  of total length of scale from posterior margin. Anterior field large, radii divergent from focus, lateral spread large, rather widely spaced, well-defined, continuous, slightly undulose, slightly curved towards the lateral margins, not numerous, 4 - 6 near the focus, increasing to 8 - 10 at the anterior margin; interradii circuli very close-set, entire, curved towards the anterior margin. Lateral fields small, circuli very close-set. Posterior field small, forming a "polar cap" to the scale, entirely covered with spines. Spines short, longest 10 - 12% of total length of scale, strong, sharp-pointed, lateral margins slightly curved, bases fairly broad. Spines few and irregularly placed, alternate arrangement obscure or absent, a marginal projecting series of 4 - 8 spines, and a small variable number of secondary spines. Spines project for about  $\frac{1}{2}$  their length beyond the posterior margin, which is slightly incised between adjacent spines.

Blind side.

More broadly oval than ocular side scales, sometimes roughly diamond-shaped. Posterior field much reduced in size and spines very few in number, 2 or 3 in all, medianly placed. Spines weaker and shorter than in ocular side scales. Maximum breadth 84 - 88% of total length.

There are no signs of annuli.

20. SAMARIS DELAGOENSIS, Von Bonde.

Samaris delagoensis, Von Bonde, 1925, Trans. Roy. Soc. S.Afr., xii, p. 289; Barnard, 1925, Ann. S. Afr. Mus., xxi, p. 397; Norman, 1934, Monogr. Flatf. (Heterosomata), i, p. 405.

## TEXT-FIG. 22.

D. 78; A.55; P. 4; L.1.94.

Very close to S.cristatus and therefore to S.ornatus.

Scales ctenoid on both sides of the body, slightly stronger on ocular side, but scattered cycloid scales may be found on blind side of body. First 15 rays of dorsal fin prolonged, filamentous. Pectoral a little shorter than head; caudal with 15 rays, bluntly pointed. First ray of ocular side pelvic fin filamentous and free, with a flattened, elongated, oval-shaped piece of skin on its end; 2nd ray similar to 1st, almost of same length, attached to 3rd. by membrane; 3rd. ray shorter but also ends in a swollen pad of skin. Dark brown, with blotches of various sizes scattered all over body and fins; third, fifth, sixth and tenth elongated dorsal rays have their bases blackish; posterior parts of dorsal and anal and whole of caudal mottled with paler; pectoral dark, mottled with black; pelvics very dark, tips of first 3 rays of that of ocular side black. Blind side whitish.

Length: Up to 170 mm.

Distribution: Delagoa Bay.

Lepidology. (Plate VII, figs. 33, 34.)

Scales mostly ctenoid on both sides of body, but less markedly so on blind side, where scattered cycloid scales may also

be found, small, adherent, imbricated, regular in arrangement; 94 scales in the lateral line.

Ocular side - independent of the l.l.

The form of the scales is somewhat variable but the typical form is roughly oval or somewhat quadrangular, anterior angles rounded, nearly  $90^\circ$ , anterior margin mostly convex, but often concave in part, rather obscurely scalloped; scallops fairly numerous, about 20, lateral margins slightly convex or nearly straight; anterior length 70 - 75% of total length, anterior breadth 75-80% of anterior length, posterior breadth 98 - 108% of anterior breadth. Focus small, well-defined, circular, rather posterior in position, about  $\frac{1}{4}$  of total length of scale from posterior margin. Anterior field very large, radii divergent from focus, lateral spread great, moderately-spaced, well-defined, continuous, markedly and widely curved towards the lateral margins, fairly numerous, 5 - 7 near the focus, increasing to 22 - 26 at the anterior margin; interradii circuli very close-set, entire, curved towards the anterior margin. Lateral fields small, circuli very close-set. Posterior field of fair size, in the form of a rather wide, curved "polar cap" to the scale, entirely covered with spines. Spines short, longest 10-12% of total length of scale, strong, sharp-pointed, lateral margins curved, bases broad. Spines of two marginal series not homogeneous, major spines stouter and longer than minor spines, others decreasing in length as the focus is approached. Alternate arrangement fairly regular, 3 - 4 major and 3 - 4 minor series medianly, reduced to 1 - 2 laterally. First major series of 9 spines and first minor series of 9 spines, giving a marginal projecting series of 18 spines. Marginal series project from  $\frac{1}{3}$  to  $\frac{2}{3}$  their length beyond posterior margin, which is incised between adjacent spines. Other spines fall wholly within the confines of the posterior field.

Adjacent to the l.l.

Similar to scales away from the lateral line. Lateral margin

adjacent to the lateral line usually definitely concave.

Lateral line.

Smaller than scales away from the lateral line, somewhat narrowed posteriorly. Muciferous canal medianly symmetrical, short, rather wide, occupying nearly the whole of the posterior margin. Spines absent.

Blind side - independent of the l.l.

Oval, a little longer than ocular side scales, anterior angles widely rounded, anterior margin convex but undulose, lateral margins convex. Maximum breadth 68 - 72% of total length. Focus a little larger than in ocular side scales. Posterior field greatly reduced in size, spines (when present) short, slender, variable in number but always few, in a fairly extensive median patch showing rather obscure alternation, or 3 or 4 or even fewer irregularly-placed spines. When spines are absent, i.e. in cycloid blind side scales, the posterior field is ornamented with a few discontinuous circuli, and the posterior margin is evenly convex.

There are no signs of annuli.

Family IV. SOLEIDAE.

Characters as given in the synopsis on pages 29-30. In addition; dorsal fin extending in advance of eye, all rays articulated. Pectorals well developed, rudimentary or absent. Teeth mostly on blind side of jaws only, no supramaxilla. Olfactory laminae arranged transversely to or radiating from a central rachis.

One subfamily represented in South African waters.

Subfamily SOLEINAE.

Anterior interneural spines supported by a special curved spine-like bone lying nearly parallel to the axis of the cranium, described as united at their base ("coalescents a leur base" - Chabanaud). Slit of mouth longitudinal. Pectorals present, rudimentary or absent.

Chabanaud's arrangement of dividing the subfamily into three parts (sections) is followed here. All three parts are represented in South African seas.

Synopsis of the Parts (Sections).

- A. Interbranchial septum entire. Preoral membranous lobe blunt, not prolonged below the level of the buccal commissure; distal extremity of the bone supporting the anterior interneural spines does not reach the level of the buccal commissure; first dorsal ray inserted, correlatively, above the level of the mouth.
- a. Posterior nostril of the ocular side circular or in the form of a vertical slit, sometimes tubular, always opening above and independent of the labial groove. Caudal free or not . . . . . a. Soleina.
- b. Posterior nostril of the ocular side in the form of a longitudinal slit, opening entirely in the labial groove and partly below the lower eye. Caudal free . . . . . b. Achirina.

B. Interbranchial septum pierced, establishing communication between the two branchial chambers. Preoral membranous lobe acute, prolonged below the level of the buccal commissure and supported by the bone on which the anterior interneural spines rest, its distal extremity extending beyond the buccal commissure on the ventral side; first dorsal ray inserted, correlatively, below the level of the mouth.

Caudal free . . . . . c. Heteromycterina.

Part a. SOLEINA.

Characters as given in the above synopsis. Nine genera found in South African waters.

Synopsis of the South African Genera.

I. Pectorals fan-shaped, very variable in form, sometimes absent, rays usually branched. Coracoid present, at least rudimentary, except when the pectoral rays are reduced to 1, 2 or 3 then vestigial. In the last case only the opercular membrane of the ocular side is joined to the pectoral rays, whereas, in all other degrees of development of the pectoral, it is joined to the cleithrum. Opercular slits confluent in advance of the pelvics. Anterior nasal tube of the ocular side short, directed flatly backwards, its extremity not extending beyond the posterior nostril, never reaching the lower eye.

A. Anterior nasal tube of the blind side very prominent, dilated distally to form a fringed cup or a rosette, base surrounded by a naked space. First dorsal ray inserted on a level with the interocular space. Pectorals well developed. Interradial circuli of the scales undulate, irregularly interrupted into anteriorly directed elements.

a. Anterior nasal tube of the blind side moderately dilated, funnel-shaped, not partitioned, but rim of funnel with fringes.

1. Last dorsal ray entirely or almost entirely attached to the caudal, at least as long as the preceding rays (in young), shorter in the adult . . . . . (xiv). Synapturichthys.
- B. Anterior nasal tube of the blind side not dilated distally.
- a. Posterior nostril of the ocular side opening on a level with the interocular space.
    1. Last dorsal ray as long as or longer than the preceding rays, closely attached for its whole length to the caudal. Abdominal haemaphyses freely prolonged to beyond the haemal canal. Interradial circuli of the scales longitudinal, confused, obscure . . . . . (xv). Austroglossus.
    2. Last dorsal rays shorter than the preceding ones, the last attached to the caudal by its base only. Abdominal haemaphyses not prolonged. Interradial circuli of the scales entire, curved anteriorly. . . . . (xvi). Barnardichthys.
  - b. Posterior nostril of the ocular side opening in advance of the lower eye, circular or in the form of a vertical slit, very rarely tubular, the tube, when present, always inserted below the level of the dorsal margin of the lower eye, rarely on the same level.
    1. Last dorsal and anal rays short. Caudal entirely free or united only by its base to the unpaired fins. Eyes more or less large, separated by a scaled space. Anterior nostril of blind side tubular, tube simple, cylindrical or vesicular, its base not forming a lobe and not surrounded by a naked groove.
      - (i). Last dorsal (and anal) ray without any vestige of a posterior membrane. Caudal entirely free. First dorsal ray inserted above the dorsal margin of the cephalic region and on the vertical

from the anterior border of the upper eye or very little in advance of this vertical. Supratemporal part of the lateral line ascending, always distinct, formed by differentiated scales or, at least, by mucous tubules projecting between the interstices of the scales. Angle of urohyal very nearly  $90^{\circ}$ . Pectorals more or less robust, each of more than 6 rays, the superior one simple, the others mostly branched. Scales smooth or rough . . . .

. . . . . (xvii). Quenselia.

(ii) Last dorsal (and anal) ray with a posterior membrane more or less developed.

\* First dorsal ray inserted on the vertical from the anterior margin of the upper eye. Supratemporal part of the lateral line forming an S-shaped figure, of which the superior curve is placed posterior to the vertical from the inferior curve. Interradial circuli of the scales interrupted into strongly retro-convex (posteriorly directed) elements. Urohyal bifid caudally, angle greatly rounded and measuring about  $150^{\circ}$ . . . . (xviii) Dicolozoglossa.

\*\* First dorsal ray inserted on the dorsal margin of the cephalic region and in advance of the vertical from the anterior margin of the upper eye. Interradial circuli of the scales entire and curved anteriorly or very slightly interrupted. Urohyal not bifid caudally, angle never more than  $95^{\circ}$ . Supratemporal part of the lateral line ascending, very distinct, semicircular above the eyes. Pectorals robust, each of more than 6 rays, the superior one simple, the others mostly branched. (xix). Solea.

2. Last dorsal and anal rays not short, the last one usually longer than the preceding ones, entirely attached to the caudal which is completely fused with the two unpaired fir

Eyes not at all or very little reduced (rarely contiguous and covered by a common translucent membrane); upper eye entirely above the level of the nostrils of the ocular side. Anterior nostril of the blind side tubular. Scales usually small. Posterior nostril of ocular side opening at the end of a tube inserted on a level with the upper margin or centre of the lower eye. Anal papilla median or sinistral, inserted on the border of the vent which is always sinistral. Inter-radial circuli of the scales confused, irregularly interrupted into anteriorly directed elements. Urohyal entire, sub-rectangular or subtrapezoidal . . . . (xx). Synaptura.

II. Pectorals always present, not very perceptibly fan-shaped, all the rays parallel and simple. Coracoid absent. Opercular membrane joined to the superior ray of the pectoral on both sides of the body. Anterior nasal tube of the blind side very short, cylindrical, no naked groove surrounding its base. The last dorsal (and anal) ray usually rather long, attached, at least basally, to the caudal.

A. Right pelvic separate from anal and from left pelvic. Abdominal cavity normally developed, 8 or 9 abdominal vertebrae. System of colouration generally consisting of a number of dark vertical bands.

1. First dorsal ray not differentiated, shorter than the following rays. Anterior nasal tube of the ocular side short, directed flatly backwards, its extremity not reaching the anterior margin of the lower eye. Last dorsal (and anal) ray joined to the caudal by a membrane which is entire. Scales quadrangular or subquadrangular; radii end exclusively on the anterior margin, rarely on the anterior part of the lateral margins.

. . . .(xxi). Zebrias.

2. First dorsal ray very long, robust, cylindrical, almost entirely free. Anterior nasal tube of the ocular side

short, hardly reaching the lower eye. Scales subelliptical; radii, for the most part, ending on the periphery; spines atrophied, not piercing the epidermis . . . . .

. . . . . (xxii). Coryphaesopia.

(xiv) SYNAPTURICHTHYS.

Synapturichthys, Chabanaud, 1927, Bull. Inst. Ocean., Monaco, 500, p. 11; Chabanaud, 1929, Ann. Inst. Ocean., Paris, N.S. vii (6), p. 220; Chabanaud, 1930, Bull. Inst. Ocean., Monaco, 555, pp. 6 & 10; Chabanaud, 1931, Riviera Sci., Suppl. Mem., ii, p. 30.

Eyes large, scaly eyelids moderately developed. Last dorsal (and anal) ray entirely or almost entirely attached to the caudal. In young examples, the last dorsal (and anal) ray is the same length as the preceding ones but shorter in adult individuals. Pectorals well developed, each of at least 6 rays, that of ocular side entirely free, uppermost ray of pectoral of both sides short. Pelvics equal and symmetrical, each of at least 5 rays, short-based. Vent median. Anterior nasal tube of blind side dilated distally to form an unpartitioned ciliated or fringed cup or funnel; posterior blind side nostril somewhat separated from its anterior fellow.

Additional characters may be found in the synopsis on pages 98-103. One species represented by a single variety, found in South African seas.

21. SYNAPTURICHTHYS KLEINI VARIOLOSA (Kner).  
(Black-finned Sole, Cape Sole.)

- Solea (Pegusa) variolosa, Kner, 1867, Novara Fische, p. 288.  
Solea capensis, Gilchrist, 1902, Mar. Invest. S. Afr., ii, p. 110, pl. ix; Gilchrist, 1916, Mar. Biol. Rept., iii, p. 17, fig. 14; Thompson, 1918, Mar. Biol. Rept., iv, p. 126; Von Bonde, 1922, Rep. Fish. Mar. Biol. Surv. S. Afr., ii, (1921), Spec. Rep. i, p. 17; Barnard, 1925, Ann. S. Afr. Mus., xxi, p. 402, pl. xvii, fig. 3.  
Synaptura melanoptera, Gilchrist, 1904, Mar. Invest. S. Afr., iii, p. 13, pl. xxxii; Thompson, 1918, Mar. Biol. Rept., iv, p. 127.  
Solea melanoptera, Von Bonde, 1922, Rep. Fish. Mar. Biol. Surv. S. Afr., ii, (1921), Spec. Rep. i, p. 21; Barnard, 1925, Ann. S. Afr. Mus., xxi, p. 401.  
Solea alboguttata, Fowler, 1929, Ann. Natal Mus., vi, p. 251, fig. 1.  
Pegusa (Synapturichthys) kleini variolosa, Chabanaud, 1929, Ann. Inst. Ocean., Paris, vii, pp. 220-229, figs. 14, 15, 16, 17, and 19, pl. i, fig. 2.

Synapturichthys kleini variolosa, Chabanaud, 1930, Bull. Inst. Ocean., Monaco, 555, p. 10.

TEXT-FIG. 23.

D. 81-95; A. 65-74; P. r. 8, 1.7 or 8; L. l. ocular 108-120, blind 132.

Body elongate ovate; depth  $2\frac{1}{2}$  to  $3\frac{2}{5}$ , head  $4\frac{1}{2}$  to nearly 6, in length of body. Anterior profile largely rounded, forming a more or less regular quarter of a circle from the end of the prebuccal prominence to the vertical through the centre of the postocular space. Ventral profile of head nearly straight. Snout prominent above the mouth. Eyes large,  $4\frac{2}{5}$  to  $6\frac{1}{4}$  in length of head, separated by a scaled space which is from  $\frac{1}{3}$  to  $\frac{2}{3}$  diameter of eye, upper in advance of lower by about  $\frac{1}{2}$  diameter; a scaly eyelid covering about  $\frac{1}{2}$  of each eyeball; oculo-dorsal space a little less than diameter of eye; dorsal border of upper eye level with axis of body. Maxillary reaching to below centre of lower eye; lower lip strongly arched but not angular, narrowly folded back on itself, its free border entire. Opercular margin fringed on both sides; dorsal opercular lobe not projecting. Opercular membrane attached to the cleithrum on the ocular side, close against the base of the lowermost ray of the pectoral; on the blind side the opercular membrane is attached to the base of the uppermost ray of the pectoral. First ray of dorsal well developed, inserted on the anterior border of the head on a level with the ventral border of the upper eye; posterior extremity of dorsal fin (and anal fin) generally angular, sometimes rounded in large-sized individuals; the last or the two last dorsal (and anal) rays somewhat short; dorso-caudal membrane developed, in young, as far as the tip of the last dorsal (and anal) ray, usually more or less deeply incised in large-or medium-sized specimens. Pectorals well developed, obtusely rounded, that of ocular side  $2\frac{1}{2}$  to  $3\frac{1}{2}$  in length of head, that of blind side of equal length or a little shorter; uppermost ray rather short, not reaching

beyond the centre of the length of the fin, 3rd. or more often 4th ray longest. Pelvics well developed, equal and symmetrical, each of 5 rays, as long as or a little shorter than the pectorals; anterior pelvic ray inserted on the vertical through the centre of the postocular space. Urinary papilla inserted close to the right margin of the base of the first anal ray, remote from the right pelvic. Vent opening between the first anal ray and the left pelvic. Anterior nasal tube of the ocular side inserted below the anterior border of the upper eye and immediately in advance of the vertical from this point, end of the tube hardly reaching the lower eye. Posterior nostril opening at the end of a short dorso-ventrally directed tube which is inserted in front of the lower eye immediately above the level of the base of the anterior nasal tube but below the level of the dorsal border of the eyeball of the lower eye. Anterior nasal tube of the blind side inserted on the margin of the labial groove, immediately in advance of the centre of the length of the buccal slit and on the anterior border of a smallish depression; tube large, elongated cylindrical, dilated at its extremity to form a cup or funnel, edge of which is ciliated or fringed. The nasal orifice itself opening at the bottom of this cup or funnel is somewhat obstructed dorsally by a meniscoid diaphragm and ventrally by a small, well developed tongue. The posterior nostril opens at the end of a short tube which is inserted on a level with or just below the axis of the body and just in advance of the vertical from the buccal commissure. More than half the length of the head anteriorly on the blind side covered with setiform fringes, completely surrounding the posterior nostril but a naked space round the base of the anterior nostril. Urohyal angle  $65^{\circ}$ . Lateral line straight as far as head, then turning vertically upwards, forming a semi-circle as it runs forwards and approaches the base of the dorsal more or less obliquely. On the ocular side the scales are ctenoid, more or less smaller on the snout and mandible than on

the rest of the head, these often as large as those of the abdomino-caudal region, which are more or less subequal. Each ray in the median section of the dorsal covered to the same height from the base with 3 or 4 series of subequal scales. Scales of the blind side a little smaller than those of the ocular side, their posterior fields reduced, spines indistinct, reduced to a few, or one, or even absent; bases of median dorsal rays scaled as on the ocular side. Yellowish brown, whole body including unpaired fins entirely covered with a fine reticulation of greyish brown or olivaceous encircling a great number of small, clear yellow spots which are hexagonal or rounded. The ground colour studded with a variable number of deep brown punctiform spots of which several often attain the size of the eye and are more or less distinctly haloed with clear yellow. On certain specimens 3 or 4 of these large spots are placed on the lateral line. Unpaired fins often darker than rest of body, narrowly bordered with white. Pectoral normally coloured at its base, ornamented with a velvety black spot, the form and size of which is very variable, generally oblong and not extending beyond  $\frac{2}{3}$ , often only  $\frac{1}{2}$ , of the length of the fin and never spreading on to the uppermost or the lowermost ray of the fin; the distal part of the pectoral, beyond the black spot, orange yellow, which fades to white shortly after death. Blind side whitish, rarely uniform, often showing signs of ambi-colouration, especially on the unpaired fins which are almost always pigmented with blackish brown along the free edges and sometimes the whole of the area of the fins is of this colour.

Length: Up to 345 mm.

Distribution: False Bay, Agulhas Bank to the Natal Coast; shallow water.

This sole is very close to Synapturichthys kleini kleini (Bonaparte) from the Mediterranean and only differs from it in the larger number of dorsal and anal rays (D. 81 - 95 against 72 - 91; A. 65 - 74 against 57 - 72) and the larger angle of the urohyal ( $65^{\circ}$  against  $45^{\circ}$  -  $50^{\circ}$ ).

Lepidology. (Plate VIII, figs. 35, 36, 39, 40).

Ctenoid on the ocular side and weakly ctenoid or cycloid on the blind side; small, smaller on the blind side than on the ocular side, adherent, regular in arrangement; 108 - 120 scales in lateral line of ocular side, 132 in that of blind side.

Ocular side - independent of the l.l.

Subrectangular, anterior margin more or less convex, finely scalloped, anterior angles largely rounded, lateral margins more or less convex or nearly straight; anterior length 71 - 83% of the total length, anterior breadth 54 - 77% of the anterior length, posterior breadth 91 - 121% of the anterior breadth. The majority of these scales are broader along the line between the anterior angles than along the line between the posterior angles. Focus minute but well defined and placed just anterior to the line joining the posterior angles.

Anterior field large; radii divergent from focus, lateral spread not great, continuous (except near the focus), smooth, well defined, increase in number from 6 - 10 near the focus to 24 - 30 at the anterior margin. Interradial circuli close-set, mostly entire, undulating, with irregular, blunt-pointed, rather obscure elements directed anteriorly interrupting their continuity.

TEXT-FIG. 24.

Lateral fields moderate in size, circuli close-set. Posterior field small, triangular, entirely covered with spines. Spines moderately long, at least those of the two marginal series (9 - 12% of the total length of the scale), strong, slightly blunt-pointed, slender, with curved lateral margins giving a somewhat broad base to each spine. Spines of the two marginal series homogeneous, of equal length, the others decreasing in length regularly as the focus is approached. Alternate arrangement into major and minor series distinct

and regular. Larger scales with 6 - 7 major and the same number of minor series in the median section of the posterior field, reduced to 2 - 4 laterally. Smaller scales with 3 - 4 similar series medianly and 1 - 3 laterally. First major series of 4 - 6 spines, and first minor series of a similar number, giving a marginal projecting series of 9 - 12 spines. Spines of the other major and minor series fall wholly within the confines of the posterior field.

Adjacent to the l.l.

A little longer than those away from the lateral line. Lateral margin adjacent to the lateral line scales practically straight or even slightly concave or undulated.

Lateral line.

Subtrapezoidal, posteriorly sharply but moderately narrowed, anterior angles more rounded than in non-lateral line scales. Maximum breadth 63% of total length.

Blind side - independent of l.l.

Oval, anterior margin convex, finely scalloped, anterior angles very largely rounded, lateral margins slightly convex. Anterior breadth 71 - 81% of total length, posterior breadth 64 - 74% of anterior breadth. Posterior field somewhat reduced in size, spines absent or few, rudimentary. Spines when present, short, blunt, forming a small group in the median section of the posterior field, sometimes only a single spine present placed medianly and well within the posterior margin. Alternate arrangement into major and minor series obscure or absent. Usually nearly all the spines fall wholly within the borders of the posterior field but occasionally one or two project, and then only their tips, beyond the posterior margin which is evenly convex. Total length of a blind side scale 49 - 56% of the total length, and 63 - 69% of the anterior length of the corresponding scale of the ocular side.

There are no signs of annuli, but occasionally lines of growth-arrest are found in a few scales.

(xv). AUSTROGLOSSUS.

Austroglossus, Regan, 1920, Ann. Durban Mus., ii, p. 217; Barnard, 1925, Ann. S. Afr. Mus., xxi, p. 406; Chabanaud, 1927, Bull. Inst. Ocean., Monaco, 500, p. 8; Chabanaud, 1930, Bull. Inst. Ocean., Monaco, 555, pp. 6 and 11.

Form elongate, tapering posteriorly. Dorsal and anal fins confluent with caudal; pectorals well developed. Lower lip not fringed; mouth strongly curved on blind side. Anterior nostril of ocular side tubular, posterior patent between the eyes; anterior nostril of blind side shortly tubular, without surrounding flap. Scales small, ctenoid on both sides of body. Lateral line straight on both sides. Pelvics small, equal and symmetrical.

Additional characters may be found in the synopsis on pages 98-103.

Two species found in South African seas.

Key to the South African Species.

- a. Pectoral of ocular side longer than head . . . 22. pectoralis.  
 b. Pectoral of ocular side shorter than head . . . 23. microlepis.

22. AUSTROGLOSSUS PECTORALIS (Kaup).  
 (East Coast Sole; Agulhas Bank Sole.).

Synaptura pectoralis, Kaup, 1858, Archiv. Natur., p. 96; Gunther, 1862, Cat. Fish. Brit. Mus., iv, p. 483; Boulenger, 1898, Mar. Invest. S. Afr., i, p. 3; Gilchrist, 1902, Mar. Invest. S. Afr., i, p. 144; Gilchrist, 1903, Mar. Invest. S. Afr., ii, p. 193; Gilchrist, 1916, Mar. Biol. Rept., iii, p. 16; Thompson, 1918, Mar. Biol. Rept., iv, p. 127.

Austroglossus pectoralis, Regan, 1920, Ann. Durban Mus., ii, p. 217; Von Bonde, 1922, Rep. Fish. Mar. Biol. Surv. S. Afr., ii, (1921), Spec. Rep. 1, p. 22; Barnard, 1925, Ann. S. Afr. Mus., xxi, p. 407; Chabanaud, 1927, Bull. Inst. Ocean., Monaco, 500, p. 8; Chabanaud, 1930, Bull. Inst. Ocean., Monaco, 555, p. 11.

TEXT-FIG. 25.

D. 95-110; A. 80-95; L. 1. 150-170.

Body lanceolate; depth  $3\frac{1}{4}$  to  $3\frac{3}{4}$ , head  $5\frac{1}{2}$  to 7, in length of body. Eyes small, separated by a scaled space which is about equal to diameter of eye, 6-9 in length of head, upper on a level with or very slightly in advance of lower. Mouth strongly curved on blind side, lips not fringed, maxillary reaching to about posterior border of pupil of lower eye. Pectorals well developed,

that of ocular side  $1\frac{1}{4}$  to 2 times as long as head, 3 times as long as that of blind side. Dorsal and anal attached to caudal, last dorsal (and anal) ray being entirely united for their whole length to its base; caudal distinct. Pelvics small, equal and symmetrical. Interior nasal tube of ocular side short, in front of lower eye, directed flatly backwards, not reaching the anterior border of the lower eye; posterior nostril not tubular, conspicuous, between the eyes. Anterior nostril of blind side shortly tubular, not dilated distally, without surrounding flap. Lateral line straight on both sides. Scales ctenoid on both sides of body, interradiial circuli confused, longitudinal. Brownish, more or less speckled with darker or uniform; dorsal and anal spotted and speckled with dark brown or black, pectoral of ocular side black; sometimes a number of indistinct darker vertical bands across body. Blind side whitish.

Length: Up to 590 mm. (23 inches).

Distribution: False Bay (rare), Agulhas Bank to Natal (rare further east than Cape Morgan), down to 60 fathoms.

Economically the most important of the South African Flatfishes. For details concerning the economics of this species attention is invited to the following:- Annexure "D" in Fisheries and Marine Biological Survey Report No.10 for 1932; Investigational Report No.1 in F.M.B.S.Rept.No.11 for 1933; and Fishery Bulletin No.2 of the F.M.B.S.Division of the Department of Commerce and Industries, published in 1935.

Lepidology. (Plate IX, figs.41,42).

Scales ctenoid on both sides of body, moderate in size, adherent, regular in arrangement; 150-170 scales in the lateral line.

Ocular side - independent of the l.l.

Quadrangular, anterior angles sharply rounded,  $90^{\circ}$ , anterior margin very slightly convex or straight, finely scalloped, scallops distinct, moderate in number, about 12,

lateral margins very slightly convex or straight; anterior length 68-72% of total length, anterior breadth 60-65% of anterior length, posterior breadth 100-102% of anterior breadth. Focus minute but well-defined, circular, rather posterior in position, about 1/3 of total length of scale from posterior margin. Anterior field of moderate size, radii parallel or sub-parallel, close-set, straight, well-defined, continuous, not very numerous, 3-4 near the focus, increasing to 10-12 at the anterior margin; interradii circuli confused, obscure, longitudinal (running in an antero-posterior direction). Lateral fields of moderate size, triangular, circuli close-set but become wider-spaced towards the junctions of the lateral and anterior fields. Posterior field relatively small, triangular, entirely covered with spines. Spines of moderate length, longest 14-16% of total length of scale, strong, slender, lateral margins very slightly curved, more markedly curved basally, bases broad, sharp-pointed. Alternate arrangement distinct and regular, 3-4 major and 3-4 minor series medianly, reduced to 1-2 laterally; first major series of 6-7 spines and first minor series of 5-6 spines, giving a marginal projecting series of 11-13 spines. Spines of the major series a little longer than those of the minor series. Marginal series project for about  $\frac{1}{2}$  to  $\frac{2}{3}$  their length beyond the posterior margin, which is slightly incised between adjacent spines. Other spines fall wholly within the confines of the posterior field.

Adjacent to the l.l.

Similar to scales away from the lateral line, but the lateral margin adjacent to the lateral line is concave.

Lateral line.

Much smaller than non-lateral line scales; more or less pear-shaped, sharply narrowed posteriorly, posterior extremity a blunt-pointed apex; anterior angles widely rounded. Muciferous canal medianly symmetrical, fairly long and narrow, entire posterior apex occupied by canal; spines absent.

Blind side - independent of the l.l.

Similar to ocular side scales, but the posterior field is a little reduced in size and the spines fewer. Marginal projecting series of 7-9 spines which are shorter and more slender than those of ocular side scales. Maximum breadth 55-58% of total length.

There are no signs of annuli.

23. AUSTROGLOSSUS MICROLEPIS (Bleeker).

(Small-scaled Sole; Super Sole; Dassen Island Sole; West Coast Sole.).

Synaptura microlepis, Bleeker, 1863, Versl. Akad. Wet. Amsterdam, xv, p. 456; Boulenger, 1898, Mar. Invest. S. Afr., i, p. 3; Gilchrist, 1902, Mar. Invest. S. Afr., i, p. 144; Gilchrist, 1916, Mar. Biol. Rept., iii, p. 16; Thompson, 1918, Mar. Biol. Rept., iv, p. 127; Von Bonde, 1922, Rep. Fish. Mar. Biol. Surv. S. Afr., ii, (1921), Spec. Rep. i, p. 22.

Austroglossus microlepis, Regan, 1920, Ann. Durban Mus., ii, p. 217; Barnard, 1925, Ann. S. Afr. Mus., xxi, p. 407; Chabanaud, 1927, Bull. Inst. Ocean., Monaco, 500, p. 8; Chabanaud, 1930, Bull. Inst. Ocean., Monaco, 555, p. 11.

TEXT-FIG. 26.

D. 82-100; A. 65-78; L. 1. 170-180.

Body elongate; depth  $3-3\frac{2}{3}$ , head 5-6, in length of body. Eyes small, separated by a scaled space which is about  $1\frac{1}{2}$  times diameter of eye, 7 to 8 in length of head, upper a little in advance of lower. Mouth strongly curved on blind side, lips not fringed, maxillary reaching to middle of lower eye. Pectorals well developed, that of ocular side  $\frac{1}{2}$  to  $\frac{2}{3}$  length of head, about  $1\frac{1}{2}$  times as long as that of blind side. Dorsal and anal attached to caudal as in A. pectoralis. Other characters as for A. pectoralis, except scales very small, ctenoid on both sides of body but more weakly so than in A. pectoralis. Brownish, speckled with darker or uniform, with or without indistinct dark vertical bands across body; dorsal and anal spotted and speckled with dark brown or black. Blind side whitish.

Length: Up to 1000 mm. (Largest specimen procured by the Fisheries and Marine Biological Survey - 41 inches, 12 lb.).

Distribution: Table Bay to Walvis Bay, shallow to moderately deep water.

The largest of the South African Flatfishes. At one time of considerable economic importance but not fished for at the

present time, although abundant.

Lepidology. (Plate IX, figs. 43a, 43b.).

Scales ctenoid on both sides of body, very small, adherent, regular in arrangement; 170-180 scales in the lateral line.

Ocular side - independent of the l.l.

Quadrangular, anterior angles narrowly rounded,  $90^{\circ}$ , anterior margin very slightly convex or straight, finely scalloped, scallops distinct, moderate in number, about 14-18, lateral margins very slightly convex or straight; anterior length 65-68% of total length, anterior breadth 78-82% of anterior length, posterior breadth 85-90% of anterior breadth. Focus minute but well-defined, circular, rather posterior in position, about  $\frac{1}{3}$  of total length of scale from posterior margin. Anterior field of moderate size, radii subparallel or very slightly divergent from focus, close-set, straight, well-defined, continuous, not very numerous, 4-6 near the focus, increasing to 14-16 at the anterior margin; interradii circuli confused, obscure, longitudinal. Lateral fields of moderate size, triangular, circuli close-set but become wider-spaced towards the junctions of the lateral and anterior fields. Posterior field relatively small, triangular, entirely covered with spines. Spines of moderate length, longest 11-13% of total length of scale, strong, slender, lateral margins very slightly curved, more markedly curved basally, base broad, sharp-pointed. Alternate arrangement mostly regular, sometimes disturbed, 4 major and 4 minor series medianly, reduced to 1-2 laterally; first major series of 8-9 spines and first minor series of 8 - 9 spines, giving a marginal projecting series of 16-18 spines. Spines of the major series a little longer than those of the minor series. Marginal series project for  $\frac{1}{2}$  to  $\frac{2}{3}$  their length beyond posterior margin, which is slightly incised between adjacent spines. Other spines fall wholly within the confines of the posterior field.

Adjacent to the l.l.

Similar to scales away from the lateral line, but the lateral margin adjacent to the lateral line is concave.

Lateral line.

Much smaller than non-lateral line scales; more or less pear-shaped, narrowly and rather sharply constricted posteriorly; anterior angles widely rounded. Muciferous canal medianly symmetrical, fairly long and narrow, entire posterior margin occupied by canal; spines absent.

Blind side - independent of the l.l.

Similar to ocular side scales, but the posterior field is much reduced in size and the spines much fewer in number. Marginal projecting series of 6 - 8 spines, which are shorter than those of ocular side scales. Maximum breadth 65-70% of total length.

There are no signs of annuli.

(xvi). BARNARDICHTHYS.

Barnardichthys, Chabanaud, 1927, Bull. Inst. Ocean., Monaco, 500, p.3; Chabanaud, 1930, Bull. Inst. Ocean., Monaco, 555, pp.6 and 11.

Characters as given in the synopsis on pages 98-103.

A monospecific South African genus.

24. BARNARDICHTHYS FULVOMARGINATA (Gilchrist).  
(Yellow-margined Sole.).

Solea fulvomarginata, Gilchrist, 1904, Mar. Invest. S. Afr., iii, p.13, pl. xxxiii; Thompson, 1918, Mar. Biol. Rept., iv, p.126; Von Bonde, 1922, Rep. Fish. Mar. Biol. Surv. S. Afr., ii, (1921), Spec. Rep. i, p.20; Barnard, 1925, Ann. S. Afr. Mus., xxi, p.400; Fowler, 1925, Proc. Acad. Nat. Sci. Philad., lxxvii, p.204.

