ANNALS

OF THE

SOUTH AFRICAN MUSEUM

VOLUME XXXVI.

PART I, *containing:—*

1. *Andrew Smith, M.D., Founder of the first South African Museum.* By PERCIVAL R. KIRBY, M.A., D.Litt., F.R.C.M., F.R.A.I., University of the Witwatersrand. (With Plates I–V.)

2. *Field Notes on the First and Second Expeditions of the Cape Museums' Mammal Survey of the Cape Province; and Descriptions of some New Subgenera and Subspecies.* By G. C. SHORTRIDGE, Director, Kaffrarian Museum, King William's Town. (With Plates VI and VII.)

SEMPER ALIQUID NOVI AFRICA AFFERT

ISSUED SEPTEMBER 1942. PRICE 9s. 6d.

PRINTED FOR THE
TRUSTEES OF THE SOUTH AFRICAN MUSEUM, CAPE TOWN
BY NEILL AND CO., LTD.,
212 CAUSEWAYSIDE, EDINBURGH.

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1942–1947.

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A. J. H. Goodwin, M.A., Honorary Keeper of the Ethnological and Archæological Collections.

Miss E. Margaret Shaw, B.A., Assistant in Charge of the Ethnological Collections.

LIST OF CONTRIBUTORS.

LIST OF NEW SUBGENERIC NAMES INTRODUCED IN THIS VOLUME.

LIST OF PLATES.

DATE OF ISSUE OF THE PARTS.

Part 1 September 1942.

Part 2 July 1943.

Part 3 May 1944.

Part 4 June 1947.

Part 5 May 1948.

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SOUTH AFRICAN MUSEUM

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1. *Andrew Smith, M.D., Founder of the first South African Museum.* —By PERCIVAL R. KIRBY, M.A., D.Litt., F.R.C.M., F.R.A.I., University of the Witwatersrand.

(With Plates I–V.)

THE origin of this paper is due to a series of "happy accidents." Some years ago, while engaged in research upon the Expedition for Exploring Central Africa, initiated and led by Dr. Andrew Smith in 1834–1836, I read, among other works, Henry Hall's *Manual of South African Geography.** In the "Table of Chronological Events relating to the History of South Africa generally, physical and political," which appears in the Appendix, I noticed, under the year 1825, the statement: "First museum established—June 10." This statement surprised me, since hitherto I had not met with any authority who had suggested such an early date for the foundation of the South African Museum. In fact Hall's next entry concerning the Museum, under the year 1855, was "Trustees of South African Museum elected—July 7." †

As I was not at the time particularly interested in following up the suggestion contained in the first of these statements, I contented myself with simply filing the reference for future use. But a second discovery, made only a few years ago, again aroused my interest in the matter. My friend Mrs. H. M. McKay, who has been working on various aspects of the life and scientific activities of William John Burchell, had arranged to visit England with a view to obtaining first-hand information upon many points connected with her research.

* Second edition, Cape Town, 1866.

† See Editor's note on p. 26.

Accordingly I asked her if she would try to trace for me the whereabouts of the nephew of Dr. Andrew Smith, or any of his descendants. It was this nephew, Mr. Andrew Michie, who inherited Smith's autograph manuscripts, and who generously donated them to the South African Museum in 1913. Mrs. McKay found him, hale and hearty although ninety-three years of age, and he lent her a large scrap-book which had belonged to Smith, and which contained many invaluable biographical documents, including a Diploma presented to the Doctor by the Mineralogical Society of Jena in 1826, in recognition of his scientific work as "Director of the Museum of the Cape of Good Hope." This document I shall discuss more fully later on. Mr. Michie also gave Mrs. McKay a photograph of a drawing of Smith made by Charles Bell, one of the artists who accompanied the Expedition of 1834–1836, and this photograph is reproduced here on Plate I. The drawing appears to have been made at the time of the Expedition.

Here, then, was conclusive evidence that the South African Museum was in existence at the time suggested by Hall in his Manual, and this information I also filed for future use.

But during December 1938, while searching the South African Public Library for traces of a volume, stated by Dr. George McCall Theal to have been published at Cape Town in the year 1836, and which, he alleged, contained an enlarged account of the famous expedition, I came across a number of pamphlets, bound together, which included several by Dr. Andrew Smith. Two of these, a catalogue of the South African Museum, printed and published in 1826, and a paper also emanating from the Museum, which consisted of instructions for preparing and preserving the different objects of the animal, vegetable, and mineral kingdoms, undated, but obviously of the same year as the catalogue, caused me to reflect anew upon the date of the founding of South Africa's first public Museum.

In order, therefore, to secure authoritative information as to what was known about the inception of the South Aftican Museum, I visited that institution and questioned the Director, Dr. E. L. Gill, and also the Assistant Director, Dr. K. H. Barnard. The latter supplied me with several documents which contained the history of the Museum so far as it was known. Two of these were:

(1) An undated typescript "compiled by Dr. Péringuey with a view to obtaining an increased grant from the Corporation" (of Cape Town).

(2) The typescript of a broadcast talk given by Dr. K. H. Barnard from the Cape Town Broadcasting Station on 16th October 1924.

The first of these begins as follows:—

"The history of the South African Museum may be said to date from 1829.

"At that time there was founded in Cape Town, by private subscription, the Scientific and Literary Society for, *inter alia*, the support of the Cape Town Public Library, which, for reasons of penury in the Revenue of the Colony, ceased to receive the unaided help from the Government of the Country [*sic*].

"The Scientific and Literary Society continued until 1855. It brought together collections of scientific interest in natural history especially, helped considerably the famous expedition of Sir Andrew Smith, who visited the then nearly unknown parts of the Transvaal and what is now the Delagoa Bay Province [*sic*]. In turn the Society was rewarded for its pecuniary help by the famous traveller and naturalist. No less than 150 members of the Society subscribed a heavy sum indeed (£5 a head, I believe) for the publication of Smith's monumental work on the Zoology of South Africa, which shall [*sic*] never be surpassed, even if equalled. . . ."

The second document commences thus:

"The history of the South African Museum may be said to date from 1829. . . ."

This statement was, of course, as Dr. Barnard admits, derived from Péringuey; and Dr. Barnard repeated Péringuey's statements regarding the Scientific and Literary Society, and also about Smith's Expedition to the Transvaal and Delagoa Bay. Dr. Barnard, however, continued:

"In 1855 this Society ceased to be, and a movement was set on foot amongst the citizens of Cape Town to inaugurate a public Museum supported by Government. . . .

"Objects were donated, and about 300 subscribers at a guinea per annum each were enrolled.

"These collections were temporarily housed in the old Slave Lodge, Government Gardens. In 1856 they were transferred to the upper story of a bookseller's shop in St. George's Street, the owner charging a nominal rent of £10 per annum. . . ."

It is obvious from these quotations that Dr. Péringuey was unaware that the South African Museum was founded fully four years earlier than the date which he suggested, and he is hardly to be blamed for such lack of knowledge, although one might have expected him to be familiar with Dr. Andrew Smith's *Report of the Expedition for Exploring Central Africa*, published in Cape Town in 1836. Had he known this report, he would not have made the mis-statement that the Expedition penetrated to the "Delagoa Bay Province," which it certainly did not.

Accordingly I determined to investigate all possible official documents, in order that I might find out the precise date of the founding of the South African Museum, the reason for its inception, and the individual or individuals who were responsible for initiating the idea.

Hitherto I have been unable to discover any autograph manuscripts dealing with the foundation of the Museum, though I have no doubt that, in time, some at any rate will come to light.* But an intensive search through the early files of the *Cape Town Gazette and African Advertiser* yielded most of the facts which were necessary for the solution of the problem which I had set myself.

In the issue of this journal (a Government publication) for Monday, 11th June 1825 (No. 1013, p. 1, col. 1), there appeared the following notice:—

Government Advertisement.

His Excellency the Governor being convinced, from various sources, of the endless diversity and novelty of the natural products of this colony, is most desirous to make them in future a subject of particular attention. His Excellency has therefore directed an Establishment to be formed in Cape Town, under the title of "The South African Museum," for the reception and classification of the various objects of the Animal, Vegetable, and Mineral Kingdoms which are found in South Africa, whereby an opportunity will be opened to the colonists of becoming acquainted with the general and local resources of the Colony. His Excellency trusts, therefore, that the Inhabitants will aid him with their exertions, in contributing whatever it is in their power to collect, to promote an Institution so interesting and useful.

His Excellency has been pleased to nominate Dr. Andrew Smith, M.D., to be Superintendant [*sic*] of this Institution, to whom all communications are to be made, addressed to him, at the South African Museum.

His Excellency has selected an apartment in the Public Library, to

* Since this paper was in proof I have been given by Dr. R. U. Moffat, grandson of the Rev. Robert Moffat, an original letter sent by Dr. Smith to the missionary. A portion of this letter is reproduced on Plate V, and the complete letter is printed as an Appendix, facing p. 26.

place the collections in for the present, and it is his intention that the Museum should be open to the Inspection of the Public, at stipulated hours to be hereafter fixed.

CAPE OF GOOD HOPE, 10th June 1825.

By His Excellency's Command,

(Signed) R. PLASKET,
Secretary to Government.

This notice also appeared in Dutch in the Dutch issue of the same date.

Here, then, was conclusive evidence that Henry Hall's statement was correct, and that Péringuey had overlooked a very important source of information. So I determined to read on.

In the issue of the *Gazette* for Saturday, 25th June 1825, the new Director issued his first appeal.

PUBLIC NOTICE.

THE SOUTH AFRICAN MUSEUM being now open for the reception of objects belonging to all the branches of Natural History, such individuals therefore as may feel an interest in forwarding, by *Donations*, the intentions of the said Establishment, are requested to make them whenever they may find it convenient. Those persons who reside near or in Cape Town will be pleased to forward them directly to the Museum, whilst those in the Country can send them to the Landdrost nearest to their place of abode.

Lists of the presents which may be so made, together with the name of the *donor*, will be published monthly in the Government Gazette; and in each succeeding publication a reference will be made to the number of specimens previously furnished by the different individuals, which plan will show, as well as record the degree of zeal and interest which have been taken by the respective inhabitants towards forwarding such a necessary and laudable undertaking. Besides those Public Acknowledgments, the Sources from whence the various articles have been derived will be mentioned on the labels attached to each in the Museum.

As not only absolute Instruction, but also considerable Experience, are necessary to enable individuals to prepare and preserve Objects of the Animal Kingdom, in such a manner as to be useful for exhibition, it is therefore particularly desirable that as many living Specimens be obtained as is possible.

Individuals whose circumstances or inclinations do not incline them to make donations of such articles as they may at present possess, or hereafter acquire, are informed, that they may personally, or by letter, state the terms upon which they will part with them, to the Superintendant of the Museum.

All persons having Objects of Curiosity for sale, are most earnestly requested to allow the Museum to have the refusal of them.

Printed Instructions, for the guidance of those who may feel inclined to assist in obtaining animals, etc., for the Museum, will be circulated.

ANDREW SMITH, M.D.,
Superintendant, etc.

This notice also appeared in Dutch in the Dutch issue of the same date.

Who was this Andrew Smith who was appointed by the Governor of the Cape to the position of "Superintendant" of the newly founded Museum? A brief outline of his biography will make this quite clear, and will explain his absorbing interest in Natural History.

Andrew Smith was born on 3rd December 1797, at Heronhall, in the parish of Kirkton, Roxburghshire, Scotland. He was at first educated at the parish school at Stobs; but on the family moving to Hassendean in 1809, he went to the parish school of Minto, and later to Lilliesleaf. Still later, having chosen to follow the practice of medicine, he was placed under the care of Mr. Walter Graham of Hawick, who was a surgeon.

In 1812, or thereabouts, Smith went to Edinburgh, and qualified in 1813. In 1815 he went to London to undergo the preliminary examination for entrance to the Medical Department of the Army. This he passed with ease, his treatise on the eye attracting the attention of no less a person than the Director General, Sir James McGrigor, who apparently never forgot him. On 15th August 1815 he was accordingly gazetted Hospital Assistant; and he was supposed to be the youngest officer ever admitted to the Department. He was just eighteen years of age.

It is important at this point to stress the fact that Sir James McGrigor, the Director General, was determined that the men under him should not only be well qualified from a medical point of view, but should also possess a wide general education.

One of the candidates for an Army Medical Post, who later became Surgeon-General Munro, M.D., C.B., tells us in his *Records of Service and Campaigning in Many Lands* * that "He insisted upon a knowledge of Latin in all cases; preferred candidates who possessed degrees in arts and in medicine; and advised the study of botany, natural history, geology, and mineralogy, subjects which I do not think are included in the requirements and examinations for the medical service of the present day."

* London, 1887, vol. i. p. 6.

This, then, was the man whom young Smith had to face at the age of eighteen, and whose attention he attracted not only because of his brilliant paper, but also because of his intimate knowledge of the habits of birds and animals, for the study of natural history had been his principal interest from his earliest youth.

In the year 1818 we find Smith quartered in Edinburgh, and using his spare time to attend the lectures and demonstrations given at the University and at Surgeons' Hall. We are therefore not surprised to find that on the 2nd August 1819 he graduated M.D., his dissertation, which was written in Latin, being entitled "De Variolis Secondariis." He was only twenty-two years of age; nevertheless he occasionally contributed to the *Edinburgh Medical Journal.*

In 1821 he was ordered to the Cape, where he remained until 1837, being attached to the 49th and 98th Regiments and the Cape Mounted Rifle Corps "for short periods." This statement, which appears in the *Dictionary of National Biography,* seems to me to be an amazing one. That a professional medical man, and an army one at that, should have been permitted to pursue many and various occupations other than those for which he was officially appointed, seems to me to require some explanation, and this I shall endeavour to give. For it is a fact that Smith was, again and again, released from his official duties in order to carry out scientific investigations or to act as the agent of the Governors of the Cape in confidential missions to native tribes. Undoubtedly one feels that the hand of Sir James McGrigor was behind all this; although Smith's own powerful personality had unquestionably a great deal to do with it.

But to continue with Smith's biography. In 1824 he was sent by Lord Charles Somerset on a mission to Kafferland, to interview the Xhosa chief, Gaika; and this expedition kept him from his official duties until 1825.

In June 1825 there appeared, as we have seen, the Governor's order for the establishment of a South African Museum, with Smith as the first Director. There can be no doubt that Smith was one of the "various sources" who convinced the Governor of the necessity for founding such a Museum. There is no question whatever but that Smith used his opportunities on this and other expeditions to further his knowledge of natural history; his published and unpublished writings afford conclusive evidence on this point.

In 1828 he was sent by Sir R. Bourke to visit the Bushmen on the Orange River. The principal result of this was his paper on the *Origin and History of the Bushmen.*

In 1830 Sir Lowry Cole sent him to Port Natal to treat with Dingaan. On this trip he was accompanied by his friend Lieutenant Edie, two German scientists, named Drège, and several others. I have succeeded in discovering his whereabouts at several points during this trek, although I have not yet traced the diary of the expedition, except for a few isolated sentences. But Dr. Austin Roberts has dealt with some ornithological notes made by Smith during these journeys, and they go far to prove my point that Smith had a double purpose in going into the wilds.*

In 1833 the Association for the Exploration of Central South Africa was formed, mainly owing to the persistence of Smith, who, having heard from traders and others of the marvels of the interior, had, from at least 1829, if not earlier, made up his mind to explore it at any cost.

He seems to have galvanised the Capetonians into unusual enthusiasm, with the result that within a year they had collected sufficient funds to send a well-equipped and fully-manned scientific expedition from the Cape to Graaff Reinet, thence to Kuruman, and beyond that to as far as the Tropic of Capricorn.

Smith carried out the objects of the expedition with astounding energy, and the only pity is that the vast collections which he made have been dispersed, and are, in most cases, no longer identifiable. But the expedition resulted in his great zoological work, and that alone justified it, whatever historians who were unaware of the true facts may have said about it.

The expedition returned to the Cape in 1836, and in the following year Smith was recalled to England, being promoted to the rank of Surgeon, and being stationed at Fort Pitt, Chatham. He succeeded in persuading Lord Glenelg and the Earl of Minto to petition the Lords of the Treasury for a grant in aid for the publications of his *Illustrations of South African Zoology*, and a sum of £1800 was earmarked for that purpose. But his projected "Travels" were not subsidised, and accordingly did not appear.

In 1841 Smith was again promoted, this time to the position of Staff Surgeon of the first class, and principal Medical Officer at Chatham.

In 1845 he was transferred to London as professional assistant to Sir James McGrigor, the Director General; and when, in 1851, Sir James retired, the Duke of Wellington selected Smith to succeed him as Superintendent Inspector General.

* Ann. Transv. Mus., xviii, p. 271, 1936.

In 1853 he was appointed Director General, the highest position that any medical man could attain to in the British Army; and in 1854 came the Crimean campaign. Everybody knows the story of Florence Nightingale, and how she denounced the Army Medical Department. Smith was the man who had to bear the brunt of her attack, and he emerged from it with flying colours. He was loaded with honours by many learned societies, and later was made a K.C.B. He had previously been elected a Fellow of the Royal Society.

In 1858 he resigned his post on account of ill-health, and devoted himself to his African studies. I have examined the fruits of these in the prodigious manuscript volumes which he left behind him unpublished, and I can testify not only to his industry, but to his open-mindedness and wide scientific outlook.

In 1864 he lost his wife, and in the following year his sister. The remainder of his life seems to have been given up to the study of the Holy Scriptures. He died in his London house, in Alexander Square, Brompton, on 12th August 1872, aged 75 years.

This, then, was the forceful personality to whose vision and energy the inception of our first South African Museum was due.

Lord Charles Somerset, having officially sanctioned the foundation of the Museum, wrote to Earl Bathurst on 18th July 1825, informing him of what he had done, and also asking for authority to pay a small salary to the new superintendent. The letter, which with the reply is quoted by G. M. Theal in his *Records of the Cape Colony*,* is as follows:—

> My Lord,
>
> It has long been a subject of Regret that, in a British Colony whose natural products are capable of contributing more largely perhaps than any other portion of the Globe to promote the objects of natural history, no Establishment should be made for collecting and arranging the various objects of the Animal, Vegetable and Mineral Kingdoms which it contains. I have hitherto been prevented from suggesting for your Lordship's sanction and approbation the forming of a Museum, from not having it in my power to submit at the same time the name of any gentleman competent to conduct the undertaking, but there being a gentleman here at present, Dr. Andrew Smith, M.D., whose Science and enthusiastic ardor in the pursuit of natural history fully qualify him for it, I have issued the enclosed notice (as a Government Advertisement in the Cape Town *Gazette*).

* London, 1904, vol. xii, pp. 227–8 and 275.

Dr. Andrew Smith has been for some time employed on the Frontier of the Settlement in the Military Medical Department and has lately been removed to Cape Town, and has for the present undertaken the superintendance of this Establishment without any compensation; but should he be ordered to Europe (which he expects) he will be compelled to retire on the half pay, if he continues to conduct it. I trust therefore that your Lordship will authorise my giving him a salary of Two Hundred pounds sterling per annum.

As I have appropriated two apartments in the Public Library for the Museum, the expense of house rent will be saved. I do not anticipate therefore any further disbursement on this account except that which may be necessary to remunerate persons for collecting and procuring objects of curiosity and some occasional assistance in preparing them: these expenses may be estimated to fluctuate from One Thousand to Two Thousand Rix Dollars per annum, or from Seventy-five Pounds to One Hundred and Fifty Pounds Sterling.

I have, etc.,

(Signed) Charles Henry Somerset.

To this letter Earl Bathurst replied, on 14th October 1825, in the following strain:—

My Lord,

I have the honour to acknowledge the receipt of your Excellency's dispatch of the 18th of July last.

Although under other circumstances, I should be disposed to sanction the establishment of a Museum of Natural History at the Cape, yet in the present state of the finances of the Colony, I should not feel myself at liberty to authorize the payment of the salary which you propose to assign to Dr. A. Smith.

I have, etc.,

(Signed) Bathurst.

Smith, however, was not recalled to England at this time, and the necessity for a salary as Superintendent of the Museum fell away. Accordingly he continued to act without remuneration.

We have already seen how Smith, a fortnight after the Government order establishing the Museum, issued his first public appeal in the official *Gazette*. From that time onwards we meet with a regular series of notices which the new Director published, and which give us considerable insight into his methods.

In the issue of the *Gazette* of Friday, 8th July 1825, there appeared the first list of donations to the Museum. This notice I reproduce in full, since it contains several names of great interest.

SOUTH AFRICAN MUSEUM.

No. 1.

LIST OF ARTICLES, which have been presented to the MUSEUM, with the names of the respective Donors.

QUADRUPEDS.

1 Specimen	His Excellency the Governor.
1 ,, ...	Mr. Ludwig, 6 Berg-street.
1 ,, ...	Mr. Villet, 71 Long-street.
1 ,, ...	Mr. Kiener, 7 Kortemarkt-street.

BIRDS.

1 Specimen	Mr. Bestandig, 22 Grave-street.
12 ,, ...	Doctor Smith.
10 ,, ...	A. B.

REPTILES.

2 Specimens	Rev. Mr. Fallows.
2 ,, ...	Mr. Villet.
3 ,, ...	Mr. Jardine.
3 ,, ...	Mr. J. J. Brink, C.S., Cape Town.

FISHES.

1 Specimen	Mr. Jardine.
4 ,, ...	Mr. Villet.
1 ,, ...	A. B.

SHELLS.

3 Specimens	Mr. Villet.
288 ,, ...	Mr. Ludwig.
30 ,, ...	Dr. Smith.

INSECTS.

231 Specimens	Mr. Ludwig.
1 ,, ...	Rev. Dr. Thom, Caledon.
87 ,, ...	Dep. Ass. Commissary Gen. Watt.

MINERALS.

30 Specimens	Rev. Mr. Fallows.
67 ,, ...	Rev. Dr. Thom, Caledon.
87 ,, ...	Mr. Perry, Surgeon, Graaff-Reinet.
3 ,, ...	Mr. Jardine.
3 ,, ...	Mr. Gill, Surgeon.
33 ,, ...	Mr. Robertson, Graaff-Reinet.
25 ,, ...	Mr. Ludwig.

VARIOUS.

4	Specimens	His Excellency the Governor.
3	,, ...	Miss Cloete, Heeregracht.
4	,, ...	Mr. Jardine.
10	,, ...	Dr. Smith.
3	,, ...	Mr. Josias Hoffman, Stellenbosch.
20	,, ...	Ass. Surgeon Kemlo, 59th Regt.

(To be continued.)

ANDREW SMITH, M.D.,
Superintendant, etc.

This notice did not appear in Dutch in the Dutch issue of Friday, 15th July.

Smith's first appeal, then, resulted in the acquisition of over eight hundred specimens of various kinds.

In the *Gazette* for Friday, 22nd July 1825, the following advertisement appeared:—

SOUTH AFRICAN MUSEUM.

Specimens of the DAS-ADDER, are particularly desired for the Museum; and all persons who may have seen the reptile that goes by that name, are informed, that information as to its nature, appearance, haunts, food, etc., will be thankfully received, either through the medium of written or verbal communications.

It is also particularly desired to know, in what parts of this Colony CAVES or FISSURES exist, and therefore information on those subjects will be received with much pleasure, according to either of the modes above stated.

ANDREW SMITH, M.D.,
Superintendant, etc.

This notice likewise appeared in Dutch in the Dutch issue of the same date, and subsequent notices were similarly treated.

In the *Gazette* of Friday, 5th August 1825, another official announcement was made.

CIVIL APPOINTMENTS.

His Excellency the Governor has been pleased to appoint the Rev. F. FALLOWS and Dr. A. SMITH, M.D., to be additional members of the Committee of the South African Library.

CAPE OF GOOD HOPE, 4th August 1825.

By Command of His Excellency the Governor.

(Signed) R. PLASKET,
Secretary to Government.

This notice is of importance because the newly founded Museum was, it will be remembered, housed in the Public Library building.

The *Gazette* of Friday, 12th August 1825, contained a second list of donations, together with the names of the donors. I give an abstract of the number of donations of each type, and shall so do in the case of subsequent lists.

Quadrupeds	3	specimens.
Birds	28	,,
Reptiles	21	,,
Fishes	2	,,
Shells	2	,,
Minerals	39	,,
Various.	15	,,
	110	Total

It is worth noting, in connection with this particular list, that two of the mineral specimens were contributed by Andrew Geddes Bain of Graaff-Reinet.

In the *Gazette* of Friday, 9th September 1825, there appeared a long communication by Smith on the subject of the Das-Adder, concerning information which he had received in reply to his "Advertisement" of Friday, 22nd July.

It is interesting to see how Smith quickly acknowledged the assistance he had received, thus paving the way for more.

SOUTH AFRICAN MUSEUM.

Mr. Robertson, of Graaff-Reynet, who has already, in various ways evinced his anxiety to forward the objests [*sic*] of this Institution, has furnished an Extract relative to the Das-Adder, from a Letter, addressed to him, which is as follows: "I have made the strictest inquiry concerning the Das-Adder and am informed that it is similar to those large lizards (the *guanas*) but of a different colour, viz., a fine yellow, with black spots, similar to a Puff Adder. It remains in the crevices of rocks, and the Das or Coney inhabiting those crevices become its easy prey. It has four short legs, and a very large mouth, and can easily swallow a Das. I am also informed it is very venomous. A certain farmer went ahunting one day with his dogs, and on the way they attacked this said *Adder*, and so powerful was its venom, that the moment the dogs were bitten they fell down dead."

The latter circumstance, if a fact, forms quite an anomaly in the History of the Lizard Tribe, as none have yet been found possessing beyond doubt the power of destroying life by poison. It is, therefore, a matter of great interest, nay, even of particular consequence, to ascertain if such a quality is inherent in the reptile in question, and consequently any information, directly or indirectly connected with the point yet in doubt will be particularly acceptable. Should an opportunity occur to any individual of procuring alive the animal under consideration, it would be well to institute a series of experiments on some of the lower animals, as on such occasions the sites and severity of the bites can generally be regulated, and thereby such information be obtained as would prove whether death (if it occurred) was the result of a single injury, or the consequence of a specific poison.

As nothing but the description forwarded by Mr. Robertson has yet reached the MUSEUM, the public are again informed that specimens of the *Das-Adder* are most anxiously wished for, as well as additional information relative to its history in general.

Andrew Smith, M.D.,
Superintendant, etc.

A third list of the donations with the names of the donors, appeared in the *Gazette* of Friday, 23rd September 1825.

Quadrupeds	3	specimens.
Birds	36	,,
Reptiles	26	,,
Fishes	2	,,
Minerals	7	,,
Plants	350	,,
	424	Total

The most noteworthy donation in this list was the large collection of botanical specimens, which were all given by Mr. Ecklon.

A fourth list of donations was printed in the *Gazette* of Friday, 4th November 1825.

Quadrupeds	12	specimens.
Birds	64	,,
Fishes	2	,,
Insects	370	,,
Reptiles	19	,,
Shells	25	,,
Minerals	28	,,
Various	4	,,
Paintings	1	,,
	525	Total

This list is of particular interest. Of the sixty-four birds presented to the Museum, no fewer than forty-seven were donated by Mr. Krebs, who is described as "Naturalist to His Prussian Majesty."

The large collection of insects was the gift of a Mr. Roschie.

But the appearance in the list of a solitary painting brings us face to face with a point of considerable importance. The artist was Mr. Ford, Junior, and a footnote added by Smith shows how the young man's gift impressed him. "This drawing evinces great talent and execution for so young an artist, and strongly claims for him the support and patronage of every individual disposed to encourage merit."

The actual drawing would appear to have survived, for in the first of two volumes of original drawings of animals and birds by Ford, most of which were executed on the Expedition of 1834-1836, and which are now housed in the Library of the University of Witwatersrand, the second and third items are coloured drawings of *Anas madagascariensis* Linn., the one being an exact copy of the other. Both drawings are unsigned, and the style is immature compared with Ford's later works.

On the back of the first of these is written, in the hand of the late Dr. Albert Günther, of Oxford, who formerly owned this collection of pictures: "One of Ford's first drawings; not from Expedition." But on the back of the second appears, also in Dr. Günther's hand: "The first drawing done by Ford for Dr. Smith—A. G."

There is no doubt of the authenticity of these pictures, even those which are unsigned, for they bear the unmistakeable stamp of the artist's individuality. Moreover, they were all in Smith's possession until the time of his death, many of them bearing notes in his handwriting. On Smith's decease in 1872 they were returned to Ford, who, on Christmas of that year, presented them to his friend Dr. Albert Günther, who inserted a signed statement to this effect in each of the two volumes. From Dr. Albert Günther they passed to his son, from whom they were purchased by the University of the Witwatersrand in 1936.

Smith did not lose touch with young Ford, for nine years later he chose him as one of the artists to accompany the Expedition for Exploring Central Africa, and it is the work of Ford that is the crowning glory of Smith's *Illustrations of the Zoology of South Africa.*

The *Gazette* of Friday, 2nd December 1825, contained another appeal.

SOUTH AFRICAN MUSEUM.

Wanted, living specimens of the BROWN and YELLOW CAPELS. They will either be received as presents or purchased, according to the wishes of the possessor.

The best instrument for catching snakes alive, is a noose fixed on the extremity of a long stick, such as a wagon whip, etc. It must first be carried over the head of the reptile, and then drawn tight by a slight jerk, after which, a removal into a box, the best place for confinement, may be easily and safely effected.

When brought to the box, the lid of which has been previousely [*sic*] raised, the animal must be placed inside, and the extremity of the stick, to which the noose is fastened, kept without. The cover must then be shut down on the noose and a division effected at the point where it is connected to the stick, which may be done without any danger, as that part will be outside when the snake is closely shut up within.

Andrew Smith, M.D.,
Superintendant, etc.

Apparently Smith met with some response to his various appeals, for in the *Gazette* of Friday, 23rd December 1825, we meet with what I imagine is the first extensive scientific questionnaire ever issued in South Africa. I reprint it in full, since it clearly shows Smith's thoroughness, and his insatiable desire for detailed information of every kind.

SOUTH AFRICAN MUSEUM.

In order to obtain a thorough knowledge of the Natural Productions of this Colony, the conjoint exertions of its Inhabitants are at least in the first instance particularly necessary; for the local knowledge they possesses will enable them to furnish information that must lead to results that all the zeal and activity of a Traveller, or temporary Resident, could never effect. Such of them as may feel an interest in forwarding the object in view, are earnestly requested to furnish, from time to time, whatever they may consider likely to answer the purpose.

Their attention is particularly requested at first to the four-footed animals; and after that division has been completed, then others will follow. In regard to each animal, as much information as possible is desirable relative to the following points:—

Its colonial name or names;
The meaning of such name or names;
Its local or provincial name or names;
The meaning of such.
Its general size, viz. height, length, circumference, etc.
Its usual weight.
Its general appearance; that is, whether clumsy or well shaped.
Its colours;
Whether these are the same in both sexes and at all ages;
If not, even the most trifling differences must be stated.
If furnished with horns or anything resembling them;
If these exist in both sexes, or only in the male;

If they are permanent, or shed at particular periods of the animal's existence;
Their form direction and colour.
Its feet, whether solid, cloven or with toes and claws.
The number, arrangement and form of teeth.
Its gait and speed.
Its food; that is, whether animal or vegetable, or partly both;
If vegetable, the particular sort;
If animal, whether it requires to destroy its own prey, or is satisfied with carrion;
If requiring the first, how does it generally procure it.
Its disposition, whether ferocious or timid, dull or lively, stupid or intelligent.
Does it search for its food during the day or in the night.
Does it chew its cud.
Does it inhabit mountains or flat country.
Does it sleep and generally live under ground or on the surface, or on trees.
Is it solitary, gregarious, or generally found in pairs.
What is the supposed length of its life.
Is there any method practised for ascertaining its age, and if so what is it.
The covering, whether hair, wool, fur, bristles, scales or what.
Is its skin applied to any useful purposes;
If so, how manufactured.
Is its flesh eatable;
Are any part or parts more relished for food than others;
Is any part or parts of it supposed to possess any medicinal virtues.
Is it tamed, and if so, with ease or difficulty.
Is its natural disposition much modified or changed by taming.
Is it on any occasions apt to evince marks of its natural disposition; such as traits of cunning, example of ferocity, instance of malice, etc.
Is it easy killed, or very tenacious of life.
In what particular parts of the country is it generally found.
Is it subject to any evident diseases, and if so, what are they;
Does instinct appear to point out to it any natural cures.
How long does it go with young;
What number has it generally at a birth;
At what time of the year are the young generally observed;
Do they immediately search for food or are they supplied with it for a time by their parents.
If the latter, in what way is that done.
Does it live, if not particularly disturbed, always nearly in the same part, or does it migrate.
Does [*sic*] any superstitious notions exist relative to it.

ANDREW SMITH, M.D.,
Superintendant, etc.

The *Gazette* of Friday, 20th January 1826, contained a list of questions in which Smith sought information on

(1) the habits of Swallows, particularly as regards migration,

(2) the habits of bats, and

(3) the habits of the night hawk.

A fifth list of donations to the Museum, wrongly described as No. 6, appeared in the *Gazette* of Friday, 17th February 1826.

Quadrupeds	6	specimens.
Birds	10	,,
Fishes	4	,,
Reptiles	7	,,
Insects	13	,,
Minerals	29	,,
	69	Total

Among the quadrupeds were three specimens presented by Mr. Krebs.

Appended to this list is a note acknowledging the receipt of information, showing that Smith did not circulate his questionnaire in vain.

"Interesting communications on subjects of Natural History" had been received by him from various individuals residing in Gnadenthal, Clan William, Uitenhage, Tokai, and Slangekop. As an illustration of the interest which had been aroused, I quote the following extract:—

> "As it would be highly inconvenient, if not quite impossible, to reply by separate letters to the numerous inquiries which are almost daily making by curious individuals, relative to what Natural Productions of the Colony are already known, short descriptions will therefore be given in successive Numbers of this Paper, of all the objects of the Animal Kingdom which have yet been found in Southern Africa. . . ."

Smith added that, in order to adapt these descriptions as much as possible to the general reader, scientific terms would be avoided wherever practicable.

A sixth list of donations, wrongly described as No. 7, was printed in the *Gazette* of Friday, 24th March 1826.

Quadrupeds	4	specimens.
Birds	6	,,
Fishes	4	,,
Insects	12	,,
Shells, etc. . . .	32	,,
Snakes, etc. . . .	25	,,
Minerals	173	,,
Various	1	,,
	257	Total

Of the minerals presented, one hundred and seventy-two were donated by Rev. Dr. Thom of Tulbagh.

Appended to this list of gifts are interesting communications from Wynberg, Albany, Clan William, and Camdebo.

The seventh, and last, list that appeared in the *Gazette* was printed in the issue of Friday, 2nd June 1826.

Quadrupeds	5	specimens.
Birds	8	,,
Fishes	5	,,
Snakes, etc. . . .	16	,,
Shells	66	,,
Minerals	24	,,
Various	1	,,
Drawings	2	,,
	127	Total

Sixty of the shells were donated by Miss Paton of Strand Street.

Beneath the list is printed the following note:—

> "Seventy-five snakes have been received from Ceylon, which were sent in consequence of a request from his Excellency *Lord Charles Somerset.*

Smith's own private research was obviously flourishing as a result of the foundation of the Museum, which now housed two thousand four hundred specimens of varying value.

The *Gazette* of Friday, 9th June 1826 (No. 1065, p. 1, col. 2), contained inquiries by Smith regarding the Cape Wolf (Tyger Wolf) and its habits, and this is the last entry in the *Cape Town Gazette and African Advertiser*, for that Journal became *The Cape of Good Hope Government Gazette* on Friday, 7th July 1826.

Two more entries remain. The issues of the new *Gazette* of Friday, 14th July and that of Friday, 21st July 1826, contain further queries concerning the Cape Wolf, and after this the references in this periodical cease.

Smith's promise to publish in the *Gazette* particulars of the animals of South Africa, couched in simple language, was redeemed in another way. In 1826 he issued the first part of a *Descriptive Catalogue of the South African Museum,* dealing with Mammalia. The title page and the first page of the descriptions are reproduced here on Plates II and III. The work was dedicated to the Governor, Lord Charles Henry Somerset.

The Introduction to this catalogue, the first independent publication of the South African Museum, is so characteristic of its author, that it merits being reprinted in full, more especially since the catalogue is a rarity.

> "If there is one spot on the surface of the globe better adapted than another for furnishing interesting objects of Natural History to a Public Museum, doubtless *that spot* is Southern Africa. Nature to it has been liberal beyond all description; and if her favors had hitherto been duly appreciated, either by England or by this Colony, it would ere this have been found, that that profusion and variety of vegetable productions which occur at the Cape, and which have been so long the wonder of the world, were not out of proportion to what existed in the other kingdoms of nature. Everywhere, both land and water, team [*sic*] with beauty and novelty, and call out loudly to the *Naturalist,* to extend human knowledge, by adding to the catalogue of objects already known, those which both of them so abundantly offer.
>
> "Such, one would almost say, irresistible inducements, which for a long time *only* called forth the industry of foreigners, were lately destined to produce a more pleasing effect, by leading to the formation of a Government Establishment in Cape Town, for the one purpose of exploring the natural history of one of the hitherto so grossly neglected parts of the world. That, under the designation of the "South African Museum," was instituted in June, 1825, by an order from His Excellency Lord Charles Henry Somerset, to serve as a depository for private donations, as well as such objects as could be purchased out of the trifling fund, recommended at the same time for the support of the establishment.

"Under such circumstances the Museum commenced, and under such it now proceeds and flourishes. Scarcely has twelve months elapsed, since the Government Notice * which announced its formation, appeared; and yet, already, several thousand objects are contained within its walls, many of which are at this moment, quite unknown in Europe. Such nearly unexampled success must be attributed to a variety of circumstances, but particularly to the public spirit of the inhabitants, to the facilities that everywhere abound, and to the aid and support of the Colonial Government, which, there is satisfaction in saying, has always evinced a degree of readiness and anxiety to forward every object connected with the infant institution.

"Curiosity, which at first was satisfied with a simple survey of the outward appearance of different objects thus collected, is now prompting many to more interesting and useful employment, and inducing them to inquire regarding the name and nature of whatever is presented to their observation. Such rapid and laudable advancement marks the benefit of example, and such desire for improvement and information, furnishes a just claim for every assistance. These therefore, in conjunction with the want of any work relative to the natural history of Africa, which is adapted to the general reader, has led thus early to the commencement of a Descriptive Catalogue, that will be continued in periodical numbers: and which, though it will only notice what is actually contained in the establishment, must, in time, handle most of the interesting productions of those parts of the world, to which it will principally relate. Throughout the language employed will be suited, as much as possible, to the general reader; and scientific arrangements, both from the plan in which the details will appear, and also from choice, will in a great measure be disregarded, and left to productions, which will appear hereafter of a strictly scientific nature. Notwithstanding such intentions it will occasionally be absolutely necessary to employ terms and expressions partaking of a technical nature, but those will invariably be explained at the ends of the numbers in which they occur.

"In the course of such an undertaking, many deficiencies will necessarily be evinced, yet most of them will probably be referable to the limited and imperfect sources of information which

* See the *Cape Town Gazette and African Advertiser*, Saturday, 11th June 1825.

here exist, touching the late discoveries in science. If, however, the substitution of new names, or the mistaking of old species for new ones, can occur in Europe, where every kind of information is attainable, and be there passed over without censure, how much more reason have those for expecting, at least, an equal consideration, who by the interposition of many thousand miles are precluded from any such advantages. Without saying more, let it then be understood, that names or other instructions which may be employed in the course of the proposed work, to designate and distinguish supposed novelties, will readily give way to a priority of claim, when such is established and that, till then, any name or character which is followed by the letter S. rests solely upon the Author's own responsibility."

This introduction shows that the catalogue was printed about the month of July 1826.

Of particular interest is Smith's explanation of the difficulty of establishing priority of claim with regard to new species of animals, and of the still greater difficulties caused by his being separated from European scientists by so many thousands of miles.

I reprint here a complete list of the mammals described in Smith's Catalogue, with all the names given by him. A copy of this printed catalogue is in the South African Public Library, Cape Town.*

			PAGE
A. No.	1.	Baboon of the English	1
		Bavian of the Dutch.	
		Cynocephalus Ursinus of Naturalists.	
A. No.	2.	Dwarf Baboon of the Cape	3
		. . . .	
		Cynocephalus Capensis. S.	
A. No.	3.	Monkey of the English	4
		Blauwe Aap of the Dutch.	
		Cercopithecus Faunus of Naturalists.	
A. No.	4.	Macauco	6
		. . . .	
		Lemur Catta of Naturalists.	
A. No.	5.	Macauco	6
		. . . .	
		Lemur Macaco of Naturalists.	
A. No.	6.	Leopard of the English	7
		Tyger of the Dutch.	
		Felis Leopardus of Naturalists.	

* 575.E.904 (15).

		PAGE
A. No. 21.	Duiker Bok of the Dutch	24
	. . . . . .	
	Antelope Mergeus of Naturalists.	
A. No. 22.	Klipspringer of the Dutch	24
	. . . . . .	
	Antelope Oreotragus of Naturalists.	
A. No. 23.	Spotted Deer of the English	25
	. . . . . .	
	Cervus Axis of Naturalists.	
A. No. 24.	Vlak Haas of the Dutch	26
	. . . . . .	
	Lepus Timidus of Naturalists.	
A. No. 25.	Spring Hare of the English	26
	Spring Haas of the Dutch.	
	Pedetes Caffer of Naturalists.	
A. No. 26.	Rock Rabbit of the English	27
	Klip Das of the Dutch.	
	Hyrax Capensis of Naturalists.	
A. No. 27.	Sand Mole of the English	28
	Zand Mol of the Dutch.	
	Georychus Maritimus of Naturalists.	
A. No. 28.	Bles Mol of the Dutch	29
	White-faced Mole of the English.	
	Georychus Capensis of Naturalists.	
A. No. 29.	Blinde Mol of the Dutch	30
	. . . . .	
	Chrysochloris Capensis of Naturalists.	
A. No. 30.	Roodekat of the Dutch	31
	. . . . . .	
	Felis Caracal of Naturalists.*	
A. No. 31.	Meerkat of the Dutch	32
	. . . . . .	
	Ryzaena Suraktta [*sic*] of Naturalists.†	

A second publication appeared about the same time. This was the *Instructions for preparing and preserving the different objects of the animal, vegetable and mineral Kingdoms*. The first page of this pamphlet is reproduced here on Plate IV. This Publication is also in the South African Public Library, Cape Town.‡

At the beginning of this study I referred to a Diploma presented to Andrew Smith by the Mineralogical Society of Jena in Germany, in

* The English name "Caracal" is given in the text.

† Altered in margin (ink) to Surikatta. In Index it appears as Surekatta (under both Klapper Muis and Meerkat). *N.B.*—Klapper Muis (the name) does not appear in the text. [Surikatta corrected in errata slip.]

‡ 575.E.904 (16).

recognition of his Scientific work and in particular of his founding the Museum at the Cape.

The Diploma was no doubt awarded to Smith as the result of representations made by his German scientific friends at the Cape, of whom Krebs and Ludwig were probably the chief. The text of the Diploma, which is dated 22nd June 1826, the thirty-seventh year of the Society's existence, is as follows:—

The Society of General Mineralogy in Jena,
Sponsored by His Serene Royal Highness the Grand Duke
Carl August,

Grand Duke of Saxony, Weimar and Eisenach, Landgrave of Thuringia, Margrave of Meissen, Grave of Hanneberg, Lord of Blankenheim, Neustadt and Tautenberg, etc., desires to show, by the present Diploma, how it counts it an honour to include among its foreign and corresponding members, Doctor Smith, Director of the Museum of the Cape of Good Hope, and member of many Societies.

It will be seen that the President of the Society at that time was Johann Wolfgang Freyherr von Göthe, who had since 1775 resided at Weimar, on the invitation of his friend Duke Carl August. From the year 1786 the great German philosopher-poet had, in addition to his literary work, devoted much time to scientific investigations, and by 1826 had published several works on scientific subjects.

During the absence of Dr. Smith while he was leading the Expedition of 1834–1836, a substitute Curator of the Museum had to be found. The choice apparently fell upon Mr. Jules Verreaux, himself a naturalist, and what is more, an expert taxidermist.* When he took over the work I am not able to determine precisely, but in *The Cape Calendar and Directory for the Leap Year*, 1836,† there is a list of Office-Bearers of the South African Literary and Scientific Institution which includes Mr. Verreaux, naturalist, keeper of the Museum. The Museum had been attached to the Institution since 1833, as the *Almanac* for that year shows, and in the issue for 1835 we are told that strangers were charged a shilling for admission. Verreaux appears to have entered into a business arrangement with the Institution, for in *The South African Quarterly Journal* ‡ we read that Mr. Verreaux was to have the "takings" of the Museum, in return for which he should add specimens to the collections.

* Smith had trained his own military servant, John Mintern, to be a taxidermist.

† Cape Town, 1835, p. 127.

‡ Second series, No. 4, July–September, 1834, part 3, Cape Town, 1834. The date on the cover is 1834; it should be 1835.

Smith himself continued to enrich the collections in the Museum which he had established until his departure from the Cape in 1837. But the lack of adequate facilities for housing the specimens, together with the perpetual shortage of financial resources, must have been a serious handicap to him and to the institution that he had initiated. As we have seen, the collections were frequently moved to new quarters; not until 1897 was anything like permanence achieved, when the new Museum building was completed.

Henry Methuen has painted a gloomy picture of the Museum as he found it in 1843, six years after Smith had returned to England. In his *Life in the Wilderness* * he wrote of Cape Town: "There are many good buildings in the place and the streets are mostly clean and airy. Attached to the South African College is a Museum, where I have now and then whiled away a few hours in copying some of the best specimens. This valuable institution, whether from want of interest, funds or other causes, is in a lamentable state of wreck, excepting the Geological, or imperishable part of it. Birds moth-eaten, and often almost featherless, rare quadrupeds begrimed with dust, lacking both eyes, or reduced to a Cyclopian state, distress the gaze of a naturalist. It is true that some of the specimens are such miserably stuffed and shrivelled mummies, that they are not worth preserving, but this is far from being the case with all.

"Considering the opportunities afforded in Cape Town of making a valuable zoological collection, as well as the information, amusement and profit derivable from such sources, it is really discreditable to the Colony, and all influential persons connected with its interests, to allow this Museum to die a natural death."

But the moving spirit had departed, and it was not until many years had elapsed that the present worthy institution arose, phœnix-like, from the ashes of its ancestor. The spirit that now sustains it is, however, the same as that which promoted the initiation of its old-time progenitor, the spirit of Andrew Smith, Doctor of Medicine.

* Second edition, London, 1848, p. 14.

EDITOR'S NOTE.

Hall's entry is not quite correct. The Governor appointed two Trustees: the Hon. Rawson W. Rawson (Colonial Secretary) and Dr. L. Pappe (Colonial Botanist), on 25th June 1855, the date when the present Museum was officially instituted by Proclamation. The third Trustee required by the constitution of the Museum was elected at a meeting of the Subscribers held on 7th July 1855. The subscribers elected Thomas Maclear, Astronomer Royal [*i.e.* H.M. Astronomer at the Cape], as their representative on the Board of Trustees.

APPENDIX.

[The letter referred to in footnote on p. 4. The date 1825 should be 1826. Latakoo = Kuruman.—P. R. K.]

South African Museum,
Cape Town.
9 *January*, 1825.

Sir,

I have long had it in contemplation to write you and beg your consideration for the South African Museum lately established here by Government.

The situation of a Missionary, the superior minds which they generally possess, and the influence which their useful labours naturally ensure them, tend to render them characters which can very materially forward the objects of an institution framed for the purpose of receiving everything, the produce either of nature or art.

I hope therefore my delay in mentioning the establishment to you will not make you the less inclined to forward its interests, and I hope and trust your labours will in time add to our knowledge of the wonders of this world and of the magnitude and boundless wisdom of their author. Everything that can tend to increase human knowledge and thereby reflect credit on the works of the author of Nature becomes in a double manner an object of interest with a Christian, and under that connection I cannot but anticipate something from you.

The institution is intended to receive everything that can be found in the Colony or in Southern Africa, and will no doubt eventually be extended to the productions of other parts of the globe.

I feel particular interest about the Snakes of this country, and will be much obliged by your taking care of what may come in your way.

I send you some printed instructions for your guidance and also some points desirable to be ascertained in the Natural History of Quadrupeds. I should feel very thankful if you could give me at your leisure some account of the Quadrupeds found in your neighbourhood, as I am satisfied many are there which have at least left the more civilised parts of this Colony.

I have heard a great deal about a very large frog that is found near you and whose noise can be heard to a very considerable distance; pray give me some account of it and send a specimen if you have an opportunity. I will also thank you to give me all the information you can relative to a large snake said to be found in the interior.

I send you some Arsenical Soap which you will see is required to preserve animal skins, and you can use instead of tow very dry grass or the down of thistles or anything of the kind.

I have heard of an animal near Latakoo somewhat like an Armadillo covered with scales; will you notice that, and by writing me as soon as possible you will confer a great favor on

Your Obedient Servant,

Revd. Mr. Moffat.
Andrew Smith, M.D.,
Superintendent of the South African Museum.

If I can do anything for you here I shall feel happy.

ANDREW SMITH, M.D.

Percival R. Kirby. Neill & Co., Ltd.

A

DESCRIPTIVE CATALOGUE

OF THE

SOUTH AFRICAN MUSEUM:

BY

ANDREW SMITH, M.D. M.W.S.

SUPERINTENDENT.

PART I.

OF

MAMMALIA.

Cape Town:

PRINTED AND PUBLISHED BY W. BRIDEKIRK,
AT THE CHRONICLE OFFICE,
No. 31, HEEREGRACHT.

1826.

Percival R. Kirby. *Neill & Co., Ltd.*

MAMMALIA;

OR,

ANIMALS WHICH SUCKLE THEIR YOUNG.

A. No. 1.

Baboon of the English.
Bavian of the Dutch.
Cynocephalus Ursinus of Naturalists.*

The colour of this Baboon, though it varies a little in different individuals, will generally be found to approximate towards a dirty black or blackish brown, tinged, however, here and there, more or less deeply, with a shade of dusky yellow or yellowish green.† The face is black, the eyes are brown, the eyebrows extremely prominent, and the hair on most parts of the body long and shaggy.

It is an animal that in all its proceedings evinces marks of great sagacity; and so highly is it capable of receiving and benefiting by instruction, that it has thereby, in many instances, been rendered useful to man: as a proof of which, the following circumstances, out of many, that

* Characters of the genus *Cynocephalus*.—Front teeth, four in each jaw, approximate, erect, and formed for cutting. Canine teeth, or tusks, one on each side, both above and below, considerably longer than the last, of a conical or pyramidical form, and with their inner sides sharp edged. Grinders, five in each side of both jaws, the anterior of which is in general considerably longer than the others, and the posterior is often larger. Nose elongated, facial angle between thirty and forty-five degrees, face bare, nostrils approximate, and separated from each other only by a narrow partition, ears sometimes entire, sometimes notched, cheek pouches, tail long and bushy, or short, or entirely wanting; teats, two situated on the chest; feet, all with five toes; nails, either flat or slightly rounded, and the hinder legs each, with a bare spot of greater or less extent near the root of the tail.

† Three examples have lately been met with in this colony, in which the colour was nearly a pure white.

B

SOUTH AFRICAN MUSEUM,

Cape of Good Hope.

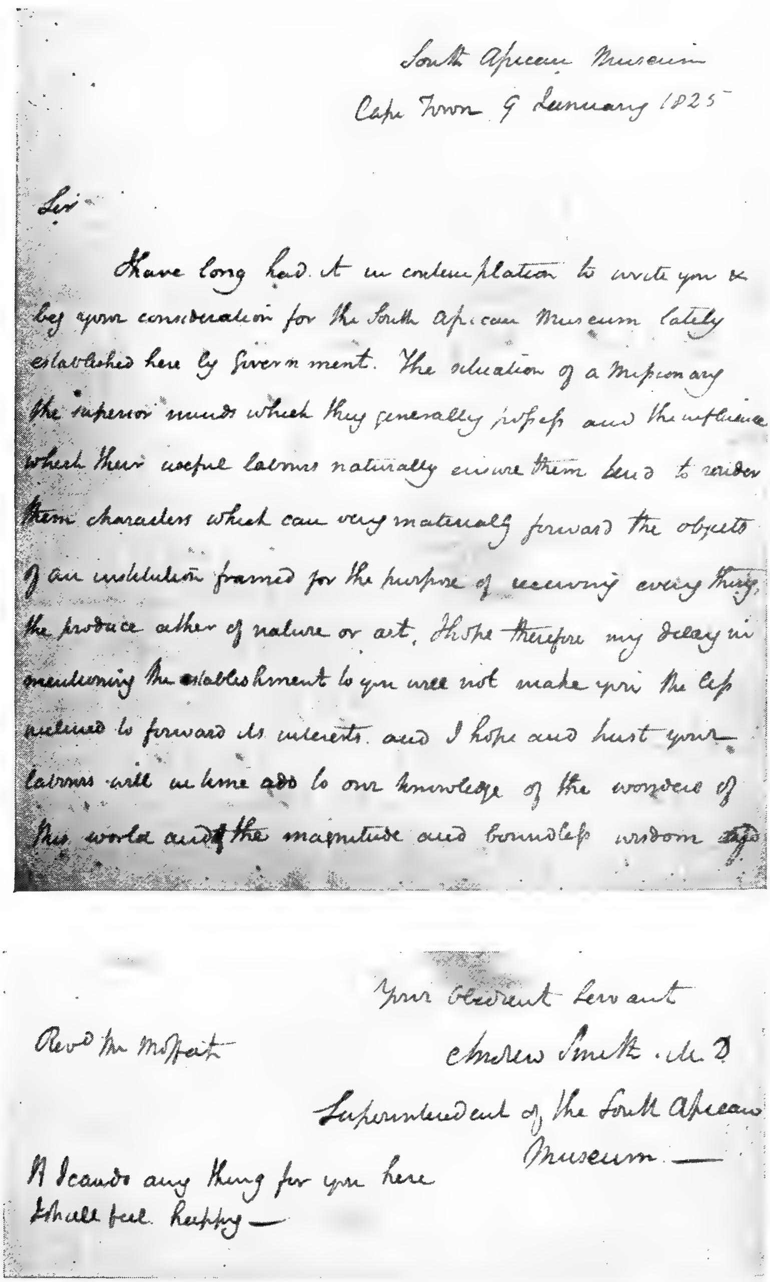
INSTRUCTIONS

FOR PREPARING AND PRESERVING THE DIFFERENT OBJECTS OF THE ANIMAL, VEGETABLE, AND MINERAL KINGDOMS.

QUADRUPEDS.

PLACE the animal, from whence the skin is to be removed, on its back, and then with a sharp knife make a cut of a proper depth (that is, just through the skin) from the top of the breast to the vent. That being finished, commence separating the hide, which ought to be done, as much as possible, without the use of cutting instruments, employing, whenever it can be done with effect, either the hand or handle of the knife. When the thighs begin to be exposed, the skin must be well loosened all round them, and then they must be drawn out till the last joints of the legs are brought into view, at which parts separations must be made; and these joints, together with the feet, allowed to continue attached to the skin. The tail is next to be cut off at its root, and the carcase afterwards suspended, or turned on its belly, to admit of the easy removal of the skin from its back.

On reaching the fore legs, the same plan must be pursued as was practised with the hinder ones, and then the


South African Museum
Cape Town 9 January 1825

Sir

I have long had it in contemplation to write you & beg your consideration for the South African Museum lately established here by Government. The situation of a Missionary the superior minds which they generally possess and the influence which their useful labours naturally ensure them tend to render them characters which can very materially forward the objects of an institution framed for the purpose of receiving every thing the produce either of nature or art. I hope therefore my delay in mentioning the establishment to you will not make you the less inclined to forward its interests and I hope and trust your labours will in time add to our knowledge of the wonders of this world and of the magnitude and boundless wisdom of its

Your obedient Servant
Andrew Smith M.D.
Superintendent of the South African Museum —
Revd Mr Moffat

If I can do any thing for you here I shall feel happy —

First page, and conclusion, of a letter written by Dr. Smith to the Rev. Robert Moffat. The date 1825 should be 1826.

Percival R. Kirby. *Neill & Co., Ltd.*

2. *Field Notes on the First and Second Expeditions of the Cape Museums' Mammal Survey of the Cape Province; and Descriptions of some New Subgenera and Subspecies.*—By G. C. Shortridge, Director, Kaffrarian Museum, King William's Town.

(With Plates VI and VII.)

Expedition No. I: Little Namaqualand (October 1936–February 1937).

On a Collection of approximately 2500 *Mammals from Little Namaqualand, including Records of Species collected between Upington and the Aughrabies Falls in* 1921.

Little Namaqualand is here regarded as comprising the region lying between the Orange River in the north, latitude 31° in the south, longitude 19° in the east, and the Atlantic Ocean on the west. It is the most arid part of the Cape Province. The yearly rainfall at Springbok averages 7 inches, and at Port Nolloth $2\frac{1}{2}$ inches.

Except on the Kamiesberg there is practically no surface water. The mountains and plateaux known as the Kamiesbergen, which rise to over 5000 feet (Welkom Kop, 5589 feet; Eselkop, 5456 feet), attract a much more adequate rainfall and have a contrastingly temperate climate. In consequence the vegetation on the higher slopes and plateaux is relatively luxuriant.

The Kamiesberg, frequently under cloud, forms a fertile oasis, and the mountain scenery between Garies and Leliefontein is very beautiful. Elsewhere the general aspect of Little Namaqualand during the greater part of the year is barren in the extreme: the sandy plains are sparsely clothed with dwarf desert plants, many of which are succulents. Apart from a narrow fringe along the Orange River, there are no trees of any description.

Between September and October, however, after the first light spring rains, Namaqualand changes, almost overnight, into one of the world's most magic gardens; the plains and hillsides for the short period of about six weeks become brilliantly carpeted with wild flowers, innumerable in variety and colours. On the Kamiesberg the flowering season continues until about the middle of December. Except in the extreme south, along the eastern border, and close to the coast, there are almost everywhere masses of outcrop, stony kopjes and rocky mountain ranges. Camps were made at the following places:—

1. *Witwater:* altitude 3500–3800 feet, a plateau high up in the Kamiesberg almost entirely surrounded by stony hills. There are a few farms, and small plots under cultivation.

2. *Eselfontein:* altitude 4300–4350 feet, close to Leliefontein Hottentot Mission, the highest plateau on the Kamiesberg.

These plateaux are watered by small perennial mountain streams which disappear underground before reaching the plains. The vegetation on the higher slopes is heathy and not unlike that on the mountains of the south-western Cape. Light crops of wheat are grown; goats and a few cattle and sheep are kept.

3. *Platbakkies:* altitude 3460 feet, about 20 miles east of the Kamiesberg. Arid high-karooveld with occasional rocky ridges and rough stony tracts. Country quite typical of "Bushmanland."

4. *Goodhouse:* altitude 300 feet approx., on the south bank of the lower Orange River at Raman's Drift. At this point the Orange River flows between almost unbroken chains of highly mineralized hills which rise from 500–1200 feet. All level country consists of heavy white sand. For the greater part of the year hardly a trace of vegetation is visible, except along the river's edge where there is a thin fringe of tree growth. In contrast to these desert surroundings is the intensely green Citrus Estate of Goodhouse, irrigated by a system of canals which lead off from the river (owner, Mr. C. Weidner).

5. *Eenriet:* altitude 3300 feet approx., 7 miles north of Steinkopf. A waterhole close to rocky hills which rise between 500 and 800 feet above the surrounding level. Beyond the hills there are wide stretches of sandveld scantily clothed with low karoo scrub and intersected here and there by dry watercourses.

6. *Port Nolloth:* A camp (altitude 50 feet approx.) was made about 15 miles inland where the white coastal sand-dune belt meets the firmer reddish-sandy country, and near the first broken line of wind-swept hills which rise to about 600 feet.

7. *Kameelboom:* altitude 800 feet approx., in the bed of the dry Spoeg River, about half-way between Garies and Hondeklip Bay. Surrounding hills rise to about 1000 feet. Red and white sandy country much broken up by rocky outcrop. Vegetation largely succulent; shrubby bushes amongst the rocks and between the hills.

During the British and Kaffrarian Museums' Expedition to the middle Orange River in 1921, collections were made close to *Upington, Swartkop, Louisvale,* and the *Aughrabies Falls.* The Upington and Aughrabies camps were on the north bank of the Orange River, those near Swartkop and Louisvale on the south bank.

Out of 106 species recorded, 78 were collected; 20 are extinct, or nearly so; 4 are of doubtful occurrence. Names of species in brackets indicate that specimens were not obtained.

Contributors towards the Cape Museums' Mammal Survey include The Museum of Comparative Zoology (at Harvard University, United States of America), The South African Museum (Cape Town), The Natal Museum (Pietermaritzburg), The Albany Museum (Grahamstown), The McGregor Museum (Kimberley), The Port Elizabeth Museum, The East London Museum, The Kaffrarian Museum (King William's Town), The National Research Council, and Dr. H. Merensky.

Family MACROSCELIDAE.

1. *Elephantulus rupestris rupestris* (A. Smith).

Hottentot: /ÜĪ/Ā≠GUĪ DURÜB (Eenriet); !KHU≠GUÏB (Goodhouse); HĀ : NG DURÜB (Kamiesberg).

Specimens from Witwater, Platbakkies, Eenriet, and from Louisvale. The series from Eenriet may be taken as topotypical of *E. rupestris,* which was described from "Mountains towards mouth of Orange River." Plentiful in rocky situations. In the south replaced coastally and to some extent subcoastally by *Elephantulus capensis.*

In cool weather Elephant Shrews may often be seen jumping from rock to rock or running from one patch of cover to another at all hours of the day. I have occasionally observed them on warm moonlight evenings. Pregnant females contained 1–2 foetuses. Newly born young are relatively large, being the size of full-grown House Mice and clothed with short hair.

2. *Elephantulus capensis* Roberts.

Specimens from Witwater, Eselfontein, Kameelboom, Paddagat.

Elephantulus capensis and *rupestris* are similar in habits, both favouring rocky and hilly situations. They overlap at Witwater in the southern Kamiesberg. At Eselfontein (about 1000 feet higher up than Witwater), and at Kameelboom (between the Kamiesberg and Hondeklip Bay), only *E. capensis* was collected. At Platbakkies (19 miles east of the Kamiesberg) only *E. rupestris* was found.

Latitude 30·5 approx. appears to be the meeting ground of (northern and eastern) *rupestris* and (southern and south-western) *capensis*.

3. *Macroscelides proboscideus melanotis* Ogilby.

Hottentot: /HEI/Ā≠GUÏ : DURÜB (Eenriet).

Specimens from Witwater, Platbakkies, Eenriet, Port Nolloth, Kameelboom.

An Elephant Shrew, presumably a *Macroscelides*, was reported from the plains on the north bank of the Orange River near Upington in 1921.

This Little Namaqualand series matches closely examples of *E. p. melanotis* from Berseba, Great Namaqualand.*

Widely distributed in Little Namaqualand and plentiful in level Karooveld. *Macroscelides* was not found on the Kamiesberg above the altitude of Witwater. These Elephant Shrews often take shelter in the warrens of karoo *Otomyinae*. When handled they will occasionally bite feebly, but their small teeth cannot penetrate the skin.

4. *Macroscelides proboscideus isabellinus* Shortridge.

One specimen from Port Nolloth (near Township).

A pale desert race of *M. proboscideus*, only known as yet from the type. It is possible that *M. p. isabellinus* may be an individually pallid individual of *M. p. melanotis*, since the latter occurs in the same region.

Family CHRYSOCHLORIDAE.

5. *Chrysochloris namaquensis* Broom.

Hottentot: ΧARIMU DURÜB (Kamiesberg); /ĀM̃≠ĀRE HĀBA TSURU (Eenriet).

Specimens from Witwater and Eselfontein.

Only known previously from the type from Garies (a skull from an owl casting—in the South African Museum).

* The type of *M. p. melanotis* is supposed to have come from "Damaraland" in 1838. No form of *Macroscelides* has otherwise been recorded from as far north as Damaraland proper—as defined to-day, and I do not believe the genus occurs anywhere north of the Tropic of Capricorn. I now propose to fix Berseba in central Great Namaqualand as the type locality for *Macroscelides proboscideus melanotis* because specimens from Berseba were compared with the type by Oldfield Thomas and considered to agree with it.

A little smaller than *C. asiatica*: colour above light seal-colour strongly washed, in the majority of specimens, with iridescent greenish or violet. One or two specimens are paler, resembling *C. concolor*, but with pale greenish reflections. Whitish-buff cheek markings, as in *C. asiatica* and *concolor*. Underparts greyish-buff with a satiny sheen; throat creamy-white. The skull of *C. namaquensis* (Kamiesberg) differs from that of *C. concolor* in having smaller, less raised temporal bullae, and in the interorbital constriction being slightly less inflated. Skulls of the Kamiesberg series referred to *namaquensis* are longer, broader, and more massive than the type, which may not be quite adult.

At Eselfontein the shallow tunnels of Golden Moles were often observed perforating the large mounds of *Bathyergus*. In the Kamiesberg they were found both in cultivated and uncultivated land.*

Measurement Table of the Skins and Skulls of 9 *Kamiesberg Specimens and of the Type Skull of* Chrysochloris namaquensis.

Original number .	562.	966.	988.	1010.	654.	719.	745.	957.	1016.	Type.
Sex . . .	♂	♂	♂	♂	♀	♀	♀	♀	♀	..
Head and body .	114	105	115	111	98	98	98	98	112	..
Hindfoot . .	12	12	11·5	12	11	12	10·5	11	12	..
Skull: Total length. .	22	22·5	22	22·5	22·5	23	21·5	23	22	20
Basal length . .	17·5	18·5	18·5	17·5	17·5	18	17	17·5	17	16·5
Greatest breadth .	18	18	18	17	17	17	17	17	17	15·5
Greatest height .	11·5	12	12	12	11·5	11·5	11·5	11·5	11	11
Interorbital breadth .	6·5	7	6·5	7	6·5	7	7	7	7	6·5
Palate across posterior molars .	8·5	9	8·5	9	8·5	8·5	8·5	9	8·5	8·5
Dental series: front of incisors to back of posterior molar .	9·5	9·5	10	10	10	9·5	9·5	9·5	9·5	9·5 mm.

* *Chrysochloris damarensis,* as its name indicates, is supposed to have come from "Damaraland." When in South West Africa I carried about the skin of a Golden Mole to show local natives, but it was never recognised. The type and only known specimen of *C. damarensis,* in the British Museum, was at one time

6. *Chrysochloris tenuis* Broom.

A single specimen from Port Nolloth district (15 miles inland) is tentatively referred to this species, the type of which is an incomplete skull without lower jaw or teeth from an owl casting (from Garies, in the South African Museum).

Colour above pale drabby seal-colour with a faint iridescent purplish wash: cheek markings buffy-white. Underparts pale drabby-buff; throat also buffy, not buff-white as in Kamiesberg specimens referred to *namaquensis*—some of which it otherwise closely resembles in colour.

The teeth of the Port Nolloth skull (No. 1860, in the Kaffrarian Museum) are much worn down, but, so far as can be judged, are considerably smaller than in the Kamiesberg series of *namaquensis*.

There are 40 teeth in all, whereas the type skull of *C. tenuis*, a smaller specimen without teeth, has sockets for only 36.

Golden Moles (excluding the essentially coastal *Eremitalpa*) occur inland from Port Nolloth in red sandveld clothed with scanty karoo scrub, but they are local if not actually scarce. A few *Chrysochloris* runways were also observed between Eenriet and Klipfontein.

Fresh workings may be traced by the cracked ground surface above the shallow tunnels. Golden Moles (in Namaqualand) often seem to travel above ground by night and to make short overland journeys. Presumably on such occasions they are preyed upon by owls.

Measurement Table of the Type Skull of Chrysochloris tenuis *and of a Specimen collected near Port Nolloth (8th February* 1937), *provisionally referred to that Species.*

Original number	Type (Garies)	1860 (Port Nolloth)
Sex	..	♀
Head and body	..	95
Hindfoot	..	11·25 mm.
Skull:		
Greatest length	20·5	20
Basal length	16	16
Greatest breadth	14·5 (approx. ?)	16·5
Greatest height	10·5	10·5
Interorbital breadth	6·5	6·5
Palate across posterior molars	7·3	8·5
Dental series: front of incisors to back of posterior molar	9·6	9·5 mm.

regarded as identical with *C. asiatica* (*cf.* W. L. Sclater, Mamm. S. Africa, ii, p. 172); but that was before the discovery of allied species in Little Namaqualand. It is possible that *damarensis* and *namaquensis* (*e.g.*) may on comparison prove

(7. *Chrysochloris wintoni* Broom.)

Range: Garies–Port Nolloth?. Habitat: coastal sandveld.

The type from Port Nolloth (a skull and a skin in alc. No. 1917) is in the South African Museum. A second specimen (skin and skull), also from Port Nolloth, is in the Transvaal Museum.

Colour above pale sandy-drab, almost as pale as in *Eremitalpa*, but with pinkish-lilac iridescent reflections and shorter fur. (In the spirit specimen the iridescent reflections are a very brilliant green shot with violet.) The head is pale drabby-buff with no defined cheek markings.

Length of head and body (type), 80–90 mm.

At Kameelboom, between Garies and Hondeklip Bay, some Golden Mole runways were observed in soft whitish sand: these were often close to the base of comparatively large bushes and may have been the workings of *C. wintoni*. No very recent activity was observed (February).

8. *Eremitalpa granti* (Broom).

Hottentot: ĒSA TSURU; ĒSA DURÜB (Port Nolloth).

Specimens from Port Nolloth.

The type, one of four skulls from owl castings (in the South African Museum), came from near Garies, but the individuals to which these skulls belonged were quite probably captured by owls *within* the coastal sand-dune belt and carried farther inland.

The genus is perhaps the most specialized of the smaller *Chrysochloridae*: *Eremitalpa*, like *Cryptochloris*, is flattened and roundly

to be synonymous. Early collectors, before the importance of recording exact type localities was recognised, as often as not attached indefinite and misleading data to specimens—such as "Southern Africa," "Cape Colony," etc. "The Cape of Good Hope" on an old label might have stood for any part of what is now the Cape Province.

"Kaffraria," which to-day is a localized name for the territory between the Kei and Great Fish Rivers in the Eastern Cape Province, might have stood for any part of eastern or central South Africa, its original interpretation having been "Habitat of the Kaffirs." "Damaraland," again, might have been almost any part of South West Africa north of the Orange River.

The type of *Thallomys nigricauda* is labelled "Hountop River, Damaraland," but that river is in central Great Namaqualand.

The northern boundary of Great Namaqualand, as defined to-day, is approximately the Tropic of Capricorn.

oval in shape, which may be an adaptation for progress through very loose sand.

Fur unusually long and silky. In subadult specimens the colour above is a beautiful aluminium-grey, changing to sandy-buff with age. The tips of the hairs, especially on the hindquarters, shine like spun glass, but there is no coloured iridescence. In immature specimens there are indications of pale cheek markings: in adult examples the entire face is whitish. The underparts vary from buffy-whitish to pale rufous.

Dimensions of an adult male: H. & b. 88, Hf. 10·5 mm.