Barnardichthys fulvomarginata, Chabanaud, 1927, Bull. Inst. Ocean., Monaco, 500, p.3; Chabanaud, 1930, Bull. Inst. Ocean., Monaco, 555, p.11.

## TEXT-FIG. 27.

D.75-80; A.60-65; P.ca.10; L.l.105-110.

Body ovate; depth  $2\frac{1}{3}$  to  $2\frac{2}{5}$ , head  $4\frac{2}{3}$  to 5, in length of body. Eye 6 to 7 in length of head, upper in advance of lower by about  $\frac{1}{2}$  diameter; eyes separated by a scaled space which is  $\frac{2}{3}$ .

diameter of eye. Pectorals small, that of ocular side 4 in head, base scaled, a little longer than that of blind side which has no scaly base. Pelvics as long as pectorals, equal and symmetrical. Snout broadly rounded, moderately hooked. Maxillary extending to below centre of lower eye. Opercular margins on both sides fringed, lips not at all. Posterior nostril of the ocular side opening on a level with the interocular space. Anterior nasal tube of the blind side not dilated distally, fringed, or surrounded by a naked space. Lateral line straight; on blind side bifurcates at middle of head, lower branch continuing straight on, upper branching off at right angles and curving round to base of anterior dorsal rays, sometimes a third branch below running to angle of mouth. First dorsal ray inserted on a level with the dorsal margin of the upper eye. Posterior margins of dorsal and anal almost vertical, the last rays of both fins short, the last one of each fin joined by its base to the caudal. Caudal rounded, peduncle deeper than long. Interradial circuli of the scales entire, convex anteriorly. Lemon yellow, most marked on the margins of the fins, except the pectoral of the blind side which is whitish. Cloudy patches of dark colour occur on the body, sometimes extending on to the bases of the vertical fins, the whole speckled with dark and white spots. Blind side of fins, extending on to the body to some extent, lemon yellow, rest of body whitish.

Length: Up to 250 mm.

Distribution: False Bay and Algoa Bay, shallow water; Natal Coast, 115 fathoms.

Lepidology. (Plate IX, figs. 44, 45.)

Scales ctenoid on both sides of body, of moderate size, adherent, regular in arrangement; 105-110 scales in the lateral line.

Ocular side - independent of the l.l.

Quadrangular, anterior angles sharply rounded, nearly 90°, anterior margin straight or evenly concave, scalloped, scallops

distinct, not numerous, 8 - 14, lateral margins rarely very slightly convex, mostly straight and slightly undulose; anterior length 68-72% of total length, anterior breadth 58-62% of anterior length, posterior breadth 90-95% of anterior breadth. Focus very small but well-defined, circular, rather posterior in position, about  $\frac{1}{3}$  of total length of scale from posterior margin. Anterior field of moderate size, radii divergent from focus, lateral spread small, moderately-spaced, straight, well-defined, continuous, not numerous, 4 - 6 near the focus, increasing to 8 - 12 at the anterior margin; interradial circuli very close-set, entire, curved towards the anterior margin. Lateral fields of moderate size, triangular, circuli very close-set. Posterior field of fair size, oval in shape, entirely covered with spines. Spines rather long, longest 10-15% of total length of scale, rather robust, lateral margins straight except basally where markedly curved, forming broad bases, sharp-pointed; alternate arrangement distinct and regular, 4 - 5 major and 4 - 5 minor series medianly, reduced to 3 - 4 laterally; first major series of 4 - 5 spines and first minor series of 4 - 5 spines, giving a marginal projecting series of 8 - 10 spines. Spines of major series a little longer than those of minor series. Marginal series project for about  $\frac{1}{2}$  their length beyond posterior margin, which is incised between adjacent spines. Spines of other major and minor series fall wholly within the confines of the posterior field.

Adjacent to the l.l.

Similar to scales away from the lateral line, but the lateral margin adjacent to the lateral line is concave.

Lateral line.

Much smaller than non-lateral line scales; more or less pear-shaped, narrowed posteriorly, anterior angles sharply rounded, anterior margin more or less straight. Muciferous canal medianly symmetrical, long and fairly wide; spines absent.

Blind side - independent of the l.l.

Similar to ocular side scales, but the posterior field is a little reduced in size and the spines are fewer. Marginal projecting series of 6 - 8 spines, 3 - 4 major and 2 - 3 minor series medianly, reduced to 2 laterally. Spines shorter than those of ocular side scales. Radii of anterior field reduced in number to 6 - 8. Maximum breadth 40 - 45% of total length.

There are no signs of annuli.

(xvii). QUENSELIA.

Quenselia, Jordan and Goss, 1889, Rep. U.S. Comm. Fish. and Fisheries, (1886), p. 306; Chabanaud, 1930, Bull. Inst. Ocean., Monaco, 555, pp. 6 and 11; Chabanaud, 1931, Riviera Sci., Suppl. Mem., ii, p. 26; Chabanaud, 1933, Mem. Soc. Sci. Nat. Maroc, xxxv, p. 78.  
Echinosolea, Chabanaud, 1927, Bull. Inst. Ocean., Monaco, 488, p. 10.

Characters as given in the synopsis on pages 98 - 103.

One species found in South African waters.

25. QUENSELIA OCELLATA (Linnaeus).  
(Ocellate Sole.)

Pleuronectes ocellatus, Linnaeus, 1758, Syst. Natur., ed. 10, reformata, i, p. 269; Risso, 1810, Ichthyol. Nice, Paris, p. 248.  
Pleuronectes pegusa, Lacépède, 1802, Hist. Nat. Poiss., iv, p. 639.  
Solea oculata, Risso, 1826, Hist. Nat. princip. product. l' Europe merid., Paris, iii, p. 248; Bonaparte, 1832, Iconograph. Faun. Ital., iii, tab. fig. 1; Günther, 1862, Cat. Fish. Brit. Mus., iv, p. 465; Verany, 1862, Statist. Dept. Alpes-Maritimes, p. 40; Moreau, 1881, Hist. Nat. Poiss. Fr., iii, p. 313.  
Quenselia ocellata, Jordan and Goss, 1889, Rep. U.S. Comm. Fish. and Fisheries, (1886), p. 307; Chabanaud, 1930, Bull. Inst. Ocean., Monaco, 555, p. 11; Chabanaud, 1930, Bull. Soc. Zool. France, lv, p. 222; Chabanaud, 1931, Bull. Mus. Nat. Hist. Nat., (2) ii, p. 626, (1930); Chabanaud, 1931, Riviera Sci., Suppl. Mem., ii, pp. 13 and 26; Chabanaud, 1933, Mem. Soc. Sci. Nat. Maroc., xxxv, p. 79.  
Solea ocellata, Kyle, 1913, Rep. Danish Ocean. Exped. Mediterr., 1908-1910, ii, pp. 115 and 119; De Buen, 1926, Res. campan. realiz. por. acuerdos internacional., Madrid, ii, p. 92.  
Solea quadriocellata, Von Bonde, 1922, Rep. Fish. Mar. Biol. Surv. S. Afr., ii, (1921), Spec. Rep. i, p. 20, pl. ii, fig. 2; Barnard, 1925, Ann. S. Afr. Mus., xxi, p. 401.  
Echinosolea oculata, Chabanaud, 1927, Bull. Inst. Ocean., Monaco, 488, p. 10.

## TEXT-FIG. 28.

D. (62)63-67; A. (48)50-57; P. r. 7-8, 1.5-7; L. 1.69-74(100).

Body ovate; depth 2 to  $2\frac{2}{3}$ , head 4 to 5 in length of body. Eye 4 to nearly 5 in length of head, upper in advance of lower by about  $\frac{1}{2}$  diameter; eyes separated by a scaled concave space

which is about  $\frac{3}{4}$  diameter of eye; scaly eyelids covering about half of eyeballs. Pectorals small, that of ocular side  $2\frac{2}{5}$  in length of head, scaled from base for about half of length, twice as long as that of blind side, base of which is only slightly scaled. Pelvics equal and symmetrical, each of 5 rays, bases scaled. Snout narrowly rounded, hooked round front of mandible. Maxillary reaching to below anterior half of lower eye. Opercular margins feebly fringed, lips not at all. Anterior nostril of ocular side situated on the vertical from the anterior border of the upper eye. Anterior nostril of the blind side not dilated distally or fringed. Supratemporal part of the lateral line not composed of pierced scales but distinct under certain conditions of light, forming an S-shaped figure, the superior curve posterior to the vertical from the inferior curve. Anterior dorsal ray inserted a little in advance of the vertical from the anterior border of the upper eye; last dorsal (and anal) ray without a posterior membrane, entirely free from caudal peduncle; dorsal and anal fins highest towards their median portions, scaled for nearly their entire lengths. Caudal rounded, of 17 rays. Scales rectangular, interradii circuli interrupted into anteriorly directed elements; spines rough, the median spine of the marginal series much longer than the others. Brownish-or reddish-grey, more or less distinctly spotted with black. A series (2 or 3) of large ocellate (black edged with white) spots on posterior part of body along base of dorsal and a similar symmetrically-placed series along base of anal. A large, vertically-elliptical, black spot nearly always present on the anterior part of the lateral line, which sometimes carries another very small black spot situated in the centre of the quadrilateral formed by the posterior ocellate spots. Dorsal and anal fins finely bordered with white, as also the caudal which is clear yellowish, more or less distinctly mottled with dark brown and carries a dark vertical band across its base. Pectoral brown or blackish. Blind side whitish.

Length: Up to 160 mm.

Distribution: Natal Coast, 30 fathoms.

Lepidology. (Plate X, figs. 46, 47.)

Scales ctenoid on both sides of body, of moderate size, adherent, regular in arrangement; 69-74 scales in the lateral line as a rule, but sometimes as many as 100 are present.

Ocular side - independent of the l.l.

Rectangular, anterior angles fairly sharply rounded, nearly 90°, anterior margin very slightly convex, finely scalloped, scallops distinct, not very numerous, 14 - 16, lateral margins very slightly convex or straight, always a little undulose; anterior length 70 - 75% of total length, anterior breadth 60 - 65% of anterior length, posterior breadth 90-95% of anterior breadth. Focus minute but well-defined, oval, rather posterior in position, about  $\frac{1}{4}$  of total length of scale from posterior margin. Anterior field of moderate size, radii divergent from focus, lateral spread small, straight or very slightly undulose, well-defined and rather wide, moderately-spaced, continuous, not numerous, 4 - 6 near the focus, increasing to 12 - 14 at the anterior margin; interradii circuli very close-set, discontinuous, interrupted into minute, anteriorly-directed, sharp-pointed crenulations (somewhat similar to those found in Synapturichthys kleini variolosa (see Text-fig.24)). Lateral fields of moderate size, triangular, circuli very close-set. Posterior field fairly large, triangular, entirely covered with spines. Spines moderately long, longest 12-16% of total length of scale, strong and robust, lateral margins very slightly curved more markedly curved basally, bases broad, more or less sharp-pointed; alternate arrangement distinct and regular, 5 - 6 major and 5 - 6 minor series medianly, reduced to 1 - 2 laterally; first major series of 9 spines and first minor series

of 8 - 9 spines, giving a marginal projecting series of 17 - 18 spines. Spines of marginal series homogeneous, of about equal length except median spine (which is also the median spine of the first major series) which is much longer than any of the others. Other spines decrease in length successively towards the focus. Spines of marginal series project for about  $\frac{1}{3}$  their length beyond posterior margin, which is slightly incised between adjacent spines. Other spines fall wholly within the confines of the posterior field.

Adjacent to the l.l.

Similar to scales away from the lateral line, but lateral margin adjacent to lateral line is concave.

Lateral line.

Much smaller than non-lateral line scales; more or less pear-shaped, narrowed posteriorly; anterior angles widely rounded. Muciferous canal in the form of a perforation, oval or circular in shape, placed medianly just inside the posterior margin, continued as a canal for a short distance towards the centre of the scale; spines absent.

Blind side - independent of the l.l.

Similar to ocular side scales, but the posterior field a very little reduced in size; spines a little shorter but hardly reduced in number. Maximum breadth 42 - 46% of total length.

There are no signs of annuli.

(xviii). DICOLOGLOSSA.

Dicologlossa (errore Dicologlossa), Chabanaud, 1927, Bull. Inst. Ocean., Monaco, 488, p. 14; Barnard, 1927, Ann. S. Afr. Mus., xxi, p. 1026.

Dicologlossa, Chabanaud, 1930, Bull. Inst. Ocean., Monaco, 555, pp. 7 and 12; Chabanaud, 1931, Riviera Sci., Suppl. Mem., ii, p. 28; Chabanaud, 1933, Mem. Soc. Sci. Nat. Maroc., xxxv, p. 86.

Characters as given in the synopsis on pages 98-103.

One species found in South African seas.

26. DICOLOGOGLOSSA CUNEATA (Moreau).  
(Blunt-nosed Sole.).

Solea angulosa (pro parte), Kaup, 1858, Archiv. Natur., p. 94; Kyle, 1913, Rep. Danish Ocean. Exped. Mediterr., 1908-1910, ii, p. 312; De Buen, 1926, Res. campan. realiz. por acuerdos internacional., Madrid, ii, p. 91.

Solea cuneata, Moreau, 1881, Hist. Nat. Poiss. France, iii, p. 312.

Solea senegalensis var. m'baoensis, Pellegrin, 1907, Bull. Soc. Zool. France, xxxii, p. 87; Pellegrin, 1914, Ann. Inst. Ocean., Paris, N.S. vi(4), pp. 74 and 75, pl. i, fig. 1.

Solea cleverleyi, Gilchrist, 1906, Mar. Invest. S. Afr., iv, p. 160, pl. xlv; Thompson, 1918, Mar. Biol. Rept., iv, p. 126; Von Bonde, 1922, Rep. Fish. Mar. Biol. Surv. S. Afr., ii, (1921), Spec. Rep. i, p. 17.

Solea vulgaris, Pellegrin, 1914, Ann. Inst. Ocean., Paris, N.S. vi(4), p. 74.

Solea senegalensis, Barnard, 1925, Ann. S. Afr. Mus., xxi, p. 399.

Dicologoglossa (errore Dicologlossa) cuneata, Chabanaud, 1927, Bull. Inst. Ocean., Monaco, 488, p. 23; Barnard, 1927, Ann. S. Afr. Mus., xxi, p. 1026.

Dicologoglossa cuneata, Chabanaud, 1930, Bull. Inst. Ocean., Monaco, 555, p. 12; Chabanaud, 1931, Riviera Sci., Suppl. Mem., ii, pp. 14 and 28; Chabanaud, 1933, Mem. Soc. Sci. Nat. Maroc, xxxv, p. 86.

TEXT-FIG. 29.

D. 81-89; A. 65-77; P. 8-10; L. 1.105-132.

Body narrow ovate; depth 3 to  $3\frac{1}{5}$ , head  $4\frac{1}{2}$  to  $5\frac{1}{2}$ , in length of body. Eye  $4\frac{1}{2}$  to  $5\frac{1}{2}$  in length of head, upper in advance of lower by about  $\frac{1}{2}$  diameter; eyes separated by a concave scaled space which is about  $\frac{1}{2}$  diameter of eye; scaly eyelids not covering half of eyeballs. Pectorals long, obliquely rounded, sometimes triangular, that of ocular side  $1\frac{2}{3}$  to 2 in head, scaled from base for about half of length, a little longer than that of blind side. Pelvics less than  $\frac{1}{2}$  pectorals, equal and symmetrical. Snout truncate, slightly in advance of lower jaw. Maxillary reaching to below posterior half of lower eye. Opercular margins feebly fringed, lips not at all. Anterior nostril of ocular side situated on the vertical from the anterior border of the upper eye, the extremity of the tube not or hardly extending beyond the posterior nostril. Anterior nasal tube of the blind side short, not dilated distally, fringed, or surrounded by a naked space. Supratemporal part of the lateral line composed of pierced scales for the most part, forming an S-shaped figure, the superior curve posterior to the vertical from the inferior curve. First dorsal ray inserted above the border of the upper eye or the base of the anterior nostril; last dorsal (and anal)

ray with a posterior membrane, extremity attached to the base of the caudal. Caudal rounded, of 20 rays. Scales smooth, rectangular, marginal series of spines homogeneous, interradii circuli interrupted into posteriorly-directed elements. Brown, more or less clear, sometimes greyish, uniform or speckled with dark brown. Occasionally a series of dark spots arranged longitudinally along the bases of the dorsal and anal, sometimes also several dark spots along the lateral line. Dorsal, anal and caudal fins more or less dusky and generally bordered with white. Pectoral with an oblong dark spot covering the distal third of the 3 or 4 longer rays, but not extending on to the superior ray. Blind side whitish.

Length: Up to 262 mm.

Distribution: Walvis Bay, South West Africa.

Lepidology. (Plate X, figs. 48, 49.)

Scales ctenoid on both sides of body, moderate to large in size, adherent, regular in arrangement; 105-132 scales in the lateral line.

Ocular side - independent of the l.l.

Rectangular, anterior angles narrowly rounded, nearly  $90^\circ$ , anterior margin very slightly convex or straight, finely scalloped scallops very distinct, not numerous, 12 - 14, lateral margins straight, slightly undulose; anterior length 75-80% of total length, anterior breadth 55-60% of anterior length, posterior breadth 100-110% of anterior breadth. Focus small but well-defined, oval, rather posterior in position, about  $\frac{1}{5}$  of total length of scale from posterior margin. Anterior field of moderate size, radii divergent from focus, lateral spread moderate, straight, rather wide, continuous, well-defined, moderately-spaced, not numerous, 4 - 6 near the focus, increasing to 10-12 at the anterior margin; interradii circuli discontinuous, interrupted into minute, semicircular, posteriorly-directed crenulations.

Lateral fields of moderate size, triangular, circuli very close-set. Posterior field somewhat small, triangular, entirely covered with spines. Spines short, longest 6 - 8% of total length of scale, strong and robust, sharp-pointed, lateral margins curved, more markedly curved basally, bases broad; alternate arrangement not always distinct, fairly regular, 4 - 5 major and 4 - 5 minor series medianly, reduced to 2 laterally; first major series of 11 - 12 spines and first minor series of 11 - 12 spines, giving a marginal projecting series of 22 - 24 spines. Spines of marginal series homogeneous, of equal length, others decreasing in length successively, towards the focus. Spines of marginal series project for about  $\frac{1}{3}$  their length beyond posterior margin, which is incised between adjacent spines. Other spines fall wholly within the confines of the posterior field.

Adjacent to the l.l.

Similar to scales away from the lateral line, but the lateral margin adjacent to the lateral line is concave.

Lateral line.

Much smaller than non-lateral line scales; pear-shaped, sharply narrowed posteriorly, posterior extremity a blunt apex, anterior angles widely rounded. Muciferous canal medianly symmetrical, narrow posteriorly but broadens out near the centre of the scale; spines absent.

Blind side - independent of the l.l.

Similar to ocular side scales, but the posterior field is slightly reduced in size; spines fewer and shorter. Maximum breadth 50 - 55% of total length.

There are no signs of annuli.

(xix). SOLEA.

Solea, Rondelet, 1554, De Piscibus, p.322; Klein, 1744, Hist. Piscium, iv, p.31; Quensel, 1806, Svenska Vetenskaps. Akad. Nya Handl., xxvii, p.44; (pro parte) Cuvier, 1817, Regne Anim., ed.2, ii, p.223; (pro parte) and Microbuglossus, Günther, 1862, Cat. Fish. Brit. Mus.

iv, p. 462; (pro parte) Moreau, 1881, Hist. Nat. Poiss. France, iii, p. 303; (pro parte) Barnard, 1925, Ann. S. Afr. Mus., xxi, pp. 399 and 1026; Chabanaud, 1927, Bull. Inst. Ocean., Monaco, 488, p. 31; Norman, 1928, Rec. Ind. Mus., xxx, p. 174; (pro parte) Weber and De Beaufort, 1929, Fish. Indo-Austral. Archipel., v, p. 147; Chabanaud, 1930, Bull. Inst. Ocean., Monaco, 555, pp. 7 and 13; Chabanaud, 1931, Riviera Sci., Suppl. Mem., ii, p. 28; Chabanaud, 1933, Mem. Soc. Sci. Nat. Maroc, xxxv, p. 87.

Characters as given in the synopsis on pages 98 - 103.

One species found in South African waters.

27. SOLEA BLEEKERI, Boulenger.  
(Bleeker's Sole.)

Solea impar, Bleeker, 1863, Versl. Akad. Vet. Amsterdam, xv, p. 458 (impar non Bennett); Von Bonde, 1922, Rep. Fish. Mar. Biol. Surv. S. Afr., ii, (1921), Spec. Rep. i, p. 18.

Solea bleekeri, Boulenger, 1898, Mar. Invest. S. Afr., i, p. 2; Gilchrist, 1902, Mar. Invest. S. Afr., i, p. 145; Regan, 1916, Ann. Durban Mus., i, p. 170; Thompson, 1918, Mar. Biol. Rept., iv, p. 125; Barnard, 1925, Ann. S. Afr. Mus., xxi, p. 403; Chabanaud, 1930, Bull. Inst. Ocean., Monaco, 555, p. 13; Fowler, 1934, Proc. Acad. Nat. Sci. Philad., lxxxvi, p. 436.

Solea turbynei, Gilchrist, 1904, Mar. Invest. S. Afr., iii, p. 10, pl. xxviii; Gilchrist and Thompson, 1909, Ann. S. Afr. Mus., vi, p. 261; Thompson, 1918, Mar. Biol. Rept., iv, p. 126; Regan, 1920, Ann. Durban Mus., ii, p. 215; Von Bonde, 1922, Rep. Fish. Mar. Biol. Surv. S. Afr., ii, (1921), Spec. Rep. i, p. 17; Von Bonde, 1925, Trans. Roy. Soc. S. Afr., xii, p. 291; Fowler, 1925, Proc. Acad. Nat. Sci. Philad., lxxvii, p. 205.

Solea simonensis, Von Bonde, 1922, Rep. Fish. Mar. Biol. Surv. S. Afr., ii, (1921), Spec. Rep. i, p. 19, pl. v, fig. 1.

TEXT-FIG. 31.

D. 62-74; A. 50-59; P. 7-8; L. 1.95-105.

Body ovate; depth  $2\frac{1}{4}$  to  $2\frac{3}{4}$ , head 4 to  $4\frac{2}{3}$ , in length of body. Eyes  $5\frac{1}{2}$  to 7 in length of head, equal to or a little less than interocular space which is scaled, upper in advance of lower by about  $\frac{1}{2}$  diameter of eye. Snout rounded, hooked; maxillary reaching to nearly below centre of lower eye; teeth minute, on blind side of both jaws. Opercular margin fringed on both sides; lips feebly fringed or not at all. Dorsal fin commences on snout above the level of the dorsal margin of the upper eye, longest ray  $2\frac{1}{2}$  to more than 4 in length of head, young specimens may have 60 rays in the dorsal; anal similar to dorsal, young specimens may have 45 anal rays. Last dorsal and anal rays free from caudal. Pectorals well developed, superior ray simple, others branched, that of ocular side  $2\frac{1}{2}$  to 3 in length of head, that of blind side

slightly shorter. Pelvics shorter than pectorals, equal and symmetrical, each of 5 rays. Anterior nasal tube of ocular side dilated distally, but not fringed or surrounded by a naked space. Lateral line straight as far as head, then bending at right angles towards dorsal profile, and then running forwards parallel with profile. Scales ctenoid on both sides of body. Caudal rounded. Brown, with darker spots and specks on body and darker streaks on dorsal and anal fins; pectoral of ocular side with black spot on distal half (rarely absent). Blind side whitish.

Length: Up to 174 mm.

Distribution: False Bay, Agulhas Bank, Natal and Zululand Coasts to Delagoa Bay, down to 30 fathoms.

Lepidology. (Plate VIII, figs. 37, 38.)

Scales ctenoid on both sides of body, small, adherent, regular in arrangement; 95 - 105 scales in the lateral line.

Ocular side - independent of the l.l.

Rectangular, anterior angles very narrowly rounded,  $90^\circ$ , anterior margin straight or slightly concave, finely scalloped, scallops indistinct, not numerous, 12 - 14, lateral margins straight anterior length 60-65% of total length, anterior breadth 65-70% of anterior length, posterior breadth 95-100% of anterior breadth. Focus minute but well-defined, circular, rather posterior in position, about  $\frac{1}{3}$  of total length of scale from posterior margin. Anterior field of moderate size, triangular, radii subparallel or very slightly divergent from focus, well-defined, straight but slightly undulose, continuous, fairly closely-set, not numerous, 3 - 5 near the focus, increasing to 10 - 12 at the anterior margin; interradii circuli very close-set, entire mostly but sometimes a little discontinuous, curved towards the anterior margin. Lateral fields of moderate size, triangular, circuli close-set. Posterior field of fair size, triangular, entirely covered with spines. Spines fairly long, longest 22 - 24% of total length of scale, strong and robust, sharp-pointed, lateral

margins straight but curved basally, bases broad; alternate arrangement distinct and regular, 4 major and 4 minor series medianly, reduced to 2 laterally; first major series of 5 - 6 spines and first minor series of 5 - 6 spines, giving a marginal projecting series of 10 - 12 spines. Spines of marginal series homogeneous, of equal length; others decrease in length successively towards the focus. Spines of marginal series project for about  $\frac{1}{6}$  to  $\frac{1}{3}$  their length beyond posterior margin; others fall wholly within the confines of the posterior field.

Adjacent to the l.l.

Similar to scales away from the lateral line, but lateral margin adjacent to lateral line is concave.

Lateral line.

Much smaller than non-lateral line scales; almost pear-shaped, narrowly and sharply constricted posteriorly; anterior angles widely rounded. Muciferous canal medianly symmetrical, wide and short, entire posterior margin occupied by canal; spines absent.

Blind side - independent of the l.l.

Similar to ocular side scales; but somewhat narrower posteriorly than anteriorly; posterior field a little reduced in size, spines fewer and shorter; radii of anterior field reduced in number, 2 - 3 near the focus and 6 - 8 at the anterior margin. Maximum breadth 45 - 50% of total length.

There are no signs of true annuli, but occasionally a few scales show a single line of growth-arrest close to the periphery of the scale.

(xx). SYNAPTURA.

Synaptura, Cantor, 1849, Journ. Roy. Asiat. Soc. Bengal, xviii, p. 222; (pro parte) Kaup, 1858, Archiv. Natur., xxiv, p. 96; (pro parte) Günther, 1862, Cat. Fish. Brit. Mus. iv, p. 480; Bleeker, 1872, Atlas Ichthyol., vi, p. 18; Barnard, 1925, Ann. S. Afr. Mus., xxi, p. 405; Chabanaud, 1928, Bull. Soc. Zool. France, liii, p. 274; (pro parte) Weber and De Beaufort, 1929, Fish. Indo-Austral. Archipel., v, p. 166; Chabanaud, 1930, Bull. Inst. Ocean., Monaco, 555, pp. 8 and 14.

Brachirus (pro parte) Norman, 1928, Rec. Ind. Mus., xxx, p. 177.

Pectorals well developed. Lower lip fringed. Anterior nostril of the blind side surrounded by a fringed flap, much

centre of the upper eye, rays gradually increasing in size to the last, longest ray about  $2\frac{2}{5}$  in length of head; on blind side, in the male, all the rays have a membranous fringe joined to the body at the base of each fin, fringes more pronounced anteriorly. Anal similar to dorsal. Dorsal and anal joined to caudal. Pectorals about equal,  $3\frac{1}{2}$  to 4 in length of head - in barnardi, that of ocular side 8 in length of head, that of blind side slightly longer. Pelvics small, more or less equal, symmetrical. Anterior nostril of ocular side tubular, posterior with a fringed flap. Anterior nostril of blind side surrounded by a fringed flap, much developed behind and covering a naked groove. Scales small, ctenoid on both sides of body, more feebly on blind side; in the male some of the scales bearing short filamentous processes which are more numerous on the head; isolated cycloid scales on blind side especially towards anterior part of fish. Lateral line straight on both sides as far as head; on blind side bifurcates, supratemporal branch bent at right angles to straight body part, running slightly obliquely backwards towards dorsal base and then curving sharply forwards and running along base of dorsal. Caudal obtusely acuminate. Dark brown or greyish, with small isolated brown spots on head and body; irregular, very small, white spots, chiefly along lateral line and on anterior upper part of head and body. Dorsal and anal slightly darker at bases, speckled with dark spots and edged with white. Pectoral blackish or lighter, edged with white. Blind side whitish.

Length: Up to 340 mm.

Distribution: Algoa Bay to Natal, shallow water.

All the specimens of S.marginata (labelled S.ciliata) examined are larger than 200 mm., whereas the single specimen of S.barnardi is only 86 mm. in length. No intermediate material is available, but, in spite of the smaller pectorals and the

peculiar fold formed by the opercular membrane of the ocular side found in the latter, other more important diagnostic features leave no room for doubt that S. barnardi is a juvenile of S. marginata.

Lepidology. (Plate X, figs. 50, 51; and Plate XI, figs. 52, 53.).

Ctenoid on the ocular side and more weakly ctenoid on the blind side. Isolated cycloid scales on the blind side in the anterior half of the body and on the head; in the male some of the scales bearing short filamentous processes, such scales more numerous on the head and along the anterior part of the lateral line. Scales small, slightly smaller on the blind side than on the ocular side, adherent, regular in arrangement; 100 to 124 scales in the lateral line.

Ocular side - independent of the l.l.

Subrectangular, anterior margin more or less convex, sometimes nearly straight, finely scalloped, anterior angles nearly  $90^\circ$ , rather acutely rounded, lateral margins more or less convex or straight; anterior length 73-76% of the total length, anterior breadth 58-68% of the anterior length, posterior breadth 94-97% of the anterior breadth. The majority of these scales are very slightly broader along the line between the anterior angles than along the line between the posterior angles. Focus minute, not very well defined, surrounded by interrupted circuli, placed just anterior to the line joining the posterior angles. Anterior field large; radii divergent from the focus, lateral spread moderate, continuous, smooth, practically straight, well-defined, increase in number from 3 - 5 near the focus to 10-14 at the anterior margin. (In the juvenile, barnardi, the radii are reduced in number - 1 - 2 near the focus and 5 - 6 at the anterior margin). Interradial circuli close-set, entire for the most part but their continuity interrupted to form rather irregular, minute, sharp-pointed peaks directed anteriorly (somewhat similar to those found in Quenselia ocellata.) Lateral fields fairly large, triangular, circuli close-set.

Posterior field small, roughly triangular, almost entirely covered with spines, two small lateral areas free of spines. Spines fairly long, 14 - 22% of the total length of the scale, strong, somewhat blunt-pointed (more sharply-pointed in barnardi), robust (more slender in barnardi), lateral margins moderately curved giving a fairly broad base to each spine. Spines of the two marginal series homogeneous, of equal length, the others very much shorter and decreasing in length regularly as the focus is approached. Alternate arrangement into major and minor series distinct and regular; 5 - 6 major and 4 - 5 minor series in the median section of the posterior field, reduced to 1 - 3 laterally. First major series of 4 - 5 spines and first minor series of 3 - 4 spines, giving a marginal projecting series of 7 - 9 spines. In the juvenile, barnardi, there is only a single major series of 2 - 4 spines and a single minor series of 2 - 3 spines, giving a marginal projecting series of 5 - 7 spines. Spines of the other major and minor series fall wholly within the confines of the posterior field.

Adjacent to the l.l.

More definitely rectangular in shape, anterior angles less rounded than in scales away from the lateral line. Lateral margins straight, or, in the case of the margin adjacent to the l.l. scales, slightly concave. Radii reduced in number, 3 - 4 at the anterior margin.

Lateral line.

Much smaller than non-lateral line scales; more or less pear-shaped, anterior angles widely rounded. Muciferous canal medianly symmetrical, long and fairly broad, occupying whole of posterior margin; spines absent.

Blind side - independent of the l.l.

Subrectangular, anterior margin convex, finely scalloped anterior angles well rounded, lateral margins slightly convex;

anterior length 86-92% of the total length, anterior breadth 54 - 66% of the anterior length, posterior breadth 86 - 98% of the anterior breadth. Posterior field considerably reduced in size, spines reduced in number, occasionally absent. Spines, when present, short, blunt, forming a small group in the median section of the posterior field, sometimes only a single spine present placed medianly. Usually all the spines fall wholly within the confines of the posterior field, but sometimes one or two may project, and then only the tips, beyond the posterior margin which is usually evenly convex but may be undulating. Alternate arrangement into major and minor series obscure or absent. Total length of a blind side scale 68-70% of the total length and 86 - 90% of the anterior length of the corresponding scale of the ocular side.

There are no signs of annuli.

(xxi). ZEBRIAS.

Zebrias, Jordan and Snyder, 1900, Proc. U.S. Nat. Mus., xxiii, p. 380; Jordan and Starks, 1906, Proc. U.S. Nat. Mus., xxxi, p. 232; Norman, 1928, Rec. Ind. Mus., xxx, p. 184; Chabanaud, 1930, Bull. Inst. Ocean., Monaco, 555, pp. 9 and 16; Chabanaud, 1934, Bull. Soc. zool. Fr., lix, pp. 421, 422 and 431.

Characters as given in the synopsis on pages 98 - 103.

One subgenus represented in South African waters.

Subgenus PS EUDAESOPIA.

Pseudaesopia, Chabanaud, 1934, Bull. Soc. zool. Fr., lix, pp. 424 and 433.

Membrane connecting the last dorsal ray with the adjacent caudal ray, and similarly the membrane connecting the last anal ray with the adjacent caudal ray, prolonged as far as the extremities of these rays but deeply incised; lowest part of this emargination on a level with the proximal quarter of the last dorsal and anal ray. Eyes contiguous. Angle of urohyal acute. Rays of all the fins simple.

A single species found in South African seas.

29. ZEBRIAS (PSEUDAESOPIA) REGANI (Gilchrist).  
(Regan's Double-banded Sole).

Synaptura zebra, Gilchrist, 1902, Mar. Invest. S. Afr., i, p. 144 (zebra non Bloch).

Synaptura regani, Gilchrist, 1906, Mar. Invest. S. Afr., iv, p. 160, pl. xlv; Gilchrist and Thompson, 1917, Ann. Durban Mus., i, p. 398.

Zebrias regani, Regan, 1920, Ann. Durban Mus., ii, p. 218; Von Bonde, 1922, Rep. Fish. Mar. Biol. Surv. S. Afr., ii, (1921), Spec. Rep. i, p. 21.

Aesopia regani, Barnard, 1925, Ann. S. Afr. Mus., xxi, p. 408; Chabanaud, 1930, Bull. Inst. Ocean., Monaco, 555, p. 17.

Zebrias (Pseudaesopia) regani, Chabanaud, 1934, Bull. Soc. zool. Fr., lix, pp. 424 and 433.

TEXT-FIG. 33.