In Little Namaqualand *Eremitalpa granti* appears to be restricted in range to the coastal strip of white shifting sand which extends from the mouth of the Orange River southwards. It may possibly cross the Orange River into the south-western littoral of Great Namaqualand.

This "Silver" Mole is very plentiful around Port Nolloth from near the coast to about twelve miles inland. It does not seem to extend farther inland where the sandveld becomes level and relatively firm.

Eremitalpa makes runways in the wind-swept, undulating sand-dunes which resemble lightly buried hose-pipes: these twist about and can often be traced for fifty yards or more. The shallow tunnels presumably fall in shortly after they have been traversed. I do not think that the animals make a practice of going back on their tracks.

The very slightly raised tunnels are quite smooth above and do not show up conspicuously against the glaringly white surroundings; but they are easily identified and quite a feature where they occur.

The surface runways communicate with deeper excavations which descend several feet below ground: in this more solid stratum the animals lie up and presumably breed. They throw up no mounds.

Specimens were obtained by trenching along the furrows until the deeper excavations were discovered. Several were kept alive for short periods, and it was noted that they have the power of blowing themselves up like tiny balloons: when below ground they may, by this means, be able to conserve air until the surface can be reached on occasions when the fine sand falls in and blocks the tunnels.

There are occasional surface openings (which I think may be blow-holes) at irregular intervals wherever recent excavations occur. During the frequent high winds surface indications of all tunnels may be obliterated in a few minutes, the powdery sand being without cohesion.

Innumerable tracks of cats, genets, and foxes were observed in the vicinity and along the lines of the runways, a possible indication that these moles frequently come to the surface and wander above ground: on such occasions they would fall an easy prey to four-footed and winged carnivores. When handled they do not attempt to bite, although in their struggles they show muscular strength.

It was of interest to discover that *Eremitalpa granti* is a *carnivorous* mole, its food consisting largely of various sand-burrowing species of anguine skinks. These small snake-like lizards, either legless or nearly so, slip through the loose sand like eels through water, and to capture them indicates corresponding agility on the part of the moles. No pregnant females were obtained (January–February).

Family SORICIDAE.

9. *Crocidura martensii* Dobson.

Hottentot: XUÜ DURÜB (Kamiesberg).

Specimens from Witwater, Eselfontein, Platbakkies.

A Platbakkies specimen is more suffused with rufous than the others; otherwise the series is very uniform.

Habitat: rocky and stony situations.

10. *Myosorex varius varius* (Smuts).

Specimens from Eselfontein and Port Nolloth.

A specimen collected by C. H. B. Grant in 1903 from near Port Nolloth was noted by Oldfield Thomas at the time to be quite similar in colour to a series from the slopes of Table Mountain.*

Habitat (Eselfontein): fairly high grass near swamp vegetation.

Port Nolloth is an entirely waterless region, but perhaps the frequent damp mists and cool atmosphere occasioned by the Antarctic current render conditions suitable for the existence of *Myosorex varius*, an animal which normally favours damp situations.

Family PTEROPIDAE.

(11. *Eidolon helvum helvum* (Kerr).)

There are two records of Fruit Bats from the barren coast of Little Namaqualand. Such obviously accidental visitors might either have been carried on ships or blown southwards by high winds.

* The type locality is Algoa Bay. The type, formerly in the Port Elizabeth Museum, has disappeared, but topotypes have since been procured, one of which is in the Kaffrarian Museum.

(1) "Captured at sea off Hondeklip Bay" (*cf.* W. L. Sclater, Mamm. S. Africa, ii, p. 109, 1901 = *Rousettus stramineus*). This specimen is still preserved in the South African Museum.

(2) From Port Nolloth: a Fruit Bat "with a wing span of 32 inches" (East London Dispatch, 19th May 1936).

A Fruit Bat reported to occur as a rarity near Upington may also be referable to this species.*

According to Mr. Weidner, "Fruit Bats" do not visit Goodhouse Citrus Estate.

Family NYCTERIDAE.

12. *Nycteris capensis damarensis* Peters.

Hottentot (all insectivorous bats): SORE : TSI//GŪBES (Kamiesberg); SERTSE//GŪBES (Goodhouse); //OETSI//OEBES (Eenriet); //GŪBES (Port Nolloth).

Specimens from Garies, Goodhouse, Port Nolloth, and from Louisvale. Provisionally referred to *damarensis*; agreeing in colour and dimensions with series from South West Africa.

Family RHINOLOPHIDAE.

13. *Rhinolophus capensis* Lichtenstein.

Specimens from Orrelgat Cave (25 miles east of Witwater), Paddagat, Leliefontein, Goodhouse.

14. *Rhinolophus denti denti* Thomas.

One specimen from Louisvale, about 20 miles west of Upington. Apparently the only record from the western Cape Province (south of the Orange River).

15. *Rhinolophus geoffroyi geoffroyi* A. Smith.

Two specimens from Leliefontein.

These specimens, matching *R. capensis* in colour, and in body, hind-foot and ear measurements, but with longer forearms and hindlegs, are tentatively referred to *R. geoffroyi*; they do not altogether agree with a series, referred to *R. auger* by Oldfield Thomas, from Karibib in South West Africa.

* There are very few other records of this tropical bat from the Cape Province: a specimen in the McGregor Museum came from Koegas on the Orange River (Griqualand West); another in the Port Elizabeth Museum is labelled "Bedford"; FitzSimons records "Steynsburg." [Editor: Durbanville, near Cape Town, 1941.]

(16. *Rhinolophus aethiops* Peters.)

Two specimens, referred by Thomas to this species, were collected by C. H. B. Grant at Klipfontein in 1903.

Family VESPERTILIONIDAE.

17. *Cistugo seabrae* Thomas.

Specimens from Goodhouse.

The most plentiful bat around Goodhouse Citrus Estate.

The wing glands are easily seen in fresh specimens; their shape varies to some extent. In several instances there are two glands close together on either side.

Cistugo seabrae and *Platymops haagneri* come out at the same time, soon after sundown. Although otherwise very similar on the wing, *C. seabrae* is neither so strong nor erratic a flyer as *Eptesicus capensis*. It perhaps resembles more closely a small *Pipistrellus*. On first appearing its flight is comparatively steady and direct, but with approaching dusk it descends and circles low around trees and bushes. At Goodhouse *Cistugo* and *Platymops* have the same habit of fluttering in the deep shadow of orange trees and snapping small insects from the leaves.

New to the Cape Province.*

(18. *Miniopterus natalensis* subsp.)

A Long-winged Bat, referred at the time to *M. schreibersi*, was collected by C. H. B. Grant in 1903.

19. *Eptesicus capensis capensis* (A. Smith).

Specimens from Eselfontein and from Louisvale.

In Little Namaqualand only observed on the Kamiesberg where a few specimens were shot whilst circling over a small pool of water.

20. *Eptesicus megalurus pallidior* subsp. n.

Specimens from Goodhouse.

A relatively large buff-coloured bat with cranial characters as in *Eptesicus*; agreeing with the type of *Eptesicus megalurus* in skull and skin dimensions, but not altogether in colour.

* The only examples of this bat previously known were the type from Mossamedes, and two specimens from Berseba (British and Kaffrarian Museums' Expedition to Great Namaqualand).

General colour above and on sides of neck pale rufous-buff: under parts drabby buff-white: all hairs above and below ashy-slate at base. Ears dusky brown: membranes horn-brown, rather translucent.

These Goodhouse specimens agree with Temminck's description of *megalurus* in that the hair is long, smooth, silky, and bicoloured throughout; but in typical *melanurus* the hair in front of the neck and abdomen is described as "cedar-brown" as far as the tip; on the flanks "dove-coloured," and on the pubic region quite white from base to tip.

Type: an adult female (Coll. No. 1157): H. & b. 74, Tl. 48, Hf. (s.u.) 11, Ear 19 mm.

A weak flyer, coming out at late dusk, about half an hour after *Cistugo* and *Platymops*. Apparently not plentiful around Goodhouse, about half a dozen observed in all.

The specimens collected were shot whilst "planing" very slowly in wide circles around a cattle kraal, to which they were attracted by swarms of flies.

These bats have a wide and broad wing span and, owing to similarity in size, were at first mistaken in flight for *Scotophilus*.

Family MOLOSSIDAE.

21. *Platymops* * *haagneri haagneri* Roberts.

Specimens from Goodhouse.

This series shows the following range of measurements: H. & b. 54–60, Tl. 36–41, Hf. 7·5–8·5, Ear 15·5–16 mm.

Plentiful around Goodhouse; a few individuals (identified in flight) were afterwards observed at Eenriet, about 40 miles south of Goodhouse. On first appearing these bats fly rather high, sometimes out of gunshot; later, they descend and circle around orange and other shade trees.

Genus new to the Cape Province.

* Miss St. Leger informs me that on a re-examination of the type skull of *Platymops macmillani*, the genotype of *Platymops*, a minute premolar 2 was found to be present on one side. In consequence it would seem that the subgenus *Sauromys* (of which *haagneri* is the genotype), previously thought to be distinguishable from *Platymops* by the presence of a minute premolar 2, is hardly necessary. *Platymops haagneri* was only known previously from the type (in alc.) from Keetmanshoop (Transvaal Museum); a second specimen (practically topotypical, now in the British Museum) from Brukaros Mountain (British and Kaffrarian Museums' Great Namaqualand Expedition); and a third recently collected by Dr. Karl Jordan at Otjosongombe (Waterberg, S.W. Africa).

22. *Nyctinomus bocagei* Seabra.

Specimens from Louisvale (near Upington).

Found roosting inside hollow trees.

Family CERCOPITHECIDAE.

23. *Cercopithecus aethiops pygerythrus* (F. Cuvier).

Hottentot: //OREGE : B (Goodhouse, Eenriet); //ORE/NĒ : RAB (Kamiesberg).

Two specimens from Goodhouse; others from Louisvale.

Vervets from the lower Orange River and from the Eastern Cape Province appear to me to be indistinguishable. These western examples from Goodhouse, and from Louisvale, about 200 miles farther east, are probably referable to *C. aethiops marjoriae* Bradfield (Description of New Races of Kalahari Birds and Mammals, p. 2, 26th September 1935), typically from Zoetvlei near Kuruman, and stated to differ from *C. aethiops pygerythrus* in being "a shade paler."

In my opinion *marjoriae* must be regarded as a synonym of *pygerythrus*.

In Little Namaqualand Vervet Monkeys are restricted in range to the banks of the Orange River; they are not very plentiful near Goodhouse, which is probably due to the narrowness there of the river tree belt. They undoubtedly wander considerable distances along the banks of the Orange River.

Vervets feed largely upon insects, and also to some extent upon the nestlings and eggs of small birds. Mr. Weidner (Goodhouse Estate) believes that their insectivorous diet more than compensates the citrus farmer for the relatively small amount of fruit taken.

24. *Papio comatus comatus* E. Geoffroy.

Hottentot: /NĒ : RAB (Goodhouse, Port Nolloth, Kamiesberg); /Ē : RAB (Eenriet).

Specimens from Witwater, Eselfontein, Eenriet.

In 1921 baboons were observed close to the Aughrabies Falls of the Orange River.

Little Namaqua baboons are intermediate in coloration between paler specimens from the Eastern Cape Province and darker specimens from Damaraland and the Kaokoveld.

Family MUSTELIDAE.

25. *Ictonyx orangiae orangiae* Roberts.

Hottentot: /GA : MIROB (Goodhouse); /A : MIROB (Eenriet); !O/E : B (Kamiesberg).

Specimens from Witwater, Platbakkies, Eselfontein, Eenriet, Port Nolloth, Kameelboom, and from Louisvale and Upington.

A very uniform series; Little Namaqualand specimens are presumably referable to *I. organiae arenarius.*

Generally plentiful throughout Little Namaqualand.

26. *Mellivora capensis capensis* (Schreber).

Hottentot: /HAREBA, /HEIDOS (Goodhouse); /Ā/HÕAS (Eenriet); /HAREB (Kamiesberg).

Specimens from Witwater, Eenriet, and from near Upington.

Family LUTRIDAE.

27. *Aonyx capensis capensis* (Schinz).

In 1921 a few tracks of *Aonyx capensis* were observed along the banks of the Orange River near Louisvale. I believe, however, that *Lutra maculicollis* is the more common Otter in the west-flowing rivers of the Cape Province.

28. *Lutra maculicollis maculicollis* * Lichtenstein.

Hottentot: //GAM!HĀ/HEI : DOB (Goodhouse).

Specimens from Louisvale.

According to Hottentots at Goodhouse, Otters are scarce in the lower Orange River. No tracks of either species were observed below the Aughrabies Falls.

Family CANIDAE.

(29. *Lycaon pictus venaticus* (Burchell).)

Hottentot: ARIB (Eenriet).†

Extinct in Little Namaqualand.

* An examination of material in the Kaffrarian Museum from the Zambesi, Okavango, and various parts of the Union has convinced me that *Lutra m. chobiensis* is inseparable from typical *maculicollis.*

† ARIB correctly refers to the Domestic Dog; Nama Hottentot names for the Wild Dog in South West Africa are: !GAUB, !GOUB, or ≠HOU ARIB. Wild

30. *Otocyon megalotis megalotis* (Desmarest).

Hottentot: !AMA/AĨERA (Eenriet); //AB/KIRAB (Kamiesberg); //AB (Goodhouse); /HOÃS, /NOÃS (H. J. Wikar).

A single specimen from Port Nolloth: representative of the typical Cape race. *

Generally scarce; presumably most plentiful along the coastal sandplains. Food: insects (including, largely, White Ants), small rodents, lizards, etc. A harmless and useful animal, much persecuted by kaross traders in Bechuanaland.

31. *Canis* (*Thos*) *mesomelas mesomelas* (Schreber).

Hottentot: /KIRAB (Goodhouse, Kamiesberg); /AĨERA (Eenriet).

Specimens from Eselfontein, Platbakkies, and from the Aughrabies Falls. Generally distributed: comparatively plentiful in the Kamiesberg. Owing to much trapping, Jackals are as wary as elsewhere in the Cape Province. Eselfontein specimens (Kamiesberg cloud region) are as richly coloured as average examples from the Eastern Cape Province; skins from the arid plains farther east (Platbakkies), although a shade paler, are not so pallid as *C. mesomelas arenarum* from South West Africa.

32. *Vulpes chama* (A. Smith).

Hottentot: /KAMAB (Goodhouse, Kamiesberg); !AMA (Eenriet).

Specimens from Port Nolloth, near Kamieskroon (?), and from near Upington.

Vulpes chama was described from "Little Namaqualand": I propose to fix Port Nolloth as the type locality.

Widely distributed throughout the plains of Little Namaqualand: said to be plentiful inland from Port Nolloth and elsewhere along the coast. Apparently not occurring on the Kamiesberg.

Dogs are no longer resident in any part of the Cape Province, although on extremely rare occasions small hunting parties still wander down from the north. The most recent record for the Cape Province appears to be that of two specimens, now in the Kaffrarian Museum, which were shot out of a troop of four or five at Gray's Halt, Amabele, near Kei Road, on 16th July 1925, by Newey Bros.

* Other specimens of *Otocyon* in the Kaffrarian Museum from South West Africa are referable to *O. megalotis steinhardti*.

Family VIVERRIDAE.

33. *Genetta genetta felina* (Thunberg).

Hottentot: //ARŌB (Goodhouse); /GARUB//ARŌB (Kamiesberg); //KARŌB (Eenriet).

Specimens from Witwater, Goodhouse, Kameelboom, and from Louisvale, Upington, and the Aughrabies Falls.

Generally distributed throughout Little Namaqualand. Not uncommon; extending to the coast (Port Nolloth).

34. *Atilax paludinosus paludinosus* (G. Cuvier).

Hottentot: GEI≠NŪ E : B (Goodhouse).

One specimen from Louisvale.

Occurs along the lower Orange River, but apparently scarce.

35. *Cynictis penicillata pallidior* Thomas and Schwann.

Hottentot: /ĒĪ/AI≠Ā (Eenriet); /AWA/E : B (Kamiesberg, Port Nolloth); XARU (Goodhouse).

Specimens from Eenriet, and from Louisvale.

Eenriet is 6 miles from Klipfontein, the type locality for *C. p. pallidior*. Much more local than *Suricata* in Little Namaqualand, but not uncommon where it occurs. Not found on the Kamiesberg.

36. *Myonax ratlamuchi upingtoni* Shortridge.

Hottentot: /AWA/GA : MIROB (Goodhouse).

Specimens from Louisvale and Upington.

Said to occur sparsely along the lower Orange River, but apparently much less plentiful than above the Aughrabies Falls.*

37. *Myonax pulverulentus ruddi* (Thomas).

Hottentot: ≠NŪ/E : B (Goodhouse); /E : B (Kamiesberg); ≠HŪ/E : B (Eenriet).

Specimens from Witwater, Eselfontein, Eenriet, Port Nolloth, Kameelboom, Steinkopf, Goodhouse.†

* "A beautiful orange-coloured Martin," undoubtedly referable to *Myonax ratlamuchi*, was recorded by Alexander (*c.* 1838) from the lower Fish River in Great Namaqualand.

† Austin Roberts informs me that he has recently obtained a specimen of this mongoose from the north of Aus in S.W. Great Namaqualand.

M. pulverulentus (subsp. inc.) was observed on several occasions near Louisvale (south bank of the Orange River) in 1921.

Eenriet is 6 miles from Klipfontein, the type locality for *M. p. ruddi*.

A characteristic of this subspecies is its extreme seasonal change of coloration, which is without parallel among South African mammals. All specimens in Grant's original series (April–June 1903) are in full winter coat: in these the lower part of the back, feet, and tail-tip are black; the remainder of the tail hairs tipped with bright russet, contrasting with the general greyish grizzling of the body.

A coloured plate in the P.Z.S. (1904, vol. i, pl. vi) gives a rather misleading idea of the coloration of the typical set which I have examined at the British Museum; in this plate the body-colour is too olivaceous, the tail too yellow, and the black markings are not sufficiently pronounced.

The present large and much more variable series, collected between October and February (summer months), are for the most part less richly coloured; the feet and extreme tail-tip are black as in the typical set, but, in the majority of the skins, the dark dorsal patch is either indistinct or absent. There are, however, several still in partial winter coat, as indicated by the black dorsal patch being well-defined. In one example only is the tail as bushy and brightly coloured as in Grant's winter series.

Plentiful in rocky situations throughout Little Namaqualand; extending as far west as the coastal hills 15 miles inland from Port Nolloth.

38. *Suricata suricatta namaquensis* Thomas and Schwann.

Hottentot: //KĀ–NÏ/AI≠Ā (Eenriet); XARAB (Goodhouse).
(Grant's "Hottentot" name 'HCRYKY for *Suricata* and *Cynictis* is presumably a modification of GRAAITJIE, a local Afrikaans name.)

Specimens from Witwater, Eselfontein, Eenriet, Port Nolloth, Steinkopf.

In 1921 a "Suricat" colony existed near Upington (south bank of the Orange River).*

Klipfontein, the type locality for *S. suricatta namaquensis*, is 6 miles from Eenriet.

Fairly widely distributed in Little Namaqualand; warrens usually large but not very numerous. Occurring on the highest plateaux of the Kamiesberg, and (at Port Nolloth) within a mile or two of the

* Reported also from Kenhardt District.

coast. Kamiesberg specimens are slightly more suffused with rufous than examples from the arid plains of Little Namaqualand.

Family PROTELIDAE.

39. *Proteles cristatus canescens* Shortridge.

Hottentot: ≠AM≠ĒRA (Eenriet); /GI : B (Goodhouse); /GI (Kamiesberg); NU/HAB, NUAAP (H. J. Wikar).
'Tkaboek Bushmen: 'NAAS, /HAS (H. J. Wikar).
Afrikaans: ERDWOLF or MAANHAAR JAKKALS.
High Dutch: AARDWOLF.

Specimens from Witwater, Eselfontein, Eenriet, Port Nolloth.

Fairly plentiful in Little Namaqualand, both on the plains and among the mountains. Aardwolves scoop out small hollows in the sides of white-ant hills, but do not tear down the mounds in the same manner as Aardvarks. They are mainly nocturnal, but sometimes wander about by day.

An Aardwolf at bay erects its dorsal crest like a Civet.

The stomachs of all specimens were packed with white ants and coarse grit in about equal proportions; the grit being presumably licked up with the ants. Newspaper controversy as to whether or no the Aardwolf habitually attacks sheep and lambs is something of a "hardy annual" in South Africa. Whilst the canines and incisors are normal in shape and size, the widely separated and almost rudimentary molars indicate their unsuitability for masticating flesh. There is no reason, however, why occasional individuals should not become "rogues." Abnormal habits in many animals happen sporadically, and as such should be dealt with: but it would be an error of judgment to advocate the destruction of all Aardwolves in the face of existing evidence of their normally insectivorous diet.

A short "baculum." The tongue is covered with slightly raised fleshy discs.

Family HYAENIDAE.

(40. *Crocuta crocuta maculata* (Thunberg).)

Hottentot: ≠NUBE≠HIRAS (Goodhouse).

Extinct in Little Namaqualand. Alexander records having met with "Hyaenas" in this region: Hottentot names indicate the former existence of both species.*

* There is a mounted Spotted Hyaena in the Kaffrarian Museum, referable to *H. c. maculata,* with "Cape Colony" on the original label.

(41. *Hyaena brunnea brunnea* Thunberg.)

Hottentot: ≠HIRAS (Goodhouse).

Extinct in Little Namaqualand. The Brown Hyaena probably survived longer in Little Namaqualand than the Spotted species.*

Family FELIDAE.

(42. *Acinonyx jubatus jubatus* (Schreber).)

Hottentot: !ARŨB (Kamiesberg, Goodhouse); !ARŨ (Eenriet).

A few Cheetah are said still to occur in Bushmanland and Kenhardt District: according to Hottentots around Goodhouse they are very nearly extinct; Mr. Weidner (1937) believes that there may be one or two in the Richtersveld and along the Orange River opposite Goodhouse. These are without doubt the only regions south of or near the Orange River in which these animals survive, and even there they have almost disappeared. Formerly Cheetah were said to have preyed upon Ostriches in the plains east of the Kamiesberg.

43. *Caracal caracal caracal* (Schreber).

Hottentot: /ABA/HÕAB (Goodhouse, Kamiesberg); /GAWA/HÕAB (Eenriet).

One specimen from near Springbok.

Generally distributed throughout Little Namaqualand: rare in the Kamiesberg.

44. *Felis lybica cafra* Desmarest.

Hottentot: /HOAB (Kamiesberg, Goodhouse); /HAB (Port Nolloth); /HŌ/HŌUB (Eenriet).

Specimens from Witwater, Eselfontein, Goodhouse, Eenriet, and from Louisvale and near Upington.

Plentiful throughout Little Namaqualand; extending to the coast (Port Nolloth).

45. *Felis lybica namaquana* Thomas.

One specimen from Platbakkies.

Matching pallid examples from Great Namaqualand and elsewhere in the southern parts of South West Africa. This specimen from

* Migrants are still recorded from the Eastern Cape Province at rare intervals: there is an old mounted Brown Hyaena in the Kaffrarian Museum labelled "Pirie Forest."

the Bushmanland border has only dusky indications of leg-bars, thus contrasting with *F. l. cafra* from the Kamiesberg and other parts of Little Namaqualand.

(46. *Panthera leo melanochaitus* (Hamilton Smith).)

Hottentot: ΧAMI (Kamiesberg); ΧAM (Goodhouse).

There are Hottentot traditions of the former occurrence of the Cape Lion in Little Namaqualand. The English translation of "Kamiesberg" is "Lion Mountain." J. E. Alexander (*c.* 1835) shot a lion on the south bank of the lower Orange River near Karahas Ford, and wrote: "*It is not altogether safe to traverse along the banks of the Gariep ; Lions are to be met with.*" On his map, "*Plains with Zebra and Lions,*" is inscribed on the north bank of the Orange (Gariep) River about opposite to where Goodhouse now stands (An Expedition of Discovery into the Interior of Africa).

47. *Panthera pardus melanotica* Gunther.

Hottentot: /GARUB (Kamiesberg, Goodhouse); /ARUB (Eenriet).

Two specimens, (*a*) from Norap (Rooifontein, north of Leliefontein in the Kamiesberg), and (*b*) from about 60 miles north of Upington.*

The Norap specimen, a flat skin, presented by W. M. Crampton, was shot in 1912: a second Kamiesberg specimen, the skin of a half-grown animal, shot about 1926, was examined at Leliefontein Hottentot Mission.

Leopards are no longer resident on the Kamiesberg, but they still occur sparsely among the mountains along the lower Orange River Valley.

Family OTARIIDAE.

(48. *Arctocephalus pusillus* (Schreber).

Hottentot: HOERÏ ΧAM (Eenriet); /AIK (Port Nolloth).†

The Cape Sea Lion breeds on small islands off the coast of Little Namaqualand. Alexander mentions a "Seal Island" between the mouths of the Gariep (Orange) and Kowsie (Buffels) Rivers.

* The Upington (Gordonia) specimen was referred by Oldfield Thomas to *Panthera pardus shortridgei*.

† /KHOAP is a Hottentot name for a whale.

Family MANIDAE.

(49. *Smutsia temminckii* (Smuts).)

The skin of a Pangolin from near Upington was examined in 1921.* Unknown in Little Namaqualand.

Family ORYCTEROPODIDAE.

50. *Orycteropus afer afer* (Pallas).

Hottentot: /KUBUS (Goodhouse); !OA/KUBUB (Kamiesberg).
Afrikaans: ERDVARK. High Dutch: AARDVARK.

One specimen from Eenriet.

This subadult specimen differs from an immature Kaffrarian skin in its generally darker body colour and in the rump and dorsal part of the back being further darkened by a profuse admixture of slaty-black hairs, these parts, however, not being so dark as the normally blackish thighs and shoulders. The tail is creamy-white (washed with rufous below), contrasting with the dark rump. The tail of the Kaffrarian specimen is pale greyish isabelline, not markedly paler than the general body colour. The Eenriet specimen approaches to some extent *O. afer albicaudus*; but the tail is not "almost pure white" terminally, as in a typical specimen of that race from Sandfontein (Gobabis District) in South West Africa.

Sparsely but widely distributed in Little Namaqualand. Said not to occur actually on the Kamiesberg, but a few burrows were observed around Platbakkies, about 20 miles east of those mountains.

Family LEPORIDAE.

51. *Lepus capensis granti* Thomas and Schwann.

Hottentot: !ÕAS (Eenriet); /KARAR (Goodhouse).

Specimens from Eselfontein, Eenriet, Port Nolloth. Port Nolloth specimens are topotypical.

Widely distributed throughout Little Namaqualand; ascending to the highest plateaux of the Kamiesberg, being fairly plentiful around Leliefontein, although outnumbered there by *L. saxatilis megalotis*. Most numerous in the coastal sand plains and in open karooveld.

* There is a second Cape Province record from Prieska, farther east along the Orange River; and a third from Colesberg—the only record I know of from the *south* of the Orange River.

As long ago as 1835 Alexander wrote: "*There are plenty of hares at the Gariep* (*Orange*) *River Mouth.*"

Lepus capensis is a more wary animal than *L. saxatilis*, but it may be coursed successfully with dogs. It is less attracted by cultivation than *Lepus saxatilis* and avoids populated areas.

The white frontal spot (Afrikaans, KOHL) is frequently present, but is seldom so conspicuous as in *L. saxatilis*.

52. *Lepus saxatilis megalotis* Thomas and Schwann.

Hottentot: !KHAERAB (Goodhouse); !KHAIRA (Eenriet); XAXARIT (Kamiesberg).

Afrikaans: RIBBOKHAAS, KOHLHAAS.

Specimens from Witwater, Eselfontein. Klipfontein, near Eenriet, is the type locality.

Generally distributed in rocky country; particularly plentiful on the Kamiesberg. Seldom penetrating far into the plains. Attracted by cultivation, cattle kraals, and Hottentot villages.

53. *Lepus saxatilis aurantii* Thomas and Hinton.

Specimens (type and co-types) from Louisvale.*

Locally plentiful; attracted by cultivation (lucerne fields, etc.).

54. *Pronolagus crassicaudatus rupestris* (A. Smith).

One specimen from Platbakkies; others from Swartkop (near Upington), south bank of Orange River.

On receipt of a "summer" series of *Pronolagus* from Swartkop, Oldfield Thomas noted that the specimens were more suffused with rufous than Grant's "winter" examples from Little Namaqualand, but, believing this to be due to season, he concluded *melanurus*, previously assigned by himself and Schwann to Little Namaqualand specimens, to be synonymous with *rupestris*. A "summer" series from Little Namaqualand now shows that there is no such seasonal change, and, in consequence, I believe that *rupestris* and *melanurus* should be regarded as distinct races.

Pronolagus crassicaudatus rupestris (from Swartkop): general colour above sandy-rufous, individual hairs mostly tipped with buffy white, the general effect being grizzled rufous and white—

* Austin Roberts has recently recorded *L. s. aurantii* from the south-west of Rehoboth (Great Namaqualand). Specimens from Griqualand West appear also to be referable to this subspecies.

except on the lower part of the back where there is a slightly darker shade, due to an admixture of hairs blackish at their extreme tips; base of hairs uniformly pale rufous to the roots (as opposed to bluish-slate in *melanurus*). Fore and hind feet pale rufous, the hairs markedly tipped with whitish.

The specimen from Platbakkies (20 miles east of the Kamiesberg, on the western edge of the Bushmanland Highveld) intergrades to some extent with both races; in external coloration it almost exactly matches *rupestris* from Swartkop, but the base of the hairs is bluish-slate as in *melanurus*.*

55. *Pronolagus crassicaudatus melanurus* (Ruppell).

Hottentot: *!*ŨE*!*ÕAS (Eenriet); TSÕARUS (Goodhouse); 'TWIGI (Kamiesberg).

Specimens from Witwater, Eselfontein, Platbakkies, Eenriet.

Pronolagus crassicaudatus melanurus: general colour above drabby-brown, markedly washed with rufous on the neck, rump, and limbs only. Hairs on back and sides buffy-white subterminally, tipped with black; the general effect being grizzled drabby and black; fore and hind feet rufous-buff without defined whitish tips to the hairs. Base of hairs bluish-slate on rump, shading to whitish on shoulders.

With regard to *Pronolagus* material from Little Namaqualand and the middle Orange River, I propose to fix Eenriet (inland from Goodhouse, lower Orange River, below the Aughrabies Falls), Little Namaqualand, as the type locality for *Pronolagus crassicaudatus melanurus*; and Swartkop (near Upington, middle Orange River (south bank), above the Aughrabies Falls) as the type locality for *Pronolagus crassicaudatus rupestris*.

Series in the Kaffrarian Museum from these regions represent two well-defined colour forms, and I consider that the status of the darker (coastal and subcoastal) *melanurus* and the paler (inland highveld) *rupestris* might thus be recognised.

The two races appear to meet or intergrade on the western edge of the Bushmanland Highveld (*e.g.* Platbakkies).

"Red Hares" are plentiful in rocky situations throughout Little Namaqualand. On the Kamiesberg they are extremely abundant at all altitudes and seem to be less shy than in most other regions.

* Specimens from Great Brukaros Mountain (Great Namaqualand) resemble closely Swartkop examples, except for having a somewhat more profuse admixture of black-tipped hairs on the back; these were not distinguished from Swartkop material by Oldfield Thomas.

Although for the most part nocturnal, in cool, cloudy weather they sometimes come out to feed by day, and in the early mornings and late afternoons may be found on almost any patch of outcrop. Flat ledges of rock and level patches of short grass on hillsides are often covered with accumulated droppings. These hares are not attracted by cultivation; they are essentially rock-dwellers, and feed upon mountain grasses and herbs. The meat has a slight aromatic flavour.

The normally dark foot-pads in Eenriet specimens were invariably whitened by powdered mica.

Family SCIURIDAE.

56. *Geosciurus inauris namaquensis* (Lichtenstein).

Hottentot: !KAẼS≠NAB (Goodhouse); /AI DURÜB (Eenriet).

Specimens from Swartkop, Louisvale, Aughrabies Falls.

No record was obtained of the occurrence of *Geosciurus* within the borders of Little Namaqualand, but in the north it may extend as far west as Pella. Well known to Hottentots around Goodhouse, but said not to occur so far west along the south bank of the Orange River.

The type locality for *G. inauris namaquensis* is Great Namaqualand west of the Fish River.*

Family MUSCARDINIDAE.

57. *Gliriscus rupicola australis* Shortridge.

Hottentot: DANÜ : DURÜB (Eenriet); !ONIS (Goodhouse).

Specimens from Eenriet and Port Nolloth.

Nocturnal; a rock dweller; apparently not plentiful.

The latitude of Eenriet may be approximately the southern limit of the range of *Gliriscus*. The genus overlaps there with *Graphiurus* (collected by Grant at Klipfontein, 6 miles from Eenriet) which itself may not extend farther north. The specimen from Port Nolloth, where there are no rocks, was caught in a timber yard close to the harbour and might have been carried there by goods train from

* A specimen with worn fur from Berseba (Great Namaqualand) was at first referred by Oldfield Thomas to *Geosciurus princeps* on skull characters; but the writer afterwards stated that there must have been an accidental interchange of skull labels between this and a Karabib specimen. I am convinced that Thomas was correct and therefore suggest that Berseba, in central Great Namaqualand, about 10 miles west of the Fish River—a locality in which *Geosciurus* is known to occur—be fixed as a definite type locality for *G. inauris namaquensis*.

up-country. Dormice are said also to occur in the Orange River Valley (around Goodhouse, etc.).

Genus new to the Cape Province.

58. *Graphiurus ocularis ocularis* (A. Smith).

Hottentot: NAMTAP (Eenriet) *; !ON : DURÜB (Kamiesberg).

Specimens from Witwater, Eselfontein.

Grant collected two specimens at Klipfontein in 1903, a locality close to Eenriet where *Gliriscus* occurs.

The present Kamiesberg series has been compared with Eastern Cape Province material; there is not much difference, except that in the Namaqualand examples the black ocular markings are perhaps somewhat wider, and in its forward extension the ocular streak entirely surrounds the roots of the mystacial vibrissae; forming a band which averages 7–8 mm. in width, extending from the upper lip to the lower margin of the ear—the forearm being also to some extent suffused with black above. Namaqualand specimens of *Graphiurus* can be regarded as typical of *G. ocularis elegans*; and the Kamiesberg (Eselfontein), visited by Alexander, may be fixed as its type locality (*cf.* Mamm. S.W. Africa, Shortridge, vol. i, p. 216, footnote by Oldfield Thomas). In my opinion, however, *elegans* is hardly separable from typical *ocularis*, although it is quite as good a race as plenty of other named subspecies of South African mammals.

The nicotine-coloured stains on the face, throat, and shoulders, so characteristic of South African Dormice, are as a rule particularly manifest in adults of *Graphiurus*. The skull is flattened, almost as much as in *Gliriscus*, which suggests similar crevice-dwelling habits. There is a short "baculum." Plentiful in the Kamiesberg.

Although doubtless to some extent arboreal where there are trees, *Graphiurus ocularis* is essentially a rock-dweller in Little Namaqualand and throughout the greater part of its range, where it is similar to *Gliriscus* in choice of habitat. It is strictly nocturnal.

At Eselfontein two specimens were trapped in an old stone wall; others were found in rocky cliffs containing horizontal fissures and amongst natural pylons of large boulders.

A local Afrikaans name for *Graphiurus* is "HUENINGMUIS," owing to the fact that it is fond of honey and, like European Dormice, said to enter bees' nests in search of it. It is also carnivorous when

* This name is used by Afrikaans-speaking farmers in the Cedarberg, Clanwilliam, district.—[Ed.] See p. 88.

opportunity offers, and, like the Fiscal Shrike in respect of smaller birds, will prey upon rodents and other smaller vertebrates less powerful than itself. In the Kamiesberg, small mammals caught in traps were often found with the heads partly eaten off and brains extracted, presumably by these Dormice. In captivity, other small rodents placed in the same cage are at once savagely attacked. *Graphiurus* is said to find its way occasionally into houses and to drink milk.

Family CRICETIDAE.

59. *Desmodillus auricularis auricularis* (A. Smith).

Hottentot: /GAWA : DURÜB (Eenriet); /AWA : DURÜB (Goodhouse).

Specimens from Witwater, Platbakkies, Goodhouse, Eenriet, Port Nolloth, Kameelboom, and from Louisvale and Aughrabies Falls.

Two specimens from Witwater are topotypical, the type, discovered and described by Sir Andrew Smith, having come from the Kamiesberg. There is considerable individual colour variation in the Namaqualand and Louisvale series: the four most vividly orange-chestnut Namaqua specimens come from four separate localities—(1) Witwater (♂), (2) Eenriet (♂), (3) Platbakkies (♂), (4) Goodhouse (♀).*

Habitat: level plains sparsely clothed with low karoo scrub.

The Short-eared Gerbil ascends the Kamiesberg to Witwater Plateau, but was not found as high up as Eselfontein.

Desmodillus (as opposed to *Taterona* and *Gerbillus*) is not communal: it is quarrelsome in captivity, and the adults soon start killing and partly devouring the weaker of their own species and other small rodents.

60. *Gerbillus* (*Gerbillus*) *paeba broomi* Thomas.†

Specimens from Witwater, Platbakkies, Goodhouse, Eenriet, Port Nolloth, Kameelboom.

The type locality is Port Nolloth.

* There is so much individual colour variation that I do not think *Desmodillus auricularis pudicus* is distinguishable from the typical subspecies.

† *Gerbillurus*: subgen. n.

I have long been of opinion that the *Dipodillus*-like *Gerbillus vallinus* should be distinguished from true *Gerbillus* (as represented by *paeba, swalius,* etc.).

Gerbillurus differs from *Gerbillus* in its long and relatively heavily tufted tail, which in some examples is half as long again as the head and body. The partially bare soles, and the triangular skull with inflated bullae (very much as in *Desmodillus*)

This series is extremely variable in size and colour; some being clear orange-chestnut above from nose to tail-tip: others are grizzled drabby brown with tails darkened above by a profuse admixture of black hairs. The majority show intermediate coloration. Range of colour matching almost exactly that of *Desmodillus.* Several specimens from Goodhouse had markedly incrassated tails, although this is not very apparent in the dry skins. Widely distributed, especially in the open plains: perhaps most plentiful in the coastal sandveld. Occurs in the Kamiesberg around Witwater, but not met with on the higher Eselfontein Plateau.

61. *Taterona brantsii namaquensis* Shortridge.

Specimens from Goodhouse.

Trapped in high grass along the edges of water-furrows bordering irrigated land on Goodhouse Estate.

Apparently not plentiful: no burrows observed.

Genus new to Little Namaqualand.

Oldfield Thomas (P.Z.S., 1927, pt. 2, p. 386) wrote: "*If we are to try to get our taxonomic arrangement and nomenclature to give some sort of idea as to the course of evolution in the different animals, . . ., we must I believe take the bold step of recognising animals as distinct if of obviously separate and independent origin, even if to our eyes they look quite the same. We should thus be recognising the locality as an essential part of the animals' individuality.*"

A difficulty in distinguishing animals subspecifically on a purely geographical basis without close personal knowledge of the country, on the supposition that they are of independent origin, is that it is not often possible to determine from the study of an ordinary map whether two presumed faunal regions are not in reality connected by a strip of similar country not indicated on the map. At the same time, when two races from distant localities, known to be disconnected, resemble one another closely, slight but consistent differences are of greater interest than more readily distinguishable but intergrading characteristics in races inhabiting adjoining areas. For this reason I had no hesitation in describing *Taterona brantsii namaquensis* from the south bank of the lower Orange River on

have already been remarked upon by Thomas and Hinton (P.Z.S., pt. 1, p. 235, 1925).

Genotype (in the Kaffrarian Museum): *Gerbillus (Gerbillurus) vallinus;* No. 578, adult ♂, H. & b. 110, Tl. 154, Hf. 30, Ear 13·5 mm., from Berseba, Great Namaqualand, 6th September 1923.

account of the distance of its habitat from that of any other known race of *brantsii*. From my knowledge of south-western Africa I am satisfied that vast tracts of country, uninhabited by any species of *Taterona*, separate *T. brantsii namaquensis* from *T. brantsii perpallida*,* the Bechuana race which *namaquensis* most closely resembles. Northwards from Goodhouse, on the inland (hardveld) plateaux of Great Namaqualand, the genus appears to be unrepresented: eastwards, along the Orange River (above the Aughrabies Falls) *T. miliaria*, a member of the *lobengulae* group, occurs.

62. *Taterona miliaria miliaria* (Wroughton).

Specimens from Swartkop and Louisvale (south bank of Orange River).

This series was originally referred incorrectly by Thomas and Hinton (P.Z.S., 1923) to *T. miliaria stellae* (= *T. lobengulae griquae*?). *T. miliaria* belongs to the *lobengulae* group; there being two pairs of pectoral mammae.

Plentiful; not found in large warrens in this region. Attracted by cultivation, but also occurring along the beds of dry water-courses. The relatively large and easily seen burrows are often excavated close to the thick scrubby bushes which fringe these water-courses.

63. *Myotomys unisulcatus broomi* (Thomas).

Hottentot: ≠HŪ : DURÜB (Eenriet); ≠NŪ : DURÜB (Goodhouse).

Specimens from Witwater, Eselfontein, Eenriet, Port Nolloth, Kameelboom. Port Nolloth is the type locality.

Widely distributed in Little Namaqualand and as a rule extremely plentiful; ranging from the highest peaks of the Kamiesberg (near the summit of Eselkop) to the sea coast (hardly above tide level at

* In 1927 (P.Z.S.) Oldfield Thomas provisionally referred a large series of *Taterona* from Gobabis District to *T. schinzi*, but mentioned (in litt.) at the time that the South West African Gerbil material had not been carefully examined. Since then about half of them have been referred by St. Leger (28th November 1935—in litt.) to *T. brantsii perpallida*. Owing to this delay the occurrence of *T. b. perpallida* in the eastern and north-eastern parts of S.W. Africa was not recorded by me in The Mammals of South West Africa. *T. schinzi* and *T. b. perpallida* are now known to occur side by side in Gobabis District, and they both extend northwards, although in the extreme north *perpallida* (a few collected at Ssannukannu village, about 10 miles south of the Okavango) is far outnumbered by *schinzi*, from which I do not think *lobengulae* is specifically separable.

Port Nolloth). Not observed around Goodhouse in the valley of the Orange River. *Myotomys* colonies construct dome-shaped nests of small sticks and twigs, above ground, from two to three feet in height in the centre of bushes—both in sandy and rocky country. Under these nests are underground tunnels; within a few yards radius there are a dozen or so escape exits, most of which are under bushes or partly hidden by slight superstructures of small sticks. The burrows of *Myotomys* (as opposed to those of *Parotomys*) are not very deep, nor do they extend any great distance. They are shallower as a rule than those of *Liotomys*, although the overhead nest-mounds of the two may resemble one another closely. Bushes containing nests of *Myotomys* and *Liotomys* have a tendency to die after a time owing to root disturbance; when this happens the animals move to a fresh site. Diurnal. (*Cf.* Plate VI.)

64. *Otomys irroratus irroratus* (Brants).

Specimens from Eselfontein.

A swamp-dweller, consequently local in this region, even on the Kamiesberg; not likely to occur elsewhere in Little Namaqualand. Trapped among reeds in small patches of marshy ground at the headwaters of mountain streams at Eselfontein and near the upper slopes of Eselkop. The runways through swamp vegetation are easy to find. *Otomys irroratus* makes no regular burrows and lives normally above ground. Both diurnal and nocturnal: one individual was captured by hand whilst sunning itself during the heat of the day. It feeds largely upon the young shoots and lower stems of reeds and rushes.

Genus new to Little Namaqualand.

65. *Parotomys brantsii brantsii* (A. Smith).

Hottentot: ≠ÃB : DURÜB (Eenriet).

Specimens from Platbakkies, Eenriet, Port Nolloth.

The type locality of *P. brantsii* is "towards the mouth of the Orange River," so that the series from Port Nolloth and Eenriet are practically topotypical.

Brants' *Otomys* abounds throughout the sandy plains of Little Namaqualand, to within a mile or so of the coast. Warrens were met with about ten miles south of Goodhouse, but not actually in the valley of the Orange River, where *Liotomys* was the only member of the group collected. It extends to the foot of the Kamiesberg, but not on to the mountain plateaux. Farther north, around Springbok, etc., it occurs everywhere on the high karooveld. Many parts of Little Namaqualand are riddled by the excavations of *Parotomys,* the sand-plains being often honeycombed, to some extent in patches, for miles in every direction. The innumerable warrens compare with those of *Taterona* in other regions, the burrows being very similar, except that much frequented *Parotomys* entrances approach those of mierkats in diameter. The communities are much larger than the more circumscribed colonies of *Myotomys* and *Liotomys.*

It was found impracticable to dig out *Parotomys* in large numbers; individual warrens are often several hundred yards in circumference; many of the tunnels descend three or four feet below the surface, and connecting passages intercommunicate everywhere. There are also numbers of bolt-holes which doubtless serve as a means of escape from snakes and muishonds. The warrens are taken advantage of to some extent by other small animals—*Macroscelides, Elephantulus, Rhabdomys, Desmodillus, Gerbillus,* etc., and a variety of lizards. These essentially communal rodents have (more perhaps than other *Otomyinae*) the marmot-like habit of sitting up on their haunches motionless at the entrances of their burrows, disappearing like a flash at the slightest sound, movement, or shadow. This extreme alertness may be partly attributable to the Harrier Hawks so frequently seen hovering above the warrens, obviously on the look out for unwary individuals.

Parotomys is not as a rule attracted by dry bait (mealies, oatmeal, etc.), and the easiest way to obtain specimens is to wait quietly near a warren and shoot them as they appear. They are exclusively diurnal, coming out to feed in the morning before the heat of the day (from 7–10 a.m.) and in the afternoon (from about 4 p.m. until just before sundown). On cool or cloudy days a few may be seen at any hour, but in windy weather they seldom venture above ground. Owing to their pale yellowish colour, which closely matches the sand, they are not at all conspicuous. Although apparently less migratory than *Taterona, Parotomys* communities move about from one aggregation of warrens to another: in consequence some warrens may be temporarily deserted, others partly or fully occupied. They feed here principally upon the leaves and flower-heads of fleshly leaved annual mesembryanthemums, and when a near-by supply fails move on to another group of burrows. As their food supply is practically inexhaustible they seldom have to wander far afield in search of it. On coming out to feed they creep cautiously to the nearest plant, bite off a shoot or a flower-head and dart back with it. Sometimes an entire plant is bitten off just above the root and dragged to the entrance of a burrow. The droppings, bright green in colour when fresh, are scuffled out of the tunnels and may be seen in small heaps outside the entrances of certain burrows which are chosen primarily for these ejections. The warrens are invariably situated in open sandy karooveld where the scattered vegetation is not more than a foot or two in height. *Parotomys, Liotomys, and Myotomys* are gentle in captivity, and even when recently caught a hand can be moved freely among them; in a short time they will allow themselves to be picked up, only attempting to bite if handled roughly. The young of all members of the group are born in an advanced state, well clothed with short hair; when newly born they cling tightly to the mammae of the female until able to run quite actively. The female moves about, even above ground, with the young so attached. *Parotomys* seems to breed throughout the year, but perhaps more regularly during the warmer months. The number of young averages 2–3; more rarely 4. *Parotomys* differs from other subgenera of the *Otomyinae* in having large *jerboa-like* eyes and relatively short ears.

66. *Parotomys brantsii pallida* (Wagner).

Specimens from Kameelboom (S.W. Little Namaqualand).

I have referred this series to *P. brantsii pallida*, for which I propose to fix Kameelboom (about half-way between Garies and Hondeklip Bay) as the type locality.

This very uniform series differs markedly from the relatively variable typical subspecies from northern and eastern Little Namaqualand in being much less brightly coloured. General colour drabby grizzled grey with a slight wash of cinnamon above; in typical *brantsii* the general colour is sandy-buff washed with varying shades of orange-rufous.

67. *Liotomys littledalei littledalei* Thomas.

Hottentot: *!*HAEB (Goodhouse).

Specimens from Eenriet, Port Nolloth, Goodhouse, and from Louisvale.

The relatively long-eared *Liotomys* should not be associated too closely with *Parotomys*. In some respects it constitutes a link between *Parotomys* and *Myotomys*, and in habits more nearly resembles the latter.

Widely distributed in the north of Little Namaqualand and very plentiful where it occurs. The discovery of *Liotomys* in this region has extended considerably its known range; south of the Orange River it had been recorded previously only from Kenhardt (Tuin—type locality) and from Louisvale. Around Eenriet and Port Nolloth *Liotomys* inhabits karooveld where bushes, averaging 2–3 feet in height, grow close together—as at the bases of hills or along the edges of dry water-courses.

At Goodhouse, however (as around Berseba in Great Namaqualand), a few were found in burrows in the open sandveld unprotected by overhead shelters. At Eenriet and inland from Port Nolloth the more typical warrens with their nest-like superstructures were not easily distinguishable from those of *Myotomys*; they are similarly constructed of small sticks and situated in the middle of comparatively large bushes. Trails of loosely woven twigs line the surface runways close to the nests and partly surround the exits, many of which extend to adjacent bushes. The burrows under the nests penetrate deeper into the ground than those of *Myotomys*.

At Eenriet, *Liotomys*, *Myotomys*, and *Parotomys* were found in close association; although *Parotomys* always favoured the more open ground away from thick bushes. *Liotomys* comes out at the same hours of the day as *Parotomys* and *Myotomys*. *Liotomys* and *Myotomys* feed largely upon the leaves of shrubby "salt-bushes" (perennial mesembryanthemums).

I once kept females of *Liotomys* and *Myotomys* together: when caught they had young attached to their mammae: I interchanged the young ones, and, in spite of close contact, no subsequent interchange took place. They were eventually released, each with its adopted offspring.

Genus new to Little Namaqualand.

68. *Poemys melanotis insignis* Shortridge.

Specimens from Eselfontein.

Trapped in high grass close to swampy country.

Genus new to Little Namaqualand, where it may be restricted to the Kamiesberg.

69. *Saccostomus anderssoni hildae* Schwann.

Specimens from Goodhouse, and from Louisvale.

Also doubtfully recorded from a farm between the Kamiesberg and Platbakkies.

Goodhouse specimens match the Louisvale series which was referred to *S. a. hildae* by Thomas and Hinton.

At Goodhouse, trapped along the edges of water-furrows close to irrigated land: apparently not very plentiful in this region. The cheek-pouches contained castor-oil seeds.

Saccostomus is not gregarious: like *Steatomys* and *Desmodillus*, it is quarrelsome in captivity and will attack and often partly devour other small rodents. It is slow in its movements, and when above ground may easily be caught by hand. In life, *Saccostomus* bears some resemblance to gregarious *Steatomys*, but I doubt if this indicates near relationship.

Genus new to Little Namaqualand.

70. *Petromyscus barbouri* Shortridge.

Specimens from Witwater, Platbakkies, Eselfontein, Eenriet.

Widely distributed in Little Namaqualand wherever there are rocks and hills. The occurrence of this species at Platbakkies, 20 miles east of the Kamiesberg, indicates that it may extend some distance into Bushmanland.

P. barbouri is fairly plentiful in the Kamiesberg and was trapped in about the same numbers as *Graphiurus ocularis*.

Nocturnal, hiding by day in horizontal rock crevices.

One specimen from Witwater was a partial albino.

Scrotum small and concealed by fur, somewhat as in the *Muscardinidae*.*

Genus new to the Cape Province.

71. *Petromyscus collinus capensis* Shortridge.

Two specimens from Goodhouse.

Replacing *P. barbouri* in the Orange River Valley.

Habitat: rocky hills along the valley of the lower Orange River.

A second representative of a genus new to the Cape Province.

* I am not sure that St. Leger is correct in associating *Petromyscus* and *Saccostomus* with the *Dendromyinae*. *Petromyscus*, in life, has the appearance of a diminutive *Myomys*, and the dark smoky coloration of very young individuals resembles that of juvenile examples of *Myomys* and *Mastomys*. The group would seem to have no close associates. It may be noted that *Petromyscus* and *Petromus* coincide in range, from south-western Angola in the north, through South West Africa, to Little Namaqualand in the south. Consequently, where one genus is found to occur the other should be looked for.

Family MURIDAE.

72. *Aethomys namaquensis namaquensis* (A. Smith).

Specimens from Witwater, Platbakkies, Eselfontein, Goodhouse, Eenriet, Kameelboom, and from Swartkop, Louisvale, Aughrabies Falls.

Aethomys namaquensis was described from "Little Namaqualand," and as Sir Andrew Smith obtained specimens from the Kamiesberg I propose fixing Witwater as the type locality. Extremely plentiful; occurring in rocky situations throughout Little Namaqualand. Ascending the highest peaks of the Kamiesberg and extending to the coastal hills 15 miles inland from Port Nolloth.

73. *Leggada minutoides minutoides* (A. Smith).

Specimens from Eselfontein, Goodhouse.

Apparently very local.

Genus new to Little Namaqualand.

74. *Mastomys coucha coucha* (A. Smith).

Specimens from Louisvale. Attracted there by cultivation.

Louisvale examples appear to constitute the most western record of the occurrence of *Mastomys* in the Orange River region.

Notwithstanding W. L. Sclater's note that the South African Museum possessed specimens of *Mastomys coucha* from "Namaqualand" (Mamm. S. Africa, vol. ii, p. 49, 1901), its occurrence in any part of the north-western Cape Province (or even in Great Namaqualand proper),* requires confirmation. There have been no subsequent records, and I do not believe that it occurs in those regions.

75. *Mus musculus musculus* Linnaeus.

Hottentot: CHUHU : DURÜB (Kamiesberg).

Specimens from Witwater, Eselfontein, and from Louisvale.

Of the Kamiesberg (Witwater, Eselfontein) series about a third of the specimens are buffy-white below and may be of North African or Asiatic origin; in others there are varying degrees of intergradation with typical dark-bellied *musculus*.

The House Mouse is plentiful at Garies and in farms and Hottentot huts in the Kamiesberg. It doubtless occurs in all of the larger

* To the east of Great Namaqualand, in Gobabis District, Gordonia, and in Griqualand West, etc., *Mastomys coucha* becomes plentiful and widely distributed. Along the middle Orange River it doubtless occurs as far west as the cultivated region around Kakamas.

settlements in Little Namaqualand, but has not yet established itself at Goodhouse.

(76. *Rattus rattus alexandrinus* (E. Geoffroy and Audouin).)

A few imported House Rats are said to occur in stores and goods-sheds at Port Nolloth. They have not yet established themselves inland in this region.

77. *Rhabdomys pumilio cinereus* (Thomas and Schwann).

Hottentot: /HOGE/GAHEB (Goodhouse); DURÜB (Eenriet).

Specimens from Witwater, Eselfontein, Goodhouse, Eenriet, Port Nolloth, Kameelboom.

Type locality Klipfontein, six miles from Eenriet.

Striped Mice from different parts of Little Namaqualand vary somewhat in size and colour, Goodhouse and Port Nolloth specimens averaging larger and paler than the others: there is also a certain amount of seasonal colour change. Widely distributed: often very numerous along the beds of dry water-courses where scrub and low bushes form thickets.

Attracted by cultivation at Goodhouse. At Port Nolloth found in company with *Myotomys* in low salt-bush within a few yards of high-tide mark.

Extremely plentiful on the Kamiesberg at all altitudes.

In cool weather these diurnal mice come out at all hours of the day; but when it is hot they seldom appear until late in the afternoon. On one or two occasions I have observed them on moonlight nights. They are active animals and, in the open, cover the ground by a series of gerbil-like jumps. In the Kamiesberg they were sometimes found hiding in the nests of *Myotomys*.

78. *Rhabdomys pumilio griquae* * (Wroughton).

Specimens from Louisvale.

Plentiful in cultivated lands. Apparently local in this region.

79. *Thallomys shortridgei* Thomas and Hinton.

Hottentot: XAIS : DURÜB (Goodhouse).

Specimens from Goodhouse, and from Swartkop and Louisvale.

Goodhouse specimens match the typical set from Louisvale.

* Although subsequently amended to *R. p. griquae*, Louisvale specimens of *Rhabdomys* were at first referred provisionally by Thomas and Hinton to *R. p. bechuanae*.

T. shortridgei differs from other known members of the genus in the apparently consistent absence of pectoral mammae.* The obsolete ocular rings, much paler ears, less blackened tail and slightly larger "bicolored" feet (dusky patches on metapodials) also distinguish *T. shortridgei* from *T. nigricauda*, and I am now of opinion that they are specifically distinct.

Apparently not very plentiful around Goodhouse, but found along the banks of the Orange River wherever sufficiently large acacias occur. There are no trees with hollow trunks for them to hide in, as around Louisvale, but untidy shelters of sticks and twigs, like large crows' nests, are built amongst the thin topmost branches. One of these was inhabited by about a dozen individuals, adult and immature. At Goodhouse these normally nocturnal Tree Rats occasionally come out by day: several were shot whilst running along branches close to the nests between 3 and 4 in the afternoon. As a rule members of the genus do not leave their hiding places before dusk.

Genus new to Little Namaqualand.

Family BATHYERGIDAE.

80. *Bathyergus janetta janetta* Thomas and Schwann.

Hottentot: /GEI!HĀBA TSŪRU (Eenriet, Port Nolloth).

Specimens from Port Nolloth.

Plentiful in the coastal sandveld, but only in areas where there is soft white sand. Extending in isolated patches inland from Port Nolloth to as far as Anenous; and from Hondeklip Bay to 20–30 miles or more from the sea.

Bathyergus janetta extends along the coast at least as far north as the mouth of the Orange River †: Alexander, in 1835, recorded that "*The numerous mole-hills near the mouth of the Orange River render riding dangerous.*" The southern limit of its range is apparently about latitude 31°.

B. janetta is very plentiful around Port Nolloth, but farther inland its distribution becomes disconnected and patchy.

* A parallel instance of mammary variation occurs in species of *Petromyscus*: in *P. barbouri* the pectoral mammae appear to be consistently absent; in *P. shortridgei* they are usually, but not invariably, absent.

† Berseba Hottentot reports indicate that *Bathyergus janetta* may extend across the Orange River into the south-western littoral of Great Namaqualand, between the mouth of that river and Luderitz.

At Port Nolloth (January and February—windy season) these mole-rats appeared to be partially dormant: owing to sand-storms the mounds had disappeared and no recent activity was observed. Their presence, however, was soon detected by the collapse of the surface tunnels in the soft sand when trodden upon. When these tunnels were opened up the occupants, half an hour or so afterwards, pushed their heads out for a few moments prior to re-closing them.

81. *Bathyergus janetta inselbergensis* Shortridge.

Hottentot: ŪRI : DURÜB (Kamiesberg).

Specimens from Eselfontein.

A mountain or southern race of *B. janetta.*

An isolated aggregation of mounds was first discovered at Eselfontein (near Leliefontein, altitude 4000–5000 feet); others were subsequently observed between Leliefontein and Kamieskroon, and between Kamieskroon and Garies; the last locality, although near the base of the Kamiesberg, is well within the restricted cloud and rainfall area. Some of the excavations were in soft sand; others in light sandy loam.

At Eselfontein mounds extended through narrow strips of sand between patches of outcrop; some were in cultivated corn land.

In the Kamiesberg mounds of *Cryptomys* and *Bathyergus* occur in close association; the latter being easily distinguishable by their large size and by the circumference of the rolls of compressed sand thrown up. The diameter of the tunnels averages $2\frac{1}{2}$–$3\frac{1}{2}$ inches. Many of the tunnels are so near the surface that they collapse when trodden upon; others penetrate far into the ground.

Stomach contents: half-digested bulbs, some fibrous matter, and the hard parts of a few large underground crickets.

No foetuses were obtained; one female (4th December) had enlarged mammae. Mammae 6 (2 pect., 2 abd., 2 ing.).

(82. *Georychus capensis capensis* (Pallas).)

Occurrence doubtful, although possibly extending as far north as the southern border of Little Namaqualand.

W. L. Sclater (Mamm. S. Africa, vol. ii, p. 76, 1901) records *Georychus capensis* from "Namaqualand"; but I suggest that the mounds of *Bathyergus janetta* (an unknown species at the time), so numerous and conspicuous in that region, had been mistaken for those of

Georychus. The size and markings of the two animals are also somewhat similar.*

83. *Cryptomys hottentotus hottentotus* (Lesson).

Hottentot: !HĀBA TSŪRU (Eenriet); ΧOU : DURÜB (Kamiesberg).

Specimens from Witwater, Eselfontein, Eenriet.

The Witwater-Eselfontein series (irrespective of sex) are somewhat variable in size and colour. *Cryptomys hottentotus* has a wide distribution in Little Namaqualand, but does not occur in the most arid type of karooveld which extends everywhere east of the Kamiesberg towards Bushmanland and in a wide belt along the south bank of the Orange River.†

Innumerable mounds were observed, sometimes covering acres of land, between Garies in the south and about half-way between Concordia and Goodhouse in the north—the northern limit being where hills and rocky outcrop merge into the desert sand-plains which lie between the interior highlands and the Orange River Valley.

Cryptomys does not occur close to the coast in Little Namaqualand, but, inland from Port Nolloth, mounds were observed about 3 miles west of Anenous; and about 18 miles inland from Hondeklip Bay.

On the Kamiesberg *Cryptomys* mounds are ubiquitous, the Leliefontein and other plateaux being riddled by their tunnels. There were mounds in a narrow strip of black soil between rocks along the steep sides of a small mountain stream within a few hundred feet of the summit of Eselkop (5456 feet).

When caught alive these mole-rats snap savagely and give vent to angry squeaks. Many females (November–January) contained foetuses, five being a frequent number. Mammae 6 (2 pect., 2 abd., 2 ing.). In one specimen there were 7 mammae (3 ing.).

Family CTENODACTYLIDAE.

84. *Petromus typicus typicus* A. Smith.

Hottentot: !K'NŌKI, or !ŨE : DURÜB (Eenriet); //HARUGES (Goodhouse); !K'NŌKI : DURÜB (Kamiesberg).

Afrikaans: DÀSSIEROT (Aughrabies Falls).

Specimens from Witwater, Platbakkies, Goodhouse, Eenriet, Kameelboom, and from the Aughrabies Falls.

* Sclater's Kimberley record for *Georychus capensis* was almost certainly based upon incorrect information.

† Nor does it appear to cross the Orange River into Great Namaqualand.

The type came from "Mountains towards the mouth of the Orange River."

The series from Goodhouse, rather more bleached-looking on the whole than Kamiesberg specimens, may be regarded as topotypical.

Specimens from the Aughrabies Falls (about 200 miles farther inland) are to some extent intermediate between the typical subspecies and *P. typicus tropicalis.*

P. typicus is plentiful in rocky localities throughout Little Namaqualand: the extreme southern limit of its range is approximately latitude 31°, south of which the coastal hills disappear and level salt-plains extend as far as the Olifants River mouth. In the Kamiesberg *Petromus* occurs as high up as Witwater (3500–4000 feet), but does not ascend to the cloudy Eselfontein plateau nor to the summits of the higher peaks. Its inland range, beyond Platbakkies, was not ascertained; in the Orange River Valley it does not occur east of Kakamas, but in South West Africa it extends as far inland as the Karas Mountains.

Whilst springing from one rock to another this diurnal rodent spreads its flattened body somewhat after the manner of a flying-squirrel; but when running along ledges or inside crevices it might easily be mistaken at a distance for a newly born Rock Dassie. The flat head and body enable it to squeeze inside the narrow horizontal rock fissures which are an essential characteristic of the hills it frequents. The "Dassie Rat" is attracted to some extent by dry bait (mealies, etc.), but its usual diet, judging by the colour of fresh droppings, is green food. The animal has a pleasant aromatic smell. After several have been trapped in one area the remainder seem to become wary and suspicious.

The tails are curiously brittle, and, with careless handling, often snap off in a lizard-like manner. Approximately 10 per cent. of the specimens collected, both in Little Namaqualand and elsewhere, were without tails, the fracture having most frequently occurred at the base.*

* Although, as with many lizards, this brittleness may be a protective aid in escape from enemies, it is suggested, as a matter of speculation, that it may be of peculiar evolutionary significance; the tail, for some reason having become redundant, being in actual process of disappearing—somewhat after the manner in which flying-ants shed their wings. (It may be noted with regard to its not very distant ally the Cane Rat that the tail also breaks off very easily.) The *Chrysochloris*-like iridescence at the base of the tail in *P. typicus tropicalis* (which disappears shortly after death) is peculiar to that subspecies. There is no trace of it in *P. typicus typicus* nor in *P. cunealis.*

Petromus does not breed throughout the year, but appears to have a well-defined breeding season. A female (5th November) contained a late foetus; a young specimen, hardly a fortnight old, was trapped on the same day. The female gives birth to a single young one, less frequently two; the young are born in an advanced state, clothed with short hair, and relatively very large.

Mammae 6 (normally)—lateral: the pectoral pair is sometimes absent. A short "baculum."

Family PEDETIDAE.

85. *Pedetes cafer cafer* (Pallas).

Hottentot: ≠HŌB (Eenriet); ≠GŌB (Goodhouse).

Specimens from Louisvale.

Spring Hares occur somewhat sparsely in the sandy desert between Concordia and Goodhouse; a few burrows were observed within a mile or two of Goodhouse itself. According to local Hottentots they become more numerous farther east towards the northern Bushmanland Border. They do not occur in the coastal regions, on the Kamiesberg, nor, I believe, anywhere in southern Little Namaqualand.

Family HYSTRICIDAE.

86. *Hystrix africaeaustralis africaeaustralis* Peters.

Hottentot: !HÕAB (Eenriet); !NÕAB) (Goodhouse).
'Tkaboek Bushmen: N!NÕAB (H. J. Wikar).

Specimens from Witwater, Eselfontein, Eenriet, and from near Upington.

Widely distributed and comparatively plentiful.

Males average slightly larger than females.

A "baculum" (♂), and a "baubellum" (♀).

Family PROCAVIIDAE.

87. *Procavia capensis capensis* (Pallas).

Hottentot: !ÕUS (Eenriet); !ÃU (Goodhouse); !ÃUB (Kamiesberg).

Specimens from Witwater, Eselfontein, Eenriet, Kameelboom, and from Upington, Swartkop, Aughrabies Falls.

Everywhere plentiful in rocky localities.

Family ELEPHANTIDAE.

(88. *Loxodonta africana africana* (Blumenbach).)

Hottentot: ≠ÕAS (Eenriet); /OAS (Kamiesberg).

In 1760 Jacobus Coetse Jansz (Journals) shot two Elephants between the Coperbergen and Groene Rivers in Little Namaqualand. On 21st September 1779, Hendrick Jacob Wikar shot two out of a herd, some with calves, near Caboopfontein, about 10 miles east of Pella on the south bank of the lower Orange River, and observed places where Elephant and Rhinoceros had been digging for water. On a later expedition he met with still larger herds in the same region (Wikar's Journals).

Family HIPPOPOTAMIDAE.

89. *Hippopotamus amphibius capensis* Desmoulins.

Hottentot: !HAUS (Eenriet); !KHAOS (Goodhouse); !KHAO (Kamiesberg).

A Hippo tusk was picked up in the bed of the Orange River near Upington in 1921 and is now in the Kaffrarian Museum.

Extinct in the Orange River since 1925 (*cf.* Shortridge, Mamm. S.W. Africa, vol. ii, pp. 646-647, 1934).*

"*A cow Hippo and a young one were shot in about* 1925 *at Dabaras, close to the junction of the Orange and Fish Rivers, which were in flood at the time. In* 1920–21 *a big bull Hippo was shot by Louw at Grootderm, between* 17 *and* 18 *miles from the mouth of the Orange River. In* 1913 *there are said to have been two Hippo farther up the river between Pella and the Aughrabies Falls.*"—C. Weidner (1937).

"*Hippo in the upper parts of the Gariep remain during the day in deep parts of the river, commonly known as 'Sea-cow Holes,' and issue out to feed at night.*"—J. E. Alexander (1838).†

(According to Wikar: "*A wounded Hippo will leave the water as it cannot endure the nibbling of the fish!*")

Family SUIDAE.

(90. *Phacochoerus aethiopicus aethiopicus* (Pallas).)

Hottentot: DIRIB (Goodhouse); /KŨ : PU-IS (Eenriet); !PHARKIT (Port Nolloth).

Wart-hog have been extinct in Little Namaqualand for many years; there are few traditions of their former existence.

* See Editor's note on p. 99.

† Alexander afterwards observed similar "Holes" in the Fish River (Great Namaqualand).

"Wild-pig" are said at one time to have existed on bush-covered islands in the Orange River between Upington and the Aughrabies Falls; but it is uncertain whether these were Wart-hog or Bush-pig.

Family GIRAFFIDAE.

(91. *Giraffa camelopardalis capensis* (Lesson).)

Hottentot: !HAIB (Eenriet); !NEIB (Goodhouse).

H. J. Wikar (Journals, 1779) saw the fresh spoor of Giraffe near Caboopfontein, about 10 miles east of Pella (south bank of the lower Orange River), and, later, observed about twenty in the same region.*

Family BOVIDAE.

(92. *Alcelaphus caama caama* (G. Cuvier).)

Hottentot: //KHAMA (Eenriet); //KAMAB (Goodhouse).

Extinct in Little Namaqualand.

According to W. L. Sclater (Mamm. S. Africa, vol. i, p. 133), there were still a few Hartebeest surviving in the deserts of Little Namaqualand and Kenhardt in 1900.†

"*There were no Hartebeest left in Little Namaqualand in* 1903."—C. Weidner.

There is a "Hartebeest River" in Little Namaqualand, a tributary of the Groene River; and another of the same name in Kenhardt District.

(93. *Connochaetes gnou* (Zimmermann).)

Hottentot (Old Cape): 'GNOU.

There appear to be no definite traditions of the former occurrence of Black Wildebeest in Little Namaqualand, but they doubtless extended at least as far west as Bushmanland.‡

* There are not many authentic records of the former occurrence of Giraffe south of the Orange River, but traditions and Bushman paintings indicate their past existence in several parts of the northern Cape Province (*cf.* Shortridge, Mamm. S.W. Africa, vol. ii, pp. 622–623, 1934).

† The Cape Hartebeest was apparently exterminated south of the Orange River very early in the present century. There is a weathered skull in the Kaffrarian Museum which was discovered on the Cape Flats by Dr. J. I. Brownlee over thirty years ago.

‡ North of the Orange River Black Wildebeest used to extend at least as far west as Gordonia. Although Black and Blue Wildebeest are commonly known to overseas zoologists as "White-tailed Gnus" and "Brindled Gnus" respectively, the name GNU (or 'GNOU) of Cape Hottentot origin, adopted by some of the early hunters, Cornwallis Harris, etc., is seldom used colloquially in South Africa.

94. *Sylvicapra grimmia grimmia* (Zimmermann).

Hottentot: /HÕUS (Eenriet); /HÃOS (Goodhouse).

One specimen from Platbakkies (a horned female).

Occurring in most parts of Little Namaqualand, but restricted to suitable localities, such as hill-slopes and level country near hills, where there is a sufficient density of bush and scrub.

Duiker are not uncommon on the Kamiesberg in the more sheltered valleys and ravines.

95. *Oreotragus oreotragus oreotragus* (Zimmermann).

Hottentot: //KHẼISIS (Eenriet); //KHÃISIS (Goodhouse, Kamiesberg).

Specimens from Witwater, Eselfontein, Goodhouse, and from the Aughrabies Falls.