D. 65-70; A. 56-60; L. 1.82-90.

Body ovate; depth  $2\frac{1}{2}$  to  $2\frac{2}{3}$ , head  $5\frac{1}{2}$ , in length of body. Eyes contiguous, upper in advance of lower by about  $\frac{1}{3}$  to  $\frac{1}{2}$  diameter,  $4\frac{1}{2}$  to 5 in length of head. Maxillary reaching to anterior part of lower eye; lips not fringed. Pectorals small, that of ocular side of 9 rays and about equal to diameter of eye, that of blind side of 9 rays and about  $\frac{1}{2}$  length of pectoral of ocular side. Last dorsal (and anal) ray attached to caudal by a membrane which reaches to its tip but is deeply incised. Pelvics of 4 rays. Caudal of 18 rays, distinct, depth of base about  $\frac{1}{2}$  length of head. Anterior nasal tube of ocular side short, directed flatly backwards, not reaching the anterior margin of the lower eye; posterior nostril not tubular, in front of lower eye. Nostrils of blind side inconspicuous. Lateral line straight on both sides to head. Scales sub-rectangular, strongly ctenoid on both sides of the body, extending on to each ray of dorsal and anal in a double series, which become a single series in the outer half of the fin. Greyish, with 26 to 27 dark cross-bands across body and head, extending on to dorsal and anal fins. The bands are arranged in pairs, each pair separated by a narrow lighter band. This pairing breaks down to some extent in the posterior half of the body; anterior band of first pair on snout, posterior passing through eyes; anterior band of fourth pair through base of pectoral; last band on base of caudal which is blackish in its posterior half with oblong white spots. Blind side whitish.

Length: Up to 140 mm.

Distribution: Natal Coast, shallow water.

Lepidology. (Plate XI, figs. 54, 55).

Scales ctenoid on both sides of body, moderate in size, adherent, regular in arrangement; 82 - 90 scales in the lateral line.

Ocular side - independent of the l.l.

Subrectangular, anterior angles fairly widely rounded, anterior margin convex, fairly markedly scalloped, scallops very distinct, not numerous, 10 - 12, lateral margins straight or very slightly convex; anterior length 60 - 65% of total length, anterior breadth 60 - 65% of anterior length, posterior breadth 100 - 105% of anterior breadth. Focus minute but well-defined, circular, not greatly posterior in position, little less than  $\frac{1}{2}$  total length of scale from posterior margin. Anterior field of moderate size, radii divergent from focus, lateral spread not large, well-defined, straight, continuous, moderately-spaced, not numerous, 3 - 4 near the focus, increasing to 10 at the anterior margin; all the radii end exclusively at the anterior margin, hardly ever at the anterior parts of the lateral margins; interradii circuli very close-set, entire mostly, curved towards the anterior margin. Lateral fields of moderate size, triangular, circuli close-set. Posterior field of fair size, triangular, entirely covered with spines. Spines rather long, longest 20-25% of total length of scale, strong and robust, sharp-pointed, lateral margins straight or slightly convex except basally where concave, bases fairly broad; alternate arrangement distinct and regular, 6 - 7 major and 5 - 6 minor series medianly, reduced to 1 - 2 laterally; first major series of 7 - 9 spines and first minor series of 7 - 9 spines, giving a marginal projecting series of 14 - 18 spines. Spines of marginal series homogeneous, of about equal length, the median spine of the projecting series (which is also the median spine of the first major series) sometimes much longer and more robust than the others; others decrease in

length successively towards the focus. Spines of the marginal series project for about  $\frac{1}{6}$  to  $\frac{1}{2}$  their length beyond the posterior margin; others fall wholly within the confines of the posterior field.

Adjacent to the l.l.

Similar to scales away from the lateral line, but the lateral margin adjacent to the lateral line is concave.

Lateral line.

Smaller than non-lateral line scales. Egg-shaped, narrower posteriorly than anteriorly; anterior angles widely rounded. Muciferous canal in the form of a perforation, oval, placed in the position occupied by the focus in non-lateral line scales, continued as a canal for a short distance towards the centre of the scale; spines absent.

Blind side - independent of the l.l.

Similar to ocular side scales; spines of the posterior field a little shorter but not usually reduced in number. Maximum breadth 50 - 52% of total length.

There are no signs of annuli.

(xxii). CORYPHAESOPIA.

Aesopia, Günther, 1862, (Kaup, 1858, pro parte), Cat. Fish. Brit. Mus., iv, p. 487; Day, 1873, Proc. Zool. Soc., p. 238; Jordan and Starks, 1906, Proc. U.S. Nat. Mus., xxxi, p. 235; Regan, 1920, Ann. Durban Mus., ii, p. 218; Barnard, 1925, Ann. S. Afr. Mus., xxi, p. 409; Norman, 1928, Rec. Ind. Mus., xxx, p. 185.

Coryphaesopia, Chabanaud, 1930, Bull. Inst. Ocean., Monaco, 555, pp. 9 and 17; Chabanaud, 1934, Bull. Soc. zool. Fr., lix, pp. 427 and 435.

Characters as given in the synopsis on pages 98 - 103.

One subspecies found in South African seas.

30. CORYPHAESOPIA CORNUTA BARNARDI, Chabanaud.  
(Horned or Single-banded Sole.).

Synaptura cornuta, Gilchrist, 1906, Mar. Invest. S. Afr., iv, p. 161.  
Aesopia cornuta, Regan, 1920, Ann. Durban Mus., ii, p. 218; Von Bonde, 1922, Rep. Fish. Mar. Biol. Surv. S. Afr., ii, (1921), Spec. Rep. i, p. 21; Von Bonde, 1925, Trans. Roy. Soc. S. Afr., xii, p. 291; Barnard, 1925, Ann. S. Afr. Mus., xxi, p. 409.

Coryphaesopia cornuta, Chabanaud, 1930, Bull. Inst. Ocean., Monaco, 555, p.17.

Coryphaesopia cornuta barnardi, Chabanaud, 1934, Bull. Soc. zool. Fr., lix, pp.430 and 436.

TEXT-FIG. 34.

D.74; A.58; P.0; V.4; L.1.105.

Body ovate; depth  $2\frac{2}{3}$  to 3, head  $4\frac{3}{4}$  to  $5\frac{1}{4}$ , in length of body. Eyes contiguous, upper very slightly in advance of lower,  $4\frac{1}{2}$  to  $5\frac{1}{2}$  in length of head. Pectorals of both sides rudimentary. First dorsal ray long, swollen, almost entirely free, papillose. Last dorsal (and anal) ray attached to the caudal, which is distinct, by a more or less incised membrane. Caudal of 11 rays. Pelvics with 4 rays. Anterior nasal tube of ocular side short, hardly reaching the anterior margin of the lower eye; posterior nostril not tubular, in front of lower eye. Nostrils of blind side inconspicuous. Lateral line straight on both sides to head. Scales very weakly ctenoid on both sides of body, spines not projecting through the skin. Greyish, with 15 to 16 dark single cross-bands across head and body, extending on to dorsal and anal fins; caudal dark with white spots. Blind side whitish.

Length: Up to 150 mm.

Distribution: Natal Coast to Delagoa Bay, shallow water. Barnard's statement that the scales are cycloid on both sides of the body is incorrect. The ctenoid elements are undoubtedly small and weak but nevertheless very distinct, even at low magnifications.

Lepidology. (Plate XI, figs. 56, 57.).

Scales weakly ctenoid on both sides of body, spines not projecting through the skin, moderate to small in size, adherent, regular in arrangement; 105 scales in the lateral line.

Ocular side - independent of the l.l.

Elongate oval or subelliptical, anterior angles widely rounded, anterior margin markedly convex, weakly scalloped, scallops indistinct, fairly numerous, about 20, lateral margins

convex; anterior length 78 - 82% of total length, anterior breadth 58 - 62% of anterior length, posterior breadth 84 - 88% of anterior breadth. Focus small but well-defined, circular, rather posterior in position, about  $\frac{1}{6}$  of total length of scale from posterior margin. Anterior field large, radii divergent from focus, lateral spread large, well-defined but thin, more or less straight, continuous, moderately-spaced, fairly numerous, 4 - 6 near the focus, increasing to 18 - 21 at the periphery; many of the radii traverse the anterior parts of the lateral fields and end at the anterior parts of the margins of these fields, some few do not reach the periphery of the scale; inter-radial circuli very close-set, entire but interrupted into minute, sharp-pointed crenulations directed anteriorly. Lateral fields small, triangular, circuli very close-set. Posterior field very small, in the form of a band-shaped "polar cap" to the scale, entirely covered with spines. Spines very short, longest 5 - 7% of total length of scale, very weak, very slender, sharp-pointed; alternate arrangement absent, two irregularly placed series of spines, a marginal projecting series of 9 - 11 spines and a secondary series variable in number, of very short spines placed more or less near the bases of the projecting spines.

Adjacent to the l.l.

Similar to scales away from the lateral line, but lateral margin adjacent to lateral line flattened.

Lateral line.

Smaller than non-lateral line scales; sharply narrowed posteriorly. Muciferous canal medianly symmetrical, in the form of a U-shaped indentation in the posterior margin, fairly deep and wide; spines absent.

Blind side - independent of the l.l.

Similar to ocular side scales. Maximum breadth 52 - 56% of total length.

There are no signs of annuli.

Part b. ACHIRINA.

Characters as given in the synopsis on pages 98 - 99. In addition; anterior nasal tube of the ocular side short. Anterior nasal tube of blind side cylindrical but variable: large short, lying longitudinally and partly attached to the underlying skin; sometimes slender, very long and entirely free. An accessory rostro-dorsal lateral line present on the cephalic region of the blind side in a number of species. Pelvics symmetrical or not. Pectorals absent, except in one species, Aseraggodes cyaneus (Alcock), in which the pectoral of the ocular side is represented by a single short ray.

One genus represented in South African waters.

(xxiii). ACHIRUS.

Achirus, Lacépède, 1902, Hist. Nat. Poiss., iv, p. 658; (pro parte) Bleeker, 1872, Atlas Ichthyol., vi, p. 23; (pro parte) Day, 1888, Fish. Ind., p. 427; Chabanaud, 1930, Bull. Mus. Nat. Hist. Nat., (2) 11, p. 265; Chabanaud, 1930, Bull. Inst. Ocean., Monaco, 555, pp. 18 and 20.  
Pardachirus, Günther, 1862, Cat. Fish. Brit. Mus., iv, p. 478; Von Bonde, 1925, Trans. Roy. Soc. S. Afr., xii, p. 290; Barnard, 1925, Ann. S. Afr. Mus., xxi, p. 405; Norman, 1926, Biol. Res. "Endeavour", v, p. 287; Norman, 1928, Rec. Ind. Mus., xxx, p. 186; Weber and De Beaufort, 1929, Fish. Indo-Austr. Archipel., v, p. 164.

Characters as given in the synopsis on pages 98 - 99 and under Part b. Achirina above.

One species found in South African waters.

31. ACHIRUS MARMORATUS, Lacépède.

Achirus marmoratus, Lacépède, 1802, Hist. Nat. Poiss., iv, p. 658; Rüppell, 1826, Atlas Fische, p. 122, pl. xxxi, fig. 2; Chabanaud, 1930, Bull. Inst. Ocean., Monaco, 555, p. 20; Chabanaud, 1931, Zool. Anzeiger, xciii, p. 102.  
Pardachirus marmoratus, Günther, 1862, Cat. Fish. Brit. Mus., iv, p. 478; Sauvage, 1891, Hist. Nat. Madagascar, xvi, Poiss., p. 472; Von Bonde, 1925, Trans. Roy. Soc. S. Afr., xii, p. 291; Barnard, 1925, Ann. S. Afr. Mus., xxi, p. 405; Fowler, 1925, Proc. Acad. Nat. Sci. Philad., lxxvii, p. 205.

D. 67; A. 53; L. 1.100.

Body ovate; depth  $2\frac{1}{2}$  to  $2\frac{2}{3}$  in length of body. Upper eye slightly in advance of lower. Mouth unsymmetrical, small, more

developed on blind side; teeth minute, on blind side only. Dorsal and anal rays scaled, with pores at bases. Dorsal commences on snout and terminates on caudal peduncle. Pectorals absent. Caudal free from dorsal and anal. Pelvics well developed, symmetrical. Gill-openings narrow, gill-membrane broadly united below throat. Scales moderate, weakly ctenoid or cycloid. Lateral line straight, with an accessory branch on blind side, commencing on snout and running along upper profile of the neck. Vent sinistral, Greyish-olive, with numerous brown dots on head, body and fins, and with or without white ocellate spots.

Length: Up to 260 mm.

Distribution: Bazaruto Island, Portuguese East Africa.

Lepidology. (Plate XII, figs. 58, 59.)

Scales weakly ctenoid on both sides of body - the ctenoid elements seldom project beyond the posterior margin of the scale, occasionally a single weak spine may project slightly - cycloid scales are commonly scattered amongst the ctenoid ones all over the body, moderate in size, thin and rather delicate, adherent, somewhat irregular in arrangement; 100 scales in the lateral line.

Ocular side - independent of the l.l.

Elongate oval, anterior angles widely rounded, anterior margin convex, finely and obscurely scalloped, scallops numerous, lateral margins convex, finely and obscurely scalloped, scallops numerous, posterior margin slightly convex, sometimes flattened; anterior length 80 - 85% of total length, anterior breadth 50 - 55% of anterior length, posterior breadth 75 - 80% of anterior breadth. Focus minute but well-defined, rather posterior in position, about  $\frac{1}{6}$  of total length of scale from posterior margin. Anterior and lateral fields large, undemarcated from each other, radii traversing all three fields, moderately divergent from focus, well defined but thin, somewhat undulose, occasionally dis-continuous,

moderately-spaced, very numerous, 20 - 25 near the focus, increasing to 75 - 85 at the periphery of the scale; interradial circuli very close-set, entire, curved towards the periphery. Posterior field small, triangular, entirely covered with spines; spines very short and weak, rather obscure, somewhat irregularly disposed in a median posterior patch which does not extend as far as the posterior angles.

Adjacent to the l.l.

Similar to scales away from the lateral line, but the lateral margin adjacent to the lateral line flattened.

Lateral line.

Much smaller than non-lateral line scales. More or less pear-shaped, sharply and markedly narrowed in posterior half of scale, coming to a blunt-pointed apex. Anterior angles very widely rounded. Muciferous canal medianly symmetrical, fairly long and wide, running out at the posterior apex; spines absent.

Blind side - independent of the l.l.

Similar to ocular side scales, but a little smaller; posterior field much reduced in size and spines greatly reduced in number. Maximum breadth 58 - 62% of total length.

There are no signs of annuli.

Part c. HETEROMYCTERINA.

Characters as given in the synopsis on pages 98 - 99.

In addition; pectorals absent in most of the species belonging to the two genera composing this part, but present in some species of Heteromycteris in a rudimentary condition on the ocular side. When present, the pectoral of the ocular side consists of a constant number of short, setiform rays hardly reaching beyond the free border of the cleithral membrane, which unites them and itself is a prolongation of the opercular membrane. The close union of the cleithral and opercular membranes takes place at an angle at the operculo-cleithral commissure; the rays are parallel between them and this rudiment of the fin is not fan-

shaped; there is no trace of a coracoid.

One genus represented in South African waters.

(xxiv). HETEROMYCTERIS.

Heteromycteris, Kaup, 1858, *Archiv. Natur.*, xxiv, p. 103; Chabanaud, 1927, *Ann. Mag. Nat. Hist.*, (9) xx, p. 523; Norman, 1928, *Rec. Ind. Mus.*, xxx, p. 190; Chabanaud, 1930, *Bull. Inst. Ocean.*, Monaco, 555, p. 21.

Achirus, (pro parte), Bleeker, 1872, *Atlas Ichthyol.*, vi, p. 23; Barnard, 1925, *Ann. S. Afr. Mus.*, xxi, p. 404; (pro parte) Weber and De Beaufort, 1929, *Fish. Indo-Austr. Archipel.*, v, p. 159.

Amate, Jordan and Starks, 1906, *Proc. U.S. Nat. Mus.*, xxxi, p. 228; Jordan, 1923, *Univ. Calif. Publ. Zool.*, xxiv, p. 11.

Monodichthys, Chabanaud, 1925, *Bull. Mus. Nat. Hist. Nat.*, Paris, p. 356.

Characters as given in the synopsis on pages 98 - 99 and under Part c. Heteromycterina above.

One species found in South African seas.

32. HETEROMYCTERIS CAPENSIS, Kaup.

Heteromycteris capensis, Kaup, 1858, *Archiv. Natur.*, xxiv, p. 103; Günther, 1862, *Cat. Fish. Brit. Mus.*, iv, p. 462; Chabanaud, 1927, *Ann. Mag. Nat. Hist.*, (9) xx, p. 525; Chabanaud, 1930, *Bull. Inst. Ocean.*, Monaco, 555, p. 21.

Achirus capensis, Boulenger, 1898, *Mar. Invest. S. Afr.*, i, p. 2; Gilchrist, 1902, *Mar. Invest. S. Afr.*, i, p. 145; Gilchrist, 1903, *Mar. Invest. S. Afr.*, ii, p. 191, pl. i, fig. 16; Gilchrist, 1916, *Mar. Biol. Rept.* iii, p. 17, fig. 13; Thompson, 1918, *Mar. Biol. Rept.*, iv, p. 126; Von Bonde, 1922, *Rep. Fish. Mar. Biol. Surv. S. Afr.*, ii. (1921), *Spec. Rep.* i, p. 17; Barnard, 1925, *Ann. S. Afr. Mus.*, xxi, p. 404.

TEXT-FIG. 35.

D. 98 - 102; A. 67 - 75; L. 1.80 - 85.

Body ovate; depth  $2\frac{1}{2}$  to  $2\frac{1}{3}$ , head 4, in length of body. Eyes  $5\frac{1}{2}$  to 6 in length of head, upper in advance of lower. Snout hooked; mouth unsymmetrical, maxillary reaching to below lower eye. Teeth minute, on blind side only; snout and lips with short fringes. Gill-openings moderately wide. Caudal free from dorsal and anal, rounded. Pectorals absent. Scales small, ctenoid on both sides of body. Lateral line straight, single on both sides. Anterior nostril of blind side dilated and fringed. Vent sinistral. Greyish or brownish, with dark specks and 3 more or less

conspicuous longitudinal series of small black spots.

Length: Up to 145 mm.

Distribution: Saldanha Bay, False Bay, Agulhas Bank, Algoa Bay to East London, shallow water.

Lepidology. (Plate XII, figs. 60, 61).

Scales strongly ctenoid on both sides of body, small, adherent, regular in arrangement; 80 - 85 scales in the lateral line. Ocular side - independent of the l.l.

Oval, anterior angles fairly widely rounded, anterior margin convex, scalloped, scallops well-defined, not numerous, 12 - 14, lateral margins straight or very slightly convex; anterior length 60 - 65% of total length, anterior breadth 70 - 75% of anterior length, posterior breadth 98 - 100% of anterior breadth. Focus small but well-defined, circular, rather posterior in position, about  $\frac{3}{8}$  of total length of scale from posterior margin. Anterior field of moderate size, triangular, radii slightly divergent from focus, lateral spread small, well-defined, fairly wide, more or less straight, continuous, fairly close-set, not numerous, 4 - 6 near the focus, increasing to 10 - 12 at the anterior margin; interradii circuli close-set, entire, slightly curved towards the anterior margin. Lateral fields of moderate size, triangular, circuli close-set. Posterior field of moderate size, triangular, entirely covered with spines; spines fairly long, longest 15 - 20% of total length of scale, strong, fairly robust, sharp-pointed, lateral margins slightly curved, more markedly curved basally, bases broad; alternate arrangement distinct and regular, 4 - 5 major and 4 - 5 minor series medianly, reduced to 2 - 3 laterally; first major series of 6 spines and first minor series of 6 spines, giving a marginal projecting series of 12 spines. Spines of marginal series homogeneous, of about equal length; others decrease in length successively towards the focus; spines of marginal series project for about  $\frac{1}{6}$  to  $\frac{1}{2}$  their length beyond posterior margin; others fall wholly within the confines of the

posterior field.

Adjacent to the l.l.

Similar to scales away from the lateral line, but lateral margin adjacent to lateral line is concave.

Lateral line:

Much smaller than non-lateral line scales. Pear-shaped, coming to a blunt-pointed apex posteriorly. Anterior angles very widely rounded. Muciferous canal medianly symmetrical, fairly long and wide, running out at the posterior apex; spines absent.

Blind side - independent of the l.l.

Similar to ocular side scales, but much smaller, oval in shape - anterior angles widely rounded, anterior margin convex; posterior field reduced in size, spines fewer and shorter. Maximum breadth 60 - 65% of total length.

There are no signs of annuli.

Family V. CYNOGLOSSIDAE.

Characters as given in the synopsis on pages 29-30 in addition; dorsal fin extending in advance of eye, all rays articulated; pelvic of blind side sometimes absent, of ocular side sometimes united with anal; pectorals absent; dorsal and anal confluent with caudal. Mouth rather small, inferior or subterminal. No supramaxilla. Olfactory laminae arranged transversely to or radiating from a central rachis. Eyes small. Lateral line single, multiple or absent.

Six genera represented in South African waters.

Synopsis of the South African Genera.

- I. Lateral line absent; lips not fringed . . .(xxv). Symphurus.
- II. Lateral line (or lines) present on one or both sides.
- A. Lips not fringed; blind side with or without lateral line.
1. Two lateral lines on ocular side, one or none on blind side . . . . .(xxvi). Cynoglossus.
2. Two lateral lines on both sides . . . . .  
 . . . . .(xxvii). Arelia.
3. Three lateral lines on ocular side, one on blind side (sometimes very faint) or absent.
- a. One nostril on ocular side (xxviii). Trulla.
- b. Two nostrils on ocular side.(xxix). Areliscus.
- B. Lips fringed; blind side with or without lateral line.  
 . . . . .(xxx). Paraplagusia.
- (xxv). SYMPHURUS.

Symphurus, Rafinesque, 1810, Indice d'Ittiol. Sicil., p.52; Jordan and Starks, 1906, Proc. U.S. Nat. Mus., xxxi, p.242; Barnard, 1925, Ann. S. Afr. Mus., xxi, p.417; Chabanaud, 1931, Riviera Sci., Suppl. Mem., ii, p.32.

Aphoristia, Kaup, 1858, Archiv. Natur., p. 106.

Ammopleurops, Günther, 1862, Cat. Fish. Brit. Mus., iv, p. 490.

Lips not fringed. Pelvic of ocular side only present, free from anal. Scales ctenoid on both sides of body. No lateral line on either side. Eyes small, close together. Two nostrils on ocular side, lower one tubular. Mouth subterminal.

Three species found in South African waters.

Key to the South African Species.

- a. Head equal to depth of body . . . . . 33. variegatus.  
 b. Depth greater than length of head.  
     (i). D. 110; A. 99 . . . . . 34. strictus.  
     (ii). D. 97; A. 82 . . . . . 35. ocellatus.

33. SYMPHURUS VARIEGATUS (Gilchrist).

Aphoristia variegata, Gilchrist, 1903, Mar. Invest. S. Afr., ii, p. 211, pl. xviii; Thompson, 1918, Mar. Biol. Rep., iv, p. 128.  
Symphurus variegatus, Von Bonde, 1922, Rep. Fish. Mar. Biol. Surv. S. Afr., ii, (1921), Spec. Rep. i, p. 25; Barnard, 1925, Ann. S. Afr. Mus., xxi, p. 417.

TEXT-FIG. 36.

D. 93-100; A. 88-95; L. 1. ca. 120-130.

Body slender, elongate; depth equal to head,  $4\frac{3}{5}$  to 5 in length of body. Eyes close together, without intervening scales, 7 to 8 in length of head. Maxillary reaching to below anterior third of eye. First 4 to 5 rays of dorsal fin more or less free. Pelvic of ocular side only present, of 4 rays, free from anal. Posterior nostril of ocular side between the eyes, covered by a flap of skin arising from its anterior border; anterior nostril shortly tubular. Scales ctenoid on both sides of body. Light brown, with indistinct and irregular cross-bands. Blind side whitish.

Length: Up to 90 mm.

Distribution: Off East London, 300-450 fathoms.

Lepidology. (Plate XII, figs. 62, 63).

Ctenoid on both sides of the body, more strongly on the ocular side than on the blind side as a rule, small, adherent regular in arrangement; about 120 - 130 scales in a longitudinal series from the upper angle of the opercle to the base of the caudal on the ocular side.

Ocular side.

Subrectangular, anterior angles moderately sharply rounded, nearly  $90^{\circ}$ , anterior margin convex, scalloped, scallops few in number, 4 - 7, lateral margins slightly convex; anterior length 69 - 72% of the total length, anterior breadth 54 - 64% of the anterior length, posterior breadth 93 - 111% of the anterior breadth. Focus of moderate size, posterior in position, about 1/3rd of total length from posterior margin. Anterior field moderate in size, radii divergent from the focus, lateral spread not great, continuous (except near the focus), smooth, well-defined, not numerous, 3 - 6. Interradial circuli fairly closely-set, mostly entire (confused and interrupted in regenerated scales) in the form of well-defined acute-angled curves, the apices of the curves produced into irregular sharp-pointed crenulations, the convexities of the curves towards the anterior margin.

TEXT-FIG. 37.

Lateral fields fairly large, circuli moderately spaced. Posterior field small, more or less triangular, entirely covered with spines. Spines moderately long, those of the two marginal series 13 - 21% of the total length of the scale, fairly strong but slender, lateral margins slightly curved, sharply-pointed. Spines of the two marginal series homogeneous, of equal length, the others decreasing in length regularly as the focus is approached. Alternate arrangement into major and minor series distinct and regular; 3 - 4 major and 3 - 4 minor series in

the median section of the posterior field, reduced to 1 - 2 laterally. First major series of 6 - 7 spines and first minor series of 6 - 7 spines, giving a marginal projecting series of 12 - 14 spines. Spines of the other major and minor series fall wholly within the confines of the posterior field.  
Blind side.

Subrectangular, anterior angles rather sharply rounded, nearly  $90^\circ$ , anterior margin convex, scalloped, scallops not very numerous, 6 - 9, lateral margins slightly convex. Anterior length 76 - 77% of the total length, anterior breadth 55 - 70% of the anterior length, posterior breadth 81 - 85% of the anterior breadth. Posterior field much reduced in size, spines shorter and fewer than in ocular side scales. Alternate arrangement of spines persistent, 2 major and 2 minor series medianly, reduced to 1 laterally. First major series of 3 - 4 spines and first minor series of 2 - 3 spines, therefore marginal projecting series of 5 - 7 spines.

Total length of blind side scale 87 - 100% of total length of corresponding ocular side scale.

There are no signs of annuli.

#### 34. SYMPHURUS STRICTUS, Gilbert.

Symphurus strictus, Gilbert, 1905, U.S. Fish. Comm., xxiii, p. 691, fig. 272; Von Bonde, 1922, Rep. Fish. Mar. Biol. Surv. S. Afr., ii, (1921), Spec. Rep. 1, p. 26; Barnard, 1925, Ann. S. Afr. Mus., xxi, p. 417.

#### TEXT-FIG. 38.

D. 110 (117 including  $\frac{1}{2}$  caudal); A. 99 (106 including  $\frac{1}{2}$  caudal).  
 Body slender, elongate; depth  $3\frac{4}{5}$ , head 6, in length of body. Eyes close together, separated by a single row of scales, 10 in length of head; upper eye slightly in advance of lower. Mouth small, curved, maxillary reaching to below middle of

lower eye; teeth very small, equally developed on both sides of both jaws. Dorsal commences over middle of upper eye, confluent with caudal, longest ray more than 4 in depth of body, anal similar to dorsal. Pectorals absent. Pelvic of ocular side only present, separated from anal by a space equal to twice diameter of eye. Caudal of 14 rays, which are easily distinguishable from dorsal and anal rays, 12 in length of body. Anterior portion of interocular space occupied by a flap of skin under which the posterior nostril opens; anterior nostril slit-like, opening under upper end of a vertical fold which extends upwards from behind angle of mouth. Scales ctenoid on both sides of body, about 130 in a longitudinal series from upper angle of opercle to base of caudal; snout, jaws and chin and a narrow streak along profile to front of dorsal naked. Whole body mottled with brown; indistinct narrow dark lines form longitudinal bands on scales; fins dusky, unmarked; peritoneum black, showing through abdominal walls. Blind side whitish.

Length: Up to 140 mm.

Distribution: Off Delagoa Bay, 260 fathoms.

Lepidology. (Plate XIII, figs. 64, 65).

Ctenoid on both sides of the body, more strongly on ocular side than on blind side as a rule; small, smaller on ocular side than on blind side, adherent, regular in arrangement; about 130 scales in a longitudinal series from upper angle of the opercle to base of the caudal on the ocular side.

Ocular side.

Elongate oval, anterior angles very largely rounded, anterior margin convex, sometimes markedly so, finely scalloped but scallops relatively few in number, about 5, more numerous in the case of regenerated scales, 7 - 10; lateral margins evenly convex; anterior length 74 - 77% of the total length,

anterior breadth 34 - 38% of the anterior length, posterior breadth 111 - 116% of the anterior breadth. The majority of the scales are broader posteriorly than anteriorly. Focus moderate in size, posterior in position, about 1/3rd. of total length from posterior margin. Anterior field relatively small, narrow; radii divergent from the focus, lateral spread small, continuous (except adjacent to the focus), smooth, well-defined, few in number, 3 - 5. In regenerated scales the anterior field is much larger and broader, the radii more numerous, 7 - 10, not so well-defined and often discontinuous. Interradial circuli moderately spaced, mostly entire, in the form of well-defined acute-angled curves, apices of the curves produced into minute irregular <sup>sharp-pointed</sup> crenulations, convexities of the curves towards the anterior margin.

TEXT-FIG. 39.

In regenerated scales the interradial circuli are confused and irregular, especially towards the central portion of the scale. Lateral fields large (smaller in regenerated scales), circuli relatively widely spaced. Posterior field small, roughly triangular, entirely covered with spines. Spines moderately long, those of the two marginal series homogeneous, 15 - 17% of the total length of the scale, fairly strong but slender, lateral margins not greatly curved, sharp-pointed; other spines decreasing in length regularly as the focus is approached. Alternate arrangement distinct and regular; 3 - 4 major and 3 - 4 minor series medianly, reduced to 1 - 2 laterally. First major series of 6 - 7 and first minor series of 5 - 6 spines, giving a marginal projecting series of 11 - 13 spines. Spines of the other major and minor series fall wholly within the confines of the posterior field. It is noteworthy that in the majority of ocular side scales the posterior field does not lie symmetrical to the antero-posterior axis of the scale but is slightly displaced, mostly towards the ventral lateral margin of the scale.

Blind side.

Subrectangular, anterior angles sharply rounded, nearly  $90^\circ$ , anterior margin very slightly convex, finely scalloped, scallops fairly numerous, 10 - 12, lateral margins very slightly convex or straight. Anterior length 74 - 78% of the total length, anterior breadth 61 - 62% of the anterior length, posterior breadth 95 - 106% of the anterior breadth. Posterior field a little reduced in size and spines a little shorter than in ocular side scales, not quite as numerous, alternate arrangement persistent, 3 - 4 major and 3 - 4 minor series medianly, reduced to 1 - 2 laterally. First major series of 5 - 6 and first minor series of 4 - 5 spines, giving a marginal projecting series of 9 - 11 spines. The anterior field is much larger than in ocular side scales and consequently the lateral fields are reduced in size in proportion; radii more numerous, 8 - 10, and in blind side regenerated scales even more so, 14 - 18.

Total length of blind side scale 118 - 120% of total length of corresponding ocular side scale.

There are no signs of annuli.

35. SYMPHURUS OCELLATUS, Von Bonde.

Symphurus ocellatus, Von Bonde, 1922, Rep. Fish. Mar. Biol. Surv. S. Afr., ii, (1921), Spec. Rep. i, p. 26, pl. 1, fig. 2; Barnard, 1925, Ann. S. Afr. Mus., xxi, p. 418.

## TEXT-FIG. 40.

D. 97 (106 including  $\frac{1}{2}$  caudal); A. 82 (90 including  $\frac{1}{2}$  caudal).

Body lanceolate, slender; depth  $3\frac{2}{5}$  (figure  $3\frac{4}{5}$ ), head  $5\frac{3}{5}$  (figure  $5\frac{1}{2}$ ), in length of body. Eyes close together, separated by a single row of scales,  $5\frac{3}{5}$  (figure 8) in length of head; upper eye very slightly in advance of lower. Mouth small, curved, maxillary reaching to below middle of lower eye; teeth very small, equally developed on both sides of both jaws and closely placed. Dorsal commencing over middle of upper eye,

confluent with caudal, longest ray more than  $3\frac{1}{2}$  in depth of body, anal similar to dorsal. Pectorals absent. Pelvic of ocular side only present, of 5 rays, separated from anal by a space equal to  $1\frac{1}{2}$  diameter of eye; base of pelvic lies on mid-ventral line and is covered by the opercle; vent near origin of anal fin. Caudal of 16 rays, median rays longest, 12 in length of body. Scales ctenoid on both sides of body. Uniform brownish over whole of body and fins except for a black spot on dorsal and anal fins at their posterior ends. Blind side whitish.

Length: Up to 105 mm.

Distribution: Natal Coast, 260 - 350 fathoms.

Lepidology. (Plate XIII, figs. 66, 67.)

Ctenoid on both sides of the body, more strongly on ocular than on blind side; small, adherent, regular in arrangement; about 115 - 120 scales in a longitudinal series from upper angle of opercle to base of caudal on ocular side.

Ocular side.

Subrectangular, anterior angles somewhat rounded, anterior margin moderately convex, scalloped, scallops not very numerous, 8 - 12, lateral margins slightly convex; anterior length 75-80% of the total length, anterior breadth 59 - 62% of the anterior length, posterior breadth 100 - 111% of the anterior breadth. Most of the scales are broader posteriorly than anteriorly. Focus rather small, posterior in position, about  $\frac{1}{4}$  of total length from posterior margin. Anterior field of moderate size, radii divergent from focus, lateral spread not great, continuous (except adjacent to the focus), smooth, well-defined, not very numerous, 7 - 11. Interradial circuli moderately spaced, mostly entire, in the form of acute-angled curves, apices of curves produced into irregular, <sup>sharp-pointed</sup> crenulations, convexities of curves directed towards the anterior margin.

In this species the apices of the curves are less acute than in either S.variegatus or S.strictus. Lateral fields relatively large, circuli relatively widely spaced. Posterior field small, roughly triangular, entirely covered with spines. Spines fairly long, those of the two marginal series 12 - 14% of the total length of the scale, fairly strong but slender, lateral margins slightly curved, sharp-pointed. Spines of the two marginal series homogeneous, of equal length, others decreasing in length regularly as the focus is approached. Alternate arrangement distinct and regular, 4 - 5 major and 4 - 5 minor series medianly, reduced to 2 - 3 laterally. First major series of 8 - 10 spines and first minor series of 7 - 9 spines, giving a marginal projecting series of 15 - 19 spines. Spines of all the other major and minor series fall wholly within the confines of the posterior field.

Blind side.

Subrectangular, anterior angles moderately rounded, anterior margin moderately convex, scalloped, scallops not very numerous, 7 - 11, lateral margins slightly convex; anterior length 74 - 78% of the total length, anterior breadth 70 - 75% of the anterior length, posterior breadth 100 - 108% of the anterior breadth. Many of the scales are broader posteriorly than anteriorly. Posterior field somewhat reduced in size, spines shorter and fewer in number than in ocular side scales; alternate arrangement persistent, 3 - 4 major and 3 - 4 minor series medianly, reduced to 1 - 2 laterally. First major series of 6 - 8 (very rarely 9) spines and first minor series of 5 - 6 (very rarely 7) spines, giving a marginal projecting series of 11 - 14 (very rarely 16) spines.

There are no signs of annuli.

(xxvi). CYNOGLOSSUS.

Cynoglossus, Hamilton, 1822, Fish.Ganges, p.32; Barnard, 1925, Ann. S.Afr.Mus., xxi, p.411.

Lips not fringed. Pelvic of ocular side only present,

more or less completely attached to anal. Scales ctenoid on both sides of body, or ctenoid on ocular side and cycloid on blind side. Two lateral lines on ocular side, one or none on blind side two nostrils on ocular side, lower one tubular. Mouth inferior.

Four species found in South African seas.

Key to the South African Species.

A. Scales ctenoid on both sides of body.

a. Eyes separated.

(i). Angle of mouth nearer gill-opening than anterior end of snout . . . 36. lida.

(ii) Angle of mouth nearer anterior end of snout than gill-opening . . 37. durbanensis.

b. Eyes contiguous . . . . . 38. gilchristi.

B. Scales ctenoid on ocular side, cycloid on blind side . .

. . . . . 39. hunteri.

36. CYNOGLOSSUS LIDA (Bleeker).

Cynoglossus lida, Günther, 1862, Cat. Fish. Brit. Mus., iv, p. 498; Bleeker, 1866, Atlas Ichthyol., vi, p. 36, pl. xii, fig. 2; Day, 1878, Fish. Ind., p. 436, pl. xcvi, fig. 3; Regan, 1920, Ann. Durban Mus., ii, p. 221, fig. 5; Von Bonde, 1922, Rep. Fish. Mar. Biol. Surv. S. Afr., ii, (1921), Spec. Rep. i, p. 25; Barnard, 1925, Ann. S. Afr. Mus., xxi, p. 411; Fowler, 1925, Proc. Acad. Nat. Sci. Philad., lxxvii, p. 206; Fowler, 1934, Proc. Acad. Nat. Sci. Philad., lxxxvi, p. 436.

TEXT-FIG. 42.

D. 99-110; A. 75-86; L. 1. 85-90.

Body elongate; depth 4 to  $4\frac{1}{2}$ , head 4 to 5, in length of body. Eyes separated by a space which is less than diameter of eye, about 10 in length of head. Maxillary reaching to below posterior border of lower eye; angle of mouth nearer gill-opening than anterior end of snout, which is 2 in length of head. Posterior nostril of ocular side between the eyes, anterior nostril in front of lower eye, tubular. Scales ctenoid on both sides of body; 13 - 14 series of scales between two lateral lines of ocular side. Lateral line on blind side more or less distinct.

Greyish or brownish, darkish patch on opercle. Blind side whitish.

Length: Up to 180 mm.

Distribution: Natal Coast, shallow water.

Lepidology. (Plate XIII, figs. 68, 69).

Scales ctenoid on both sides of body, moderate to large in size, adherent, regular in arrangement; 85 - 90 scales in the lateral line.

Scales from both ocular and blind sides of a specimen in the British Museum were obtained for examination but their exact location on the body is unknown, and lateral line scales were not included in the sample.

Ocular side.

Elongate oval, anterior angles widely rounded, anterior margin convex, finely scalloped, scallops numerous, 25 - 30, lateral margins slightly convex; anterior length 80 + 85% of total length, anterior breadth 65 - 70% of anterior length, posterior breadth 75 - 80% of anterior breadth. Focus very small but well-defined, circular, rather posterior in position, about 1/5th of total length of scale from posterior margin. Anterior field very large, radii divergent from focus, lateral spread moderate, well-defined, straight, continuous, fairly closely-spaced, numerous, 8 - 10 near the focus, increasing to 25 - 30 at the anterior margin; interradii circuli very close-set; entire, in the form of acute-angled curves, apices of the curves produced into somewhat irregular, blunt-pointed crenulations, convexities of the curves towards the anterior margin.

**TEXT-FIG. 43.**

Lateral fields small, triangular, circuli very close-set. Posterior field small, triangular, entirely covered with spines. Spines short, longest 7 - 9% of total length of scale, strong but slender, lateral margins curved, bases broad, sharp-pointed; alternate arrangement distinct and regular, 4 - 5 major and 4 - 5 minor series medianly, reduced to 1 - 2 laterally; first major series of 12 - 15 spines and first minor series of 12 - 15 spines, giving

a marginal projecting series of 24 - 30 spines. Spines of marginal series homogeneous, of equal length; others decreasing in length successively towards the focus. Spines of marginal series project for about  $\frac{1}{3}$ rd to  $\frac{1}{2}$  their length beyond posterior margin.

Blind side.

Similar to ocular side scales, but a little smaller; posterior field a very little reduced in size, spines shorter and slightly reduced in number. Maximum breadth 54 - 56% of total length.

There are no signs of annuli.

37. CYNOGLOSSUS DURBANENSIS, Regan.

Cynoglossus durbanensis, Regan, 1921, Ann. Durban Mus., iii, p. 2; Von Bonde, 1922, Rep. Fish. Mar. Biol. Surv. S. Afr., ii, (1921), Spec. Rep. i, p. 25; Barnard, 1925, Ann. S. Afr. Mus., xxi, p. 412; Fowler, 1925, Proc. Acad. Nat. Sci. Philad., lxxvii, p. 206.

D. 101-105; A. 80-84; L. l. ca. 115.

Body elongate; depth  $3\frac{1}{4}$  to  $3\frac{3}{5}$ , head  $5\frac{1}{3}$  to  $5\frac{2}{3}$ , in length of body. Eyes separated by a space which is less than diameter of eye, 9 - 10 in length of head. Maxillary reaching to below centre or posterior third of lower eye; angle of mouth nearer anterior end of snout, which is 3 in length of head, than gill-opening. Posterior nostril of ocular side between the eyes, anterior nostril in front of lower eye, tubular. Scales ctenoid on both sides of body; 18 - 20 series of scales between two lateral lines of ocular side; no lateral line on blind side. Greyish, with more or less distinct darker blotches or irregular cross-bands, and numerous small dots over head, body and fins. Blind side whitish.

Length: Up to 195 mm.

Distribution: Natal Coast to Delagoa Bay, shallow water.

Lepidology. (Plate XIV, figs. 70, 71).

Scales ctenoid on both sides of body, moderate to large in size, adherent (although normal scales are not easily

found, most of the scales with regenerated centres), regular in arrangement; about 115 scales in the lateral line.

Ocular side - independent of the l.lines.

Elongate oval, anterior angles widely rounded, anterior margin convex, finely scalloped, scallops numerous, 35 - 45, lateral margins slightly convex; anterior length 68 - 72% of total length, anterior breadth 70 - 75% of anterior length, posterior breadth 98 - 100% of anterior breadth. Focus small but well-defined, circular or oval, rather posterior in position, about 1/6th of total length of scale from posterior margin. Anterior field very large, radii divergent from focus, lateral spread moderate, well-defined, straight, continuous, fairly closely-spaced, numerous, 8 - 12 near the focus, increasing to 33 - 43 at the anterior margin; interradii circuli very close-set, entire, in the form of acute-angled curves, apices of curves produced into somewhat irregular, blunt-pointed crenulations, convexities of the curves towards the anterior margin.

**TEXT-FIG. 44.**

Lateral fields small, triangular, circuli very close-set. Posterior field small, triangular, entirely covered with spines. Spines fairly short, longest 10 - 14% of total length of scale, strong but slender, lateral margins slightly curved, bases broad, sharp-pointed; alternate arrangement distinct and regular, 4 - 5 major and 4 - 5 minor series medianly, reduced to 1 - 2 laterally; first major series of 10 - 12 spines and first minor series of 10 - 12 spines, giving a marginal projecting series of 20 - 24 spines. Spines of marginal series homogeneous, of equal length; others decreasing in length successively towards the focus. Spines of marginal series project for about 1/3rd. to  $\frac{1}{2}$  their length beyond the posterior margin.

Adjacent to the l.lines.

Similar to scales away from the lateral lines, but the lateral margins adjacent to the lateral lines flattened or concave.

Lateral lines.

Similar to non-lateral scales. Muciferous canal medianly symmetrical, short and narrow; spines persistent except where canal cuts posterior field.

Blind side - independent of the l. lines.

Similar to ocular side scales, but posterior field a very little reduced in size and spines fewer. Maximum breadth 50 - 55% of total length.

There are no signs of annuli.

38. CYNOGLOSSUS GILCHRISTI, Ogilby.

Cynoglossus brachycephalus (non Bleeker), Gilchrist, 1904, Mar. Invest. S.Afr., iii, p. 12, pl. xxx; Gilchrist and Thompson, 1917, Ann. Durban Mus., i, p. 399; Von Bonde, 1922, Rep. Fish Mar. Biol. Surv. S.Afr., ii, (1921), Spec. Rep. i, p. 25.

Cynoglossus gilchristi, Ogilby, 1911, Proc. Queensl. Roy. Soc., xxiii, p. 39; Regan, 1920, Ann. Durban Mus., ii, p. 222; Von Bonde, 1925, Trans. Roy. Soc. S.Afr., xii, p. 294; Barnard, 1925, Ann. S.Afr. Mus., xxi, p. 412.

## TEXT-FIG. 45.

D. 105-110; A. 82-84; L. 1. 76-80.

Body elongate; depth 4 to  $4\frac{1}{2}$ , head  $5\frac{1}{4}$  to  $5\frac{1}{2}$ , in length of body. Eyes close together, orbits almost contiguous, 6 to  $6\frac{1}{2}$  in head, upper slightly in advance of lower, posterior margin of lower in middle of length of head. Greatest height of head more than its length. Maxillary reaching to middle of lower eye, posterior extremity nearer end of snout than gill-opening. Snouth hooked, reaches to just anterior to the vertical from the anterior margin of the upper eye. Dorsal and anal confluent with caudal. Pectorals absent. Pelvic of ocular side only present, slightly joined to anal. Anterior nostril of ocular side tubular, in front of lower eye. Posterior nostril not tubular, in angle between the eyes. Two lateral lines on ocular side, 14 rows of scales between them. No lateral line on blind side. Scales ctenoid on both sides of body. Light brown, with darker mottlings and speckles; dorsal and anal light brown with dark brown patches or streaks (mostly in pairs); caudal light with dark brown central blotch.

Blind side whitish.

Length: Up to 155 mm.

Distribution: Natal coast to Delagoa Bay, 4 - 30 fathoms.

Lepidology. (Plate XIV, figs. 72, 73.)

Scales ctenoid on both sides of body, moderate to large in size, adherent, regular in arrangement; 76 - 80 scales in the lateral line.

Ocular side - independent of the l.lines.

Elongate oval, more than twice as long as broad, anterior angles fairly widely rounded, anterior margin convex, fairly markedly scalloped, scallops numerous, 44 - 46, lateral margins very slightly convex or nearly straight, always a little undulose; anterior length 74 - 78% of total length, anterior breadth 42 - 46% of anterior length, posterior breadth 100 - 104% of anterior breadth. Focus very small but well-defined, circular, rather posterior in position, about 1/5th of total length of scale from posterior margin. Anterior field very large, radii divergent from focus, lateral spread moderate, well-defined, straight continuous, fairly closely-spaced, numerous, 8 - 12 near the focus, increasing to 42 - 44 at the anterior margin; interradii circuli very close-set, entire, in the form of acute-angled curves, apices of curves produced into somewhat irregular, blunt-pointed crenulations, convexities of curves towards the anterior margin.

TEXT-FIG. 46.

Lateral fields small, triangular, circuli very close-set. Posterior field small, triangular, entirely covered with spines. Spines short, longest 8 - 10% of total length of scale, strong but slender, lateral margins slightly curved, bases broad, slightly blunt-pointed; alternate arrangement distinct and regular, 4 major and 4 minor series medianly, reduced to 1 - 2 laterally; first major series of 11 - 13 spines and first minor series of 11 - 13

spines, giving a marginal projecting series of 22 - 26 spines. Spines of marginal series homogeneous, of equal length; others decrease in length successively towards the focus. Spines of marginal series project for about  $\frac{1}{3}$ rd. to  $\frac{1}{2}$  their length beyond posterior margin.

Adjacent to the l. lines.

Similar to scales away from the lateral lines, but lateral margins adjacent to the lateral lines are concave.

Lateral lines.

Similar to scales away from the lateral line. Muciferous canal medianly symmetrical, short and narrow. Spines persistent except where canal cuts posterior field.

Blind side - independent of the l. lines.

Similar to ocular side scales, but posterior field a little reduced in size and spines a little shorter, but not reduced in number. Maximum breadth 38 - 40% of total length.

There are no signs of annuli.

39. CYNOGLOSSUS HUNTERI, Von Bonde.

Cynoglossus hunteri, Von Bonde, 1925, Trans. Roy. Soc. S. Afr., xii, p. 293; Barnard, 1925, Ann. S. Afr. Mus., xxi, p. 413.

D. 130; A. 98; L. 1. 97.

Body very elongated, thin; depth  $4\frac{1}{2}$ , head 5, in length of body. Eyes close together but not contiguous, upper in advance of lower by about  $\frac{1}{4}$  diameter, 8 in length of head. Mouth moderate, curved, maxillary reaching to vertical from posterior border of lower eye; teeth very small, few, on blind side only; snout almost equal to postorbital length of head, sharply rounded and hooked. Dorsal and anal confluent with caudal. Pelvic of ocular side only present, separate from anal. Pectorals absent. Anterior nostril of ocular side tubular, in front of lower eye. Posterior nostril not tubular, between

anterior margins of eyes. Two lateral lines on ocular side, upper running parallel to dorsal profile to anterior border of snout, where it curves round and turns back to run as a straight line above upper eye, meeting lower lateral line; at the point of junction there is a vertical connection between upper and lower lines; lower line runs in middle of body, straight on to caudal. Dorsal line continues round anterior border of snout and then extends backwards towards anterior nostril, where it gives rise to two short branches. Single lateral line on blind side in centre of body. Scales ctenoid on ocular side and cycloid on blind side. Uniform brown, operculum darker. Blind side whitish.

Length: 78 mm.

Distribution: Delagoa Bay, 3 fathoms.

Lepidology. (Plate XIV, figs, 74, 75.)

Scales ctenoid on ocular side, cycloid on blind side, moderate to large in size, adherent, regular in arrangement; 97 scales in the lateral line.

Ocular side - independent of the l. lines.

Somewhat broadly oval, anterior angles widely rounded, anterior margin convex, finely scalloped, scallops fairly numerous, 22 - 24, lateral margins slightly convex; anterior length 75 - 78% of total length, anterior breadth 80 - 85% of anterior length, posterior breadth 98 - 102% of anterior breadth. Focus very small but well-defined, circular, rather posterior in position, about  $\frac{1}{4}$  of total length of scale from posterior margin. Anterior field large, radii subparallel or very slightly divergent from focus, well-defined, straight, continuous, rather closely-spaced, fairly numerous, 6 - 8 near the focus, increasing to 18 - 20 at the anterior margin; interradii circuli very close-set, entire, in the form of acute-angled curves, apices of curves produced into somewhat irregular, blunt-pointed crenulations, convexities of curves towards the anterior margin.

Lateral fields small, triangular, circuli very close-set. Posterior field very small, forming a "polar cap" to the scale, entirely covered with spines. Spines short, longest 8 - 10% of total length of scale, strong but slender, lateral margins slightly curved, bases moderately broad, sharp-pointed; alternate arrangement distinct and regular, 2 - 4 major and 2 - 3 minor series medianly, reduced to 1 - 2 laterally; first major series of 7 - 8 spines and first minor series of 7 - 8 spines, giving a marginal projecting series of 14 - 16 spines. Spines of marginal series not homogeneous, those of major series longer and stronger than those of minor series; spines of marginal series project for about 2/3rds. their length beyond posterior margin.

Adjacent to the l.lines.

Similar to scales away from the lateral lines, but lateral margins adjacent to lateral lines concave.

Lateral lines.

Similar to non-lateral line scales. Muciferous canal medianly symmetrical, short and narrow. Spines persistent, except where canal cuts posterior field.

Blind side - independent of the l.lines.

Oval, anterior angles widely rounded, anterior margin convex, lateral margins convex, posterior margin convex but somewhat undulose, smooth. Posterior field larger than its counterpart in ocular side scales, ornamented with close-set, well-defined circuli. In all other respects similar to ocular side scales. Maximum breadth 73 - 77% of total length.

There are no signs of annuli.

(xxvii). ARELIA.

Arelia, Kaup, 1858, Archiv. Natur., p. 106; Barnard, 1925, Ann. S. Afr. Mus., xxi, p. 413.  
Cynoglossoides, Von Bonde, 1922, Rep. Fish. Mar. Biol. Surv. S. Afr., ii, (1921), Spec. Rep. i, p. 23.

Lips not fringed. Pelvic of ocular side only present, more or less confluent with anal. Scales mostly ctenoid. Two

lateral lines on both sides of body. Two nostrils on ocular side, lower one tubular. Mouth inferior.

One species found in South African waters.

40. ARELIA ATTENUATA (Gilchrist).

Cynoglossus attenuatus, Gilchrist, 1904, Mar. Invest. S. Afr., iii, p. 11, pl. xxix; Gilchrist and Thompson, 1917, Ann. Durban Mus., i, p. 398; Regan, 1920, Ann. Durban Mus., ii, p. 221; Fowler, 1925, Proc. Acad. Nat. Sci. Philad., lxxvii, p. 206.

Cynoglossoides attenuatus, Von Bonde, 1922, Rep. Fish. Mar. Biol. Surv. S. Afr., ii, (1921), Spec. Rep. i, p. 23; Von Bonde, 1925, Trans. Roy. Soc. S. Afr., xii, p. 292.

Arelia attenuata, Barnard, 1925, Ann. S. Afr. Mus., xxi, p. 413; Fowler, 1934, Proc. Acad. Nat. Sci. Philad., lxxxvi, p. 436.

TEXT-FIG. 48.

D. 100-118; A. 88-95; L. 1. 84-88.

Body elongate; depth 4 to  $4\frac{1}{8}$ , head  $4\frac{2}{5}$  to 5, in length of body. Eyes separated by a space which is a little less than  $\frac{1}{2}$  diameter of eye, about 10 in length of head. Maxillary reaching to below posterior border of lower eye; angle of mouth nearer gill-opening than anterior end of snout, which is  $2\frac{1}{3}$  to  $2\frac{1}{2}$  in length of head. Posterior nostril of ocular side between the eyes, anterior nostril tubular, in front of lower eye on a level with its lower border. Scales ctenoid on ocular side, cycloid on blind side; 12 series of scales between two lateral lines of ocular side. Two lateral lines on blind side. Uniform brown. Blind side whitish.

Length: Up to 290 mm.

Distribution: Northern Natal Coast, Zululand Coast to Delagoa Bay, 3 - 26 fathoms.

Lepidology. (Plate XV, figs. 76, 77.)

Scales ctenoid on ocular side, cycloid on blind side, large, larger on blind side than on ocular side, adherent, regular in arrangement; 84 - 88 scales in the lateral line.

Ocular side - independent of the l. lines.

Broadly oval, almost subcircular, anterior angles very

widely rounded, anterior margin convex, finely scalloped, scallops distinct, numerous, 47 - 52, lateral margins moderately convex; anterior length 73 - 77% of total length, anterior breadth 85 - 90% of anterior length, posterior breadth 100 - 105% of anterior breadth. Focus small but well-defined, circular, rather posterior in position, about  $\frac{1}{4}$  of total length of scale from posterior margin. Anterior field very large, radii divergent from focus, lateral spread small, numerous, 18 - 20 near the focus, increasing to 45 - 50 at the anterior margin, well-defined, continuous, straight, closely-set; interradii circuli very close-set, entire, in the form of acute-angled curves, apices of curves produced into somewhat irregular, blunt-pointed crenulations, convexities of curves towards anterior margin.

**TEXT-FIG.49.**

Lateral fields small, triangular, circuli very close-set. Posterior field somewhat small, forming a "polar cap" to the scale, entirely covered with spines. Spines short, longest 5 - 6% of total length of scale, strong, lateral margins very slightly curved, more markedly curved basally, bases fairly broad, sharp-pointed; alternate arrangement distinct and regular, 5 - 6 major and 5 - 6 minor series medianly, reduced to 1 - 2 laterally; first major series of 16 - 18 spines and first minor series of 16 - 18 spines, giving a marginal projecting series of 32 - 36 spines. Spines of marginal series homogeneous, of equal length, projecting for about  $\frac{1}{2}$  to  $\frac{2}{3}$  their length beyond posterior margin.

Adjacent to the l.lines.

Similar to scales away from the lateral lines, but the lateral margins adjacent to the lateral lines flattened.

Lateral lines.

Similar to scales away from the lateral lines. Muficerous canal medianly symmetrical, funnel-shaped, fairly long; spines persistent except where canal cuts posterior field.

Blind side - independent of the 1.lines.

Larger than ocular side scales and elongate oval, broader posteriorly than anteriorly. Posterior margin convex and smooth; posterior field larger than its counterpart in ocular side scales, ornamented with very closely-set circuli. In other respects similar to ocular side scales. Maximum breadth 60 -62% of total length.

There are no signs of annuli.

(xxviii). TRULLA.

Trulla, Kaup, 1858, Archiv.Natur., p.106; Barnard, 1925, Ann.S.Afr.Mus., xxi, p.415.

Lips not fringed. Pelvic of ocular side only present, more or less confluent with anal. Scales ctenoid on ocular side, ctenoid or cycloid on blind side. Three lateral lines on ocular side, one (indistinct) or none on blind side. One nostril on ocular side, situated in front of lower eye. Mouth inferior.

Two species found in South African seas.

Key to the South African Species.

- a. Eyes very close together, 6 -7 in length of head; caudal blackish . . . . . 41. capensis.
- b. Eyes separate,  $8\frac{1}{2}$  -10 in length of head; caudal light . . . . . 42. microphthalmus.

41. TRULLA CAPENSIS, Kaup.  
(Sand Sole.).

Solea vulgaris (non Quensel), Pappe, 1853, Synops. Edible Fish., Cape, p.32; Bleeker, 1860, Vische v.d.Kaap, p.56.

Trulla capensis, Kaup, 1858, Archiv.Natur., p.109; Barnard, 1925, Ann.S.Afr.Mus., xxi, p.416.

Plarusia capensis, Castelnau, 1861, Mem.Poiss.Afri.Austr., p.71.

Cynoglossus capensis, Günther, 1862, Cat.Fish.Brit.Mus., iv, p.503; Boulenger, 1898, Mar.Invest.S.Afr., i, p.4; Gilchrist 1902, Mar.Invest.S.Afr., i, p.144; Thompson, 1918, Mar.Biol.Rept., iv, p.128.

Arelicus capensis, Von Bonde, 1922, Rep. Fish. Mar. Biol. Surv. S. Afr., ii, (1921), Spec. Rep. i, p. 24; Von Bonde, 1925, Trans. Roy. Soc. S. Afr., xii, p. 292.

**TEXT-FIG. 50.**

D. 115-130; A. 97-110; L. 1. ca. 100-118.

Body elongate; depth  $3\frac{1}{3}$  to  $3\frac{1}{2}$ , head 5 to  $5\frac{1}{2}$ , in length of body. Eyes close together or even contiguous, 6 - 7 or 8 in length of head, upper slightly in advance of lower. Snout hooked, mouth unsymmetrical, maxillary extending to below centre of lower eye; angle of mouth nearer anterior end of snout than gill-opening; teeth minute, on blind side only. Scales ctenoid on ocular side, weakly ctenoid (especially on posterior part of body) and cycloid on blind side. Three lateral lines on ocular side extending on to head, where connected by a perpendicular line between eyes and gill-opening. Brown, more or less mottled, especially in young; dorsal and anal fins speckled and spotted in adult with numerous, bright-red, round spots; caudal blackish. Blind side whitish.

Length: Up to 400 mm.

Distribution: West Coast, Saldanha Bay to Table Bay, False Bay, Agulhas Bank to Algoa Bay, Natal Coast, Delagoa Bay, 10 to 100 fathoms.

Lepidology. (Plate XV, figs. 78, 79).

Scales ctenoid on ocular side, very feebly ctenoid or cycloid on blind side; cycloid scales more commonly found in posterior parts of body; moderate in size, adherent, regular in arrangement; about 100-118 scales in the lateral line.

Ocular side - independent of the l. lines.

Oval (slightly elongate), anterior angles widely rounded, anterior margin convex, finely and irregularly scalloped, some scallops larger and more prominent than others, numerous, 35 - 40, lateral margins slightly convex; anterior length 72-76% of total

length, anterior breadth 52 - 56% of anterior length, posterior breadth 112-117% of anterior breadth. Focus small but well-defined, oval, rather posterior in position, about  $\frac{1}{4}$  of total length of scale from posterior margin. Anterior field large, radii divergent from focus, lateral spread moderate, numerous, 6 - 10 near the focus, increasing to 35 - 40 at the anterior margin, well-defined, straight, continuous, fairly closely-set but spacing unequal; interradii circuli very close-set, entire, in the form of acute-angled curves, apices of curves produced into somewhat irregular, blunt-pointed crenulations, convexities of curves towards anterior margin.

TEXT-FIG. 51.

Lateral fields small, triangular, circuli fewer and wider-spaced than in anterior field. Posterior field small, forming a "polar cap" to the scale, entirely covered with spines. Spines fairly long, longest 9 - 11% of total length of scale, very slender and tending to be almost filamentous, slightly undulose, lateral margins curved basally, bases moderately broad, sharp-pointed; alterante arrangement distinct and regular, 3 - 4 major and 3 - 4 minor series medianly, reduced to 1 - 2 laterally, first major series of 12 - 16 spines and first minor series of 12 - 16 spines, giving a marginal projecting series of 24 - 32 spines. Spines of marginal series homogeneous, of equal length, projecting for about  $\frac{1}{2}$  their length beyond posterior margin.

Adjacent to the l. lines.

Similar to scales away from the lateral lines, but lateral margins adjacent to lateral lines flattened or slightly concave.

Lateral lines.

Similar to non-lateral line scales. Muciferous canal medianly symmetrical, of even width throughout, fairly long; spines persistent except where canal cuts posterior field.

Blind side - independent of the 1. lines.

Similar in most respects to ocular side scales. Weakly ctenoid scales with very small posterior field, spines grouped in a small median patch, in variable numbers, hardly ever more than 15 all told, of which 4 project beyond posterior margin; spines shorter and stouter than those of ocular side scales. Cycloid scales with a moderately-sized posterior field, triangular in shape, ornamented with moderately-spaced circuli. Maximum breadth 48 - 52% of total length.

There are no signs of annuli.

42. TRULLA MICROPHTHALMUS (Von Bonde).

Areliscus microphthalmus, Von Bonde, 1922, Rep. Fish. Mar. Biol. Surv. S. Afr., ii, (1921), Spec. Rep. i, p. 24, pl. iv, fig. 3; Von Bonde, 1925, Trans. Roy. Soc. S. Afr., xii, p. 292.  
Trulla microphthalmus, Barnard, 1925, Ann. S. Afr. Mus., xxi, p. 416.

## TEXT-FIG. 52.

D. 110-117; A. 86-95; L. 1.89-95.

Body elongate; depth  $3\frac{2}{5}$ , head  $4\frac{4}{5}$ , in length of body.

Eyes  $8\frac{1}{2}$  to 10 in length of head, separated by a slightly concave space which is equal to or a little less than vertical diameter of eye, upper in advance of lower by about  $\frac{1}{2}$  diameter of eye. Maxillary reaching to vertical through posterior border of lower eye; teeth minute, on blind side only. Snout hooked, hook extending around mandible to a point just anterior to vertical from anterior border of upper eye. Scales ctenoid on ocular side, weakly ctenoid (mostly) and cycloid on blind side. Three lateral lines on ocular side extending on to head, connected by a perpendicular line between eyes and gill-opening; anteriorly dorsal lateral line follows outline of head, curves down on snout and then bends sharply backwards a short distance along a line, which, if continued, would pass through centre of interocular space; from anterior end of lower jaw ventral lateral line runs along lower outline of head and has a distinct arch in its middle, breaks off on opercle but commences again at anterior end

of anal fin and runs backwards along base of anal to caudal; faint trace of lateral line on blind side. Brown, more or less mottled, especially in young; dorsal and anal with numerous, reddish-brown, round spots; caudal light. Blind side whitish.

Length: Up to 140 mm.

Distribution: Table Bay, East London, Port St. John's, Natal Coast, Delagoa Bay, 10 to 200 fathoms.

Lepidology. (Plate XV, figs. 80, 81).

Scales ctenoid on ocular side, feebly ctenoid or cycloid on blind side, cycloid scales less numerous than in T. capensis and scattered all over body, moderate in size, adherent, regular in arrangement; 89 - 95 scales in the lateral line.

Ocular side - independent of the l. lines.

Elongate oval, anterior angles widely rounded, anterior margin convex, finely and irregularly scalloped, some scallops larger and more prominent than others, numerous, 27 - 32, lateral margins very slightly convex, nearly straight; anterior length 88 - 92% of total length, anterior breadth 46 - 50% of anterior length, posterior breadth 100-105% of anterior breadth. Focus small but well-defined, circular, very posterior in position about 1/10th of total length of scale from posterior margin. Anterior field large, radii divergent from focus, lateral spread moderate, well-defined, straight, continuous, rather closely-set but spacing unequal, numerous, 8 - 12 near the focus, increasing to 25 - 30 at the anterior margin; interradial circuli very close-set, entire, in the form of acute-angled curves, apices of curves produced into somewhat irregular blunt-pointed crenulations, convexities of curves towards the anterior margin.

**TEXT-FIG. 53.**

Lateral fields small, triangular, circuli very close-set. Posterior field small, forming a "polar cap" to the scale, entirely covered with spines. The marginal series of spines is commonly lost in these scales. Spines present usually very short, longest

not more than 3% of total length of scale, strong, lateral margins straight and sloping to a fairly broad base, blunt-pointed; alternate arrangement distinct and regular, 4 major and 4 minor series medianly, reduced to 1 - 2 laterally; first major series present (in these scales actually the second major series) of 8 - 10 spines and first minor series present (actually the second minor series) of 8 - 10 spines, giving a marginal projecting series of 16 - 20 spines. Spines of marginal series homogeneous, of equal length, only the extreme tips projecting beyond the posterior margin.

Adjacent to the l.lines.

Similar to scales away from the lateral lines, but lateral margins adjacent to lateral lines concave.

Lateral lines.

Similar to non-lateral line scales. Muciferous canal medianly symmetrical, of even width throughout, fairly long; spines persistent except where canal cuts posterior field.

Blind side - independent of the l.lines.

Similar to ocular side scales in most respects, but a little smaller and not quite so elongate. Posterior field in weakly ctenoid scales much reduced in size, spines grouped in a small median patch, in variable numbers, hardly ever more than 30 in all, of which about 6 - 8 project beyond the posterior margin; spines shorter than those of ocular side scales. Posterior field of cycloid scales larger than its counterpart in ocular side scales, ornamented with a few moderately-spaced circuli. Maximum breadth 58 - 62% of total length.

There are no signs of annuli.

(xxix). ARELISCUS.

Areliscus, Jordan and Snyder, 1900, Proc. U.S. Nat. Mus., xxiii, p. 380;  
Jordan and Starks, 1906, Proc. U.S. Nat. Mus., xxxi, p. 240;  
Barnard, 1925, Ann. S. Afr. Mus., xxi, p. 414.

Lips not fringed. Pelvic of ocular side only present, more or less confluent with anal. Scales mostly ctenoid. Three

lateral lines on ocular side, lowermost one often discontinuous, or even absent in the young. Two nostrils on ocular side, lower one tubular. Mouth inferior.

Two species found in South African waters.

Key to the South African Species.

- a. Angle of mouth nearer gill-opening than anterior end of snout.  
 . . . . .43. marleyi.
- b. Angle of mouth nearer anterior end of snout than gill-opening.  
 . . . . .44. ecaudatus.

43. ARELISCUS MARLEYI (Regan).

Cynoglossus marleyi, Regan, 1921, Ann. Mag. Nat. Hist., (9) vii, p. 418.  
Areliscus marleyi, Von Bonde, 1922, Rep. Fish. Mar. Biol. Surv. S. Afr.,  
 ii, (1921), Spec. Rep. i, p. 25; Von Bonde, 1925, Trans. Roy. Soc.  
 S. Afr., xii, p. 292; Barnard, 1925, Ann. S. Afr. Mus., xxi, p. 414.

D. 130; A. 105-110; L. 1. ca. 130.

Body elongate; depth 4, head  $5\frac{1}{4}$  to  $5\frac{1}{3}$ , in length of body. Eyes 9 - 10 in length of head, separated by a space which is about  $\frac{1}{2}$  diameter of eye. Maxillary reaching to below posterior border of lower eye; angle of mouth considerably nearer gill-opening than anterior end of snout, which is rather pointed,  $2\frac{1}{4}$  in length of head. Posterior nostril of ocular side between the eyes, anterior nostril tubular, in front of lower eye. Scales ctenoid on both sides of body. Three lateral lines on ocular side; 20 series of scales between upper and middle lateral lines, 26 between middle and lower lines. No lateral line on blind side. Uniform brown, caudal and outer margins of dorsal and anal fins blackish. Blind side whitish.

Length: Up to 430 mm.

Distribution: Natal and Zululand Coasts, to Delagoa Bay, 63 - 130 fathoms.

Lepidology. (Plate XVI, figs. 84, 85).

Scales ctenoid on both sides of body, moderate to large in size, larger on blind side than on ocular side, adherent,

regular in arrangement; about 130 scales in the lateral line.  
Ocular side - independent of the l.lines.

Elongate oval, anterior angles rounded, anterior margin convex, finely and irregularly scalloped, some scallops larger than others, numerous, 37 - 42, lateral margins very slightly convex, nearly straight; anterior length 78 - 82% of total length, anterior breadth 51 - 54% of anterior length, posterior breadth 102 - 106% of anterior breadth. Focus small but well-defined, circular or oval, rather posterior in position, about 1/5th of total length of scale from posterior margin. Anterior field large, radii divergent from focus, lateral spread moderate, well-defined, straight, continuous, rather closely-set but spacing unequal, numerous, 8 - 12 near the focus, increasing to 35 - 40 at the anterior margin; interradii circuli very close-set, entire, in the form of acute-angled curves, apices of curves produced into somewhat irregular blunt-pointed crenulations, convexities of curves towards anterior margin.

TEXT-FIG. 54.

Lateral fields small, triangular, circuli very close-set. Posterior field moderate in size, roughly triangular, entirely covered with spines. Spines short, longest 5 - 7% of total length of scale, strong, lateral margins slightly curved, bases fairly broad, and slightly blunt-pointed; alternate arrangement distinct and regular, 5 - 7 major and 5 - 7 minor series medianly reduced to 1 - 2 laterally; first major series of 17 - 19 spines and first minor series of 17 - 19 spines, giving a marginal projecting series of 34 - 38 spines. Spines of marginal series more or less homogeneous, of about equal length, projecting for about  $\frac{1}{2}$  their length to only their tips beyond the posterior margin.

Adjacent to the l.lines.

Similar to scales away from the lateral lines, but

lateral margins adjacent to lateral lines concave.

Lateral lines.

Similar to non-lateral line scales. Muciferous canal medianly symmetrical, fairly long, of even width throughout, rather narrow; spines persistent except where canal cuts posterior field.

Blind side - independent of the l.lines.

Similar to ocular side scales in most respects, but larger and tending to become subrectangular in shape. Posterior field reduced in size and spines fewer, but contrary to the usual rule, spines of marginal series somewhat longer - longest a little more than 9% of total length of scale; marginal projecting series of spines total 19 - 22. Maximum breadth 48 - 52% of total length.

There are no signs of annuli.

44. ARELISCUS ECAUDATUS (Gilchrist).

Cynoglossus acaudatus, Gilchrist, 1906, Mar. Invest. S. Afr., iv, p.162, pl. xlv; Gilchrist and Thompson, 1917, Ann. Durban Mus., i, p.398; Thompson, 1918, Mar. Biol. Rept., iv, p.128.  
Cynoglossus ecaudatus, Regan, 1920, Ann. Durban Mus., ii, p.222; Von Bonde, 1922, Rep. Fish. Mar. Biol. Surv. S. Afr., ii, (1921), Spec. Rep. i, p.25.  
Areliscus natalensis, Von Bonde, 1922, Rep. Fish. Mar. Biol. Surv. S. Afr., ii, (1921), Spec. Rep. i, p.23.  
Areliscus ecaudatus, Barnard, 1925, Ann. S. Afr. Mus., xxi, p.415.