Klipspringer are generally distributed in rocky mountainous country: fairly plentiful on the Kamiesberg.

96. *Raphicerus campestris campestris* (Thunberg).

Hottentot: /ARIS (Eenriet); !ARIS (Goodhouse, Kamiesberg).

Specimens from Eenriet.

Not everywhere plentiful, but widely distributed over the open plains and coastal sand-dunes. Steenbok do not occur on the plateaux of the Kamiesberg.

(97. *Pelea capreolus* (*Bechstein*).)

Hottentot: !KHORIP, SÃMP, !AMI (Eenriet); SÃS (Goodhouse).

The Vaal Rhebok is extremely rare in Little Namaqualand and very little is known about it. A few are believed to exist in the Richtersveld and on other mountain ranges near the mouth of the Orange River, west of its junction with the Fish River. I received rather indefinite reports of one or two small troops on hill ranges south-west of the Kamiesberg. Extinct to-day on the Kamiesberg itself, except for a party of three on one of J. Studer's farms (1936).

98. *Antidorcas marsupialis hofmeyri* Thomas.

Hottentot: //HŨ (Eenriet); //GŪS (Goodhouse); //GŬB (Kamiesberg).

One specimen (skull and horns) from Upington District (subsp. inc.).

Towards the end of the last century Scully shot a Springbok in the Richtersveld which astonished him on account of its size, and was informed that all in that region were about as large. He recalled having read that Francis Galton had shot a specimen near Walvis Bay weighing 160 lb. Scully was also informed that the Richtersveld Springbok did not trek, and suggested that they might be referable to a distinct west coast race.

Antidorcas m. hofmeyri from South West Africa is believed to average heavier than the typical subspecies; its range, therefore, presumably extends coastally across the lower Orange River into Little Namaqualand.*

Springbok are almost extinct in Little Namaqualand: there are some still in the Richtersveld, possibly reinforced now and again by occasional migrants from South West Africa, and a few scattered troops in the north-west towards the Bushmanland Border.

"*Springbok were plentiful near Goodhouse up to about* 1925: *scattered herds of from* 10–20 *still occur. They used to cross the Orange River from the north at Sendlings Drift in herds of* 100 *at a time during the winter months when the water was low. They still cross over periodically in small numbers.*"—C. Weidner (1937).

(99. *Oryx gazella gazella* (Linnaeus).)

Hottentot: /HAIB (Eenriet); /GÄEB (Kamiesberg);
/GÄES (Goodhouse).

A few Gemsbok still survive in the Richtersveld, near the mouth of the Orange River, where they are protected so far as possible. In January 1937 (Port Nolloth) a poacher was fined for shooting one.

(In 1835–6, Alexander recorded Gemsbok from Komekas, near the Orange River mouth.)

They are extinct elsewhere in Little Namaqualand, except for occasional individuals or small parties that cross the Orange River at low water from South West Africa between its junction with the Fish River and Pella.

"*There are very few Gemsbok south of the Orange River to-day ; on the north bank they were plentiful up to about* 1930, *where, from Sperlingsputs westwards, herds of from* 30 *and* 40 *to* 60 *were seen together. They*

* If this is correct, the typical race (*A. m. marsupialis*) from "Southern Cape Colony" may be extinct in a feral state everywhere south of the Orange River and only represented there to-day inside fenced farms. I doubt the validity of *A. m. centralis*, typically from Deelfontein; the Kaffrarian Museum possesses a mounted head from Middleburg, only 20 miles from Deelfontein, which does not differ from Cradock and Bedford specimens.

have been scarce since the great drought of 1932 *and have been much shot out.*"—C. Weidner (1937).

(100. *Strepsiceros strepsiceros strepsiceros* (Pallas).)

Hottentot: ꭓEIB (Eenriet, Kamiesberg); ꭓYB (Goodhouse).

Kudu are practically extinct in Little Namaqualand: there may be a few in the Richtersveld; and occasional stragglers from South West Africa have been recorded within recent years from mountains close to the Orange River between the Fish River mouth and Pella.

In 1921 I saw Kudu tracks on the north bank of the Orange River near the Aughrabies Falls.

In 1779, H. J. Wikar (Journals) observed "a large herd of Kudu" in Little Namaqualand.

"*The last Kudu shot in the Kamiesberg was between thirty and forty years ago.*"—J. Studer (1936).

"*The last four Kudu observed near Goodhouse were at Haakiesdoorn Farm (Sperlingsputs) in about* 1921: *one of them was watched coming down to drink. In about* 1933 *a single individual was seen close to Pella Drift.*"—C. Weidner (1937).

(101. *Taurotragus oryx oryx* (Pallas).)

Hottentot: !HANS (Eenriet); !KHAN (Goodhouse).

In 1835–36, Alexander found Eland in Little Namaqualand near the mouth of the Orange River (presumably in the Richtersveld).

(102. *Syncerus caffer caffer* (Sparrman).)

Hottentot: /GAUB (Goodhouse).

In 1779, H. J. Wikar (Journals) saw skulls of Buffalo, which had been killed by natives, before crossing the Orange River, and, later, observed big herds along the banks of that river.

There is a "Buffels River" in Little Namaqualand.

Family RHINOCEROTIDAE.

(103. *Ceratotherium simum simum* (Burchell).)

Hottentot: !HĀBA (Eenriet).

Although the Black Rhinoceros (*D. bicornis*) was always, presumably, more plentiful than *Ceratotherium simum* south of the Orange River, !HĀBA, the Hottentot name, still locally surviving, refers correctly to the White species, an indication of its former occurrence in Little Namaqualand.*

(104. *Diceros bicornis bicornis* (Linnaeus).)

Nama Hottentot (Great Namaqualand): /KI : S.

H. J. Wikar (Journals, 1779) met with Rhinoceros at Caboopfontein, Kaykoop (many of these early name-places have been lost sight of), and elsewhere in Little Namaqualand.†

Family EQUIDAE.

(105. *Equus* (*Quagga*) *quagga quagga* Gmelin.)

Hottentot: /HEI/NOREB (Eenriet); ≠NŪ!GOREB (Goodhouse).

Hottentot names for two kinds of Zebra still survive in Little Namaqualand; it is presumed that the Zebra of the plains was the "Cape" Quagga. In 1779, Wikar (Journals) noted the occurrence of "Wild Horses," as opposed to "Zebras" in Little Namaqualand.‡

(106. *Equus* (*Hippotigris*) *hartmannae hartmannae* Matschie.)

Hottentot: /ŨE/NOREB (Eenriet); !GOREB (Goodhouse, Kamiesberg).

It seems almost certain that the Mountain Zebra which formerly existed in Little Namaqualand was the South West African *Equus hartmannae*. Within the last ten years or so there have been one or two accounts of stray Zebra seen between Klipfontein and the Richtersveld; these may have been temporary migrants from the north bank of the Orange River which, in the dry season, is fordable in several places.§

* In the Port Elizabeth Museum there is a weathered pair of White Rhinoceros horns (*oswellii* type), discovered at Seeheim (Great Namaqualand) by G. Wicham in 1919.

† In 1895–96, Alexander recorded both species of Rhinoceros from the Fish River Valley in Great Namaqualand.

‡ In Alexander's Map (1835–36) "Plains with Zebra" is inscribed on the north bank of the Orange River about opposite to where Goodhouse now stands; but the Zebras recorded by Alexander from Great Namaqualand, "with striped neck and body and unstriped white legs," were perhaps referable to the Griqualand West subspecies, *E. quagga burchelli*, now, like the Cape Quagga, extinct.

§ *E. hartmannae*, which has a wide but disconnected and sparse distribution in the coastal mountains of South West Africa, is said still to occur in southern Great

There are traditions of the past existence of Mountain Zebra on the Kamiesberg, supported by name places, such as Eselkop, Eselfontein, "Wilde Paard Hoek" (Alexander), etc.

Expedition No. 2: The North-West Cape Province (November 1937–February 1938).

On a Collection of over 1500 *Mammals from the Olifants River Basin and surrounding country.*

Five main collecting camps were made at the following places:—

1. *Nieuwoudtville:* 42 miles west of Calvinia; altitude 3500 feet approx. Situated on the western edge of the Bokkeveld Mountains near the summit of Van Rhynsdorp Pass. Heathy high-veld with numerous small springs; and fairly open, level, and undulating sandy bush-veld; a few patches of limestone outcrop. One or two farms and a small amount of cultivation.

2. *Travellers Rest:* 18 miles north-east of Clanwilliam; altitude 600 feet approx. A sheltered valley, partly under cultivation, between rocky hills and ridges of outcrop. A belt of swamp vegetation along the banks of the Boontjes Stream, an affluent of the Doorn River—itself a tributary of the Olifants River.

3. *Kliphuis* (*Pakhuis Pass*)*:* about 11 miles east of Clanwilliam, on a northern spur of the Cedarberg Mountains; altitude 2500–3000 feet. A narrow defile between precipitous cliffs; rather thick bush and much rocky outcrop; several mountain streams.

4. *Hex River Estate*:* low-lying country close to the Olifants River, partly surrounded by steep rocky hills; flats under cultivation, orange orchards, etc.; altitude 300 feet approx. 10 miles north of Citrusdal.

5. *Compagnies Drift:* 10 miles inland from Lamberts Bay; altitude 100 feet approx. Undulating soft sandy country with an even peppering of comparatively low bush. Occasional narrow stretches

Namaqualand between the Fish River mouth and Kanus Railway Station (near Luderitz).

In 1895, C. Weidner met with many Mountain Zebra in the Tiras Mountains in Great Namaqualand, and, as recently as 1921, saw a few on some hills about 10 miles north of the Orange River opposite Goodhouse.

* This Hex River is a small tributary of the Olifants River, and must not be confused with the better-known river of the same name which rises in the Hex River Mountains.

or pools of surface water in the bed of the "Jakkals" River. A few scattered farms and patches of corn land.

Short visits were paid to *Clanwilliam, Lamberts Bay, Klaver, Citrusdal, Het Kruis, The Cold Bokkeveld* (S.E. of *Citrusdal*), etc.: specimens from these and other named localities were also collected and contributed by local residents.

59 out of 73 recorded species were collected: of the remaining 14, 3 are extinct, and 7 of the others widely distributed or locally scarce forms previously obtained in Little Namaqualand.

Family MACROSCELIDAE.

1. *Macroscelides proboscideus* subsp.

One specimen from Compagnies Drift, near Lamberts Bay.

M. proboscideus langi was described from Vlermuisklip, Van Rhynsdorp District, about 25 miles distant, but I am unable to form an opinion as to the subspecific status of this single specimen; it matches very closely Little Namaqualand material, which, following Thomas, who compared Grant's Namaqualand series with the type, I referred previously to *M. proboscideus melanotis*.*

2. *Elephantulus capensis* Roberts.†

Specimens from Travellers Rest, Kliphuis, Citrusdal, Hex River Estate, Het Kruis.

Tail gland slightly ridged; length $\frac{1}{2}$–1 inch; width about 1 mm.

Family CHRYSOCHLORIDAE.

3. *Chrysochloris asiatica* (Linnaeus).

Four specimens from Citrusdal.

These examples, with greenish reflections, match typical specimens of *C. asiatica* from Cape Town.

* The typical subspecies was described from "The Cape" (Beaufort West?).

† *Elephantulus edwardsii* was described by Sir Andrew Smith from "near the Olifants River, Cape Colony"; but since *capensis* is the only species of *Elephantulus* known to occur in the North-Western Cape Province (south of Little Namaqualand), the greater part of which comprises the basin and watershed of the Great Olifants River, I suspect the Olifants River referred to by Smith to be another of the same name which flows past Oudtshoorn, through a region in which he collected. This second Olifants River is a main tributary of the Gouritz River, which enters the sea near Mossel Bay. *Elephantulus vandami*, typically from Cradock, may prove

4. *Chrysochloris minor* Roberts.

Hottentot: 'TSANGGAS (Lamberts Bay).

Specimens from Compagnies Drift and Graaffwater (both inland from Lamberts Bay), Travellers Rest, Kliphuis.

Lamberts Bay is about 25 miles from Klaver, the type locality for *C. minor.* The majority of the above specimens are distinguishable externally from *C. asiatica* by the metallic reflections on the back being violet or indigo without a trace of greenish, and by their definitely smaller *average* size, although the dimensions of some examples in the present large series (up to 115 mm. in length) exceed considerably those of the type.

In the Lamberts Bay material there are two colour forms: (*a*) darker (typical), and (*b*) paler (without decided metallic lustre); they appear to intergrade, but, pending further examination, I am not altogether satisfied that they are all referable to the same species. Many bear some resemblance to Kamiesberg specimens (referred to *C. namaquensis*) in their smaller size and brownish general coloration; darker and larger specimens correspond more closely with *C. asiatica.* Although occurring in the same region (the Lamberts Bay hinterland), *Chrysochloris minor* and *Cryptochloris zyli* differ altogether in choice of habitat. *Chrysochloris,* which is plentiful, inhabits alluvial soil near the banks of streams, cultivated lands, etc.; whereas *Cryptochloris,* relatively scarce, is restricted in range to the white coastal sand-dunes and occurs side by side with *Eremitalpa granti*; the two making similar runways and appearing to be almost identical in habits.

5. *Chrysochloris concolor* Shortridge.

Two specimens from Nieuwoudtville (42 miles west of Calvinia),* and Travellers Rest.

A study of colour variations in a large series of *Chrysochloridae* from around Lamberts Bay, one of which is almost as pallid as *C. concolor,* indicates that both *C. minor* and *concolor* are closely allied to *C.*

to be synonymous with *E. edwardsii* when accepted topotypes of the latter become available for comparison. There are specimens of *Elephantulus* in the Kaffrarian Museum from Bedford, between Cradock and the "Oudtshoorn" Olifants River.

(There is a third Olifants or Olifants Vlei River in the Cape Province, in Kenhardt District.)

* In the South African Museum there is a specimen of *Chrysochloris* from Calvinia, labelled *C. calviniae* (Lang)—"type"; but no description was ever published. The skin (without skull), made up from an old spirit specimen, is bleached beyond recognition and quite useless for diagnostic purposes.

asiatica. For geographical reasons, however, the (apparently) inland high-veld range (Nieuwoudtville-Calvinia) of *concolor* is in favour of its specific rank being provisionally retained.

Around Nieuwoudtville *Chrysochloris* runways were sometimes found to radiate from the base of bushes: they are also relatively numerous in cultivated and open grass lands. When the shallow tunnels occur in thick turf their course can be traced by disturbed grass roots, in addition to the usual surface cracks. Golden Moles burrow and move about below ground at all hours; most if not all of them, however, appear to be more active during the night, when they often travel overland.

6. *Eremitalpa granti* (Broom).

Three specimens from Compagnies Drift.

These appear to match exactly the large Port Nolloth series previously collected. *Eremitalpa* does not seem to be so plentiful around Lamberts Bay (where it occurs side by side with *Cryptochloris*) as at Port Nolloth. It is possible that both genera extend as far south along the coast as the Berg River mouth.

7. *Cryptochloris zyli* Shortridge.*

Specimens from Compagnies Drift.

Except for being a shade paler, *Cryptochloris zyli* much resembles average specimens of *Chrysochloris minor* in colour; but the fur is shorter (more plush-like) and the silvery-violet reflections are restricted to a profuse peppering of metallic hairs which are very slightly coarser than the smoky underfur: this gives the back an obscurely spangled appearance. In *Cryptochloris* the hindclaws are larger and longer than in *Chrysochloris minor.* The three long foreclaws are subequal, to the extent that they meet almost in a point; in the type the foreclaw measurements are as follows: 1st, 6·5; 2nd, 8; 3rd, 10; 4th, 2 mm. The 2nd claw protrudes slightly beyond the 1st and 3rd, the 1st being much longer and stouter than in *Chrysochloris.*

Cryptochloris would seem to form a link between *Chrysochloris* and *Eremitalpa.*

* In the original description of *Cryptochloris zyli* I suggested the possibility of *Chrysochloris wintoni* being allied to it, owing to some cranial similarity; but skins of *wintoni* indicate that it has the cylindrical shape of a *Chrysochloris*; whereas *Cryptochloris* and *Eremitalpa*, in life, differ from all other members of the family in being lozenge-shaped and flattened, like small tortoises.

When handled *C. zyli* gives vent to a fairly sharp squeak; it shams dead when first picked up or even when turned over with a spade. The surface runways are quite like those of *Eremitalpa*, except that, owing to the extremely powdery nature of the sand in which it burrows, the roofs of the tunnels fall in almost at once and form shallow furrows. After rain, when there is a slight crust on the sand, fresh workings are indicated by minute surface cracks which disappear as soon as the ground becomes dry. The deeper tunnels were usually found to lead to the base of bushes; this tendency for the "lying up" chambers to be situated under and protected by the tangled roots of desert vegetation was not noticed in the case of *Eremitalpa*. After unsuccessful attempts to dig them out, they almost invariably desert the disturbed ground and escape overland the following night, often to a distance of several hundred yards. Judging by the number of surface tracks visible in the early mornings these tiny sand moles travel considerably above ground by night.*

Range: the coastal sand-dune belt within about 10 miles of the sea south of the Olifants River mouth, and perhaps some distance northwards.

Family SORICIDAE.

8. *Suncus warreni* Roberts.

Specimens from Compagnies Drift, Redlinghuis.

These Pigmy Shrews agree well with the description of *S. warreni*, typically from Doorn River, Van Rhyndorps District, a region not far from Compagnies Drift.

A very uniform series at once distinguishable from *S. varilla* by the far more pallid dorsal coloration, whitish underparts and feet, bicolored tail and longer fur.

9. *Suncus gracilis* (Blainville).

One specimen from Compagnies Drift (Coll. No. 3652).

A few shades darker above than *S. warreni* and without rusty tips to the hairs; underparts slate, hardly paler than above; hands and feet dusky and markedly larger than in *warreni*; tail dark slate above and below. Resembling *warreni* in its relatively long fur.

Pending further comparative material this Pigmy Shrew is referred provisionally to *S. gracilis*, typically from "The Cape of Good Hope."

* More so, perhaps, than do any of the other small *Chrysochloridae*, but the Giant Forest Golden Mole (*Chrysospalax trevelyani*), during the summer months, spends a very great deal of its time above ground amongst dead leaves and wandering about in thick undergrowth.

10. *Crocidura cyanea* (Duvernoy).

One specimen from Citrusdal (Coll. No. 221).

A medium-sized pale smoky-grey Shrew, quite certainly referable to and consequently topotypical of *C. cyanea*, which was originally described in 1838 from "La rivière des Eléphants, au sud de l'Afrique."

Citrusdal, which is situated centrally on the Olifants River, may now be fixed as a definite type locality for *Crocidura cyanea*.*

11. *Crocidura martensii* Dobson.†

Specimens from Citrusdal, Het Kruis, Redlinghuis, Hex River Estate, Vredendal, Travellers Rest, Kliphuis, Compagnies Drift, Elands Bay.

This very uniform series agrees in all respects with Little Namaqualand specimens.

Comparatively plentiful and widely distributed over the North-Western Cape Province. Habitat: sandy, grass or rocky country; attracted by irrigated gardens at Travellers Rest.

12. *Myosorex varius varius* (Smuts).

Specimens from Kliphuis, Redlinghuis, Het Kruis, Citrusdal, Hex River Estate, Compagnies Drift

A series matching closely specimens previously collected in Little Namaqualand; some of the Namaqualand specimens are perhaps a shade paler.

Family NYCTERIDAE.

13. *Nycteris capensis capensis* A. Smith.

Specimens from Compagnies Drift.

Family RHINOLOPHIDAE.

14. *Rhinolophus capensis* Lichtenstein.

Specimens from Compagnies Drift, Het Kruis. One specimen (Het Kruis) illustrates the bright orange phase.

* *Crocidura argentata* (Sundeval), apparently a similar, if not still paler silver-grey species, typically from Roodeval (near Cookhouse), about half-way between Cradock and Grahamstown, Eastern Cape Province, was described in 1860, over twenty years after *C. cyanea*.

† It may be that *Crocidura martensii* is a synonym of *C. capensoides*.

Family VESPERTILIONIDAE.

15. *Cistugo lesueuri* Roberts.

Two specimens from Hex River Estate. Also identified in flight at Clanwilliam.

Wing glands are present, but in an entirely different position to those in *C. seabrae*. In *C. lesueuri* the glands are less thickened, narrower, and situated in the wing membrane a short distance from the centre of the radius. In dry skins these glands become absorbed and lost to sight. Larger and darker in colour than *Cistugo seabrae*, but similar in flight. Appearing on the wing as early in the evening as *Eptesicus*, and favouring the close neighbourhood of orange groves and other shade trees.

16. *Eptesicus capensis capensis* (A. Smith).

Specimens from Travellers Rest, Compagnies Drift.

Compagnies Drift specimens were much infested with parasites (*Cimex* sp.).

17. *Scotophilus angusticeps* Shortridge.

Two specimens from Hex River Estate; also identified on the wing at Citrusdal.

Similar in flight to other members of the genus; appearing to favour the neighbourhood of shade trees.

Family MOLOSSIDAE.

18. *Nyctinomus bocagei* Seabra.

One specimen from Compagnies Drift.

Agreeing in measurements with specimens from the Orange River (Upington District) referred by Oldfield Thomas to *N. bocagei.**

* In the Kaffrarian Museum large series of *Nyctinomus* from the Eastern Cape Province and elsewhere have variable forearm measurements, but they intergrade and extremes often occur side by side in the same colonies: (*a*) larger, with a forearm averaging 52 mm., perhaps referable to *N. africanus*; and (*b*) smaller, with a forearm averaging 48–49 mm., provisionally referred to *N. bocagei*. Glover Allen (in litt., 15th June 1939) believes that the names *Nyctinomus condylurus* and *N. dubius* of A. Smith, 1833, should prove identifiable if one knew all of the South African species, and may perhaps replace other names now in current use.

In his recent Check List of African Mammals (p. iii), Allen notes that *N. condylurus* is probably valid for the larger *Nyctinomus* of South Africa (=*N. africanus*?); and that, although its status is uncertain, *N. dubius* is probably applicable to some one of the South African species of *Chaerephon* or *Nyctinomus*.

19. *Platymops haagneri umbratus* Shortridge.

One specimen from Kliphuis.

Shot whilst flying high amongst pine trees shortly after sundown. About three others were observed.

A second representative of a genus new to the Cape Province.

Family CERCOPITHECIDAE.

20. *Papio comatus comatus* E. Geoffroy.*

(Plate VII.)

Specimens (skulls) from Hex River Estate.

* The Eastern Cape Baboon, which appears to have an almost consistently longer skull than typical *comatus* from the Western Cape (type locality "The Cape of Good Hope") and the darker form from South West Africa, has been separated under the name *P. c. orientalis* Goldblatt. In *P. c. comatus* the general coloration is browner (approaching rufescent in an old Kamiesberg male) than in *P. c. orientalis*. *P. c. orientalis* is paler (greyish-buff in an old male from Grahamstown) and more heavily grizzled.

I agree with Hewitt in objecting to Schwarz's choice of a Queenstown specimen as lectotype of *orientalis*, in view of the fact that over fifty Albany examples (including some females and young) were examined by Goldblatt, and only two males from Queenstown. Moreover, Queenstown was not even mentioned amongst the list of specimens that possess the characteristic rostro-cranial angle of *orientalis* (*cf.* Goldblatt, S. Afr. Journ. Sci., xxiii, p. 772, December 1926). Schwarz clearly should have chosen an Albany specimen (especially since comparative material is so easily obtainable from that region), and I therefore designate as a substitute lectotype of *orientalis* an Albany specimen in the Kaffrarian Museum (K.M., No. 1686 *d*, a very large adult male from Atherstone, near Grahamstown, collected 12th April 1933).

A further reason for rejecting the Queenstown lectotype is because there is an adult male (mounted) in the Kaffrarian Museum from the Pirie Forest, near King William's Town (about 70 miles south-east of Queenstown), which differs from the Albany series in the hind feet being without a trace of blackish, and the hands and lower forearms only slightly darkened. Without further Pirie and Queenstown material it is impossible to tell whether dark or grey feet are in any way locally constant characters in the North-Eastern Cape Province. The skull of a male from Kubusie (within 25 miles of King William's Town) is shorter than in Albany and Bedford specimens, and approaches typical *comatus* in this respect.

Papio comatus ruacana subsp. n.

I propose the above name for the race from Damaraland, the Kaokoveld, and S.W. Angola—Baboons were observed on the Angola side of the Rua Cana Falls of the Cunene River. General coloration in *ruacana* more ochraceous than in either of the southern races and very much darker dorsally, a broad and well-defined area extending along the centre of the back. In both *comatus* and *ruacana* there is a heavier suffusion of black on the feet, hands, and forearms than in *orientalis*.

Family MUSTELIDAE.

21. *Ictonyx orangiae orangiae* Roberts.

Specimens from Compagnies Drift, Het Kruis.

The specimens from Compagnies Drift (Lamberts Bay) are topotypical of *I. orangiae arenarius*, but I can see no distinguishing characters.

Type (in the Kaffrarian Museum): No. 3646, adult male, collected 23rd June 1927, at Otjiwau (10 miles north of Kaoko-Otavi), Kaokoveld. Dimensions of type: H. & b. 850, Tl. 540, Hf. 210, Ear 57 mm.

P. c. ruacana is a relatively short-skulled race, like typical *comatus*, but with somewhat broader nasals. Greatest skull length (of No. 3993, a large male, topotype, also from the Kaokoveld) 215 mm. Breadth across nasals 52·5 mm.

Eight adult uniformly coloured specimens (4 ♂♂ from the Kaokoveld; 1 ♂ from Karibib, S. Damaraland; also 3 unmeasured skins and 1 skull, ♂♂, from Gobabis District.

Of other accredited races of *Papio comatus* from Southern Africa, *P. c. rhodesiae* Haagner from Southern Rhodesia, *P. c. transvaalensis* Zukowsky from near Messina, northern Transvaal, and *P. c. jubilaeus* Schwarz from Misale, close to the Northern Rhodesia-Nyasaland Border, are regarded by Schwarz as synonyms of *P. c. griseipes* Pocock, described from a captive specimen that was supposed to have come from Potchefstroom, southern Transvaal. I agree with Schwarz in suspecting that the type of *griseipes* originated from the northern Transvaal or Southern Rhodesia, rather than so far south as Potchefstroom. (There is a grey-footed Baboon, "adult male, mounted," in the McGregor Museum from Southern Rhodesia.)

P. c. jubilaeus (*cf.* E. Schwarz, Ann. Mag. N.H., ser. 10, vol. xiv, p. 260, 1934) from east-central Northern Rhodesia is now regarded by its describer as a synonym of *griseipes*; it should therefore be compared with *P. c. chobiensis* Roberts, in view of the fact that a specimen in the Kaffrarian Museum from the middle Kafue River in central Northern Rhodesia, collected by Gordon Lancaster, is indistinguishable from topotypes of *P. c. chobiensis*, males of which approach *P. c. orientalis* in skull length. In a series, 3 from the Chobi River, Caprivi, and 3 from the north bank of the Zambesi, Sesheke District, west of Livingstone, colour variation would seem to indicate that *chobiensis* and *ngamiensis* are inseparable. Even before the bridge was built, the "Rain Forest" Baboons were able to cross the Zambesi, *via* the Victoria Falls, at low water; and occur there, as elsewhere east of the Gonye Falls, on both sides of the river. Haagner (S. Afr. Mamm., p. 17, 1920) records *P. c. rhodesiae* (=*griseipes*) from the Kafue Flats; and Schwarz refers specimens from Kabulabula, west of Livingstone, and from various parts of Southern Rhodesia and Portuguese East Africa, to as far south as Lourenço Marques, to *griseipes*. Baboons referable to *chobiensis* (or perhaps the earlier described *jubilaeus*) are essentially tree-dwellers and inhabit regions where there are often neither rocks nor hills; and I incline to the belief that the Forest Baboons of the Caprivi and Northern Rhodesia will prove distinguishable from *griseipes* from the more open and frequently rocky regions of Southern Rhodesia.

22. *Ictonyx striatus striatus* (Perry).

Specimens from Citrusdal, Travellers Rest, Clanwilliam.

An external distinction (in this region) between *I. orangiae* and *I. striatus* appears to be the more slender and relatively longer foreclaws in *orangiae.**

(23. *Mellivora capensis capensis* (Schreber).)

Sparsely but apparently widely distributed.

Van Zyl (Compagnies Drift) records an instance of a Ratel attacking and killing a Caracal.

Family LUTRIDAE.

(24. *Anonyx capensis capensis* (Schinz).)

Said to occur in the Olifants and Berg Rivers, and occasionally along the coast.

(25. *Lutra maculicollis maculicollis* Lichtenstein.)

Probably more numerous than *Aonyx capensis* in the North-Western Cape Province. One (at least) of the two species of Otter is plentiful in the Olifants River.

Comatus, orientalis and *ruacana* favour rocky, often entirely treeless, hill country.

If there should prove to be a distinguishable southern Transvaal form of *comatus*, the name *occidentalis* Goldblatt might perhaps be revived for it, since the lectotype (a skull in the Witwatersrand University) came from Rustenburg, west-central Transvaal, of which *P. c. nigripes* Roberts from the Magalakuin River, north-western Transvaal, may be a synonym.

Notwithstanding very much smaller skulls and more slender limbs, body dimensions of specimens in the Kaffrarian Museum referred to *Papio cynocephalus* are not appreciably less than of *Papio comatus*. The foreshortened, almost vervet-like skull of the former would seem to signify more than a specific difference between *P.* (*Chaeropithecus*) *cynocephalus* and *P. comatus*.

The skin of a newly born specimen of *P. cynocephalus* is clothed with pure white woolly fur, except on the crown where the hairs are dusky slate basally. An equally young example of *P. comatus* is sparsely clothed with lanky blackish hairs.

P. cynocephalus, as its long limbs indicate, is extremely agile. It is probably one of the swiftest of all the *Primates*, and will run like a Jackal when hunted; only taking to trees in a last emergency.

It may be accepted that *P. cynocephalus* does not occur in Southern Rhodesia, nor anywhere in Portuguese East Africa south of the Zambesi.

* The occurrence side by side of (apparently) closely allied forms, although unusual, is not unique; and there may be structural differences (*e.g.* in the "bacula") to account for the presumed stability of *Ictonyx striatus, orangiae,* and *kalaharicus*.

Family CANIDAE.

(26. *Otocyon megalotis megalotis* (Desmarest).)

Occurs in the coastal sand-plains, but apparently not plentiful. Cubs resemble adults in colour, being smoky grey with blackish on limbs and tail; owing to the absence of rufous coloration anywhere, Delalande's Fox cubs cannot be mistaken for those of Jackals (*C. mesomelas*) or Silver Foxes (*V. chama*).

27. *Canis* (*Thos*) *mesomelas mesomelas* (Schreber).

Specimens from around Clanwilliam.*

28. *Vulpes chama* (A. Smith).

Specimens from Compagnies Drift and around Clanwilliam

Plentiful in the coastal sand-veld. I found Silver Foxes particularly numerous around Lamberts Bay, and Mr. van Zyl, at Compagnies Drift, informed me that he regarded them as innocuous and was satisfied that they did not, habitually at any rate, attack lambs. There is, of course, no knowing what a hungry animal might do under exceptional circumstances. Stomach contents indicate that they feed mainly upon small rodents, insects (locusts, beetles, etc.), lizards, small ground-nesting birds, and, more occasionally, the young of hares (and of Suricats—C. H. B. Grant). These tiny foxes must account for countless numbers of gerbils and other plague-carrying rodents, and should, like Delalande's Fox, be protected by legislation.

Apart from difference in size, there is some similarity between the cubs of Black-backed Jackal (*C. mesomelas*) and Silver Fox (*V. chama*). In quite young cubs of approximately the same age, the Jackal is woolly throughout, and dull rufous-brown in general coloration with

* "Habitat modification" is well exemplified in *C. mesomelas*. In arid regions these Jackals become bleached-looking. *C. mesomelas arenarum* from South West Africa is markedly paler than typical *mesomelas*, but individuals from Little Namaqualand and other intervening regions show gradation between saturate and desert coloration extremes. *C. mesomelas achrotes* from Rooibank (Walvis Bay hinterland) may prove to be inseparable from *arenarum*; the Namib Desert is a coastal strip of particularly arid country, averaging only 30 miles in width, although climatically and physically quite unlike the interior highlands. The type of *achrotes* is certainly considerably paler than any specimens of *arenarum* collected, but it may be an unusually light coloured individual, since a topotype recently received by the Kaffrarian Museum from Walvis Bay is not much paler than average inland specimens.

a smoky tinge due to a scattering of slightly longer fine black hairs; the head is less contrastingly rufous than in the Fox; but the legs and feet are uniformly rufous; the tail relatively short-haired and tapering, as in the puppies of dogs.

In Silver Fox cubs the general coloration is buffy (much more pallid); the greyish grizzling on the back and forehead, due to an admixture of white-tipped hairs, being already manifest; and, except on the head which is contrastingly rufous, the fur is much less woolly. The legs are pale buffy, shading to rufous on the upper forearms and thighs only. Tail, at least a third longer than in the young Jackals, cylindrical and starting to become bushy at an early age.

Family VIVERRIDAE.

29. *Genetta genetta felina* (Thunberg).

Specimens from Travellers Rest, Compagnies Drift, and around Clanwilliam.

Little Namaqualand specimens and the present series match Eastern Cape Province material.

30. *Atilax paludinosus paludinosus* (G. Cuvier).

Specimens from Compagnies Drift.

The Water Mongoose extends to the coast around Lamberts Bay. I believe it to be quite plentiful along the banks of the Olifants River.

31. *Cynictis penicillata penicillata* (G. Cuvier).

Specimens from Compagnies Drift, Klaver, Het Kruis.

As may be expected, there is gradual intergradation between *C. p. penicillata* and *C. p. pallidior*; the extremes, however, are very distinct.

32. *Myonax pulverulentus pulverulentus* (Wagner).

Specimens from Travellers Rest, Klaver, Kliphuis, Redlinghuis, Compagnies Drift.

The Lamberts Bay (Compagnies Drift) series is topotypical of *Myonax p. maritimus,* and the specimens in this collection form in every respect a connecting link between what has hitherto been regarded as typical *pulverulentus* and *ruddi.* In one Lamberts Bay specimen there are traces of a dark dorsal patch which renders it indistinguishable from typical summer specimens of *M. p. ruddi* from northern Little Namaqualand and the Kamiesberg. On the other hand, over half a dozen of the Namaqualand specimens match exactly average specimens from the Olifants River basin. The feet, and the lower parts of forearms and hindlegs of all in the present series are darker than in average specimens from the Eastern Cape Province (to at least as far south as Port Elizabeth and Grahamstown), and the tail tip, to the extent of a few dozen hairs only in some instances, is blackish.* In juvenile specimens, however, both from Little Namaqualand and from Lamberts Bay, the black tail tip appears to be consistently well defined.

33. *Suricata suricatta namaquensis* Thomas and Schwann.

Specimens from Compagnies Drift.

The present series matches exactly Little Namaqualand material.†

According to Mr. van Zyl (Compagnies Drift), the Suricat only

* But there is an Eastern Cape specimen in the Kaffrarian Museum (labelled "Kaffraria") with the feet every bit as dark as in any of the Western Cape series, and with a small but well-defined black tail tip. "South" Eastern Cape specimens from Albany and Bedford Districts have slightly more darkly speckled feet and toes than average Kaffrarian examples. ("*Herpestes*" *punctatissimus*, described by Temminck from Algoa Bay in 1853, is presumably a synonym of *Myonax pulverulentus*; an Algoa Bay specimen of *pulverulentus*, lent for examination by the Port Elizabeth Museum, is indistinguishable from Albany and Bedford material.)

Since the type of *pulverulentus* came from the Western Cape Province ("Cape of Good Hope"), I shall not be surprised if material from the Cape Peninsula and other adjacent regions indicates that the dusky-footed *maritimus* is a synonym of typical *pulverulentus* (Redlinghuis is approximately half-way between Lamberts Bay and Cape Town), and the uniformly grey and more distant form, from Kaffraria and the interior high-veld, northwards to Basutoland, synonymous with or not very distinct from the geographically adjacent *M. p. basuticus*.

Large series of *Myonax pulverulentus* in the Kaffrarian Museum, numbering over 60 specimens, show gradual colour intergradation between the variably semi-melanistic *ruddi* in the north-west and the uniformly grey form, which I refer to *basuticus*, in the north-east; typical *pulverulentus* being the connecting link between them.

R. I. Pocock (Fauna of British India, vol. i, p. vii, Preface, 1939) writes: "*Where a complete series of examples of a species spread over a wide diversified area is available, it is the custom to select for scientific denomination the best differentiated local races, leaving the equally interesting intermediate forms without the trinominal symbol . . . large numbers of names, although without real significance, have to be reckoned with and investigated by the serious student, thus leading to waste of time and making his task, difficult enough already, still more exacting and arduous.*"

† The two most distinct and geographically distant known forms of *Suricata* are *S. s. hahni* from the western Kalahari and *S. s. lophurus* from the Eastern Cape Province. When the Windhuk Zoo was in existence a number of specimens of *hahni* were kept; as a result of captivity, the hair had grown profusely and they had become almost indistinguishable from *lophurus*.

crossed the Olifants River from the north and established itself around Lamberts Bay in 1925 after the large Olifants River dam was completed. Previously a wide permanently flowing river, the lower reaches are now almost entirely diverted for irrigation purposes. In consequence it no longer forms a barrier against the migrations of small mammals. The Suricat is to-day extremely plentiful in soft sandy country around Lamberts Bay, to as far inland as Graaff-water. It excavates warrens in soft sand, whereas in Namaqualand it usually selects hard patches of ground even where the surroundings are sandy. It has not, as yet, extended farther south along the basin of the Olifants River. Around Lamberts Bay, as elsewhere where both occur, *Suricata* and *Cynictis* live in close association.

Family PROTELIDAE.

34. *Proteles cristatus canescens* Shortridge.

Specimens from Kliphuis, Clanwilliam, Klaver.

Family FELIDAE.

35. *Felis lybica cafra* Desmarest.

Specimens from Clanwilliam, Compagnies Drift.

The young of *F. l. cafra* from the North-West Cape Province are sometimes almost as strongly striped and spotted as *Felis nigripes*; and the markings are somewhat similar.*

(36. *Felis* (*Panthera*) *pardus melanotica* Gunther.)

Leopards occur in the Cedarberg and in other sparsely populated mountainous regions in the North-West Cape Province.

37. *Caracal caracal caracal* (Schreber).†

Specimens from around Clanwilliam.

* A very young kitten from Kovares, S. Kaokoveld, referable to *F. l. namaquana* or *xanthella*, is pale rufous narrowly and indistinctly banded with deeper rufous, the leg-bars only being dusky.

† Cape Province material (34 specimens) indicates that *C. caracal coloniae* is inseparable from the typical race. Among considerable series in the Kaffrarian Museum there is some amount of individual colour variation: Caracals from South West Africa average, as may be expected, slightly paler and more brightly rufous (less grizzled); on the other hand, specimens from the Caprivi and Northern Rhodesia are hardly distinguishable from the Cape series.

It is easy, when unaccompanied by more positive characteristics, to overestimate

Family OTARIIDAE.

(38. *Arctocephalus pusillus* (Schreber).)

The Cape Sea-lion is said to breed on Elephants Rock off the mouth of the Olifants River.

Family ORYCTEROPODIDAE.

(39. *Orycteropus afer afer* (Pallas).)

The Aardvark occurs very sparsely inland from Lamberts Bay, and elsewhere in the coastal and subcoastal sand-veld.

Family LEPORIDAE.

40. *Lepus capensis capensis* Linnaeus.

Specimens from Compagnies Drift.

Underparts more strongly suffused with yellowish rufous than in *L. capensis granti* from Little Namaqualand.

Plentiful in the coastal sand-veld belt around Lamberts Bay.

Some specimens were much infested with ticks.

41. *Lepus saxatilis saxatilis* F. Cuvier.

Specimens from Travellers Rest, Kliphuis, Compagnies Drift.

Plentiful in rocky and mountainous country; scarce in the coastal sand-veld (around Compagnies Drift, etc.).

Although normally rather sluggish, these large hares show considerable speed when coursed by dogs: they can double and turn with great agility; I have seen them outpace greyhounds in rocky country. When running, the long legs give them the appearance of small antelopes; hence the Afrikaans name "RIBBOKHAAS."

the significance of saturate and desert coloration, when due to climatic (altitudinal or rainfall) conditions over unsatisfactorily small, patchy, and overlapping regions which can have little geographical bearing. Widely distributed mammals, especially large and medium-sized forms, cannot *very often* be sufficiently isolated within ill-defined and extremely restricted areas to justify multiplicity in subspecific denomination. A colour change definitely due to environment is not necessarily a slow evolutionary process. Caracals from most, if not all, supposedly different faunal regions in Southern Africa, in captivity, would without much doubt become indistinguishable in a year or two. I am of opinion that the wandering habits of the larger carnivora are not taken into consideration sufficiently. (There are, for instance, no less than 36 described subspecies of *Lycaon pictus*, perhaps the most migratory of all African mammals, 15 from East Africa alone.)

42. *Pronolagus crassicaudatus australis* Roberts.

Specimens from Travellers Rest, Kliphuis.

Kliphuis is 11 miles from Clanwilliam, the type locality of *P. crassicaudatus australis*; Travellers Rest (7 miles from Kliphuis) is within sight of Klaver, the type locality of *P. crassicaudatus mulleri*. Klaver and Clanwilliam are 30 miles apart and are both situated on the banks of the Olifants River. *P. c. mulleri*, in my opinion, cannot be distinguished from *P. c. australis*. In the present series from Travellers Rest and Kliphuis (which are inseparable) the amount of smoky blackish suffusion at the end of the tails is variable, some having hardly any trace of it.

"Red Hares" often come out in the early mornings and early evenings as well as by night.

Family MUSCARDINIDAE.

43. *Graphiurus ocularis ocularis* (A. Smith).

Afrikaans (Hottentot extraction): NAMTAP.

One specimen from Clanwilliam.

There are no more savage small rodents than African Dormice; in captivity any other small mammal placed in the same cage with *G. ocularis* is at once attacked furiously; it will kill and feed upon species considerably larger than itself.

Family CRICETIDAE.

44. *Desmodillus auricularis auricularis* (A. Smith).

Specimens from Citrusdal, Het Kruis, Compagnies Drift.

There is individual colour variation, but less than in Little Namaqualand material.

45. *Gerbillus (Gerbillus) paeba broomi* Thomas.

Specimens from Nieuwoudtville, Het Kruis, Citrusdal, Compagnies Drift.

As in *Desmodillus*, there is some amount of individual colour variation, but less so than in the Little Namaqualand series.

46. *Taterona afra afra* (Grey).

Specimens from Nieuwoudtville, Travellers Rest, Kliphuis, Het Kruis, Compagnies Drift.

The Compagnies Drift (Lamberts Bay) series is topotypical of *T. afra gilli*.

Plentiful on the coastal plains and in cultivated sandy country farther inland; also ascending to the mountain plateaux and on to the western edge of the interior highveld. Relatively scarce around Nieuwoudtville, which may approximate to the farthest inland extension of its range. Gregarious; the warrens being often scattered over large tracts of country. A white forehead spot is not unusual.

47. *Otomys irroratus irroratus* (Brants).

Specimens from Travellers Rest, Kliphuis, Hex River Estate, Citrusdal, Clanwilliam, Compagnies Drift, Elands Bay.

There are three jet black melanistic specimens from Elands Bay. This "Vlei" Otomys extends close to the coast at Lamberts Bay along the banks of the Jakkals River, in the bed of which there are small disconnected pools of surface water. To some extent nocturnal here (hot season).

48. *Otomys karoensis* Roberts.*

Specimens from the "Cold Bokkeveld" Mountains (S.E. of Citrusdal).

A mountain species: diurnal; inhabiting belts of dry rushes in heathy country on high mountain slopes. Apparently local.

49. *Myotomys unisulcatus unisulcatus* (F. Cuvier).

Specimens from Travellers Rest, Het Kruis, Enderskuil, Compagnies Drift.

The series from Compagnies Drift (Lamberts Bay) is topotypical of *M. unisulcatus bergensis*, with which specimens from southern Little Namaqualand (Kameelboom, Kamiesberg, etc.) may also be compared.

(50. *Parotomys brantsii* subsp.)

Colonies of *Parotomys* were observed on the highveld between Nieuwoudtville and Travellers Rest. North of the Olifants River it is said to occur in the lowveld, near the coast.

The race in this region may be referable to *P. brantsii pallida*, the southern Little Namaqualand subspecies.

When alarmed *Parotomys* (and *Liotomys*) dart back into their burrows with little squeaks of alarm.

* I can find no appreciable difference, cranial or otherwise, between these specimens and some "dryveld" *Otomys* from near King William's Town which have been compared and seem to correspond with the type of *Otomys tugelensis saundersiae*.

51. *Dendromus mesomelas pumilio* (Wagner).

Specimens from Redlinghuis and Tulbagh.

In a Tulbagh specimen (♂) there is no trace of a dorsal stripe.

In two out of five Redlinghuis specimens (♂, ♀ imm.) the dorsal stripe is only just discernible. In the other three (♂♂, ♀) the stripe is relatively well defined.

Underparts: hairs dark slate basally, tipped with buffy white.*

52. *Poemys melanotis capensis* Roberts.

Specimens from Het Kruis, Redlinghuis, Citrusdal.

Habitat: more or less open sandy grass country; living in small burrows and locally plentiful.

The presence or absence of a dark frontal patch in southern forms of *Poemys* would seem to be an individually variable characteristic. In three out of twelve specimens from Het Kruis dark frontal markings are present but ill defined; in one out of two from Redlinghuis this forehead mark is relatively well defined. The type (from Wolseley), as in the remainder of the present series, is without a frontal patch. Faint dusky ocular rings are present.†

* The type of *Dendromus pumilio* (a specimen without a dorsal stripe) was described from "The Cape of Good Hope" (presumably the Cape Peninsula, which may be fixed as the type locality).

Typical *Dendromus mesomelas* was described from the Zondags (Sundays) River, Eastern Cape Province, which enters the sea about 25 miles N.E. of Port Elizabeth. Eastern Cape Province specimens in the Kaffrarian Museum (from the Pirie Forest and East London), which I refer to typical *mesomelas*, although very similar dorsally to Western Cape Province material, differ markedly in having pure white underparts without slaty bases to the hairs; and are on an average somewhat smaller in size, the hind feet being definitely smaller.

† With regard to Cape material of *Poemys melanotis* and its described subspecies, the two extremes are clearly the typical race from Natal and the North-East Cape Province, and *P. m. insignis* (without ocular rings) from Little Namaqualand (N.W. Cape).

P. m. capensis may be accepted as an intermediate form from the extreme south. But, in my opinion, *P. m. thorntoni*, without consistent distinguishing characters, and matching examples from the N.E. Cape (Kaffraria, etc.), is redundant.

In seven topotypes of *P. m. thorntoni* (from Port Elizabeth) four are strongly washed with rusty brown; the other three agree with the type in their grey coloration. In one specimen the frontal patch is well defined; in three specimens it is less strongly defined; in the other three it is absent.

Large series of *Poemys* in the Kaffrarian Museum (over 150 specimens from widely distant regions) show every gradation of colour (both in *P. melanotis* and *P. nigrifrons*) between ash-grey and rusty-rufous, indicating that this is individual variation, and therefore without diagnostic value.

The following external characters and differences in habits distinguish *Poemys* from *Dendromus*:—

(a) *Poemys :*

Fifth hind toe with nail.

Ears large, angular and "bat-like"; naked and bicoloured —greyish and blackish (as in *Malacothrix*).

Hair relatively silky, colour grey to rusty.

Tail, as a rule, only slightly longer than head and body.

Eyes larger, usually surrounded by a dark ocular ring.

Occurs both in forest and in treeless grass country; lives in small burrows in the ground.

Although more closely allied to *Dendromus*, *Poemys* is in some respects intermediate between *Dendromus* and *Malacothrix*.*

(b) *Dendromus :*

Fifth hind toe with claw.

Ears relatively small and oval (as in *Steatomys*); clothed above with short chestnut coloured hairs.

Hair woolly, colour chestnut.

Tail considerably longer than head and body.

Eyes smaller, no ocular ring.

More arboral than *Poemys*; usually occurring close to trees or fairly high bushes: makes a grass nest (similar to that of an English Dormouse) in bushes, hollow tree stumps, etc.

53. *Steatomys pentonyx* (W. L. Sclater).

Specimens from Citrusdal, Het Kruis.

Locally plentiful in more or less open subcoastal grass and bushveld.

If kept in captivity with Elephant Shrews, or other small rodents of its own size, *Steatomys*, which is a savage animal, will soon start killing and partly devouring them.

S. pentonyx was originally referred by Sclater to the genus *Malacothrix*. If this species is ever found to occur in the Eastern Cape Province it may have to be regarded as a synonym of *S. krebsi*.†

* As opposed to *Poemys* and *Malacothrix*, *Dendromus*, when handled, will often attempt to bite, although, unlike *Steatomys*, it is not aggressively savage.

† I am not satisfied about the status of *Steatomys krebsi*, which is presumed to have come from the Eastern Cape Province for no apparent reason except that Krebs was known to have collected thereabouts during his travels. There is no authentic record of the occurrence of any species of *Steatomys* from the Eastern

Family MURIDAE.

54. *Acomys subspinosus* (Waterhouse).

Specimens from Kliphuis, Hex River Estate, Cold Bokkeveld (S.E. of Citrusdal).

Habitat: accumulations of loose rocks or boulders on heathy slopes and plateaux, especially in the vicinity of small mountain streams. Most plentiful at rather high altitudes; one specimen, however, was trapped at the base of a hill (Hex River Estate) in low-lying rocky country. Nocturnal: more local and much less plentiful than *Myomys verroxii*.*

When handled in the flesh the spines render *Acomys* slippery and lizard-like; skin fragile, as in *Petromus*. Head (ear to snout) markedly longer than in *Mus*.

55. *Aethomys namaquensis namaquensis* (A. Smith).

Specimens from Travellers Rest, Kliphuis, Citrusdal, Hex River Estate, Het Kruis.

Series (from Travellers Rest and Kliphuis) doubtless referable to *A. namaquensis klaverensis*.

Everywhere plentiful where rocky hills occur.

56. *Myomys* (*Myomyscus*) *verroxii* (A. Smith).†

Specimens from Kliphuis, Citrusdal, Hex River Estate.

Habitat: coastal and subcoastal hill and mountain ranges of the Southern Cape Province. Range approximating to that of *Acomys*

Cape Province. The recorded locality for *krebsi* in 1852, "The Interior of Caffraria," might equally have stood for Natal, The Orange Free State, or, in fact, anywhere in Southern Africa. [See Editor's note on p. 99.]

Various assumed races of *krebsi* have since been described, although the type locality for the original subspecies is entirely conjectural.

* The range of *Acomys subspinosus* coincides almost exactly with that of *Myomys verroxii*. They both inhabit the coastal and subcoastal mountains of the Southern Cape Province, from the Pakhuis Pass (Kliphuis), a northern spur of the Cedarberg Mountains which extends as far north as the Olifants-Doorn River junction in the west, to as far as Knysna (Grant) in the east.

† The genotype of *Myomys* is *M. colonus*; some years ago three female specimens were trapped near King William's Town in "vlei" country, which, although otherwise apparently resembling *Mastomys coucha*, had a mammary formula agreeing with that recorded for *Myomys colonus* (10: 6 pect., 4 ing.), with a short hiatus between the pectoral and inguinal mammae. They were sent to the British Museum and were stated at the time to correspond with the type of *colonus*.

No further examples with a similar mammary formula have since been collected, and it is suggested that these specimens (including the type, and a small series in *subspinosus* (extending from the northern spurs of the Cedarberg Mountains in the west, around the Cape of Good Hope, to Knysna (Grant) in the east).

Myomys verroxii hides by day in crevices in the more sheltered sides of rocky hills where there is plenty of bush and scrub in preference to the more arid slopes, which are equally favoured by the less conservative *Aethomys namaquensis*. This long-tailed Rock Rat is apparently local even within its range. At Kliphuis it was often trapped in long grass and tangled undergrowth in the higher valleys under precipitous cliffs or piled up rocks. Although also occurring at the base of hills in comparatively low-lying country, it does not extend on to the plains.

According to W. L. Sclater, the English vernacular for *Mastomys coucha* is "The White-nosed Rat," but that name would be more

the British Museum from Zululand and elsewhere) may be ordinary Multimammate Mice with a subnormal number of mammae.

But, since the type of *colonus* and only other material supposed to agree with it appear to be in the British Museum, it remains for someone in that institution to investigate and clear up the matter. It may be that more helpful material will be forthcoming when further systematic collecting has been done in the Eastern Cape Province. If *Mastomys coucha* proves to be inseparable from the earlier described *Myomys colonus*, the genus *Mastomys* will become a synonym of *Myomys* (which was described higher up on the same page), and *Myomys colonus* would also replace *Mastomys coucha* for the typical Multimammate Mouse; the subspecific name *coucha* being perhaps available for the Griqualand West race. *Myomys shortridgei* (a distinct and well-defined species possessing 10 mammae, recorded in error by myself as a subspecies of *colonus*), which occurs in association with the Multimammate Mouse close to the Okavango, is a definitely local swamp rat; whereas the Multimammate Mouse is plentiful and widely distributed in that region both in damp and dry country. I have recently examined a small series of Multimammate Mice from Algoa Bay (the type locality of *Myomys colonus*), and a subadult female possesses at least 16 mammae. But these Algoa Bay specimens (lent by the Port Elizabeth Museum) cannot be regarded with certainty as topotypical of *colonus*, since *colonus* may be restricted to swampy country, and, like *shortridgei*, occur in suitable situations side by side with the more ubiquitous *coucha*.

Myomyscus subgen. n.

In the meanwhile I do not think the long-tailed (*Aethomys*-like) *Myomys verroxii* and allied rock-dwelling forms should remain in the same subgenus as relatively short-tailed swamp rodents, which, except for a different mammary formula, closely resemble Multimammate Mice (e.g. *Myomys shortridgei*); and I propose the above name for the *Myomys verroxii–M. granti group*.

Genotype: (in the Kaffrarian Museum) *Myomys* (*Myomyscus*) *verroxii*; No. 2935, adult ♂; H. & b. 122, Tl. 165, Hf. 25·5, Ear 19 mm.; from Kliphuis, 11 miles N.E. of Clanwilliam, N.W. Cape Province; 14th December 1937.

applicable to *Myomys verroxii* which has a markedly silvery-white nose.

As in *Mastomys coucha* (and *Petromyscus*), the young are smoky-slate in colour. Mammae 10 (6 pect., 4 ing.).

57. *Leggada minutoides minutoides* (A. Smith).

Specimens from Travellers Rest, Clanwilliam, Kliphuis, Citrusdal, Hex River Estate, Compagnies Drift.

58. *Mus musculus musculus* Linnaeus.

Specimens from Nieuwoudtville, Travellers Rest, Hex River Estate, Compagnies Drift.

There are no examples in this series with whitish underparts corresponding with a percentage of the Kamiesberg (Little Namaqualand) material.

59. *Rattus rattus alexandrinus* (E. Geoffroy and Audouin).

One specimen from Hex River Estate.

This imported House Rat is not as yet widely distributed along the basin of the Olifants River; but it occurs in some of the towns, villages, and farms—Clanwilliam, Citrusdal, Hex River Estate, etc., along the main lines of communication. Apparently unknown around Lamberts Bay.

60. *Rhabdomys pumilio pumilio* (Sparrman).*

Specimens from Nieuwoudtville, Travellers Rest, Kliphuis, Citrusdal, Hex River Estate, Clanwilliam, Compagnies Drift.

Family BATHYERGIDAE.

61. *Bathyergus suillus suillus* (Schreber).

Hottentot: 'KNOGAS (Lamberts Bay).

Specimens from Travellers Rest, Klaver, Het Kruis, Compagnies Drift.

The above large series is referable to *B. suillus intermedius*, typically from Klaver; but adult specimens are equal in size and otherwise

* If *Rhabdomys* from the Western Cape Province proves to be distinguishable from typical *pumilio* from Tsitzikama Forest (Snake River), Knysna, it would seem that one of the two names, *donovani* (Lesson) or *major* (Brants), both described in 1827 from "The Cape of Good Hope," will have to be revived. *R. pumilio meridionalis* (Wroughton), also from the Cape of Good Hope (Tokai), was described many years later.

similar to Cape Peninsula material. The white forehead spot is variable in size and as often as not absent; it is sometimes accompanied by less noticeable throat patches. This forehead spot occurs quite frequently in specimens from the Cape Flats, so it is not a geographical variation. There is no connecting link between *B. s. suillus* and the considerably smaller *B. j. janetta*; the two being entirely distinct species.*

This Giant Mole-rat is extremely plentiful in the North-West Cape Province. It is subcoastal as well as coastal in the sandy low-veld and extends inland along the valley of the Olifants River to beyond Citrusdal. Although *Bathyergus suillus* ascends the slopes of fairly high sand-dunes, on the higher mountain plateaux only *Georychus* occurs.

Mound concentrations were observed chiefly in cultivated or recently ploughed lands and in stretches of soft sand, or alluvial grass flats close to the banks of rivers and streams. In some places along the valleys of the Olifants and Doorn Rivers the large white "mole-hills" occur in such numbers as to form a conspicuous feature of the landscape; in fact, large areas are often so honeycombed by the mounds and their inter-communicating tunnels that one sinks two feet or more into the sand at almost every step if an attempt be made to walk across the warrens.

Unlike *Georychus* and *Cryptomys*, *Bathyergus* is seldom turned out of the ground during the ploughing season, owing to the greater depth of the main burrows. In addition to wild bulbs, grass roots, and other indigenous tubers, *Bathyergus suillus* feeds upon most kinds of root crops, especially potatoes, and it ranks among the most serious of agricultural pests in the Western Cape Province. As opposed to *Georychus* and *Cryptomys*, it does not store up food below ground.

A specimen kept alive for a short period made a chattering noise whilst burrowing and would turn and snap savagely if interfered with. It did not attempt to progress more than a yard or two above ground, but started to dig with its fore feet almost at once, scuffling the loose sand back with its hind feet. The short tail with hori-

* There is a belt of low-lying country to the north of the Olifants River mouth, approximately 20 miles in width (between Van Rhynsdorp District and southern Little Namaqualand), known as "The Hardeveld," intersected by small flowing salt rivers, which appears to form a barrier separating *B. janetta* in the north from *B. suillus* in the south. (Neither *Petromus* nor *Petromyscus* extend south of this barrier.)

zontally flat rows of bristles on either side is an aid in throwing back the sand. If caught in a trap it will often break its incisor teeth against the iron. The halves of the lower jaw, although not altogether ankylosed, do not enable the lower incisors to separate widely as in *Georychus* and *Cryptomys*. The cheek and other cranial muscles are enormously developed. Even newly born animals, like young parrots, can bite severely.

Bathyergus, in common with other South African Mole-rats, appears to be able to see indistinctly for a short distance; and if the head be touched it will close the eyelids. The small circle of bare skin around the ear orifice protrudes slightly, the opening itself being directed backwards and downwards.

One specimen (No. 2726) was a buff-white, pink-eyed albino.

62. *Georychus capensis capensis* (Pallas).

Afrikaans: KOHLMOL (also individuals of *Bathyergus* with a white forehead spot).

Specimens from Nieuwoudtville, Kliphuis, Citrusdal.

The Nieuwoudtville examples (alt. 3500 feet) appear to be the first authentic high-veld record for typical *G. capensis*; I believe them to be also the north-western record.

Although coastal around Cape Town, in the North-West Cape Province *Georychus* appears to favour more inland districts and extends from the middle Olifants River Valley on to the mountain plateaux, as at Kliphuis and Nieuwoudtville. Around Nieuwoudtville, where it is local and not very plentiful, mounds were observed mostly in ploughed land. In the low-veld *Georychus* seems to be very much scarcer than *Bathyergus*, but, since, where the two occur together, it is not always easy to distinguish between the mounds of *Georychus* and *Bathyergus*, it may be more widely distributed than appeared to be the case.

Georychus is unknown to residents around Lamberts Bay, and I did not hear of its occurrence anywhere along the coast in this region. The mounds are often nearly as large as those of *Bathyergus*; and the burrows approximate in diameter to those of *Bathyergus*, rather than of *Cryptomys hottentotus*. Accumulated stores of bulbs, iris corms, etc., all smaller than hazel-nuts, were found in excavated burrows.

Georychus apparently does not differ in size sexually so much as do *Bathyergus* and *Cryptomys*; the largest specimen in the present series is a female. The white forehead spot (occasionally almost absent) and other white head markings vary individually in North-West Cape material, which otherwise matches closely Cape Town specimens.*

63. *Cryptomys hottentotus hottentotus* (Lesson).

Specimens from Nieuwoudtville, Travellers Rest, Kliphuis, Citrusdal, Hex River Estate, Compagnies Drift.

Widely distributed throughout the North-West Cape Province and plentiful both on mountain plateaux and in the low-veld. Plentiful around Nieuwoudtville (high-veld), and extending (sparsely) as far inland as Calvinia.†

Where all occur together, the mounds of *Cryptomys*, *Georychus*, and *Bathyergus* may often be found in close association, the different size of the tunnels presumably eliminating actual contact.

Family HYSTRICIDAE.

(64. *Hystrix africaeaustralis africaeaustralis* Peters.)

Widely distributed; apparently plentiful in the mountains; numerous shed quills observed around Hex River Estate.

Family PROCAVIIDAE.

65. *Procavia capensis capensis* (Pallas).

Specimens from Travellers Rest, Kliphuis, Clanwilliam, Compagnies Drift.

Family ELEPHANTIDAE.

(66. *Loxodonta africana africana* (Blumenbach).)

Elephant have been extinct in the North-West Cape Province for at least 150 years: I can find no record since Jacobus Coetse Jansz crossed the Olifants River in 1760 "for the purpose of shooting Elephant." All other big game has long since disappeared from this region.

* There is an albino specimen of *Georychus c. canescens* in the Port Elizabeth Museum.

† Albinism in *Cryptomys hottentotus* is not infrequent.

Family HIPPOPOTAMIDAE.

(67. *Hippopotamus amphibius capensis* Desmoulins.)

There are local traditions of the past occurrence of Hippo in the lower Olifants River. The type of *H. amphibius capensis*, from the Berg River, is still preserved in the Paris Museum.

Family SUIDAE.

(68. *Phacochoerus aethiopicus aethiopicus* (Pallas).)

I was informed by Mr. Visser (Hex River Estate) that skeletal remains, including tushes, of Wart-hog were discovered a few years ago in a Bushman cave not far from his estate, and sent to Stellenbosch University. This is the only record, so far as I am aware, of the former existence of Wart-hog in the North-West Cape Province.

Family BOVIDAE.

69. *Sylvicapra grimmia grimmia* (Linnaeus).

Two specimens from Lamberts Bay.

There are plenty of Duiker in the Lamberts Bay Game Reserve; farther inland they seem to be restricted mostly to the Cedarberg and other mountainous regions.

70. *Oreotragus oreotragus oreotragus* (Zimmermann).

Specimens from Kliphuis.

Klipspringer are still fairly numerous among the mountains of the North-West Cape Province.

71. *Raphicerus campestris campestris* (Thunberg).

Specimens from Lamberts Bay Game Reserve and Compagnies Drift.

Plentiful in the Game Reserve; more sparsely distributed elsewhere along the coastal sand-plains.

(72. *Raphicerus* (*Nototragus*) *melanotis* (Thunberg).)

Hottentot: 'TSAUGHAT.

In the Western Cape Province the Grysbok extends as far north as the northern spurs of the Cedarberg. It is well known around Kliphuis, but believed not to be found anywhere north of the junction of the Olifants and Doorn Rivers.* Besides inhabiting the mountains, it is said to concentrate in thickets which fringe at intervals the banks of the middle and upper reaches of the Olifants River.

(73. *Pelea capreolus* (Bechstein).)

Hottentot: 'KNARIES.

Sparsely distributed among the mountains; one or two small troops of Vaal Rhebok are protected privately on farms near Clanwilliam.

* The Grysbok is coastal and subcoastal throughout its range, and extends, around the Cape, to as far north-east as Pondoland. In common with the Bontebok, it does not occur outside the Cape Province.

Editor's Note to Page 67.

Sub-Inspector S. V. Bowden (Cape Mounted Police, Ramans Drift) reported to the South African Museum in 1907 that there were about two dozen Hippo in the river [Orange River], chiefly in the 80-mile stretch between Viols Drift and the Fish River mouth, but that he had no definite information from localities east of Pella (S.A. Mus. files).

Editor's Note to Footnote on Page 92.

In the Krebs collection in the Berlin Museum is the type of *Barbus serra*, a freshwater fish peculiar to the Olifants River, Clanwilliam Division. This may indicate that Krebs travelled also to the N.W. Cape, possibly in company with Dr. Andrew Smith.

EXPLANATION OF PLATE VII.

Upper Photograph.

No. 1 (K.M. No. 3762*d*), *Papio comatus orientalis*, ♂, Bedford, Eastern Cape Province.

No. 2 (K.M. No. 459), *Papio comatus comatus*, ♂, Kamiesberg, Little Namaqualand.

No. 3 (K.M. No. 3993), *Papio comatus ruacana*, ♂, Kaokoveld, South West Africa.

No. 4 (K.M. No. 719*d*), *Papio comatus chobiensis*, ♂, Caprivi Strip, Zambesia.

No. 5 (K.M. No. 2014), *Papio cynocephalus*, ♂, Balovale, Upper Zambesi.

Lower Photograph.

No. 1 (K.M. No. 42*c*), *Papio comatus orientalis*, ♀, Grahamstown, Eastern Cape Province.

No. 2 (K.M. No. 605), *Papio comatus comatus*, ♀, Kamiesberg, Little Namaqualand.

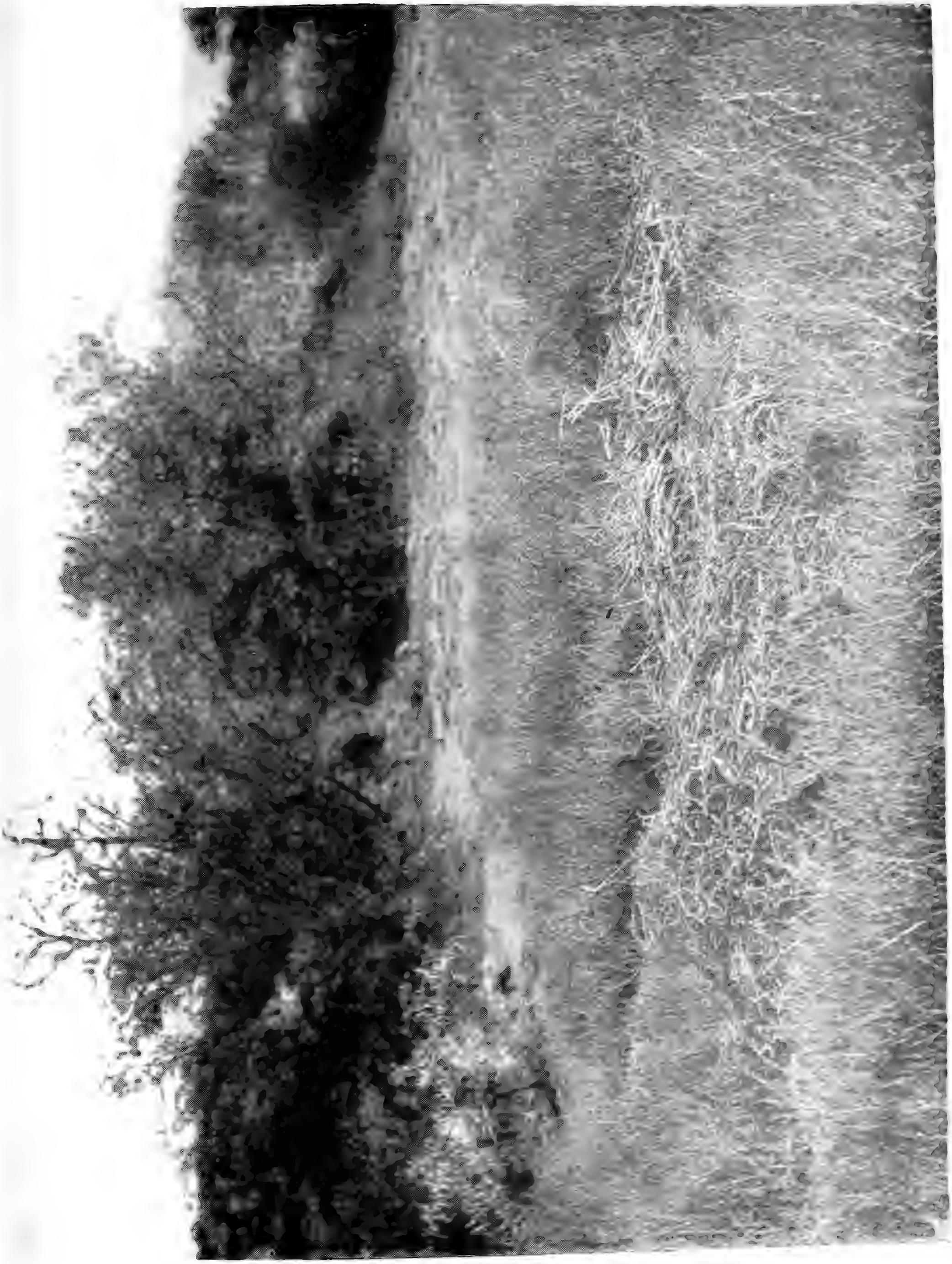
No. 3 (K.M. No. 8311), *Papio comatus chobiensis*, ♀, Sesheke, Zambesi (north bank, opp. Caprivi).

No. 4 (K.M. No. 2669), *Papio cynocephalus*, ♀, Balovale, Upper Zambesi.

No. 5 (K.M. No. 2672), *Papio cynocephalus*, ♂ (juv.), Balovale (Young of No. 4).

No. 6 (K.M. No. 718), *Papio comatus comatus*, ♂ (juv.), Kamiesberg (Young of No. 2).

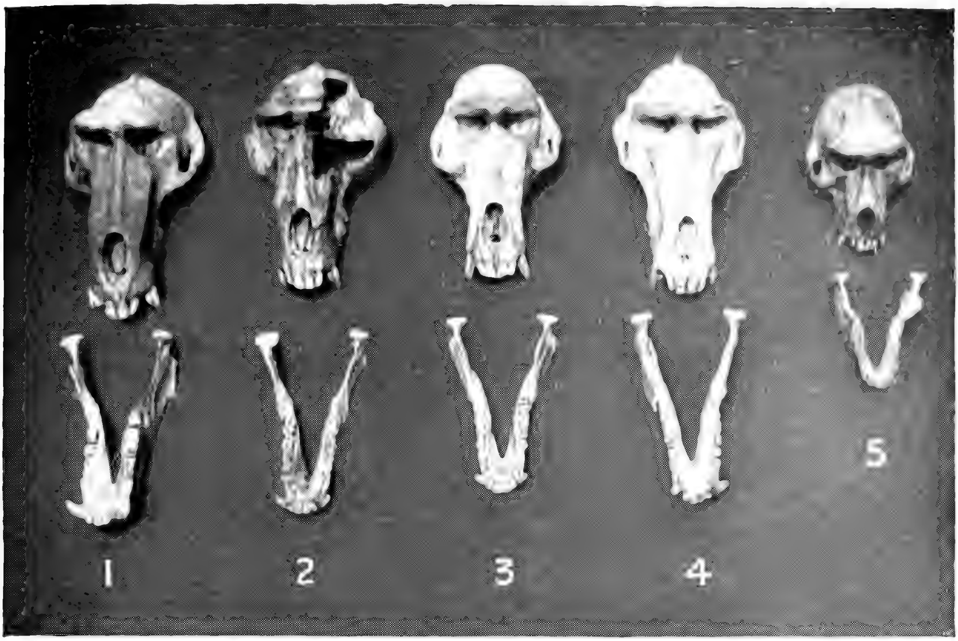
Nos. 5 and 6 (newly born) were approximately the same age.