TEXT-FIG. 55.

D. 102-106; A. 85-86; L.l. 63-67.

Body elongate; depth 3 to  $3\frac{2}{5}$ , head  $4\frac{4}{5}$ , in length of body. Eyes contiguous, 7 to  $7\frac{1}{3}$  in length of head, upper in advance of lower by about  $\frac{1}{2}$  diameter. Mouth moderate, maxillary reaching to below middle of lower eye, nearer end of snout than gill-opening; teeth small, on blind side only. Snout hooked, reaching around mandible to point just anterior to vertical from anterior border of upper eye. Dorsal commences about midway between end of snout and vertical from

anterior border of upper eye, confluent with pointed caudal, anal similar to dorsal. Pectorals absent. Pelvic of ocular side present only, joined to anal (shown free in Von Bonde's figure - text-fig.55. ). Anterior nostril tubular, in front of lower eye; posterior nostril small, not tubular, placed in angle between the eyes. Scales ctenoid on both sides of the body. Three lateral lines on ocular side, lowest one frequently discontinuous and often absent in the young; faint trace of lowest one just behind operculum, extending for a distance of about 1 inch; part of lowest one represented on lower part of head running from mandible to operculum with a small median arch; uppermost one extends only about halfway along dorsal profile of body; 10 scales between upper lateral lines. No lateral line on blind side. Head and body dusky brown; fins darker and slightly mottled, lighter towards borders; fins dusky on blind side; about 6 more or less distinct, dark, vertical cross-bands across body. Blind side of body whitish.

Length: Up to 140 mm.

Distribution: Natal and Zululand Coasts, 26 - 30 fathoms.

Lepidology.(Plate XVI, figs. 86, 87.)

Scales ctenoid on both sides of body, moderate to large in size, adherent, regular in arrangement; 63 - 67 scales in the lateral line.

Ocular side - independent of the l.lines.

Elongate oval, anterior angles rounded, anterior margin convex, finely but irregularly scalloped, some scallops larger than others, numerous, 34 - 38, lateral margins slightly convex or nearly straight; anterior length 84 - 88% of total length, anterior breadth 59 - 63% of anterior length, posterior breadth 106 - 112% of anterior breadth. Focus very small but well-defined, circular, rather posterior in position, about 1/5th to 1/6th of total length of scale from posterior

margin. Anterior field large, radii divergent from focus, lateral spread moderate, well-defined, straight, continuous, rather closely-set but spacing a little unequal, numerous, 6 - 8 near the focus, increasing to 32 - 36 at the anterior margin; interradii circuli very close-set, entire, in the form of acute-angled curves, apices produced into somewhat irregular, blunt-pointed crenulations, convexities of curves towards the anterior margin.

TEXT-FIG. 56.

Lateral fields small, triangular, circuli very close-set. Posterior field of moderate size, roughly triangular, entirely covered with spines. Spines short, longest 5 - 7% of total length of scale, strong, lateral margins slightly curved, bases fairly broad, slightly blunt-pointed; alternate arrangement distinct and regular, 6 - 7 major and 6 - 7 minor series medianly, reduced to 1 - 2 laterally; first major series of 15 spines and first minor of 15 spines, giving a marginal projecting series of 30 spines. Spines of marginal series more or less homogeneous, of about equal length, projecting for about  $\frac{1}{2}$  their length to only their tips beyond the posterior margin.

Adjacent to the l.lines.

Similar to scales away from the lateral lines, but lateral margins adjacent to lateral lines concave.

Lateral lines.

Similar to non-lateral line scales. Muciferous canal medianly symmetrical, fairly long, of even width throughout, rather narrow; spines persistent except where canal cuts posterior field.

Blind side - independent of the l.lines.

Similar to ocular side scales in most respects, but a very little larger and tending to become subrectangular in shape. Posterior field a little reduced in size, spines shorter but not reduced in number, in fact sometimes more

numerous - marginal projecting series of spines total up to 35. Maximum breadth 48 - 50% of total length.

There are no signs of annuli.

(xxx). PARAPLAGUSIA.

Plagusia (nom. preocc.), Cuvier, 1817, Regne Anim., ii, p. 224.  
Paraplagusia, Bleeker, 1866, Atlas Ichthyol., vi, p. 26; Barnard, 1925, Ann. S. Afr. Mus., xxi, p. 410.

Lips fringed. Pelvic of ocular side only present, more or less completely joined to anal. Scales ctenoid. Two lateral lines on ocular side, one or more on blind side. Mouth inferior.

One species found in South African seas.

45. PARAPLAGUSIA MARMORATA, Bleeker.

? Plagusia dipterygia, Rüppell, 1828, Atlas Fish., p. 123, pl. xxxi, fig. 3.

Plagusia marmorata, Bleeker, 1852, Verh. Batav. Gen., xxiv, Pleuron., p. 20; Günther, 1862, Cat. Fish. Brit. Mus., iv, p. 491; Day, 1878, Fish. Ind., p. 431, pl. xcv, fig. 1; Gilchrist and Thompson, 1917, Ann. Durban Mus., i, p. 399.

Paraplagusia marmorata, Bleeker, 1866, Atlas Ichthyol., vi, p. 28, Pleuron., pl. xv, fig. 5; Regan, 1920, Ann. Durban Mus., ii, p. 219; Barnard, 1925, Ann. S. Afr. Mus., xxi, p. 410.

Plagusia marmorata var. africana, Gilchrist, 1906, Mar. Invest. S. Afr., iv, p. 163, pl. xlvii; Gilchrist and Thompson, 1909, Ann. S. Afr. Mus., vi, p. 263; Gilchrist and Thompson, 1917, Ann. Durban Mus., i, p. 399; Von Bonde, 1922, Rep. Fish. Mar. Biol. Surv. S. Afr., ii, (1921), Spec. Rep. i, p. 23.

Plagusia robinsoni, Regan, 1919, Ann. Durban Mus., ii, p. 203, fig. 6.  
Paraplagusia robinsoni, Regan, 1920, Ann. Durban Mus., ii, p. 220; Von Bonde, 1922, Rep. Fish. Mar. Biol. Surv. S. Afr., ii, (1921), Spec. Rep. i, p. 23.

TEXT-FIG. 57.

D. 99-110; A. 75-86; 1.1. 100-110.

Body elongate; depth  $3\frac{1}{2}$  to 4, head 4 to  $4\frac{1}{2}$ , in length of body. Eyes small, equal to or a little greater than interorbital width; upper in advance of lower, slightly anterior to middle of length of head. Maxillary reaching to below posterior margin of lower eye, nearer edge of operculum than end of snout. Snout rounded and blunt (male), or more pointed (female). Dorsal and anal confluent with caudal. Pelvic of ocular side present only, joined to anal. Pectorals absent. A tubular nostril on ocular side in front of lower eye and a

corresponding one on the blind side. Two lateral lines on ocular side, separated by 16 - 19 rows of scales; no distinct lateral line on blind side. Scales ctenoid on both sides of body. Brown or greyish, marbled or spotted with darker. Blind side whitish.

Length: Up to 250 mm.

Distribution: Natal and Zululand Coasts, shallow water.

Lepidology. (Plate XVI, figs. 82, 83).

Scales ctenoid on both sides of body, rather weakly so on blind side, moderate to large in size, adherent, regular in arrangement; 100 - 110 scales in the lateral line.

Ocular side - independent of the l.lines.

Oval, anterior angles widely rounded, anterior margin convex, finely and regularly scalloped, scallops numerous, 40 - 44, lateral margins convex; anterior length 78 - 81% of total length, anterior breadth 75 - 78% of anterior length, posterior breadth 96 - 100% of anterior breadth. Focus very small but well-defined, circular, rather posterior in position, about 1/5th of total length of scale from posterior margin. Anterior field large, radii very slightly divergent from focus (subparallel in median section of the field), well-defined, straight, continuous, rather closely-set and equally-spaced, numerous, 8 - 10 near the focus, increasing to 38 - 42 at the anterior margin; interradial circuli very close-set, mostly entire, in the form of acute-angled curves, apices of curves produced into very irregular, sharp-pointed crenulations, convexities of curves towards the anterior margin.

**TEXT-FIG. 58.**

Lateral fields small, triangular, circuli very close-set. Posterior field of moderate size, triangular, entirely covered with spines. Spines short, longest 6 - 8% of total length of scale, strong but inclined to be slender, lateral margins curved, bases broad, sharp-pointed; alternate arrangement

distinct and regular, 4 - 5 major and 4 - 5 minor series medianly, reduced to 1 - 2 laterally; first major series of 12 - 14 spines and first minor series of 12 - 14 spines, giving a marginal projecting series of 24 - 28 spines. Spines of marginal series homogeneous, of equal length, projecting for about  $\frac{1}{3}$ rd. to  $\frac{1}{2}$  their length beyond the posterior margin.  
Adjacent to the l.lines.

Similar to scales away from the lateral lines, but lateral margins adjacent to lateral lines concave.

Lateral lines.

Similar to non-lateral line scales. Muciferous canal medianly symmetrical, moderately long, narrow and of even width throughout; spines persistent except where canal cuts posterior field.

Blind side - independent of the l.lines.

Similar to ocular side scales in most respects, but a little smaller. Posterior field reduced in size to varying degrees, spines shorter and fewer - sometimes only a small median patch of spines present. Maximum breadth 44 - 50% of total length.

There are no signs of annuli.

C. SCALE CHARACTERS IN RELATION TO IDENTIFICATION  
AND CLASSIFICATION.

## 1. REVIEW OF LITERATURE.

This section of the paper is a brief resumé of the literature on fish scales, more particularly in ~~the~~<sup>so</sup> far as the characters of scales and their utilization in taxonomy are concerned. Every paper listed in Part I of the bibliography is not reviewed here, but for the most part only those works which state definite views in regard to the feasibility of using scale characters in identification and classification.

The study of fish scales dates from as early as the middle of the 16th Century, when Borello(3), shortly after the invention of the microscope, wrote a brief description of the microscopic appearance of a fish scale and added a diagrammatic figure of the same. About a century later Hooke (27) in his Micrographia gave a very brief description but a fairly accurate figure of the scales of the sole.

Leuwenhoeck (31) made several interesting observations on the development and structure of scales. He was the first investigator to propose the theory of the annual growth of scales by addition of a new zone. He modified his first idea of the yearly increase in size of the scale by means of adding a new zone or circle to the pre-existing scale however, when he examined certain scales and found that those of old fish were very thick, much thicker in fact than they would necessarily be if their mode of increase was simply by the addition of a new circle or zone each year. In his second paper (32) he states his new conclusion to be that the portion which he had at first taken for a new zone disposed round the primitive scale, was simply the most external part of a new scale, the part which exceeded the old scale in size, and that all these scales were intimately welded together. The scale of a ten-year-old fish is therefore composed of ten scales secondarily superimposed the one upon the other.

Reaumur (41) agreed with this latter conclusion of Leuwenhoeck's and in addition had some interesting comments to make on the silvery matter, sometimes known as "l'essence d'orient", of scales. Petit (40) in his memoir on the carp dealt with the following points in connection with scales, but only very superficially: - the manner in which scales overlap each other; the size of scales in different parts of the body; the way in which scales are enclosed in the skin; the furrows (sillons) on the upper surface of the scale; the silvery matter on the lower surface, etc. He gave a much fuller description of the lateral line scales however.

In the writings of Schaeffer (42) we find a few observations on scales. He notes the external characters of scales and their variation in different parts of the body, but does not go in for any detailed descriptions as regards their structure and development. He also gives figures of scales from five different species of perch.

Broussonet (4) demonstrates the presence of scales in a number of genera of fish in which their existence had either previously been denied, overlooked or held in doubt, e.g. Cepola, Remora, Ammodytes, Anguilla, and Scomber. His descriptions are very brief.

To Heusinger (23) we owe the first attempt at a classification of fish by means of their scales. Fishes provided with scales were divided into five groups in his system.

- (i) Fish with small scales entirely hidden in skin. (Anguilla, Muraena, Blennius, Muraenophis).
- (ii) Fish with scales properly so-called. (Cyprinus, Esox, and Salmo).
- (iii) Fish with scales strongly toothed at their free margins. (Chaetodon).
- (iv) Fish with osseous scales (Knochenschuppen). These scales resemble group (ii), but have so much calcareous matter as to resemble hard teeth. They are not usually imbricated but are isolated or merely contiguous; their surface often possesses spines. (Lepidosteus and several species of the

genus Trigla, Cottus, Silurus, Gasterosteus, etc.)

- (v) Fish with osseous plates (Knochenplatten). These plates form a continuous solid cuirass round the fish (Ostracion, Diodon, Syngnathus, Hippocampus, Acipenser, etc.).

Heusinger also gives a concise description of true scales, and in regard to their structure agrees with Agassiz in looking upon each scale as made up of superimposed plates or layers.

Kuntzmann's paper (3) is important chiefly because it contains the germ of an idea which Agassiz later developed more fully in his Classification des Poissons. Kuntzmann opposes the views of Schaeffer, who had emphasized the differences between scales of the same fish. The former maintained "that though one does not easily find absolutely similar scales on the same species of fish, yet the scales of each species have some characteristic feature, and that an examination of scales may enable one to acquire a more exact knowledge of species, and that one may identify some genera and even some species simply by an examination of their scales".\*

He compares scales with the leaves of plants, in which although there is frequently quite a degree of variation among the leaves of the same species, still one may often recognise the species of plants by their leaves. Kuntzmann worked out a classification of scales into seven classes, remarking at the same time that quite gradual transitions existed between these classes and that certain scales might equally well be placed in one class as in another. His classes are the following: -

- (i) Membranous scales (hautigen Schuppen). Scales which do not show concentric lines (Gadus lota).
- (ii) Semi-membranous scales (halbhautigen). Scales with membranous posterior portion, but with the anterior portion marked out by incomplete concentric lines, crossed over by other lines running longitudinally (Clupea harengus).
- (iii) Simple scales (einfachen). Scales with concentric lines covering their entire surface without those lines forming any definite design by other lines crossing over them (Salmo salar).
- (iv) Scales with a design (gezeichneten). Scales in which the concentric lines on the scale surface form a regular design due to the arrangement of the same (Muraena anguilla).
- (v) Scales divided into several regions (gefelderten). Scales on which there occur numerous ornaments which divide up the

\* Thomson's translation.

scale into four distinct fields. These different fields or areas, usually triangular in shape, meet at a point, which is usually at the same time the centre of the concentric lines or the focus of the scale. (Cyprinus carpio).

- (vi) Scales with prickles. These scales are also often divided into four areas. The posterior area bears prickles on a more or less extended portion of its surface, or sometimes only at its free border. These prickles fall off on prolonged maceration, showing that they are not really portions of the scale but arise from the skin, which covers the scales. These prickles also fall off naturally at certain seasons, and others take their place (Scorpaena spp.)
- (vii) Spinous scales (gedornite). These scales are also portioned off into several areas or fields. The spines in this case are true prolongations or appendages of the scale, and do not become detached on maceration, nor are they periodically moulted (Perca lucioperca).

Kuntzmann gives a short description of each type of scale with a corresponding figure.

Agassiz's comments (1) on scales as regards their structure and development are interesting and lengthy, but do not concern us very closely, so that all we need mention regarding his work is that he agreed with Leuwenhoeck and Reaumur as to the structure of scales with regard to the superimposed layers. He introduced his classification of fishes into four orders according to the nature of their scales: Placoid, Ganoid, Cycloid and Ctenoid.

Mandl (33), the opponent of Agassiz held very different views on scale structure and development from all previous investigators. As to the use of scales for the purpose of classification, Mandl says that up to the present "we have found definite and characteristic forms for each family", and that further research on a sufficient number of individuals would decide whether this might also be applied to genera and species.

Peters (39) was the first to devote his attention to scales as part of an integumental organisation. He gave a critical review and summary of the observations of Mandl and Agassiz. He agrees with Agassiz in some respects and with Mandl in others.

Müller (34) issued a paper on Ganoids and natural classification of fishes. In part of his paper he deals with some points relating to taxonomic value of scale characters. He main-

tained that the differences between the scales of Cycloids and Ctenoids are of little importance and can only be useful for purposes of classification in a very limited way. A little later Vogt (50) published a paper in which he discussed the value of the characters of scales in distinguishing different orders of Ganoids.

In the Manual of Comparative Anatomy by Siebold and Stannius (43), the latter regards it as doubtful whether it would be right to take the different forms of scales exclusively as a basis for classification.

Williamson's paper (51) does not concern us much and we may dispose of it by mentioning that he criticized the views of Agassiz and Mandl without making any great contribution towards the research on fish scales.

Darresté (17) in a paper on Blochius longirostris gives some considerations on the value of scale characters in classification. He states that he would not give them the role of dominating characters.

Hollard (24) in his monograph on the family Balistidae deals with the disposition of their tubercles and spines on the scales, their grouping and mode of formation. That is as far as he goes in this monograph on the subject of scales. He published a second monograph (25) on the Ostracions in which he gave a detailed description of the scale systems in this family. He held that the spines on scales are of value for purposes of specific classification.

Steenstrup (44) says in his paper "that allied species may be distinguished with certainty by the number of scales in each longitudinal line."

Carpenter (5) says regarding the cycloid and ctenoid divisions established by Agassiz, he considers this sharp division as having little harmony with the general organisation of the types which it has the aim of separating.

Vaillant (49) also takes up the question of the value of cycloid and ctenoid characters as propounded by Agassiz for

purposes of classification. He shows the great variation which occurs in the scales of Percidae, not only in different individuals of the same species, but also in different regions of the body in the same individual. Owing to this variation he regards Agassiz's division into cycloid and ctenoid as of little value.

Baudelot (2) published a lengthy and interesting paper on scales, divided into three parts. Part III deals with a number of facts on the value of the characters found in scales in relation to classification. He says "nothing is more variable than the external characters of scales, and as in a tree one does not find two leaves exactly identical, so is it in regard to the scales of fishes; but the particular features of scales, as of leaves, do not all vary at the same time, and thus there generally remain several general characters of resemblance which scarcely allow us to confound the scales of one species with those of another."<sup>x</sup> He considers the question of classification depending on scale-characters in great detail in relation to the following points: (i) connection of scales with the integument; (ii) the form of scales; (iii) the dimensions of scales; (iv) the ridges on scales; (v) the spines on scales; (vi) the grooves on scales; (vii) the perforating canaliculi and interior lacunae of scales; (viii) the focus of scales; (ix) the tissue of scales; and (x) the presence or absence of scales. In summarising the results obtained from a consideration of these points, he comes to the conclusions that none of these characters of scales taken by themselves can serve as a basis for the classification of fishes, that the most important of all of them, viz., the cycloid and ctenoid character, does not possess the degree of importance which many zoologists have attached to it, and that the other characters noticed are of still less value. Although each character by itself is of little value, yet the characters of scales, in toto, ought not to be neglected in the establishment of natural groups. He

<sup>x</sup> Thomson's translation.

recognises that, in order to put such a programme into execution, a much more precise and detailed knowledge is necessary of the external characters, structure and development of scales in large numbers of types of fishes.

Klaatsch (29) did some important work on the structure and development of scales, but does not go into the question of classification by means of scale characters.

Holt (26) records the appearance of spines on the scales of the plaice in restricted areas of the body. Normally plaice scales are cycloid.

Thomson's two papers (46) and (47) are primarily of a descriptive nature, but the second paper (47) has been invaluable as a guide to early literature on fish scales. I am greatly indebted to the author for the splendid review of available literature up to his time incorporated in his second cited paper, and liberal use has been made of it in this study.

Tims (48) in his paper distinguishes the various groups of the Gadidae by means of their scales but goes no further into classification.

Hutton's paper (28) was found useful as a guide to the technique of fish-scale photography.

Cockerell, the chief modern worker in taxonomic lepidology, describes the scales of various groups of fishes, either in collaboration with other workers or as sole author, in numerous papers (6 - 14). A paper of special note (10) includes descriptions of the scales of various species of flatfish and also an artificial key for distinguishing and classifying these species of Heterosomata, according to their scale characters. Another of Cockerell's papers (11) of importance gives some additional notes on flatfish scales and in his introduction he says "a few years ago an eminent European ichthyologist expressed the opinion that the detailed work on scales was a waste of time, for said he, 'We have other excellent characters on which to classify fishes, so why bother with

scales?' Possibly this particular authority will never be converted to lepidology, but I do not believe anyone could spend much time in the minute study of scales without becoming convinced of their great value for purposes of identification and classification". He then goes on to say that scales, like all other structures, vary and present characters of all degrees of significance and stability; in the earlier work on scales some mistakes were made, because of poor judgement in these matters. The correct estimation of the importance of particular scale characters can only come with experience.

Cunningham in his publication (16), Reptiles, Amphibians and Fishes, edited by him, says on page 361, "the scales of Teleostei afford some of the most important specific characters and these characters exhibit continuous variations."

Taylor's paper (45) has been found of great value as a guide to literature, and those papers of earlier authors dealing more specifically with taxonomy were easily picked out as his literature was reviewed under definite headings, one of which was classification. His paper is the more interesting because of a new theory advanced as regards the function and origin of radii. His conclusion, if established will either negative or very materially change systems of classification in which radii are employed as taxonomic characters. His conclusions on the subject of classification of fish by means of their scale characters are noteworthy. He holds that none of the characters taken separately has any value, but taken collectively they may be of some use. To his mind circuli seem to be of some taxonomic value because of their constant character.

Hutton (28) says "probably most people nowadays are aware that the life-history of every fish is indelibly written on almost every single one of its scales, but perhaps it is not so generally known that each species of fish has its own particular type of scale." He says later on in his paper that it must be

noted, however, that the scales of fish, which are closely related are often somewhat similar to one another. There is a sort of family likeness.

Milne's papers (35) and (36) were of the greatest assistance and value as guides to the technique of scale collection, examination and photography. This author's method of mounting scales between two glass slides in a dry state has been followed in the present study. In the second paper (36) cited the following statement appears: -"As a general rule fish belonging to the same genus possess scales similar in type; but the rule has many exceptions and though genus, and even family, may be guessed at from the appearance of a scale, no reliance can be placed on identification by this method."

Peabody (38) working on the question of "identification and classification of fishes by their scale," chose a group of fishes, the suborder Clupeoidei. In this group, besides clearly delimited species, there are certain species which have been classified, now in one family and then in another by different taxonomists. An endeavour has been made to ascertain what light on the relationship of the species could be derived from a study of the scale patterns, and to determine whether the scales could help to decide the proper positions of some of the fishes, the indefinite relationships of which had been shown by their numerous changes from one family to another. The author draws the general conclusion that scales have a diagnostic value and are distinctive of families and genera but not always of species. Those families which have been clearly delimited by taxonomists on the evidence of the morphology of the entire fish and have not been subjected to subsequent changes of position by other workers, exhibit definite scale-characters which distinguish them from other families. On the other hand, in those groups, the genera of which have been changed again and again by taxonomists, the

scales reflect the indefiniteness of the border lines. The author rightly points out that if scales, convenient as they are for study, can yield results similar to those obtained by the usual process, then their use in cases where the whole fish is not conveniently at hand, or cannot be produced, as in palaeontological work, is of importance.

2. DISCUSSION.

In order to facilitate reference during the course of discussing the application of lepidological diagnostics to taxonomic identification, a tabulation of the classification adopted in this paper will now be given. Thus:-

HETEROSOMATA.I. PSETTOLIDAE.(i). Psettodes Bennett.

1. Psettodes erumei (Schneider) - The Adalah.

II. BOTHIDAE.A. PARALICHTHINAE.(ii). Pseudorhombus Bleeker.

2. Pseudorhombus arsius (Hamilton) - Large-toothed Flounder.

3. Pseudorhombus natalensis, Gilchrist.

(iii). Citharoides Hubbs.

4. Citharoides macrolepis (Gilchrist) - Large-scaled Flounder.

B. BOTHINAE.(iv). Arnoglossus Bleeker.

5. Arnoglossus capensis, Boulenger - Cape Scald-fish.

6. Arnoglossus dalgleishi (Von Bonde) - Dalgleish's Flounder.

7. Arnoglossus microphthalmus (Von Bonde).

(v). Engyprosopon Gunther.

8. Engyprosopon grandisquama (Temminck and Schlegel).

9. Engyprosopon natalensis, Regan.

(vi). Crossorhombus Regan.

10. Crossorhombus valde-rostratus (Alcock) - Broad-forehead Flounder.

(vii). Bothus Rafinesque.

11. Bothus pantherinus (Ruppell) - Mottled Flounder.

(viii). Chascanopsetta Alcock.

12. Chascanopsetta lugubris, Alcock.

(ix). Laeops Gunther.

13. Laeops nigromaculatus, Von Bonde.

14. Laeops natalensis, Norman.

15. Laeops pectoralis (Von Bonde).

### III. PLEURONECTIDAE.

#### A. POECILOPSETTINAE.

(x). Poecilopsetta Gunther.

16. Poecilopsetta natalensis, Norman.

(xi). Marleyella Fowler.

17. Marleyella bicolorata (Von Bonde) - Blue-green Flounder.

#### B. PARALICHTHODINAE.

(xii). Paralichthodes Gilchrist.

18. Paralichthodes algoensis, Gilchrist.

#### C. SAMARINAE.

(xiii). Samaris Gray.

19. Samaris ornatus, Von Bonde - Crested Flounder.

20. Samaris delagoensis, Von Bonde.

### IV. SOLEIDAE.

#### A. SOLEINAE.

##### a. Soleina.

(xiv). Synapturichthys Chabanaud.

21. Synapturichthys kleini variolosa (Kner) - Black-finned Sole, Cape Sole.

(xv). Austroglossus Regan.

22. Austroglossus pectoralis (Kaup) - East Coast Sole, Agulhas Bank Sole.

23. Austroglossus microlepis (Bleeker) - Small-scaled Sole, Dassen Island Sole, West Coast Sole, Super Sole.

(xvi). Barnardichthys Chabanaud.

24. Barnardichthys fulvomarginata (Gilchrist) - Yellow-margined Sole.

(xvii). Quenselia Jordan and Goss.

25. Quenselia ocellata (Linnaeus) - Ocellate Sole.

(xviii). Dicologoglossa Chabanaud.

26. Dicologoglossa cuneata (Moreau) - Blunt-nosed Sole.

(xix). Solea Quensel.

27. Solea bleekeri, Boulenger - Bleeker's Sole.

(xx). Synaptura Cantor.

28. Synaptura marginata, Boulenger - White-margined Sole.

(xxi). Zebrias Jordan and Snyder.

Subgenus Pseudaesopia Chabanaud.

29. Zebrias(Pseudaesopia)regani (Gilchrist) - Regan's Double-banded Sole.

(xxii). Coryphaesopia Chabanaud.

30. Coryphaesopia cornuta barnardi, Chabanaud - Horned or Single-banded Sole.

b. Achirina.

(xxiii). Achirus Lacepede

31. Achirus marmoratus, Lacepede.

c. Heteromycterina.

(xxiv). Heteromycteris Kaup.

32. Heteromycteris capensis, Kaup.

## V. CYNOGLOSSIDAE.

(xxv). Symphurus Rafinesque.

33. Symphurus variegatus (Gilchrist).

34. Symphurus strictus, Gilbert.

35. Symphurus ocellatus, Von Bonde.

(xxvi). Cynoglossus Hamilton.

36. Cynoglossus lida, Bleeker.

37. Cynoglossus durbanensis, Regan.

38. Cynoglossus gilchristi, Ogilby.

39. Cynoglossus hunteri, Von Bonde.

(xxvii). Arelia Kaup.

40. Arelia attenuata (Gilchrist).

(xxviii). Trulla Kaup.

41. Trulla capensis, Kaup - Sand Sole.

42. Trulla microphthalmus(Von Bonde)

(xxix). Areliscus Jordan and Snyder.

43. Areliscus marleyi (Regan).

44. Areliscus ecaudatus (Gilchrist).

(xxx). Paraplagusia Bleeker.

45. Paraplagusia marmorata, Bleeker.

#### PSETTODIDAE.

The "primitively ctenoid" character - the finely crenulated posterior margins and ridge-like ornamentation of the posterior field - of the scales of Psettodes erumei immediately distinguishes this sole representative of the genus and family in South African waters from all other species occurring in this zoo-geographical area.

#### BOTHIDAE.

The family Bothidae is represented by 14 species in South African seas in all of which the common characteristic of cycloid scales on the blind side is found. On the ocular side the scales may be either ctenoid or cycloid. The 3 species of the subfamily Paralichthinae have ctenoid scales on the ocular side and cycloid scales on the blind side. The subfamily Bothinae includes 11 species, of these 6 have ctenoid ocular side scales and cycloid blind side scales, and 5 have cycloid scales on both sides.

The genera Pseudorhombus and Citharoides are readily separated from each other by the moderately-sized, adherent scales of the former as compared with the large, deciduous scales of the latter. The 2 South African representatives of the genus Pseudorhombus approximate one another very closely morphologically and this close relationship is borne out by the scale-characters. The scales are very similar in most respects, but the triangular posterior field and well-formed accessory spines of ocular side scales of P.arsius, are characteristically different from the narrow band-like posterior field and minute almost rudimentary accessory spines of P.natalensis. C.macrolepis is easily recognisable by the bifurcate, Y- or T-shaped muciferous canals of its lateral line scales.

Those genera of Bothinae with ctenoid scales on the ocular side are distinguishable from the genera in Paralichthinae by the arrangement of the spines of the posterior fields. In Paralichthinae the spines show a regular and distinct alternate arrangement into major and minor series, whereas in Bothinae the spines are always arranged as a single, more or less homogeneous, marginal series with a few (variable in number), irregularly disposed accessory spines. The genera of Bothinae including species with ctenoid scales on the ocular side are Arnoglossus, Engyprosopon, Crossorhombus, and Bothus.

Norman (1934, p.199) remarks on the striking similarity between the scales of Crossorhombus and Psettina (a genus not represented in South African waters), and considers the possibility of uniting these two genera for that reason. He expresses the opinion that due to the marked differences in the interorbital region found in the above two genera, this does not seem advisable, since the logical outcome would mean the union of Arnoglossus and Engyprosopon. The interorbital regions of the last-mentioned two genera also show considerable differences however, yet their scales are strikingly similar in many respects. On the basis of lepidological diagnostics we have the following close relationships:-

Arnoglossus -- Engyprosopon

Crossorhombus -- Psettina,

whereas on the basis of the morphology of the interorbital regions the close relationships are as follows:-

Arnoglossus -- Psettina

Crossorhombus -- Engyprosopon.

If the first arrangement is adopted the Arnoglossus -- Engyprosopon group comprises no less than 39 recognised species and the Crossorhombus -- Psettina group 5 recognised species. In the case of the second arrangement the Arnoglossus -- Psettina group includes 27 recognised species and the Crossorhombus -- Engyprosopon group 17 recognised species. A union on either basis would result in the formation of rather cumbersome and somewhat heterogeneous groups, and it would seem therefore that

the retention of four separate genera is desirable.

The 3 genera represented in South African waters are therefore readily distinguishable by utilising the morphology of the interorbital region and the scale-characters as complementary diagnostic features.

The genus Arnoglossus is represented by 3 species, and of these the scales of A.capensis and A.dalgleishi are "apparently" very similar (only a few lateral line scales from the latter species were available). In the latter species the posterior part of the muciferous canal appears as a U-shaped indentation in the posterior margin of its lateral line scales, whereas in the former this characteristic is not found. A.microphthalmus has cycloid scales on both sides of the body and therefore cannot be confused with either of the foregoing species. Norman (1934, p.197), although placing this species in the genus Arnoglossus, notes that this placement is provisional and that only the type-specimen is known. The species was originally identified as a Laeops by Von Bonde (1922), and on comparison of the scale-characters of this species with those of the 3 recognised species of Laeops found in South African seas, the similarity is so striking (Vide Plate IV, fig.13 and Plate VI, figs.23,24, and 25) that I am convinced further work on additional material will demonstrate the validity of Von Bonde's identification. However, in the absence of adequate material, and due to the fact that the first two dorsal rays in A.microphthalmus are not separated off by an interspace from the remainder of the fin, as is generally the case in Laeops (not found in L.nigromaculatus, it may be noted), in this paper I adhere to the provisional placement of the species in the genus Arnoglossus in deference to Norman's opinion.

The 2 species of Engyprosopon found in South African seas show very close morphological relationships and in conformity with this the scales are very similar in most respects. The main

distinguishing lepidological features are the following : muciferous canal of lateral line scales medianly symmetrical in E.natalensis, unsymmetrical - coursing obliquely across the scale from the ventral posterior angle towards the dorsal lateral field - in E.grandisquama; scales more elongate (longer than broad), radii usually fewer in number, and spines usually fewer in number in the former than in the latter.

The ctenoid elements of ocular side scales of the sole representative of the genus Crossorhombus occurring in South African waters are so distinctive - a single marginal series of very long, almost filamentous spines - that the species is immediately identified without possibility of error.

The scales of the single species of Bothus are readily distinguishable from those of all the species in the genera of Bothinae previously dealt with, in that they are strongly adherent, much smaller in size, and the spines of ocular side scales are much stouter, more robust and more blunt-pointed.

The two wholly cycloid genera of Bothinae are easily separated by their scale-characters. The scales of Chascanopsetta, represented by a single species, C.lugubris, are very minute, very thin and delicate, the circuli relatively few in number, and the radii not merely confined to the anterior field but also present in the major portions of the lateral fields. The scales of Laeops, represented by 3 species in South African seas, are small, but in proportion much larger than those of Chascanopsetta, circuli much more numerous and closer-spaced, and the radii confined to the anterior field. The 3 species of Laeops are not easily distinguishable solely by their scale-characters, and identification based on the scales from any one species, when scales from the other two species are not available at the same time for detailed comparison, is quite unreliable. Even when adequate scale-samples are at hand from all three species, identifications based solely on scale-characters can only be made with reservations. The lepidological variations to be found in any one species are often wider than the speci-

fic differences. At their maximum the specific distinctions consist of the following: number, spacing, divergence and lateral spread of the radii - L.nigromaculatus, 16-20, moderately-spaced, divergent with small lateral spread; L.natalensis, 22-24, closer-set than in the previous species, subparallel with negligible lateral spread; L.pectoralis, 24-28, moderately-spaced as in the first-mentioned species, with small but greater lateral spread than in that species; form of the interradial circuli - more or less straight in the first two species, slightly curved towards the posterior aspect of the scale in the last species.

#### PLEURONECTIDAE.

Three subfamilies of the family are represented in the South African area, Poecilopsettinae by 2 genera, each with a single species, Paralichthodinae (a subfamily with a single monospecific genus), and Samarinae by a single genus containing 2 species. The genera in Poecilopsettinae have ctenoid ocular side scales and cycloid blind side scales, as in some genera of the subfamilies Paralichthinae and Bothinae of the family Bothidae, but are readily separated from the latter by the shape of the interradial circuli, which are markedly bent anteriorly in the form of "average curves". The genera Poecilopsetta and Marleyella show close relationships morphologically and this approximation is borne out in the lepidology. The South African species may be distinguished by the following scale-characteristics however:-

#### P.natalensis.

Anterior length 78-82% of total l.  
 Ant.br. 60-65% of ant.l.  
 Post.br. 124-128% of ant.br.  
 Focus rather large.  
 Radii 8-12.  
 Spines 4-6% of total l., in 4 major and 4 minor series medianly.

#### M.bicolorata.

Ant.l. 72-75% of total l.  
 Ant.br. 75-80% of ant.l.  
 Post.br. 110-115% of ant.br.  
 Focus very small.  
 Radii 6-8.  
 Spines 6-8% of total l., in 5 major and 5 minor series medianly.

Scales of Paralichthodes cycloid on both sides of body, but readily distinguishable from scales of wholly cycloid genera of Bothinae by the very much closer-set, crowded circuli.

In the genus Samaris the scales are ctenoid on both sides

of the body, more strongly ctenoid on the ocular side than on the blind side. The 2 South African species of Samaris have fairly similar scales but are easily specifically identified by the fact that the ocular side scales of S.delagoensis are much more strongly ctenoid than the ocular side scales of S. ornatus.

#### SOLEIDAE.

The family is represented in South African waters by 11 genera, 10 of which have each a single specific representative and the remaining genus including 2 species. These 12 Sole species have a common lepidological characteristic which is distinctive of this family as occurring in the South African area, viz., the lateral line scales are very much smaller than the other scales, pear-shaped or egg-shaped, and almost completely or entirely hidden by and underneath the scales of the rows adjacently dorsal and ventral to the lateral line.

All the species have ctenoid ocular and blind side scales, but in a few species isolated cycloid scales may be found on the blind side.

The genera which can most readily be identified by reason of a single distinctive lepidological characteristic, or two such characters in combination, are the following:-

Austroglossus is at once recognised by the longitudinal and confused interradiial circuli; Dicologlossa by the minute, semicircular, posteriorly-directed crenulations into which the interradiial circuli are interrupted; Quenselia by the persistent prolongation of the median spine of the posterior field and the perforated lateral line scales, the perforation being very close to the posterior margin; Barnardichthys by the uncommonly robust spines in both ocular and blind side scales; Zebrias by the exceptionally beautiful pattern presented by the ctenoid elements, which are particularly regular in their alternate arrangement, long, straight-margined, and very sharp-pointed, and by the perforated lateral line scales, the perforation being somewhat removed from the posterior margin; Coryphaesopia

by the very weak, somewhat irregularly-disposed spines of the posterior field in both ocular and blind side scales; and Achirus by the thin, delicate, fragile scales and obscure, rather irregularly-disposed, somewhat rudimentary spines grouped in a triangular median patch in the posterior field of ocular and blind side scales.

Synapturichthys and Synaptura, as the generic nomenclature signifies, are morphologically somewhat closely related, and the scales show similar approximation. However, the radii in the former are always very much more numerous (24-30) than in the latter (10-14), the posterior field of ocular side scales in the former entirely covered with spines, but small lateral areas of the posterior field of the same scales in the latter free of spines, in the former spines short (9-12% of total length of scale) and slender, but longer (14-22% of total length of scale) and robust in the latter. In both genera the interradial circuli are interrupted into irregular, minute, sharp-pointed peaks directed anteriorly (also found in Quenselia). The robust spines of Synaptura may be confused with those of Barnardichthys, but the former never has more than a few rudimentary medianly-placed spines in blind side scales, whereas the latter is almost as strongly ctenoid on the blind side as on the ocular side. In addition the interradial circuli of the latter are entire and evenly curved anteriorly.

In various respects the scales of Solea and Heteromycteris are somewhat similar, but specific identity are readily determined. The typical well-marked rectangular form of the scales of Solea is distinctive as compared with the well-rounded oval form of the scales of Heteromycteris - anterior and lateral margins straight with narrowly rounded anterior angles in the former, and convex anterior and lateral margins with widely rounded anterior angles in the latter.

To return to the genus Austroglossus, the scale-characters of the 2 species in this genus show close approximation in conformity with the close morphological relationship. Nevertheless,

the very small size of the scales in proportion to the body-size of A.microlepis (the specific name speaks for itself), compared with the much larger scales in proportion to the body-size of A.pectoralis, ensures recognition of specific identity with ease.

#### CYNOGLOSSIDAE.

The family is represented in South African waters by 6 genera comprising 13 species. All 13 species have a common lepidological characteristic which is distinctive of this family as occurring in the South African area, viz., the apices of the acute-angled interradial circuli are produced into somewhat irregular but well-defined crenulations which may either be sharp-pointed or blunt-pointed (Vide Text-figs.37,39,41,43,44, 46,47,49,51,53,54,56, and 58.).

The genera Symphurus and Paraplagusia have sharp-pointed crenulations, and are thereby separated off from the genera Cynoglossus, Arelia, Trulla, and Areliscus with blunt-pointed crenulations.

Symphurus is at once distinguished from Paraplagusia by the number of radii - few in the former (3-11) and numerous in the latter (38-42), and the number of ocular side ctenoid elements in the marginal series - 11-19 in the former and 24-28 in the latter.

Symphurus is represented by 3 species in the South African area and these are not very readily specifically identified solely by their scale-characters. Variations in any one species may show as much divergence as that found between the 3 species. At their maximum divergence certain scale-characters may be used for distinguishing the 3 species, however, e.g.,

	<u>Radii(No).</u>	<u>Spines(No).</u>	<u>Spines(Length).</u>
<u>S.variegatus.</u>	3-6	12-14	13-21% of total l.of scale.
<u>S.strictus.</u>	3-5	11-13	15-17% of total l.of scale.
<u>S.ocellatus.</u>	7-11	15-19	12-14% of total l.of scale.

From the above table it is obvious that S.ocellatus is fairly readily separated off from the other 2 species, but S.variegatus and S.strictus are easily confused. However, scale-characters of some value in distinguishing between these two

species are the following:- in S.variegatus the blind side scales are slightly smaller or equal in size to the ocular side scales, have 6-9 radii and 5-7 spines in the marginal series; in S.strictus the blind side scales are larger than the ocular side scales, have 8-10 radii and 9-11 spines in the marginal series.

Arelia is recognised by the following characteristics - ctenoid on ocular side and cycloid on blind side, muciferous canal of lateral line scales funnel-shaped. Trulla is likewise separated off by the fact that the scales are strongly ctenoid on the ocular side but weakly ctenoid and cycloid on the blind side, muciferous canal being of even width throughout its length. Cynoglossus and Areliscus have strongly ctenoid scales on both sides of the body (except C.hunteri - see below), and are at first sight perhaps not so easily separated, but certain scale-characters are distinctive, e.g., ctenoid elements (spines) always longer but fewer in the former (7-14% of total length of scale, and 14-30) than in the latter (5-7% of total length of scale, and 30-38); the muciferous canal of lateral line scales is short and narrow in the former but long and narrow in the latter.

Cynoglossus is represented by 4 species, 3 have ctenoid ocular and blind side scales and 1, C.hunteri, is ctenoid on the ocular side and cycloid on the blind side, a specific distinguishing character. C.hunteri cannot be confused with A.attenuata, T.capensis, or T.microphthalmus (the last two species have fair numbers of cycloid scales on their blind sides) for the following reasons:- A.attenuata has funnel-shaped muciferous canals in its lateral line scales, and both radii and ctenoid elements are more numerous (radii 45-50 as compared with 18-20; spines 32-36 in comparison with 14-16); T.capensis and T.microphthalmus have large numbers of weakly ctenoid scales on their blind sides, and both radii and ctenoid elements are more numerous (radii 35-40 and 25-30 respectively compared to 18-20; spines 24-32 and 16-20 respectively compared to 14-16). The 3 wholly ctenoid species of Cynoglossus are not so readily distinguishable solely by their scale-characters, and variations in any one species may be as

wide as inter-specific divergence. Certain scale-characters are fairly distinctive and at their maxima can be used for specific identification, e.g.,

	<u>Radii(No).</u>	<u>Spines(No).</u>	<u>Spines(Length).</u>
<u>C.lida.</u>	25-30	24-30	7-9% of total l.of scale.
<u>C.durbanensis.</u>	33-43	20-24	10-14% of total l.of scale.
<u>C.gilchristi.</u>	42-44	22-26	8-10% of total l.of scale.

The 2 species of Trulla found in South African waters are fairly easily specifically identified by their scale-characters - T.capensis has 35-40 radii and 24-32 spines in the marginal projecting series, whereas in T.microphthalmus the numbers are as follows:- radii 25-30, spines (marginal series) 16-20.

The genus Areliscus is represented by 2 species which are fairly easily separated - A.marleyi has a larger number (34-38) of spines marginally than A.ecaudatus (30); in the former the posterior field of blind side scales is reduced in size, the spines fewer (19-22) but longer than in ocular side scales, whereas in the latter, although the posterior field is reduced in size, the spines are not reduced in number, often being more numerous (up to 35), but are shorter than those of ocular side scales.

#### GENERAL CONCLUSIONS.

Scale-characters are of considerable value in relation to identification and are distinctive of families and genera but not always of species. Families and genera showing close relationships with respect to general morphological features reveal approximating lepidological characteristics, and conversely divergence in general morphology is accompanied by distinctive divergent scale-patterns.

Lepidological diagnostics, in many instances, are solely sufficient for identification and classification of families, genera and species, but in as many instances are not adequate in themselves for distinguishing species. In the latter cases scale-characters will however assist materially if utilised as complementary to general morphology in determining doubtful relationships and identities.

The lepidological characteristics of isolated scales from

unknown or unspecified body locations are of greater or less diagnostic value in accordance with the distinctiveness or otherwise of those characteristics. To be of maximum value therefore, adequate and definite scale material must be available, and the scale-characters determined must be viewed and utilised as a morphological whole.

Since therefore scales can yield results similar to those procured by normal morphological means and are so convenient for study, lepidology is of considerable importance at all times and particularly when the whole fish is not available or cannot be produced.

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B. EXPLANATION OF PLATES.

## PLATE I.

Microprojection tracing (Edinger Apparatus) of a typical flatfish scale - in this instance from the pectoral region of the ocular side of Bothus pantherinus (Rüpp.) - to illustrate the lepidological terminology used in this paper.

AF. - Anterior field; PF. - Posterior field; LF.- Lateral field; Sp.-Spines; R.-Radius(Radii); C.-Circulus(Circuli); A.-Annulus (Annuli); F.-Focus; P.-Periphery or Margin.

## PLATE II.

- Fig. 1. Psettodes erumei: View of posterior field of ocular side scale. x 41. (From a specimen 463 mm. in length in the S.A.Mus.Collect.).
- Fig. 2. Psettodes erumei: View of posterior field of blind side scale. x 41. (Same specimen as Fig. 1.).
- Fig. 3. Pseudorhombus arsius: View of posterior section of ocular side scale. x 41. (From a specimen of Pseudorhombus russellii (Gray), 145 mm. in length, in the F.S.Div.Collect.).
- Fig. 4. Pseudorhombus arsius: View of posterior section of blind side scale. x 41. (Same specimen as Fig. 3.).
- Fig. 5. Pseudorhombus natalensis: View of posterior part of ocular side scale. x 41. (From a specimen 135 mm. in length in the F.S.Div.Collect.).
- Fig. 6. Pseudorhombus natalensis: View of posterior half of blind side scale. x 41. (Same specimen as Fig. 5.).

## PLATE III.

- Fig. 7. Citharoides macrolepis: View of portion of posterior field of ocular side scale. x 41. (From the type specimen Arnoglossus macrolepis, Gilch., 192 mm. in length, in the S.A. mus. Collect.).
- Fig. 8. Citharoides macrolepis: View of portion of posterior section of blind side scale. x 41. (Same specimen as Fig. 7.).
- Fig. 9. Arnoglossus capensis: View of posterior part of ocular side scale. x 41. (From a specimen 60 mm. in length in the F.S.Div. Collect.).
- Fig. 10. Arnoglossus capensis: View of posterior field of blind side scale. x 41. (Same specimen as Fig. 9.).
- Fig. 11. Arnoglossus dalgleishi: View of posterior section of lateral line scale from ocular side. x 41. (From the paratype specimen, 155 mm. in length, in the British Museum).
- Fig. 12. Arnoglossus dalgleishi: View of anterior field of scale portrayed in Fig. 11. x 41. (Same specimen as Fig. 11.).

## PLATE IV.

- Fig. 13. Arnoglossus microphthalmus: Typical ocular side scale. x 41. (From the type specimen Laeops microphthalmus Von Bonde, 135 mm. in length, in the British Mus. Collect.).
- Fig. 14. Engyprosopon grandisquama: View of posterior part of ocular side scale. x 41. (From a specimen of Scaeops grandisquama (T. & S.), 79 mm. in length, in the F.S. Div. Collect.).
- Fig. 15. Engyprosopon grandisquama: View of posterior part of blind side scale. x 41. (Same specimen as Fig. 14.).
- Fig. 16. Engyprosopon natalensis: View of regenerated scale from ocular side. x 41. (From a specimen 55 mm. in length in the F.S.Div. Collect.).

Fig.17. Engyprosopon natalensis: View of posterior half of blind side scale. x 41. (Same specimen as Fig. 16).

PLATE V.

- Fig.18. Crossorhombus valde-rostratus: View of portion of posterior field of ocular side scale. x 41. (From a specimen of Crossorhombus dimorphus (Gilch.), 155 mm. in length, in the F.S.Div.Collect.)
- Fig.19. Crossorhombus valde-rostratus: View of portion of posterior field of blind side scale. x 41. (Same specimen as Fig. 18.)
- Fig.20. Bothus pantherinus: Typical ocular side scale. x 75. (From a specimen of Platophrys pantherinus (Rüpp.), 121 mm. in length, in the F.S.Div.Collect.)
- Fig.21. Bothus pantherinus: Typical blind side scale. x 75. (Same specimen as Fig. 20.)

PLATE VI.

- Fig 22. Chascanopsetta lugubris: Typical ocular side scale. x 41. (From a specimen of Chascanopsetta gilchristi Von Bonde, 190 mm. in length, in the F.S.Div.Collect.)
- Fig.23. Laeops nigromaculatus: Typical ocular side scale. x 41. (From a specimen 178 mm. in length in the Brit.Mus.Collect.)
- Fig.24. Laeops natalensis: Typical ocular side scale. x 41. (From a specimen of Lambdopsetta kitaharae (non Smith and Pope) Von Bonde, 135 mm. in length in the F.S. Div. Collect.)
- Fig.25. Laeops pectoralis: Typical ocular side scale. x 37. (From a specimen of Lambdopsetta pectoralis Von Bonde, 190 mm. in length, in the F.S.Div.Collect.)
- Fig.26. Poecilopsetta natalensis: View of posterior part of ocular side scale. x 41. (From a specimen of Limanda beanii (non Goode) Von Bonde, 173 mm. in length, in the F.S. Div. Collect.)
- Fig.27. Poecilopsetta natalensis: View of posterior field of blind side scale. x 41. (Same specimen as Fig. 26.)

PLATE VII.

- Fig.28. Marleyella bicolorata: View of posterior field of ocular side scale. x 41. (From a specimen of Poecilopsetta bicolorata Von Bonde, 183 mm. in length, in the F.S.Div. Collect.)
- Fig.29. Marleyella bicolorata: Typical blind side scale. x 37. (Same specimen as Fig. 28.)
- Fig.30. Paralichthodes algoensis: View of posterior section of ocular side scale. x 41. (From a specimen 314 mm. in length in the F.S.Div. Collect.)
- Fig.31. Samaris ornatus: Typical ocular side scale. x 24. (From the type specimen 103 mm. in length in the Brit. Mus. Collect.)
- Fig.32. Samaris ornatus: Typical blind side scale. x 24. (Same specimen as Fig. 31.)
- Fig.33. Samaris delagoensis: Typical ocular side scale. x 37. (From the type specimen 134 mm. in length in the F.S.Div. Collect.)
- Fig.34. Samaris delagoensis: Typical blind side scale. x 37. (Same specimen as Fig. 33.)

## PLATE VIII.

- Fig.35. Synapturichthys kleini variolosa: View of posterior half of ocular side scale. x 41. (From the type specimen, Synaptura melanoptera Gilch., 83 mm. in length, in the S.A.Mus. Collect.)
- Fig.36. Synapturichthys kleini variolosa: Typical blind side scale. x 41. (Same specimen as Fig. 35).
- Fig.37. Solea bleekeri: Typical ocular side scale. x 41. (From a specimen of Solea turbynei Gilch., 120 mm. in length, in the F.S.Div.Collect.)
- Fig.38. Solea bleekeri: Typical blind side scale. x 41. (Same specimen as Fig. 37).
- Fig.39. Synapturichthys kleini variolosa: View of posterior field of ocular side scale. x 41. (From a specimen of Solea capensis Gilch., 257 mm. in length, in the F.S.Div. Collect.)
- Fig.40. Synapturichthys kleini variolosa: View of posterior field of blind side scale x.41. (Same specimen as Fig.39.)

## PLATE IX.

- Fig.41. Austroglossus pectoralis: View of posterior half of ocular side scale. x 41. (From a specimen 120 mm. in length in the F.S.Div.Collect.)
- Fig.42. Austroglossus pectoralis: Typical blind side scale. x 41. (Same specimen as Fig. 41).
- Fig.43a. Austroglossus microlepis: View of posterior third of ocular side scale. x 41. (From a specimen 475 mm. in length in the F.S.Div.Collect.)
- Fig.43b. Austroglossus microlepis: View of posterior third of blind side scale. x 41. (Same specimen as Fig. 43a.)
- Fig.44. Barnardichthys fulvomarginata: View of posterior field of ocular side scale. x 41. (From the type specimen Solea fulvomarginata Gilch., 246 mm. in length, in the S.A. Mus. Collect.)
- Fig.45. Barnardichthys fulvomarginata: View of posterior field of blind side scale. x 41. (Same specimen as Fig. 44).

## PLATE X.

- Fig.46. Quenselia ocellata: View of posterior part of ocular side scale. x 41. (From the type specimen Solea quadriocellata Von Bonde, 108 mm. in length, in the F.S. Div. Collect.)
- Fig.47. Quenselia ocellata: View of posterior part of blind side scale. x 41. (Same specimen as Fig. 46).
- Fig.48. Dicologoglossa cuneata: View of posterior field of ocular side scale. x 41. (From the type specimen Solea cleverleyi Gilch., 257 mm. in length, in the S.A. Mus. Collect.)
- Fig.49. Dicologoglossa cuneata: View of posterior field of blind side scale. x 41. (Same specimen as Fig. 48).
- Fig.50. Synaptura marginata: View of posterior field of ocular side scale. x 41. (From a specimen of Synaptura ciliata Gilch., 211 mm. in length, in the F.S.Div. Collect.)
- Fig.51. Synaptura marginata: View of posterior field of blind side scale. x 41. (Same specimen as Fig. 50).

## PLATE XI.

- Fig. 52. Synaptura marginata: Typical ocular side scale. x 41. (From the type specimen Synaptura barnardi Smith, 86 mm. in length, in the Albany Mus. Collect.)

- Fig. 53. Synaptura marginata: Typical blind side scale. x 41. (Same specimen as Fig. 52.).
- Fig. 54. Zebrias (Pseudaesopia) regani: View of posterior field of ocular side scale. x 41. (From a specimen of Zebrias regani (Gilch.), 144 mm. in length, in the F.S.Div.Collect.).
- Fig. 55. Zebrias (Pseudaesopia) regani: View of posterior field of blind side scale. x 41. (Same specimen as Fig. 54.).
- Fig. 56. Coryphaesopia cornuta barnardi: View of posterior half of ocular side scale. x 41. (From a specimen of Aesopia cornuta Kaup, 136 mm. in length, in the F.S.Div.Collect.).
- Fig. 57. Coryphaesopia cornuta barnardi: View of posterior half of blind side scale. x 41. (Same specimen as Fig. 56).

## PLATE XII.

- Fig. 58. Achirus marmoratus: View of posterior third of ocular side scale. x 41. (From a specimen of Pardachirus marmoratus (Lacep.), 260 mm. in length, in the F.S.Div.Collect.).
- Fig. 59. Achirus marmoratus: View of posterior half of blind side scale. x 41. (Same specimen as Fig. 58).
- Fig. 60. Heteromycteris capensis: View of posterior section of ocular side scale. x 41. (From a specimen of Achirus capensis Blgr., 107 mm. in length, in the F.S.Div.Collect.).
- Fig. 61. Heteromycteris capensis: Typical blind side scale. x 48. (Same specimen as Fig. 60).
- Fig. 62. Symphurus variegatus: Typical ocular side scale. x 41. (From a specimen 85 mm. in length in the F.S.Div.Collect.).
- Fig. 63. Symphurus variegatus: Typical blind side scale. x 41. (Same specimen as Fig. 62).

## PLATE XIII.

- Fig. 64. Symphurus strictus: View of posterior two-thirds of ocular side scale. x 41. (From a specimen (length?) in the Brit.Mus.Collect.)
- Fig. 65. Symphurus strictus: Typical regenerated blind side scale. x 41. (Same specimen as Fig. 64.).
- Fig. 66. Symphurus ocellatus: Typical ocular side scale. x 37. (From the type specimen 105 mm. in length in the F.S. Div.Collect.).
- Fig. 67. Symphurus ocellatus: Typical blind side scale. x 37. (Same specimen as Fig. 66.).
- Fig. 68. Cynoglossus lida: View of posterior part of ocular side scale. x 41. (From a specimen (length?) in the Brit. Mus. Collect.)
- Fig. 69. Cynoglossus lida: View of posterior part of blind side scale. x 41. (Same specimen as Fig. 68.).

## PLATE XIV.

- Fig. 70. Cynoglossus durbanensis: View of posterior section of ocular side scale. x 41. (From a specimen 154 mm. in length in the F.S. Div.Collect.).
- Fig. 71. Cynoglossus durbanensis: View of posterior field of blind side scale. x 41. (Same specimen as Fig. 70.).
- Fig. 72. Cynoglossus gilchristi: View of posterior part of ocular side scale. x 41. (From a specimen of Cynoglossus brachycephalus (nom. preocc. Bleeker) Gilch., 98 mm. in length, in the F.S.Div.Collect.).
- Fig. 73. Cynoglossus gilchristi: View of posterior part of blind side scale. x 41. (Same specimen as Fig. 72.).

- Fig. 74. Cynoglossus hunteri: Typical ocular side scale. x 41. (From the type specimen 78 mm. in length in the F.S. Div. Collect.).
- Fig. 75. Cynoglossus hunteri: View of posterior third of blind side scale. x 41. (Same specimen as Fig. 74.).

## PLATE XV.

- Fig. 76. Arelia attenuata: View of portion of posterior field of ocular side scale. x 41. (From the type specimen Cynoglossoides attenuatus Von Bonde, 258 mm. in length, in the F.S. Div. Collect.).
- Fig. 77. Arelia attenuata: View of portion of posterior field of blind side scale. x 41. (Same specimen as Fig. 76.).
- Fig. 78. Trulla capensis: View of posterior section of ocular side scale. x 41. (From a specimen 245 mm. in length in the F.S. Div. Collect.).
- Fig. 79. Trulla capensis: View of posterior section of blind side scale. x 41. (Same specimen as Fig. 78.).
- Fig. 80. Trulla microphthalmus: View of posterior section of ocular side scale. x 41. (From the type specimen Areliscus microphthalmus Von Bonde, 140 mm. in length, in the F.S. Div. Collect.).
- Fig. 81. Trulla microphthalmus: View of posterior section of blind side scale. x 41. (Same specimen as Fig. 80.).

## PLATE XVI.

- Fig. 82. Paraplagusia marmorata: View of posterior part of ocular side scale. x 41. (From a specimen of Plagusia marmorata var. africana Gilch., 109 mm. in length, in the F.S. Div. Collect.).
- Fig. 83. Paraplagusia marmorata: View of posterior third of blind side scale. x 41. (Same specimen as Fig. 82.).
- Fig. 84. Areliscus marleyi: View of posterior part of ocular side scale. x 41. (From a specimen 250 mm. in length in the F.S. Div. Collect.).
- Fig. 85. Areliscus marleyi: View of greater portion of posterior field of blind side scale. x 41. (Same specimen as Fig. 84.).
- Fig. 86. Areliscus ecaudatus: View of posterior section of ocular side scale. x 41. (From a specimen 140 mm. in length in the F.S. Div. Collect.).
- Fig. 87. Areliscus ecaudatus: View of posterior section of blind side scale. x 41. (Same specimen as Fig. 86.).

F. S U M M A R Y.

In its broadest sense this paper is a contribution to the science of lepidology in its relation to identification and taxonomy. For the purposes of research into this problem the South African Heterosomata as a homogeneous group of fishes has been selected and studied both taxonomically and lepidologically.

The first part of the paper consists of general introductory and explanatory matter, and comprises, a statement of the material available and studied, notes on lepidological terminology and technique, notes on morphological and scale measurements, and bibliographical notes. Two explanatory text-figures are included in this part.

The second part is a systematic review of the South African Heterosomata with synopses of families, subfamilies and genera, and keys to species. The accounts of genera include synonymy and description in considerable detail, and those of species comprise synonymy, detailed general morphological description, South African distribution, and lepidological description in detail. The total number of species recognised and dealt with is 45, of which 32 are peculiar to the South African area. The species fall under 30 genera which are divided amongst the 5 recognised families of Heterosomata as follows :-

PSETTODIDAE - 1 genus, 1 species; BOTHIDAE - 2 subfamilies, PARALICHTHINAE - 2 genera, 3 species, BOTHINAE - 6 genera, 11 species; PLEURONECTIDAE - 3 subfamilies, POECILOPSETTINAE - 2 genera, 2 species, PARALICHTHODINAE - 1 genus, 1 species, SAMARINAE - 1 genus, 2 species; SOLEIDAE - 1 subfamily, SOLEINAE - 3 parts(sections), Soleina - 9 genera, 10 species, Achirina - 1 genus, 1 species, Heteromycterina - 1 genus, 1 species; CYNOGLOSSIDAE - 6 genera, 13 species.

There are 56 text-figures in this part of the paper, these being figures of species and figures of certain special lepidological characteristics.

The third part of the paper deals with scale-characters in relation to their value in identification and classification, and consists of firstly, a review of the relevant lepidological literature, and secondly, a discussion on the application of lepidological diagnostics to the identification and taxonomy of the South African Heterosomata, as also a statement of the general conclusions arrived at with respect to the main problem of the value and utilisation of scale-characters in identification and classification.

In broad outline the results of this study may be summarised as follows :-

Scale-characters are diagnostic of families and genera but not always of species, although always of assistance and value when utilised as complementary to general morphology.

The fourth and fifth parts of the paper comprise the bibliography and explanation of plates respectively. There are 16 plates in all; Plate I is a microprojection tracing of a typical flatfish scale appropriately labelled to show the lepidological terminology employed, Plates II - XVI incorporate 88 photomicrographs of scales of South African flatfishes.

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G. A P P E N D I X.

List of Published Research Papers.

1. 1928. Salinity Investigations in the South African Seas. Fish Mar. Biol. Survey, Rept. No. 6, 1927-28, Spec. Rept. No. 4.
2. 1928. The Nature of the Sea-Floor Deposits in Certain Regions on the West Coast. Fish. Mar. Biol. Survey, Rept. No. 6, 1927-28, Spec. Rept. No. 5.
3. 1929. Salinity Investigations in the South African Seas. Fish. Mar. Biol. Survey, Rept. No. 7, 1928-29, Spec. Rept. No. 4.
4. 1932. Hydrographic Investigations during 1930. Fish Mar. Biol. Survey, Rept. No. 8, 1929-30, Spec. Rept. No. 2.
5. 1932. Salinity Results obtained during 1931. Fish. Mar. Biol. Survey, Rept. No. 9, 1931, Annexure C.
6. 1933. Salinity Results obtained during 1932. Fish. Mar. Biol. Survey, Rept. No. 10, 1932, Annexure C.
7. 1933. Report on Certain Investigations on the Agulhas Bank Sole Grounds lying between Cape Agulhas and Cape Infanta, with special reference to the question of Overfishing. Fish. Mar. Biol. Survey, Rept. No. 10, 1932, Annexure D.
8. 1934. Salinity Results obtained during 1933. Fish. Mar. Biol. Survey, Rept. No. 11, 1933, Annexure C.
9. 1934. Savings-Trawl Investigations in relation to the Conservation and Regulation of the Agulhas Bank Sole-Fishery. Fish. Mar. Biol. Survey, Report No. 11, 1933, Investigational Report No. 1.
10. 1935. Report on Preliminary Fishing Experiments with the Trammel-net. Fish. Mar. Biol. Survey, Rept. No. 12, 1934, Annexure C.
11. 1935. Studies in the Canning of the Cape Crawfish, Kreef or Spiny Lobster Jasus lalandii (Milne Edwards) Ortmann. (Co-author with Cecil von Bonde.) Fish. Mar. Biol. Survey. Investigational Rept. No. 5.
12. 1935. The Natural History and Utilisation of the

Cape Crawfish, Kreef or Spiny Lobster, Jasus (Palinurus)  
lalandii (Milne Edwards) Ortmann. (Co-author with  
Cecil von Bonde.). Fish. Mar. Biol. Survey, Fishery  
Bulletin No. 1.

13. 1935. The South African Marine Fishes of Commercial and  
Angling Importance (Illustrated). Fish. Mar. Biol.  
Survey, Fishery Bulletin No. 2.
14. Savings-Trawl Investigations in South African Waters during  
1935. (Co-author with W. Taylor Jnr.). Fish. Mar.  
Biol. Survey. Investigational Rept. No. 8. (In the  
press).

TEXT - FIGURES.

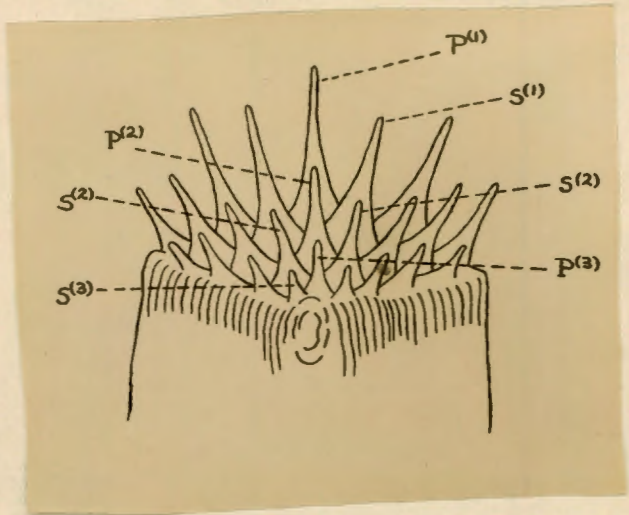


Fig. 1.

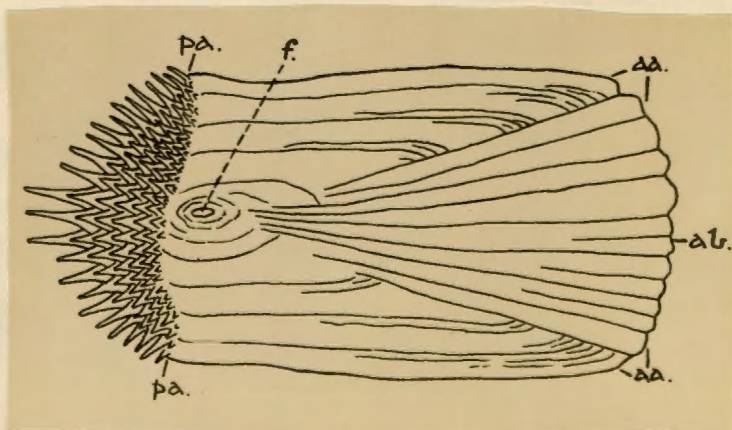


Fig. 2.

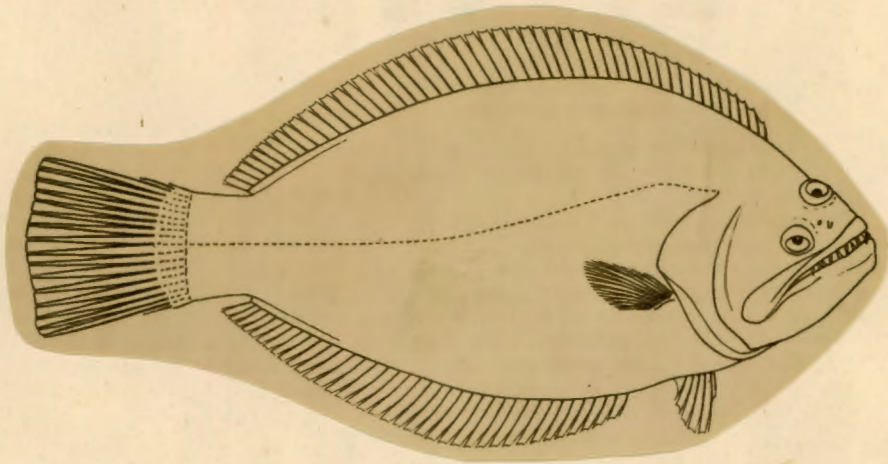


Fig. 3.

PSETTODES ERUMEI.  
(From Norman).

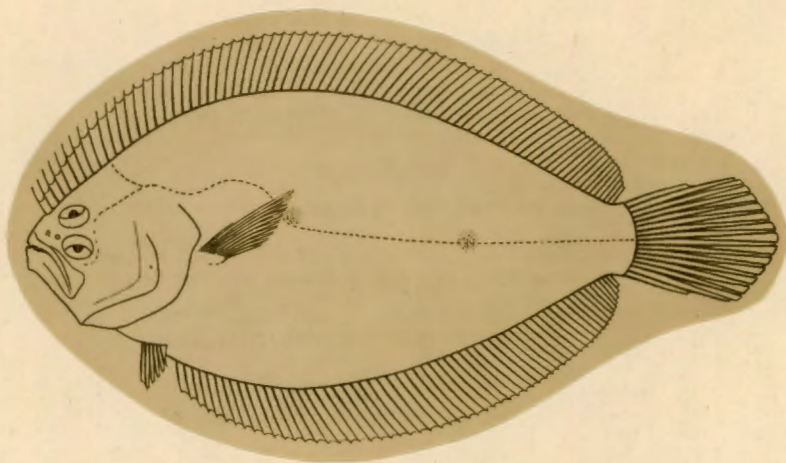
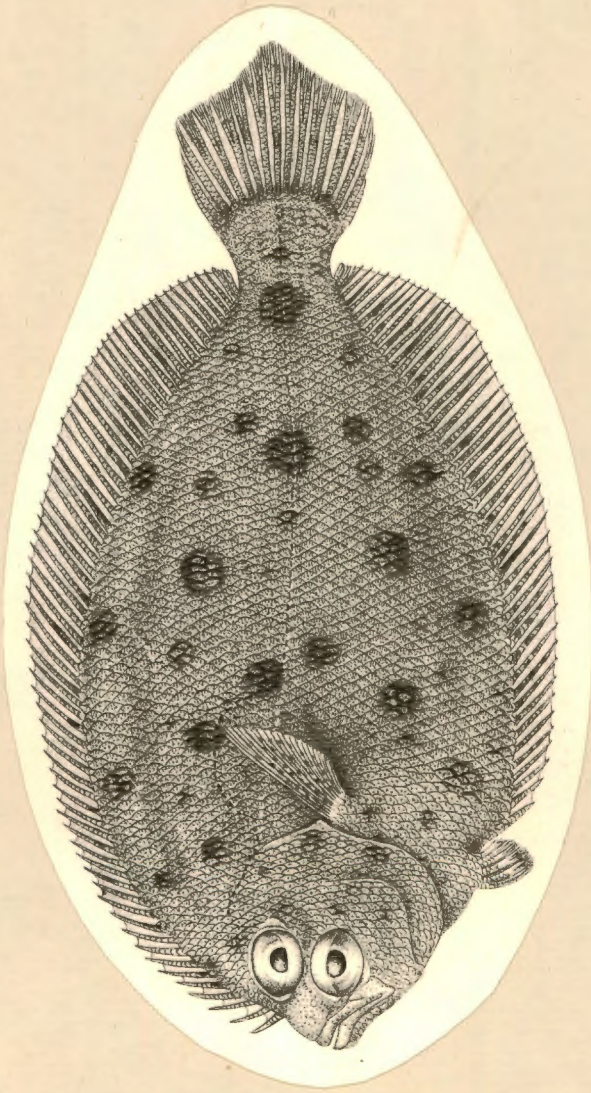


Fig. 4.