An unusually large "Otomys" nest, presumably of *Myotomys unisulcatus* subsp., from the Fish River Valley, near Halesowen, Eastern Cape Province.

(*By courtesy of the Albany Museum, Grahamstown.*)

G. C. Shortridge. *Neill & Co., Ltd.*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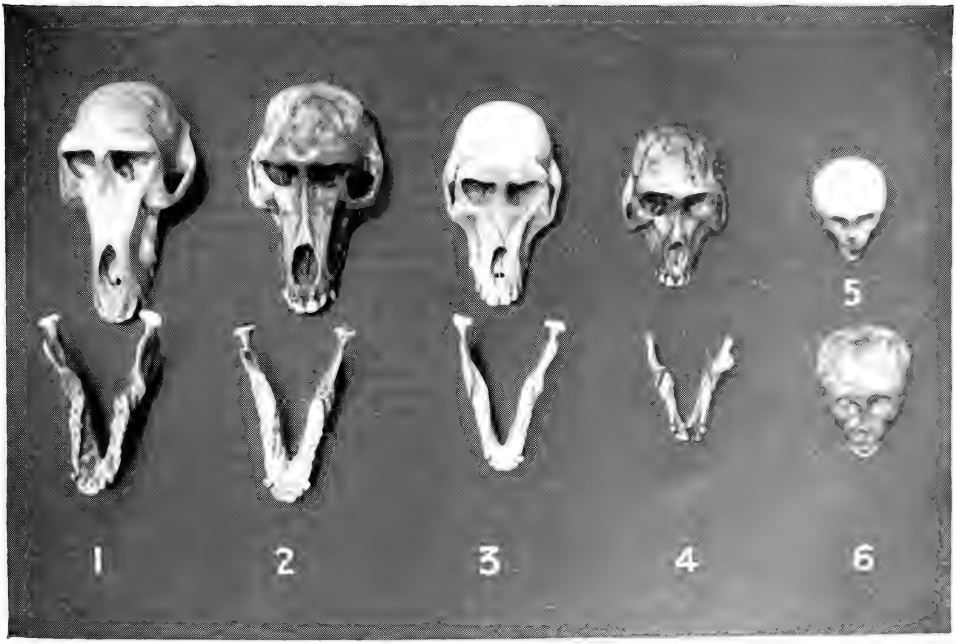
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ANNALS

OF THE

SOUTH AFRICAN MUSEUM

VOLUME XXXVI.

PART II, *containing:*—

3. *Revision of the Indigenous Freshwater Fishes of the S.W. Cape Region.*—By K. H. BARNARD, D.Sc., F.L.S., Assistant Director. (With 33 Text-figures.)

SEMPER ALIQUID NOVI AFRICA AFFERT

ISSUED JULY 1943. PRICE 10s.

PRINTED FOR THE
TRUSTEES OF THE SOUTH AFRICAN MUSEUM, CAPE TOWN
BY NEILL AND CO., LTD.,
212 CAUSEWAYSIDE, EDINBURGH.

3. *Revision of the Indigenous Freshwater Fishes of the S.W. Cape Region.*—By K. H. Barnard, D.Sc., F.L.S., Assistant Director.

(With 33 Text-figures.)

This constitutes the twelfth report in connection with my researches on the fauna of the mountainous areas of the S.W. Cape, aided by grants from the Royal Society of South Africa (1917) and the Research Grant Board (1928–1941), to both of which bodies my thanks are tendered.*

The introduction of Trout many years ago, and the recent establishing of the Black Bass in the rivers of the Cape, necessitate a prompt survey of the indigenous fish-fauna. This survey is essential for scientific purposes, and for any discussion of the former relationships and possible changes in the river-systems. There are admittedly many difficulties in the way, but it is sincerely hoped that such a survey will be undertaken.

With a view to putting the nomenclature of the fishes of this region on a more satisfactory basis, I have re-examined the material of the relevant species on which Gilchrist and Thompson worked (Ann. S. Afr. Mus., xi, pts. 5 and 6, 1913 and 1917), together with considerable new material either supplied by Mr. A. C. Harrison, Hon. Sec. of the Cape Piscatorial Society, and other correspondents, or collected by myself and other members of the Museum staff.

In the course of this study several unexpected queries and interesting facts have cropped up, necessitating some changes in the nomenclature and synonymy of the Cape species. I have not attempted to deal with any species found outside the somewhat arbitrary limits here adopted for the "S.W. Cape" region, or to express any definite

* Previous reports: 1. "Freshwater Crustacea," Trans. Roy. Soc. S. Afr., vol. xiv, 1927. 2. "Colophon (Coleoptera)," *ibid.*, vol. xviii, 1929. 3. "Alder-flies," *ibid.*, vol. xix, 1931. 4. "May-flies," *ibid.*, vol. xx, 1932. 5. "Terrestrial Isopoda (Woodlice)," Ann. S. Afr. Mus., vol. xxx, 1932. 6. "Further New Species of Colophon," Stylops, vol. i, pt. 8, 1932. 7. "A New Corduline Dragonfly," *ibid.*, vol. ii, pt. 7, 1933. 8. "Caddis-flies," Trans. Roy. Soc. S. Afr., vol. xxi, 1934. 9. "Stone-flies," Ann. S. Afr. Mus., vol. xxx, 1934. 10. "Dragon-flies," *ibid.*, vol. xxxii, 1937. 11. "Additions to Alder-flies, May-flies, Caddis-flies, etc.," *ibid.*, vol. xxxii, 1940.

opinion on the identity or otherwise of the extra-territorial specimens assigned (erroneously in my opinion) to Cape species. My endeavour has been to find out what well-defined species can be recognized in the Cape, and to characterize them specifically in all stages of growth as far as possible. Comparisons with other species have been necessary, and where the results appear to shed light on the nomenclature of the species, they have been included.

"*The advancement of systematic Zoology is best served, in the present state of the science, not so much by the description of new species, as by the revision and putting in order of the species that are supposed to be already known*" (Calman, Nature, cxli, no. 3567, p. 452, 1938).

This study is merely a beginning, for there are many gaps in our knowledge of some of the species, and many rivers whose fish-fauna has not been investigated.* The results, so far obtained, show that the whole life-history of the species in each river or river-system should be studied, preferably by someone who is on the spot and does the collecting himself, or who can rely on a good collector and the accuracy of his data.

Only in this manner can one appreciate the true nature of certain abnormalities and variations, which is not apparent except in conjunction with long series of normal specimens. Some of these, which I have been able to examine, would probably become the types of nominal or "Museum species," if they got into the hands of a systematist without full data and extensive material for comparison. The description of "n. spp." based on single specimens, especially by overseas specialists, however eminent, without knowledge of the local geography, is liable to lead to confusion, and is to be deprecated. *Cf.* Pappenheim's remarks on the difficulty of identifying single specimens from different localities (Schultze, Reise . . . Südafr., iv, p. 277, 1910).

The monographs of Boulenger (Catalogue of Freshwater Fishes of Africa, vols. i–iv, 1911–1916) and Gilchrist and Thompson (*l.c.*) are of great value, in spite of their authors having had no field acquaintance with the species. Boulenger, as is shown below, failed to examine certain type specimens, and thereby came to adopt entirely wrong conceptions of at least two species. These misconceptions were followed, quite unsuspectingly, by Gilchrist and Thompson, whose work contains in addition several misprints and errors; and

* I have not been able to extend my investigations to, *e.g.*, the Sundays River, owing to War conditions and Museum administrative duties thrown upon me by the Director's retirement (Jan. 1942).

also more recently by J. L. B. Smith (Guide to Vertebrate Fauna of Eastern Province, Albany Museum, Grahamstown, pt. 2, Fishes, 1937). Several papers on South African freshwater fishes have been published since 1917, but only three contain any new matter concerning the fauna of the area here discussed (J. L. B. Smith, 1936, and K. H. Barnard, 1937 and 1938).

Measurement and Colour.—As regards the length of specimens, Mr. W. W. Thompson (who did most of the practical work for the joint monograph) was not always consistent in his measuring, sometimes including the caudal rays, sometimes not. In the present paper the *total length* is measured as from the tip of the snout to the end of the middle caudal rays; but for the ratio of head to length, the *body length* is reckoned only to the end of the scales on the caudal peduncle (*i.e.* the "standard length").

The depth of the body may vary so much according to the condition of the specimen, its sex and maturity, and the method of preservation, that it is of minor taxonomic importance. Among the species herein dealt with, it is useful as a diagnostic character only in the case of *Barbus asper* and *tenuis*.

Colours, when given, are taken from the living fish. After preservation the coloration is rarely a reliable guide, as it may vary according to the method of preservation, and fades in course of time; dark lateral stripes are usually more conspicuous after preservation than in the living fish.

Tables of Growth-changes.—These tables are intended to give an epitome of the life-history and growth-changes of the species. As far as possible they have been compiled from series of individuals collected in the same or a nearby locality, preferably at the same time and place; and preserved in the same manner. In the great majority of cases the ratios, etc. represent the averages of several specimens of each size.

It must not be expected, however, that individuals from other localities, or even all individuals from the same locality, will conform exactly in all details. Dwarfing may occur in small-sized streams, or owing to poor food-supply, or other factors; and allowance must be made for this.

Method of preservation is also a factor to be considered. Comparison of specimens preserved in formalin with those preserved in alcohol may lead to different results. Further, the preserving fluid may be either weak or rather too strong, resulting respectively in flacidity or rigidity of the muscles, and possibly a slight increase or decrease in the length of the body. The fleshy tip of the snout may be considerably modified by the kind and strength of preservative. Hence in a measurement any fraction less than $\frac{1}{4}$ or $\frac{1}{5}$ is really meaningless.

Abbreviations used in the tables. *TL*, total length, *i.e.* from tip of snout to end of middle caudal rays, in millimetres. *L*, body length, *i.e.* from tip of snout to end of scales on caudal peduncle. *H*, head-length. *E*, eye-diameter. *S*, snout. *I*, interorbital width. *d.a.n.*, distance between anterior nostrils (*Gephyroglanis*). *l.l.*, lateral line scales. *c.ped.*, scales around caudal peduncle. *str.*, striae on exposed (posterior) field of scale (main striae, not short intercalaries). *g.r.*, gill-rakers on upper and lower parts of anterior arch. *barb.*, barbels. *p*, posterior, *a*, anterior; (*p*) and (*a*) indicate that the barbel is just beginning to show. *d.sp.s.*, serrations on dorsal spine. The *barb.* column is left blank after the barbels (one or both pairs according to the species) have fully appeared.

Acknowledgments are made: to Mr. A. C. Harrison, Hon. Secretary of the Cape Piscatorial Society and Inland Fisheries Advisory Officer, for enthusiastic help and co-operation, and to Mr. A. T. Packham, another member of the same Society; to Mr. F. G. Chaplin, Curator of the Jonkershoek Fish Hatcheries; to the late Mr. A. E. Manley, of the Olifants River Irrigation Scheme, Klaver; and to my colleagues on the South African Museum staff—Dr. A. J. Hesse, Dr. L. D. Boonstra, and Mr. C. W. Thorne. To Mr. Thorne I am especially grateful for his untiring energy in collecting. To my overseas correspondents I also express thanks: to Mr. J. R. Norman, and more recently Dr. E. Trewavas of the British Museum, for information concerning Boulenger's material; and to Dr. de Beaufort of Amsterdam, and Dr. E. Ahl of Berlin, for the loan of types and other material essential for the present study.

To numerous farmers and owners of property grateful acknowledgment is made for permission to camp and for other facilities.

To the late Mr. E. H. Cooke of Cape Town, and to his son Mr. Vernon Cooke, my thanks are due for the use of a light-weight boat, without which netting operations in many localities would have been impossible.

Topography.

The area embraced in this study is the south-western portion of the Cape Province, approximately as far north as 31° S. and as far east as Port Elizabeth, $25\frac{1}{2}°$ E. Certain species living in the lower Orange River are included because the South African Museum has recently obtained important material illustrating their growth-changes.

Of the rivers in this area, the Berg and the Olifants (Clanwilliam) rivers run approximately north-westwards to the Atlantic Ocean; the others flow southwards and south-eastwards, arising on the south side of the main Cape watershed (fig. 1).

This main Cape watershed runs from about Tulbagh north-eastwards to Matjiesfontein and along the line of the Klein Roggeveld, Komsberg, Nieuwveld, and Sneeuwberg ranges.* North of this line, and east of the Roggeveld escarpment, lie the catchment areas of the southern tributaries of the Orange River. The formation of this watershed, which appears to have had an important influence on the distribution of the fish-fauna, is considered to have occurred or to have been intensified during Tertiary times.†

From Tulbagh a continuous chain of mountains strikes south-wards and south-south-westwards to Cape Hangklip. The fish-fauna, and also the distribution of certain insects, indicates that these mountains have been a barrier of some importance.

In the northern part of the Cape Peninsula only the rivers arising on the eastern and southern slopes of Table Mountain, Constantia Berg and the Kalk Bay Mts. contain fishes. Of these the Black River (with its tributaries the Liesbeek and Kromboom streams) flows northwards into Table Bay; the Palmiet River flows southwards into Hout Bay on the Atlantic coast; the Diep River and Silvermine River drain southwards into False Bay (fig. 28).

In the southern part of the Peninsula the highest land is on the east side, and a few more or less perennial streams flow westwards, *e.g.* the Bokram, Schusters, and Klaasjagers rivers (fig. 28).

There are several lakes (vleis) on the Cape Flats (isthmus) which are more or less interconnected, at least during periods of heavy rainfall. The poverty of the fish-fauna (*Galaxias* and *Sandelia* only) of the streams on the Cape Peninsula and the adjacent (western) portion of the Cape Flats is evidently due to the whole isthmus between Table Bay and False Bay having been formerly under the sea.‡

* Rogers, Trans. S. Afr. Philos. Soc., xiv, p. 375, 1903.

† Rogers, *l.c.*, 1903. See also Barnard, S. Afr. Geogr. J., xix, p. 6, 1936.

‡ Haughton, Geology . . . Cape Town, Explan. Sheet 247, Geol. Surv., p. 58, 1933.

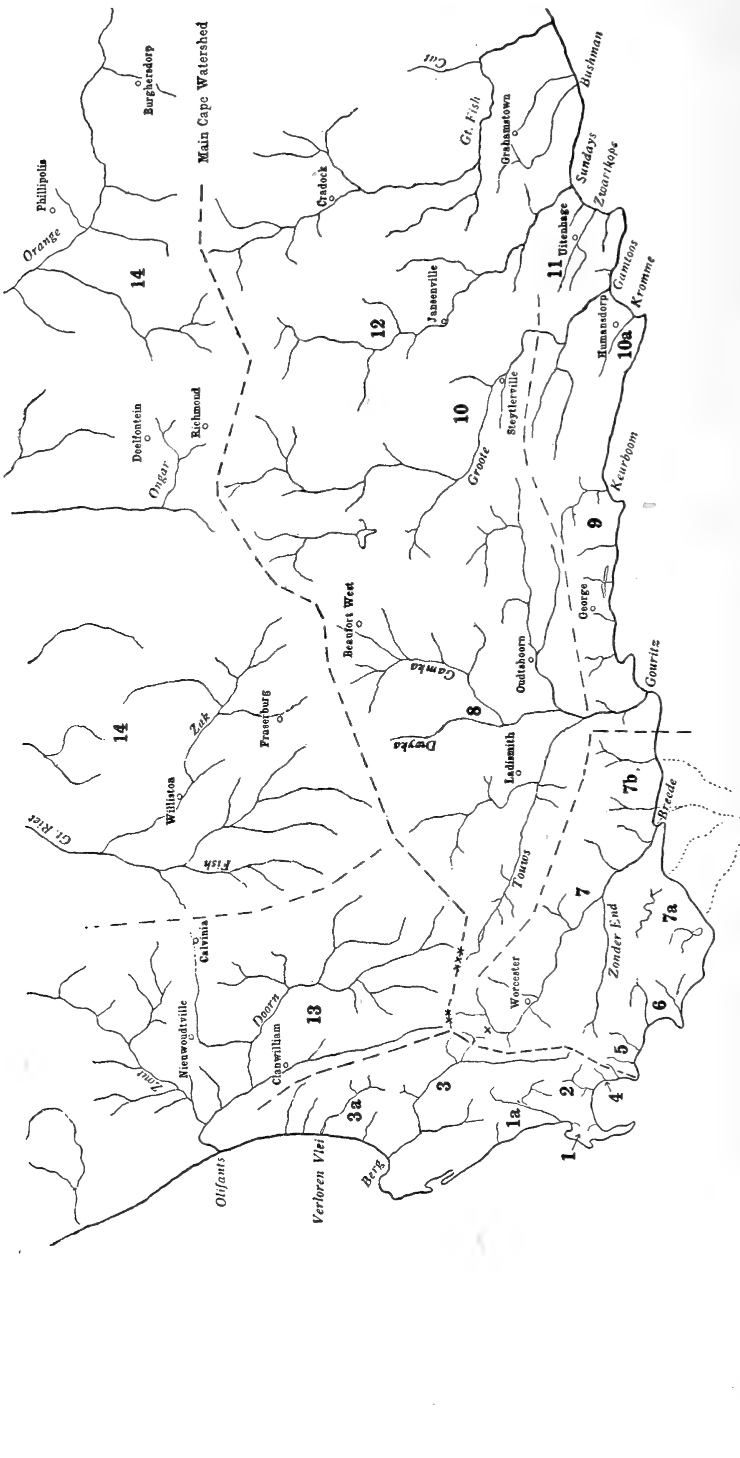


FIG. 1.—River-systems of the S.W. Cape.

× Low watershed between Berg River and Breede River systems.
× × Watershed between Olifants River and Breede River systems.
× × × Low watershed between Olifants River and Gouritz River systems.

The outcome of this study seems to show that the species living in the south-western corner of the Cape Province are confined to this area. There are a few records (*e.g.* see under *B. burchelli*) which appear to refute this generalization; but those specimens which I have been able to examine have proved to be erroneously identified.

The fact that each river-system harbours its own characteristic species may be found to be more strikingly exemplified in the S.W. Cape than in regions farther east and north-east.

Whether any of the typical Cape species (excluding those of the Orange River) will eventually be found to inhabit other river-systems in Natal, or the Orange Free State and Transvaal, remains for some future investigator. But, as already remarked, the investigation of these Provinces should not be delayed. And the caution may be repeated that single specimens, or records based on such, are useless unless supported by a thorough study (field and laboratory) of the species living in each river-system.

In examining the above areas, the possibility of river piracies, such as have occurred in the S.W. Cape, must be borne in mind.* Some of those in the S.W. Cape may be noted here. The Steenbras River now flows through the strike of the Hottentots Holland range, but its headwaters obviously drained formerly into the Palmiet River (fig. 1, between the numerals 4 and 5). The Klein River (Stanford) has tapped the Hartebeest River, which appears to have formerly flowed into the Kars River (Bredasdorp), and thus formed part of the Breede River system (fig. 1, above the numeral 6). In this latter case, the presence of the "red-fin" *Barbus vulneratus* as a relict in the Hartebeest River would not be surprising; we were informed by a local farmer that there were "red-fins" (rooi-vlerke) in the river, but our netting operations have failed to find any true "red-fins" (*Barbus*) (see pp. 120, 248).

These are two examples of relatively minor piracies. On the other hand, the two following may be regarded as major piracies, as they affect adjacent, but totally distinct, drainage systems. The Little Berg River, flowing through Tulbagh Poort, has tapped the former source of the Breede River (fig. 1, between the numeral 3 and ×). The tributary of the Breede River which has cut back through Michell's Pass appears to have tapped streams which may formerly

* Barnard, *l.c.*, pp. 8, 9, 1936. Haughton, Geology . . . Gamtoos Valley, Explan. Sheet 151, Geol. Surv., p. 8, with map, 1937. J. de Villiers, Tr. Geol. Soc. S. Afr., xli, pp. 38, 40, map on p. 39, 1939.

have drained eastwards into the Touws, and thence into the Gouritz River (fig. 1, at ×). These two piracies, especially the first, may possibly have had some effect on the fish-faunas (*cf.* p. 114).

Geological Considerations.

No fossil representatives of the genus *Barbus*, or of Catfishes (*Clarias*, etc.), are known from pre-Tertiary formations.* The present fish-fauna must have spread over South Africa during or since the Tertiary epoch. Nevertheless a brief epitome of the main geological events which have contributed to the making of the South African region may be included. It may help us, not so much to visualize the conditions under which the present fish-fauna has been evolved and dispersed, as to realize the difficulties in the way of a satisfactory explanation.

At the beginning of the Jurassic period South Africa was a vast waste of lava plains in process of elevation, and as the whole country except the coastal border has been dry land ever since, the main drainages, mostly radiating from the highlands of Basutoland, date from that time.†

Mountain building (N.–S. Cedarberg folds, and E.–W. Zwartberg folds) was reaching its climax, although these folds were renewed and intensified later. The Cretaceous deposits were laid down in intermontane troughs in the folded (coastal) belt, but their extent to the west and south-west is uncertain.‡

Marginal faulting (Worcester fault, etc.) occurred, and also, which is perhaps more important from our present point of view, cross-flexuring. A series of basins was thus formed, in which the Cretaceous beds are to-day preserved. And the primitive E.–W. drainages were converted into N.–S. drainages cutting across the mountain ranges, and by later entrenchment right through the ranges in some cases. It may be noted that the Breede, Gouritz, and Gamtoos river-systems each contains its remnant of Cretaceous beds; and *each contains at the present day its own characteristic fish-fauna* (fig. 6).

It is not, of course, intended to imply that the fish-fauna dates from Cretaceous times (there is no record of any freshwater Cretaceous fish-fauna in South Africa); but the cross-flexuring may have had two results: one geological, one faunistic.

* Meek, Migrations of Fish, pp. 170, 176, 1916.

† This account of the geology is based on A. du Toit, Geology of South Africa, pp. 437–543, 1926.

‡ Rogers, *l.c.*, 1903. See also Rogers, S. Afr. J. Sci., xix, p. 23, note 17, 1922.

The Tertiary uplift and planation caused the removal of most of the Cretaceous deposits, and intensified the main Cape watershed and the entrenchment of the N.–S. rivers. Allusion has already been made to various piracies.

We cannot but look towards Central Africa for the source of our freshwater fish-fauna, except possibly in the case of *Galaxias* (see p. 113). Freshwater and subaerial deposits were being laid down on the Jurasso-Cretaceous Kalahari peneplain, under varying climatic conditions.* But there is no fossil evidence, and before any attempt is made to explain the origin of the S.W. Cape fish-fauna the other areas (Natal, etc.) must be studied, and also the phyletic relationships of the species, *e.g.* of the species of the genus *Barbus.*

On the south coast an Eocene peneplain was cut by the sea, and continued inland by the rivers as far as the southern Karroo (fig. 24). It seems to have been connected, *via* the Cape Flats, with the Saldanha Bay and Olifants River (Clanwilliam) peneplain (du Toit only says "possibly connected" and makes no allusion to the Cape Flats). The distribution of *Galaxias* in South Africa may perhaps have been determined at this period (p. 113).

Elevation continued until the Agulhas Bank and the whole of the continental shelf, as far as the present 400-fathom isobath, were laid bare. Some of the old river courses are still traceable in spite of their re-submergence in late Pleistocene times.†

The extension of the river courses across the Agulhas Bank is an interesting point. Both du Toit and Krige consider that the extended Breede River joined the extended Gouritz River. *But the fish-faunas of the two rivers are totally different* (p. 123). Had these two rivers (and others also) at that time the same, undifferentiated, fauna? Or were they never connected? The latter seems more plausible. Moreover, it is safe to say that two intervening rivers, viz. the Duivenhoks and Kafferkuils rivers, at the present day relatively small and cut off short by the coast-line, were formerly tributaries of the Breede and not of the Gouritz River, because they contain *Barbus vulneratus* (characteristic of the former), but not one of the species found in the latter river (*Galaxias* excepted) (fig. 1).

The fish-fauna of the Kromme River and Zwartkops River, and

* Rogers, Post-Cretaceous Climates, S. Afr. J. Sci., xix, pp. 1 sqq., 1922. See also F. Dixey, Tr. Geol. Soc. S. Afr., xli, p. 113, 1939.

† In addition to du Toit, *l.c.*, 1926, p. 443, see du Toit, S. Afr. Geogr. J., v, pp. 9–12, 1922, and xvi, pp. 4–5, 1933; A. V. Krige, Ann. Stellenb. Univ., v, sect. A, No. 1, pp. 14–19, 1927.

the intervening rivers, points to a former connection on the Agulhas Bank. But the evidence is scanty. Some rivers in the Gamtoos system require further investigation.

Hydrogen-ion Concentration.

Many observations have been made and collected by Mr. A. C. Harrison for purposes of testing the suitability of the Cape rivers for the introduction of trout, black-bass, etc. With the reagent supplied by Mr. Harrison I have also tested the water of many rivers which Mr. Harrison has not had an opportunity of visiting. On these combined observations are based the following general statements of the pH character of the different rivers.

Rivers and streams arising in the Table Mountain Sandstone mountains of the S.W. Cape are as a rule neutral (pH 7–7·5) in their middle and lower reaches. After winter rains, however, they may become slightly acid owing to sudden scouring of the upper reaches where the streams flow through boggy areas with abundant Sphagnum and decaying vegetation. *E.g.* the middle reaches of the Olifants (Clanwilliam), Berg, Breede, and Eerste rivers.

Where the topography is especially favourable to the formation of sphagnum bogs and vegetable cover, such as the dip-slopes facing south or south-east in the folded mountain ranges, and where there is a comparatively short run between the source and the mouth, the rivers are acid, sometimes strongly acid (pH 4–5·5). *E.g.* Silvermine (Cape Peninsula), Steenbras, Palmiet, streams between Onrust and Hermanus, and the rivers flowing *south* from the Outeniqua-Tsitsikama mountains (from George eastwards to near Humansdorp).

When, however, the sources of the rivers, or the major portion of the catchment area, lie on the Malmesbury and Bokkeveld formations, the water is either neutral or distinctly alkaline (pH 7–8·5). *E.g.* Diep-Mosselbank rivers (Malmesbury), lower portions of the Olifants (Clanwilliam), Verloren Vlei, and Great Berg rivers, Zout River (Bredasdorp).

Alkalinity is especially characteristic of the two large rivers, the Gouritz and the Gamtoos, which have their sources in, and for the most part flow over, the Karroo formation. Some of the smaller tributaries arising on Table Mountain Sandstone mountains are acid at their headwaters, but their water is swamped in the great volume emanating from the major tributaries.

If the map of the river-systems (fig. 1) were coloured red and blue to indicate respectively acidity and alkalinity, the extreme south-west area and the coastal belt from about George eastwards to Humansdorp would appear for the most part red; while dividing these two red areas would be a large blue patch representing the catchment basin of the Gouritz; another blue patch farther east representing the Gamtoos basin.

It is perhaps possible that the noticeable absence of large-sized species of *Barbus* from the Gouritz, Gamtoos, Sundays, and other rivers may be due to this alkalinity (*cf.* p. 112).

Outstanding Features of the Freshwater Fish-fauna of the S.W. Cape.

1. The whole family of *Cichlidae* is absent from the area under discussion. Gilchrist and Thompson's record of *Tilapia natalensis* from Lakeside, Cape Peninsula (*l.c.*, p. 487), was due to an error in labelling: Lakeside was the domicile of the donor of the specimens, not the locality where the fishes were caught.*

There are no *Cyprinodontidae*. The locality given for *Fundulus*

* For Smith's types of *T. sparrmanii* Boulenger (1915, *l.c.*, iii, p. 208) gives the locality as "Namaqualand, N. of Orange R." Trewavas (1936, Novit. Zoolog., xl, p. 72) also says Namaqualand. But Smith merely said "north of Orange R." Actually the type locality is Boetsap, *eastern* Bechuanaland (see Note on Andrew Smith, p. 117).

Trewavas (1936, *l.c.*) records no Cichlids from south of the Otavi region in South West Africa. None were collected in the Gt. Fish River (tributary of the Orange River) or in the Orange River at Goodhouse or the Aughrabies Falls by the South African Museum expeditions in 1936 and 1939.

Fowler's reference (Ann. Transv. Mus., xvi, p. 286, 1935) to Weber's locality for *Haphochromis moffatii* is a misquote: Weber gave two localities in Natal, not "Vivolsdrift, Klein-Namaqualand " [*sic* = Violsdrift].

The South African Museum has no records of any Cichlids from south-west of a line between (approximately) Kuruman and East London (*cf.* Weber, 1897, Zool. Jahrb., x, p. 195).

Some examples of *T. mossambica* were introduced into a dam on the farm "Highlands," Malmesbury, by Mr. W. R. Hewett in 1937. Since then they have been placed in other dams in the neighbourhood, and are flourishing and multiplying. In January 1940 they were found (A. C. H., K. H. B., and C. W. T.) to be spreading to one of the tributary streams of the Diep River at Malmesbury, and there seems every likelihood of their extending to the main Diep River and becoming an integral part of its fauna. It is therefore important to note that *T. mossambica* is not a *natural* component of the fauna of this river.

Haplochromis philander (Gilchrist, Mar. Biol. Rep., no. 1, 1913, p. 69, pl. 3, as *Tilapia philander*) has been introduced at the Jonkershoek Fish Hatchery, but does not seem to have escaped from captivity into the Eerste River.

capensis Garman, 1895—"False Bay, Cape of Good Hope"—cannot be taken seriously. The most charitable explanation is that "False Bay" refers to the subsidiary bay of that name inside St. Lucia Bay in Zululand. *F. mkuziensis* Fowler, 1934, came from the Umkuzi River, which flows into St. Lucia Bay.

Gambusia has been introduced into Groen Vlei (between George and Knysna) and other places for mosquito control and as a forage-fish.

2. The presence of the Catfish (*Gephyroglanis*) in the Orange and Olifants (Clanwilliam) rivers. The absence of *Sandelia* is a further, though negative, link between these two rivers.

3. The absence of *Clarias* from the *southern* tributaries of the Orange River (so far as the Cape Province is concerned); *e.g.* the Kraai River (Aliwal North), Ongar (or Ongers) River (Richmond–Prieska Divisions), and Zak–Hartebeest River (Kenhardt Division). Although well adapted for existence in periodic rivers, *e.g.* the Molopo, Kuruman, and Gt. Fish (S.W.A.) rivers, there are no records from the southern tributaries. This may be due to lack of collecting, or possibly temperature may be a restricting factor.

4. The absence of *Labeo* and the *anoplus* group of *Barbus* in any river south-west of the Olifants–Gouritz systems.

5. The absence of large-sized species of *Barbus* from all systems south of the main Cape watershed, except the Breede River, until Natal is reached.

6. The presence of a group of small *Barbus* with "red-fins" in the south-west and southern areas as far east as (and including) the Zwartkops River, and, so far as we yet know, confined to these areas.

7. The absence of *Sandelia* in the Olifants River (Clanwilliam) although *Galaxias* is present.

8. The presence of *Galaxias* in the rivers on the Tertiary sea-cut terrace around the south-west and south coasts, and its extension to inland localities drained by the headwaters of these rivers (fig. 24).

The explanation of these rather remarkable features of distribution is not easy. The full facts are not yet available. For example, are the red-fin species really confined to the S.W. Cape; are they absent from the Orange River system and the rivers of the Eastern Province and Natal, and the Transvaal and East Africa? In tracing the distribution of these species reliance should only be placed on *living* specimens, not on "Museum" specimens which may *appear* to belong to, or have been "identified" as, species known to be red-fins (*e.g.* Boulenger's "*burchelli*" from Deelfontein).

Are there really no large, radiately striate scaled *Barbus* in the Orange system, or indeed anywhere south of the Limpopo system, until one reaches the south-west corner of the Western Cape Province?

Are there really no large-sized, either longitudinally or radiately striate scaled, *Barbus* in the rivers east of the Breede River until one reaches Natal? In the present state of our knowledge it seems that not only is the presence of *B. andrewi* in the Breede River an anomaly, but the presence of *any radiately striate scaled large Barbus* in the Olifants–Berg–Breede area is a greater anomaly. The nearest such species is *B. rapax* from the Transvaal.

It is a reasonable assumption that *B. capensis* has been derived from *holubi* (or both from a common ancestor); *serra* and *andrewi* may be closely allied to one another, but not to either of the longitudinally striate scaled species.

It is legitimate to suggest queries for future research to investigate, but speculation without much fuller data than we yet possess is not advisable.

Nevertheless, perhaps the following suggestions may be made. The distribution of *Galaxias* over the Tertiary peneplain on the west and south coasts offers little difficulty in view of the marine ancestry of these fishes (and the katadromous habits of some of them at the present day). The explanation is all the *easier on the basis of the Continental Displacement hypothesis* and the one-time close juxtaposition of the southern continents.*

Sandelia seems to have been a later immigrant, from the east, which managed to spread over the whole of the southern Tertiary peneplain and the Cape Flats and Berg River area, but which seems to have been in some manner prevented from entering the Olifants system, and also the southern part of the Cape Peninsula. Although formerly, before the Tertiary uplift had given impetus to erosion, the watersheds were much less well-defined and the possibilities of intercommunication (by flooding) greater, we must assume that the watershed between the Gouritz and Olifants rivers, even at Karroo Poort, was sufficiently marked to prevent the migration of *Sandelia* (fig. 1, × × ×). On the other hand, even at the present day the watershed between the Breede and the Little Berg rivers in the

* Sir A. C. Seward: "It is difficult, it is probably impossible, to explain the facts without calling to our aid the hypothesis of drifting continents. . . . I can do little more than reaffirm adherence to the view that plant records from rocks of many ages raise problems which seem to be insoluble unless we postulate movement and sliding of the earth's crust."—Nature, vol. 144, no. 3644, Suppl., p. 424, Sept. 1939.

neighbourhood of Tulbagh is comparatively low (fig. 1, ×). The capture of the headwaters of the Breede River by the Little Berg River may have been the means of introducing *Sandelia* from one (? the former) into the other (? the latter).

And if this transference occurred in the case of *Sandelia*, may it not also have happened to *B. andrewi*? But if so, in which direction, from the Berg River into the Breede River or *vice versa*?

And if *serra* and *andrewi* are derived from one another (or a common ancestor), where and when were the drainage systems of the Olifants on the one hand, and the Berg–Breede on the other hand, in (periodical) intercommunication? So far as one can judge from the present-day topography, the most likely place is the Witzenberg Vlakte between the Witzenberg Range and the Schuurfteberg Range (near Gydo, north of Ceres) (fig. 1, × ×). Here the actual sources of the Olifants and the Dwaars (Ceres) rivers arise on the same intermontane plain. But as I have suggested elsewhere, the headwaters of the Dwaars once flowed, not through Michell's Pass into the Breede River, but eastwards into the Kasdies River and Touws River drainage, thence to the Gouritz system.* Thus it is necessary to introduce a time element, and to suppose that the Michell's Pass river, in cutting its way back, first tapped the sources of the Kasdies River before reaching the Witzenberg Vlakte, where intercommunication with the Olifants River might have been possible. If this did happen, one might have expected to find the *anoplus* group represented in the Breede River system. But it is not represented. Thus one speculation leads to another!

Note on Sir Andrew Smith's Species.

Andrew Smith described and figured the following freshwater fishes in "Illustrations of the Zoology of South Africa." Bound copies bear the date 1849, but the work was issued in parts prior to that date (see Waterhouse, Proc. Zool. Soc. Lond., 1880, p. 489), viz.:

1840.	Part 9.	Plate 5.	*Tilapia sparrmanii* [original spelling].
1841.	Part 14.	Plate 10, fig. 1.	*Barbus capensis.*
		fig. 2.	*Barbus marequensis.*
		Plate 11, fig. 1.	*Barbus burchelli.*
		fig. 2.	*Barbus pallidus.*
		Plate 12, fig. 1.	*Abrostomus* [=*Labeo*] *umbratus.*
		fig. 2.	*Abrostomus capensis.*
1845.	Part 23.	Plate 27.	*Clarias capensis* [=*gariepinus*, not *capensis* C. and V.].

* *L.c.*, p. 9, 1936.

Of these species the types, *i.e.* specimens considered by Boulenger to be the types, of *T. sparrmanii*, *Barbus capensis* and *marequensis*, and *Clarias capensis*, are in the British Museum.

The figures of these species are coloured, and give the impression of considerable accuracy on the part of the artist. When, however, the number of scales represented by the artist in the coloured figures (both freshwater and marine species, but excluding of course *Clarias* and other scaleless species) is compared with the number found in actual specimens, it is seen that the artist has inserted too many (in some cases far too many) scales.* To take one case where Andrew Smith has (exceptionally) stated the number of scales, *T. sparrmanii*: "about 10 longitudinal rows, from 23–27 scales in each"—the artist has shown at least 37 scales along the middle of the side of the body. In other cases Andrew Smith did not state the number of scales.

Dr. V. Fitzsimons has examined the remains of Andrew Smith's collection of Reptiles and Amphibians, and his remarks relative to the descriptions and figures may be quoted here. "It is apparent that in many of his original descriptions Smith had more than one specimen before him, and although at a later date these species were figured, there is no guarantee that he actually figured one of hi original specimens. Some of the actual specimens figured by him in his "Illustrations" are now in the British and Royal Scottish Museums, and in spite of the doubts expressed above, I feel that it would be quite legitimate to regard these as the types, in the absence of any proof to the contrary. In other cases the evidence available points often to composite descriptions and even composite figures, and in such the definite localizing of the type is impossible." † ‡

I have shown that Andrew Smith's description of *Barbus capensis* is accurate as far as it goes, and includes one essential character, namely, the scale-sculpture; but although he gives its true habitat, he states that it also inhabits an entirely different river, which latter statement we now know to be erroneous. §

In this case the type was fortunately extant, and the confusion arising out of Boulenger's Catalogue could be rectified. But the

* In the uncoloured figures this discrepancy is not found, or is very much less noticeable, thus suggesting a different artist.

† Ann. Transv. Mus., xvii, p. 260, 1937.

‡ In reply to an enquiry addressed to the Royal Scottish Museum, Mr. A. C. Stephen, Keeper of the Natural History Department, states (1/xii/37) that there are no fishes in Sir Andrew Smith's collection preserved in that Museum.

§ Ann. Mag. Nat. Hist. (10), xix, p. 304, 1937.

absence of the types of *B. burchelli* and of *Labeo umbratus* and *capensis* leaves no alternative to the adoption of Boulenger's diagnoses of these species.

It is impossible to say whether *B. burchelli* was founded on *burchelli* (as now defined) or on *vulneratus*. The type of *pallidus* also is lost, and no author has claimed to have recognized it, or has identified specimens with it. Boulenger thought it might have been based in part on *vulneratus*, but the size (2 in., 9 lines) alone excludes this species and the other "red-fin" species, all of which develop their "red-fins" considerably before reaching this length. There is no doubt in my mind that Boulenger's *hemipleurogramma* is really Andrew Smith's *pallidus*. The two species of *Labeo* are discussed below (p. 125).

Andrew Smith's collection of freshwater fishes was in all probability derived from various localities and various sources. He himself travelled widely in the Colony; he instituted and was the first Curator of the South African Museum established in Cape Town in 1825.*

The localities given by Andrew Smith in the "Illustrations" do not help much. Although he mentions the Olifants, Breede, and Orange rivers in some cases, for the very two species of *Barbus* whose types are missing and whose exact status is thus, to some extent, doubtful, he gives only a general locality: "various rivers of the Cape Colony" (*B. burchelli*); "clear streams in various parts of the Cape Colony" (*B. pallidus*).

On the chance of finding an entry recording the capture of freshwater fishes on the Expedition led by Andrew Smith in 1834 from Port Elizabeth *via* Graaf Reinet and Colesberg to Philippolis (*i.e.* within the region covered by the present paper), I have consulted the original MSS. Diary, which is in the South African Museum. This Diary, however, only begins with the departure from Graaf Reinet, and contains no reference to the capture of any fishes *en route* until the Expedition reached Boetsap (Bootscap). As this record and a

* See A. Michie, Memoir of Sir A. Smith, Trans. Berwickshire Naturalists Club, Alnwick, 1877; A. Roberts, Ann. Transv. Mus., xviii, p. 271, 1936; V. Fitzsimons, *ibid.*, xvii, p. 259, 1937.

Chief expeditions (dates taken from Michie): Kaffirland, 1824–25; West coast to Orange River, 1828; Natal and Zululand (with Krebs and Drège), 1830; Port Elizabeth to Graaf Reinet, Philippolis, Basutoland, Kuruman, and Limpopo River, 1834–35.

P. R. Kirby, "Andrew Smith, M.D., Founder of the First South African Museum," Ann. S. Afr. Mus., xxxvi, pp. 1–26, pls. 1–5, 1942.

later one in the Diary enable the type localities of two of Andrew Smith's species to be fixed, they may be quoted here.*

At Boetsap on 23rd January 1835 Andrew Smith obtained "Fish No. 76" (published Diary, i, p. 228). The description of the coloration, which mentions the anterior and posterior portions of the dorsal fin, corresponds unmistakably with the coloured figure (pl. 5) of *Tilapia sparrmanii* in the "Illustrations." The type locality for this species, therefore, may be accepted as the Hartz River near Boetsap, Bechuanaland, Cape Province.

On 15th August 1835 Andrew Smith records: "A fish with four palpi to the upper lip was this day caught in the Marique [=Marico River] nearly if not same that occurs in the Orange River. It appeared thicker in proportion to its length than those of the last-named river. It was of a fine green colour, the scales edged with golden yellow; belly and chin white; under lip yellowish white; eyes silvery, clouded in some parts with bronze, and a fine bright golden yellow ring margined the pupil; fins greenish, pectoral ones purplish at base on outer scale; upper lip pale yellowish green" (published Diary, ii, pp. 161, 162). On this date the Expedition was alongside the Marico River near where it reaches the border of Bechuanaland at Deerdepoort and Sekwani, east of Gaberones (Kirby's map in Diary, ii).

This place must be regarded as the type locality for *Barbus marequensis*, though perhaps it would be rash to assume that the so-called type specimen in the British Museum actually came from the Marico River. Fresh specimens from this locality should be obtained, and a re-examination of the type specimen would not be superfluous.

From the shape of the anal fin in the figure in the "Illustrations" (pl. 10, fig. 2) the species is one with longitudinally striate scales (*cf.* p. 144), although Andrew Smith is not so definite on this point as he is in the case of *B. capensis*; further, he says "scales very large," his figure shows about 45 in the lateral line, and (apparently) 14 around the caudal peduncle; whereas Boulenger (1911, Cat. Fw. Fish. Afr., ii, p. 36) gives 33 and 12 respectively. The figure shows the last dorsal spine as rather strong, and accentuated by bright yellow colour; Boulenger describes it as rather feeble (see further p. 160).

* This Diary has now been edited by Prof. P. R. Kirby, and published as Nos. 20 and 21 of the Publications of the Van Riebeeck Society, Cape Town, vol. 1, 1939, vol. 2, 1940.

Note on Mr. C. R. Seeber.

Gilchrist and Thompson recorded three species: *Labeo seeberi, Barbus seeberi,* and *Barbus serra,* collected by "Dr. Seeber" in the "Olifants River." In the case of the first and third species these authors in their monograph place the locality in the Transvaal, but in that of the second species in the Cape Province. In the latter case the locality is still ambiguous because there are two well-known rivers of this name in this Province, one in the Clanwilliam Division, the other in the Oudtshoorn Division (*cf.* p. 119). In the South African Museum Register book, in W. W. Thompson's handwriting, the word "Transvaal" (after Olifants River) occurs only in the case of *Labeo seeberi,* the other two being recorded merely as from the Olifants River.

As it seemed strange that Seeber should have collected in only two rivers, both of the same name, but in two different Provinces, and since it has been found that all the three species in question are common in the Clanwilliam Olifants River, but have not been recorded from any other localities, enquiries were made in likely quarters.

Seeber was evidently in communication with Dr. Gilchrist (see Gilchrist and Thompson, *l.c.*, p. 404), but not with the South African Museum, as his name does not appear on the Museum files.

In the Report of the South African Museum for 1906, however, Dr. Gilchrist recorded the name "C. R. Seeber, Clanwilliam" as a donor of freshwater fishes (Rep. S. Afr. Mus. for 1906, Cape Town, 1907, p. 37).

Consequently it is quite clear: that "Dr." was a misprint for "C. R."; that Seeber obtained all his specimens from the Clanwilliam Olifants River; and that Gilchrist and Thompson inadvertently wrote the word "Transvaal" instead of "Cape" in recording the localities of *Labeo seeberi* and *Barbus serra.*

I have recently (1940) traced and personally met Mr. Seeber. He confirms that the only fishes he sent to Dr. Gilchrist were caught in the Clanwilliam Olifants River, while he was Chief Constable at Clanwilliam.

Note on Krebs.

On one of his expeditions, namely, to Natal and Zululand in 1830, Sir Andrew Smith was accompanied by Krebs (Roberts, Ann. Transv. Mus., xviii, p. 271, 1936), and also by the botanist Drège (Fitzsimons, *ibid.*, xvii, p. 259, 1937). But I am not aware of any record of Krebs' travels or itinerary.*

The types of *Barbus afer* and *serra* are in the "Krebs collection" now in the Berlin Museum. *B. serra* is a species known only from the Olifants River (Clanwilliam), but *B. afer* has not yet been rediscovered.

Notes on Duplication of Place-names.

Reference has already been made to the ambiguity arising from there being three rivers, two in the Cape Province and one in the Transvaal, bearing the same name of Olifants River (p. 118). Duplication, nay multiplication, of the same place-name occurs with great frequency in South Africa, and the compiler of locality-records should be on his guard.

For the purpose of the present paper the following additional cases may be noted :—

Diep River arising on Table Mt. and flowing into False Bay; Diep River arising near Malmesbury and flowing into Table Bay. In the present paper no reference is made to the Diep River, Caledon, a minor tributary of the Zwart–Bot River.

Gt. Fish River, a *northern* tributary of the Orange River, arising in South West Africa; a large river in the Eastern Cape Province arising on the south of the main Cape watershed; and Fish River, a *southern* tributary of the Orange River connected with the Zak River.

Klip River, Natal (Max Weber), and Klip River, Transvaal (Gilchrist and Thompson).

Palmiet River in the Cape Peninsula, flowing from Table Mt. into Hout Bay; and the Palmiet River (area 5 on map, fig. 1) on the east side of the Hottentots Holland Mts. and Cape Hangklip. There are several other "Palmiet" rivers, or farms called "Palmietrivier."

Similarly there are several Riet, Dwars (or Dwaars), and Zout (or Salt) rivers. There is a Groot (or Groote) River near Ladismith, and one at Steytlerville. Both the Clanwilliam Olifants River and the Oudtshoorn Olifants River have a tributary called the Doorn River. The former of these as well as the Breede River has a tributary, Hex River.

Crocodile River (Transvaal): one of the headwaters (others are the Magalies and Yokeskei rivers) of the Aapies River, arising on

* In a list of donations to the South African Museum in 1825 he was described as "naturalist to His Prussian Majesty." See Kirby, Ann. S. Afr. Mus., xxxvi, p. 14, 1942.

the north of the Witwatersrand in the Krugersdorp and Pretoria Divisions, and belonging to the Limpopo system; a larger river arising on the east of the Drakensberg escarpment in the Lydenburg Division, and joining the Komati River.

In the case of towns, there is Richmond in the Cape Province and in Natal; Heidelberg in the Cape and the Transvaal; Lad*i*smith in the Cape and Lad*y*smith in Natal.

Montagu Pass, north of George, is a long way from the village of Montagu.

Colloquial Names.

As in the case of many other animals, so in the case of fishes, there are very few colloquial names, and these are often applied to several fishes which the scientist now recognizes as distinct species. Consequently they are of little use in scientific work. For example, in the Reports on Inland Waters,* Mr. S. A. Hey employs only colloquial names, and expresses the opinion that "To my mind there is but little, if any, difference between the yellow-fish, scaley, and witte-vis" (Rep., iii, p. 29). Yet his records of the occurrence of these fishes in the various rivers investigated seem to have been based on some character or coloration easily observable in the field (either by himself or his informants), because his records coincide *in general* with the distribution as known from authoritatively identified specimens or recent investigations. *E.g.* Holub's Yellowfish (*B. holubi*) is found (so far as the Cape Province is concerned) in the tributaries of the Orange River (Rep., iii, p. 28), *i.e.* only north of the main Cape watershed.

In detail, however, his records could not be used to delimit the distribution of particular species. These remarks are not intended as criticism, because the Survey was undertaken only with a view "to ascertaining the possibilities of the inland waters of the Union for stocking" with non-indigenous edible fish (Rep., i, p. 1).

In the case of the Kurper, or Rockey as it is known in the Eastern Province, the records show that in all probability *Sandelia* occurs from the Cape along the coastal belt as far as the East London and Komgha districts. When we come to the Transvaal, however, we have to bear in mind that in that part of the country the name Kurper refers to various species of *Tilapia*.

"Rooivlerk Kurper" is a name which, in my own experience, has

* Union S. Afr. Fisheries Survey, Inland Waters, Report, i, 1926; Report, ii, 1926; Report, iii, 1928.

caused confusion owing to the omission of the second word (see pp. 107, 248).

In reports on the Black Bass,* certain statements regarding the local and scientific names, and the distribution, of some of the indigenous fishes are incorrect, though this was unavoidable at the time the reports were written. Later researches have shown, *e.g.*, that the term "rooivlerk" is ambiguous, and that the published records of "*Barbus anoplus*" refer to more than one species, but none of them to the true *anoplus* (p. 206).

"Gillieminkie" is a name applied in the Eastern Province and Natal to any small species of *Barbus* which is not a red-fin. In a MS. note on fishes from the Klip River, Transvaal, the late Dr. Gilchrist spelt the name "Kilimkjas."

Therefore, in order that the various species in the Cape may be referred to with greater exactitude by anglers and others, the following names are proposed. They have been chosen in consultation with Mr. A. C. Harrison, Hon. Secretary of the Cape Piscatorial Society and Advisory Officer on Inland Fisheries to the Cape Provincial Administration.

Labeo capensis	Orange River Sandfish.
,, *umbratus*	Moggel; Mud Mullet (E.P.†).
,, *seeberi*	Clanwilliam Sandfish, Sandvis.
Barbus holubi	Holub's Yellowfish, Geelvis.
,, *capensis*	Clanwilliam Yellowfish, Geelvis.
,, *serra*	Saw-fin.
,, *andrewi*	Andrew Smith's or Cape Whitefish, Witvis.
,, *burchelli*	Burchell's Red-fin, Rooivlerk.
,, *vulneratus*	Castelnau's Red-fin, Rooivlerk.
,, *calidus*	Clanwilliam Red-fin, Rooivlerk.
,, *asper*	Plump Red-fin, Rooivlerk.
,, *tenuis*	Slender Red-fin, Rooivlerk.
,, *senticeps*	Uitenhage Red-fin, Rooivlerk.
,, *pallidus*	Goldie.
,, *karkensis*	Gillieminkie or Gillie (E.P. and Natal).
,, *anoplus* and varieties	Chubby-head (Gouritz, Clanwilliam, Orange River).

* A. C. Harrison, Union S. Afr. Fish. Mar. Biol. Survey, Investigational Reports, 4, 1934, pp. 21, 22, 80; and 7, 1936, pp. 17, 18, 20, 79, 88, 90, 94, 95, 101.

† W.P., E.P. = Western, Eastern Province respectively.

Clarias	Mud-barbel, Platkop Barber.
Gephyroglanis sclateri	Orange River Rock-baager or Catfish.
,, *gilli*	Clanwilliam Catfish.
Galaxias zebratus	Mountain Galaxias (W.P.)
,, *punctifer*	Lake or Vlei Galaxias (W.P.).
Sandelia capensis	Cape Kurper.
,, *bainsii*	Bain's Kurper, Rockey (E.P.).
Gilchristella aestuarius	Whitebait, Freshwater Sprat.
Mugil	Springer, Harder.
Anguilla mossambica	Freshwater Eel, Paling.
Monodactylus falciformis	Moonfish, Kaapse Nooitje.

Parasites.

Infestation by trematode worms, causing black warts under the scales, may be very heavy in some places, *e.g.* on Red-fins (*Barbus asper*) in a tributary of the Gamtoos River at Patentie. But in most localities the fishes seem to be very free from parasites.

The Fish-louse (*Argulus*) has only been found on *Sandelia capensis* in one locality (see p. 253) in the area dealt with, although Dr. V. Fitzsimons of the Transvaal Museum has submitted specimens from Cichlid hosts from the Transvaal.

Fish-fauna of the River-systems.

The following are not specially listed:—

The Eel (*Anguilla*) is found in all rivers flowing southwards and south-eastwards, *i.e.* in areas 2 and 4–12 (p. 255).

Gobies (*Gobius* and *Psammogobius*) are found in the lower reaches and estuaries of the Breede River and other rivers eastwards (p. 258).

The Moonfish or Kaapse Nooitje (*Monodactylus*) occurs in the Eerste, Breede, and other rivers eastwards.

Springers and Harders (*Mugil*) occur in all estuaries and often for some considerable distance inland (p. 255).

Area on Map, fig. 1.	Rivers and Systems.	Species.	Number of Species.
1	Cape Peninsula and western Cape Flats	*Galaxias zebratus* ,, *punctifer* *Sandelia* *Gilchristella*	4

Area on Map, fig. 1.	Rivers and Systems.	Species.	Number of Species.
1A	Diep River, Mosselbank River (Malmesbury district)	*Galaxias punctifer* *Sandelia* [*Tilapia mossambica*, introduced]	2
2	Eerste River	*Galaxias zebratus* ,, *punctifer* *Sandelia* *Barbus burchelli*	4
3	Berg River (Great and Little Berg)	*Galaxias zebratus* ,, *punctifer* *Sandelia* *Barbus andrewi* ,, *burchelli*	5
3A	Zoutkloofs River, Verloren Vlei River, Lange Vlei River	*Galaxias zebratus* ,, *punctifer* *Sandelia*	3
4	Lourens River	*Galaxias zebratus*	1
5	Steenbras River, Palmiet River, Bot River, Onrust to Hermanus streams	*Galaxias zebratus* *Sandelia*	2
6	Hartebeest and Klein River, Zonntagskloof and Uilenkraal rivers, Bushman River	*Galaxias zebratus* *Sandelia* *Gilchristella* (lower reaches, Klein River)	3
7	Breede River, River Zonder End, Buffeljagt River	*Galaxias zebratus* *Sandelia* *Barbus andrewi* ,, *vulneratus* *Gilchristella*	5
7A	Nieuwejaars River, Grashoek River, Kars River (Bredasdorp district)	*Galaxias zebratus* *Sandelia* *Barbus vulneratus* *Gilchristella*	4
7B	Duivenhoks River, Heidelberg, Vette and Kaffirkuils rivers, Riversdale	*Galaxias zebratus* *Sandelia* *Barbus vulneratus*	3
8	Gouritz system: Touws, Buffels, Groote (Ladismith), Dwyka, Gamka, Grobelaars, Le Roux, Olifants (Oudtshoorn); and (south of the Langebergen) Weiders and Valsch rivers	*Galaxias zebratus* *Sandelia* *Labeo umbratus* *Barbus asper* ,, *tenuis* ,, *anoplus*	6
9	Little Brak River, Mossel Bay (upper reaches)	*Galaxias zebratus* *Barbus asper*	2
	Little Brak River and Great Brak River	*Labeo umbratus* (see p. 137)	1
	Malagas River, George	*Galaxias zebratus*	1
	Homteni, Goukama, Kruis River, Knysna; Keurbooms River	*Sandelia* *Barbus asper*	2
10	Groote River, Steytlerville, Baviaans Kloof River, Gamtoos River	*Sandelia* *Labeo umbratus* *Barbus asper* ,, *pallidus*	4

Area on Map, fig. 1.	Rivers and Systems.	Species.	Number of Species.
10A	Kromme River, Geelhoutboom River, Kabeljouw River, Rondebosch River, Zeekoe River, (Humansdorp district)	*Sandelia* *Barbus asper* ,, *pallidus* ,, *senticeps*	4
	van Stadens River	*Sandelia* *Barbus pallidus*	2
11	Baakens and Zwartkops River	*Sandelia* *Barbus pallidus* ,, *senticeps* ,, *asper?* *Gilchristella*	4 or 5
12	Sundays River [not fully investigated]	*Labeo umbratus*	
13	Olifants River, Clanwilliam	*Galaxias zebratus* *Labeo seeberi* *Barbus capensis* ,, *serra* ,, *calidus* ,, *phlegethon* ,, *cernuus* *Gephyroglanis gilli*	8
14	Orange River, western or lower section, below Aughrabies Falls, incl. Gr. Fish River (S.W.A.)	*Labeo capensis* *Barbus holubi* ,, *paludinosus* ,, *hospes* *Engraulicypris gariepinus* *Clarias gariepinus*	6
14A	Orange River, middle section from Aughrabies Falls to junction of Caledon River, incl. southern tributaries Great Riet, Zak, Ongars, etc. (excl. Dry Hartz, Vaal, Modder, and other northern tributaries)	*Labeo capensis* ,, *umbratus* *Barbus holubi* ,, *paludinosus* ,, *anoplus* var. *Gephyroglanis sclateri* *Clarias gariepinus*	7

Family CYPRINIDAE.

Gen. Labeo Cuv.

1913. Gilchrist and Thompson, Ann. S. Afr. Mus., xi, pp. 346, 553, 562.

Historical (excluding Transvaal and Rhodesian species).

1841. Andrew Smith described and figured:

Abrostomus umbratus from rivers north of the Orange River, with "very small" scales (actual number not stated, but figure shows at least 110 along lateral line); and *A. capensis* from rivers of Cape Colony [*i.e.* south of the Orange River] but without definite locality, with "rather small" scales (figure shows about 60 in lat. line).

Such an enormous number of scales as is represented in the figure of *umbratus* is unknown in the genus; the nearest approach being 82–90 in *seeberi*. It is possible that Andrew Smith did actually obtain a specimen of the Olifants River (Clanwilliam) species together with specimens of *Barbus capensis* (p. 116, footnote); but both *umbratus* and *capensis* are stated to have two pairs of barbels, which *seeberi* (adult) has not got. On the other hand, as noted above (p. 115) the artist responsible for Smith's figures persistently represented more scales than were necessary.

We may therefore regard Smith's figures of *umbratus* and *capensis* as representing two species, one with relatively smaller and one with relatively larger scales. Although there may be a suspicion that *umbratus* was based on (or perhaps partly based on) a specimen of what we now know as *seeberi*, there is no means of proving it; and we must accept Boulenger's diagnoses based on specimens in the British Museum.

1861. Castelnau described inadequately:

Labeo cafer from Cat River (Gt. Fish River), and *L. sicheli* from "la partie supérieure de la rivière d'Orange"; the latter is stated to have about 60 scales in the lateral line and "D 3/9." He also recorded *A. capensis* Smth. from Burghersdorp (Orange system).

1868. Günther (Cat. Fish. Brit. Mus., vii, p. 68) abstracted brief diagnoses of Smith's two species, but mentioned no specimens in the British Museum or elsewhere. We may assume that Smith's types were, even then, lost or not available.

1894. Steindachner described and figured:

A. capensis Smith, from Philippolis, O.F.S., with 59–60 scales in the lat. line; and *L. tenuirostris* from the Limpopo River, with 46 scales in the lat. line.

1909. Boulenger made no reference to Smith's types, and appears to have recognized that the artist exaggerated the number of scales in the figures. He therefore based his descriptions on more recent material, and defined:

L. umbratus (Smith) as having 58–65 scales in the lat. line, 30–34 around caudal peduncle, dorsal rays 8–10, and anal not reaching caudal.

L. capensis (Smith) as having 44–50 scales in the lat. line, 20–24 around caudal peduncle, dorsal rays 10–11, and anal reaching to caudal (or nearly).

He made *cafer* Cast. and *sicheli* Cast. synonyms of *umbratus* (Smith) Blgr., and in accordance with his interpretation of Smith's species transferred *capensis* of Steindachner to *umbratus*, and *tenuirostris* Stndnr. to *capensis* (Smith).

The British Museum material listed by Boulenger constitutes the plesiotypes of the two species, the authorship of which should be credited to Boulenger as well as to Smith.

It cannot be maintained that Steindachner in assigning a specimen, described in detail by him, to *capensis* thereby crystallized the diagnosis of this species. Smith's two species must be taken *in conjunction*, and as Steindachner's specimen has the smaller scales it is rightly regarded as a synonym of *umbratus*. His figure shows well the plump head (see fig. 3, *a*) and the short anal fin.

1911. Gilchrist and Thompson described (not figured until 1913):

L. seeberi from "Olifants River, Transvaal" (see p. 118), with 83 scales in lat. line, and "about 32" (actually 48) around the caudal peduncle.

1913. The same authors followed Boulenger as regards the diagnoses of Smith's two species, and accepted his synonymy. In addition they described and figured:

L. stenningi from Potchefstroom (Vaal–Orange system), with 60 scales in lat. line, and 28 around caudal peduncle. The single specimen has actually 30 scales around caudal peduncle, and 4 dorsal spines (as in many specimens of *umbratus*, though the 1st is very small and inconspicuous). I am unable to accept it as a valid species, and include it under *umbratus*, with which it further agrees in the shape of the head and the position of the barbels.

L. rubromaculatus from Zululand (Tugela River system), with 43 scales in lat. line, and 20 [22] around caudal peduncle. Besides the type (total length 270 mm.) there is in the South African Museum a series of 14 specimens, 120–190 mm. in length, from the same locality. The type has D iii. 9, one other has iii. 10, all the others have iv. 9, although the 1st spine is very inconspicuous. Red spots may occur also in *capensis* (p. 133).

1916. Boulenger accepted *stenningi* and *rubromaculatus* as valid species, the former without comment, the latter with the remark that it was very close to *capensis*.

1938. A peculiar little (90 mm.) species, *L. quathlambae* Brnrd., was described (Barnard, 1938, Ann. Natal Mus., viii, p. 526, text-fig.) from Natal. Apparently allied to *umbratus*.

Key to the Cape Species.

1. Two barbels on each side (fig. 3, *a*, *b*). Scales moderate.
   a. Scales l.l. 43–50, c.ped. 20–24. Dorsal branched rays usually 11. Anal reaching to caudal (or nearly) . . . . . *capensis.*
   b. Scales l.l. 57–65, c.ped. 30–34. Dorsal rays usually 9. Anal not reaching caudal . . . . *umbratus.*
2. No barbels (in adult) (fig. 3, *c*). Scales very small, very numerous, l.l. 82–90. Dorsal rays usually 9. Anal not reaching caudal . *seeberi.*

Distribution (fig. 2).

L. capensis. Although Andrew Smith stated that this species was found in Cape Colony [*i.e.* south of the Orange River], published records and material in the South African Museum indicate that it occurs in the Vaal–Orange system north of the main Cape watershed, but not south of this watershed. In an Albany Museum Guidebook (*l.c.*, *infra*, 1937, p. 129) it is recorded that "when the Gt. Fish River [*i.e.* the one in the Eastern Province] comes down in flood many thousands of this species are thrown up on the shore near the mouth of the river." But Dr. J. L. B. Smith, who compiled the list, tells me (*in litt.* 21/v/41), when I pointed out that the occurrence of this species in this river seemed to be an anomaly, that the paragraph in question was intended to apply to *umbratus*.

Gilchrist and Thompson record a specimen from the Crocodile River (? which one, see p. 119), Transvaal; and *tenuirostris* came from the Limpopo River. The former specimen is supposed to be in the Transvaal Museum. I have not seen it; but I have seen another specimen from the Crocodile River, Pretoria district (caught 3/x/13).* This latter specimen, like *tenuirostris*, shows slightly different proportions (larger eye) from those of the Vaal–Orange series of *capensis*, as may be seen from the table. Whether this feature is constant and definite enough to justify resurrecting *tenuirostris* remains to be tested on a long series from the Limpopo system.

The Pretoria Crocodile River rises on the north of the Witwatersrand, not far from some of the headwaters of the Vaal system, but flows northwards to join the Aapies River (Limpopo system).

In the Tugela River system occurs *L. rubromaculatus*, a species exceedingly close to, if not identical with, *capensis*.

For the present I do not include *tenuirostris* or *rubromaculatus* in the synonymy of *capensis*.

* Thanks to the kindness of the Director and Dr. V. Fitzsimons.

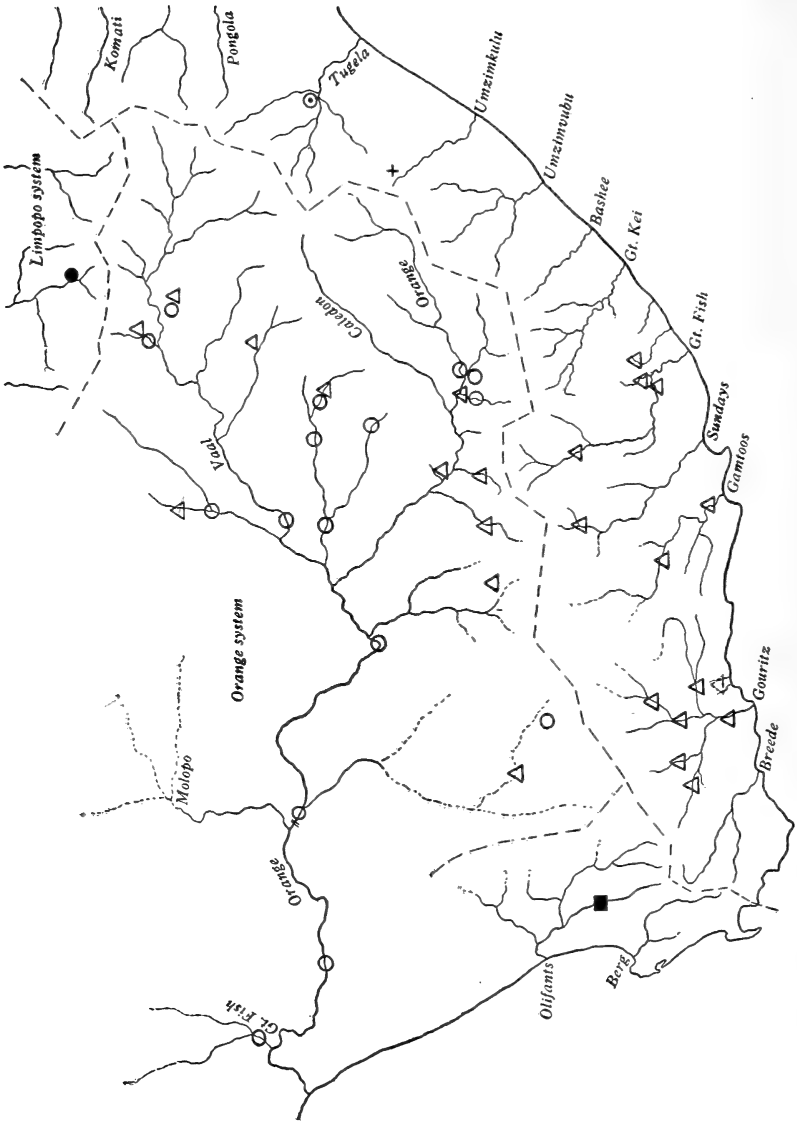


FIG. 2.—Distribution of *Labeo* in Southern Africa.

■ *seeberi.* △ *umbratus.*
○ *capensis.* ⊙ *rubromaculatus.*
● *tenuirostris.* + *quathlambae.*

L. umbratus was recorded by Andrew Smith from streams north of the Orange River, but most later records are from the southern tributaries of the Orange and localities south of the main Cape watershed: the exceptions being Castelnau's *sicheli*, Boulenger's record from Vredefort, O.F.S. (from a tributary of the Vaal River), the type of *stenningi* from Potchefstroom; and half a dozen other specimens (South African and Kimberley Museums) from the Modder River at Glen, O.F.S., and Vryburg, Bechuanaland; also from a tributary of the Zand River near Whites (20 miles south of Kronstad).

It occurs as far west as the Gouritz River system; it has been collected in the Gamtoos River, and is reported from the Sundays River and the Gt. Fish River, but not from the Gt. Kei River or farther east.

The limits of distribution of these two species requires to be worked out in much greater detail.

L. quathlambae occurs in the Upper Umkomazana River (Umzimkulu River system) near Himeville, Natal.

L. seeberi. Evidence has been given above (p. 118) showing that the original specimen came from the Clanwilliam Olifants River, from which river alone all recent specimens have been obtained.

Taxonomic Characters.

Dorsal Fin Spines.—In the three Cape species 4 dorsal spines can usually be seen without difficulty in the juveniles; but the 1st spine is very small and in half-grown and adults is usually obscured under the skin and last predorsal scale (cf. *Barbus, infra*, p. 142).

Anal Fin.—No marked growth-change in shape occurs. The fin has the shape seen in certain species of *Barbus* (e.g. *holubi*, *q.v.*), characterized by the apex of the 1st branched ray reaching beyond that of the last ray when laid back. The tip of the fin (as also of the ventral fins) may be somewhat bluntened in large specimens. The extent to which the tip of the fin (1st ray) reaches along the caudal peduncle appears to have some specific value, at least in the Cape species. Juveniles (30 mm.) of *capensis* can be distinguished easily from those of *umbratus* by this character alone.

Pectoral Fin.—No growth-change or sexual difference has been observed in the three species examined.

Scales.—The striae are subparallel, or very slightly radiating. No appreciable difference in the number of striae occurs in the three Cape species.

Mottley (Fishing Gazette, cxv, no. 3155, Oct. 1937, p. 444) shows that the difference in the number of scales in North American trout, hitherto regarded as a specific character, is dependent on the temperature at the eyed-egg stage and for five weeks thereafter: the higher the temperature, the lower the scale-count. The quoting of this reference must not be taken to imply that a similar phenomenon may have occurred in the genus *Labeo*, leading to the differentiation of such a form as *seeberi*. In comparison with the more tropical species, *seeberi* has a remarkably high scale-count. But we have no very definite data on the spawning season or seasons, and none on the concomitant water-temperature factors, of any of the South African species. A very cursory plotting of localities of the species, and the *air* temperatures of the nearest recorded meteorological station (Union of South Africa Year Book), seems to show that such an investigation *might possibly* prove interesting.

Warts on Head.—Many of the species of this genus, e.g. *cylindricus*, develop conspicuous horny tubercles on the snout in the adults of both sexes, though they are often better developed or more numerous in males than in females. These warts are perhaps caducous after the actual spawning period, leaving crater-like scars.

The Cape species *capensis*, *umbratus*, and *seeberi* do not develop these horny warts; nor does *rubromaculatus* (in the material at hand).

On the other hand, it seems to be a property of the mucous covering on the head and body, both in those species which develop large warts and in those which do not, to show when preserved a large number of minute whitish pimples. They are often indistinct, and the variability in this respect seems dependent on the method or state of preservation. Sometimes they are so numerous as to lead one to suppose they might be sexual or even specific; but they are not so, as their occurrence has been noted in both sexes of both "tuberculate" and non-tuberculate species. In fact they can be seen sometimes in the mucus on the scales, especially on the back and shoulders, but not of course if the specimen has been wiped clean.

Macrocephaly.—Specimens of both *capensis* and *umbratus* are occasionally found with an abnormally large head, so to speak a "bull-head": see the 300 mm. Laingsburg and the 240 mm. Keiskama specimens in the table of measurements for *umbratus*.

Labeo capensis (A. Smith) Blgr.

Orange River Sandfish.

Figs. 3, *b*, 4.

1841. A. Smith, Illustr. Zool. S. Afr. Pisces, pl. 12, fig. 2.
1861. Castelnau, Mem. Poiss. l'Afr. austr., p. 57 (name only).
1909. Boulenger, Cat. Fw. Fish. Afr., i, p. 340.
1913. Gilchrist and Thompson, Ann. S. Afr. Mus., xi, p. 360.
1937. J. L. B. Smith, Guide Vert. Fauna East. Prov., Albany Mus., Grahamstown, pt. 2, p. 128, pl. 31, fig. 3.

(The figures in Boulenger, G. and T., and J. L. B. Smith are of *tenuirostris*, after Steindachner.)

[Not *capensis* Steindachner, 1894.]

In addition to the diagnostic characters in the key, the following may be given: nape, especially in mature examples, rising in a sharp curve; lower profile of head flat; snout as long as or slightly longer than postocular part of head; rostral flap well developed; distance between bases of anterior barbels about 2 in snout and subequal to distance between bases of the anterior and posterior barbels; posterior nostril oval or subcircular, closed by a rather large flap (easily overlapping the rim of the nostril in well-preserved specimens).

The growth-changes may be illustrated by the following table compiled from two long series of specimens: one from the Modder River (Kimberley district), the other from Goodhouse on the Orange River and Aiais on the Great Fish River (S.W.A.) *; measurements of a few larger specimens from other localities (including the largest in the S.A. Mus.) are included.

The two series are very similar. In the largest Aiais specimens (2 each of 170 and 190 mm.) the head is proportionately larger than might be expected (*cf.* also *L. umbratus*).

In the smallest example (16 mm.) only the posterior barbel is present (fig. 4); but at 18 mm. the first indication of the anterior barbel is distinguishable. At this stage also the lips are already thick and papillose.

The scales are developed between the 22 and 25 mm. stages. Large specimens show granular roughening on the shoulder and nape scales.

At about 60–65 mm. minute whitish granules or pimples can be noticed in the mucus on the top of the head and snout, extending down the sides of the latter, but not strong hard warts as in *cylindricus*,

* See note, p. 119.

rubropunctatus, etc. These pimples continue throughout life, being present in the largest specimens, and in both sexes (see p. 130).

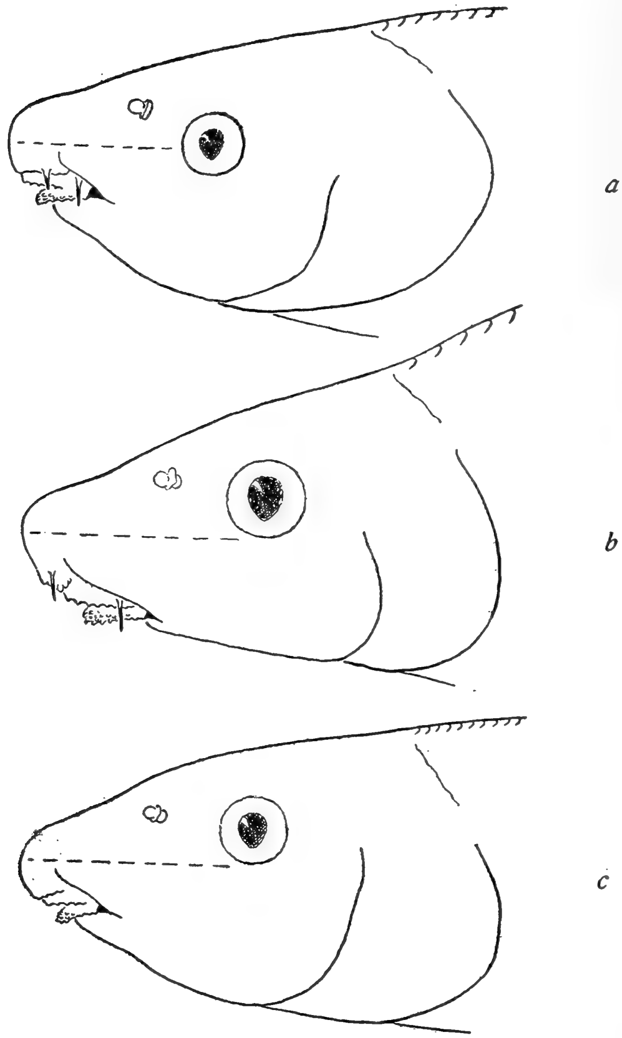


Fig. 3.—*Labeo*. Semidiagrammatic outlines of heads of half-grown specimens (150–200 mm.). Anterior predorsal scales indicated. Line from middle of snout to indicate relative position of eye.
a. umbratus. *b. capensis.* *c. seeberi.*

The smallest ovigerous ♀ measures 200 mm. in length (Zak River, Fraserburg).

Young specimens 21–25 mm. in length are easily distinguished from young *Barbus holubi* of same size (in addition to morphological characters) by a heavier pigmentation. All the specimens obtained from the Great Fish and Orange rivers had numerous minute dots on the scales over the whole body except those on the throat and ventral portion of the belly. Two of the larger ones had several dull reddish, round spots irregularly and asymmetrically arranged on the sides; according to the collectors these spots were not noticeable when the fishes were caught (cf. *rubromaculatus* G. and T., p. 360).*

No records of time of spawning are available. The Aiais and Goodhouse series, including juveniles from 16 mm. upwards, were collected early in November (1936).

Localities.—Orange River system: lower Orange (below Aughrabies Falls) and its tributary Gt. Fish River (coll. C. W. T. and A. J. H.); middle Orange (between Aughrabies Falls and junction with Caledon River) at Prieska and above the Aughrabies Falls (S. Afr. Mus.), Zak River, Fraserburg (Boulenger, G. and T.); upper Orange at Burghersdorp (Castelnau), Aliwal North (S. Afr. Mus.), Stormberg River north of Burghersdorp (coll. C. W. T. and L. D. B.).

Vaal and northern tributaries: Dry Hartz at Taungs (coll. C. W. T. and L. D. B.), Kimberley † (Boulenger, G. and T.), Warrenton (coll. C. W. T. and L. D. B.), Potchefstroom (Boulenger, G. and T.),

* Sir J. E. Alexander, "An Expedition of Discovery into the Interior of Africa" (London, 1838), vol. 2, p. 204: "Among other fish caught here [in the Gt. Fish River at Kuis, near Kub, north of Gibeon] were two which seemed to be novel: one, eighteen inches long, was brown on the back, with *red blotches on the sides* [italics mine], and yellowish-white belly; it had a purse or bag-like mouth, and eleven rays to the dorsal fin, was evidently a barbel (*barbus*), but peculiar from having its nose produced and rounded, like *Cyprinus Narus*, and from the form of the back being elevated and rounded.

"The other was a foot long; its back was bluish, | p. 205, yellowish on the sides; it was probably a Leuciseus [*sic*], for there were no indications of beards. Mr. J. E. Gray, of the British Museum, to whom my sketches were shown, proposed to call the first of these two varieties of fish *Barbus Namaquaensis*, and of the second he said that he was not aware that any species of the genus, to which it appeared to belong, had before been recorded as a native of the southern part of Africa."

The first fish is clearly *Labeo capensis*. Gray's name was never published, and though we must credit Andrew Smith with knowing Alexander's work, it is doubtful whether he would have recognized either his *capensis* or *umbratus* in a fish stated to have red blotches on the sides.

The second fish would seem to be *Barbus holubi*, though Alexander said it had no barbels, and made no mention of the characteristic stout dorsal spine; but there is no other species of that size.

† See note on Kimberley Reservoir under *Barbus kimberleyensis*, p. 159.

Labeo capensis.

Locality	TL in mm.	L/H	H/E	S/E	I/E	l.l.	c.ped.	g.r.	barb.	Sex and Remarks.
Goodhouse (16–40 mm.) and Aiais (21–190 mm.).	16	$3\frac{1}{4}$	$3\frac{1}{4}$	1	$1\frac{1}{4}$	No scales		Very feeble	p.	D iv. 11, fin rays distinct.
	18	$3\frac{1}{4}$	$3\frac{1}{4}$	1	$1\frac{1}{4}$	No scales			p.(a)	
	20	$3\frac{1}{4}$	$3\frac{1}{4}$	1	$1\frac{1}{4}$	No scales			p.a.	Lips thick and sub-papillose.
	22	$3\frac{1}{4}$	$3\frac{1}{4}$	1	$1\frac{1}{4}$	No scales			p.a.	
	25	$3\frac{1}{4}$	$3\frac{1}{3}$	1	$1\frac{1}{4}$	43	20	3 + 14		
	28–30	$3\frac{1}{4}$	$3\frac{1}{3}$	1	$1\frac{1}{4}$	42–43	20	5 + 17		
	32–34	$3\frac{1}{4}$	$3\frac{1}{3}$	$1–1\frac{1}{5}$	$1\frac{1}{4}–1\frac{1}{3}$	,,	,,			
	36	$3\frac{1}{4}$	$3\frac{1}{2}$	$1\frac{1}{4}$	$1\frac{1}{2}$	,,	,,			
	40	$3\frac{1}{4}–3\frac{1}{3}$	$3\frac{1}{2}$	$1\frac{1}{4}–1\frac{1}{3}$	$1\frac{1}{2}$	,,	,,			
	45	$3\frac{1}{2}$	$3\frac{3}{4}$	$1\frac{1}{4}–1\frac{1}{3}$	$1\frac{1}{2}$	43–44	,,	6 + 20		
	50–55	$3\frac{1}{2}–3\frac{2}{3}$	$4–4\frac{1}{3}$	$1\frac{1}{2}–1\frac{3}{4}$	$1\frac{1}{2}–1\frac{3}{4}$	43–45	20–22			
	60–65	$3\frac{2}{3}–3\frac{3}{4}$	$4\frac{1}{3}$	$1\frac{3}{4}$	$1\frac{3}{4}$	,,	22			
	70–75	$3\frac{3}{4}–4$	$4\frac{1}{2}$	2	2	44–46	,,			
	80–85	,,	,,	,,	,,	,,	,,			
	90	,,	,,	,,	,,	,,	,,	10 + 26		
	110	4	5	2	$2\frac{1}{4}$	,,	,,			
	160	$4–4\frac{1}{5}$	$5\frac{1}{3}–5\frac{1}{2}$	$2\frac{1}{4}$	3	45–46	,,			
	170	$4\frac{1}{4}–4\frac{1}{3}$	$5\frac{1}{2}$	$2\frac{1}{4}$	3	,,	,,			
	190	$4\frac{1}{3}$	$5\frac{1}{2}–5\frac{3}{4}$	,,	,,	,,	,,	12 + 30		
Modder R., south of Kimberley.	28–30	$3\frac{1}{4}$	$3\frac{1}{3}$	1	$1\frac{1}{4}$	43–44	20	5 + 16	p.a.	
	35	$3\frac{1}{4}–3\frac{1}{3}$	$3\frac{1}{3}–3\frac{1}{2}$	$1\frac{1}{4}$	$1\frac{1}{3}–1\frac{1}{2}$	,,	,,			
	40–45	$3\frac{1}{3}–3\frac{1}{2}$	$3\frac{2}{3}–3\frac{3}{4}$	$1\frac{1}{3}–1\frac{1}{2}$	$1\frac{1}{2}–1\frac{3}{4}$	,,	,,			
	50	$3\frac{1}{3}–3\frac{2}{3}$	4	$1\frac{1}{2}$	$1\frac{3}{4}$	,,	,,	7 + 20		
	60	$3\frac{2}{3}$	$4\frac{1}{3}–4\frac{1}{2}$	$1\frac{3}{4}$	2	43–45	22			
	70	$3\frac{4}{5}$	$4\frac{1}{3}$	$1\frac{4}{5}$	2	,,	,,			
	80	4	$4\frac{1}{2}$	2	2	,,	,,			
	90	4	$4\frac{1}{2}$	2	2	,,	,,	10 + 26		
	98	4	5	2	2	,,	,,			
Prieska,	115	$4\frac{1}{5}$	6	$2\frac{1}{2}$	3	44	22			
Zak R.,	200	$4\frac{1}{2}$	$6\frac{1}{5}$	$2\frac{3}{4}$	3	45	,,	. .	. .	♂, ovig. ♀.
Vaal R.,	215	$4\frac{1}{2}$	6	$2\frac{3}{4}$	3	46	,,			
Potchefstroom,	255	$4\frac{2}{3}$	6	$2\frac{3}{4}$	3	44	,,			
Modder R., Glen, O.F.S.,	260–270	$4\frac{1}{2}$	$7–7\frac{1}{2}$	3	$3\frac{1}{2}$	44–45	,,		. .	♂♂.
Limpopo R.,	260	$4\frac{1}{2}$	$5\frac{1}{2}$	$2\frac{1}{2}$	$(2\frac{3}{4})$	46	(22)		. .	*tenuirostris* Stndnr.
Aliwal N.,	325	$4\frac{1}{2}$	$8\frac{1}{2}$	4	$4\frac{1}{2}$	47	22	12 + 38		
Crocodile R., Pretoria,	340	$4\frac{2}{3}$	7	$3\frac{1}{4}$	4	43	20	. .	. .	♂ (Pretoria Mus.).
Modder R.,	350	$4\frac{2}{3}$	$8\frac{1}{2}$	4	$4\frac{1}{2}$	45	22	. .	. .	Ovig. ♀.
Zak R.,	450	$4\frac{3}{4}$	9	$4\frac{1}{3}$	5	46	,,	. .	. .	Ovig. ♀.

Vredefort Road (Boulenger), Modder River, south of Kimberley (G. and T.), 25 miles north of Bloemfontein (coll. C. W. T. and L. D. B.), Glen (S. Afr. Mus.), Kromspruit, 38 miles south of Bloemfontein (coll. C. W. T. and L. D. B.).

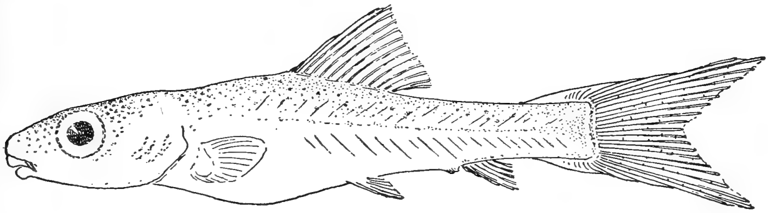


FIG. 4.—*Labeo capensis.* Juvenile, 16 mm. Goodhouse, Orange River.

Records from the Transvaal (Crocodile and Limpopo rivers) are not included above, as the status of *tenuirostris* should be investigated more closely.

Labeo rubromaculatus.

For comparison with *L. capensis.*

	TL	L/H	H/E	S/E	I/E	l.l.	c.ped.	g.r.	Sex and Remarks.
M'fongosi, Zululand.	120	4	$4\frac{4}{5}$	2	$2\frac{3}{4}$	44	22	10 + 28	
	130	4	5	2	3	,,	,,		
	140	4	5	2	3	,,	,,		
	150	$4\frac{1}{4}$	$5\frac{1}{2}$	$2\frac{1}{2}$	$3\frac{1}{2}$	,,	,,		
	160	$4\frac{1}{3}$	$5\frac{1}{2}$	$2\frac{1}{2}$	$3\frac{1}{2}$	,,	,,		
	170	$4\frac{1}{2}$	$5\frac{3}{4}$	$2\frac{3}{4}$	$3\frac{1}{2}$	,,	,,		
	180	$4\frac{1}{2}$	6	3	4	,,	,,		
	190	$4\frac{1}{2}$	6	3	4	43	20		
	270	$4\frac{3}{4}$	$6\frac{1}{2}$	3	4	,,	22	12 + 36	♂ Type D iii, 9.

13 specimens D iv. 9, one (160 mm.) D iii. 10.

Labeo umbratus (A. Smith) Blgr.

Moggel; Gamkavis; Vaalvis; Mud Mullet.

Fig. 3, *a*.

1841. A. Smith, *l.c.*, pl. 12, fig. 1.

1861. Castelnau, *l.c.*, p. 60 (*cafer* and *sicheli*).

1894. Steindachner, Sb. Ak. Wiss. Wien, ciii, p. 12, pl. 4, fig. 1, 1 *b* (*capensis* non Smith).

1909. Boulenger, *l.c.*, p. 339, fig. 255.

1913. Gilchrist and Thompson, *l.c.*, p. 362, fig. 30 (after Blgr.).

1913. *Id.*, *ibid.*, p. 363, fig. 31 (*stenningi*).
1916. Boulenger, *l.c.*, iv, p. 208, fig. 131 (after G. and T.) (*stenningi*).
1937. J. L. B. Smith, *l.c.*, p. 129, pl. 31, fig. 4 (after Boulenger).

Characters additional to those given in the key: nape not rising; lower part of head swollen, profile convex (this is well shown in Steindachner's figure; Andrew Smith's figure is not drawn in true side-view and shows the broad snout); snout shorter than postocular part of head; rostral flap feebly developed; distance between bases of anterior barbels $1\frac{1}{2}$ in snout, and $2–2\frac{1}{2}$ times as great as the distance between bases of anterior and posterior barbels; posterior nostril narrow oblong-crescentic, the flap just large enough to close the aperture.

The usual dorsal fin formula is D iii. 9; the true 1st spine is very small and mostly obscured in half-grown and adult specimens, but juveniles show 4 distinct spines. Occasionally specimens with D iv. 8 or D iv. 10 are found (Zak River, 44 with 9 rays, 3 with 10).

The anal fin is shorter than in *capensis*, not reaching beyond about half-way along the caudal peduncle.

The table seems to show that in addition to these differences this species has a smaller eye relatively to the length of the head.

Like *capensis*, the young have the scales heavily dotted with dark pigment. The colour in life is silvery, greyish or greenish-grey or buff on back, fins with a faint pink tinge.

It appears to start breeding at about the same size as *capensis*. The largest recorded size is 310 mm. (Boulenger). The earliest stages have not yet been obtained. Ripe adults were obtained in middle and late October (1937), as were also the 30 mm. and other juveniles listed in the table. Information received from Cradock by the Department of Agriculture of the Cape of Good Hope in 1894, stated that these fish spawned in September; and it was suggested that the close season should be from September to November.

No large warts on head in either sex.

Variability is shown in the three specimens from the Keiskama River. Normally the distance between tip of snout and origin of dorsal fin is greater than distance between base of last dorsal ray and end of scaling on caudal peduncle. The 240-mm. specimen is normal in this respect, but in the 210-mm. specimen the two distances are equal; and the 230-mm. specimen is intermediate.

Localities.—Gouritz River and tributaries—Touws River; Buffels River (Laingsburg); Gamka River (Prince Albert); Buffels or Groot River (Ladismith); Valsch River (Albertinia); Olifants River

Labeo umbratus.

Locality	TL	L/H	H/E	S/E	I/E	l.l.	c.ped.	g.r.	barb.	Sex and Remarks.
Ladismith.	30	$3\frac{2}{3}$	$3\frac{1}{3}$	1	$1\frac{1}{2}$	53	26	3 + 15	p (a)	D iv. 9.
	35	$3\frac{2}{3}$	$3\frac{1}{2}$	1	$1\frac{1}{2}$	57	28	4 + 18	p (a)	Lips papillose.
	40	$3\frac{3}{4}$	$3\frac{3}{4}$	$1\frac{1}{4}$	$1\frac{1}{2}$	57–58	28–30	..	p.a.	
Gamka Poort.	45	$3\frac{3}{4}$	4	$1\frac{1}{3}$–$1\frac{1}{2}$	$1\frac{3}{4}$	,,	,,	5 + 20	p.a.	
	55	$3\frac{4}{5}$	4	$1\frac{1}{3}$–$1\frac{1}{2}$	$1\frac{3}{4}$–2	56–58	,,	5–6 + 20		
	65	4	$4\frac{1}{3}$	$1\frac{1}{2}$–$1\frac{2}{3}$	$2\frac{1}{3}$	58–61	30–32	6–7 + 23		
Buffels R., Laingsburg.	75	4	$4\frac{1}{2}$	$1\frac{2}{3}$	$2\frac{1}{2}$	,,	,,			
	85	4	5–$5\frac{1}{4}$	2	$2\frac{3}{4}$–3	60–62	32			
	95	4	$5\frac{1}{2}$	2	$3\frac{1}{3}$	,,	32–34			
	100	4	$5\frac{3}{4}$	$2\frac{1}{4}$	$3\frac{1}{2}$	58–60	32	8 + 25		
	135	4–$4\frac{1}{4}$	6	$2\frac{1}{3}$	$3\frac{3}{4}$	59–64	32–34			
	145	4–$4\frac{1}{4}$	6	$2\frac{1}{3}$	$3\frac{3}{4}$	59–62	32			
	160	4–$4\frac{1}{4}$	6–$6\frac{1}{4}$	$2\frac{1}{2}$	$3\frac{3}{4}$–4	59–60	32	..	..	♂♂ immature and ripe.
	170	$4\frac{1}{4}$	$6\frac{1}{2}$	$2\frac{1}{2}$	4	57	32	9–10 + 30	..	♂.
	180	4–$4\frac{1}{4}$	$6\frac{3}{4}$–7	$2\frac{1}{2}$	4–$4\frac{1}{4}$	59–65	32–34	..	..	♂♂, ♀♀.
	210	4–$4\frac{1}{4}$	7	$2\frac{1}{2}$–$2\frac{3}{4}$	$4\frac{1}{3}$	58–61	,,	10 + 32	..	♂, ovig. ♀.
	230	$4\frac{1}{4}$	7	$2\frac{3}{4}$	$4\frac{1}{3}$	56	34	..	..	,,
	240	$4\frac{1}{4}$–$4\frac{1}{3}$	7–$7\frac{1}{4}$	$2\frac{3}{4}$–3	$4\frac{1}{2}$	60–63	32	..	..	,,
	270	$4\frac{1}{3}$	$7\frac{1}{3}$	3	5	68	,,	..	..	Ovig. ♀.
	290	$4\frac{1}{3}$	8	3	5	61	,,	..	..	♂, ovig. ♀.
	300	4	9	$3\frac{1}{2}$	5	54	30	..	..	Ovig. ♀.
Keiskama R., Alice.	210	4	$7\frac{1}{4}$	$2\frac{3}{4}$	$4\frac{1}{3}$	60	30	10 + 32	..	♂.
	230	4	8	3	$4\frac{1}{2}$	62	32	..	..	Ovig. ♂.
	240	$3\frac{1}{2}$	9	$3\frac{1}{2}$	5	61	30	12 + 30	..	♂.
	205	$4\frac{1}{4}$	$6\frac{1}{2}$	$2\frac{1}{2}$	$3\frac{4}{5}$	60	30	10 + 30		♀ Type *stenningi.*

(Oudtshoorn) (the last-mentioned according to Mr. Pocock of Oudtshoorn, all the former collected by K. H. B., C. W. T., and A. J. H., 1937); Grobelaars River (Oudtshoorn) and Gamka River (Boulenger, Gilchrist and Thompson).

Little Brak River and Great Brak River—a MS. note by the late Dr. Gilchrist refers to specimens from these rivers sent to the S. Afr. Museum and identified by Mr. Trimen (date ?. Mr Trimen ceased to be Director in 1895).

Gamtoos River—upper reaches (= Groote River) at Fullarton and Steytlerville; lower reaches at Patentie (coll. K. H. B., C. W. T., and A. J. H., 1938).

Sundays River—Van Ryneveld's Pass Dam, Graaff-Reinet (A. C.

Harrison in F. Mar. Biol. Surv., Investigat. Rep., 7, 1936, p. 75, specimens not seen by me).

Gt. Fish River—Cradock (Boulenger); Fort Brown, Albany Div. (Grahamstown Museum, seen by me); Tyumi River, tributary of Keiskama River, Alice (Gilchrist and Thompson). Also Cat River (a tributary) if Castelnau's *cafer* be regarded as synonymous.

Orange River—streams N. of Orange River (A. Smith); upper Orange (Castelnau, *sicheli*); Philippolis (Steindachner); tributary of Zand River at Whites, approx. 20 miles south-west of Kronstad (coll. D. Hey, Jonkershoek Fish Hatchery, seen by me); tributary of Vaal River at Vredefort Road (Boulenger); Potchefstroom (Gilchrist and Thompson, *stenningi*); Vryburg (S. Afr. Mus., Kimberley Mus.); Zak River, Williston, and Ongar River, Richmond (Cape) (coll. K. H. B., C. W. T., and L. D. B., 1939); Modder River at Glen (S. Afr. Mus.); Sea Cow (Seekoe) River, 8 miles N.E. of Hanover, Oorlogspoort River, 20 miles S.E. of Colesberg, and Stormberg River, 11 miles N. of Burghersdorp (all coll. C. W. T., L. D. B., A. J. H., 1939).

Labeo seeberi G. and T.

Clanwilliam Sandfish.

Fig. 3, *c*.

1911. Gilchrist and Thompson, Ann. Mag. Nat. Hist. (8), vii, p. 477.

1913. *Id.*, Ann. S. Afr. Mus., xi, p. 347, fig. 18.

1916. Boulenger, Fw. Fish. Africa, iv, p. 211, fig. 133.

The following description is supplemental to that of Gilchrist and Thompson:—

Depth $4\frac{1}{2}$ (juv. and the type) to $4\frac{3}{4}$ (largest specimen), length of head 4 (70 mm.) to $5\frac{1}{4}$ (largest specimen) in length of body, excluding caudal fin. Interorbital width twice in length of head (slightly more than twice in smallest specimen). Snout subequal to postocular part of head in juv. up to 96 mm., longer in specimens of 185 mm. and upwards. Eye $3\frac{3}{4}$ (70 mm.) to 7 (the type, and 280 and 380 mm.) in length of head. (Measurements involving the length of the head are dependent somewhat on the method of preservation, as the tip of the snout is very fleshy.)

A low fleshy ridge runs obliquely from the origin of the rostral flap towards the junction of the upper and lower lips, and ends in a very small barbel ($\frac{1}{5}$ eye diameter) on the left side in one 83-mm. specimen, on both sides in one 93-mm. specimen; in all other specimens the ridge ends bluntly; both ridge and barbel (when present) are hidden under the preocular margin when the mouth is closed.

Posterior nostril oval or subcircular, the flap just closing the aperture.

In all specimens up to 280 mm. (including the type), distance between *nostril* and base of 3rd dorsal spine subequal to distance between base of last dorsal ray and base of median caudal rays; in the largest specimen the latter distance is subequal to that between *tip of snout* and base of 3rd dorsal spine. In all cases base of ventral spine vertically below base of 4th or 5th dorsal ray.

D iv. 9 (–10). Pectoral $\frac{2}{3}$ (juv.)–$\frac{4}{5}$ length of head. The type has the lower caudal lobe longer than the upper (as G. and T. describe, though the figure scarcely shows it), but this seems to be merely casual, as the other specimens have the upper lobe slightly longer than the lower. Anal fin not reaching lower caudal rays. Caudal peduncle twice as long as deep in juv. and type, nearly $2\frac{1}{2}$ as long as deep in the 280-mm. specimen, and nearly 3 times in the 380-mm. specimen.

Scales: l.l. 82–87, the largest specimen 90; between l.l. and ventral spine 16; around caudal peduncle 36 (juv.) increasing to 50 (the type has 48).

Gill-rakers on 1st arch: 7 (upper part) + 24 (lower part) (72 mm.), increasing with age to 14 + 40.

Stomach-contents, all ages, fine vegetable debris and microscopic algal growths.

Pale grey or brown with silvery sheen, belly silvery white, each scale (not the body as in G. and T.'s account) on back and sides with minute dark dots, more noticeable in juveniles than adults.

Locality.—Olifants River, Clanwilliam, Cape.

Remarks.—This species is more slender than either *capensis* or *umbratus.* Even ripe females in good condition are scarcely so plump as the type; and none have the arched dorsal profile shown in the figure, which is due to the position in which the specimen has been preserved; also the artist has "improved" the profile of the belly, giving an unnatural depth of body. In the largest specimen the slenderness, especially of the hinder part of the body and of the caudal peduncle, is very noticeable.

Of 50 specimens netted in mid-April 1937, ranging from about 150–290 mm., there were 6 ♂♂ and 7 ♀♀ apparently nearly ripe, and 37 immature; the mature ones were 250 mm. upwards in length. Six specimens had 10 dorsal rays. No strong warts on head in either sex.

The young stages have not yet been obtained (see *infra*).

Mr. A. C. Harrison has kept a small specimen, $4\frac{1}{2}$–5 in. long, in captivity for four years. Although it fed well on algae, etc., it did not increase in size.

Labeo seeberi.

TL	L/H	H/E	S/E	I/E	l.l.	c.ped.	g.r.	barb.	Sex and Remarks.
70	4	$3\frac{3}{4}$	$1\frac{1}{2}$	$1\frac{1}{2}$	82	36	7 + 24		
75	4	4	$1\frac{2}{3}$	$1\frac{3}{4}$	83	38	8 + 25		
80	$4\frac{1}{4}$	$4\frac{1}{4}$	$1\frac{3}{4}$	2	83	38	8 + 25	p.	
90	$4\frac{1}{4}$	$4\frac{1}{2}$	$1\frac{3}{4}$	2	86	38	..	p.	
95	$4\frac{1}{4}$	5	$2\frac{1}{4}$	$2\frac{3}{4}$	85	40	8 + 25		
110	$4\frac{1}{3}$	5	$2\frac{1}{4}$	$2\frac{3}{4}$	85	40	9 + 25		
140	$4\frac{1}{3}$	$5\frac{1}{4}$	$2\frac{1}{2}$	$2\frac{4}{5}$	86	42	10 + 26		
175	$4\frac{1}{2}$	$5\frac{1}{2}$	$2\frac{2}{3}$	3	84	44	11 + 28		
185	$4\frac{1}{2}$	$5\frac{1}{2}$	$2\frac{2}{3}$	3	87	46	12 + 30		
210	$4\frac{1}{2}$	6	$2\frac{2}{3}$	3	84	48	12 + 33		
268	$4\frac{1}{2}$	7	3	$3\frac{1}{2}$	85	48	14 + 38		Type.
275	$4\frac{2}{3}$	7	3	$3\frac{1}{2}$	85	48	14 + 40		
280	$4\frac{3}{4}$	7	3	$3\frac{1}{2}$	83	48	,,		
290	$4\frac{3}{4}$	7	3	$3\frac{1}{2}$	87	48	,,		
310	$4\frac{3}{4}$	7	3	$3\frac{1}{2}$	85	48	,,		♂?.
380	$5\frac{1}{4}$	7	3	4	90	50	,,		

YOUNG OF ? *Labeo seeberi*.

Fig. 5.

Some very young specimens, 9·5–15 mm., were taken at Keerom, Upper Olifants River, on 16th April 1938 (K. H. B., A. C. H., C. W. T.).

They are more heavily pigmented than the young of any of the species of *Barbus* occurring in the Olifants River, and would be, with considerable confidence, referred to *Labeo*, but for the fact that in the largest specimen (15 mm.) (only one of this size) the ventrals arise below the anterior spines of the dorsal fin, a position that is not in keeping with the adults of any species of *Labeo*. In the dorsal fin 7, possibly 8, rays can be counted, and 5 in the anal.

In addition to the pigmentation, the fact that at 15 mm. there still remains an appreciable amount of the ventral lamina, shows that these young do not belong to the Olifants River species of *Barbus*, all of which have been traced back stage by stage.

In the *Barbus* species the ventral lamina disappears at about the 13-mm. stage, except in *B. cernuus* where it can still be traced in the 15-mm. stage, though it has completely disappeared at 16 mm. But in *B. cernuus* the ventral fins are well formed and free at the 13-mm. stage, whereas in the 15-mm. ? *Labeo* specimen they are merely tiny lobes.

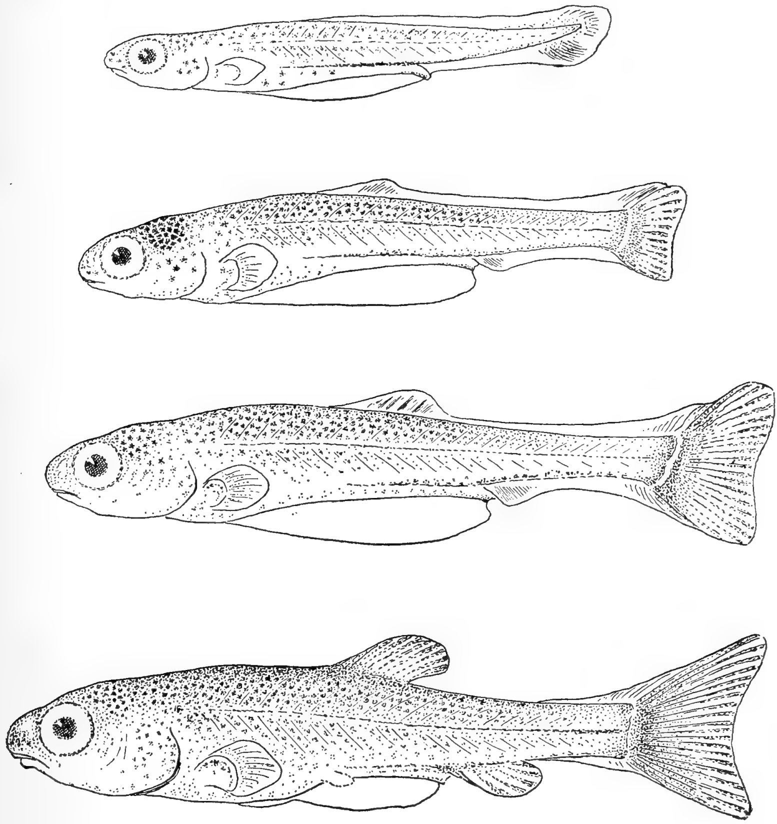


Fig. 5.—Juveniles of ? *Labeo*. Olifants River, Clanwilliam. Lengths: 9·5 mm., 10·5 mm., 12 mm., and 15 mm.

	$\frac{L}{H}$	$\frac{H}{E}$	$\frac{S}{E}$	$\frac{I}{E}$	Scales.	Barbs.	
9·5	$4\frac{3}{4}$	$2\frac{1}{2}$	$e > s$	$e > i$	none	none	
10·5	$4\frac{1}{2}$	3	,,	,,	,,	,,	
12	$4\frac{1}{4}$	3	,,	,,	,,	,,	
15	$3\frac{3}{4}$	3	,,	,,	,,	,,	Dorsal and anal distinct. Ventral just beginning. Ventral lamina present.

Gen. Barbus Cuv.

1913. Gilchrist and Thompson, Ann. S. Afr. Mus., xi, pp. 366, 554, 562.

1938. Barnard, Ann. Mag. Nat. Hist. (xi), 2, p. 80.

Taxonomic Characters.

The study of long series of specimens has shown the necessity of revising some of the characters which hitherto have been relied upon for distinguishing the species.

The number of dorsal spines is given as 3 in some cases, 4 in others. It seems, however, that 4 is the usual number; the first one being very small and often hidden under the skin and the hindmost predorsal scale. In juveniles of, *e.g.*, *burchelli* and *vulneratus* the 4 spines are distinct, but in the adult the true 1st spine is not discernible without dissection. In *calidus* all 4 spines are at all stages more distinct than usual. In practice therefore the number given in the dorsal fin formula is that which is usually visible without dissection.

Similarly in the anal fin the 1st spine is often indistinct in the adult, so that observers have given 2 anal spines in their descriptions (see also under *pallidus*, and note on *viviparus*).

Although the normal number of dorsal and anal branched rays is generally distinctive for many of the species, too much reliance should not be placed on these formulae in identifying single specimens. The following instance will serve to show the possibilities of error in this respect (*cf.* also *pallidus*, p. 194).

On 13th and 14th February 1939 at Keerom on the Olifants River above Citrusdal (Clanwilliam Division), a large quantity of young fry was collected, viz. 723 specimens of 25 mm., and under, in length, comprising the following (only the branched rays are counted):—

capensis,	normal,	D 9,	A 5.	Number of specimens, . .	44
		D 8,	A 5.	,,	2
		D 10,	A 5.	,,	1
serra,	normal,	D 8,	A 5.	,,	122
		D 8,	A 6.	,,	9
		D 8,	A 7.	,,	2
		D 7,	A 5.	,,	1
		D 8,	A 3 (spines and 2 rays absent) . .		1

calidus,	normal, D 7,	A 6.	Number of specimens . .	470
	D 8,	A 6.	,,	1
	D 7,	A 7.	,,	19
phlegethon,	normal, D 7,	A 5.	,,	50
	D 7,	A 6.	,,	1

In all cases the abnormality is caused by the interpolation or omission of one or two rays, the last ray being as usual a double one (counted as one).

There are of course collateral characters by which the true identity of a specimen can be determined; the dorsal and anal fin formula being only a "first aid." For example, the shape of the anal fin will show whether a specimen with D 7 and A 6 (rays) is a normal *calidus* or an abnormal *phlegethon*; or again, the details of the colour pattern and the position of the ventral fins will distinguish an "8/5" *capensis* from a *serra*.

Ignorance, or possibly a glossing-over, of sexual characters has been responsible for the institution of "new species." In several of the smaller species the relative length of the pectoral fin varies: in males it reaches to, or nearly to, the base of the ventral fin spine; whereas in adult females it is shorter, leaving a definite gap between the end of the pectoral and base of ventral amounting to about $\frac{1}{3}$ or $\frac{2}{5}$ the length of pectoral fin. In most of the species showing this sexual difference the juveniles are more like the male, but in *anoplus*, *cernuus*, and *phlegethon* the juveniles are like the female. That is, in the former the pectoral fin becomes relatively shortened in the female, in the latter relatively lengthened in the male.

In the larger species, on the other hand, the pectoral fin does not seem to show any sexual difference in length.

Max Weber (1897) appears to have regarded the length of the pectoral fin as a specific character. The only real distinction between *burgi* Blgr. and *burchelli* is the length of the pectoral fin, and yet Boulenger in describing *asper* later on in the same work definitely notes the difference in length as being sexual.

The anal fin shows no sexual differences,* but in most descriptions the extent of the fin (reaching, or not reaching, to base of caudal fin) is mentioned, and several different shapes are represented in the illustrations (see Boulenger, and Gilchrist and Thompson, *l.c.*). So far as I am aware no comment has been made on these differences

* Such as occur in some Indian species (Hora and Misra., J. Bombay N.H. Soc., xl, 1938); and in *B. wöhlerti* (Trewavas, Ann. Mag. Nat. Hist. (xi), ii, p. 64, 1938).

in the various species, or on the possibility of their being due to growth-changes. Among the species dealt with here, a growth-change occurs in *holubi* and *capensis* (*q.v.*), and there is an essential difference in shape between the anal fin of these two species and all the other S.W. Cape species.

The difference in shape is seen by comparison of the figures of *holubi*, or *capensis*, and *serra* (*cf.* figs. 8 and 9 with 12, etc.). In the former the 1st branched ray when folded back extends, at all stages, beyond the end of the last ray; in the latter the last ray extends beyond the 1st ray. In *andrewi*, *burchelli*, etc., the 1st and last rays extend about equally far back, the former slightly less far in adult than in young—that is, the fin (as also the dorsal and ventral fins) becomes somewhat shortened or bluntened in adult (see fig. 16).

It so happens that both the species in which this growth-change occurs are species with longitudinally striate scales; but whether this correlation holds good for all the African or South African species needs investigation. From the illustrations in Boulenger's monograph it would seem that *rhoadesii* comes nearest to being an exception to the statement that all longitudinally striate species have an elongate anal fin in the adult. On the other hand, amongst the radiately striate species there seem to be several with an elongate anal fin, taking Africa as a whole, but none among the S.W. Cape species.

The males of several species, particularly the smaller species, develop large conical tubercles on the snout and top of the head. It is not yet known whether these tubercles are developed only at certain seasons when breeding takes place, or, once developed, are retained throughout life. In preserved specimens they are often easily caducous, but this may be merely the effect of the preservative. *B. asper* and *burchelli* are good examples. In the Modderfontein specimen recorded (erroneously) as *anoplus* by Gilchrist and Thompson (*l.c.*, p. 429) the tubercles are very numerous, extending over interorbital, snout, preopercle, sub- and pre-orbital, upper lip, chin, and rami of lower jaw. In the Indian species *B. hexagonolepis* they occur in a patch on the sub- and pre-orbital (Hora, 1940, J. Bombay Nat. Hist. Soc., xlii, pp. 81, 82, figs. 1, 2, and pl.).

The larger species do not develop these relatively large and few tubercles. Instead, both sexes may have the top of the head and snout thickly sprinkled with numerous minute pimples (cf. *Labeo*, p. 130). *B. holubi* (and *kimberleyensis*), and *andrewi*, *e.g.*, have these pimples, but *capensis* and *serra* apparently have not. They are very noticeable in *hospes* (♂, adult ♀ unknown), and often so in *calidus*; but as remarked under *Labeo* their conspicuousness seems to be dependent to some extent on the method or state of preservation.

In two Indian species (*B. kolus* and *ticto*) Hora and Misra (1938, J. Bombay N.H. Soc., xl, pp. 28, 29, pl. 1 and fig. 3) find that tubercles are developed in the males not only on the sides of the snout, but also on certain rays of the anal fin and lower lobe of the caudal. Trewavas (1938, Ann. Mag. Nat. Hist. (xi), ii, pl. 64) finds the same in *B. wöhlerti*, a species believed to have been found in Mozambique. This has not been observed in any of the S.W. Cape species.

External Sexual Differences.

	Difference in Length of Pectoral Fin.	Pimples or Tubercles on Head.
holubi . .	None.	Minute pimples in both sexes.
capensis .	None.	None.
serra . .	None.	None.
andrewi . .	None.	Minute pimples in both sexes.
calidus . .	None.	,,
paludinosus .	None.	None.
hospes . .	Not reaching ventral ♂, ? ♀.	Minute pimples ♂, ? ♀.
burchelli .	Shorter in ♀ than in ♂.	Large tubercles in ♂.
vulneratus .	,,	,,
asper . .	,,	,,
senticeps .	,,	,,
tenuis . .	,,	None.
pallidus . .	,,	None.
anoplus . .	,,	None.
cernuus . .	,,	None.
phlegethon .	,,	None.
afer . .	Not reaching ventral ♀, ? ♂.	?.

The institution of new species solely or mainly on the presence of enlarged fleshy lips and labial lobes appears quite unwarranted (*cf.* Worthington, Proc. Zool. Soc. Lond., 1929, p. 131). These "rubber-lip" forms (see under *capensis*, p. 166) seem to occur only in those species with longitudinally striate scales.*

* *B. labialis*, G. and T., 1913, appears to be an exception; but the specimen is not in the South African Museum, and I have not had an opportunity of checking whether the scales really are radiately striated.

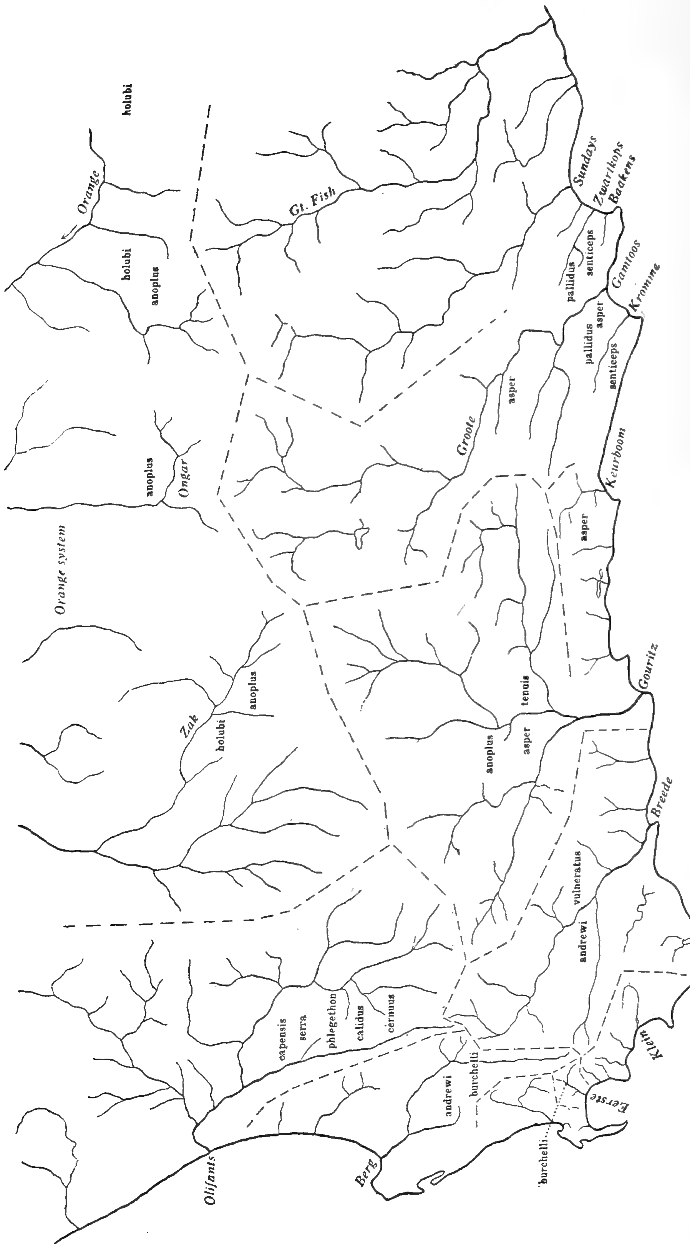


Fig. 6.—Distribution of the species of *Barbus* in southern Cape region. The three forms: *anoplus* f. *typica* (Gouritz system), f. *oraniensis* (Zak and Ongar rivers), and f. *cernuus* (Clanwilliam Olifants River) are extremely closely allied, especially the first and third forms.

The number of barbels, one or two pairs, has been regarded as a specific character, but it seems to have been assumed that the character is constant from juvenile to adult. This assumption is quite wrong, and no species can be said to be adequately described until the life-history has been studied and it is known at what stage the respective pairs of barbels (and scaling) are developed. The requisite series showing these stages have been obtained for nearly all the Cape species (table, p. 154).

As the anterior pair of barbels develops later, sometimes considerably later than the posterior pair, and sometimes not at all, it may happen that an immature specimen with only one pair of barbels is quite erroneously identified. This has actually happened (see *burchelli*).

From the tables given for each species it will be seen that other characters may change as the fish grows. An increase in the number of scales along the lateral line or around the caudal peduncle may take place concomitant with growth. Accessory scales are not infrequently developed, especially in fully grown specimens, around the caudal peduncle, and chiefly in the dorsal region. A long series of specimens, however, indicates clearly what is the normal number of scales. The increase is usually more marked in the larger than in the smaller species; but often the scale formula remains fairly constant for each species.

The bright red patches at the bases of the pectoral, ventral, dorsal, and anal fins, found in certain of the smaller species, known as "Redfins," are neither sexual nor seasonal. It may be, however, that the colour becomes more vivid during the actual breeding season. It is more vivid in males, and may become dull in spent females. Indications of the colour can be seen at quite an early stage, round about 30 mm. usually. None of the larger species develop these red patches, but in the case of some species the fins may be *wholly* suffused with a *pale* salmon or pink tinge.

Dark lateral bands, which are so often seen and described in preserved specimens, are usually not at all conspicuous in the living fishes.

The collecting and examination of long series of all stages is considered of paramount importance in diagnosing and fixing the limits of a species. For example, the difficulty of separating certain individual specimens which might have been either *burchelli* or *vulneratus* suggested that the two might be synonymous. But though the difficulty of separating isolated and individual specimens remains, the long series of normal individuals at once showed that two species should be recognized. Another case is that of *anoplus* and *cernuus* (but see *infra*, p. 213). These cases are important also from the geographic point of view, because once the morphological difference was demonstrated, each species was found to be confined to its own particular river-system.

From the foregoing it will be seen how cautious one should be in accepting records based on single specimens, unless the species is a very clearly defined one.

B. gobionides C. and V. (Hist. Nat. Poiss., xvi, 1842, p. 189) is best relegated to oblivion, unless the type happens to be extant. The description is based on a single dried specimen, 4 inches long, collected by Verreaux, and there are said to be 26–30 scales [in one specimen!] along the side. The authors end their brief description by saying that the specimen may not be a *Barbus* in spite of its four barbels.

Distribution (figs. 6 and 7).—Subject to the aforesaid qualification (*supra*, p. 120), Hey's reports (*l.c.*) provide a useful survey of the distribution of certain species of this genus. Thus we find a "rooi-vlerkie" [Red-fin], although said to be exterminated in the Eerste River (Rep., i, p. 36), in the coastal belt from the Duivenhoks River (Heidelberg) to the Kromme River (Humansdorp). Farther east, from Cradock–Victoria East–Keiskama to Queenstown–Cathcart–Komgha, its place is taken by the "Gillieminkie," a "similar" fish but without red fins (Rep., i, p. 65). Hey also notes that the "Scaley," one of the larger species (*B. elephantis*), does not occur south of Natal.

So far as recent investigations in the S.W. Cape go, Hey's statements can be confirmed, except that the Red-fin is not extinct in the Eerste River; and the following points in the distribution of *Barbus* seem to be correct:—

1. None in the Cape Peninsula, and none on the Cape Flats, except in the Eerste River on the eastern border of the latter region.
2. Absent from the *smaller* rivers on the once-submerged post-Tertiary terrace. The Cape Flats being part of this terrace explains the absence of *Barbus* from the Cape Peninsula.
3. (*a*) Red-fin species (i.e. *calidus*, *phlegethon*, *burchelli*, *vulneratus*, *asper*, *tenuis*, *senticeps*) occur only in the Olifants (Clanwilliam), Berg, Eerste, Breede (and its former tributaries Nieuwjaar River and Grashoek River), Gouritz, Gamtoos, and Zwartkops systems, and intermediate localities. Their presence east of the Port Elizabeth area has not yet been confirmed.

(*b*) The occurrence of the true *anoplus* (not a Red-fin) in the Grahamstown, Alicedale, Pirie, and Bedford districts needs confirmation.

4. (*a*) No *large*-sized species (like *holubi, serra, capensis, andrewi, elephantis,* all over 150 mm.) are found in the area, *south of the main Cape watershed,* between the Breede River (*andrewi*) and Natal (*elephantis*).* The presence of *andrewi* in the Breede River seems a curious anomaly (see p. 113).

   (*b*) No large-sized *radiately* striate scaled species except in the extreme west and south-west (Olifants, Berg, Breede rivers), in fact nowhere in the Cape, O.F.S., or Natal, south of the Limpopo system.

5. Only one species, viz. *andrewi* (see p. 114), is common to two totally distinct river-systems, the Berg and the Breede. But there is a very close relationship between *burchelli* (Berg River) and *vulneratus* (Breede River). An even closer relationship exists between *anoplus* (Gouritz system), *anoplus* var. (Zak and Ongers rivers, tributaries of the Orange River), and *cernuus* (Olifants River, Clanwilliam) (see p. 214).

Identification of Specimens.—During the progress of this investigation an attempt was made to construct keys applicable to every successive stage of growth at every 5 or 10 mm. But since it was found that each river-system has its own set of species, such keys would be redundant, apart from certain inherent difficulties.

From the table of development of barbels and scales (p. 154), it will be seen that all the species have attained their adult characters at a length of about 55 mm. A synopsis and key, applicable to specimens over that length, are given. For the identification of

* It is possible that this statement will have to be slightly modified, but until proper investigations have been made and actual specimens properly identified, the following two quotations are not to be regarded as contradicting it.

Hey (Survey Rep., no. 1, 1926, p. 66): "It is said that a few years back, mud-fish (a very bony fish) were taken from the Kat River . . . and placed in a dam in the Tyumie catchment area . . . and found their way into Tyumie River . . . after spreading over lower reaches of Tyumie it found its way into the Keiskama and has now become well established . . . to the detriment of the mullet which is a far more edible and desirable fish."

Harrison (Fish. Mar. Surv., Investig. Rep., 7, 1936, p. 73) in reporting on Black Bass in a Kat River dam, Fort Beaufort: "It [reservoir fed from Kat River] contains small fish, . . . and large 'yellow-fish' (a species of indigenous *Barbus*)."

If this really is a large-sized *Barbus*, it considerably reduces the area in which such fish are said to be absent. Personally I think it is more likely to be a *Labeo*.

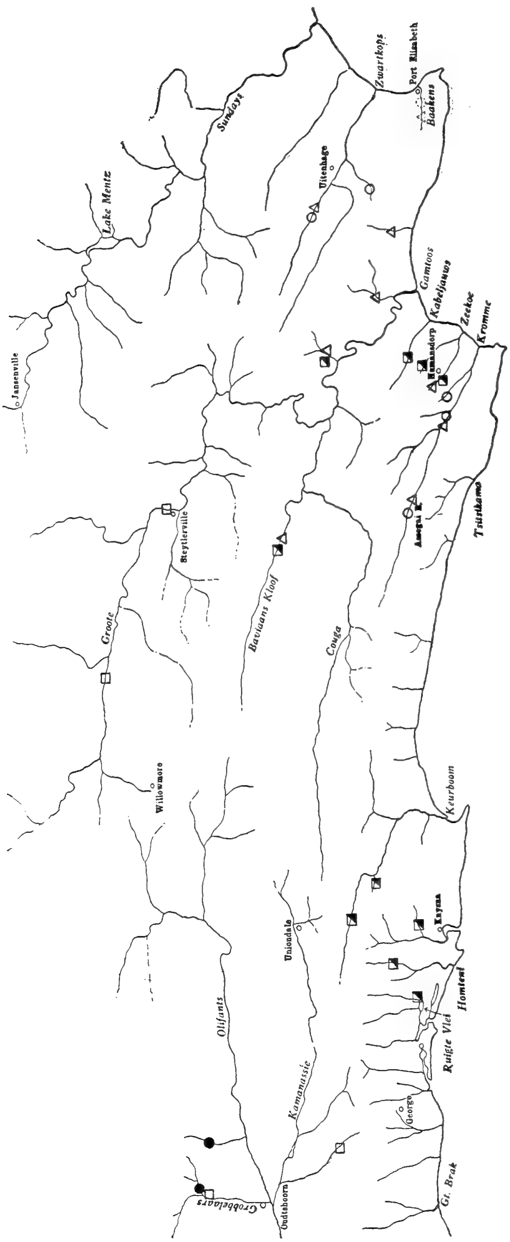


FIG. 7.—Distribution of certain species of *Barbus* in the area between the eastern tributaries of the Gouritz River and the Sundays River.

□ *asper*. ◪ *asper* var.
○ *senticeps*. △ *pallidus*.

(Records based on recent material, except those from the Baakens River.)

specimens under that length, the table just mentioned should be a guide, in conjunction with other data.

As the characteristic number of dorsal and anal rays (branched) is developed at a very early stage, this character is of primary importance. The first five species in the synopsis (*infra*) are at once definitely signalized, and the only remaining difficulty is to separate those species combining 7 dorsal with 5 anal rays.*

It is important to notice that certain species in the latter "7/5"

Synopsis of the S.W. Cape species of Barbus, over 55 mm. (2 in.) in length.

	A.	R.	S.	Dorsal Rays.	Anal Rays.	Lateral Line Scales.	Caudal Peduncle Scales.	Pre-Dorsal Scales.†	Striae on Scales.	Barbels (pairs).
capensis .	A	..	..	9	5	41–45	16–18 (20)	15–17	longi-tudinal	2
holubi . .	A	..	..	8–9	5	34–43	14–16	13–15	,,	2
andrewi .	..	..	S	8	6	38–41	16	13–14	radiate	2
serra . .	..	..	S	8	5	41–44	20 (22)	18–20	,,	2
calidus. .	..	R	S	7	6	36–38	14–16	15	,,	2
paludinosus .	..	..	S	7	5	33–36	16 (–18)	15–17	,,	2
hospes . .	..	..	S	7	5	37–39	16	21	,,	2
asper . .	..	R	..	7	5	35–41	16–18 (20)	19–25	,,	1
tenuis . .	..	R	..	7	5	33–36	12–14	17–20 (bare patch)	,, ,,	1
senticeps .	..	R	..	7	5	30–32	12	14–16	,,	1
vulneratus .	..	R	..	7	5	33–26	14	17–18	,,	2
burchelli .	..	R	..	7	5	30–36	12	13–15	,,	2
phlegethon .	..	R	..	7	5	34–36	12	14–16	,,	1
pallidus .	..	..	..	7	5	27–29	12	10–11	,,	2
afer . .	..	..	..	7	5	27	12	12	,,	1
anoplus .	..	..	..	7	5	34–36	(14) 16	13	,,	1
cernuus .	..	..	..	7	5	33–35	(14) 16	14–15	,,	1 ‡

A = anal fin with 1st branched ray extending beyond the last ray when folded back, the fin reaching in adult to or almost to base of caudal.

R = red-fin.

S = last dorsal spine serrate.

* David and Poll (Ann. Mus. Congo Belge., Zool., ser. 1, T. iii, fasc. 5, p. 262, 1937) in describing *B. microbarbus*, remark on the fact that the only species hitherto known with 6 anal rays were Moroccan species (Boulenger, *l.c.*, species 67–73). They overlooked Boulenger's "*capensis*" (= *andrewi*). We now know a second Cape species with 6 anal rays: *calidus*.

† On the variability of the predorsal scales, *cf.* Hora, Misra and Malik, 1939, Rec. Ind. Mus., xli, p. 269.

‡ Sometimes a second barbel developed on one side or both sides.

group never develop the anterior pair of barbels (with the one exception of *cernuus*, which occasionally does do so); and that in *burchelli* its development is delayed until a very late stage of growth.

If the locality of a juvenile specimen, which is required to be identified, is known (and if it is not, then the specimen is better ignored!), the identification is easier.

For example, in dealing with Olifants River (Clanwilliam) specimens, *capensis*, *serra*, and *calidus* on the one hand are each identified by their respective fin formulas, and on the other hand *phlegethon* and *cernuus* are distinguished one from the other by the caudal peduncle scale-count, and the number of striae on the scales. The anal rays (and caudal peduncle scales) separate the two Berg River species *andrewi* and *burchelli*. Of the three Gouritz River species *asper*, *tenuis*, and *anoplus*, the first is distinguished from the other two by the striae on the scales, and the second from the first and third by the caudal peduncle scale-count.

Key to S.W. Cape Species (specimens over 55 *mm.* (2½ *in.) in length).*

Group I.

Scales longitudinally striate (figs. 8, 9).
Last dorsal spine moderately or strongly enlarged, but never serrated.
Anal fin with 1st branched ray when folded back extending beyond the last ray, the fin in fully grown examples reaching to or almost to base of caudal.
Prominent conical warts on head in ♂ not developed.
Red-fins (brilliant patches at bases of fins) not developed.
Two pairs of barbels.
"Rubber-lips" sometimes developed.
Large species.

A. Last dorsal spine strongly enlarged. Ventral spine below or in advance of 1st dorsal spine . . . . *holubi.*
B. Last dorsal spine feebly or only moderately enlarged. Ventral spine below 4th dorsal spine . . . . *capensis.*

Group II.

Scales radiately striate (figs. 12, 16).
Last dorsal spine thin or moderately or strongly enlarged, smooth or serrate.
Anal fin with 1st ray when folded back not extending beyond last ray; no change in shape of fin from young to adult (in S.W. Cape species).
Prominent conical warts on head in ♂ in several of the smaller species.
Red-fins in some of the smaller species.
One pair or two pairs of barbels.
"Rubber-lips" not developed (in S.W. Cape species).
Large and small species.

A. Dorsal spine more or less enlarged; serrate. Two pairs of barbels. No large warts on head in ♂.

1. Dorsal rays 8. No red-fins. Large species.
   a. Anal rays 5. Dorsal spine strongly serrate . . . . *serra.*
   b. Anal rays 6. Dorsal spine feebly serrate * . . . *andrewi.*
2. Dorsal rays 7. Small species.
   a. Anal rays 5. No red-fins.
      i. When dorsal fin extended, anterior margin at 60°, hind margin at 90°, to long axis of body . *paludinosus.*
      ii. Anterior and hind margins both at 60° to body axis . *hospes.*
   b. Anal rays 6. Red-fins . . . . *calidus.*

B. Dorsal spine not enlarged; thin and flexible; not serrate.
1. Two pairs of barbels.
   a. Radial striae on scales few (less than 20, usually less than 10).
      i. L.l. 30–35, c.ped. 12, pred. 13–15. Red-fins. Warts on head in ♂ . . . . . . *burchelli.*
      ii. L.l. 33–36, c.ped. 14, pred. 17–18. Red-fins. Warts in ♂ . . . . . . *vulneratus.*
      iii. L.l. 27–29, c.ped. 12, pred. 10–11. No red-fins. No warts . . . . *pallidus.*
   b. Radial striae numerous (20–30). L.l. 33–35, c.ped. 16, pred. 14–15. No red-fins. No warts in ♂ . *anoplus* f. *cernuus* †
2. One (the posterior) pair of barbels.
   a. Radial striae few (less than 20). Red-fins.
      i. C.ped. 16–18(20), pred. 19–25. Warts on head in ♂ . *asper.*
      ii. C.ped. 12, pred. 14. Warts in ♂ . . . . *senticeps.*
      iii. C.ped. 12, pred. 14–16. No warts. . . . *phlegethon.*
   b. Radial striae numerous (20–30, or more).
      i. C.ped. 12(14), pred. 17–20. Red-fins. No warts in ♂ . *tenuis.*
      ii. C.ped. 16, pred. 13–15. No red-fins. No warts . *anoplus.*

Barbus holubi Stndr.

Holub's Yellow-fish, Geelvis.

Fig. 8.

1894. Steindachner, Sb. Ak. Wiss. Wien, ciii, p. 449, pl. 3, fig. 1.

1897. Weber, Zool. Jahrb. Abt. Syst., x, p. 151 (*capensis* non A. Smith, non Boulenger; part: juv. from Viol's Drift, Orange River).

1911. Boulenger, Cat. Fw. Fish. Afr., ii, p. 22, fig. 4.

1913. Gilchrist and Thompson, Ann. S. Afr. Mus., xi, p. 374, fig. 35.

1937. J. L. B. Smith, Guide Vert. East. Prov., Albany Mus., Grahamstown, ii, p. 126, pl. 31, fig. 1.

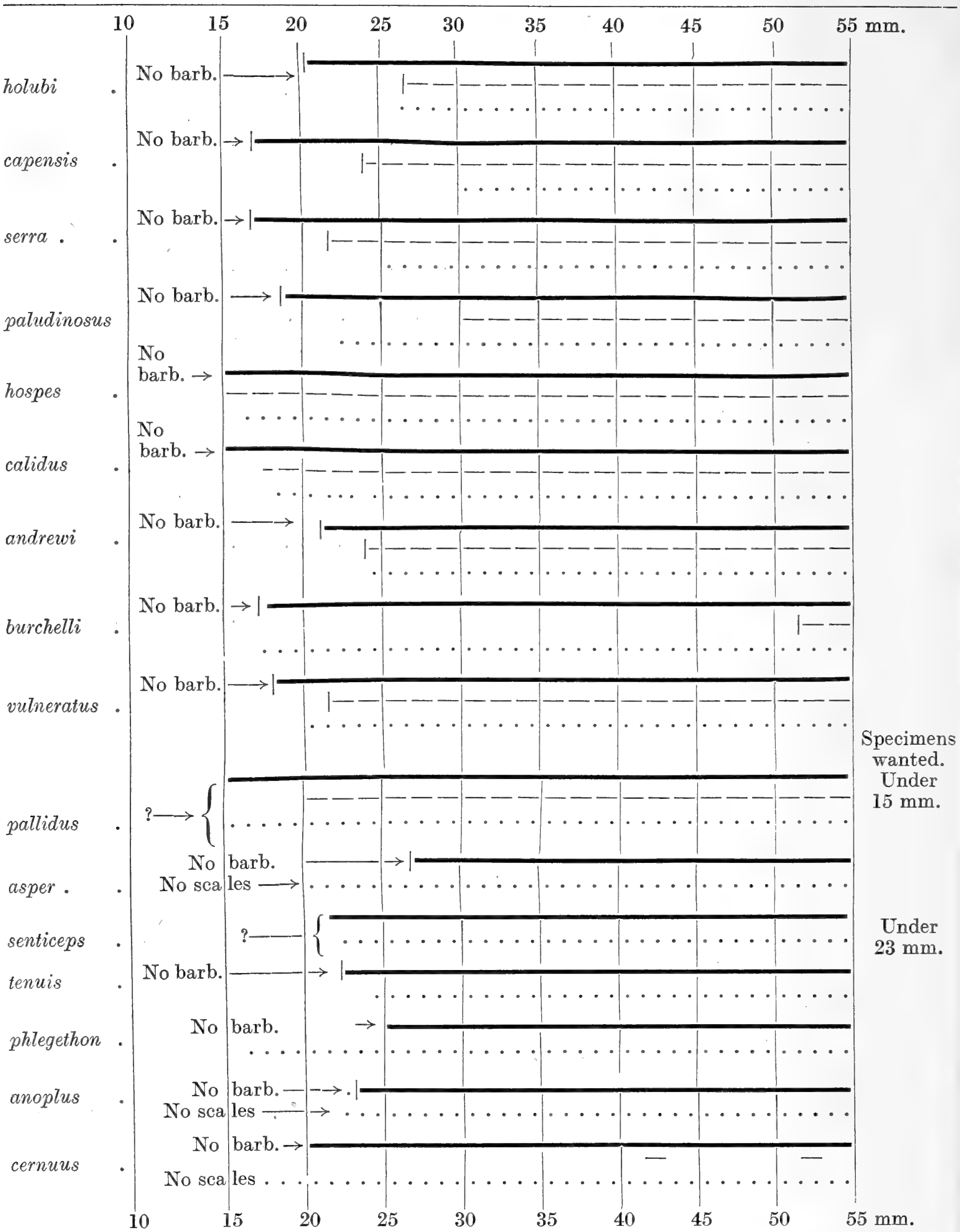
1938. Barnard, Ann. Mag. Nat. Hist. (xi), 2, p. 81.

* Serrations sometimes obsolete in large specimens.

† Normally only one pair of barbels, but occasionally the anterior barbel is developed on one or both sides.

Barbus, development of barbels and scales. Early stages complete for each species except *pallidus* and *senticeps*.

——— posterior barbel. — — — anterior barbel. . . . . . scales.



This species is easily distinguished by the very stout and non-serrated 4th dorsal spine, the longitudinally striated scales, and the ventral fins arising below or slightly in advance of the 1st dorsal spine.

In half-grown, and more so in fully grown, specimens the nape rises very sharply immediately behind the head, and more so in ovigerous ♀♀ than in ♂♂; in one very large specimen (410 mm.) the head appears ridiculously small in comparison with the depth of the fish.

The species appears to be distributed throughout the whole of the Orange River system. The localities nearest to our area, so far known, are the Zak River (Fraserburg) (fig. 6), above the Aughrabies Falls (Orange River), and Goodhouse on the lower reaches of the Orange River. Having a long series from the latter locality, and also from the Great Fish River in South West Africa, some remarks on growth-changes may not be out of place here.

The tables are compiled from 103 specimens from Goodhouse, 12–82 mm. in length, and 109 specimens from Aiais on the Great Fish River, 30–215 mm. in length (Nov. 1936). A few specimens from other localities are also given.

The posterior barbel begins to develop at about 20–21 mm., the anterior one at about 26–27 mm.; at the latter size the scales also are just becoming recognizable. There are at first 14 scales around the caudal peduncle, but very soon the full normal number of 16 is developed.

The striae on the scales increase from 4–5 when the scales are first formed, up to about 36 (410 mm.).

Although the number of dorsal fin rays is given as 8, 9 would appear to be an equally typical number. In some communities the number 9 predominates, in others 8, and in others again both numbers might occur in equal proportions, judging by the specimens at hand.

Gilchrist and Thompson did not mention any specimens with 9 dorsal rays, but amongst their material there are the following:—

One specimen	out of	3,	from	Kraai River, Aliwal North.
One	,,	3,	,,	Modder River, Kimberley.
Two specimens	,,	3,	,,	Mooi River, Potchefstroom.
One specimen	,,	7,	,,	Potchefstroom (see *infra*, under *kimberleyensis*).

I have also seen 2 specimens out of 3 collected in the Great Fish River at Gibeon (South West Africa), with 9 dorsal rays. From the

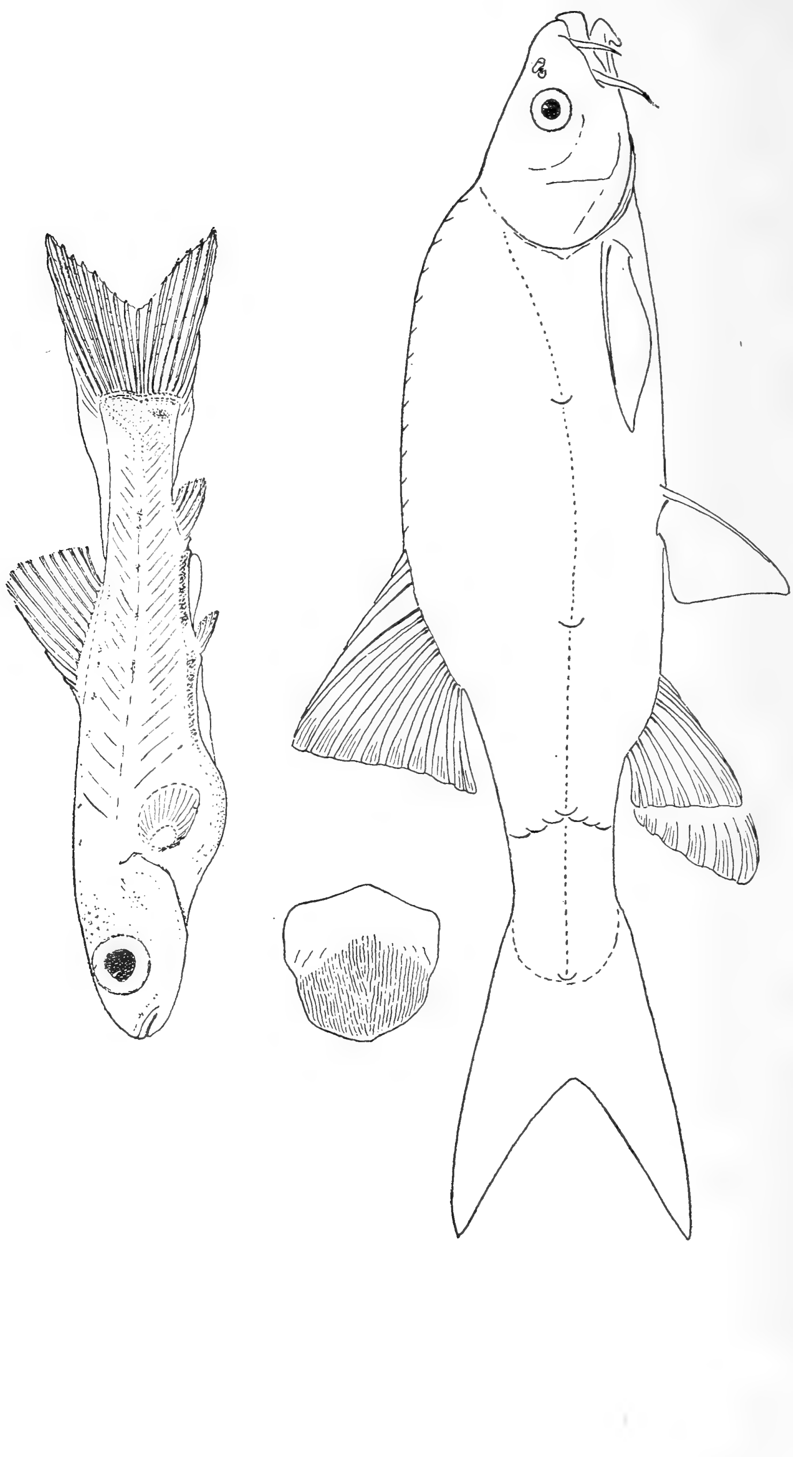


Fig. 8.—*Barbus holubi*. Juvenile, 12 mm. Goodhouse, Orange River. Adult, with scale enlarged; predorsal scales and every 10th scale in lateral line indicated; anal fin showing change in shape from young and half-grown to adult.

latter river at Aiais (*i.e.* nearer its confluence with the Orange River), out of 109 specimens of various sizes there are 24 with 8 rays, one with only 7, while the rest have 9. Of the 103 specimens from Goodhouse on the Orange River only 6 have 8 rays. Out of 27 specimens from the Orange River above the Aughrabies Falls 9 have 9 rays, 17 have 8 rays, and one has only 7 rays. Max Weber's specimens from Viol's Drift on the Orange River also had 9 rays.*

The proportions of the fish vary. Up to about 80–90 mm. the length of the head is greater than the depth of the body; from this size up to about 190–200 mm. these two measurements are sub-equal; from about the latter size upwards the head-length is less than the body-depth owing to the development of the nape.