PSEUDORHOMBUS ARSIUS.  
(From Norman).



**Fig. 5.**

PSEUDORHOMBUS NATALENSIS.  
(From Gilchrist).

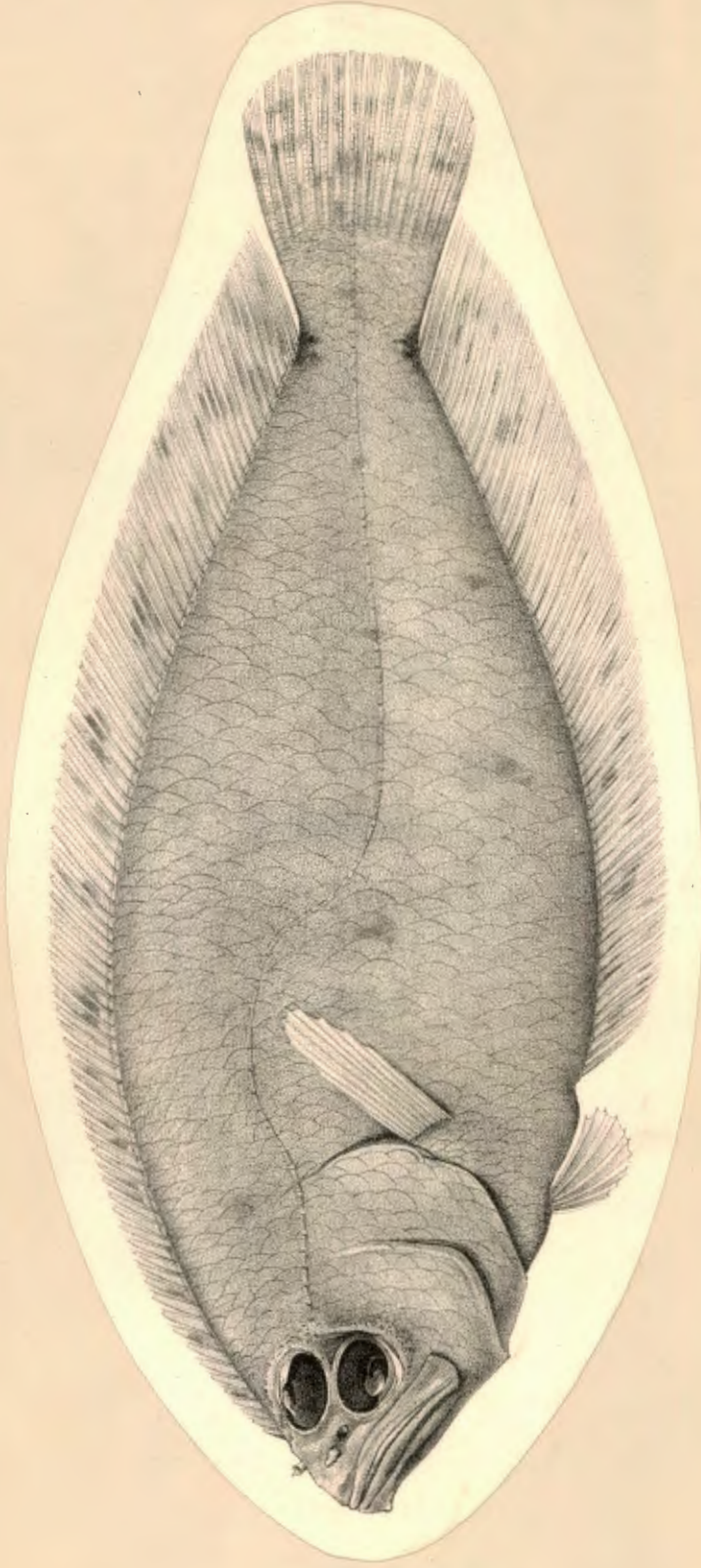


FIG. 6.

CITHAROIDES MACROLEPIS.  
(From Gilchrist, *Arnoglossus macrolepis*).

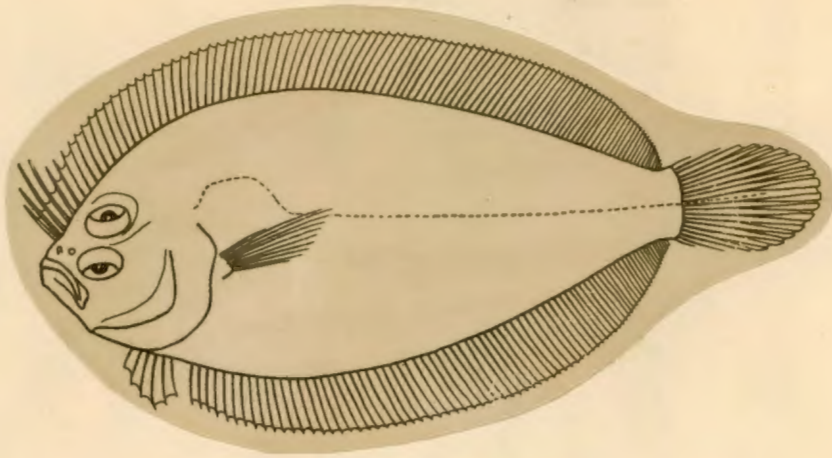


Fig. 7.

ARNOGLOSSUS CAPENSIS.  
(From Norman).

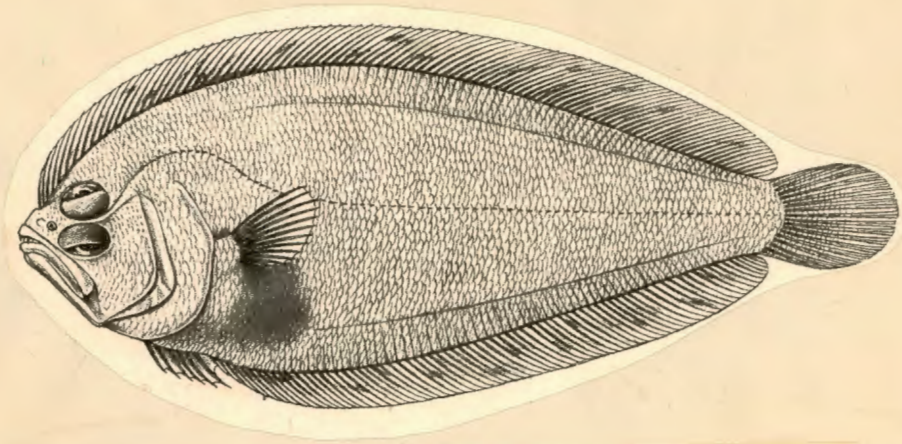


Fig. 8.

ARNOGLOSSUS DALGLEISHI.  
(From Von Bonde, Trichopsetta dalgleishi).

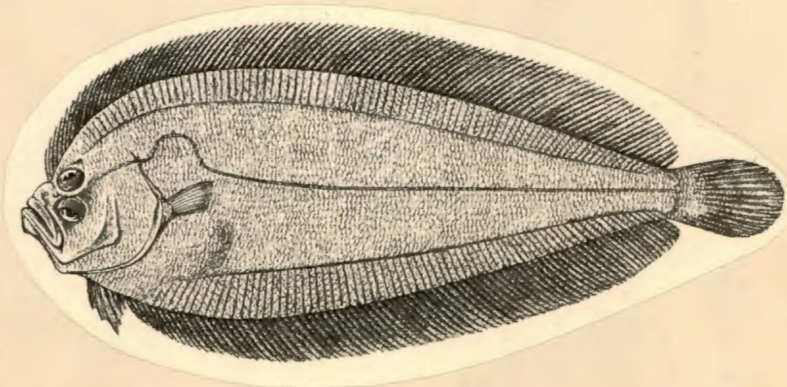


Fig. 9.

ARNOGLOSSUS MICROPHthalmus.  
(From Von Bonde, Laeops microphthalmus).

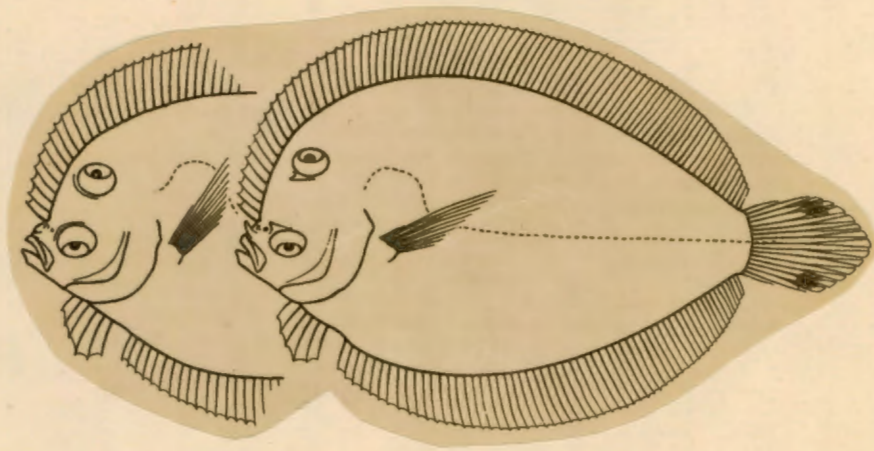


Fig.10.

ENGYPROSOPON GRANDISQUAMA.  
(From Norman).

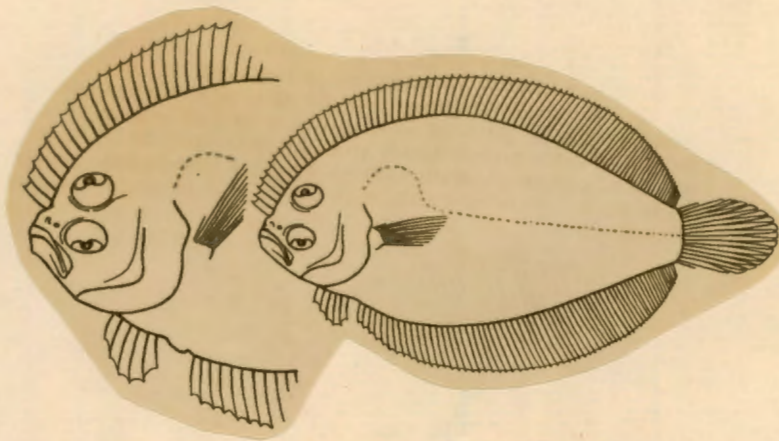


Fig.11.

ENGYPROSOPON NATALENSIS.  
(From Norman).

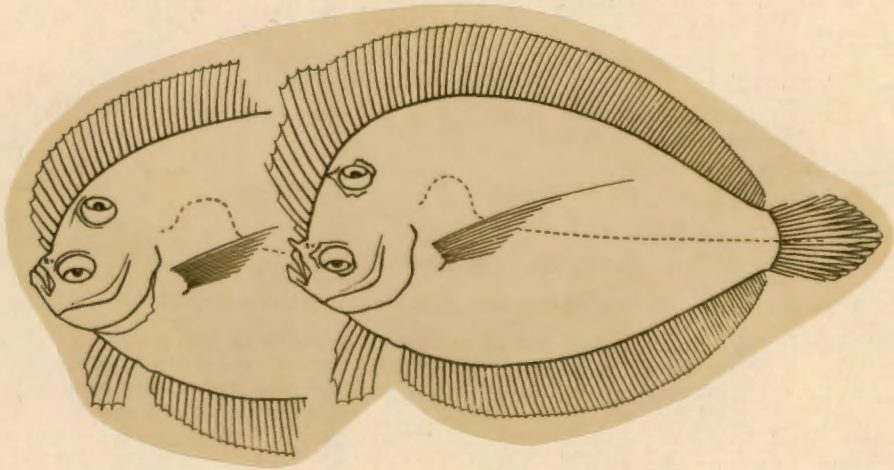


Fig. 12.

CROSSORHOMBUS VALDE-ROSTRATUS.  
(From Norman).

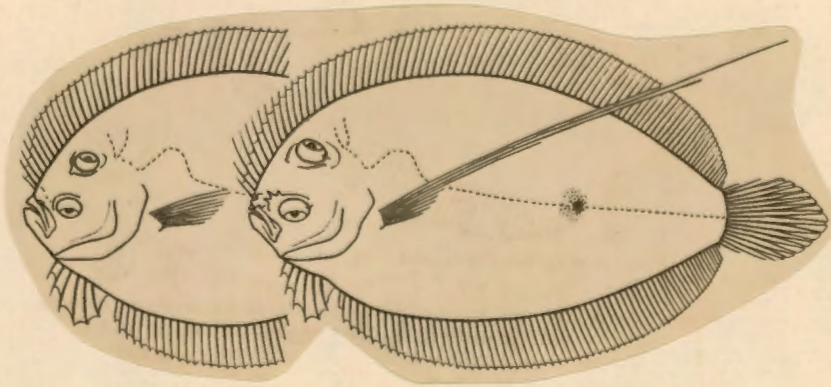


Fig. 13.

BOTHUS PANTHERINUS.  
(From Norman).



Fig. 14.

CHASCANOPSETTA LUGUBRIS.  
(From Von Bonde, Chascanopsetta maculata).

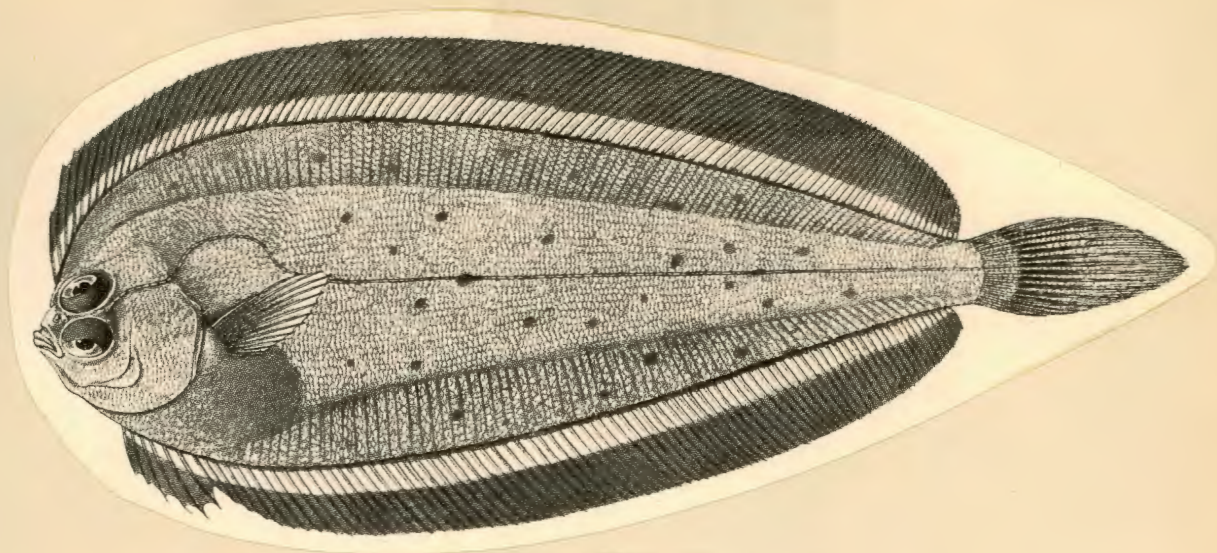


Fig. 15.

LAEOPS NIGROMACULATUS.  
(From Von Bonde).

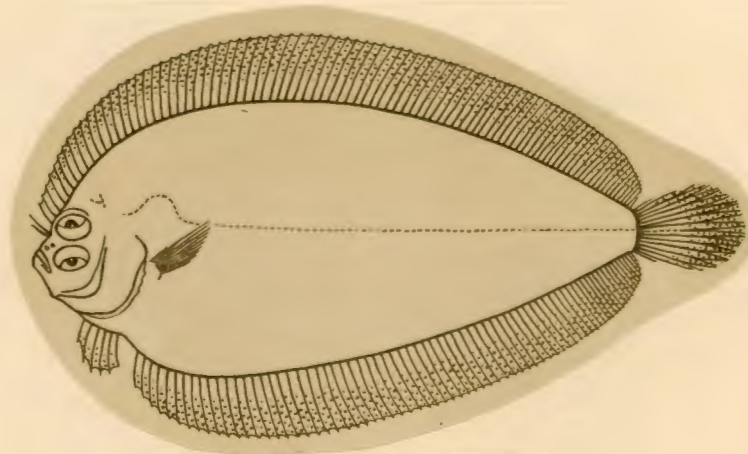


Fig. 16.

LAEOPS NATALENSIS.  
(From Norman).

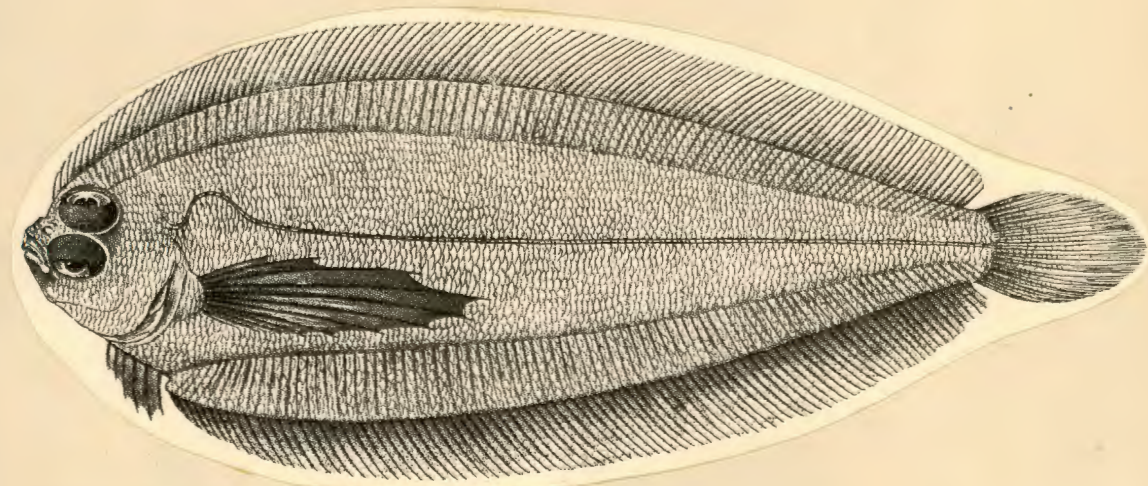


Fig. 17.

LAEOPS PECTORALIS.  
(From Von Bonde, Lambdopsetta pectoralis).

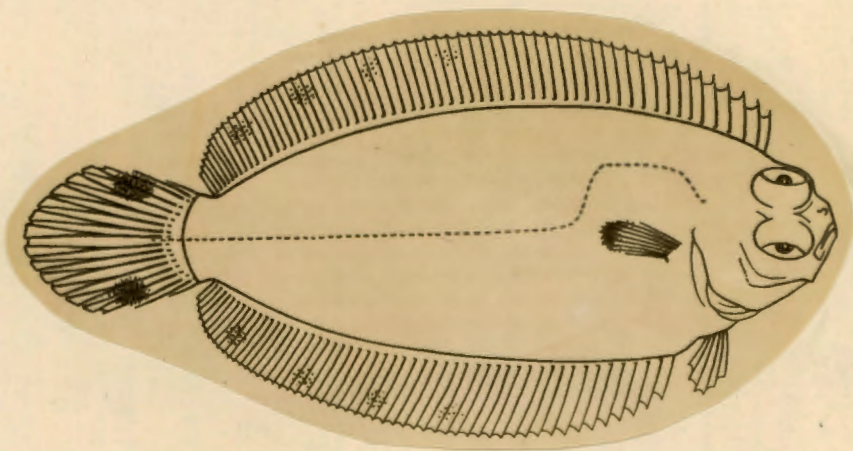


Fig. 18.

POECILOPSETTA NATALENSIS.  
(From Norman).

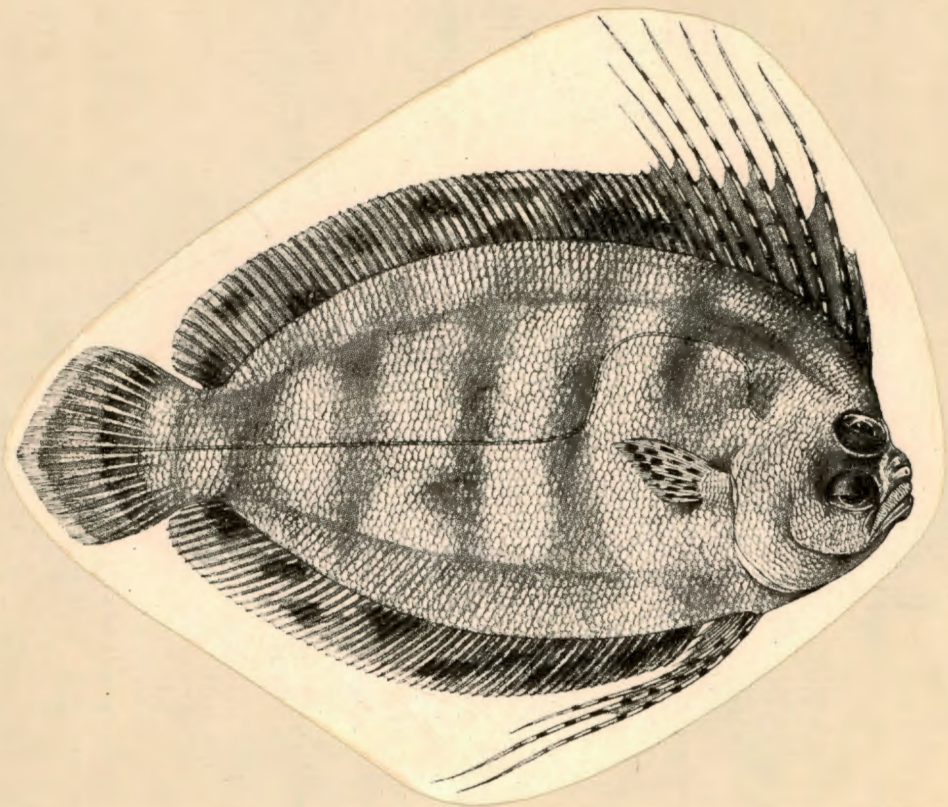


Fig. 19.

MARLEYELLA BICOLORATA.  
(From Von Bonde, Pdecilopsetta bicolorata-male).



Fig. 20.

PARALICHTHODES ALGOENSIS.  
(From Gilchrist).



Fig. 21.

SAMARIS ORNATUS.  
(From Von Bonde).

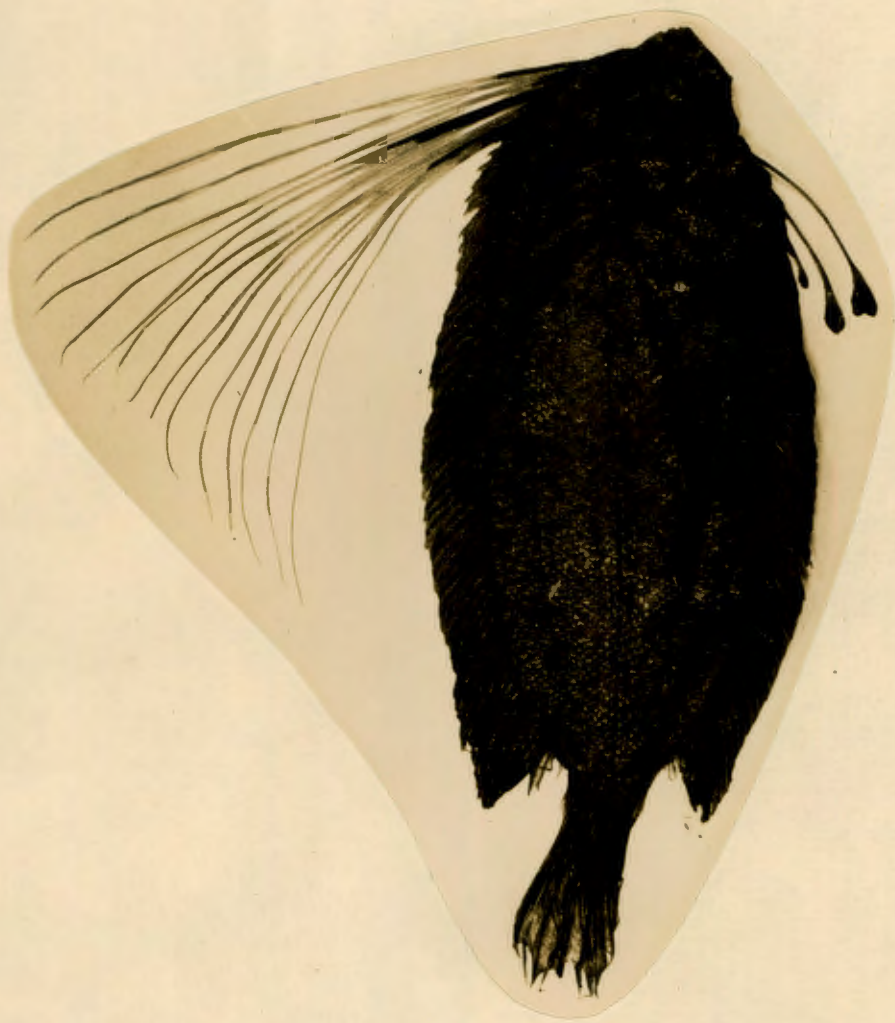


FIG. 22.

SAMARIS DELAGOENSIS.  
(Original photo).

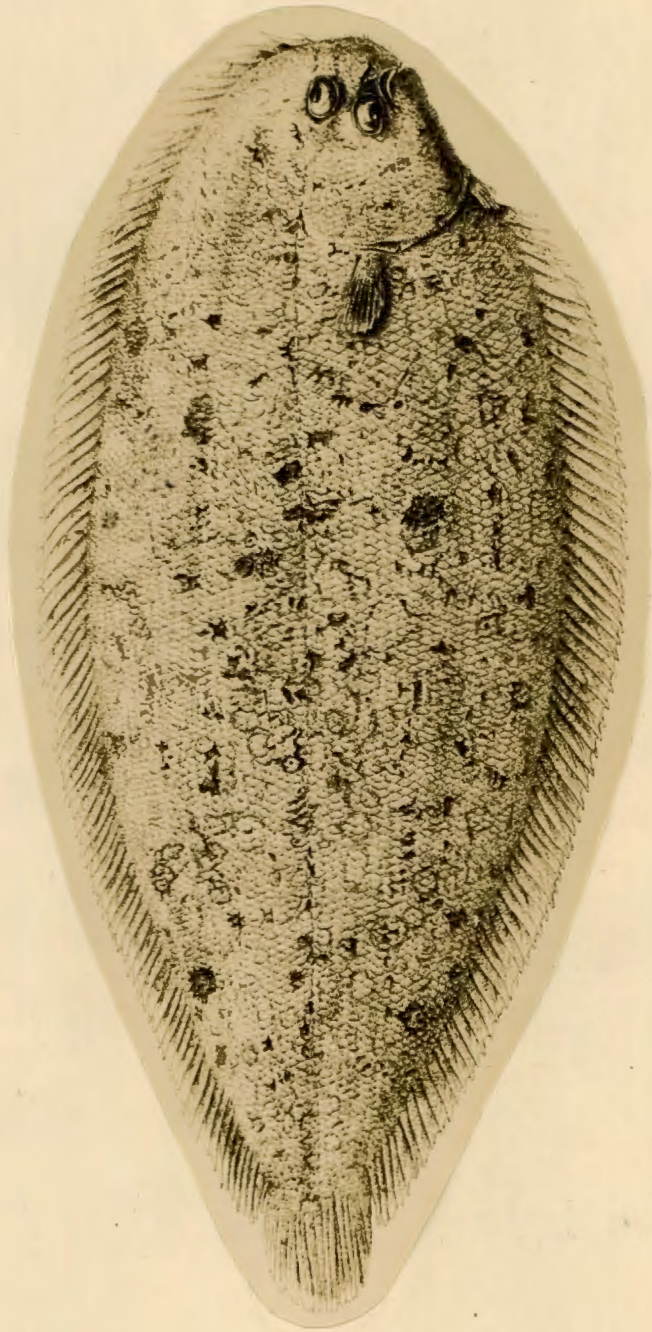


Fig. 23.

SYNAPTURICHTHYS KLEINI VARIOLOSA.  
(From Gilchrist, Solea capensis).



Fig. 24.

Interradial circuli and junction of anterior  
and lateral fields.(x 3). (After Chabanaud).



Fig. 25.

AUS TROGLOSSUS PECTORALIS.  
(Original photo).

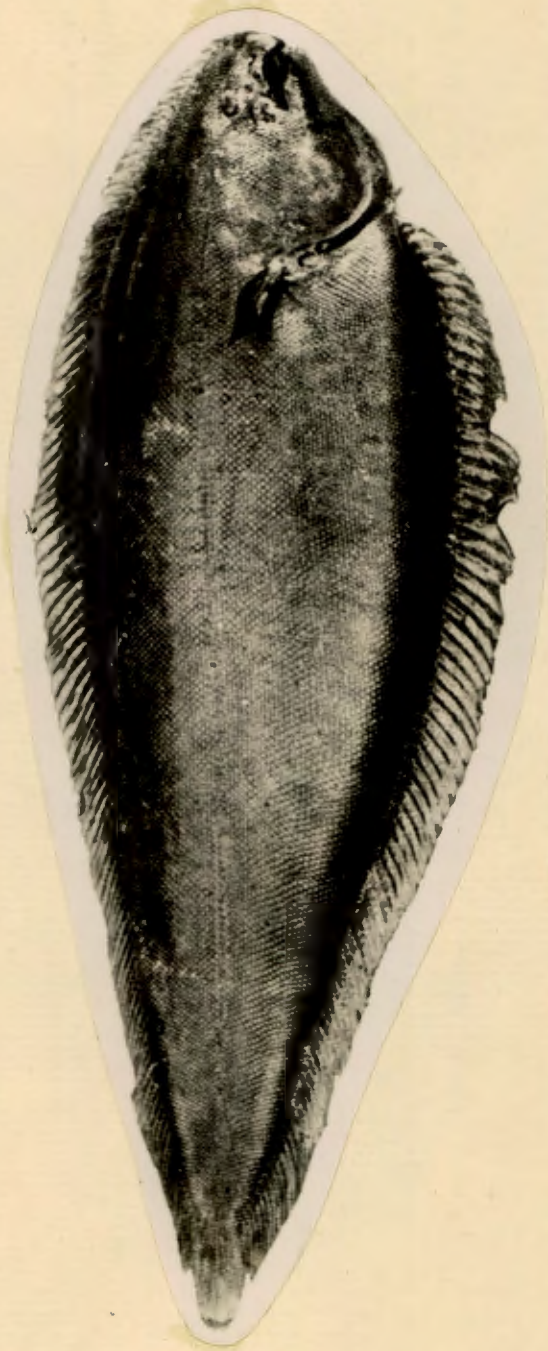


Fig. 26.

AUS TROGLOSSUS MICROLEPIS.  
(Original photo).



Fig. 27.  
BARNARDICHTHYS FULVOMARGINATA.  
(From Gilchrist, Solea fulvomarginata).

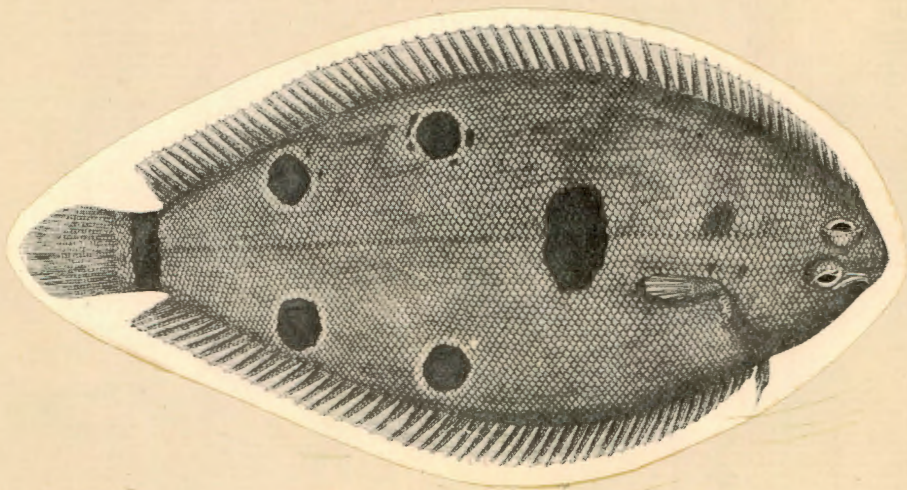


Fig. 28.

QUENSELIA OCELLATA.  
(From Von Bonde, Solea quadriocellata).

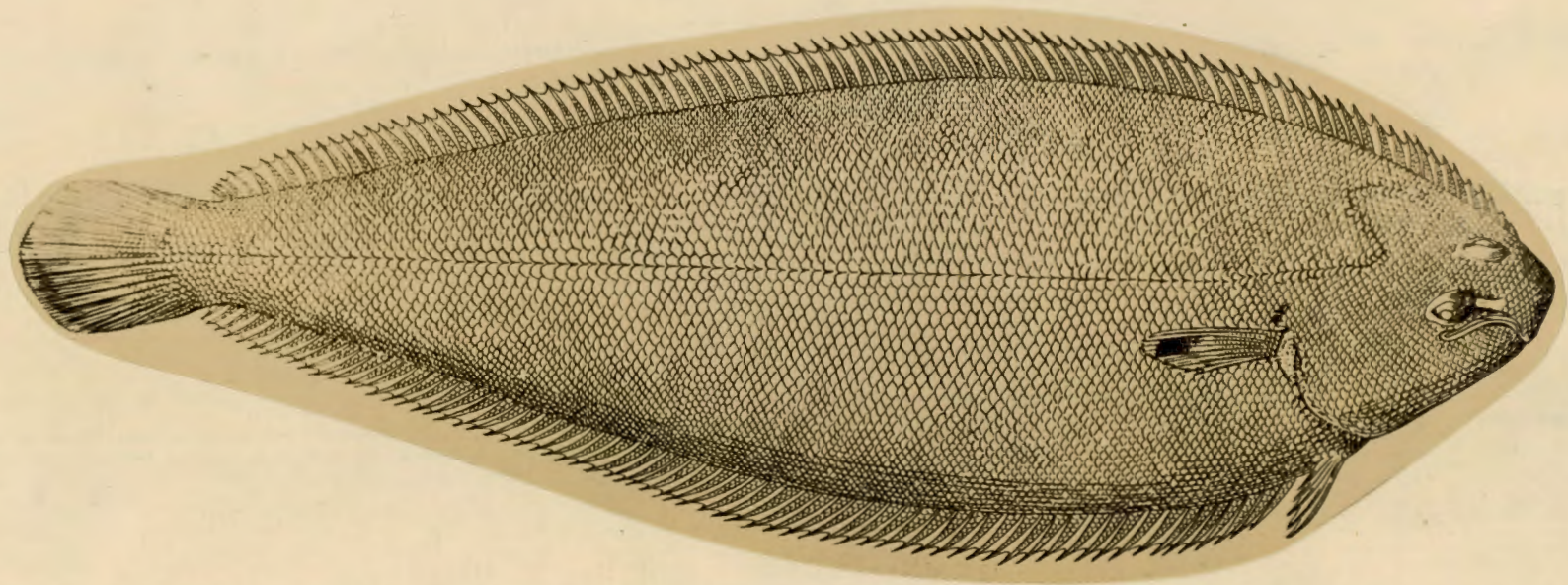


Fig. 29.

DICOLOGLOSSA CUNEATA.  
(From Chabanaud).