In very young stages up to about 40 mm., the base of the ventral fin spine is situated below the 4th dorsal spine; it then shifts forward (relatively) to below the 1st dorsal spine, and from about 90–100 mm. onwards it is slightly in advance of the vertical from the 1st dorsal spine.

Growth-change occurs in the anal fin, similar to that described in *capensis* (*q.v.*).

The ends of the lower labial grooves are connected by a groove or fold across the chin from quite an early stage (30 mm.) upwards; but the chin-lobe does not develop (in the specimens at hand) very strongly, being always broader than long, with a very short freely projecting flap. In one 300-mm. ♀ (Kimberley), however, there is a well-developed freely projecting flap as long as it is broad, evidently an incipient "rubber-lip" (see *infra*, *capensis*, p. 166).

The 410-mm. ♀ from Zak River (length as given by G. and T. 360 mm.) is the largest specimen I have seen.

Colour (Aiais specimens, freshly preserved); half-grown and smaller specimens with irregular dark spots on upper part of body, these spots usually somewhat vertically oval in shape, or even like short vertical cross-bars, usually a sub-triangular spot on the lat. line at end of caudal peduncle.

Burchell (1822) says of Zak River specimens: "A beautiful kind of carp entirely of a yellow-green with a brazen lustre."

Boulenger (*l.c.*, 1911, pp. 23 and 144 resp.) refers to the two inadequately described species of Castelnau, *natalensis* and *kurumanni* [original spelling], under *holubi* and *trevelyani* respectively. It seems to me far more likely that *natalensis* is the same as *elephantis* Blgr.;

* I have to thank Professor de Beaufort as well as the late Professor Max Weber for their courtesy in sending these specimens for my personal inspection.

while from the locality, the dorsal spine being "très forte," and the black spot at base of tail, *kurumanni* is obviously *trimaculatus.** Castelnau's *natalensis*, however, should be ignored unless the type specimen can be found.

Boulenger (*l.c.*, 1916, p. 223) places *lineolatus* G. and T. and *zuluensis* G. and T. as synonyms of *holubi*. The former certainly has 4 (not 3) dorsal spines, but the latter has only 3. In neither species does the ventral fin arise in advance of the dorsal fin, as it does in typical *holubi* of the sizes given for these species. And in *zuluensis* the lower labial grooves are discontinuous across the chin. Thus, whatever *lineolatus* may be, *zuluensis* cannot be regarded as synonymous with *holubi*. The localities also are not altogether in keeping with the distribution of *holubi*.

Barbus holubi.

	TL	L/H	H/E	S/E	I/E	l.l.	c.ped.	striae.	g.r.	barb.	Sex and Remarks.
Goodhouse, Orange R.	12–13	$3\frac{1}{3}$	3	e > s	e > i	No s	cales		7 weak	None	Dorsal and anal rays distinct.
	14	3	3	,,	,,	,,	,,		,,	,,	
	15–16	3	3	,,	,,	,,	,,		7–8	,,	
	17–18	3	3	,,	,,	,,	,,		0 + 9	,,	
	20–21	3	3	,,	,,	,,	,,		0–1 + 9	(p)	
	22–23	3	3	,,	,,	,,	,,		1 + 9	p	
	25–26	3	3	,,	,,	,,	,,			p	
	27	3	3	,,	,,	Scarce	ly disti	nct	1 + 9	p (a)	
	28	3	3	,,	,,	37	14		1 + 9	p (a)	
Aiais, Gr. Fish R., S.W.A.	30	3	3	,,	,,	37–38	14–16	4–5	1 + 9	p a	
	33	$3\frac{1}{6}$	3	,,	1			,,	1 + 9	p a	
	35	$3\frac{1}{5}$	$3\frac{1}{3}$	,,	1			6–7	2 + 9		
	40	$3\frac{1}{4}$	$3\frac{1}{2}$	1	1						
	45	$3\frac{1}{4}$	$3\frac{1}{2}$	1	1				2 + 10		
	50	$3\frac{1}{4}$–$3\frac{1}{3}$	$3\frac{1}{2}$	1	1			10			
	55	$3\frac{1}{3}$–$3\frac{1}{2}$	$3\frac{2}{3}$	1	$1\frac{1}{5}$						
	60	$3\frac{1}{2}$	$3\frac{3}{4}$	1	$1\frac{1}{5}$				3 + 10		
	65	$3\frac{1}{2}$	$3\frac{4}{5}$	$1\frac{1}{5}$	$1\frac{1}{5}$			12			
	70	$3\frac{1}{2}$	$3\frac{4}{5}$	$1\frac{1}{5}$	$1\frac{1}{5}$				3 + 11		
	75	$3\frac{1}{2}$	$3\frac{4}{5}$–4	$1\frac{1}{5}$–$1\frac{1}{4}$	$1\frac{1}{5}$–$1\frac{1}{4}$						
	80	$3\frac{1}{2}$	4	$1\frac{1}{4}$	$1\frac{1}{3}$	38–41	16		4 + 11		
	85	$3\frac{1}{2}$	$4\frac{1}{3}$	$1\frac{1}{3}$	$1\frac{1}{3}$						
	90	$3\frac{1}{2}$	$4\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$						
	100	$3\frac{1}{2}$	$4\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$			14–15			
	105	$3\frac{2}{3}$	$4\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$				4 + 11		
	160	4	$4\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$			18			
	170	4	$4\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$						Minute white pimples on head.
	180	4	$4\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$–$1\frac{2}{3}$			20			
	190	4	$4\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$–$1\frac{2}{3}$						
	195	4	$4\frac{2}{3}$	$1\frac{1}{2}$	$1\frac{2}{3}$						Minute white pimples.
	215	$4\frac{1}{2}$	5	$1\frac{1}{2}$	$1\frac{2}{3}$			25	4 + 11		

* Specimens from Kuruman, recently collected, confirm this latter synonymy.

Barbus holubi.

TL		L/H	H/E	S/E	I/E	l.l.	c.ped.	striae.	g.r.	barb.	Sex and Remarks.
Modder R.	55	$3\frac{1}{2}$	$3\frac{1}{3}$	·1	1	40	16	10	2 + 10	p a	
Upington, Orange R.	62	$3\frac{1}{2}$	$3\frac{1}{2}$	1	$1\frac{1}{10}$	37	16	..	3 + 10	p a	
	66	$3\frac{1}{2}$	$3\frac{1}{2}$	1	$1\frac{1}{5}$	40	16	12	3 + 10		
	68	$3\frac{1}{2}$	$3\frac{1}{2}$	1	$1\frac{1}{5}$	40	16	..	4 + 11		
Gibeon, S.W.A.	68	$3\frac{1}{2}$	$3\frac{1}{2}$	1	$1\frac{1}{5}$	40	16				
Modder R., Kimberley	75	$3\frac{2}{5}$	4	$1\frac{1}{5}$	$1\frac{1}{4}$	38	16	14	4 + 10		
	81	$3\frac{1}{2}$	$4\frac{1}{4}$	$1\frac{1}{5}$	$1\frac{1}{4}$	40	16	..	4 + 11		
Gibeon, S.W.A.	94	$3\frac{1}{2}$	$4\frac{1}{3}$	$1\frac{1}{5}$	$1\frac{1}{4}$	40	16	..	4 + 11		
Upington	125	$3\frac{1}{2}$	$4\frac{1}{3}$	$1\frac{1}{4}$	$1\frac{1}{2}$	42	16	15	4 + 11		
	145	$3\frac{3}{4}$	$4\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{2}{3}$	41	16	17	4 + 12		
Vaal R. .	. 170	$3\frac{3}{4}$	$4\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{3}{4}$	41	16	20	4 + 11		
Kimberley	. 300	4	6	2	2	40	16	34	4 + 11		♀.
Zak R. .	. 410	4	$8\frac{1}{2}$	$2\frac{1}{2}$	$3\frac{1}{5}$	40	16	36	4 + 11		♀.

Barbus kimberleyensis

TL		L/H	H/E	S/E	I/E	l.l.	c.ped.	striae.	g.r.	barb.	Sex and Remarks.
Potchef-stroom D iv. 8.	115	$3\frac{2}{3}$	$4\frac{1}{5}$	$1\frac{1}{3}$	$1\frac{1}{3}$	..	..	16–17			
	125	$3\frac{3}{4}$	$4\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$	..	..	..	..	..	♂ pimples.
	160	$3\frac{3}{4}$	$5\frac{1}{3}$	$1\frac{2}{3}$	$1\frac{3}{4}$	..	..	..	..	..	♂.
	190	$3\frac{4}{5}$	$5\frac{1}{2}$	$1\frac{3}{4}$	$1\frac{3}{4}$	..	..	..	..	..	♂ pimples.
	222	4	$5\frac{1}{2}$	$1\frac{3}{4}$	2	..	..	25	..	..	♂ few pimples.
	280	4	6	2	$2\frac{1}{5}$	..	..	..	..	..	♂ pimples.
Kimberley Reservoir D iv. 9.	375	$3\frac{1}{2}$	$7\frac{1}{2}$	$2\frac{1}{2}$	$2\frac{1}{5}$	..	..	48	..	..	♂ Type.
Largest and 3 others D iv. 9.	41	$3\frac{1}{3}$	$3\frac{1}{2}$	1	1						
	50	$3\frac{1}{2}$	$3\frac{1}{2}$	1	1	..	..	10			
	57	$3\frac{1}{2}$	$3\frac{1}{2}$	1	1						
7 with D iv. 9 Warrenton	72	$3\frac{1}{2}$	$3\frac{1}{2}$	1	1						
	80	$3\frac{1}{2}$	4	1	1	..	..	12–14			
	180	$3\frac{3}{4}$	5	$1\frac{1}{3}$	$1\frac{1}{3}$	..	..	24	..	..	Immature. No pimples.

Barbus kimberleyensis G. and T.

1913. Gilchrist and Thompson, Ann. S. Afr. Mus., xi, p. 378, fig. 38.
1916. Boulenger, Cat. Fw. Fish. Afr., iv, p. 226, fig. 142.
1938. Barnard, *l.c.*, p. 82.

This species was based on a single specimen of very different appearance from typical *holubi*. The type came from the Kimberley Reservoir, which is fed from the Vaal River near Riverton.* Apart from its slender body, which lacks the prominent bulge on the nape

* My thanks are due to Miss Wilman, Curator of the McGregor Memorial Museum, Kimberley, for making enquiries of the Town Clerk, who stated (*in litt.* 22/ii/37) that the Reservoir was first filled in 1883, and that it now contained large numbers of indigenous fishes commonly called yellow-fish (a 12-pounder was caught in 1936), silver-fish, mud-fish, barbel, carp, and *Tilapia sparmanni*.

(depth at least $4\frac{1}{2}$ in length excl. caudal fin), the presence of 9 dorsal rays evidently seemed to the authors to warrant specific separation.

But any attempt to separate *kimberleyensis* from *holubi* on other characters fails, and the above demonstration that *holubi* of typical body-shape can have either 8 or 9 dorsal rays, reduces the differences to one of body-shape only.

Among Gilchrist and Thompson's material are 7 specimens from Potchefstroom which these authors apparently identified as *holubi* without further ado. One of these (255 mm., but not the one so measured by G. and T.) has the typical *holubi* body-shape, but in spite of its size the head-length is not less than the body-depth; and it has 9 dorsal rays. The other 6 specimens, including the largest one of 280 mm., are typical *kimberleyensis* in body-shape, but have 8 dorsal rays. These 6, together with 11 from Warrenton, are included in the table with the type of *kimberleyensis*.

Although all these 6 specimens and the type are ♂♂, the difference in body-shape is apparently not sexual, as there are in the collection undoubted ♂♂ with the typical *holubi* shape. The 125, 190, 222, and 280 mm. specimens have the top of the head and snout more or less thickly sprinkled with minute pearly pimples.

The status of *kimberleyensis* is thus doubtful, and before making any decision it might prove interesting to investigate the *holubi–kimberleyensis* community in the Kimberley Reservoir. The problem is outside the scope of the present paper, and has only been mentioned because it arose inevitably out of the study of the *holubi* material.

Barbus marequensis A. Smith

1841. A. Smith, Illustr. Zool. S. Afr. Fish., pl. 10, fig. 2.

1911. Boulenger, *l.c.*, p. 36, fig. 16.

1913. Gilchrist and Thompson, *l.c.*, p. 377, fig. 37 (after Blgr.).

A stuffed specimen, regarded as "one of the types," 350 mm. in length, is in the British Museum. According to Boulenger it has 33 scales in the lateral line and 12 around the caudal peduncle, and the last dorsal spine is "rather feeble." Smith's figure shows about 45 scales in l.l. and 14 around caudal peduncle, and gives the impression that the last dorsal spine is rather *strong*, although perhaps not so strong as in typical *holubi*.*

* On variability in size and strength of the last (or main) dorsal spine in *B. hexagonolepis* McC., see Hora, 1940, J. Bombay Nat. Hist. Soc., xlii, p. 82, fig. 4. It is found that the fishes from rivers flowing through limestone areas have better developed dorsal spines.

The figure given by Boulenger is a black-and-white reproduction of Smith's coloured figure. The so-called type specimen should be re-examined.

Although other species of *Barbus* have been recorded from the tributaries of the Limpopo River, no one has yet recorded any specimens from the Marico River under the name *marequensis*. Gilchrist and Thompson recorded specimens of *holubi* from Six-mile Spruit (Hennops River), Dwaars River, and Pienaars River, all tributaries of the Limpopo. As these specimens are not in the South African Museum, I enquired whether the Transvaal Museum had any *Barbus* material from the Marico River, with a view to determining what species are present in this river, and, if *holubi* is present, whether it is actually the same as the Orange River *holubi*.

Thanks to the Director and Dr. Fitzsimons, I have been able to examine 5 specimens of "*holubi*" from near Zeerust on the Marico River, a locality about 70–80 miles distant from Andrew Smith's type locality.

As *marequensis* is obviously not closely allied to any other form but *holubi*, it would be reasonable to assume that the Zeerust specimens are representatives of *marequensis*. And the assumption would be strengthened if a re-examination of the type showed that Smith's figure, as regards the number of scales, is nearer the truth than Boulenger's statements.

A further question is whether the Marico specimens are to be regarded as specifically the same as the Orange River *holubi*. A table of the 5 Transvaal Museum specimens is given for comparison with typical *holubi*.

The differences which can be observed are not so significant as the trend of variation.

It has been stated above (p. 157) that in *holubi* from about 90 mm. upwards the length of the head becomes approximately equal to the depth of body, but here the head-length is definitely greater than the depth in specimens up to a length of nearly 200 mm.

Secondly (also *cf.* p. 157), whereas in *holubi* the base of the ventral spine gradually shifts forward so that in specimens from about 90–100 mm. upwards it lies slightly in advance of the 1st dorsal spine, here even in the largest specimens it has not yet reached a position in *advance* of the 1st dorsal spine.

Far more material is necessary, especially a complete series showing the growth-changes of the Marico River "*holubi*"; but it seems not unlikely that *holubi* and *marequensis* may be regarded as two extremely closely allied species, the former inhabiting the Orange system and the latter the Limpopo system. The extent of the distribution within the Limpopo system should also be investigated.

TL	L/H	H/E	S/E	I/E	l.l.	c.ped.	H : D.	Sex and Remarks.
(*a*) 150	$3\frac{4}{5}$	$4\frac{3}{4}$	$1\frac{1}{2}$	$1\frac{2}{3}$	41	16	H > D	Immat. ? ♂. V below 3rd–4th dorsal spines.
(*b*) 175	$3\frac{2}{3}$	5	$1\frac{2}{3}$	$1\frac{2}{3}$	40	16	H > D	Immat. V below 3rd dorsal spine.
(*c*) 190	$3\frac{3}{4}$	$5\frac{1}{4}$	$1\frac{2}{3}$	$1\frac{3}{4}$	41	16	H > D	♂. V below 2nd–3rd dorsal spines.
(*d*) 200	$3\frac{3}{4}$	5	$1\frac{2}{3}$	$1\frac{3}{4}$	40	16	H ≡ D	♂. V below 3rd dorsal spine.
(*e*) 200	$3\frac{2}{3}$	$5\frac{1}{4}$	$1\frac{3}{4}$	$1\frac{4}{5}$	42	16	H ≡ D	♂. V below 1st dorsal spine.

In all specimens D iv. 8. In (*d*) the 1st dorsal spine seems to have been torn out, or to be degenerate. In (*b*) the right anterior barbel is bifurcated. V = ventral spine. H = length of head. D = depth of body.

Barbus capensis A. Smith

Clanwilliam Yellow-fish, Geelvis.

Figs. 9–11.

1841. A. Smith, Illustr. Zool. S. Afr., pl. 10, fig. 1.
1913. Gilchrist and Thompson, *l.c.*, p. 398, fig. 57 (*seeberi*).
1916. Boulenger, *l.c.*, iv, p. 241, fig. 150 (*seeberi*).
1937. Barnard, Ann. Mag. Nat. Hist. (10), xix, p. 305.
1938. *Id.*, *l.c.*, p. 82.

[not *capensis* Weber, Zool. Jahrb. Abt. Syst., x, p. 151, 1897.
not *capensis* Pappenheim in Schultze, Reise, iv, p. 276, 1910.
not *capensis* Boulenger, *l.c.*, ii, p. 123, 1911, except A. Smith's type specimen.
not *capensis* Gilchrist and Thompson, *l.c.*, p. 412, 1913.
not *capensis* J. L. B. Smith, *l.c.*, p. 125, 1937.]

A large species characteristic of the Clanwilliam Olifants River (fig. 6), where of late years it has become known as an excellent sporting fish. Very large examples are known as "Kalverkop" (calf's head). Examples with fleshy lips are known to anglers as "rubber-lips"! *

* Trout-flies, by "Kingfisher." London, 1938. The author on p. 172, speaking of the Olifants River "rubber-lip," says specimens were identified with specimens at the South African Museum as "Barbus m'fongosi." No specimens were

Gilchrist and Thompson's description of *seeberi* was based on three specimens ranging from "95–102 mm." in length. In fact, "102" is a misprint for 210, the lengths of the specimens being 95, 115, and 210 mm. Owing to Boulenger having included *capensis* among the species with radiately striate scales, Gilchrist and Thompson were bound to consider their specimens as representing an undescribed species.

All three specimens seem to have been originally preserved in formalin, the tissues on the throat, chin, and lips are plump, and especially in the largest one the symphysial region is considerably puffed out. The groove connecting the ends of the lower labial grooves across the chin is consequently very inconspicuous, and it is not surprising that Gilchrist and Thompson stated "lower lip interrupted on chin." This groove is, however, traceable on the two smaller specimens, and in all fresh specimens is distinct.

Boulenger (*l.c.*) places the species after *gilchristi*, and says it is distinguished from the latter "chiefly by the interrupted lower-lip." It would seem, however, to be far more closely allied to *B. holubi*, which is widely distributed in the Orange River system. This latter species is occasionally found with 9 rays in the dorsal fin, and the resemblance of the two species is then very striking, the differences being in the enlargement of the 4th dorsal spine (strong in *holubi*, weak in *capensis*), the relative positions of the dorsal and ventral fins, the dorsal profile, and the extra scales around the caudal peduncle. One might suggest on morphological grounds that *holubi* and *capensis* are derivatives of one ancestral species.

The original description (of *seeberi*) can be emended or supplemented by the following details.

Depth sometimes 4, but usually $4\frac{1}{4}$–$4\frac{1}{2}$ in length of body (excluding caudal fin). Depth of caudal peduncle twice or nearly twice in its length. D iv. 9. Base of 1st dorsal spine equidistant between tip of snout and base of middle caudal rays (or slightly nearer the latter). Anal fin in large specimens reaching to base of caudal fin, shorter in half-grown and young specimens (*v. infra*). Ventral spine arising in vertical from 4th dorsal spine. Scales l.l. 41–45; around caudal peduncle 16 in young, 16–18 in half-grown, and (usually) 18 in adult (16 in a 635 mm. ♂, and 20 in a 650 mm. ♀, see table); predorsal

submitted for official identification. The author saw the specimens formerly exhibited in glass cases in the Museum, among which was a Natal "rubber-lip" labelled *m'fongosi.* Needless to say, the "rubber-lip" is the only point of resemblance.

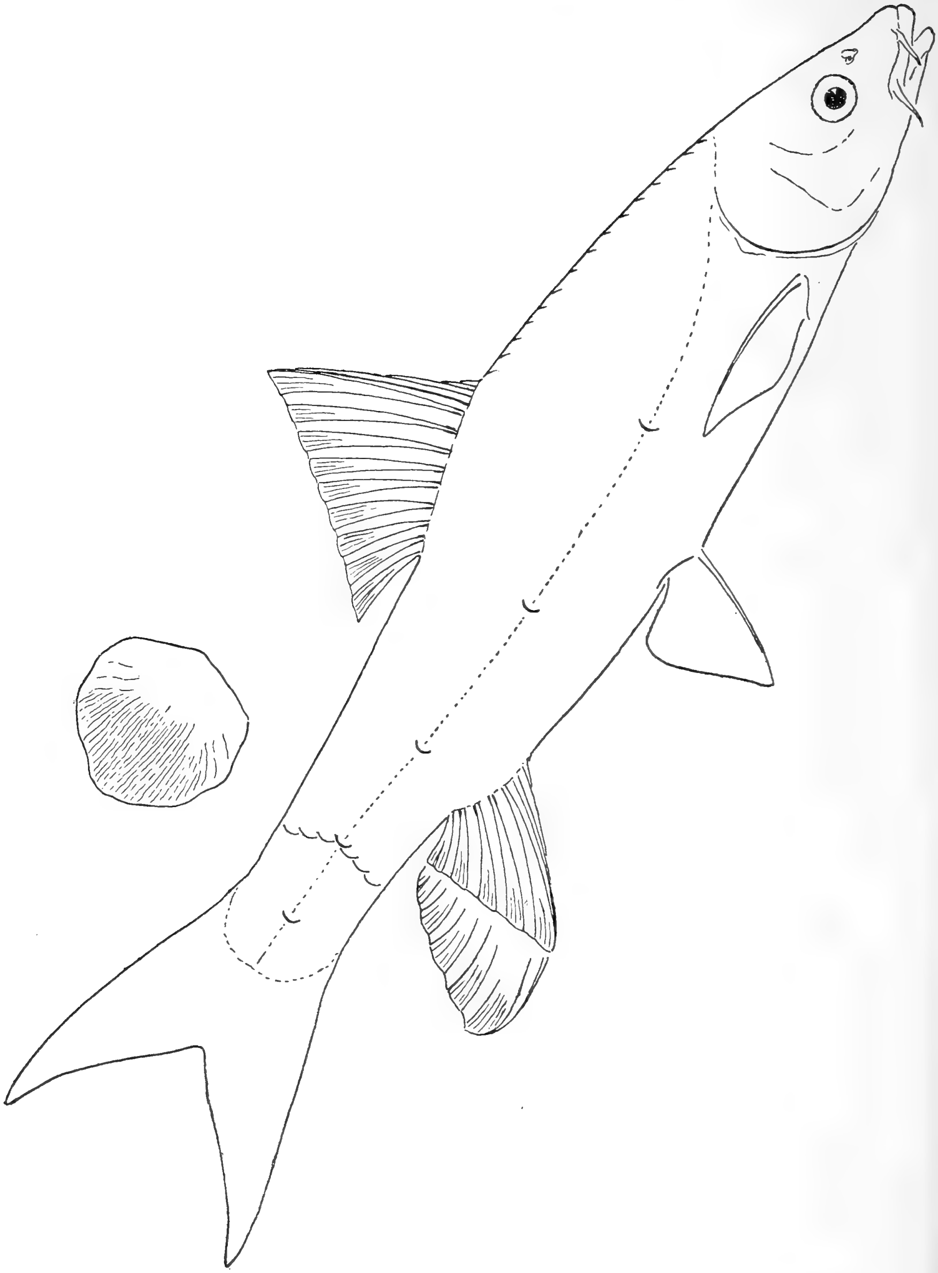


Fig. 9.—*Barbus capensis.* Adult, with scale enlarged; predorsal scales and every 10th scale (and approximately the 36th) in lateral line indicated; anal fin showing change in shape from young and half-grown to adult.

15–17. In large specimens the posterior barbel may be $2\frac{1}{3}$ times as long as eye.

The posterior barbel is developed at the 17–18-mm. stage, the anterior barbel at 24–25 mm.; scaling begins at 30–31 mm.

Largest specimen seen by myself: 730 mm. This specimen weighed $15\frac{1}{2}$ lbs., but specimens up to $22\frac{1}{2}$ lbs. have been reported (*Cape Argus*, Cape Town, 21/iv/38, with photo.). Specimens from about 180–200 mm. with developing roes. Males without trace of warts on head. The smallest juveniles were caught in mid-February; but spawning evidently takes place also later, and probably earlier in the summer.

Adult more or less golden or brassy above, silvery below, cheeks, opercles, and lips (especially in the "rubber-lip" forms) lemon-yellow; all fins tinged with pale gamboge or lemon-yellow. Juveniles with an irregular series of horizontally or vertically oval spots along the sides, composed largely of pigment-specks (chromatophores) of a characteristic square or oblong shape; fins as in adult.

Locality.—Olifants River, Clanwilliam Division, Cape. Long series collected by A. C. H., K. H. B., A. J. H., C. W. T., 1936–1939, together with single large specimens submitted by F. Bowker, the late Morch-Ohlsen (Warmbaths, Citrusdal), G. D. Jooste, and E. Wale.

Remarks.—The anal fin undergoes a notable change of shape during growth (fig. 9). When extended so that the last ray is horizontal, the hind margin is vertical and straight in the young and half-grown (slightly concave in very young), but in large specimens it is oblique and gently convex. In the latter the anterior margin is rather strongly curved. The first ray is always appreciably longer

Length of Fish.	1st Anal Ray extending	Least Depth of Caudal Peduncle in length of 1st Anal Ray.	When last Anal Ray horizontal, hind margin of Fin is
70 mm.	Half-way to caudal	About $1\frac{1}{4}$	Slightly concave and sloping slightly forwards (and downwards).
100 ,,	,,	,,	Straight and vertical.
200 ,,	,,	,,	,,
270 ,,	Three-quarters to caudal	$1\frac{1}{3}$	Straight and vertical (or slightly convex).
300 ,,	,,	$1\frac{1}{2}$	Gently convex and sloping backwards (and downwards).
350 ,,	To caudal	$1\frac{2}{3}$	,,
390 ,,	,,	2	,,

than the last ray, and when folded back reaches well beyond the latter; in young and half-grown it reaches to about half-way between base of last ray and bases of lower caudal rays, in the fully grown examples it reaches to or almost to the bases of the lower caudal rays.

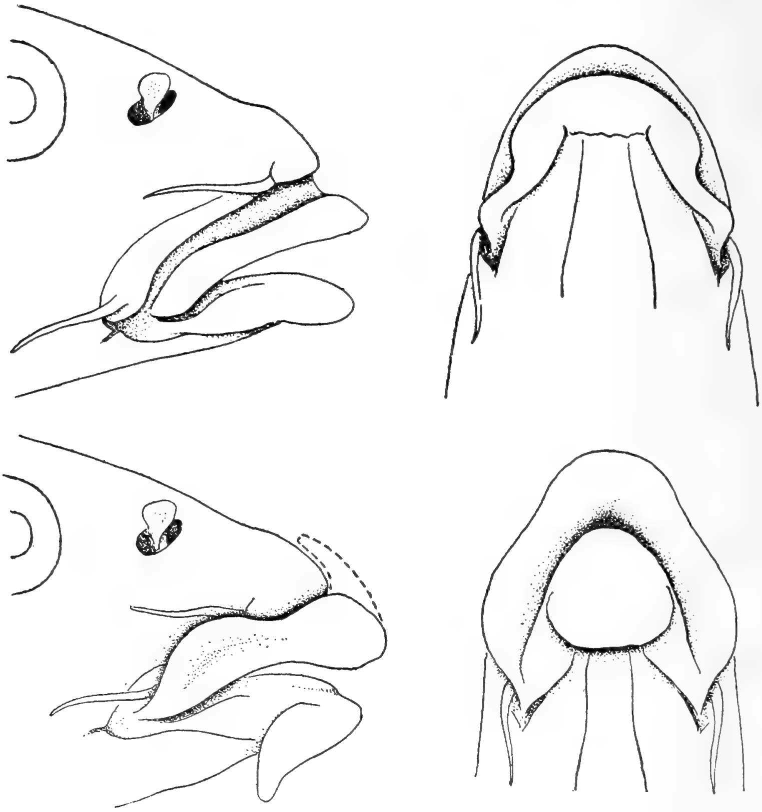


FIG. 10.—*Barbus capensis*, normal and "rubber-lip" variety. Lateral and ventral views of mouth ; the dotted line shows the extreme development of the upper lip.

The shape of the fin, which is similar in *holubi*, is essentially different, even in the early stages, from that of *serra* (*q.v.*) and other Cape species, in that the 1st ray when folded back extends beyond the end of the last ray.

Rubber-lips.—Amongst the normal *capensis* there is sometimes found a form with thick fleshy lips, both the upper and lower lip being produced in a median lobe (fig. 10). This form is known to local anglers by the very expressive name of "Rubber-lip." Except this fleshy enlargement of the lips there is no other distinction between the forms. The smallest rubber-lip I have seen is an immature one 145 mm. in length; one 255 mm. long has been gutted; one 335 mm. long is a ♂; and the two largest, 390 and 410 mm. in length, are both ♀♀.

Worthington (Proc. Zool. Soc. London, 1929, p. 431, fig. 3) has figured the extreme variations in the lips of *B. radcliffii* and its

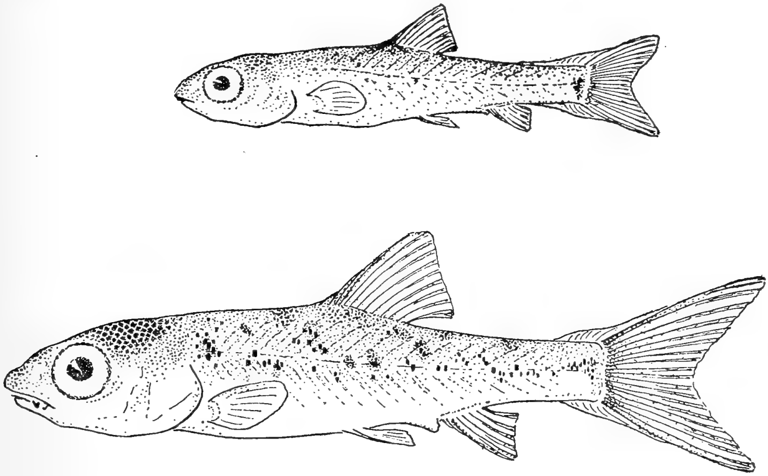


Fig. 11.—*Barbus capensis.* Juveniles, 15 mm. and 23 mm.

synonyms *bayoni* and *lobogenys,* and has stated that every gradation between the thin-lipped and rubber-lipped forms may occur in *both* sexes.

The occurrence of rubber-lips in both sexes of *capensis* has been confirmed. Of three specimens of *gunningi* in the South African Museum, 2 are ovigerous ♀♀, the third probably ♀.

Several other pairs of "species" may be suggested as being probably synonymous, e.g. *mentalis,* a synonym of *kimberleyensis,** *sector* and *dwaarsensis* of *brucii* (this has line precedence over *sector*), and *m'fongosi* of *elephantis.*

It is a little curious that specific importance should be attached to the lip development. Day (Fishes, India, 1878–1888, p. 564, pl. 136, fig. 5, and pl. 140, fig. 1) described and figured both the thin-lipped and thick-lipped forms of *Barbus tor* (the Mahseer), and evidently assumed without question that they were one and the same

* Perhaps both these are synonyms of *gilchristi;* the latter based on a single specimen, collected together with a typical example of *holubi.* The curiously short pectoral fin of *gilchristi* may be abnormal.

species. Hora (J. Bombay Nat. Hist. Soc., 1939, xli, pp. 279–282, fig. 2 and pl. 2; *ibid.*, 1940, xli, p. 522, pl. 2; and *ibid.*, 1940, xli, p. 787) holds the same opinion. He suggests that the excessive development of fleshy lips to form a suction disc may be for the purpose of adhesion to rocks in swift currents. In conformity with this hypothesis it may be mentioned that local anglers seem to be of opinion that the rubber-lip variety of the Yellow-fish is usually found in the more rapid parts of the Olifants River. Many more observations, however, are required.

Barbus capensis.

TL	L/H	H/E	S/E	I/E	l.l.	c.ped.	striae.	g.r.	barb.	Sex and Remarks.
15	$3\frac{1}{2}$	3	e > s	e > i	No s	cales		0 + 7	None	Dorsal, anal, ventral fins distinct. No ventral lamella.
18	$3\frac{1}{4}$	3	e > s	e > i	,,	,,		1 + 8	(p)	
20	3	3	e > s	1	,,	,,		2 + 9	(p)	
25	3	3	e > s	1	,,	,,			p (a)	
30	3	$3\frac{1}{4}$	e > s	1	,,	,,		2 + 10	p (a)	p $\frac{1}{3}$ eye.
33	$3\frac{1}{4}$	$3\frac{1}{3}$	1	1	41	14–16	5–6	,,	p.a.	p $\frac{1}{2}$ eye.
35	$3\frac{1}{4}$	$3\frac{1}{2}$	1	1	42	16	6	3 + 10	p.a.	
40	$3\frac{1}{4}$	$3\frac{1}{2}$	1	1	41	16		,,	p.a.	
50	$3\frac{1}{4}$	$3\frac{1}{2}$	1	1	42	16		3 + 10–11		
60	$3\frac{1}{4}$	$3\frac{2}{3}$	1	1	41		10–12	4 + 11		
70	$3\frac{1}{4}$–$3\frac{1}{3}$	$3\frac{3}{4}$	1	$1\frac{1}{5}$						
80	$3\frac{1}{3}$	4	$1\frac{1}{5}$	$1\frac{1}{5}$						
90	$3\frac{1}{3}$	$4\frac{1}{5}$	$1\frac{1}{4}$	$1\frac{1}{5}$						
95	$3\frac{1}{3}$	$4\frac{1}{4}$	$1\frac{2}{5}$	$1\frac{1}{4}$						Type *seeberi.*
115	$3\frac{1}{3}$	$4\frac{1}{4}$	$1\frac{2}{5}$	$1\frac{1}{4}$						Type *seeberi.*
125	$3\frac{1}{2}$	$4\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{4}$			16–18			
140	$3\frac{1}{2}$	$4\frac{1}{2}$	$1\frac{2}{5}$	$1\frac{1}{4}$						
145	$3\frac{2}{3}$	$4\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{3}$						"Rubber-lip.'
150	$3\frac{1}{2}$	$4\frac{1}{2}$	$1\frac{2}{5}$	$1\frac{1}{4}$						
160	$3\frac{2}{3}$	$4\frac{2}{3}$	$1\frac{1}{2}$	$1\frac{1}{3}$			22–24			
170	$3\frac{3}{4}$	$4\frac{3}{4}$	$1\frac{1}{2}$	$1\frac{1}{2}$	42–45	16–18				
180	$3\frac{3}{4}$	$4\frac{3}{4}$	$1\frac{1}{2}$	$1\frac{1}{2}$						♂ juv.
190	$3\frac{3}{4}$	$4\frac{3}{4}$	$1\frac{1}{2}$	$1\frac{1}{2}$						
200	$3\frac{3}{4}$	$5\frac{1}{4}$	$1\frac{1}{2}$	$1\frac{3}{4}$						
210	$3\frac{3}{4}$	$5\frac{1}{3}$	$1\frac{1}{2}$	$1\frac{3}{4}$						Type *seeberi.*
240	$3\frac{3}{4}$	6	2	$1\frac{4}{5}$			26–28			♂ juv.
255	$3\frac{3}{4}$	6	2	$1\frac{3}{4}$						"Rubber-lip."
300	$3\frac{3}{4}$	$6\frac{1}{4}$	$2\frac{1}{4}$	2						♂.
335	$3\frac{3}{5}$	$6\frac{1}{2}$	$2\frac{1}{4}$	2				4 + 12		♂ "rubber-lip."
350	$3\frac{3}{4}$	$6\frac{1}{2}$	$2\frac{1}{4}$	2						♀ "rubber-lip" and
390	$3\frac{3}{4}$	$6\frac{3}{4}$	$2\frac{1}{2}$	2						normal.
410	$3\frac{3}{4}$	7	$2\frac{1}{2}$	2			..	..	..	♂. ♀ "rubber-lip."
490	$3\frac{3}{4}$	$8\frac{1}{4}$	3	3	44	18		4 + 14		♀.
600	$3\frac{3}{5}$	9	$3\frac{1}{3}$	$3\frac{1}{2}$	?	?		4 + 14		Gutted, and scales removed.
635	$3\frac{3}{5}$	$9\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	44	16	36	4 + 14		♂.
650	$3\frac{3}{5}$	$9\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{3}{4}$	42	20				♀.
730	$3\frac{1}{2}$	$9\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	43	18				♀.

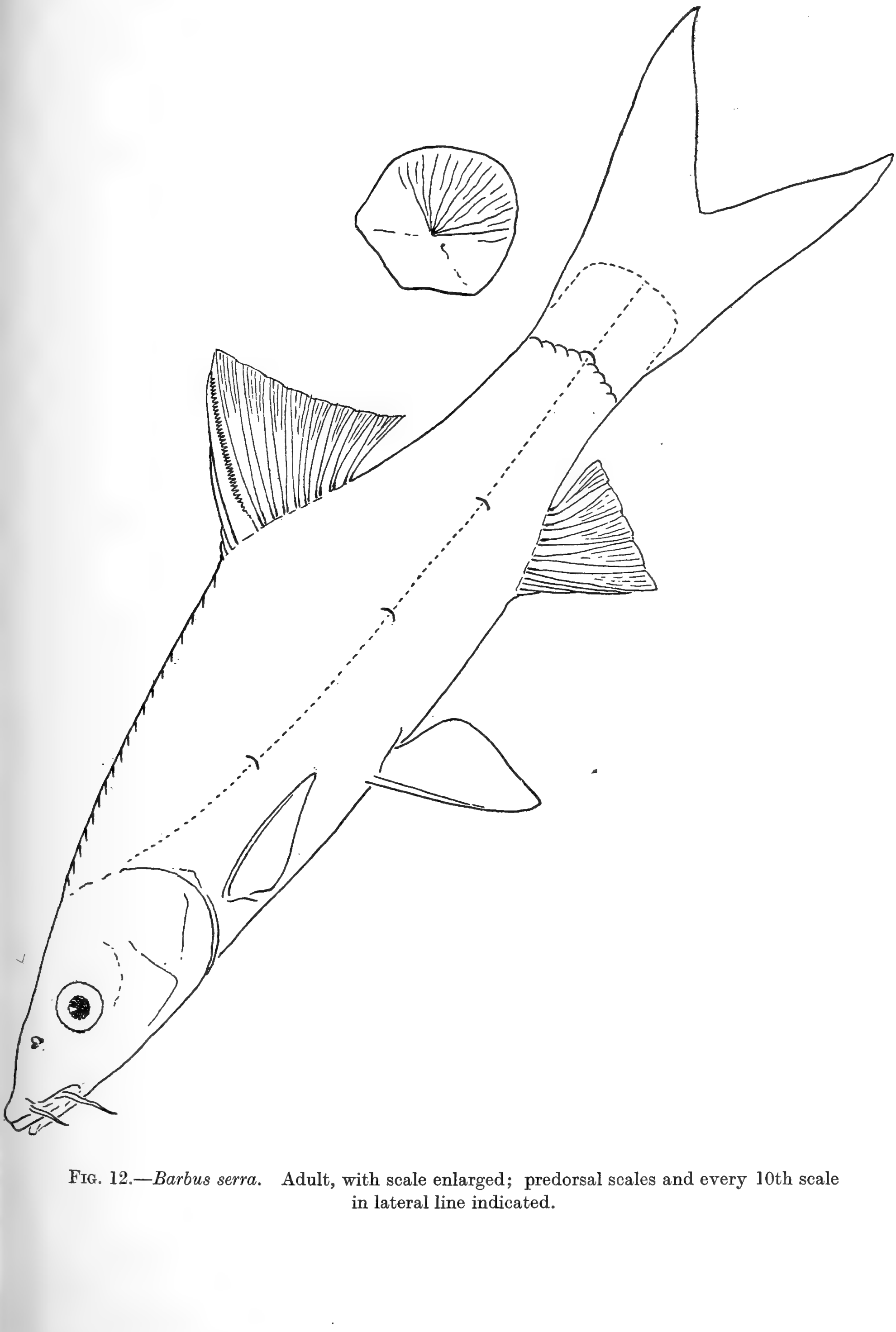


FIG. 12.—*Barbus serra.* Adult, with scale enlarged; predorsal scales and every 10th scale in lateral line indicated.

Barbus serra Peters

Saw-fin.

Figs. 12, 13.

1911. Boulenger, *l.c.*, p. 114, fig. 91.

1913. Gilchrist and Thompson, *l.c.*, p. 403, fig. 61 (part: not the two smallest of the three specimens coll. Leipoldt).

1938. Barnard, *l.c.*, p. 82.

Distinguished from *holubi* and *capensis* by the serrated dorsal spine, radiately striate scales, and shape of anal fin. The latter undergoes

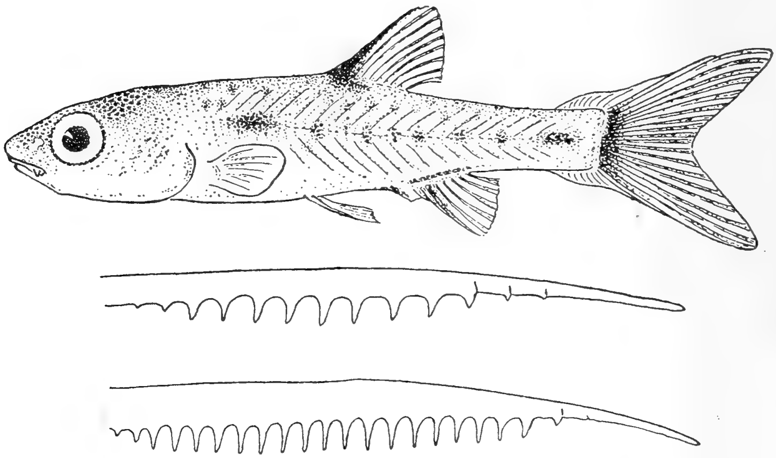


FIG. 13.—*Barbus serra*. Juvenile, 18 mm. Dorsal spine of young 40 mm. (spine 9 mm.) and 70 mm. (spine 14 mm.). (There are actually 2 rows of serrations, but only one row is shown.)

no change of shape during growth. Lower labial grooves not continuous across the chin. No warts on head in ♂.

Largest specimen examined, 380 mm. The posterior barbel is developed at about 17–18 mm., the anterior at about 20–22 mm. Scaling begins at 25–27 mm., and serration of the dorsal spine at 20 mm.

The smallest juveniles were collected in mid-February; but spawning continues later, and probably begins earlier.

Silvery greyish or drab-coloured above; dorsal, caudal, anal, and ventral fins suffused with pale orange-salmon. Juveniles with a series of dark spots, longitudinally or vertically oval, along the side, the largest being at end of caudal peduncle, often a second less numerous series on back; these spots become more prominent after preservation; fins faintly tinged with orange or salmon.

Originally described from "Cape of Good Hope" (coll. Krebs). Like *capensis*, this distinctive species has only been found in the Olifants River, Clanwilliam Division (fig. 6); the insertion of the word "Transvaal" in Gilchrist and Thompson's monograph being a slip (p. 118).

Barbus serra.

TL	L/H	H/E	S/E	T/E	l.l.	c.ped.	striae.	g.r.	barb.	Sex and Remarks.
13	$3\frac{1}{2}$	$2\frac{1}{2}$	e>s	e>i	No scales		..	..	None	Dorsal, anal, ventral fins distinct, no ventral lamella.
15	$3\frac{1}{3}$	$2\frac{3}{4}$	,,	,,	,,	,,	..	..	,,	
18	3	3	,,	,,	,,	,,	..	..	(p)	
20	3	3	,,	,,	,,	,,	..	..	p (a)	0–1 serrations on dorsal spines.
22	3	3	,,	,,	,,	,,	..	1 + 9	p (a)	1–2 ,, ,,
25	3	$3\frac{1}{4}$	,,	1	,,	,,	..	2 + 9	p. a.	2–3 ,, ,,
					(or a few anteriorly)					
27	3	$3\frac{1}{3}$	1	1	40	18	4	2 + 10	p. a.	4–5 ,, ,,
30	3	$3\frac{1}{3}$	1	1	41	18–20	4	3 + 10	..	5–6 ,, ,,
35	$3\frac{1}{5}$	$3\frac{1}{2}$	1	1	41	(18) 20	..	5 + 11	..	7–8 ,, ,,
40	$3\frac{1}{4}$	$3\frac{1}{2}$	$1\frac{1}{5}$	$1\frac{1}{5}$	42		4	5 + 11		
45	$3\frac{1}{4}$	$3\frac{1}{2}$	$1\frac{1}{5}$	$1\frac{1}{5}$	42		..	,,		
50	$3\frac{1}{4}$	$3\frac{3}{4}$	$1\frac{1}{4}$	$1\frac{1}{4}$			..	5 + 12	..	14 serrations.
55	$3\frac{1}{4}$	$3\frac{3}{4}$	$1\frac{1}{4}$	$1\frac{1}{4}$			4–5			
65	$3\frac{1}{4}$	4	$1\frac{1}{4}$	$1\frac{1}{4}$						
70	$3\frac{1}{4}$	$4\frac{1}{4}$	$1\frac{1}{3}$	$1\frac{1}{4}$			..	6 + 12		
75	$3\frac{1}{4}$	$4\frac{1}{3}$	$1\frac{2}{5}$	$1\frac{1}{4}$			5–6			
95	$3\frac{1}{4}$	$4\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{4}$						
100	$3\frac{1}{3}$	$4\frac{2}{3}$	$1\frac{1}{2}$	$1\frac{1}{4}$		20				
110	$3\frac{1}{3}$	$4\frac{4}{5}$	$1\frac{3}{4}$	$1\frac{1}{3}$						
125	$3\frac{1}{2}$	5	$1\frac{4}{5}$	$1\frac{1}{2}$			7–8			
140	$3\frac{1}{2}$	$5\frac{2}{3}$	2	$1\frac{1}{2}$						
170	$3\frac{2}{5}$	$5\frac{2}{3}$	2	$1\frac{1}{2}$	41–44					
210	$3\frac{1}{2}$	6	$2\frac{1}{4}$	$1\frac{3}{4}$			10–12	6 + 12		
260	$3\frac{1}{2}$	6	$2\frac{1}{4}$	$1\frac{3}{4}$			..	..	..	♂.
280	$3\frac{1}{2}$	$6\frac{1}{2}$	$2\frac{1}{2}$	2			..	..	..	♂.
300	$3\frac{1}{2}$	$7\frac{1}{2}$	$2\frac{3}{4}$	$2\frac{1}{2}$			15	..	..	♂.
320	$3\frac{1}{2}$	$7\frac{1}{2}$	3	$2\frac{1}{2}$			..	..	..	♂.
340	$3\frac{1}{2}$	8	3	3			..	..	..	Spent ♀.
350	$3\frac{1}{2}$	8	$3\frac{1}{3}$	3		20–22	..	..	..	♂.
360	$3\frac{1}{2}$	$8\frac{1}{4}$	$3\frac{1}{2}$	$3\frac{1}{5}$			..	..	..	♂.
380	$3\frac{1}{2}$	$8\frac{1}{2}$	4	$3\frac{1}{4}$			17	6 + 12	..	♂.

Barbus paludinosus Peters

Fig. 14, *a*, *b*.

1911. Boulenger., Cat. Fw. Fish. Afr., ii, p. 115, fig. 92.

1913. Gilchrist and Thompson, Ann. S. Afr. Mus., xi, p. 404, fig. 62.

1935. Fowler, Ann. Transvaal Mus., xvi, p. 265, fig. 9 (*tsotsorogensis*).
1936. Trewavas, Novit. Zoolog., xl, p. 66.
1936. Pellegrin, Arc. Mus. Bocage, Lisbon, vii, p. 53.
? 1937. J. L. B. Smith, *l.c.*, p. 125, pl. 30, fig. 4.

A very fine series of over 200 specimens of all sizes was collected by Dr. Hesse and Mr. Thorne in the Gt. Fish River at Aiais, South West Africa, Nov. 1936. Although strictly speaking the locality is outside our area, it seems desirable to include some details of the young stages of this species, particularly for comparison with the following species *hospes*.

This series shows that the posterior barbel develops at about the 19–20 mm. stage, the anterior one at about 29–30 mm. The scales are developed at about 23 mm., with 3 striae (radiating); at 68 mm. there are about 12 main striae and several "intercalaries" (15–18 in all).

The first serrations on the 3rd dorsal spine appear at about 22–23 mm., increasing in number until in the adult there are about 18 serrations, closely set and all curving downwards towards base of the spine. The tip of the spine is delicate and easily broken. In the adult the 2nd spine is not more than $\frac{1}{3}$ length of the 3rd.

The dorsal fin from the earliest stage onwards has a characteristic elevated shape, the hind margin being approximately vertical when the fin is extended (3rd spine at an angle of 60° with the long axis of body).

The lowermost gill-rakers (about 6) are knob-like and rather stout, not lanceolate. (In the Gibeon and Etosha Pan specimens in S.A. Museum all the gill-rakers are slender.)

External sexual differences are not apparent, no warts or mucous pores being developed on the head in ♂, and the pectoral fin not differing in length. Males are adult at about 55 mm., and females at about 62 mm. (Aiais series).

Adults show a faint creamy-yellow tinge on the fins, including the caudal, but no red spots.

A series from Middelburg, Transvaal (Limpopo system), includes specimens from 20 mm. in length upwards (only the larger ones were recorded by Gilchrist and Thompson), and fits in with the table drawn up from the Aiais series.

In addition to the localities mentioned by Gilchrist and Thompson, the South African Museum has material from Ovamboland and the Etosha Pan, S.W.A.; from the Gt. Fish River at Gibeon, S.W.A.; from the Orange River, lower section at Goodhouse, and middle section above the Aughrabies Falls and at Upington; from the Dry Hartz River at Taungs, and Vaal River at Warrenton.

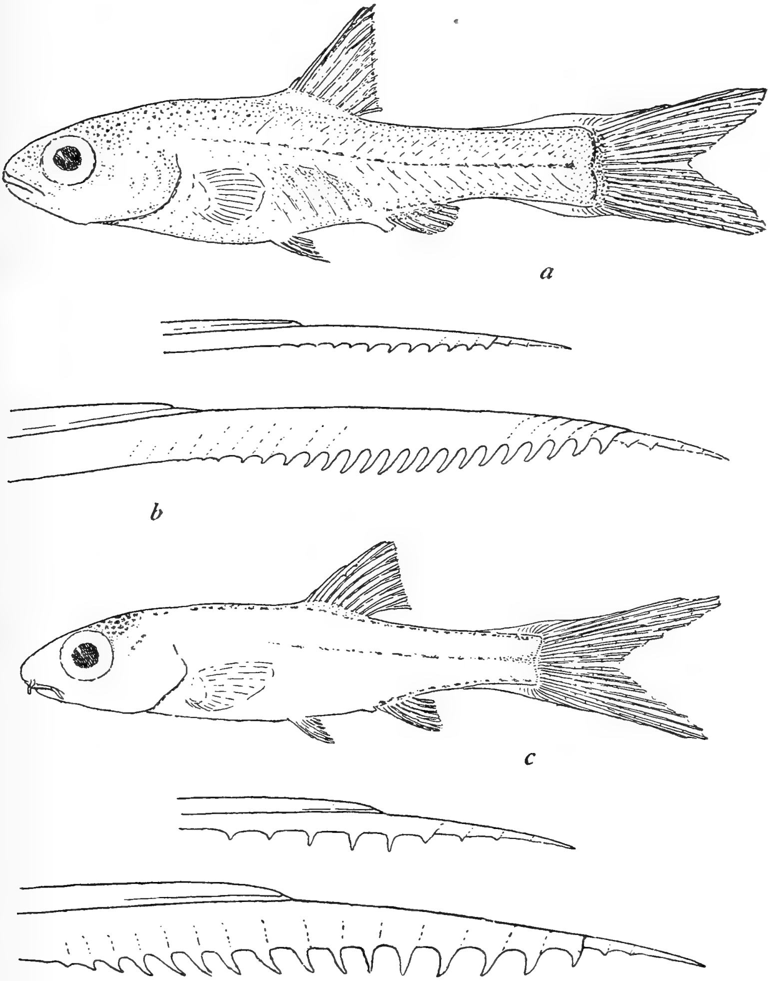


Fig. 14.—*Barbus paludinosus: a.* Juvenile, 12 mm. Gt. Fish River, South West Africa. *b.* Dorsal spines of specimens 35 and 68 mm. in length. *Barbus hospes: c.* Juvenile, 18 mm. Goodhouse, Orange River. *d.* Dorsal spines of specimens 32 and 63 mm. in length. (Only one row of serrations on the spines is shown.)

I have examined specimens of *tsotsorogensis* Fowler; it is merely another synonym of *paludinosus*.

Recent investigations appear to show that this species is absent from the *southern* tributaries of the Orange River.

J. L. B. Smith (1937) says it is common in the Grahamstown and Eastern Cape districts. There are no previous records from this region and the identification should be checked.

Barbus paludinosus.

TL	L/H	H/E	S/E	I/E	l.l.	c.ped.	striae.	g.r.	barb.	Sex and Remarks.
11	$3\frac{1}{5}$	3	e > s	1	No s	cales	..	..	None	Dorsal and anal fin rays distinct. Dorsal spine not serrate.
13	$3\frac{1}{5}$	3	e > s	1	,,	,,	..	..	,,	
15	$3\frac{1}{5}$	3	e > s	1	,,	,,	..	..	,,	
18	$3\frac{1}{4}$	3	e > s	1	,,	,,	..	..	,,	
20	$3\frac{1}{4}$	3	e > s	1	,,	,,	..	8	(p)	
23	$3\frac{1}{4}$	$3\frac{1}{5}$	e > s	1	32	14	..	8–9	(p)	Dorsal spine serrate.
25	$3\frac{1}{4}$	$3\frac{1}{4}$	e > s	$1\frac{1}{5}$	33	16	3	,,	p	
28	$3\frac{1}{4}$	$3\frac{1}{4}$	e > s	$1\frac{1}{4}$			..	,,	p	
30	$3\frac{1}{4}$	$3\frac{1}{4}$	e > s	$1\frac{1}{4}$			3–4	,,	p (a)	
32	$3\frac{1}{4}$	$3\frac{1}{3}$	e > s	$1\frac{1}{4}$			..	1 + 9	p (a)	
35	$3\frac{1}{2}$	$3\frac{1}{2}$	e > s	$1\frac{1}{3}$			..	2 + 9	p. a.	
38	$3\frac{1}{2}$	$3\frac{1}{2}$	1	$1\frac{1}{2}$			4			
40	$3\frac{1}{2}$	$3\frac{1}{2}$	1	$1\frac{1}{2}$						
42	$3\frac{2}{3}$	$3\frac{1}{2}$	1	$1\frac{1}{2}$			4–5			
45	$3\frac{3}{4}$	$3\frac{1}{2}$	1	$1\frac{1}{2}$	33–36	16				
48	4	$3\frac{1}{2}$	1	$1\frac{1}{2}$			7–8	2 + 9	..	♂ juv.
52	4	$3\frac{1}{2}$	1	$1\frac{1}{3}$–$1\frac{1}{2}$			..	2 + 10	..	♂ juv.
55	4	$3\frac{1}{2}$	1	$1\frac{1}{3}$–$1\frac{1}{2}$			..	..	..	♂.
58	4	$3\frac{1}{2}$	1	$1\frac{1}{3}$–$1\frac{1}{2}$			9	..	..	♂.
60	4	$3\frac{1}{2}$	1	$1\frac{1}{2}$				3 + 10	..	♂.
62	4	$3\frac{2}{3}$	1	$1\frac{1}{3}$–$1\frac{1}{2}$			..	..	..	♀ ova.
65	4	$3\frac{3}{4}$	1	$1\frac{1}{3}$–$1\frac{1}{2}$			10	..	..	♀.
68	4	$3\frac{3}{4}$	1	$1\frac{1}{3}$			10–11	..	..	♀.

Barbus hospes Brnrd.

Fig. 14, *c*, *d*.

1938. Barnard, *l.c.*, p. 85.

Depth of body (largest specimens) about 4 in length (excluding caudal fin); length of head 3 (juv.), $3\frac{2}{3}$ (adult) in length; eye 3 (juv.), $3\frac{1}{2}$ (adult) in length of head, 1–$1\frac{1}{3}$ in interorbital width, and, from the 30-mm. stage upwards, subequal to snout. Snout rounded, mouth inferior, lower labial grooves interrupted across chin; 2 pairs of barbels, both appearing simultaneously at about the 15-mm. stage, subequal to one another, and from about the 32-mm. stage upwards subequal to eye-diameter.

D iii. 7. 1st spine slightly nearer to end of middle caudal rays than to tip of snout, 2nd spine about half length of 3rd, 3rd spine in adult thickened, serrated from near base, about 14 serrations, those on basal half directed apically, those on distal half directed towards base of spine, serrations fewer in young and half-grown; margin of fin forming an angle of about 60° with long axis of body. A iii. 5. Pectoral not reaching to ventral (♂). Ventral spine arising in advance of 1st dorsal spine, base of last ray about below 3rd dorsal spine. Caudal elongate, length of longest rays 3 times in length of body (excluding caudal fin) in juv., to $2\frac{3}{4}$ or $2\frac{2}{3}$ in adult.

Gill-rakers in adult 2 + 6 (7) on anterior arch, the 3–4 lowermost ones short and broad.

Scales developed at about the 22–23-mm. stage, radiately striate, 3 striae in juv. to 6–7 in adult; l.l. 37–39, 16 (14 in youngest scaled stage) around caudal peduncle, 6 between 3rd dorsal spine and l.l., 4 between ventral spine and l.l. (the l.l. scale not counted), 5 between l.l. and anal spines, predorsal about 21.

Top of head and snout in the largest specimens thickly sprinkled with minute white pimples (about 4–5 per sq. mm.); all these are ♂♂, no adult ♀ was collected.

Colour (as preserved): silvery, green-brown above, belly in the largest specimens with an orange-salmon tinge, fins pale. According to the collectors, no markings or red spots at fin-bases were present in the freshly caught specimens. The specimens are notably paler in all stages than the specimens of *paludinosus* caught, and preserved, at the same time.

Locality.—Orange River, at Goodhouse, Namaqualand (A. J. Hesse and C. W. Thorne, Nov. 1936).

This species is distinguished by the particular character of the serrated 3rd dorsal spine, the long caudal fin, and the *simultaneous* development of the two pairs of barbels.

From *paludinosus*, with which it was associated, it is easily distinguished in all stages by the shape of the dorsal fin, serration of 3rd dorsal spine, and the length of the anterior barbel. In very young stages the serration of the dorsal spine may not be very distinctive, but the two other characters just mentioned, together with the length of the caudal fin, enable the species to be separated without difficulty.

The serration of the dorsal spine differs from that of any other

South African species in that the proximal serrations curve towards the apex of the spine.

Mr. A. C. Harrison has examined the scales and finds that there are a few weak striae (radiating) in the exposed (posterior) field, but none in the anterior field: "The entire absence of radii in the anterior field and the weakness of those in the posterior field gives the scales a facies differing markedly from that of other small *Barbus* scales examined; the concentric circuli about the focus are without breaks or scalloping in consequence of this absence of radiating striae."

The specific name in allusion to "Goodhouse," the name of the farm on the south bank of the Orange River at Raman's Drift, owned by the hospitable Mr. C. Weidner.

Barbus hospes.

TL	L/H	H/E	S/E	I/E	l.l.	c.ped.	striae.	g.r.	barb.	Sex and Remarks.
14	3	3	e > s	1	No scales		..	5	None	Dorsal and anal fin rays distinct.
15	3	3	e > s	1	,,	,,	..	..	(p) (a)	
16	3	3	e > s	1	,,	,,	..	..	p. a.	
18	3	3	e > s	1	,,	,,	..	5–6	p. a.	Dorsal spine 1–2 serrations.
20	3	3	e > s	1	,,	,,	..	..	..	,, ,, 3 ,,
23	3	3	e > s	1	37	14	..	1 + 5–6	..	,, ,, 4 ,,
25	$3\frac{1}{5}$	$3\frac{1}{5}$	e > s	1	37	16	..	1 + 6	..	,, ,, 4–5 ,,
28	$3\frac{1}{4}$	$3\frac{1}{4}$	e ≡ s	1	38	16	..	1 + 6	..	,, ,, 5 ,,
30	$3\frac{1}{3}$	$3\frac{1}{3}$	1	$1\frac{1}{3}$	37	16	3	..	..	,, ,, 5–6 ,,
32	$3\frac{1}{3}$	$3\frac{1}{2}$	1	$1\frac{1}{3}$	37	16				
52	$3\frac{1}{2}$	$3\frac{1}{2}$	1	$1\frac{1}{3}$	38	16	4–5	6 + 6	..	♂ with pimples.
55	$3\frac{2}{3}$	$3\frac{1}{2}$	1	$1\frac{1}{3}$	37	16	5–6	..	..	♂ ,,
60	$3\frac{2}{3}$	$3\frac{1}{2}$	1	$1\frac{1}{3}$	39	16	6–7	2 + 6	..	♂ ,,
63	$3\frac{2}{3}$	$3\frac{1}{2}$	1	$1\frac{1}{3}$	38	16	7–8	2 + 7	..	♂ ,,

Barbus calidus Brnrd.

Clanwilliam Red-fin; Rooivlerk.

Fig. 15, *a–c*.

1913. Gilchrist and Thompson, Ann. S. Afr. Mus., xi, p. 404 (part *serra* non Peters—the two smallest of the three specimens coll. Leipoldt).

1938. Barnard, *l.c.*, p. 86.

Depth of body $4\frac{1}{2}$ (juv.), 4 or $3\frac{3}{4}$ (adult), length of head 3 (juv.), $3\frac{3}{4}$ (adult), in length of body (excluding caudal fin). Eye 3 (juv.), $3\frac{1}{2}$ (adult) in length of head, subequal to snout and to interorbital width in adult, but greater than these in juveniles. Snout rounded, projecting slightly beyond mouth. Lips thin, the lower labial grooves interrupted for a short distance medianly on chin. Two barbels on each side, the posterior equal to eye-diameter, the anterior

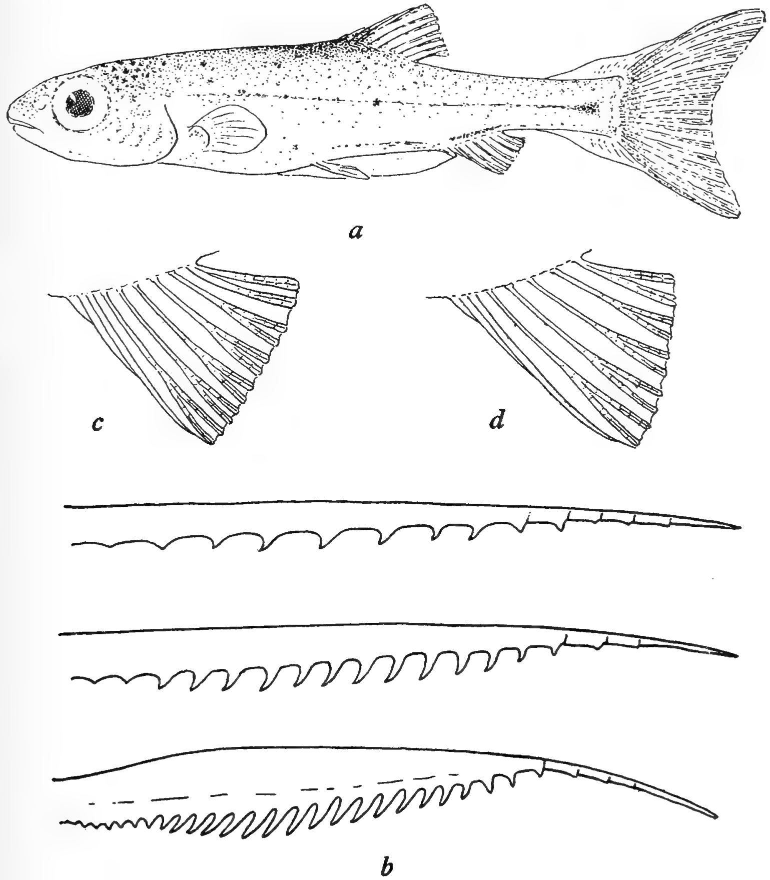


Fig. 15.—*Barbus calidus: a.* Juvenile, 13 mm. *b.* Dorsal spines of specimens 25, 40, and 70 mm. in length (length of spine 5·3, 8, and 13 mm. respectively). (Only one row of serrations on the spines is shown.) *c.* Anal fin. *Barbus phlegethon: d.* Anal fin.

slightly less. Gill-rakers 2 + 6 (juv.), 2 + 7 or 8 (adult) on anterior arch. No tubercles on head in ♂, but minute pimples often visible in both sexes.

D iv. 7. The 1st spine about midway between the last scales on caudal peduncle and the centre or front margin of eye; 3rd spine about $\frac{1}{3}$ length of 4th, the latter not exceeding $\frac{3}{4}$ head length; 4th spine serrate in the youngest specimens (17 mm.), with few and rather widely spaced serrations; in adult enlarged and with numerous strong, closely set serrations pointing downwards towards base of spine. A iii. 6 (–7). Pectoral reaching to or nearly to base of ventral spine in both sexes. Last ray of ventral fin below, or even slightly in advance of, the 1st dorsal spine. Caudal peduncle about $1\frac{1}{2}$ times as long as deep.

Scales radiately striate, striae 4–5 (juv.), 12–14 (adult); lat. line 36–37 (34–38), tr. 6 between dorsal spines and lat. line, 3 between latter and base of ventral spine; around caudal peduncle 12 in specimens up to about 30 mm., 14 in those up to about 55 mm., and 16 in adults. Predorsal about 15.

The posterior barbel is developed at 13–14 mm., the anterior at 17–18 mm. Scaling begins at about 18 mm.

Up to 93 mm. (tip of snout to end of middle caudal rays). Greenish-brown above, silvery with pale yellowish tinge on belly; in specimens from 21 mm. in length upwards red patches are developed in both sexes at bases of the dorsal and anal fins, and in the axils of pectoral and ventral fins; caudal fin also frequently with a pinkish tinge. In preserved specimens a dark lateral stripe becomes visible, more or less broken up into several spots posteriorly; juveniles with dark spots along side and back (somewhat similar to *serra* and *capensis*).

Localities.—Olifants River, Clanwilliam (C. J. Leipoldt, 1897, and R. M. Lightfoot, 1898); Jan Diesel's River, Clanwilliam (K. H. B. and C. W. T., 1936); Tratra River, Wupperthal, Clanwilliam District (K. H. B. and C. W. T., Sept. 1936); Boontjes River, Citrusdal (A. J. H. and C. W. T., Nov. 1936; A. C. H., K. H. B., and C. W. T., April 1937 and 1938); Keerom (S. of Citrusdal), Olifants River (A. C. H., K. H. B., and C. W. T., April 1938, February 1939).

Remarks.—The three specimens collected by C. J. Leipoldt in 1897 were recorded as *serra* by Gilchrist and Thompson, but only the largest one is that species. The error is quite pardonable, as at that time the presence of another species was not suspected and no long series of any species was available to the above collaborators.

Juveniles were obtained at the end of September, in November, February, and early April.

Distinguished from the other Red-fin found in the Olifants River (*phlegethon*), and also from all other Red-fin species, by the serrated dorsal spine. The shape of the anal fin also distinguishes it from *phlegethon* (fig. 15, *d*).

Named after the brightness of the red patches, and the heat of the Olifants River valley in summer time.

Both the Jan Diesel's River and the Tratra River are in the Olifants River system, the former flowing direct into the Olifants River at Clanwilliam, the Tratra flowing into the Doorn and then into the Olifants. The Boontjes flows into the Olifants River between Citrusdal and Clanwilliam (figs. 1 and 6).

Barbus calidus.

TL	L/H	H/E	S/E	I/E	l.l.	c.ped.	striae.	g.r.	barb.	Sex and Remarks.
11	$3\frac{3}{4}$	$2\frac{1}{2}$	e < s	e < i	N	o scale	s	..	None	Dorsal and anal fins distinct.
12	$3\frac{1}{2}$	3	,,	,,		,,		0 + 3	,,	Ventral fins free.
13	$3\frac{1}{2}$	3	,,	,,		,,		..	(p)	No ventral lamella.
14	$3\frac{1}{2}$	3	,,	,,		,,		1 + 4	(p)	
15	3	3	,,	,,		,,				
16	3	3	,,	,,		,,		..	p	Dorsal spine 0–1 serration.
17	3	3	,,	,,		,,		2 + 6	p (a)	
19	3	3	,,	,,		,,		..	p (a)	2–3 serrations.
21	$3\frac{1}{5}$	3	,,	,,	34	12	4	..	p a	Red patches begin.
25	$3\frac{1}{5}$	3	,,	,,	35	12	4–5	,,	..	7 serrations.
27	$3\frac{1}{5}$	3	,,	,,	36	12	..	2 + 7		
30	$3\frac{1}{5}$	3	,,	,,	36	12	6–8	,,		
32	$3\frac{1}{5}$	$3\frac{1}{6}$	,,	,,	37	12	..	,,	..	10 serrations.
39	$3\frac{1}{4}$	$3\frac{1}{6}$	,,	,,	36	14	..	,,		
43	$3\frac{1}{4}$	$3\frac{1}{5}$	1	1	37	14	..	,,		
50	$3\frac{1}{3}$	$3\frac{1}{4}$	1	1	37	14	..	,,		
55	$3\frac{1}{3}$	$3\frac{1}{3}$	1	1	36	14	10	,,		
68	$3\frac{1}{2}$	$3\frac{1}{3}$	1	1	37	14–16	..	2 + 7–8	..	♀♀ ova.
70	$3\frac{1}{2}$	$3\frac{1}{3}$	1	1	37	16	..	,,	..	♀ ova.
75	$3\frac{1}{2}$	$3\frac{1}{2}$	1	1	37	16	12	,,		
80	$3\frac{3}{4}$	$3\frac{1}{2}$	1	1	36	16	..	,,	..	♂.
88	$3\frac{3}{4}$	$3\frac{1}{2}$	1	1	36	16	..	,,	..	♀ ova.
93	$3\frac{3}{4}$	$3\frac{1}{2}$	1	1	38	16	14	,,	..	♂.

Barbus andrewi Brnrd.

Andrew Smith's White-fish; Berg and Breede River White-fish; Witvis.

Figs. 16, 17.

1897. Weber, Zool. Jahrb. Abt. Syst., x, p. 151 (part *capensis*, non A. Smith: the French Hoek and Paarl specimens, but not the juv. from Viol's Drift).

1911. Boulenger, *l.c.*, p. 123, fig. 100 (part *capensis*, non A. Smith: all specimens except Smith's type) (figure shows only 7 dorsal rays).

1913. Gilchrist and Thompson, *l.c.*, p. 412, fig. 70 (*capensis*, non A. Smith) (fig. after Boulenger, showing 7 dorsal rays).

1937. J. L. B. Smith, *l.c.*, p. 125, pl. 30, fig. 1 (*capensis*, non A. Smith).

1937. Barnard, Ann. Mag. Nat. Hist. (10), xix, p. 305.

1938. *Id.*, *ibid.* (11), ii, p. 82.

This species and *serra* are the only two *large*-sized *Barbus* with *radiately* striate scales in the region under discussion. The Saw-fin (*serra*), however, is easily distinguished by the much stronger serration of the dorsal spine, only 5 branched anal rays, and the scale-count.

The dorsal fin formula is given as D iii. 8; but there are actually 4 spines, the true 1st spine being obscured in half-grown and adult examples. In large specimens the dorsal spine is often less strongly developed, relatively, than in younger specimens, and the serrations become nearly obsolete.

The posterior barbels are developed at about 21–22 mm., the anterior at about 24–25 mm.; scaling begins at about 24–25 mm., and from about 25 mm. the dorsal spine serrations begin to develop.

Although published records give 380 mm. as the length to which this species grows, local farmers and anglers report that it reaches a length of at least 2 feet (600 mm.); the largest I have seen was a ♀ $20\frac{3}{4}$ inches (525 mm.) in length, weighing 6 lbs. 7 ozs., caught in the Brand Vlei Dam at Worcester by Mr. H. Botha in November 1941, and forwarded to the South African Museum by Mr. Perkins who stated that it was a record for the Worcester Trout Anglers Association.

The sexes can be distinguished by the roes at a length of about 160 mm., and sexual maturity is attained probably at about 200 mm. There is no sexual difference in the length of the pectoral fin. No warts are developed on the head in the ♂, but in both sexes there are numerous minute pimples on the top of the head, and extending over the scales as far back as the dorsal fin. When a fish is taken out of the water and allowed to dry, these pimples are quite visible to the naked eye, and can be felt with the finger as a slight roughness. After preservation they become white, but are not to be seen if the mucous covering has been rubbed off; where the mucus is lost minute pits can be seen on the top of the head (cf. *Labeo*).

The fishes mass for spawning at the head of a stony pool or run below rapids from the middle of November onwards into January. On 27th November 1938 Messrs. F. G. Chaplin, A. C. Harrison, C. W. Thorne, and the writer netted and "stripped" several ripe ♂♂ and

♀♀ in the Berg River at Drakenstein. Mr. Chaplin took the fertilized eggs to the Jonkershoek Fish Hatchery, where the fry hatched on 2nd December. Juveniles were preserved at various stages, and have been used to check observations on juveniles caught free in the river.

Coloration, up to about 100 mm. in length, silvery, with irregular dark spots or vertical bars, more marked in the younger stages; larger specimens are duller especially on the back, with the centre of each scale pale lemon-yellow, giving the freshly caught fish a distinct yellow tinge; old examples are dull bronzy-green or brassy, becoming paler yellowish and more or less silvery on the belly; all the fins pale rosy or dull orange-salmon, including the caudal, but usually only the anterior part (if at all) of the anal fin; quite small specimens of 30–35 mm. begin to show the pink tinge on the fins, which often becomes intensified in breeding ♂♂.

Dr. Andrew Smith had examples of this fish from the Breede River, but unfortunately he confused them with examples from the Olifants River. The Berg and Breede River White-fish does not correspond with his description of *capensis* (with *longitudinally* striate scales), nor with his type specimen of *capensis* in the British Museum. Consequently a new name had to be instituted (1937).

B. andrewi is found throughout the Berg and Breede river-systems, but has not been recorded from elsewhere (fig. 6). Gilchrist and Thompson recorded a specimen emanating from the Durban Museum, but there is no evidence to show that it was actually caught in Natal.

This is the only species of *Barbus* which is found in two major catchment basins separated by well-defined topographical barriers.

On p. 42 of Report, i (1926), Hey says: "It is stated that 35–40 years ago the Wittevis was unknown in the Breede River or its tributaries. It is suggested that this fish made its way from the Berg River by means of a furrow connecting the Small Berg and the Witte River" [near Wellington]. The first statement is refuted by Andrew Smith recording *Barbus* "*capensis*" (the fact that he confused two species under the same name has no significance in this connection) from the Breede River; secondly, only one furrow is known and it *leads off from the Witte River* (a tributary of the Breede River) and has such a precipitous fall *down to the Krom River* (tributary of the Berg River) that any migration *up*-stream from the latter to the former is out of the question.*

* This furrow was completed in 1860, and constitutes a "counter act of piracy through human agency," because the Witte River at one time flowed into the

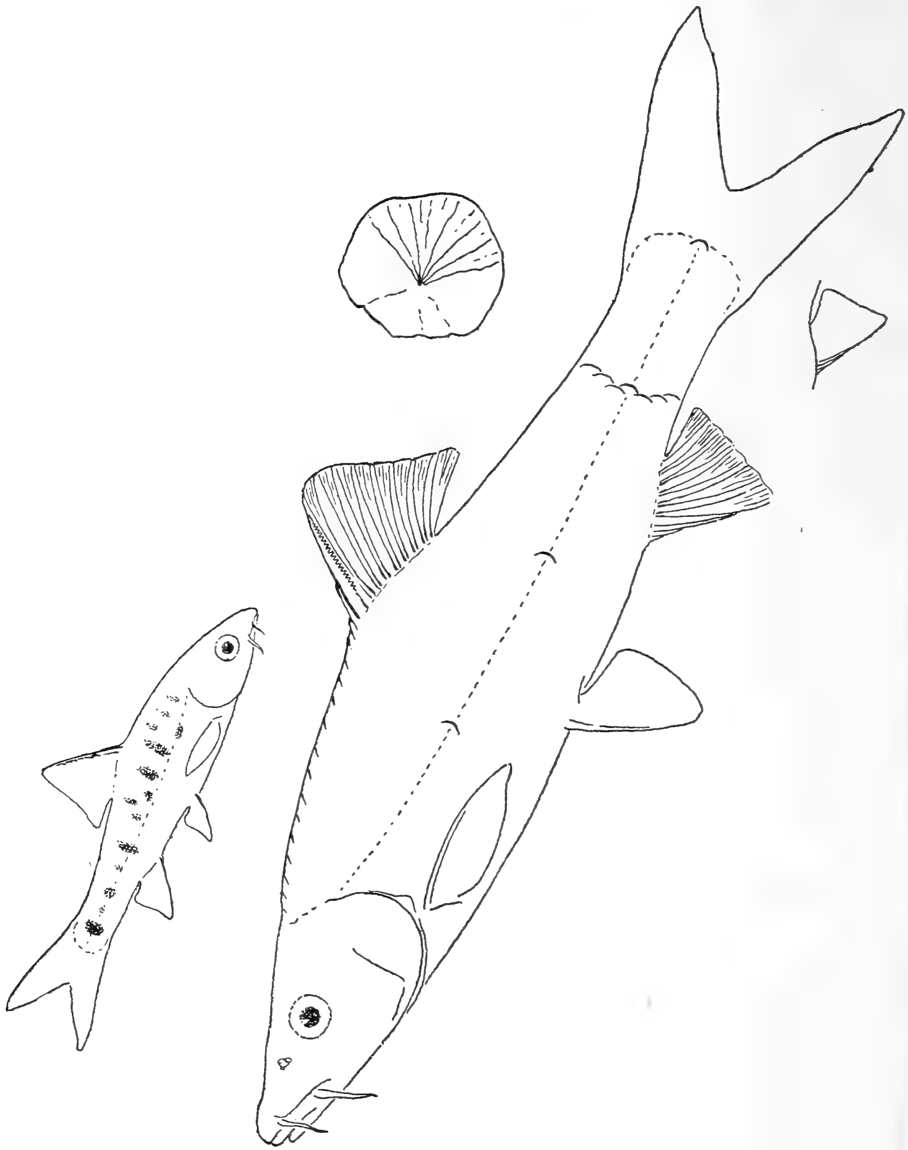


Fig. 16.—*Barbus andrewi.* Young, showing markings, and half-grown (nat. size); in the latter the predorsal scales and every 10th scale in lateral line are indicated; scale enlarged; anal fin of an intermediate sized example showing change in shape between young and adult.

It is possible that the early colonists transported the white-fish from the Berg into the Breede River, but the suggestion does not seem altogether plausible and is not based on any historical record.

At the present day the lowest and least accentuated watershed between the Berg and Breede systems lies between the sources of the Little Berg River and the main Breede River in the Tulbagh–Wolseley area (fig. 1, ×). Heavy flooding might have made intercommunication possible. But, on the other hand, the topographic evidence

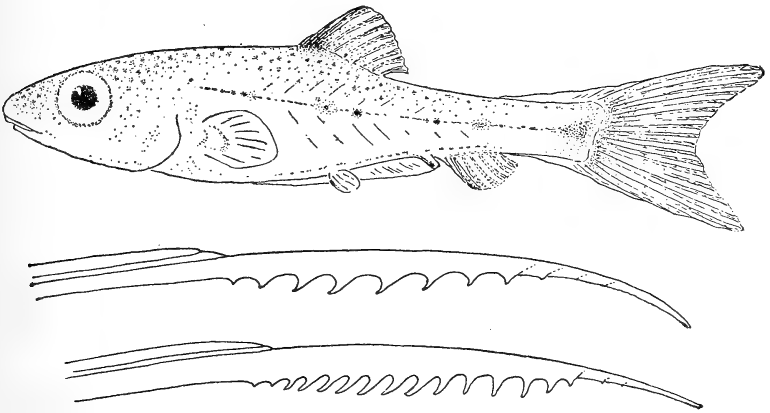


FIG. 17.—*Barbus andrewi.* Juvenile, 14 mm. Berg River. Dorsal spines of specimens 40 mm. and 70 mm. in length (length of spines 8 and 13 mm. respectively). (Only one row of serrations on the spines is shown.)

shows that in former times the Little Berg River captured the true headwaters of the Breede River.

Aberrations.—Two specimens have been examined which agree in nearly all respects with typical specimens; but if submitted to a systematist without any data, or long series of typical specimens for comparison, they would probably be regarded as a distinct, undescribed species.

One of 85 mm. length was caught in the Witte River valley (a tributary of the Breede River). The last dorsal spine is slender, flexible, and non-serrated. There are only 2 + 5 gill-rakers on the anterior arch.

One of 95 mm. length was caught among a shoal of typical *andrewi*

Berg River, but was captured by the energetic tributary of the Breede River cutting up through Bain's Kloof. See River Piracy, The Origin of the Witte River Furrow, by B. L. [Bernard Lewis], Journ. Mountain Club S. Afr., No. 38 for 1935, p. 21, Cape Town, 1936.

in the River Zonder End by Mr. Thorne and myself. It was not distinguishable at the time of capture, or after preservation, by coloration. Like the first specimen, it has the last dorsal spine slender and non-serrate, and the gill-rakers are slightly fewer, 3 + 8 (normal for these sizes: 5 or 6 + 10, see table *infra*).

Barbus andrewi.

TL	L/H	H/E	S/E	I/E	l.l.	c.ped.	striae.	g.r.	barb.	d.sp.s.	Sex and Remarks.
12	$3\frac{3}{4}$	$2\frac{3}{4}$	e > s	e>i	No scales			0 + 4	None	..	Dorsal formed, anal and ventrals forming.
14	$3\frac{1}{2}$	3	,,	,,		,,		..	,,	..	Dorsal and anal formed, ventrals free.
15	$3\frac{1}{3}$	3	,,	,,		,,		..	,,		
18	$3\frac{1}{4}$	3	,,	,,		,,		1 + 6	,,		
21	3	3	,,	,,		,,		1 + 8	,,	None	
23	3	$3\frac{1}{2}$	1	,,		,,		1 + 9	(p)	0–1	
25	3	$3\frac{1}{2}$	1	,,	38	14–16	3	2 + 9	p (a)	2–4	
30	3	$3\frac{1}{2}$	1	1	38	16	3–4	3 + 10	p a	5–7	
35	3	$3\frac{1}{2}$	1	1			,,	,,	..	6–8	
40	3	$3\frac{1}{2}$	$1\frac{1}{5}$	$1\frac{1}{6}$			,,	4 + 10	..	8–10	
45	3	$3\frac{3}{4}$	$1\frac{1}{4}$	$1\frac{1}{5}$			4	5 + 10	..	9–12	
50	3	4	$1\frac{1}{4}$	$1\frac{1}{4}$			4–5	,,	..	10–13	
55	$3\frac{1}{5}$	$4\frac{1}{4}$	$1\frac{1}{3}$	$1\frac{1}{4}$			5	,,	..	12–14	
65	$3\frac{1}{4}$	$4\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{3}$			,,	,,	..	13–16	
75	$3\frac{1}{3}$	$4\frac{1}{2}$	$1\frac{2}{3}$	$1\frac{1}{2}$			5–6	,,	..	14–16	
85	$3\frac{1}{3}$	$4\frac{3}{4}$	$1\frac{3}{4}$	$1\frac{1}{2}$			6	,,			
95	$3\frac{1}{3}$	5	2	$1\frac{1}{2}$			6–7	6 + 10	..	15–18	
105	$3\frac{1}{2}$	5	2	$1\frac{1}{2}$			,,	,,			
115	$3\frac{1}{2}$	$5\frac{1}{3}$	2	$1\frac{1}{2}$			..	,,	..	17–20	
125	$3\frac{1}{2}$	$5\frac{1}{2}$	2	$1\frac{1}{2}$			9–10	,,			
135	$3\frac{1}{2}$	$5\frac{1}{2}$	2	$1\frac{2}{3}$			..	,,			
145	$3\frac{1}{2}$	6	$2\frac{1}{2}$	2	38–40 (41)	16	12	6 + 11	..	19–22	
155	$3\frac{1}{2}$	$6\frac{1}{4}$	$2\frac{1}{2}$	2			..	,,			
170	$3\frac{1}{2}$	$6\frac{1}{2}$	$2\frac{1}{2}$	2			..	,,			
180	$3\frac{1}{2}$	$6\frac{1}{2}$	$2\frac{1}{2}$	$2\frac{1}{3}$			12 +	,,	..	25–26	♂.
195	$3\frac{1}{2}$	$6\frac{3}{4}$	$2\frac{1}{2}$	$2\frac{1}{3}$			..	,,			
225	$3\frac{1}{2}$	$7\frac{1}{2}$	3	$2\frac{1}{2}$			..	,,			
245	$3\frac{1}{2}$	$7\frac{1}{2}$	3	$2\frac{1}{2}$			..	,,			
295	$3\frac{1}{2}$	8	$3\frac{1}{2}$	$2\frac{4}{5}$			..	,,			
305	$3\frac{1}{2}$	$8\frac{1}{4}$	$3\frac{1}{2}$	3			12 +	,,	..	ca. 30	♀ ova.
340	$3\frac{1}{2}$	$8\frac{1}{4}$	$3\frac{1}{2}$	3			..	,,	..	..	♂.
350	$3\frac{1}{2}$	$8\frac{1}{4}$–$8\frac{1}{3}$	$3\frac{1}{2}$	3			14 +	,,	..	..	♂♀ Spine often slender and
365	$3\frac{1}{2}$	$8\frac{1}{3}$	$3\frac{1}{2}$	3			..	,,	..	..	♂ serrations feeble.
525	$3\frac{4}{5}$	$10\frac{1}{2}$	$4\frac{1}{2}$	$4\frac{1}{3}$	38	16	14 +	6 + 12	..	..	♀ serrations obsolete.

Barbus burchelli A. Smith

Burchell's Red-fin; Rooivlerk.

Fig. 18, *a.*

1841. A. Smith, Illustr. Zool. S. Afr. Fish., pl. xi, fig. 1.

1897. Weber, *l.c.*, p. 152 (part *anoplus*, the juv. from French Hoek).

1911. Boulenger, *l.c.*, p. 146, fig. 122 (part: nos. 1–3, but not the juv. from Deelfontein).

1911. *Id.*, *ibid.*, p. 147, fig. 124 (*burgi*=♂).

1911. *Id.*, *ibid.*, p. 178, fig. 156 (*afer* from Cape Town, non *afer* Peters).

1913. Gilchrist and Thompson, *l.c.*, p. 417, fig. 75 (part, not the Robertson specimens).

1913. *Id.*, *ibid.*, p. 419, fig. 76 (*burgi*).

1913. *Id.*, *ibid.*, p. 430, fig. 88 (*afer*, after Blgr., non Peters).

1938. Barnard, *l.c.*, p. 82.

[Not *burchelli* Weber, *l.c.*, p. 153. Oudtshoorn and Laingsburg= *asper*.

Probably not *burchelli* Fowler, Proc. Ac. Nat. Sci. Philad., lxxxvi, 1934, p. 429. Natal.

Probably not *burgi* Pellegrin, Arquiv. Mus. Bocage. Lisbon, vii, 1936, p. 55. Angola.

Probably not *burchelli* J. L. B. Smith, *l.c.*, 1937, p. 127, pl. 30, fig. 2.]

A smallish species, growing to a length of 117 mm., and very closely allied to *vulneratus*. Its most remarkable feature is the belated appearance of the anterior pair of barbels.

There are actually 4 dorsal spines, but the true 1st is very small and can only be seen moderately easily in juveniles; in adults it becomes obscured, and for practical purposes the species is reckoned as having only 3 dorsal spines, the last being thin and flexible, without serrations.

The spine of the ventral fin arises at the vertical from the 2nd (*i.e.* penultimate) dorsal spine. The ventral fins become free at a slightly earlier stage than in *vulneratus*.

The scaling begins at about 17–18 mm. The number of lateral line scales may increase slightly in adults, but the normal number around the caudal peduncle is 12. One or two extra scales may be interpolated at the forward end of the peduncle in large specimens. Predorsal scales 13–15, usually 15. The lateral line tubules are complete except in very rare cases.

The posterior pair of barbels is developed at about the 17–18 mm. stage. The development of the anterior barbels is delayed until a quite unusually late stage in life, viz. 52–53 mm. I have seen two specimens of 62–64 mm. in which the anterior barbels were either absent or mere points, easily overlooked. This explains the identification of young specimens (having only the posterior pair of barbels) as

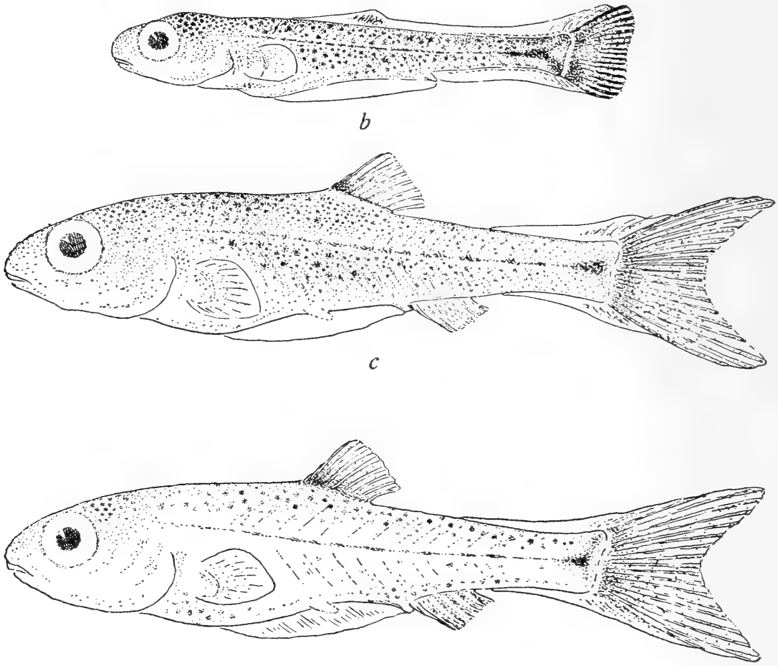


FIG. 18.—*Barbus burchelli:* *a.* Juvenile, 13 mm. Berg River. *Barbus vulneratus:* *b, c.* Juveniles, 11 mm. and 15 mm. Genadendal, River Zonder End.

anoplus by Weber (1897).* The anterior barbel always remains relatively small, scarcely ever equalling the diameter of the eye.

The pectoral fin shows sexual differences. In the young, and throughout life in the ♂, it reaches to, or almost to, the base of the ventral fin (*burgi* Blgr.). In the adult ♀ it is appreciably shorter and does not reach to the ventral fin; the gap between the end of the pectoral and the base of the ventral is at least $\frac{1}{3}$ the length of the pectoral fin.

Breeding ♂♂, about 80 mm. in length (one of 62 mm. examined),

* I have seen these specimens.

develop conical tubercles on the snout and top of head. In preserved specimens these tubercles are easily rubbed off, and possibly they are naturally caducous after the breeding season.

In juveniles about 20–35 mm. there are obscure dark spots on the body, in addition to the line of pigment along the sides; later the lateral stripe usually becomes more distinct, and it may swell out in places forming more or less disconnected spots; there is nearly always a subtriangular spot at the end of the caudal peduncle. The dorsal, caudal, anal, and ventral fins begin to develop the salmon or reddish tinge at about 30–40 mm. in length, and the red patch in the axil of the pectoral fin also begins at the same stage. These red patches develop before sexual maturity, and in both sexes; they are retained throughout the year, but may become more brilliant during the breeding periods.

As regards synonymy there is the initial difficulty in that we do not know what fish Andrew Smith actually described, as he did not give a definite locality, and his type is not extant. It may have been either *burchelli* (as we now know it) or *vulneratus* of Castelnau. Smith's description says "base [of dorsal fin] anteriorly directly over base of pectoral [*sic*, =ventral] fins"; the figure shows the ventral spine actually in advance of the origin of the dorsal fin. Smith's "*burchelli*" *might* be a *vulneratus*, though the ventral fin is figured as too far forward for this species. To avoid upsetting the nomenclature, Smith's discrepancies may be overlooked; and it will be assumed that his specimens came from a locality where *burchelli* (as now diagnosed) is known to occur.

Reasons for including part of Weber's *anoplus* material (juv.) and Boulenger's *burgi* (♂) have already been given.

At my request Mr. Norman examined the specimen (about 73 mm. in length) collected by H.M.S. *Challenger* "near Cape Town," which Boulenger identified and figured as *afer* Peters. It has *two* pairs of barbels, the anterior one at least $\frac{1}{5}$ the eye-diameter according to Mr. Norman; and Dr. Trewavas later informed me that the specimen agrees with the types of *burgi*.*

I have seen the specimen from Deelfontein, identified by Boulenger as this species; actually it is a specimen of *anoplus*. I have also

* While in Cape Town the staff of the *Challenger* made several excursions, but no details are given (Challenger Rep. Narrative, vol. i, pt. 1, p. 282). Without doubt they visited Stellenbosch and Paarl, where *burchelli* is common; and a specimen of the freshwater crab *Potamonautes perlatus* is recorded from the river at Wellington (Miers, Challenger Rep., xviii, 1886).

seen Weber's Oudtshoorn and Laingsburg specimens and find that they are really *asper*. Pellegrin's record of *burgi* from Angola will, I believe, prove to be another species, and probably not one with red-fins.

The two specimens from Robertson recorded by Gilchrist and Thompson are *vulneratus*.

The record of *Barbus? burchelli* in the Klein River, Stanford (Fish. Mar. Biol. Surv., Investigat. Rep., 7, p. 94, 1936) was based on casual observation of specimens in the water. Specimens netted on a later occasion proved to be juvenile *Mugil* and *Gilchristella*.

Barbus burchelli.

TL	L/H	H/E	S/E	I/E	l.l.	c.ped.	striae.	g.r.	barb.	Sex and Remarks.
9	4	$2\frac{1}{2}$	e > s	e > i	No scales					
10	$3\frac{3}{4}$	$2\frac{3}{4}$	,,	,,		,,		..	..	Dorsal and anal forming.
11	$3\frac{1}{2}$	3	,,	1		,,		2 + 5	None	Dorsal and anal rays distinct. Ventrals forming.
13	$3\frac{1}{2}$	3	,,	1		,,		..	..	Ventrals free.
15	$3\frac{1}{2}$	3	,,	1		,,				
18	$3\frac{1}{2}$	3	,,	1	28	12	..	..	(p)	
20	$3\frac{1}{2}$	3	,,	1	28	12	3	2 + 5	(p)	
25	$3\frac{1}{2}$	3	,,	$1\frac{1}{5}$	29	12	..	,,	p	
30	$3\frac{1}{2}$	3	,,	$1\frac{1}{5}$	28	12	4	,,	p	Red patches begin.
35	$3\frac{2}{3}$	$3\frac{1}{5}$	,,	$1\frac{1}{5}$	29	12	..	,,	p	
40	$3\frac{3}{4}$	$3\frac{1}{3}$	,,	$1\frac{1}{4}$	29	12	4–5	3 + 5	p	
45	$3\frac{3}{4}$	$3\frac{1}{2}$	1	$1\frac{1}{3}$	29–30	12	..	,,	p	
50	$3\frac{4}{5}$	$3\frac{1}{2}$	1	$1\frac{1}{3}$		12	5	,,	p	
55	$3\frac{4}{5}$	$3\frac{1}{2}$	1	$1\frac{1}{2}$	30–33	12	6–7	,,	p (a)	
60	$3\frac{4}{5}$	$3\frac{1}{2}$	1	$1\frac{1}{2}$		12	7–8	,,	p a	♂ with warts, ♀ ova.
70	$3\frac{3}{4}$	4	$1\frac{1}{4}$	$1\frac{1}{2}$		12	8	3 + 5–6	p a	
75	$3\frac{4}{5}$	$4\frac{1}{3}$	$1\frac{1}{3}$	$1\frac{1}{2}$	32–35	12	..	,,		
80	$3\frac{3}{4}$	$4\frac{3}{4}$	$1\frac{1}{2}$	$1\frac{2}{3}$		12	10	4 + 6		
85	$3\frac{3}{4}$	5	$1\frac{1}{2}$	$1\frac{2}{3}$		12				
90	$3\frac{3}{4}$	5	$1\frac{1}{2}$	$1\frac{2}{3}$		12	12	4 + 6		
95	$3\frac{4}{5}$	5	$1\frac{2}{3}$	2	34–36	12				
100	$3\frac{4}{5}$	$5\frac{1}{4}$	$1\frac{2}{3}$	2		12	14			
117	$3\frac{3}{4}$	$5\frac{1}{2}$	2	$2\frac{1}{4}$		12	16	4 + 6	..	♀ ova.

Barbus vulneratus (Cast.)

Castelnau's Red-fin; Rooivlerk.

Fig. 18, *b*, *c*.

1861. Castelnau, Mem. Poiss. Afr. Austr., p. 57 (*Gnathendalia vulnerata*).

1870. Steindachner, Sb. Ak. Wiss. Wien, lxi, p. 633, pl. 3, fig. 2 (*B. multimaculatus*).

1911. Boulenger, *l.c.*, p. 148, fig. 125 (part: the specimens from Zonder Eende River).

1913. Gilchrist and Thompson, *l.c.*, p. 416, fig. 73 (but not any of the recorded specimens).

1913. *Id.*, *ibid.*, p. 418 (*burchelli*, part: the 2 specimens from Robertson).

1937. J. L. B. Smith, *l.c.*, p. 127, pl. 31, fig. 2.

1938. Barnard, *l.c.*, p. 83.

[Probably not Fowler, Proc. Ac. Nat. Sci. Philad., lxxxvi, 1934, p. 428; and *ibid.*, lxxxvii, 1935, p. 371. Natal.]

Castelnau placed this smallish species in a new genus named after the Moravian Mission, Genadendal. His description was inadequate for purposes of distinguishing the species from *burchelli.* Boulenger incorporated Steindachner's species, and separated *vulneratus* from *burchelli* by the slightly more forward origin of the ventral fins.

On a recent visit to the type locality a complete series of all stages was collected, which shows that the species is valid, although some individuals are sometimes difficult to distinguish from *burchelli.*

In specimens of *vulneratus* over 55 mm. in length: the ventral fins arise at the vertical from the 1st (apparent) dorsal spine or slightly in advance thereof; the interpolation of 2 more rows of scales (dorsally) on the caudal peduncle, making 14 in all (there are occasionally even 16), continues at least to the middle section, often along the whole, of the caudal peduncle; so that the scale count is normally 14 in contrast to the normal 12 in *burchelli*; the anterior pair of barbels is always better developed than in *burchelli*; there is also sometimes a tendency to the suppression of the tubule on some of the lateral line scales on the caudal peduncle. Predorsal scales 17–18.

The real validity of the species, however, is shown by the early development of the anterior pair of barbels, at the 21-mm. stage, as opposed to the delayed appearance of them (52–53 mm.) in *burchelli.*

As in *burchelli*, there are actually 4 dorsal spines, but the true 1st spine is very small and becomes obscured in half-grown and adult examples.

The scaling begins at 20–21 mm. At first there are only 12 scales around the caudal peduncle, but at about 30–35 mm. an additional row appears on either side dorsally, and from about 40 mm. upwards the normal number is 14.

The posterior pair of barbels appears at about 19 mm., and the anterior pair very soon afterwards at about 21 mm. The anterior barbel becomes well developed, and in adults is usually as long as the eye-diameter.

The pectoral fin shows the same sexual difference as in *burchelli.* Large warts on head in ♂, as in *burchelli.*

Judging by the Genadendal series, *vulneratus* arrives at sexual maturity at a smaller size than does *burchelli*: ♂♂ with conical tubercles on the head at 50–55 mm., and ♀♀ with ripe ova at 55–60 mm. Castelnau said the species grew to a length of 120 mm., but the largest caught on the recent visit were 90 mm. in length.

The coloration is the same as in *burchelli,* but the spots in the young and half-grown, and even the adults, appear to be more conspicuous. The red colour on the fins and in axil of pectoral is very brilliant.

Details at different stages are as follows: up to 15 mm. heavily and more or less uniformly pigmented, dorsal fin pigmented along its base and in the angle of the 3rd spine; at 18–20 mm. body paler and becoming silvery on opercles and belly, pigment aggregated more or less into ill-defined spots along the side, with a more definite spot at end of caudal peduncle, angle at base of 3rd dorsal spine and the spine itself dark; at 30 mm. spots along sides and on back, spot on caudal peduncle distinct, base of dorsal fin dark, a faint tinge of salmon at base of dorsal and caudal fins; at 45 mm. brownish, more or less silvery on belly, the dark spots subcircular, or vertically or horizontally oval, more or less united into a longitudinal stripe, spot on caudal peduncle subtriangular and always distinct, all fins (except pectoral) and the spot in axil of pectoral more or less reddish; from 55 mm. upwards the red patches get their full blood-red colour, the pectoral fin remains greyish, with only a faint pink tinge in its basal half in some large specimens.

The status of Steindachner's *multimaculatus* is doubtful, and is likely to remain so unless the precise locality of his specimens were discoverable and a series obtained from that locality.

Boulenger assigned to *vulneratus* some specimens from "Zonder Eende River (tributary of Forcade River) near Ondtsloon" [*sic*].* Boulenger repeatedly misspells Oudtshoorn, but I am unable to trace on any map, or by local enquiries, a "Forcade" River in that neigh-

* In a letter (9.xii.09) to Gilchrist he asked for the exact position of "Porcade (?) R." and "Ondtsloon." Apparently Gilchrist never enlightened him. Gilchrist's handwritten labels could be easily misread by anyone not knowing the localities.

bourhood; in any case the Zonder End River, though correct for Castelnau's type locality, is nowhere near Oudtshoorn.

Baakens River, near Port Elizabeth, is another locality recorded by Boulenger which must be deleted, because the 3 specimens, which were recorded by Gilchrist and Thompson from this locality and which bear the identification label "*vulneratus*" in Boulenger's handwriting, have only a single pair of barbels and are referable to *senticeps* (*v. infra*).

Of Gilchrist and Thompson's other material, the Yokeskei River specimens are probably *motebensis*; the smaller of the two specimens from Zwartkops River is *pallidus* and the larger one *senticeps*!

Even if Gilchrist and Thompson's material had not been available, the Baakens and Zwartkops localities would have been open to doubt, as the species is absent from the intervening Gouritz River system. And on a recent collecting trip to the Zwartkops River no specimens of *vulneratus* were obtained.

Besides the Genadendal series, other specimens are at hand from the headwaters of the River Zonder End on the east side of French Hoek Pass (near Villiersdorp) (K. H. B. and C. W. T., Oct. 1936); Slanghoek and Witte rivers (tributaries of the Breede River); Michell's Pass River (H. G. Wood, 1938); Hex River at Sandhills, near

Barbus vulneratus.

TL	L/H	H/E	S/E	I/E	l.l.	c.ped.	striae.	g.r.	barb.	Sex and Remarks.
10–11	4	$2\frac{1}{2}$	e > s	e > i	N	o scale	s	..	None	
12–13	$3\frac{4}{5}$	$2\frac{3}{4}$	,,	,,		,,		..	,,	Dorsal forming.
14	$3\frac{3}{4}$	3	,,	,,		,,		..	,,	Anal forming.
15	$3\frac{1}{2}$	3	,,	1		,,		0 + 4	,,	Dorsal and anal rays distinct; ventral fins just free.
17–18	$3\frac{1}{3}$	3	1	1		,,		0 + 5–6	,,	
20	$3\frac{1}{4}$	3	1	1	Not	distin	ct	1 + 5	(p)	
22–23	$3\frac{1}{3}$	3	1	1	34	12	3	2 + 5	p (a)	
25	$3\frac{1}{3}$–$3\frac{1}{2}$	3	1	1	34	12	..	..	p a	
30	$3\frac{1}{2}$	3	1	1	33	12–14	4	2 + 6	p a	
35	$3\frac{2}{3}$	3–$3\frac{1}{5}$	1	$1\frac{1}{6}$	33	12–14	..	..	..	Red patches begin.
40	$3\frac{2}{3}$	$3\frac{1}{4}$	1	$1\frac{1}{5}$	33	14	5–6			
45	$3\frac{2}{3}$	$3\frac{1}{3}$	1	$1\frac{1}{4}$	34	14				
50	$3\frac{2}{3}$	$3\frac{1}{2}$	1	$1\frac{1}{3}$	34	14	8	2 + 6	..	♂ with warts.
55	$3\frac{1}{2}$–$3\frac{2}{3}$	4	$1\frac{1}{3}$	$1\frac{1}{2}$	34–36	14	..	..	..	♂ with warts. ♀ ova.
60	$3\frac{1}{2}$	$4\frac{1}{4}$	$1\frac{1}{2}$	$1\frac{1}{2}$	35	14	..	2 + 6	..	♂♀.
70	$3\frac{1}{2}$–$3\frac{2}{3}$	$4\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$	35	14	..	..	..	♂♀.
80	$3\frac{1}{2}$–$3\frac{2}{3}$	$4\frac{3}{4}$	$1\frac{1}{2}$	$1\frac{2}{3}$	34	14	10	3 + 6–7	..	♂♀.
90	$3\frac{2}{3}$	5	2	2	36	14	..	..	..	♂♀.

Worcester (A. C. Harrison); Cogman's Kloof River at Montagu (tributary of the Breede River) (H. G. Wood, 1938); Buffelsjagt River (tributary of the Breede River); the Robertson (Breede River) specimens recorded by Gilchrist and Thompson; long series from the Nieuwejaar, Grashoek, and Kars rivers in the Elim-Bredasdorp area (K. H. B. and C. W. T., 1937); Duivenhoks River, Heidelberg (Cape) and Vette and Kaffirkuils rivers, Riversdale (A. C. H., K. H. B., and C. W. T., 1938) (figs. 1 and 6).

The occurrences in the Nieuwejaar, Grashoek, Kars, Duivenhoks, and Kaffirkuils rivers are interesting as indicating the former connection of these, now independent, rivers with the extended Breede River across the Agulhas Bank (fig. 1, area 7, 7*a*, 7*b*).

Barbus pallidus A. Smith

Goldie.

1841. A. Smith, Illustr. Zool. S. Afr. Fish., pl. xi, fig. 2.

1911. Boulenger, *l.c.*, p. 149 (species *dubia*).

1911. *Id.*, *ibid.*, p. 150, fig. 126 (*hemipleurogramma*).

1913. Gilchrist and Thompson, *l.c.*, p. 426, fig. 85 (*hemipleurogramma* (part: the specimens from Baakens River, not the Transvaal specimens).

1913. *Id.*, *ibid.*, p. 416 (*vulneratus* non Cast., part: the smaller specimen from Zwartkops River).

1916. Boulenger, *l.c.*, p. 272 (*anoplus* non Weber).

1937. J. L. B. Smith, *l.c.*, p. 127, pl. 29, fig. 4 (*hemipleurogramma*).

1938. Barnard, *l.c.*, p. 83.

Sir Andrew Smith not only travelled widely in the Cape, but set out on one of his most important expeditions from Port Elizabeth (see *supra*, p. 116). It is reasonable to assume that he obtained samples of the fishes from the rivers in that neighbourhood, where to-day the species described by Boulenger as *hemipleurogramma* is common.

Smith's figure shows the following essential features: 2 barbels on each side, l.l. scales 31 or 32, caudal peduncle 12, pre-dorsal 12 or 13, l.tr. $\frac{4\frac{1}{2}}{4\frac{1}{2}}$, and 3 between l.l. and ventral. If allowance be made for the artist's propensity for indicating too many scales (see *supra*, p. 115)—and the fewer the scales the less likelihood of exceeding the correct number—all these features are characteristic of *hemipleurogramma*. Yet Boulenger in a note on *pallidus* on the page preceding the description of his *n. sp.* failed to recognize the resemblance, or was too cautious to resuscitate *pallidus* in the absence of Smith's type specimen.

There cannot be, I think, the slightest doubt that Smith and Boulenger refer to one and the same species. It is the only species in the western Cape Province with 2 pairs of barbels and non-serrate dorsal spine, combined with so few and such large, radiately striate, scales. Smith himself remarked on the large size of the scales.

The coloration of the living fish, well described by Smith, fades on preservation to that given by Boulenger. A somewhat more detailed note of the coloration was taken (K. H. B.) at the time of capture of specimens in the Zwartkops and other rivers: silvery, brownish above, more or less golden, especially in adult ♂♂, more greyish in ♀♀; a line of black spots along sides; one at base of caudal and one at base of anal fin present in the youngest stages upwards; when the brilliant golden colour in ♂ is fully developed the lateral spots are not apparent; a golden tinge on opercle behind eye; fins pale; caudal more or less yellowish, and in golden specimens (♂♂, and often also in ♀♀) the middle caudal rays are deep orange or even reddish.

Although Smith described the lateral line as extending to the base of the caudal fin, this is not necessarily an objection to the suggested synonymy. The incompleteness of the lateral line, regarded as one of the specific characters of *hemipleurogramma*, is not at all constant. Though not frequent, there are specimens in which the lateral line is complete at least on one side; and there are many in which the line is interrupted at two or more places; that is, the line ceases at the anterior third or half of the body and is indicated by two or more single tubules, or groups of tubules, and ending with one or two tubules at the base of the tail. Incompleteness of the lateral line is, however, the normal condition; but where a tendency to suppression of the tubules occurs, the utmost inconstancy and variability may be expected (*cf.* also *vulneratus* and *asper*).*

This species has a very neat appearance due to the regularity of the large scales; this regularity is particularly noticeable along the dorsal profile, where there are normally 10 (10–11) predorsal scales, in contrast with the frequently irregular arrangement in species having a larger number of predorsal scales.

It is a small species attaining sexual maturity at about 38–40 mm. The largest specimens examined are females.

There are no red patches at the bases of the fins, and no warts

* *Cf.* Hora, Misra and Malik, 1939, Rec. Ind. Mus., xli, pp. 268, 269.

on the head in the ♂. The pectoral fin in juveniles and ♂♂ reaches to or almost to the base of the ventral fin spine, but in ♀♀ is separated by a gap about half the length of the pectoral fin.

At 15 mm. the posterior barbel is just beginning, and the anterior one appears at about 17–18 mm. Scaling begins at 15 mm.

The young, once they have attained their scales, are thereby distinguished from the young of *senticeps*, with which species they are often associated, as well as by the black spot at base of anal and caudal fins. But the very young stages I have not yet been able to discriminate with certainty. Breeding in aquaria would settle this point.

In the anal fin only 2 spines are observable in the adult, but in the young 3, sometimes 4 or even 5, can be counted.

In addition to Gilchrist and Thompson's material (Baakens and Zwartkops rivers) I have collected and examined series from the Zwartkops River at Uitenhage (Groendal valley); Van Staden's River; Baviaans Kloof, and smaller tributaries of the Gamtoos River at Loerie and Patentie; Zeekoe River near Humansdorp; Kromme River at Assegai Bush. Also I have seen a single specimen from Howieson's Poort, Grahamstown (Kariega River), which appears to be conspecific; I should prefer to see living and fresh material before finally accepting this locality (figs. 6 and 7).

Boulenger's 1916 specimens of "*anoplus*" are referred to the present species on the authority of Dr. Trewavas.

Not having seen any fresh material, I express no opinion on the specimens from the Transvaal recorded by Gilchrist and Thompson.

Abnormalities.—The following abnormalities have been noticed and should be borne in mind in discussing the possibility of "n. spp." having been based on such casual variants. Approximately 6·2 per cent. of the specimens have 8 dorsal rays instead of the normal number of 7.

Out of 19 specimens from Baakens River, one juv. with 8 branched dorsal rays.

Out of 7 specimens from Zwartkops River, Uitenhage (C. L. Biden, 1935), one ♀ with 8 dorsal rays, one ♂ with 6 dorsal rays and in addition l.l. 32 (right), 31 (left), caudal peduncle 12, predorsal 13, and *only the posterior pair of barbels.* This latter specimen, on paper, might have been thought to be a *senticeps*, but the specimen was seen by me in a fresh state, had no red-fins, and was obviously *pallidus*. Out of 150 specimens from same locality (K. H. B. and C. W. T., 1938), 3 (1 ♂, 2 ♀♀) with 8 dorsal rays; 2 ♀♀ with 6 dorsal rays. Out of 4 specimens from Van Staden's River, one ♀ with 8 dorsal rays. Out of 7 specimens from Zeekoe River, Humansdorp, 2 ♀♀ with 8 dorsal rays. Out of 25 specimens from Loerie, 4 ♂♂ with 8 dorsal rays, 1 juv. with 9 dorsal rays, one ♀ with 7 rays, the 4th and 5th intertwined. Out of 6 specimens from Assegai Bush, 1 juv. with 5 dorsal rays. Out of 135 specimens from Baviaans Kloof, 2 ♂♂, 4 ♀♀, 3 juv. with 8 dorsal rays, 1 ♀ with 6 anal rays, 1 ♀ with 8 dorsal and 6 anal rays, 1 ♀ with 7 dorsal rays, the 4th and 5th intertwined.

There is a distinct resemblance (accepting current diagnoses) between specimens with 8 dorsal rays and *B. lineomaculatus*, and even more so with *B. viviparus*, in view of the black spot at base of anal fin.

Parasites.—When slitting the bellies of specimens in the field it was noticed that some specimens contained large globular bodies which appeared as if they might be large ova indicating viviparity. The case of *B. viviparus* recurred to mind, especially as the specimens were superficially very like *viviparus*.

Closer examination, however, at once showed that these bodies were parasitic Trematodes. They were encysted in the gonads, and

Barbus pallidus.

	TL	L/H	H/E	S/E	I/E	l.l.	c.ped.	striae.	g.r.	barb.	Sex and Remarks.
	15	$3\frac{1}{4}$	3	e > s	1	26	12	4	1 + 4	(p)	Fin rays distinct. Black spot at base of anal and caudal.
	18	$3\frac{1}{4}$	3	,,	1	27	12	..	2 + 4	p (a)	
	20	$3\frac{1}{3}$	3	,,	1	28	12	4–5	..	p a	
Baakens R., P. Eliz.	25	$3\frac{1}{2}$	3	,,	1	27	12				
	30	$3\frac{3}{4}$	3	,,	1	28	12	5–6			
	35	$3\frac{3}{4}$	$3\frac{1}{4}$	,, or =	$1\frac{1}{4}$	27–29	12				
	40	$3\frac{3}{4}$	$3\frac{1}{3}$	1	$1\frac{1}{4}$			,,	,,	..	♀ ovig.
	42	$3\frac{3}{4}$	$3\frac{1}{3}$	1	$1\frac{1}{3}$						
Zwartkops R., Uitenhage.	45	$3\frac{4}{5}$	$3\frac{1}{2}$	1	$1\frac{1}{3}$	27–30	12	6	2 + 4–5		
	50	4	$3\frac{1}{2}$	1	$1\frac{1}{2}$			..	..	..	♂ ovig. ♀.
	52	4	$3\frac{1}{2}$	1	$1\frac{1}{2}$			6–7	..	..	♂.
	55	4	$3\frac{1}{2}$	1	$1\frac{1}{2}$			..	..	..	♀ ovig.
	57	4	$3\frac{2}{3}$	1	$1\frac{1}{2}$			7–8	..	..	♀ ovig.
Zwartkops	60	4	$3\frac{3}{4}$	1	$1\frac{1}{2}$	28	12	8	2 + 4–5	..	♀ ovig.*
Howieson's Poort	47	4	$3\frac{2}{3}$	1	$1\frac{1}{2}$	29	12	6	2 + 4	..	♀ ova.

* Gilchrist and Thompson's 52-mm. (measured to end of scaling) specimen recorded by them as "vulneratus."

occurred in both sexes, but more frequently in ♀♀ than ♂♂. In some cases nearly the whole space normally occupied by the ova was filled with 4–6 of the parasites, leaving scarcely any space for the ova. When removed from the cyst, the flukes were oval-shaped, narrowing in front, 7–8 mm. in length and 5 mm. in width.

Dr. Baylis of the British Museum very kindly identified these Trematodes as the metacercariae of *Euclinostomum* sp., probably *E. heterostomum* (Rud., 1809), the adult of which is a parasite of herons.

Barbus asper Blgr.

Plump Red-fin, Rooivlerk.

Fig. 19, *a*.

1897. Weber, *l.c.*, p. 153 (*burchellii* non A. Smith, from Buffles River, Laingsburg, and Kammenassie River, Oudtshoorn).

1911. Boulenger, *l.c.*, p. 176, fig. 154.

1911. *Id.*, *ibid.*, p. 177 (*anoplus* non Weber, part: nos. 1–10, Grobelaars River, Oudtshoorn).

1913. Gilchrist and Thompson, *l.c.*, p. 427, fig. 86, and p. 579.

1913. *Id.*, *ibid.*, p. 428 (*anoplus* non Weber, part: only the 12 specimens from Grobelaars River, Oudtshoorn).

1917. Boulenger, C.R. Ac. Sci. Paris, clxiv, p. 299 ("*spinosus*," laps. cal.).

1938. Barnard, *l.c.*, p. 84.

[Probably not *asper* Borodin, Zool. Jahrb. Abt. Syst., lxviii, 1936, p. 6. Lake Tanganyika! *]

The editorial statement on p. 579 of Gilchrist and Thompson's monograph is true in so far as the said specimens are adults of the species which was at that time thought to be *anoplus*, but which is in fact *asper*; the suggestion that *asper* was a synonym of *anoplus* has been shown to be wrong.

This species has no anterior barbels at any stage of growth. The posterior barbels develop at about 28 mm. Juveniles from this size up to 50 mm. are distinguished from *burchelli*, which at this size has only the posterior barbels, by the larger number of predorsal and caudal peduncle scales. Scaling begins at about 23 mm.

The red patches at the bases of the fins begin to show at about 30 mm. in both sexes. Warts on the head in males. The pectoral

* Myers (1936, Proc. U.S. Nat. Mus., lxxxiv, p. 11, footnote) declines to accept this author's identifications. As regards "asper," I most emphatically agree with Dr. Myers.

fin reaches to or almost to the base of the ventral fin in juveniles and males, but is relatively shorter in females.

Spawning takes place between September and February. Sexual maturity is reached at about 60 mm.; and the greatest length hitherto recorded is 110 mm., but recently one of 118 mm. was caught in the Kabeljouw River (see *infra*).

Originally described from the Groote River * (Gamtoos system) at Steytlerville, and Le Roux River near Oudtshoorn (Gouritz system). I have collected long series in both of the type localities; and have obtained specimens from the following localities:—

(*a*) Gouritz system—Buffels River, Laingsburg, and its lower course (Groote River) † near Ladismith; Gamka Poort and Meiring's Poort in the Zwartberg Range; Rossel River, near Klaarstroom; Le Roux River at Schoemann's Poort, near Oudtshoorn; Doorn River, north of Montagu Pass (tributary of the Kamanassie-Olifants); Touws River between Ladismith and Montagu (village) ‡; Langtouw River, near Herbertsdale; Weiders and Valsch rivers in the Albertinia district. Also at Haalkraal on upper reaches of the Little Brak River, an independent river entering the sea in Mossel Bay.

(*b*) Gamtoos system—Baviaans Kloof River; Couga River at Haarlem; tributary of the Gamtoos River at Patentie. Also the independent rivers: Kabeljouw, Rondebosch, and Zeekoe in the Humansdorp district.

(*c*) Keurbooms River, near Paardekop, and at Edmonton; a tributary of the Kruis River, near Knysna; the Homteni River (= upper part of the Goukama River); and Ruigte Vlei ‡ (figs. 6 and 7).

Dr. Trewavas of the British Museum has kindly examined the specimens nos. 1–10 from the Grobelaars River, Oudtshoorn, which Boulenger recorded as "*anoplus*" and finds that the scales around the caudal peduncle number 16 to (in the largest specimens) 20. I have seen samples of the scales from these specimens, and they agree with my own material, and also a scale from the type specimen of *asper* from Steytlerville. Dr. Trewavas also finds that the specimens nos. 17, 19, and 20 have respectively 14 or 15, 14, and 16 scales around the caudal peduncle. These might also be *asper*, and if they are, the Port Elizabeth area must be included in the distribution of the species. I prefer, however, to withhold my opinion on this for

* See *supra*, p. 119, on duplication of place-names.

† See p. 119, duplication of place names.

‡ Opposite Post Office, Ruigte Vlei. The railway siding of the same name is opposite Groen Vlei.

the present, because in the course of my own collecting in the Zwartkops River, and other neighbouring rivers, no specimens of *asper* were obtained. I have not, however, examined as yet the Baakens River at Port Elizabeth.

I have seen Max Weber's specimens from the Buffels and Kamanassie rivers, which he called "burchellii." It seems that Weber overlooked the absence of the anterior barbels, or else laid more stress on the presence of the red-fins corresponding with Andrew Smith's

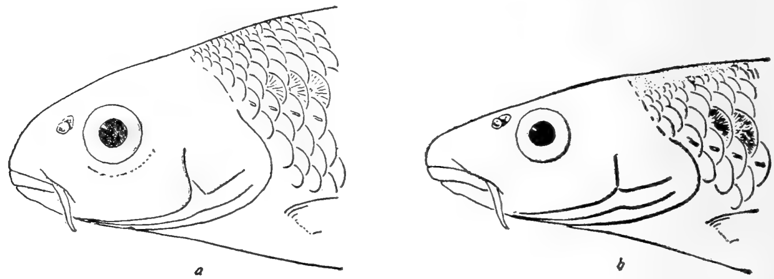


FIG. 19.—*Barbus asper:* *a*. Head of ♀ (semidiagrammatic). *Barbus tenuis:* *b*. Head (semidiagrammatic; dotted portion represents bare post-occipital area). De Rust, near Oudtshoorn.

coloured figure. His statement that the pectorals do not reach the origin of the ventral fin is true of the ♀, but apparently he did not examine the ♂♂ in his collection.

For comparison with the next two species (*senticeps* and *tenuis*) the chief diagnostic features may be given: mature ♂♂ with warts on head; mouth terminal; depth of body subequal to or greater than length of head; scales with few (8–12) striae, l.l. 36–42, l.tr. 7–8 between dorsal spine and l.l., 5–6 between latter and ventral spine (the lateral line tubuliferous scale not counted); 16–18 or 20 around caudal peduncle, 19–25 predorsal, commencing immediately behind occiput, without any bare patch; base of ventral below anterior dorsal rays; the l.l. series of tubules may be complete, but more often (75 per cent.) is incomplete or irregularly interrupted.

Silvery, greyish or brownish above, innumerable tiny dark dots tending to form a dark spot in centre of each scale, giving a speckled appearance; bright red patches at bases of dorsal, anal, and ventral, and in axil of pectoral fins. After preservation a more or less (usually less) conspicuous dark lateral stripe.

The above diagnosis, in regard to the number of predorsal and caudal peduncle scales, applies to what may be called the typical form, found at Steytlerville and throughout the Gouritz River system.

Barbus asper.

	TL	L/H	H/E	S/E	I/E	l.l.	c.ped.	striae.	g.r.	barb.	Sex and Remarks.
Gouritz River system.	7–8	$4\frac{1}{2}$	$2\frac{1}{2}$	e > s	e > i	N	o scale	s	..	None	
	10	4	$2\frac{3}{4}$	,,	,,		,,		..	,,	Dorsal and anal fins beginning.
	12–13	4	3	,,	,,		,,		..	,,	Dorsal and anal rays distinct.
	14	4	3	,,	,,		,,		..	,,	Ventral fins showing.
	15	4	3	,,	,,		,,		..	,,	Ventral fins free.
	17	4	3	,,	,,		,,		..	,,	
	20	$3\frac{3}{4}$	3	,,	1		,,		..	,,	
	25	$3\frac{1}{2}$	$3\frac{1}{4}$	,,	1	30–32	14	4	1 + 4	,,	
	30	$3\frac{1}{2}$	$3\frac{1}{3}$	,,	$1\frac{1}{4}$	34	14–16	4–5	2 + 5	(p)	Red patches begin.
	35	$3\frac{1}{2}$	$3\frac{1}{2}$	1	$1\frac{1}{2}$	34–38	16	6	..	p	
	40	$3\frac{1}{2}$	$3\frac{1}{2}$	1	$1\frac{1}{2}$		16–18	..	3 + 6		
	45	$3\frac{2}{3}$	$3\frac{3}{4}$	1	$1\frac{1}{2}$			8			
	50	$3\frac{3}{4}$	4	$1\frac{1}{5}$	$1\frac{1}{2}$			..	3 + 7–8		
	55	$3\frac{4}{5}$–4	4	$1\frac{1}{4}$	$1\frac{1}{2}$			10			
	60	4	4–$4\frac{1}{4}$	$1\frac{1}{3}$	$1\frac{2}{3}$			..	..	..	♂ with warts, ♀ ova.
	65	4	$4\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{3}{4}$			..	..	..	♂♀ The L/H figure is often a little less than that here given in the case of ♂♂, *i.e.* the head is relatively slightly larger in ♂♂ than in ♀♀.
	70	4	$4\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{3}{4}$	36–42	18	12	..	..	,,
	75	4	$4\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{4}{5}$		18	..	3–4 + 8	..	,,
	80	4	$4\frac{3}{4}$	$1\frac{2}{3}$	$1\frac{4}{5}$		18	..	..	..	,,
	85	4	5	$1\frac{3}{4}$	2		18–20	..	4 + 9	..	,,
	90	4	5	$1\frac{3}{4}$	2			..	..	..	,,
	95	$3\frac{4}{5}$	5	$1\frac{2}{3}$–$1\frac{3}{4}$	2			..	..	..	,,
	100	$3\frac{4}{5}$	5	$1\frac{2}{3}$–$1\frac{3}{4}$	2			12 (–14)	4 + 9–10	..	,,
	105	$3\frac{4}{5}$	5	$1\frac{3}{4}$	2			..	..	..	,,
Kabeljouw R.	118	$3\frac{4}{5}$	$5\frac{1}{4}$	$1\frac{3}{4}$	2	37	16	..	..	..	♀ ovig. Record size.
Ruigte Vlei.	45	$3\frac{3}{4}$	$3\frac{1}{2}$	1	$1\frac{1}{3}$	36–38	16	7–8	2 + 8	p	
	50	$3\frac{3}{4}$	$3\frac{3}{4}$	1	$1\frac{1}{2}$			..	..	..	♂.
	55	$3\frac{3}{4}$	$3\frac{4}{5}$	$1\frac{1}{5}$	$1\frac{1}{2}$			..	..	..	♂.
	60	$3\frac{3}{4}$	$3\frac{4}{5}$	$1\frac{1}{5}$	$1\frac{1}{2}$			..	..	..	♀ ovig.
	65	$3\frac{3}{4}$	$3\frac{4}{5}$	$1\frac{1}{4}$	$1\frac{1}{2}$–$1\frac{2}{3}$			8–9	..	..	♂ with warts.
	70	$3\frac{3}{4}$	4	$1\frac{1}{4}$	$1\frac{3}{4}$			..	..	..	♂ ,, ,,
	75	$3\frac{3}{4}$	$4\frac{1}{5}$	$1\frac{1}{4}$	$1\frac{3}{4}$			..	..	..	♂ ,, ,,
	80	$3\frac{3}{4}$	$4\frac{1}{4}$	$1\frac{1}{3}$	$1\frac{3}{4}$			..	..	..	♀ ovig.
	83	$3\frac{4}{5}$	$4\frac{1}{3}$	$1\frac{1}{3}$	$1\frac{3}{4}$			10–11	..	..	♀ ovig.

In the localities given above under (*b*) and (*c*), certain local varieties occur (see fig. 7). *E.g.* in the Kabeljouw River a large number of adults was obtained, including one of record size (118 mm.). None of these had more than 16 scales around the caudal peduncle, and the number of predorsal scales varied from 17–20. As a result of this latter feature the rather crowded appearance of the scales on the upper part of the shoulder, so characteristic of the typical form, was lacking.

The Ruigte Vlei series agrees with those from the Kabeljouw River and other localities as regards the predorsal and caudal peduncle scaling. But when alive they had a beautiful warm brown or golden-brown appearance, in marked contrast to the usual silvery-grey colour of the typical form. This colour was noticeable, but to a lesser degree, in the Homteni River specimens. In both these localities the water is of rather high acidity (pH 4–4·5), whereas the more silvery-grey forms come from water which is alkaline (pH 8–9). The acid waters are brown in colour; and the alkaline ones are frequently opaque with a considerable amount of mud in suspension. Compare a similar correlation between the colour of the fish and the clarity or opacity of the water in *Sandelia* (p. 248).

Barbus senticeps J. L. B. Smith

Uitenhage Red-fin, Rooivlerk.

1911. Boulenger, *l.c.*, p. 177, fig. 155 (*anoplus*, part, non Weber: no. 18, Port Elizabeth, the specimen figured, assuming figure is natural size).

1913. Gilchrist and Thompson, *l.c.*, p. 416 (*vulneratus* part, non Cast.: 3 specimens from Baakens River, and the larger of the 2 from Zwartkops River).

1913. *Id.*, *ibid.*, fig. 87, after Boulenger (*anoplus* non Weber. Not the description, nor the recorded specimens).

1936. J. L. B. Smith, Trans. Roy. Soc. S. Afr., xxiv, p. 54, fig. 3.

1937. *Id.*, *l.c.*, p. 124, fig. 2.

1938. Barnard, *l.c.*, p. 84.

Dr. Trewavas has kindly examined Boulenger's specimens nos. 11–20 of "*anoplus*," and informs me that nos. 11–17 have 12–14 or 15, and nos. 19 and 20 respectively 14 and 16, scales around the caudal peduncle; and that no. 18, with 13 scales around caudal peduncle, appears to be the specimen figured by Boulenger, assuming the figure to be natural size. No. 11 is clearly a *senticeps*, and probably also nos. 12 and 13 (13 scales c.ped.); but whether nos. 14, 15, 16, and 19 (14–15 scales) can be included is doubtful. Confirmation must be sought by further collecting in the Port Elizabeth area to see if *asper* occurs along with *senticeps*. Specimen no. 20 (16 scales) would certainly seem to be *asper*.

This species agrees with *asper* in having only one pair of barbels, but is distinguished by having normally only 12 scales around caudal peduncle. The posterior barbel is already showing in a specimen of 23 mm., the smallest specimen of this species yet obtained. The red-fins begin at about 30 mm. Pectoral shorter in ♀ than in ♂.

Barbus senticeps.

	TL	L/H	H/E	S/E	I/E	l.l.	c.ped.	striae.	g.r.	barb.	Sex and Remarks.
Kromme R., Assegai Bush.	23	$3\frac{1}{4}$	$2\frac{1}{2}$	e > s	e > i	30	12	4–5	1 + 6	(p)	
	25	$3\frac{1}{3}$	$2\frac{1}{2}$	,,	,,	30	12	4–5	1 + 6	p ($\frac{1}{6}$ eye)	
	30	$3\frac{1}{3}$	$2\frac{3}{4}$	,,	,,	30–32		..	..		Red patches begin.
	35	$3\frac{1}{3}$	3	,,	1			6	2 + 6		
Zwartkops R., Uitenhage.	40	$3\frac{1}{2}$	3	,,	1						
	45	$3\frac{1}{2}$	$3\frac{1}{3}$	1	$1\frac{1}{4}$			..	..	..	♂ immat. ♀ ovig.
	50	$3\frac{1}{2}$	$3\frac{1}{2}$	1	$1\frac{1}{4}$			8	..	..	♂, ovig. ♀.
	55	$3\frac{1}{2}$	$3\frac{2}{3}$	1	$1\frac{1}{3}$						,,
	60	$3\frac{2}{3}$	$3\frac{2}{3}$	1	$1\frac{1}{3}$			..	..	..	♂ with warts, ovig. ♀.
	65	$3\frac{2}{3}$	$3\frac{3}{4}$	1	$1\frac{1}{3}$		12	..	..	..	,,
	70	$3\frac{3}{4}$	4	1 +	$1\frac{1}{2}$	30–34		..	2 or 3 + 6 or 7	..	,,
	75	$3\frac{3}{4}$	4	$1\frac{1}{5}$	$1\frac{1}{2}$			10	..	..	,,
	80	$3\frac{4}{5}$	4	$1\frac{1}{4}$	$1\frac{1}{2}$			..	2 + 8	..	,,
	85	$3\frac{3}{4}$	4	$1\frac{1}{3}$	$1\frac{2}{3}$			12	..	..	♂ Head slightly larger in ♂ than in ♀ (cf. *asper*).
	85	4	4	$1\frac{1}{4}$	$1\frac{1}{2}$			..	..	..	♀
	90	4	4	$1\frac{1}{4}$	$1\frac{1}{2}$			..	..	..	♀.
	95	4	$4\frac{1}{4}$	$1\frac{1}{4}$	$1\frac{2}{3}$			12	3 + 8	..	♀.

For comparison with *asper* and *tenuis* the following characters are given: mature ♂♂ with warts on head; mouth subterminal; depth of body subequal to length of head; scales with few (8–12) striae, l.l. 30–34, l.tr. 5–6 between dorsal spine and l.l., 4–5 between latter and ventral spine, 12 around caudal peduncle, 14–16 predorsal; lateral line tubules more or less incomplete.

This species was described by J. L. B. Smith from a single ♂ specimen from the Kromme River, Assegai Bush, Humansdorp Division, with only 10 scales around the caudal peduncle.

The South African Museum has a ♀ from the same locality (F. G. Chaplin, 1935); 2 ♂♂ from the Zwartkops River, north of Uitenhage (C. L. Biden, 1935); 1 ♀ from Zwartkops River recorded by Gilchrist and Thompson as *vulneratus*; and 3 specimens from the Baakens River. The latter three were identified by Boulenger (label in his handwriting accompanies the specimens) as *vulneratus* in spite of their having only one pair of barbels, and were recorded by Gilchrist and Thompson as *vulneratus.*

I have collected a good series in the type locality at Assegai Bush, and in the Geelhoutboom River, a tributary of the Kromme River; and also in the Zwartkops River above Uitenhage, and its tributary the Brak River. Contrary to the expectation expressed in my 1938 paper (p. 84), *senticeps* has not yet been found in the Gamtoos system.

So far as at present known, therefore, this species is confined to two of the smaller river-systems, separated by the lower reaches of the large Gamtoos River (fig. 7). In former times the Kromme River was certainly a tributary of the Gamtoos, and apparently the Zwartkops was also. But it is difficult to explain why *senticeps* and *asper* appear to be mutually exclusive in a river, while *pallidus* is found associated with the one or the other of these two species in all the rivers in the Uitenhage, Port Elizabeth, Humansdorp area.

The fauna of the Baakens River, Port Elizabeth, has not been investigated in recent years.

Barbus tenuis Brnrd.

Slender Red-fin.

Fig. 19, *b.*

1913. Gilchrist and Thompson, *l.c.*, p. 428 (*anoplus* non Weber, part: the specimens from Le Roux River, Cango).

1938. Barnard, *l.c.*, p. 87.

Depth of body less than length of head, the former $4\frac{1}{2}$, the latter $3\frac{1}{3}$ (juv.), 4 (adult) in length of body (excluding caudal fin). Eye $2\frac{1}{2}$ (juv.), 5 (adult) in length of head, 1–2 in interorbital width, greater than snout to about 35 mm., after that 1–2 (or nearly 2) in snout. Snout rounded, projecting beyond mouth, which is definitely inferior. Lips thin, lower labial grooves interrupted medianly. A single (posterior) barbel on each side, developing at the 22-mm. stage, not exceeding eye-diameter in length. Gill-rakers $2+5$ (6) to $3+7$ (8) on anterior arch. No warts on head in ♂.

D iii. 7, the 3rd spine a little nearer to end of caudal peduncle than to tip of snout, shorter than depth of body, thin, flexible, non-serrated. There are really 4 spines, but the true 1st is obscured in half-grown and adults. A iii. 5. Pectoral extending to or nearly to base of ventral spine in juv. and ♂, but in ♀ extending only to about $\frac{2}{3}$ distance between bases of pectoral and ventral. Ventral fin in advance of dorsal, the last ventral ray below the 1st–3rd dorsal spines.

Scales radiately striate, striae numerous, about 8 (juv.), 24 (adult); l.l. 32–36 (37), the series of tubules complete, rarely one or two missing posteriorly; l.tr. 5 between dorsal spine and l.l., 3 between latter and ventral spine; 12–14 around caudal peduncle, with occasionally in large specimens accessory scales; predorsal (12) 15–20, usually beginning, but irregularly and somewhat inconstantly, some little distance behind occiput, thus leaving a bare triangular patch, nearly always present but variable in extent.

Up to 85 mm. Silvery, rather heavily suffused with brown above, after preservation a dark lateral stripe expanding into a more or less defined spot on end of caudal peduncle; fins greyish, base of dorsal, anal, ventrals, and axil of pectoral brilliant red, beginning to develop at about the 30-mm. stage.

Localities.—Gouritz River system—Seven Weeks Poort, Amalienstein, near Ladismith; Meiring's Poort; Rossel River, near Klaarstroom; tributary of the Olifants River, near De Rust, Oudtshoorn; Grobelaars and Le Roux rivers, near Oudtshoorn; Moeras River, between Oudtshoorn and Robinson Pass; tributary of Kamanassie River (farm "Waterval"); Langtouw River, Herbertsdale (figs. 6 and 7).

Remarks.—Although the 4 largest of Boulenger's specimens nos. 1–10 of "*anoplus*" from Grobelaars River have 16–20 scales around caudal peduncle, as Dr. Trewavas informs me (p. 197), possibly some of the smaller ones from the same lot really belong to this species. Gilchrist and Thompson's Le Roux River material, recorded as "*anoplus*," belongs to this species.

In the field, when freshly caught it is easily distinguished from *asper* by its slender shape, and the more suffused brownish coloration; *asper* tends to be more silvery, with greyish speckling, like a "speckled hen." After preservation the dark lateral stripe, though often to be seen in *asper*, is always much more pronounced in *tenuis*.

For comparison with *asper* and *senticeps* the following characters are given: no warts on head in ♂♂; mouth inferior; depth of body less than length of head (even in gravid ♀♀ it is scarcely equal to head); scales with numerous (14–24) striae, l.l. 32–36, l.tr. 5 between dorsal spine and l.l., 3 between latter and ventral spine, 12–14 around caudal peduncle, (12) 15–20 predorsal, usually not beginning immediately behind occiput, but leaving a bare triangular space; base of ventral in advance of dorsal; lateral line tubules nearly always complete.

The scales, with their numerous striae, resemble those of *anoplus*; but in specimens which have lost all trace of distinctive coloration, the shape of the snout and the number of caudal peduncle scales are decisive differences.

The bare patch behind the occiput is very noticeable in the material from De Rust (fig. 19, *b*), but is not so constant in that from other localities; in nearly every specimen from the Langtouw River the scales start almost immediately behind the occiput. This feature therefore cannot be regarded as always decisive.

Barbus tenuis.