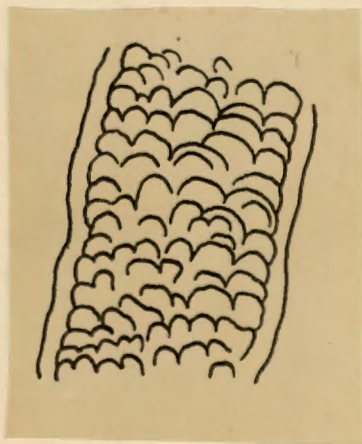


Fig. 30.

Interradial circuli.

(x 200).

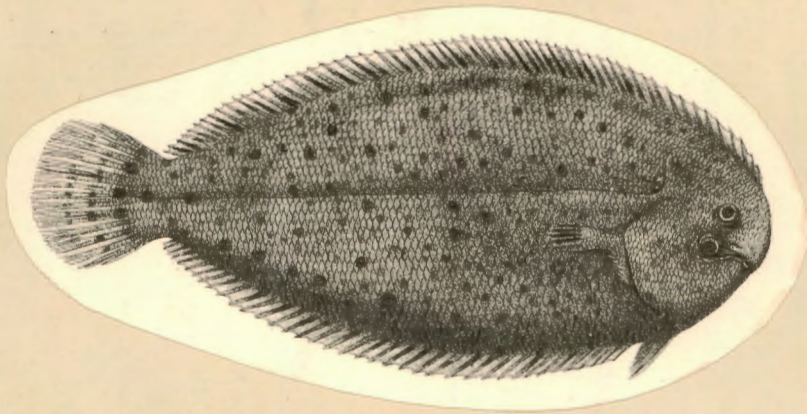


Fig. 31.

SOLEA BLEEKERI.  
(From Gilchrist, Solea turbynei).

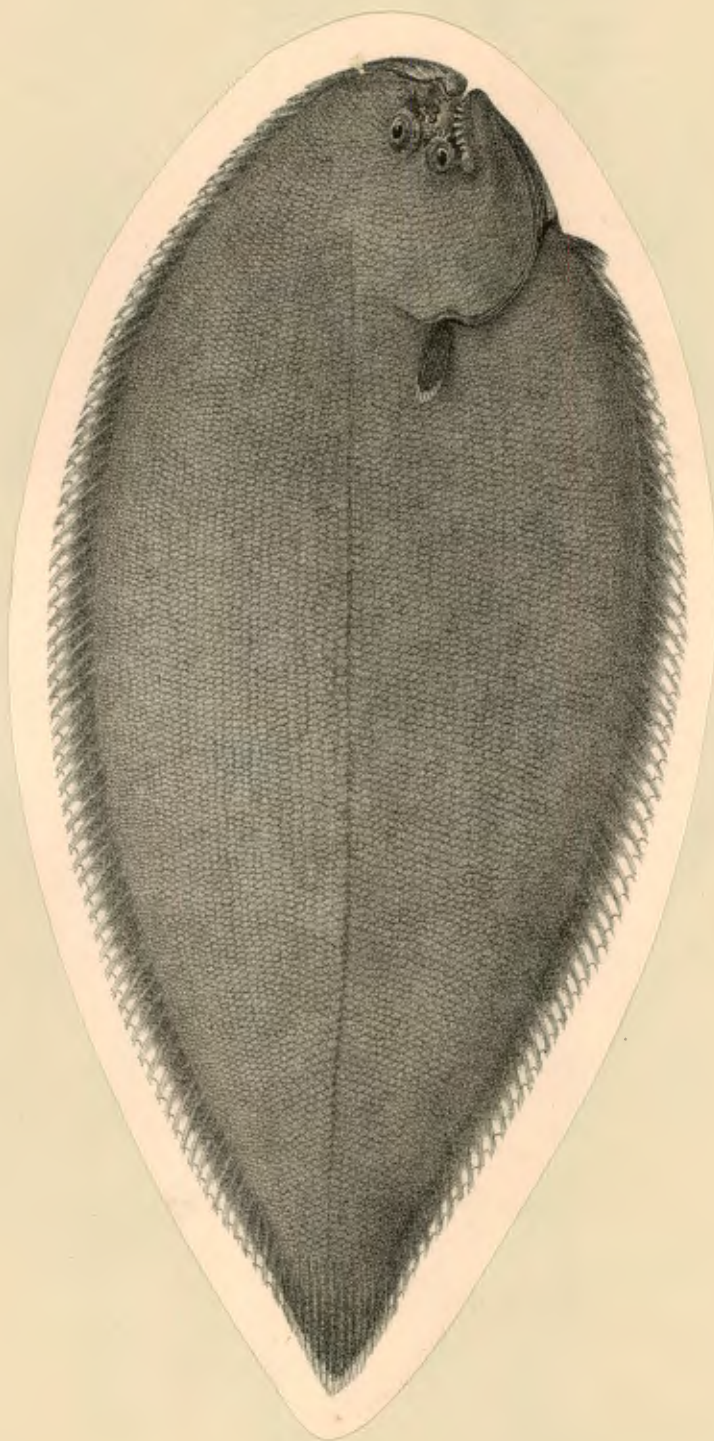


Fig. 52.

SYNAPTURA MARGINATA.  
(From Gilchrist).

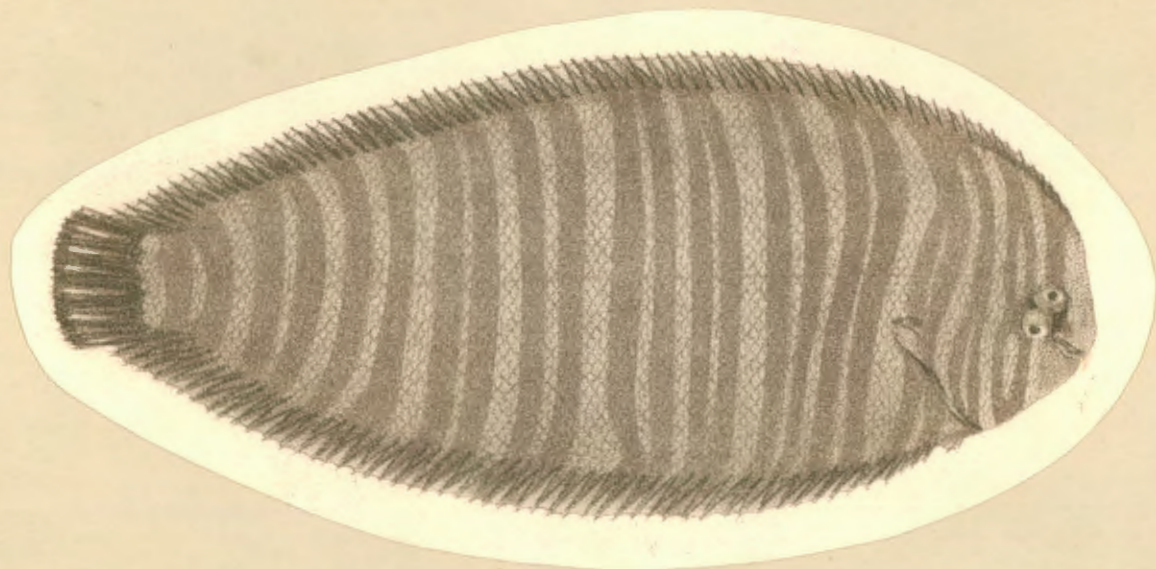


Fig. 33.

ZEBRIAS (PSEUDAESOPIA) REGANI.  
(From Gilchrist, Synaptura regani).

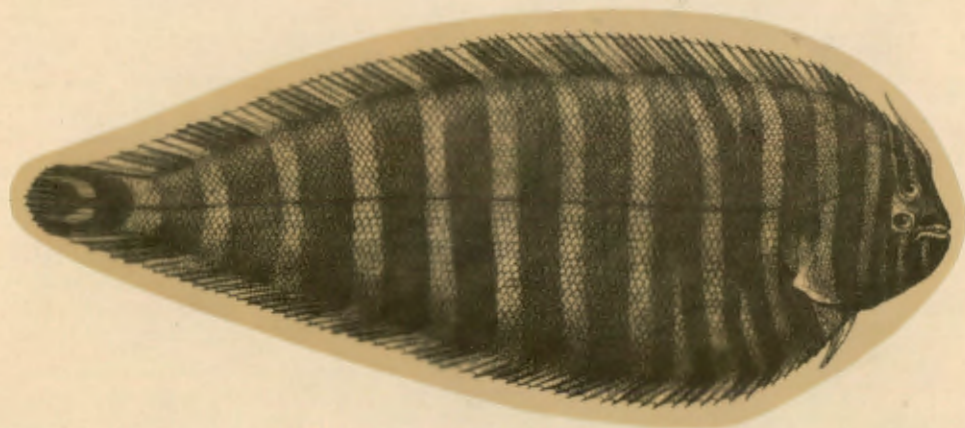


Fig. 34.

CORYPHAESOFIA CORNUTA BARNARDI.  
(From Day, Synaptura cornuta).



Fig. 35.

HETEROMYCTERIS CAPENSIS.  
(Original photo).

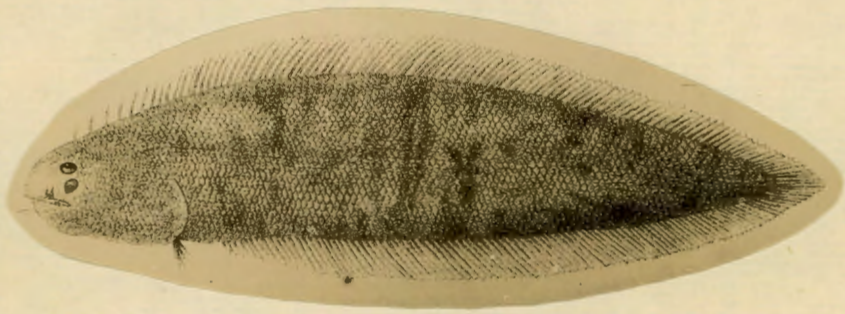


Fig. 36.

SYMPHURUS VARIEGATUS.  
(From Gilchrist, Aphoristia variegata).

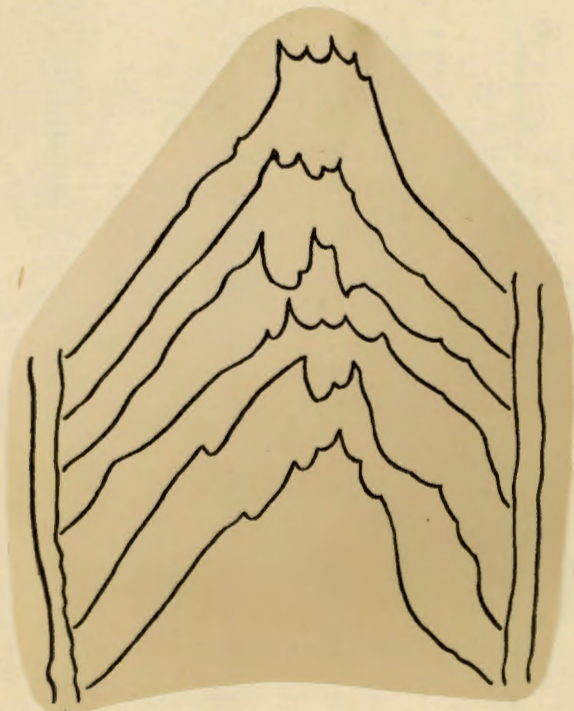


Fig. 37.  
Interradial circuli.  
(x400).



Fig. 38.

SYMPHURUS STRICTUS.  
(From Gilbert).

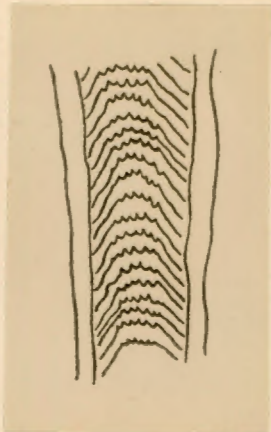


Fig.39.

Interradial circuli.  
(x 100).

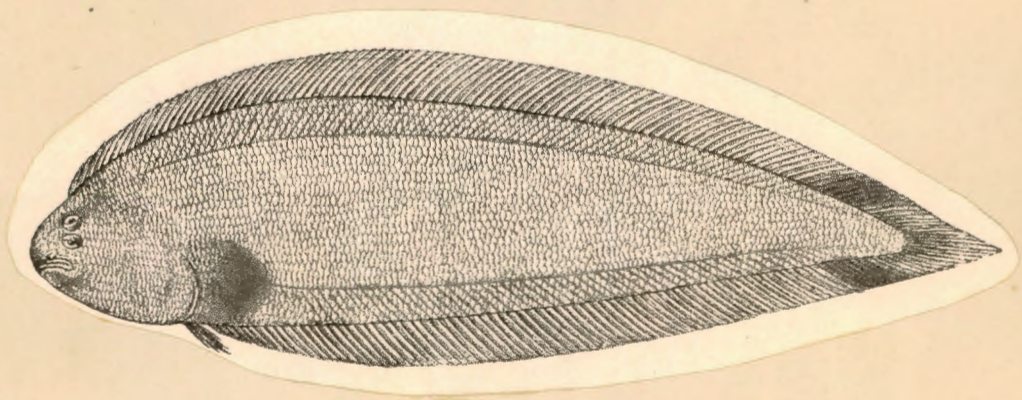


Fig. 40.

SYMPHURUS OCELLATUS.  
(From Von Bonde).

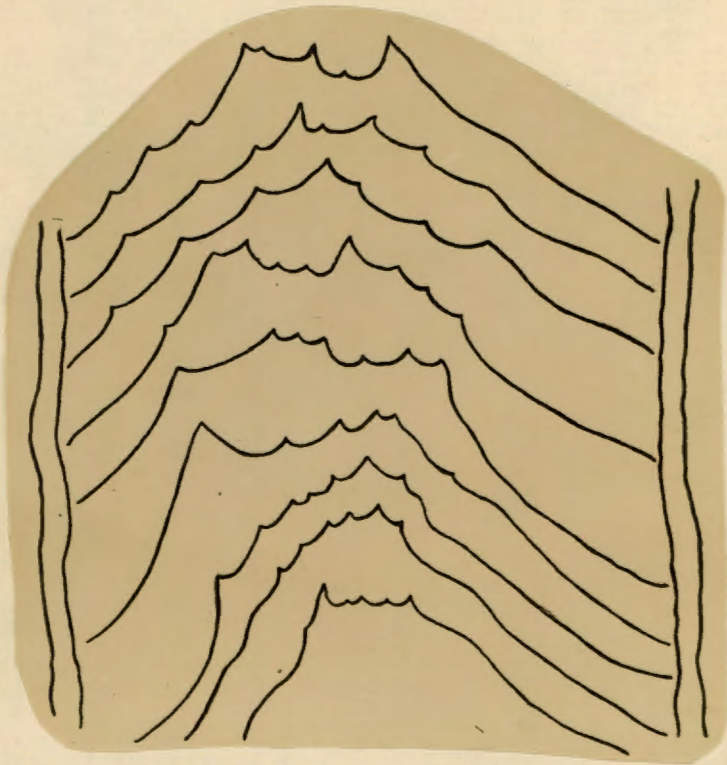


Fig. 41.  
Interradial circuli.  
(x600).



Fig. 42.

CYNOGLOSSUS LIDA.  
(From Day).

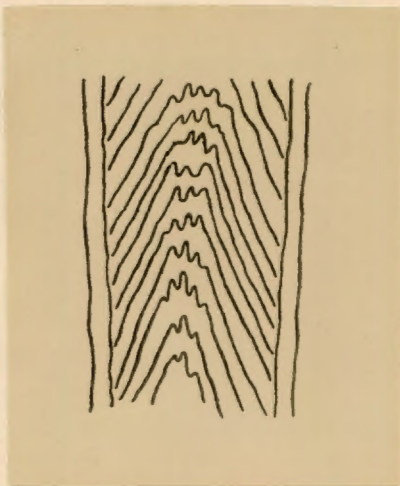


Fig.43.

Interradial circuli.  
(x 100).

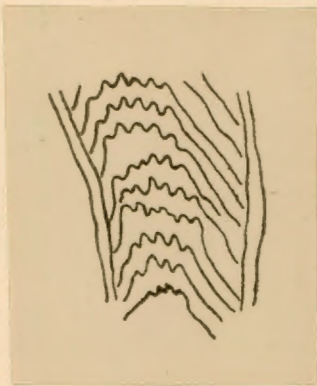


Fig.44.

Interradial circuli.  
( x 100 ).

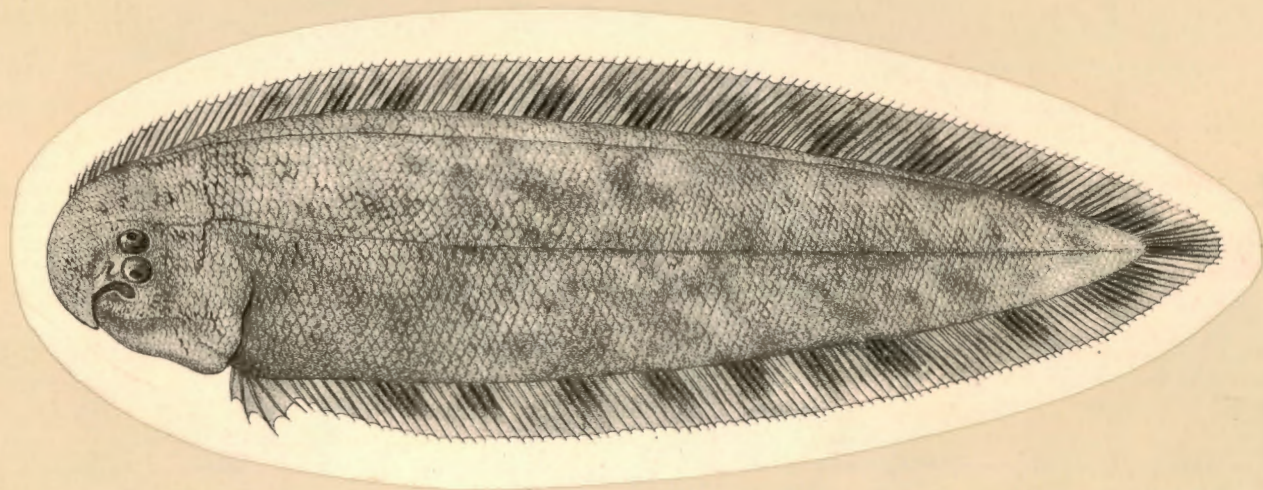


Fig. 45.

CYNOGLOSSUS GILCHRISTI.  
(From Gilchrist, Cynoglossus brachycephalus).

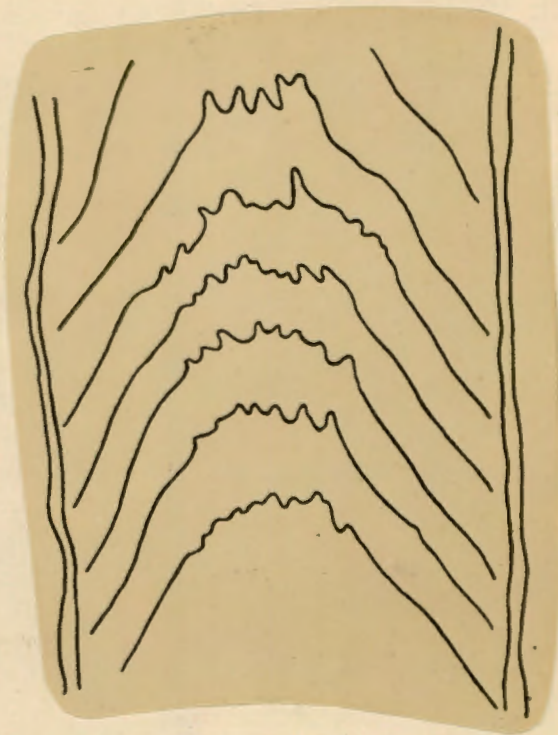


Fig. 46.  
Interradial circuli.  
(x 600).

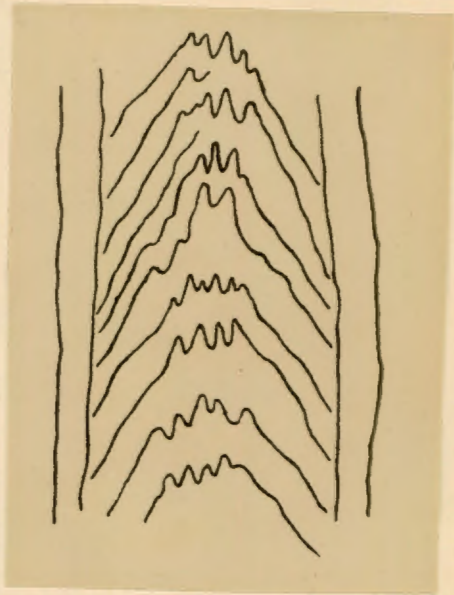


Fig.47.

Interradial circuli.  
(x 500).

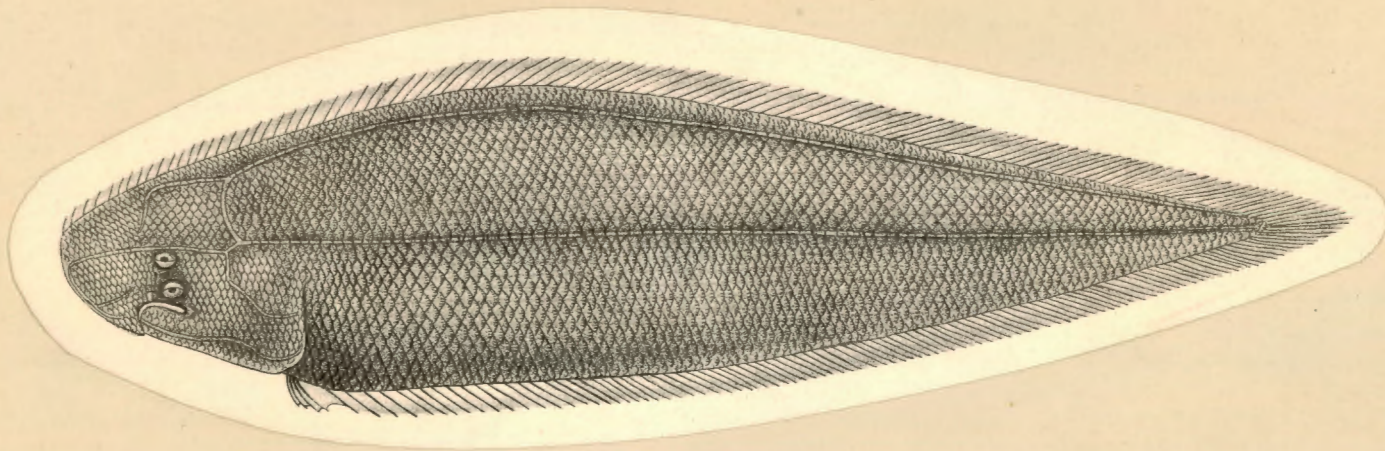


Fig. 48.

ARELIA ATTENUATA.

(From Gilchrist, Cynoglossus attenuatus).

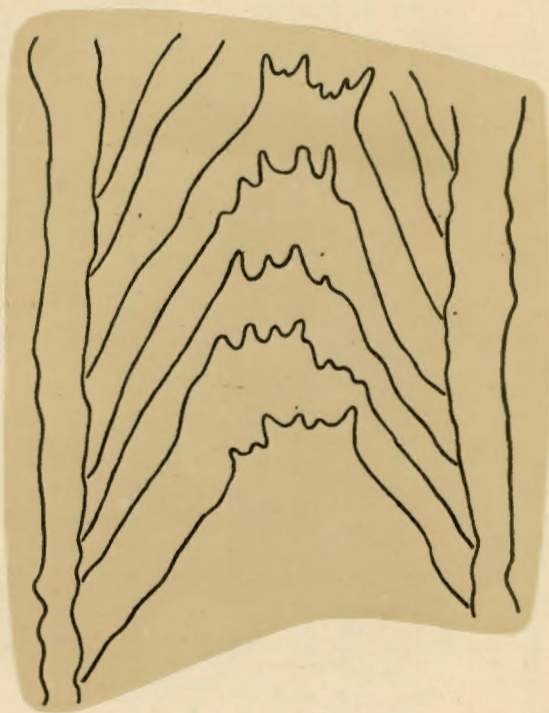


Fig. 49.

Interradial circuli.  
(x 600).



FIG. 501

TRULLA CAPENSIS.  
(Original photo).

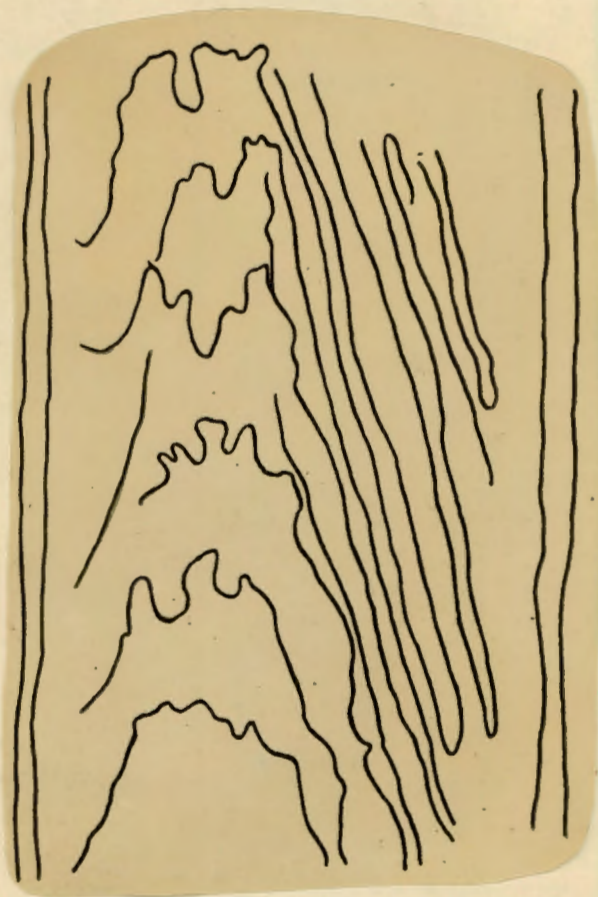


Fig. 51.  
Interradial circuli.  
(x600).

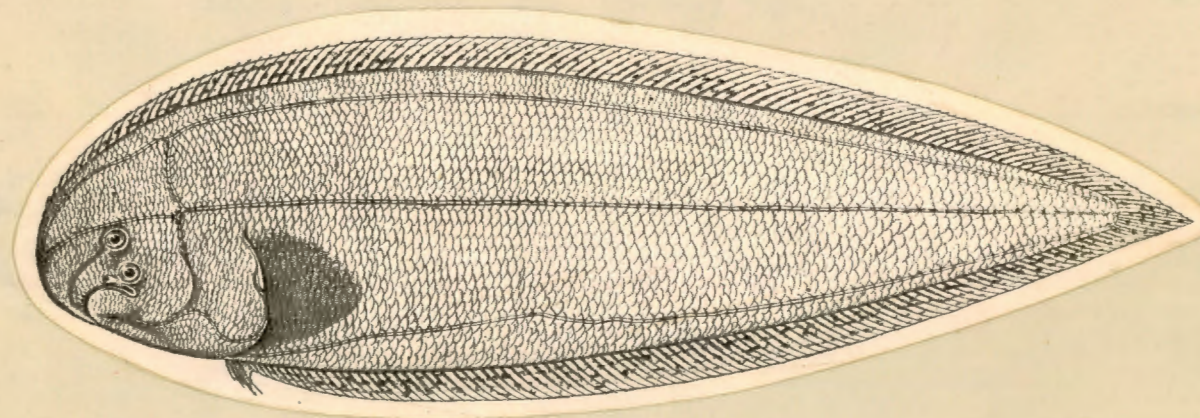


Fig. 52.

TRULLA MICROPHthalmus.  
(From Von Bonde, Areliscus microphthalmus).

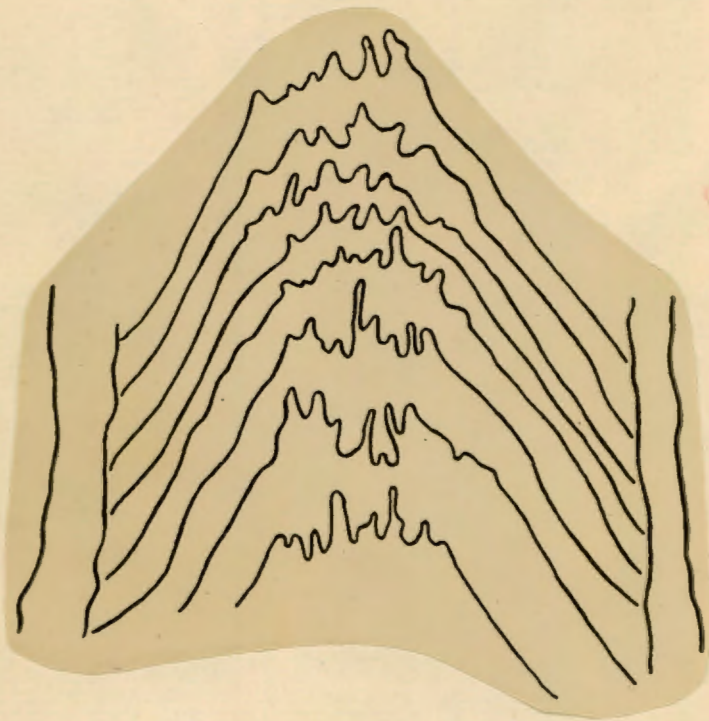


Fig.53.  
Interradial circuli.  
(x600).

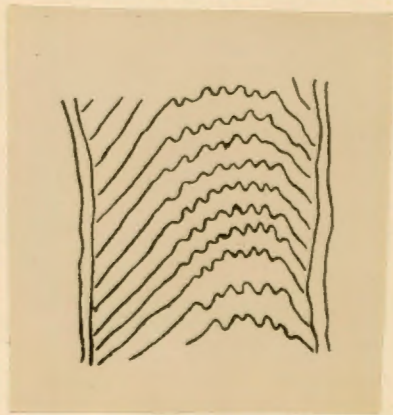
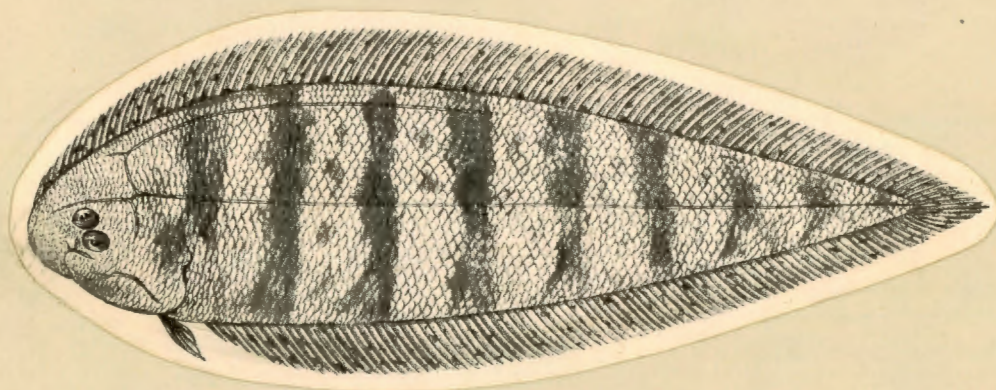


Fig.54.

Interradial circuli.  
(x 100.



*Fig. 55.*

ARELISCUS ECAUDATUS.

(From Von Bonde, Areliscus natalensis).

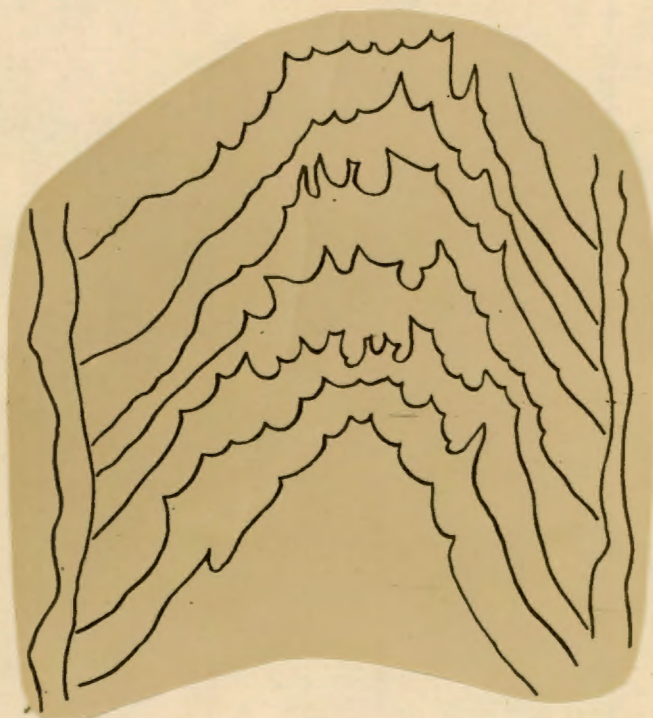


Fig. 58.  
Interradial circuli.  
(x 600).

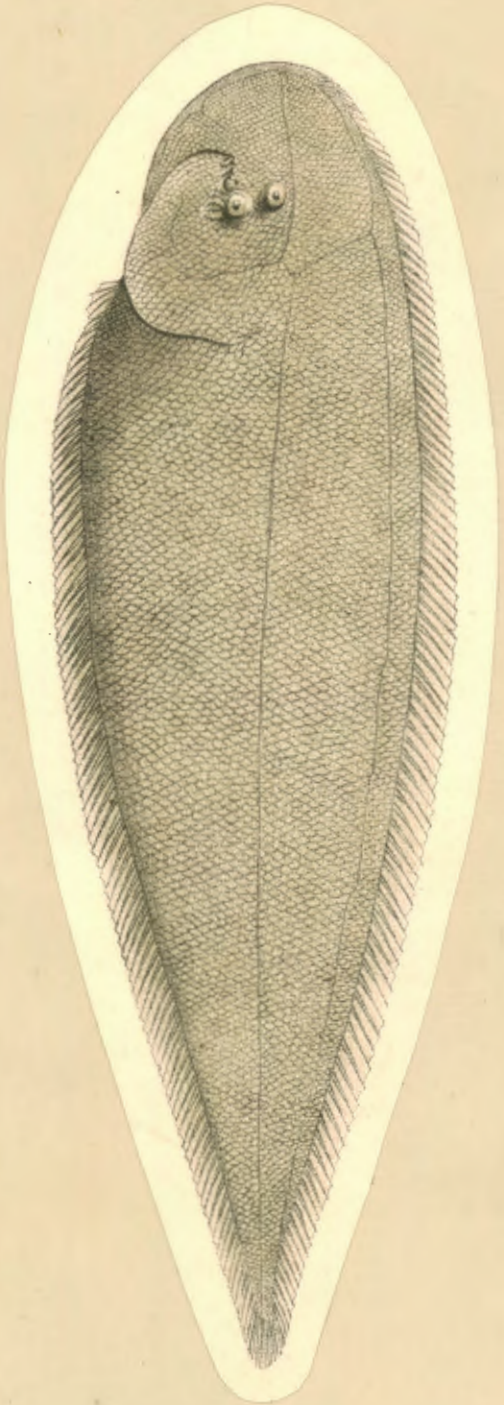


Fig. 57.

PARAPLAGUSIA MARMORATA.

(From Gilchrist, Plagusia marmorata var. africana).

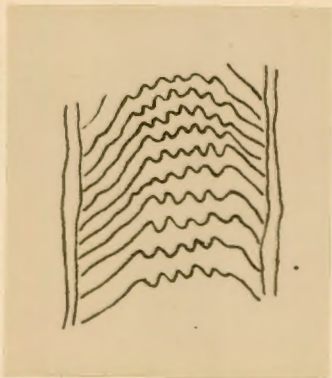


Fig.56.

Interradial circuli.  
(x 100).