		TL	L/H	H/E	S/E	I/E	l.l.	c.ped.	striae.	g.r.	barb.	Sex and Remarks.
	Moeras R.	15	$3\frac{2}{3}$	$2\frac{1}{2}$	e < s	1	No scales			..	None	Fin rays distinct.
Grobelaars R.	Moeras R.	17	$3\frac{1}{2}$	$2\frac{3}{4}$	,,	1		,,		..	,,	
Grobelaars R.	Moeras R.	20	$3\frac{1}{3}$	$2\frac{4}{5}$	,,	1		,,		1 + 4	,,	
Grobelaars R.	Moeras R.	23	$3\frac{1}{3}$	$2\frac{4}{5}$–3	,,	1		,,		..	(p)	
Grobelaars R.	Moeras R.	25	$3\frac{1}{3}$	3	,,	1	33	12	8	2 + 5	p	
Grobelaars R.	Moeras R.	30	$3\frac{1}{2}$	3	,,	1	32	12	..	..	p	Red patches begin.
Grobelaars R.	Moeras R.	35	$3\frac{1}{2}$	3	,,	1	33–34	12	10–12	2 + 5–6		
Grobelaars R.	Moeras R.	40	$3\frac{1}{2}$	$3\frac{1}{2}$	1	$1\frac{1}{3}$	33	12	..	..	..	Immature ♂♂ and ♀♀.
Grobelaars R.		45	$3\frac{1}{2}$	$3\frac{1}{2}$	1	$1\frac{1}{3}$	32–35	12(–14)	12–14	..		♂♂ no warts. ♀♀ ovig.
Grobelaars R.		50	$3\frac{2}{3}$	$3\frac{3}{4}$	$1\frac{1}{4}$	$1\frac{1}{3}$	32–35	12(–14)		2 + 6–7		♂♂ no warts. ♀♀ ovig.
Grobelaars R.		55	$3\frac{3}{4}$	4	$1\frac{1}{3}$	$1\frac{1}{3}$	32–35	12(–14)	16–18			♂♂ no warts. ♀♀ ovig.
Grobelaars R.		60	$3\frac{3}{4}$	4	$1\frac{1}{3}$	$1\frac{1}{2}$	32–35	12(–14)				♂♂ no warts. ♀♀ ovig.
Grobelaars R.		65	$3\frac{3}{4}$	$4\frac{1}{4}$	$1\frac{1}{2}$	$1\frac{1}{2}$	32–35	12(–14)	18–20			♂♂ no warts. ♀♀ ovig.
Grobelaars R.		70	$3\frac{3}{4}$	$4\frac{1}{2}$	$1\frac{2}{3}$	$1\frac{2}{3}$	32–35	12(–14)		3 + 7–8		♂♂ no warts. ♀♀ ovig.
Grobelaars R.		75	$3\frac{3}{4}$–$3\frac{4}{5}$	$4\frac{3}{4}$	$1\frac{3}{4}$	$1\frac{3}{4}$	33–36	12(–14)	22–24			♂♂ no warts. ♀♀ ovig.
Grobelaars R.		80	$3\frac{4}{5}$	5	$1\frac{4}{5}$	$1\frac{4}{5}$	33–36	12(–14)				♂♂ no warts. ♀♀ ovig.
Grobelaars R.		85	4	5	$1\frac{4}{5}$–2	2	33–36	12(–14)	24	3 + 7–8		♂♂ no warts. ♀♀ ovig.

Barbus phlegethon Brnrd.

Figs. 15, *d*, 20.

1938. Barnard, *l.c.*, p. 87.

Depth of body $3\frac{3}{4}$–4, length of head $3\frac{1}{2}$ (juv.), 4 (adult) in length of body (excluding caudal fin). Eye $2\frac{1}{2}$ (juv.), $3\frac{1}{2}$ (adult) in length of head, 1–$1\frac{1}{3}$ in interorbital width (greater than interorbital in very young), greater than snout up to about 37 mm., equal to snout in larger specimens. Snout moderately rounded, projecting slightly beyond mouth, which is subinferior or definitely inferior. Lips thin, lower labial grooves interrupted medianly. A single (posterior) barbel on each side, developing at about the 25-mm. stage, not exceeding $\frac{1}{2}$ eye-diameter. Gill-rakers 2 + 4–6 on anterior arch.

D iii. 7, the 3rd spine equidistant from tip of snout and last scales on caudal peduncle, not quite equal to length of head, thin, flexible, non-serrate. A iii. 5. Pectoral extending to about $\frac{2}{3}$ distance between bases of pectoral and ventral in ♀, $\frac{3}{4}$ or $\frac{4}{5}$ that distance in ♂. Ventral spine arising in vertical from 3rd dorsal spine. Caudal peduncle about $1\frac{2}{3}$ as long as deep.

Scales radiately striate, beginning at about the 15–16-mm. stage, striae few, about 4 or 5 (juv.) to 7 or 8 (adult); l.l. 34–36, tubules

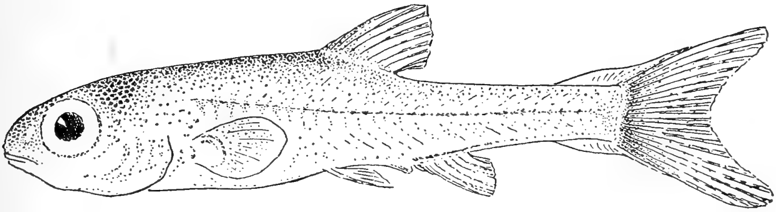


FIG. 20.—*Barbus phlegethon.* Juvenile, 13 mm.

complete, seldom one or two absent posteriorly; l.tr. 4–5 between dorsal spine and l.l., 3 between latter and base of ventral spine; around caudal peduncle 12; predorsal 14–15.

Up to 55 mm. Silvery, rather heavily tinted with brownish above, after preservation a dark lateral stripe ending in a more or less defined and rather large spot on end of caudal peduncle; fins pale greyish,

Barbus phlegethon.

TL	L/H	H/E	S/E	I/E	l.l.	c.ped.	striae.	g.r.	barb.	Sex and Remarks.
13	$3\frac{3}{4}$	$2\frac{1}{3}$	e > s	e > i	No scales			..	None	Dorsal, anal and ventrals developed.
15	$3\frac{1}{2}$	$2\frac{1}{2}$	,,	,,		,,	..	..	,,	
17	$3\frac{1}{2}$	$2\frac{1}{2}$	,,	,,	30	12	..	1 + 3	,,	
19	$3\frac{1}{2}$	$2\frac{1}{2}$	,,	,,	31	12	4	1 + 4	,,	
21	$3\frac{1}{2}$	$2\frac{1}{2}$	,,	,,			..	..	,,	
23	$3\frac{1}{2}$	$2\frac{3}{4}$	,,	1	31–33		..	..	,,	
25	$3\frac{1}{2}$	3	,,	1			4–5	2 + 4	(p)	
32	$3\frac{1}{2}$	3	,,	1			..	..	p	
35	$3\frac{1}{2}$	3	,,	1			..	..	..	Red patches begin.
37	$3\frac{3}{4}$	3	,,	1						
40	$3\frac{4}{5}$	$3\frac{1}{4}$	1	1 +		12	5–6	2 + 6		
42	$3\frac{4}{5}$	$3\frac{1}{4}$	1	1	34–36					
44	$3\frac{4}{5}$	$3\frac{1}{3}$	1	$1\frac{1}{4}$			..	..	..	♂.
47	$3\frac{4}{5}$	$3\frac{1}{3}$	1	$1\frac{1}{4}$			6–7			
50	4	$3\frac{1}{2}$	1	$1\frac{1}{4}$						
55	4	$3\frac{1}{2}$	1	$1\frac{1}{3}$			7–8	2 + 6 or 7	..	♂, ovig. ♀.

the fork of each branched ray in dorsal and anal rather dark, giving the semblance of a band when the fin is partly open; base of dorsal, ventral, most of caudal and anal, axil and base of pectoral brilliant red, beginning to develop at about the 35-mm. stage.

Locality.—Boontjes River, Citrusdal, a tributary of the Olifants River, and in the main Olifants River at Keerom (south of Citrusdal), Clanwilliam Division, Cape (A. C. H., K. H. B., and C. W. T., April 1937 and 1938, February 1939) (fig. 6).

Remarks.—This species rivals *calidus* in the brilliancy of the red splashes on the fins. It is distinguished from *calidus* by the non-serrate dorsal spine, the shape of the anal fin (see fig. 15, *d*) and the single pair of barbels.

Barbus anoplus Weber, forma *typica*

Gouritz River Chubby-head.

Fig. 21 (head).

1897. Weber, *l.c.*, p. 151 (part: only the Buffels River, Laingsburg, specimens).

1938. Barnard, *l.c.*, p. 84.

[Not Boulenger, *l.c.*, 1911, p. 177, fig. 155. = *asper, senticeps,* and probably other species.

Not Gilchrist and Thompson, *l.c.*, 1913, p. 428, fig. 87. = *asper, tenuis,* and probably other species.

Not Boulenger, *l.c.*, 1916, p. 272. = *pallidus* (*fide* Trewavas).

Not J. L. B. Smith, *l.c.*, 1937, p. 124, pl. 29, fig. 2, figure after Boulenger. = *senticeps.*

Probably not Fowler, Proc. Ac. Nat. Sci. Philad., lxxxvi, p. 430, 1934, and lxxxvii, p. 371, 1935. Natal.]

The first point to be emphasized in discussing this species is that it is *not* a red-fin.

Gilchrist and Thompson had no specimens of the true *anoplus.* Boulenger appears not to have examined the types, because, if he had done so, he could not have failed to notice the striking difference in "facies" between the true *anoplus* and the specimens he assigned to Weber's species. The specimens recorded in 1916 are really *pallidus* according to information given me by Dr. Trewavas.

Thanks to Dr. de Beaufort, I have been able to examine the type series from the Buffels River, Laingsburg, comprising over 100 specimens from 22 mm. up to 87 mm. The largest specimen measured to the end of the caudal lobes 95 mm., thus corresponding with the measurement given by Weber; it has had the mouth cut and the gill-rakers on one side extracted.

From this series and the very large amount of material recently collected by the South African Museum, the following diagnosis has been compiled.

Proportions as in table, p. 209. Snout short, in adult equal to, in very large specimens very slightly longer than eye, bluntly rounded like that of the European Chub (hence "Chubby-head") (see fig. 21). Mouth terminal. Lower labial grooves interrupted medianly. A single (posterior) barbel on each side, $\frac{1}{2}$–$\frac{3}{4}$ eye-diameter, developing at about the 24-mm. stage. Gill-rakers 2 + 5–7 on anterior arch. No tubercles on head in ♂.

D iii. 7 (actually 4 spines, true 1st very small, and obscured in adult), hindmost spine thin, flexible, non-serrated. A iii. 5. Pectoral reaching to or nearly to base of ventral in ♂, shorter in ♀. Base of ventral fin below dorsal spines in juv., but shifting slightly forwards so that in adult base of the last ray is below 1st dorsal spine.

Scales with very numerous (20–28) radiating striae; scaling beginning before the barbel is developed, at about the 23-mm. stage. Lat.l. 33–35, tubules variously interrupted and incomplete, sometimes only half a dozen anteriorly; l.tr. 5–6 between dorsal spine and l.l., 4 between latter and ventral spine; 16 around caudal peduncle; 13–14 or 15 predorsal.

Colour of the living fish: metallic silvery, greenish or greyish above, with a more or less pronounced yellow or golden tinge in ♂, more greyish in ♀; fins whitish, without either red patches at their bases or any pinkish suffusion, but in ♂♂ they may partake of the yellow tinge, especially the caudal fin. After preservation there is a more or less conspicuous dark lateral stripe, not expanding at end, but ending in a small more or less indistinct spot.

The smallest ovigerous ♀ examined was 35 mm. in length. Spawning, as far as observations have gone, takes place from September onwards to March and April.

Weber's insistence on the pectoral fin not reaching the base of ventrals is curious, as there are several ♂♂ in his Laingsburg material in which the pectoral does reach almost to the ventrals.

Weber noted the more pointed snout and higher dorsal fin in the Klip River, Natal, specimens, but nevertheless included them with *anoplus*. I have seen the specimens; they show several other differences, and are certainly not *anoplus*, nor *karkensis* (see p. 216).

The French Hoek specimens, also included in *anoplus* by Weber, are young *burchelli* in the "single-barbel" stage (see p. 186).

B. karkensis G. and T., regarded by Boulenger (1916, p. 272) as a synonym of what he thought was *anoplus*, is quite different from the true *anoplus* (*karkensis* has a complete lateral line, see *infra*, p. 215).

Gilchrist and Thompson's "*anoplus*" material (except the Albany

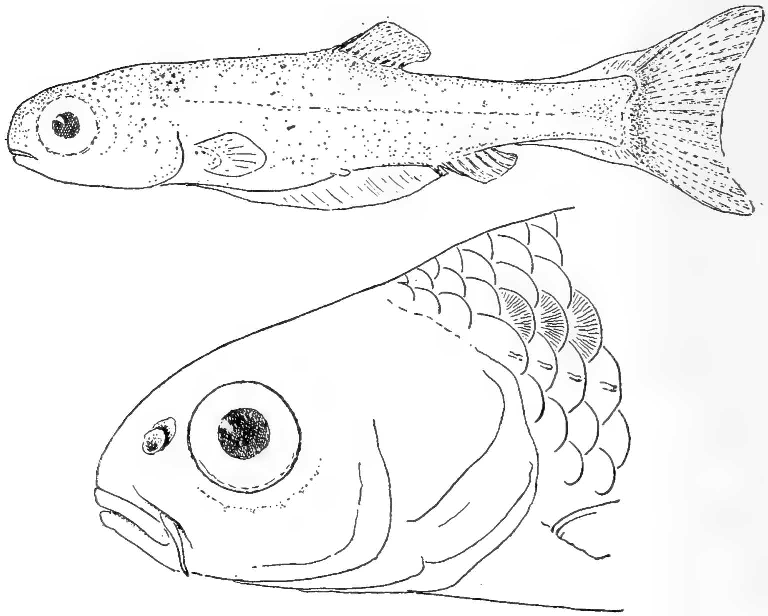


Fig. 21.—*Barbus anoplus.* Head of adult of typical form and forma *cernuus* (but not forma *oraniensis*, which has shorter barbel). Juvenile of forma *cernuus*, 13 mm., Olifants River, Clanwilliam.

Museum specimen which I have not seen) consists of *asper*, *tenuis*, and other species, on the identity of which latter I express no opinion except that they are not *anoplus*.

South African Museum material, including recent collecting, shows that this species occurs throughout the Gourtiz River system: Verkeerde Vlei and Touws River; Gamka River at Letjesbosch, Kruidfontein, and Gamka Poort (Zwartberg Range); Bushman River, tributary of the Gamka River, near Letjesbosch; Buffels River, Laingsburg, and its continuation (Groote River) at Ladismith; Le Roux River, Oudtshoorn; Langtouw River, Herbertsdale.

I have also seen 3 specimens, which *appear* to be conspecific, from a dam at Bedford, in the Great Fish River system (F. G. Chaplin coll.).

Up to the present, however, recent collecting has failed to find this species in any river-system south of the main Cape watershed except the Gouritz River system (fig. 6).

Note on a locality in the Karroo. In March 1937 Dr. Boonstra and Mr. Thorne discovered a colony of this species on a farm near the Bushman River, a tributary of the Gamka River, near Letjesbosch. In April 1939 they took me to see the place. No one would dream of looking for fish in such a locality. It affords a very striking example of subterranean pools or reservoirs enabling fish to maintain their existence in what is on the surface a drought-stricken area.

A small spring arises on the farm, and the farmers have enlarged the opening and cut a channel, 2–3 feet wide, back into a low hill, so that now the water comes out of the rock about 10 feet below the surrounding surface. It is about 50 yards from the nearest tributary stream leading to the Gamka. Except for short periods after heavy rain this "stream" is only a dry stream-bed, and the Gamka itself at this part of its course is only a periodic river. The spring, however, is perennial, and must be fed from underground sources, as the local rainfall is certainly insufficient to keep it flowing. At the time of our visit the fish were there in large numbers, of all sizes.

On a neighbouring farm where a spring forms a surface pool no fish were found, although it also is perennial.

Barbus anoplus forma *typica*

Buffels (Groote) River, Ladismith.

TL	L/H	H/E	S/E	I/E	l.l.	c.ped.	striae.	g.r.	barb.	Sex and Remarks.
18	$3\frac{1}{4}$	$2\frac{3}{4}$	e > s	1	No scales			..	None	Fin rays distinct.
20	$3\frac{1}{3}$	3	,,	1		,,		..	,,	
23	$3\frac{1}{3}$	3	,,	1	32–33	14	8–10	1 + 4	,,	
25	$3\frac{1}{2}$	3	,,	1		14	10–12	2 + 5	(p)	
30	$3\frac{1}{2}$	$3\frac{1}{4}$	,,	1		14–16	12–14	..	p	
35	$3\frac{1}{2}$	$3\frac{1}{3}$	,,	1		16	14–16	2 + 6–7	p	♀ ova.
40	$3\frac{1}{2}$	$3\frac{1}{3}$	,,	1			16–18	..	..	♂ ♀ ova.
45	$3\frac{1}{2}$	$3\frac{1}{2}$	,,	$1\frac{1}{4}$			..	..	..	♂ ♀ ,,
50	$3\frac{1}{2}$	$3\frac{1}{2}$	1	$1\frac{1}{3}$	33–35		24–26	..	..	♂ ♀ ,,
55	$3\frac{2}{3}$	$3\frac{2}{3}$	1	$1\frac{1}{3}$–$1\frac{1}{2}$		16	..	..	..	♂ ♀ ,,
60	$3\frac{3}{4}$	$3\frac{2}{3}$	1	$1\frac{1}{2}$			30	2 + 6–7	..	♂ ♀ ,,
70	$3\frac{3}{4}$	4	1	$1\frac{3}{4}$			32–34	..	..	♂ ♀ ,,
80	4	$4\frac{1}{4}$	$1\frac{1}{5}$	2			..	..	..	♀ ova.
87	4	$4\frac{1}{2}$	$1\frac{1}{4}$	2			36–38	2 + 6–7	$\frac{3}{5}$ eye	♀ ,,

Barbus anoplus forma *oraniensis* nov.

Orange River Chubby-head.

1911. Boulenger, *l.c.*, p. 146 (no. 4, juv., Deelfontein, recorded as *burchelli*).

Since my proposal to give the Clanwilliam Olifants River form a separate specific name, a large series of specimens has been obtained from the north-eastern and southern tributaries of the Orange River.

Although this paper deals only incidentally with the Orange River fish-fauna, some account of this form is necessary. A table of characters at successive stages is given for comparison with those of typical *anoplus* and f. *cernuus*.

The table shows a closer approximation to *cernuus* than to *anoplus* in the L/H and H/E proportions; but there is a lag in the development of the scales, especially of the full complement around the caudal peduncle, as in typical *anoplus*. The lateral line tubules are greatly reduced, often appearing on the anterior scales only.

This form differs from both *anoplus* and *cernuus* in the very short barbel, and the later period at which it develops. No trace of an anterior barbel was found in any of the 1300 specimens examined.

Localities.—Laken Vlei River, Merriman (Richmond Division), a tributary of the Ongar River (K. H. B., L. D. B., and C. W. T., April 1939); Zak River, Williston (Calvinia Division) (R. Smithers, March 1939; K. H. B., L. D. B., and C. W. T., April 1939) (fig. 6). All the following collected by C. W. T., L. D. B., A. J. H., Oct.–Nov. 1939: Dry Hartz River at Taungs; Vaal River at Warrenton; Modder River and tributaries near Boshof, Bloemfontein, and Dewetsdorp; tributary of Caledon River at Smithfield; Stormberg River near Burghersdorp; Brandspruit north of Steynsburg; Oorlogspoort River south-east of Colesberg; and Sea-Cow (Seekoe) River near Hanover.

Remarks.—Thanks to Mr. Norman, I have examined Boulenger's no. 4 specimen from Deelfontein, a locality near Merriman. At first glance the "Chubby-head" was sufficient to indicate that, as I suspected, it was not *burchelli*.

Both the Ongar and the Zak rivers are in the Orange River system, and arise on the northern slopes of the main Cape watershed. To the west of the Zak River there is a tributary (Fish River), between which and the source of the Oorlogs River (a tributary of the Clanwilliam Olifants River) there is an ill-defined watershed. Further, the sources of the Tanqua River (Olifants system), Fish River

(Orange system), and Buffels River (Gouritz system) approximate in the Division of Sutherland; the Tanqua being separated from the Buffels by the Klein Roggeveld Mts., and both from the Fish River by the Roggeveld–Komsberg escarpment. Intercommunication in past times has certainly been possible.

It is not possible, however, to decide whether the original "*anoplus*" stock was spread over all three river-systems, or whether one river has been stocked from another by river-capture or intercommunication during sheet-flooding. It seems probable that *anoplus* and f. *cernuus*, being almost indistinguishable, have been isolated from the Zak River stock for a longer period than they have from one another.

Recent investigations have traced the presence of this form of *anoplus* in some of the other southern and north-eastern affluents of the Orange River. If the occurrence of *anoplus* in the Gt. Fish River (Eastern Cape Province), or in the Sundays River (which has not yet been investigated), were confirmed, it would form a parallel with the occurrence in the Gouritz River, as both systems arise on the main watershed opposite to the southern tributaries of the Orange River. In former times intercommunication may have been easier than it is to-day.

The Orange River itself might repay investigation. As no *anoplus* were found by Dr. Hesse and Mr. Thorne at Goodhouse and Aiais, *i.e.* in the section below the Aughrabies Falls, the possibility should be borne in mind that the fauna of the Orange River may not be homogeneous.

Recent (Nov. 1939) results obtained by Mr. Thorne, in company with Dr. Hesse and Dr. Boonstra, confirm the above statement that the fish-fauna of the Orange River is not entirely homogeneous. Whereas *paludinosus* has been found only in the lower and middle sections and the northern and north-eastern tributaries, but not in the southern tributaries, *anoplus* occurs in the northern and north-eastern *and* the *southern* tributaries, but not apparently in the lower and middle sections.

It is indeed remarkable that, in spite of its evidently wide distribution in the southern tributaries (as well as in the Vaal, etc.), neither *anoplus*, nor any other species with radiately striate scales and only one pair of barbels, has been recorded from the lower and middle sections of the Orange River.

Although formerly it seemed justifiable to give the form from the Clanwilliam Olifants River (*cernuus*) full specific rank, I now think that the geographical distribution can be better expressed and the factors leading to this distribution more readily discussed by uniting all three forms under one specific name. The Gouritz River form must for taxonomic reasons be regarded as the typical form, although chronologically it *may* be the latest offshoot from the ancestral stock.

Barbus anoplus forma *oraniensis.*

(Merriman and Zak River, Williston.)

TL	L/H	H/E	S/E	I/E	l.l.	c.ped.	striae.	g.r.	barb.	Sex and Remarks.
14	$3\frac{1}{5}$	$3\frac{3}{4}$	e < s	1	None		..	1 + 4	None	Fin rays distinct, no ventral lamina.
15	$3\frac{1}{4}$	3	,,	1	,,		..	..	,,	
18	$3\frac{1}{3}$	3	,,	1	,,		..	..	,,	
20	$3\frac{1}{2}$	3	,,	1	,,		..	1 + 4	,,	
22	$3\frac{1}{2}$	3	,,	1	,,		..	..	,,	
23	$3\frac{1}{2}$	$3\frac{1}{4}$	,,	1	(32	12)	..	..	,,	Scales scarcely distinct.
25	$3\frac{1}{2}$	$3\frac{1}{3}$	,,	1	33	14	12	..	,,	
30	$3\frac{1}{2}$	$3\frac{1}{2}$	,,	$1\frac{1}{4}$		14	..	..	(p)	
35	$3\frac{1}{2}$	$3\frac{1}{2}$	,,	$1\frac{1}{4}$		14	14–16	..	(p)	♂.
40	$3\frac{1}{2}$	$3\frac{1}{2}$	,,	$1\frac{1}{4}$		14–16	..	2 + 5	$\frac{1}{8}$ eye	♂ ♀.
45	$3\frac{3}{4}$	$3\frac{2}{3}$	,,	$1\frac{1}{3}$			..		$\frac{1}{6}$ eye	♂ ♀.
50	$3\frac{3}{4}$–$3\frac{4}{5}$	$3\frac{3}{4}$–4	1	$1\frac{1}{2}$			20–22		$\frac{1}{4}$–$\frac{1}{3}$ eye	
55	$3\frac{4}{5}$	4	1	$1\frac{1}{2}$	33–35 (36).					♂·♀.
60	$3\frac{4}{5}$–4	$4\frac{1}{4}$	1	$1\frac{2}{3}$			26		$\frac{1}{3}$ eye	
65	4	$4\frac{1}{2}$	$1\frac{1}{6}$	$1\frac{3}{4}$		16		2 + 5 or 6		
70	4	$4\frac{2}{3}$	$1\frac{1}{5}$	2			28		$\frac{1}{2}$ eye	♂ ♀.
75	4	$4\frac{3}{4}$	$1\frac{1}{4}$	2						♀.
80	4	$4\frac{4}{5}$	$1\frac{1}{4}$	2						♀.
85	4	5	$1\frac{1}{4}$	2	37		32		$\frac{1}{2}$ eye	♀.

Barbus anoplus forma *cernuus*

Clanwilliam Chubby-head.

Fig. 21 (head, and juv.).

1938. Barnard, *l.c.*, p. 88 (*cernuus*).

Depth of body $3\frac{1}{2}$, length of head $3\frac{1}{2}$ (juv.), 4 (adult) in length of body (excluding caudal fin). Eye 3 (juv.), 4 (adult) in length of head, subequal to snout from about the 30-mm. stage upwards, 1 (juv.), $1\frac{1}{3}$ (adult) in interorbital width. Snout rounded, mouth terminal. Lips thin, lower labial grooves interrupted for only a short distance medianly. Normally, from 22 mm. upwards, only the posterior barbel on each side, $\frac{1}{2}$–$\frac{2}{3}$ (scarcely ever $\frac{3}{4}$) eye-diameter in length; occasionally in medium-sized specimens the anterior barbel is feebly developed. Gill-rakers 2 + 4 or 5 on anterior arch, feebly developed. No tubercles on head in ♂.

D iii. 7, the 3rd spine about equidistant from the last scales on caudal peduncle and from tip of snout; 3rd spine about $\frac{4}{5}$ length of head, thin, flexible, non-serrate. A iii. 5. Pectoral extending to about $\frac{3}{4}$ the distance between its (upper) base and base of ventral spine in ♂, $\frac{2}{3}$ the distance in ♀. Ventral spine arising in vertical from 3rd dorsal spine, slightly more forward in juveniles. Caudal peduncle about $1\frac{1}{4}$ or $1\frac{1}{5}$ as long as deep.

Scales radiately striate, striae numerous, about 20–25 in adult, l.l. 31–35, tubules usually nearly complete, but not seldom interrupted or incomplete posteriorly, l.tr. 6 between dorsal spine and l.l., 3 between latter and ventral spine; around caudal peduncle 12 in very young, 14 up to about 45 mm., usually 16 in adult; predorsal 14–15.

Up to 70 mm. Silvery, slightly brownish above, with bright yellow or golden tinge in ♂, and a pinkish or violet sheen in ♀; after preservation a more or less conspicuous dark lateral stripe, ending usually in a small spot at end of caudal peduncle; fins pale, without red patches or any pinkish suffusion.

Locality.—Olifants River at Keerom, south of Citrusdal; Boontjes River, Doorn River, irrigation furrow at Klaver, and Troe Troe River at Van Rhyns Dorp—all in the Olifants River system, Clanwilliam Division, Cape (long series collected by the late A. E. Manley, A. C. H., K. H. B., C. W. T., 1936, 1937, 1938, 1939) (fig. 6).

Remarks.—This small species is easily distinguished from the other species of *Barbus* found in the Olifants River by its bluntly rounded snout with terminal mouth, numerous radiating striae on the scales, and the absence of red-fins. The terminal mouth is distinctive even in juveniles, which, moreover, are distinguished from those of *calidus* by their non-serrated dorsal spine, and from those of *phlegethon* by their scales and (after preservation) paler colour.

On the other hand, it is so like typical *anoplus* that I doubt whether isolated specimens could be satisfactorily distinguished on *morphological* characters (unless a rudimentary anterior barbel is present). The proportions of the head, and of the eye are slightly different, the striae on the scales are slightly more numerous in typical *anoplus*, the ventral fin is slightly more forward in *anoplus*, but the difference is scarcely tangible; the lateral line tubules are usually nearly complete in *cernuus*, but in typical *anoplus* very far from complete, often greatly reduced. Where a feature is inconstant, the inconstancy cannot be used to differentiate varieties and races, as is justly noted by Hora, Misra and Malik (1939, Rec. Ind. Mus., xli, pp. 268, 269).

But when the life-histories of the two forms are compared, there is seen to be a distinct lag in the development of the scaling and the barbel in the case of typical *anoplus*. On the other hand, the full

Barbus anoplus forma *cernuus*.

TL	L/H	H/E	S/E	I/E	l.l.	c.ped.	striae.	g.r.	barb.	Sex and Remarks.
11	$3\frac{1}{2}$	3	e < s	1	No scales			..	None	Ventrals not free. Dorsal and anal fin rays distinct.
13	$3\frac{1}{2}$	3	,,	1		,,		..	,,	Ventrals just free.
15	$3\frac{1}{2}$	3	,,	1		,,		..	,,	Ventral lamine almost gone.
16	$3\frac{1}{2}$	3	,,	1	31	12	10–12	..	,,	No ventral lamina.
20	$3\frac{1}{2}$	3	,,	1	33	14	12–14	1 + 4	,,	
22	$3\frac{1}{2}$	$3\frac{1}{4}$	,,	1		14	..	..	(p)	
25	$3\frac{1}{2}$	$3\frac{1}{2}$	,,	1		14	16–18	2 + 4	p	
30	$3\frac{1}{2}$	$3\frac{1}{2}$	,,	1		14	..	..	p	
35	$3\frac{2}{3}$	$3\frac{3}{4}$	1	$1\frac{1}{3}$		14	18–20			
40	$3\frac{2}{3}$	$3\frac{4}{5}$	1	$1\frac{1}{3}$		14				
45	$3\frac{2}{3}$	$3\frac{4}{5}$	1	$1\frac{1}{3}$	33–35	14–16	22–24			
50	$3\frac{3}{4}$	$3\frac{4}{5}$	1	$1\frac{1}{3}$		14–16	..	2 + 5	..	♂, ovig. ♀.
55	$3\frac{4}{5}$	4	1	$1\frac{1}{3}$		16	..	..	..	♂, ovig. ♀.
57	4	4	1	$1\frac{1}{3}$		16	26–28	..	..	♂, ovig. ♀.
60	4	4	1	$1\frac{1}{3}$–$1\frac{1}{2}$		16	..	..	..	♀ ovig.
65	4	4	1	$1\frac{1}{2}$		16	..	2 + 5	..	♀ ovig.
70	4	$4\frac{1}{5}$	1	$1\frac{2}{3}$		16	28–30	2 + 5(6)	$\frac{2}{3}$ eye	♀ ovig.

complement of 16 scales around the caudal peduncle is reached a little sooner in *anoplus* than in *cernuus*.

A curious feature of *cernuus*, which has not been observed in typical *anoplus* or forma *oraniensis*, is the occasional, and sometimes asymmetrical, development of the anterior barbel. This has been noticed in 17 specimens out of 250 (counting only those from 30 mm. in length upwards). In all cases it was only feebly developed, and occurred only in specimens between the lengths of 30 and 55 mm.: on both sides in 7 specimens, only on the left in 4, and only on the right in 6.

For these reasons the maintenance of two specific names formerly seemed to me to be justified. But the advent of the Orange River material has caused me to revise this opinion. The very close relationship of the two forms is assuredly correlated with the close topographical approximation of the headwaters of the respective river-systems, the Olifants (*cernuus*) and Gouritz (*anoplus*). The two systems abut on the main Cape watershed, and especially at Karroo Poort the headwaters of the Doorn River (Olifants system) and the Touws River (Gouritz) are at the present day separated only by low-lying country. In earlier times when the whole country was lower and the watershed less elevated or developed, it is possible, nay probable, that some interconnection existed.

Very early stages and ovigerous ♀♀ were caught in November, February, March, April.

The Clanwilliam Chubby-head is hardy in captivity, examples having been kept by Mr. Harrison for two years. They have a curious habit, while floating in the water, of bobbing the head down and up, as if making obeisance to some invisible Fish-god.

Barbus karkensis G. and T.

Gillieminkie or Gillie (*Eastern Province and Natal*).

1913. Gilchrist and Thompson, *l.c.*, p. 430.

1916. Boulenger, *l.c.*, p. 272 (synonym of *anoplus*).

1934. Fowler, Proc. Ac. Nat. Sci. Philad., lxxxvi, p. 431 (? part only).

Although there is no fresh material from the type locality, Mr. Harrison has recently collected material which appears to be this species. In view of its similarity with *anoplus*, and the distributional questions raised thereby, some notes on this material are given.

There are no specimens under 30 mm. in length, consequently nothing can be said as to the stage at which the barbel and scaling develop.

All the stages above 30 mm. up to 87 mm. agree with the table given for *anoplus* forma *typica* (p. 209), except in one feature. The lateral line tubules are continuous and complete, except on the hindmost 2–5 (sometimes 6) scales on the caudal peduncle; sometimes the tubules are missing only from the last scale.

Gilchrist and Thompson's type (73 mm. to end of middle caudal rays) also agrees.

The striae on the scales, although numerous, are slightly fewer than in *anoplus*.

The completeness of the series of lateral line tubules, and the fewer striae on the scales, seem to be the only morphological differences between *karkensis* and *anoplus*, although the snout is not quite so blunt and rounded in *karkensis* as it is in *anoplus*.

The Gillieminkie is not a "red-fin." In other respects the coloration appears to be the same as in *anoplus*. In some specimens, as preserved, there is a distinct yellowish tinge, those which show it best being males (as in *anoplus*); and at Kokstad Mr. Harrison's attention was drawn to these yellow specimens.

Localities.—Tugela River system: Helpmakaar, Natal (Fowler); Driefontein, Ladysmith, Natal (ex Natal Museum). Umgeni River system: Karkloof, Natal (Gilchrist and Thompson). Umzimhlava River system: Kokstad commonage, Eastern Griqualand) (A. C. H.). Gt. Kei River system: Kubusie River at Stutterheim (A. C. H.); Nahoon River at Berlin (A. C. H.). Buffalo River system: Tyusha stream at Pirie (A. C. H.). Gt. Fish River system: dam at Bedford (F. G. Chaplin, 1933). Vaal River system: Bethlehem, O.F.S (Fowler).

Fowler says (*l.c.*, p. 431) only first 10 lateral line scales are tubular "in young"; he records specimens of 50–63 mm. from Bethlehem, 58 mm. from Helpmakaar, and 55 mm. from "Zwartsberg River," * none of which can be called young. In the present material the lateral line tubules are developed and complete at the 35–40-mm. stage. And I have seen a single specimen from Harrismith (also Vaal River system) with incomplete lateral line. Consequently I am inclined to think that Fowler's description is composite. Much more material is required from the Bethlehem-Harrismith area before one can say whether the Vaal River specimens are a form of *anoplus* or true *karkensis*.

No investigation has yet been made of the southern Natal area between the Umgeni River system and the Umzimhlava system (Umkomaas and Umzimkulu rivers). And as regards the south-westerly limit of *karkensis*, the area between the Gt. Fish River and the Sundays River, including the Bushmans and Sundays rivers, has also not yet been investigated.

I have seen Weber's Klip River specimens, 11 in number, from 32–55 mm. in length. Although very similar to both *anoplus* and *karkensis*, they differ in certain respects. From *anoplus* they differ in having a complete series of lateral line tubules, and slightly fewer striae on the scales; and at 50 and 55 mm. (ovig. ♀) they have not developed more than 14 scales around the caudal peduncle.

The two former characters bring them into agreement with *karkensis*, but in the latter character they differ from *karkensis* as well as from *anoplus*, in both of which species specimens of 30–40 mm. typically exhibit 16 scales around the caudal peduncle. Weber's specimens cannot therefore be included with *karkensis*, but no conclusions should be drawn from so small a series.

* It is impossible to say where this locality is.

The same applies *a fortiori* to a single specimen from Howieson's Poort, Kariega River system (ex Albany Mus.), which is 50 mm. in length with only 14 scales around the caudal peduncle.

Barbus afer Peters

1864. Peters, MB. Ac. Wiss. Berlin, p. 395.

1868. Günther, Cat. Fish. Brit. Mus., vii, p. 148.

1938. Barnard, *l.c.*, p. 85.

[Not Boulenger, *l.c.*, 1911, p. 178, fig. 156, the description is composite, the recorded specimen and its figure = *burchelli*.

? Pellegrin, Bull. Soc. zool. Fr., xlv, p. 148, 1920. Name only. Upper Zambezi.

? Fowler, Proc. Ac. Sci. Philad., lxxxvi, p. 431, 1934. Natal and Cape Province. 35 and 37 mm.

Not Gilchrist and Thompson, *l.c.*, 1913, p. 430, fig. 88. After Boulenger.]

Thanks to the kindness of Dr. E. Ahl of the Berlin Museum, I was able to examine one of three specimens labelled as types (Cape of Good Hope, coll. Krebs), preserved in that Museum. Dr. Ahl said all three specimens were in poor condition. The specimen sent to me was an ovigerous ♀ measuring 100 mm. in length; it had lost most of its scales, but as these are of large size, the scale-pockets could be counted with reasonable accuracy.

Depth of body approximately (the belly was very flabby) 4, length of head 4 in length of body (excluding caudal fin). Eye 4 in length of head, subequal to snout, $1\frac{2}{3}$ in interorbital width. Mouth terminal or subterminal. One barbel on each side, subequal to eye-diameter. Gill-rakers $2 + 6 - 7$ on anterior arch.

D iii. 7. 3rd spine thin, flexible, non-serrated, slightly shorter ($\frac{4}{5}$) than length of head, origin of 1st spine midway between tip of snout and base of middle caudal rays. Pectoral not reaching ventral (♀), the latter arising below dorsal spines. A iii. 5. Scales large, striae few (about 8), l.l. 27, c.ped. 12, tr. 4 (5) between dorsal spines and l.l., 3 between l.l. and ventral spine, between l.l. and base of anal 3 anteriorly, 2 posteriorly; 12 predorsal (no scales left, pockets counted); lateral line tubules present on scales 1–6, 12–15, 18, 19, and 25, absent on 20th scale right side, and 26th and 27th scales left side, other scales missing; l.l. therefore probably complete or nearly so.

Note on Barbus viviparus *Weber*

1941. Barnard, Ann. Mag. Nat. Hist. (xi), 8, p. 469.

On account of the alleged viviparity of this species, and also of its resemblance to *pallidus*, I thought it desirable to re-examine the original material. Thanks to the kindness of Dr. de Beaufort of the Amsterdam Museum, I have been able to do this; and a brief note has been published (*l.c., supra*).

Weber (Zool. Jahrb. Abt. Syst., x, 1897, p. 153) stated that he took embryos, 8 mm. in length, with large yolk-sacs, from a ♀ 53 mm. in length. As Weber remarked, no case of viviparity among the *Cyprinidae* was known. So far as I am aware, these observations have not been commented upon, or confirmed.

In the material loaned to me, there were one large and one small specimen from Isipingo, and 25 specimens, 17–49 mm. in length, from the Umhloti River, Verulam. The large Isipingo specimen measures 64 mm. to the end of the caudal lobes, and a 49-mm. specimen measures 53 mm., thus conforming with the measurements given by Weber.

None of these specimens had been opened for purposes of sexing. Neither the specimen from which Weber took the embryos, nor any of the embryos, were included in the material.

I opened all the specimens sent to me, and found that the sexes could be distinguished in specimens from 35 mm. in length upwards. Most of them were males; the 59-mm. Isipingo specimen, and 3 Verulam specimens, 45–49 mm., were females.

The ovaries in all the ♀♀ were in all respects normal, containing a *large number* of *normal-sized* ova. The ♂♂ were *without intromittent organs.* I failed, therefore, to find any evidence suggesting that this species is viviparous.

Later, Dr. de Beaufort informed me (15/iv/39) that there were two more specimens in the Amsterdam Museum: one ♀ "with embryos in the ovarium," mounted in the exhibited collection; and another ♀ which had been cut open and "the embryos fallen out of the body-cavity and lying on the bottom of the glass." The former specimen could not, of course, be sent to me, but Dr. de Beaufort very kindly sent the latter.

Examination of this specimen showed that the stomach and intestines had been removed, the ovaries were nearly intact and contained a large number of normal-sized ova (as in the previous lot of specimens), and the supposed embryos lying loose in the tube were really the fry of a Cichlid!

Weber (*l.c.*, p. 148) mentions that he obtained young fry from the mouths of "Chromis philander" in the Umhloti River at Verulam, one of the localities where he obtained *B. viviparus*. And in the tube of 25 *B. viviparus* from Umhloti River, previously sent to me, there were also 8 small Cichlids. The explanation, therefore, seems to be that in the exigencies of field-collecting, all these specimens were preserved together; later one ♀ *viviparus* had been put in a separate tube together with the Cichlid fry assumed to be its embryos.

The investigation has thus been narrowed down to a re-examination of the ♀ mounted in the exhibition collection at Amsterdam to see whether: (*a*) the young are actually *in utero* (not perchance in the stomach or intestine, indicating that the *Barbus* had been feeding on them, which is unlikely), and (*b*) they are actually young *Barbus*.

Pending this re-examination and confirmation of Weber's statements, in view of the above evidence and the novelty of the phenomenon of viviparity in a Cyprinid, the specific name "*viviparus*" must be regarded as a misnomer, although of course nomenclatorily it remains valid.

The following notes on diagnostic characters may be useful. *B. viviparus* is a pretty little species, resembling *pallidus* in many respects, but with different markings in preserved specimens. It has, as Weber described, a thin dark lateral streak ending in a round spot on the end of the caudal peduncle. In Weber's types (collected 1894–5) the tubuliferous lateral line is not dark; in Boulenger's Durban specimen (1911, *l.c.*, p. 170) it is dark. The dark spot on either side of the base of the anal fin is distinct at all stages (cf. *pallidus*).

Length of head in length of body changes from $3\frac{1}{3}$ (17-mm. stage), $3\frac{1}{2}$ (20 mm.), $3\frac{3}{4}$ (25 mm.), to 4 (35 mm. upwards); diameter of eye in head from $2\frac{1}{2}$ (20 mm.), 3 (25 mm.), $3\frac{1}{4}$ (40 mm.), $3\frac{1}{2}$ (45 mm.), $3\frac{3}{4}$ (49 and 59 mm.). Up to about 45 mm. the eye is slightly greater than the snout, only after that stage being subequal to it. The 17-mm. specimen is mutilated, but at the 20-mm. stage the scales and the posterior barbel are present, and the anterior barbel is just visible as a mere knob; at 23 mm. the latter is easily discernible.

The striae on the scales are few, not more than about 5 or 6, sometimes 7; and a feature of those in the largest specimens is the incompleteness of the striae (not reaching the hind margin of scale).

Predorsal scales 10–11, usually 10. The dorsal and anal fin formulas are given as D iii. 8 and A ii. 5. These may be regarded as normal. But among the 27 specimens examined there were 3 (one of them being the mutilated 17-mm. specimen, and one the large 59-mm. Isipingo specimen) with only 7 dorsal rays.* One other specimen had 6 anal rays. As a rule only 2 anal spines are visible, but in most cases, especially in the juveniles, 3 can be distinguished, the true 1st spine being very short.

Gen. Engraulicypris Gnthr.

1911. Boulenger, Cat. Freshw. Fish. Afr., ii, p. 209.

1913. Gilchrist and Thompson, Ann. S. Afr. Mus., xi, p. 436.

1917. Nichols and Griscom, Bull. Amer. Mus. Nat. Hist., xxxvii, p. 703.

1930. Fowler, Proc. Ac. Nat. Sci. Philad., lxxxii, p. 39.

1934. Van der Horst, Ann. Transv. Mus., xv, p. 281.

1936. Fowler, Proc. Ac. Nat. Sci. Philad., lxxxviii, p. 294 (with subgenera).

Engraulicypris gariepinus n. sp.

It is a little uncertain whether one or two South African species should be recognized. *E. brevianalis* Blgr., 1908, was founded on a single specimen from Zululand (37 mm.) with 12 branched anal rays and 52 scales in the lateral line. The number of gill-rakers was not given. In Boulenger (*l.c.*) the original description is supplemented by the inclusion of 3 specimens from the Dwaars River, Transvaal, viz. anal rays 12–13, scales l.l. 50–52, and gill-rakers about 15. Whether it is the type specimen, which has "about 15" gill-rakers, or the Dwaars River specimens, remains ambiguous.

In the South African Museum are the 7 specimens from the Dwaars River (Limpopo system) recorded in Gilchrist and Thompson's work, which are part of the original lot, 3 having been sent to Boulenger. These 7 specimens show the following features: D ii. 7. A iii. 12–14 (one specimen with 12, two with 13, and four with 14 branched rays). The number of gill-rakers is 10–11 (total number on 1st arch), Gilchrist and Thompson did not give the number of gill-rakers, but gave scales l.l. 52–55 (which numbers are confirmed herewith).

There are also 3 specimens from the Sabi River (Komati River system) which agree with the above 7 specimens in the number of gill-rakers; one, however, has D ii. 8, one has A iii. 14, and two have A iii. 15.

* Cf. *pallidus*, p. 194.

Further, 7 specimens from the Hluhluwe Reserve, Zululand (Dr. R. F. Lawrence, Natal Mus.): gill-rakers and scales as above, five specimens with 13, two with 14 anal rays, one with 8 dorsal rays (this specimen has 13 anal rays).

From the Orange River at Goodhouse I have over 1000 specimens, 11–55 mm. in length; and from the Gt. Fish River at Aiais, S.W.A. (a tributary of the Orange River), 106 specimens, 22–56 mm. in length. These show: D ii. 7–8. A iii. 15–17, gill-rakers 9–10, scales l.l. 45–48 (-49–50), caudal peduncle 16.

In 1934 van der Horst described a second South African species: *whitei*, from the Aapies River (Limpopo system), with A iii. 15–16, gill-rakers 12, and scales l.l. 58–59.

As van der Horst gives 3 anal spines, and the same number is constant in all my specimens, it may be assumed to be normal, and that the minute 1st spine was overlooked by Boulenger, and by Gilchrist and Thompson.

Counting the branched rays only, we see that a complete series can be obtained from comparatively few specimens (taking a haphazard sample of 20 from the Orange River specimens):—

Number of Specimens.	Number of Branched Anal Rays.	Material.	Authority.
1	12	Type of *brevianalis* (Zululand)	G. A. B.
1	12	Dwaars River (G. and T.'s material)	K. H. B.
2	13	,, ,,	,,
5	13	Zululand	,,
2	14	,,	,,
4	14	Dwaars River (G. and T.'s material)	,,
1	14	Sabi River	,,
2	15	,,	,,
9	15	Orange River	,,
9	13–16	Aapies River, *whitei*	v. d. H.
9	16	Orange River	K. H. B.
2	17	,,	,,

Similarly there is a continuous series as regards the scales in the lateral line from 47–55 and 58–59. This is not correlated with the number of anal rays; but, on the other hand, one may note that the number of gill-rakers decreases as the number of anal rays increases.

Although it may seem premature to give a name to the Orange River specimens, they are at least as distinct from *brevianalis* and *whitei* as these two forms are from one another, and I think no great harm will come if they be recorded under the name *gariepinus* n. sp. (essential characters given above).

Before the limits of the species can be determined, a detailed analysis of abundant material from many more localities must be made. It is rather astonishing that hitherto no examples of *Engraulicypris* have been obtained from the upper reaches or tributaries of the Orange River. If the genus really is absent from the latter region, its presence in the lower section of the Orange River, below the Aughrabies Falls, and its tributary the Gt. Fish River, is even more remarkable.

Gilchrist and Thompson mentioned one feature which seems to have escaped the attention of Boulenger; they say the under surface of the lower jaw is either "entire" (= smooth) or covered with minute tubercles. They do not suggest that it is a sexual character; but to some extent it is. The lower surface of the lower jaw in the ovigerous ♀ has very minute tubercles or villi; in the ♂ these are much more numerous and distinct, and extend on to the symphysial and branchiostegal membranes, and the interopercle and lower border of the preopercle.

The very fine series from the Orange River and Gt. Fish River were collected by Dr. A. J. Hesse and Mr. C. W. Thorne of the South African Museum (Nov. 1936). When freshly caught the colour was pale yellowish-silvery; as preserved the whole body is silvery and there is a more or less obvious stripe along the side formed by minute pigment specks; dark specks are also present along the back, on the top of the head, snout, upper border (and to a lesser extent the lower border) of the eye-ball, and along base of anal fin; opercle, cheek, and iris brilliantly silvery, pupil black.

Family CLARIIDAE.

Clarias, the Mud-barbel, occurs in the Orange River system, but it need not be considered here, except to record the actual occurrence of *L. gariepinus* at Goodhouse on the Orange River, and at Aiais on its tributary the Gt. Fish River in South West Africa (A. J. H. and C. W. T., Nov. 1936) (fig. 22).

Family BAGRIDAE.

Gen. Gephyroglanis Blgr.

1911. Boulenger, *l.c.*, ii, p. 344.
1913. Gilchrist and Thompson, *l.c.*, p. 452.
1916. Boulenger, *l.c.*, iv, p. 304.

The distribution of this genus is discontinuous: Lake Chad, Ogowe River (French Equatorial Africa), Congo River, and the Orange River system.

Gilchrist and Thompson recorded two specimens from the Kafue River, a northern tributary of the Zambezi River. Mr. Drury, of the South African Museum, tells me he does not definitely remember catching this particular kind of Catfish; the specimens were not registered by Mr. W. W. Thompson at the time, merely put in a bottle

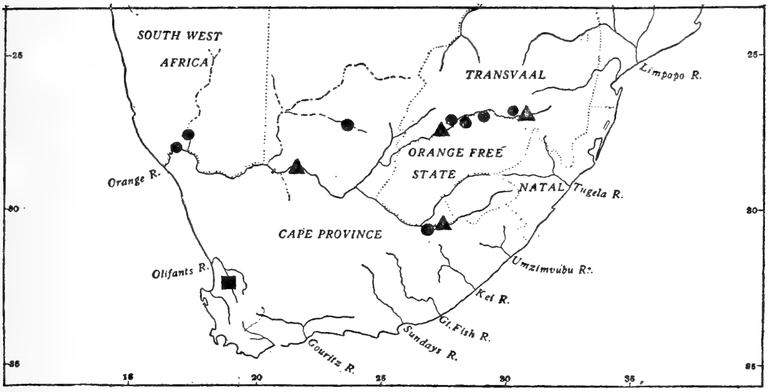


FIG. 22.—Map showing recorded localities of ● *Clarias gariepinus*, ▲ *Gephyroglanis sclateri* (in the Orange River system), and ■ *Gephyroglanis gilli* (in the Clanwilliam Olifants River).

with a pencilled label *outside*; and there is now only one specimen, instead of two. Confirmation of the locality seems desirable.

Dr. van der Horst (*l.c., infra*) mentions *G. sclateri* from the Transvaal, but without definite locality.

Dr. J. L. B. Smith (*l.c., infra*) gives Natal as a locality, but see *infra*, p. 227.

The recent discovery (September 1936, K. H. B. and C. W. T.) of specimens in the Clanwilliam Olifants River is one of the most surprising results of the investigation of the indigenous fish-fauna (fig. 22).

Of the species described in Boulenger's work, the Orange River species, *sclateri*, is the only one with obtuse or rounded caudal lobes.

The number of anal rays differs in each species, but appears to be characteristic, especially the number of branched rays. The anal fin is composed of short weak spines, longer simple rays, and branched rays. The spines are concealed under the rather thick skin; without dissection, and sometimes even after dissection, they are difficult to count. The simple rays are segmented, at least distally. The branched rays in specimens up to about 75 mm. in length (both the Orange River and Olifants River forms) are simply bifurcate; but in those over this length each branch is split up, and the ray becomes quadrifurcate. In the largest specimen (Orange River) there may be 5 or 6 branches to each ray. The first ray, however, usually remains bifurcate, or only one of the branches splits (trifurcate). The last ray, which begins as a simple ray, becomes bifurcate, and remains so (in the smallest specimens, although simple, it is counted among the branched rays).

The Catfishes of this genus are distinguished from the marine Catfish *Galeichthys* (also called a Barbel): by the deep angle or notch in the gill-membranes on the lower surface; by the well-separated nostrils, the anterior nostril tubular, the posterior with a short barbel or tentacle; by the dorsal and pectoral spines being smooth on the front edges, the former is smooth also on its hind edge, only the pectoral spine being serrate on its hind edge.

Key to the Species.

1. Distance between anterior nostrils equal to distance between inner mental barbels, but *less* than distance between posterior nostrils; the distance between the latter equal to distance between outer mental barbels; the former distance $1\frac{1}{2}$ in the latter. Orange River . . . . . *sclateri.*
2. Distance between anterior nostrils equal to distance between inner mental barbels, and also *equal* to the distance between posterior nostrils; this distance twice in the distance between outer mental barbels. Olifants River . . . . *gilli.*

Gephyroglanis sclateri Blgr.

Orange River Rock-baager, or Cat-fish.

Fig. 23, *a*, *b*.

1911. Boulenger, *l.c.*, ii, p. 346, fig. 269.

1913. Gilchrist and Thompson, *l.c.*, p. 453, fig. 104.

1931. van der Horst, Ann. Transv. Mus., xiv, p. 246. (Transvaal, without definite locality.)

1934. Fowler, Proc. Ac. Nat. Sci. Philad., lxxxvi, p. 419.

1937. J. L. B. Smith, *l.c.*, p. 130.

Gilchrist and Thompson did not dissect the anal fin in their material, nor did Boulenger apparently. I find from an examination of 23 specimens that the composition of the fin does not quite agree with previous statements.

There are usually 4 spines, in two cases 3; in one case only 2; 2 or 3 simple rays; and 10–12 branched rays. The formula may be

2.2.12, 3.3.11 or 12, 4.3.10–12, 4.2.11 or 12; the most frequent being 4.2.12. The total number varies from 17 to 19; among the 23

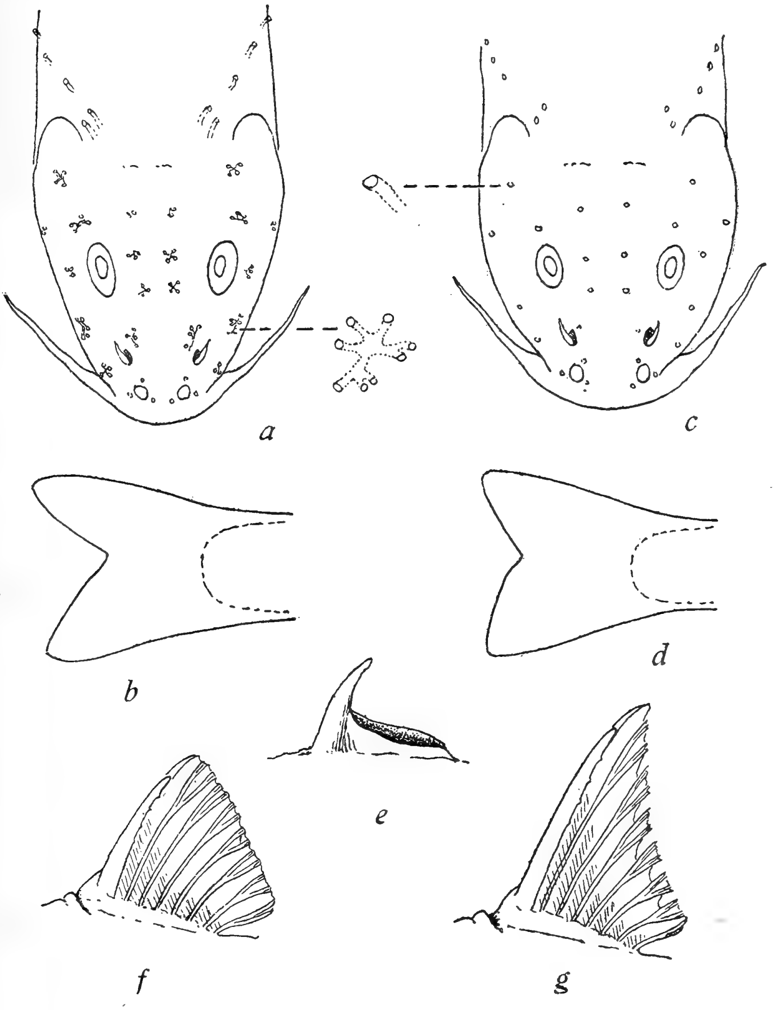


FIG. 23.—*Gephyroglanis. G. sclateri:* *a.* Dorsal view of head. *b.* Caudal fin. *G. gilli* n. sp.: *c.* Dorsal view of head. *d.* Caudal fin. *e.* Side view of posterior nostril. *f, g.* Low and high varieties of dorsal fin.

specimens there is one with 19 (4.3.12), 6 with 17, 15 with 18, and one with only 16. (The Kafue River specimen is included.)

In the dorsal fin there are, in 22 specimens, 7 rays, the last being small and less branched than the preceding ones; in one specimen, 140 mm., there are 8 rays.

The large dorsal spine is preceded by a short, blunt, and more or less movable bony process, which might be regarded as the true 1st dorsal spine; but following Boulenger's practice only one spine is counted.

The dorsal fin varies in shape irrespective of age or sex (*cf.* fig. 23, *f*, *g* of *gilli*). In high fins the dorsal spine equals the distance from hind margin of opercle to posterior nostril; the 1st ray equals the distance from hind margin of opercle to anterior nostril. The dorsal spine is a little longer than the pectoral spine.

In low fins the dorsal spine and the 1st ray are equal to the distance from hind margin of opercle to, respectively, about midway between eye and posterior nostril, and to posterior nostril. The dorsal and pectoral spines are subequal.

In both forms the length of the base of the dorsal fin is the same: subequal to the snout.

Both dorsal and pectoral spines are measured to the end of the bony portion, excluding the flexible membranous tip.

The table shows certain growth-changes. At about 170 mm. the sexes are distinguishable but immature; at 180 mm. onwards the specimens are ripe or nearly so.

For comparison with the new species described below, the following details, taken from the 75- and 115-mm. specimens, are given: distance between anterior nostrils $1\frac{1}{2}$ in distance between posterior nostrils; snout slightly longer than postocular part of head; distance between bases of anterior (inner) mental (or mandibular) barbels $1\frac{1}{2}$ in distance between posterior (outer) mental barbels, and equal to distance between anterior nostrils; distance between posterior mental barbels equal to distance between anterior margin of eye and posterior nostril. These details apply also to the larger specimens.

The caudal lobes tend to become blunter in large specimens, but the emargination is always greater than in the next species (fig. 23, *b*).

The mucus tubules on the head are more or less dendritic (fig. 23, *a*), *i.e.* each tubule opens by two or more pores.

Localities.—In addition to Boulenger's and Gilchrist and Thompson's records, Fowler describes a specimen from Bethlehem, O.F.S. (on a tributary of the Vaal River); the S. Afr. Mus. has Kannemeyer's specimen from the junction of the Orange and Caledon rivers,* and several specimens from Upington.

* Kannemeyer, Proc. 26/vi/95 in Trans. S. Afr. Philos. Soc., viii, p. xcvii, 1896.

J. L. B. Smith gives Natal as a locality. It might be thought, perhaps, that he was referring to Fowler's record which was published in a paper dealing with fishes "mostly from Natal and Zululand." But Smith gives 15 inches as the greatest recorded length; this is much greater than any actually published record (220 mm. G. and T.), and may be a misprint; Smith informs me (*in litt.* 21/5/41) that he has no specimens in his collection.

Dr. Kannemeyer explains that this species gets its name from its preference for rocky spots, as opposed to the mud-loving *Clarias*.*

Gephyroglanis sclateri.

	TL	L/H	H/E	S/E	I/E	I/d.a.n.	Pectoral Spine Serrations.	g.r.	Sex and Remarks.
Potchefstroom	75	3¾	5	2	1½	2	6–7	4 + 10	
,,	115	4	5½	2⅓	1¾	2⅓	9	4 + 12	
Kraai R. .	135	4	5½	2⅓	1⅘	2⅓	11		
Upington .	140	4	5½	2⅓	1⅘	2⅓	..	..	Di. 8.
Johannesburg	145	4	6	2½	1⅘	2⅓	12–13	5 + 13	
Upington .	165	4	6	2½	1⅘	2⅓	..	..	♀ immature.
Potchefstroom	175	4	6	2½	1⅘	2⅓	14–15	..	♂ ,,
Vaal R. .	185	4	6	2½	1⅘	2⅓	16	..	♂ ♀.
Upington .	200	4	6½	2¾	2	2⅓	16–17	5 + 14	♂ ♀.
,, .	210	4	7	3	2¼	2½	17	..	♂ ♀.
Kafue R. .	210	4	7	3	2⅓	2½	14	5 + 15	♀ ovig.
Upington .	215	4	7¼	3⅓	2⅓	2½	15	5 + 15	♀ ovig.
Potchefstroom	220	4	7⅓	3½	2⅓	2½	16–17	5 + 15	♂.
,,	230	4	7½	3½	2⅓	2½	16–17	5 + 16	♀ ovig.
Orange R. .	300	4	7½	3½	2⅓	2¾	18–19	6 + 16	♀ ovig.*

23 specimens. * Kannemeyer's specimen.

Gephyroglanis gilli n. sp.

Clanwilliam Catfish.

Fig. 23, *c–g*.

Closely allied to *sclateri* (D i. 7, caudal lobes obtuse, etc.), but distinguished by the following characters.

The caudal lobes are more obtuse and the notch much shallower in *gilli* than in *sclateri*; the middle caudal rays being a little longer than the depth of the caudal peduncle instead of subequal (*cf.* fig. 23, *b* and *d*). As in *sclateri*, the lower lobe is usually slightly larger than the upper lobe. At 32 and 38 mm. the caudal is truncate with rounded corners; at 43 mm. slightly emarginate.

* Kannemeyer, Proc. 26/vi/95 in Trans. S. Afr. Philos. Soc., viii, p. xcvii, 1896.

The composition of the anal fin is different: 2 or 3 spines, 2 simple rays, 10 or 11 branched rays (including the last one, which in the smaller specimens is simple): total number 14–16. The usual formula is 3.2.10 = 15 (contrast with *sclateri*: 4.2.12 = 18).

The head is relatively larger and the eye smaller in *gilli* (*cf.* the 73, 77, and 105 mm. specimens of *gilli* with the 75 and 115 mm. *sclateri* in the tables).

The length of the snout is subequal to the postocular part of head. The snout is broader in *gilli*: distance between the anterior nostrils subequal to that between the posterior nostrils.

The distance between anterior nostrils equals distance between bases of anterior mental barbels (as in *sclateri*), but this distance is *twice* in distance between bases of posterior mental barbels; the latter distance almost as long as distance from anterior margin of eye and tip of snout. The distance between anterior nostrils is almost twice in snout in *gilli*, but almost thrice in *sclateri* (*cf.* fig. 23, *a* and *c*). The mucus tubules on the head are all simple (fig. 23, *c*), each opening by a single pore.

On the basis of these differences the institution of a separate species for the Olifants River form is justified. As Boulenger named his species after the then Director of the South African Museum, so it is appropriate to name this n. sp. after the present Director, Dr. E. L. Gill.*

Locality.—Olifants River system, Clanwilliam Division: in an irrigation furrow off the Jan Diesel's River in Bosch Kloof, Clanwilliam (Sept. 1936, K. H. B. and C. W. T.); Boontjes River, Citrusdal (A. C. H., K. H. B., and C. W. T., April 1937); upper reaches of Olifants River at the farm "Keerom" and in a side tributary on the farm "Noordhoek" (K. H. B. and C. W. T., Feb. 1939).

The dorsal fin formula is normally D i. 7, counting only one spine, although there is the same short blunt bony process in front of it as in *sclateri*. There are two very feeble and inconspicuous denticles on the hind margin of the spine at 55 mm., and 4–5 at later stages (fig. 23, *f*, *g*).

In 4 specimens out of 27 there are only 6 dorsal rays: one 38 mm., one 43 mm., and two between 70 and 80 mm.

As in *sclateri*, there are two forms of dorsal fin (fig. 23, *f*, *g*), which are irrespective of age (and by analogy, probably irrespective of sex also). The length of the base of the fin is the same in both forms, subequal to the snout.

* Written before Dr. Gill's retirement in January 1942.

In high fins the dorsal spine and 1st ray are equal to the distance from hind margin of opercle to, respectively, anterior margin of eye (or midway between eye and posterior nostril), and to posterior nostril. In low fins the dorsal spine and 1st ray are equal to the distance from hind margin of opercle to, respectively, hind margin of eye and to midway between eye and posterior nostril.

As in *sclateri*, the dorsal spine is a little longer than the pectoral spine (measured as indicated above) in the high fin form, but in the low fin form the two spines are subequal.

The margin of the low fin is even, with fine scalloping between the rays; the margin of the high fin is uneven, ragged, the rays projecting more or less beyond the membrane.

Although there is a slight amount of variation, there is no difficulty in at once separating the high and low finned forms. In the extreme forms, if they came from different river-systems, this difference might almost be regarded as constituting a specific difference. In fact, however, the difference appears to be due to habitat. In the case of *sclateri* no details are available as to the particular habitat of any of the specimens. But the Clanwilliam specimens were all collected by myself and my assistant Mr. Thorne and the following correlation can be observed.

The first seven specimens, 43–88 mm. in length, were caught in September 1936 in an artificial furrow leading from a side tributary of the Jan Diesels River. The furrow was from 1–2 feet wide and about the same in depth, with muddy bottom, and margins overgrown with vegetation. The current was moderate, and would probably be fairly constant even after heavy rains, as most of the flood water would be carried by the natural stream. All these specimens have low, untorn dorsal fins.

Four specimens, 70–105 mm., were caught in April 1937 in the Boontjes River near Citrusdal (a tributary of the Olifants River). The Boontjes is from 10–20 feet wide in this section; the bottom is rocky and stony in some places, sandy and muddy in other places. The specimens were caught under the banks of a muddy bottom; but they may have come down from the stony parts; the stony parts were not closely examined, as we were working with a fine net, and at that time we were unaware of the habits of these fish. These four specimens have high ragged fins.

In February 1939 in the upper reaches of the Olifants River ("Keerom") we discovered that these fish were quite common under the stones and boulders near the margin of the river. We found them in a similar habitat in a side stream ("Noordhoek"). All these (16 specimens were killed, from 32–95 mm. in length) have high ragged dorsal fins.

Thus it appears that the low untorn fin is correlated with a placid and muddy habitat; whereas the high ragged fin is correlated with a stony and more turbulent habitat.

Several specimens were brought alive to Cape Town in February 1939 and handed over to Mr. A. C. Harrison. The smaller ones soon became quite tame and fed openly on Enchytraeid worms, but the larger ones remained shy. All were maintained in good condition until July 1939, when all but the smallest one died; and the latter died six months later. We hoped that they would attain maturity and breed in captivity, but apparently there was something lacking in the diet, as they all became very thin, although otherwise perfectly healthy.

Gephyroglanis gilli.

TL	L/H	H/E	S/E	I/E	I/d.a.n.	Pectoral Spine Serration.	g.r.	Sex and Remarks.
32	$3\frac{1}{2}$	$5\frac{1}{4}$	2	$1\frac{3}{4}$	$1\frac{1}{2}$	5	3 + 10	Di. 7.
38	$3\frac{1}{2}$	$5\frac{3}{4}$	$2\frac{1}{4}$	$1\frac{3}{4}$	$1\frac{1}{2}$	6	..	Di. 6.
43	$3\frac{1}{2}$	$5\frac{3}{4}$	$2\frac{1}{3}$	$1\frac{3}{4}$	$1\frac{1}{2}$	4–5	..	Di. 6.
55	$3\frac{1}{2}$	$5\frac{3}{4}$	$2\frac{1}{3}$	$1\frac{3}{4}$	$1\frac{1}{2}$	6–8	..	Di. 7. 2 feeble dorsal spine serrations.
60	$3\frac{1}{2}$	6	$2\frac{1}{3}$	$1\frac{3}{4}$	$1\frac{1}{2}$	5–8		
65	$3\frac{1}{2}$	6	$2\frac{1}{3}$	2	$1\frac{1}{2}$	5–10		
70	$3\frac{1}{2}$	6	$2\frac{1}{3}$	2	$1\frac{1}{2}$	6–10 *	4 + 10	4 feeble serrations.
73	$3\frac{1}{2}$	$6\frac{1}{4}$	$2\frac{1}{2}$	2	$1\frac{1}{2}$	6–10		
77	$3\frac{1}{2}$	$6\frac{1}{3}$	$2\frac{1}{2}$	2	$1\frac{1}{2}$	7–10		
83	$3\frac{1}{2}$	$6\frac{1}{2}$	$2\frac{1}{2}$	2	$1\frac{1}{2}$	7–10		
88	$3\frac{1}{2}$	$6\frac{3}{4}$	$2\frac{3}{4}$	2	$1\frac{1}{2}$	7–10	4 + 11	
90	$3\frac{1}{2}$	7	3	2	$1\frac{1}{2}$	8–10 *	..	4–5 feeble serrations.
95	$3\frac{1}{2}$	7	3	2	$1\frac{1}{2}$	10 *		
105	$3\frac{1}{2}$	7	3	2	$1\frac{1}{2}$	10	4 + 11	Immature.

27 specimens.

* 11, 12, or even 13, owing to obvious duplication of one or two serrations.

Family GALAXIIDAE.

1906. Regan, Proc. Zool. Soc. Lond., 1905, ii, p. 363.
1915. Boulenger, *l.c.*, iii, p. 12.
1917. Gilchrist and Thompson, *l.c.*, p. 470.
1936. Scott, Pap. and Proc. Roy. Soc. Tasman. for 1935, p. 85.

1938. *Id.*, *ibid.*, for 1937, p. 111 (statistics for *G. attenuatus*).

1941. *Id.*, *ibid.*, for 1940, p. 55 (colour pattern phases in *G. truttaceus*).

In New Zealand these scaleless fishes are known as Minnow, Gudgeon, Mud-fish, Whitebait, or Inanga (and other Maori names) (W. J. Phillips, Bibliogr. N. Zeal. Fish., 1927, Fish Bull., No. 1, pp. 13, 14). As they are quite different from the true (European) Minnow, the use of this name is to be deprecated. Attempts are being made, therefore, to familiarise Cape anglers and the general public with the name "Galaxias" as a colloquial name, adding "mountain form" and "lake (vlei) form" respectively for *zebratus* and *punctifer*.

Various opinions have been expressed as to the bearing of the geographical distribution of *Galaxias* on the question of the former approximation of the southern land-masses (Günther, 1886; Weber, 1897; Boulenger, 1905; Regan, 1913 and 1914; Meek, 1916; Macfarlane, 1923). Up to the present the discussion has been based on the bare fact that *Galaxias* is found in certain countries; its distribution within each country, in relation to the topography and the geological history of the respective countries has not been studied. Whether *Galaxias* has arisen from a marine ancestor independently in each of the southern continents, or whether its presence in these countries is evidence of their former intimate connection, are questions outside the scope of this paper. For the present an analysis of the specific characters of the South African species, and comments on the present-day distribution will suffice.

Scott (1936, *l.c.*, p. 105) proposes the name *Agalaxis*, as a subgenus of *Galaxias*, for the South African species because they possess only 6 rays in the ventral (pelvic) fins instead of 7 as in typical *Galaxias* from Australasia and South America.

If the anatomy of the South African species had been better known, it is probable that Scott would have suggested full generic rank for *Agalaxis*. Although the teeth resemble those of typical *Galaxias* in being uniserial in the jaws (*v. infra*), the number of vertebrae is less than that of any other Galaxiid yet investigated. According to Regan (1906), W. J. Phillips (1926), and Scott (1936), the number of vertebrae in certain Australasian and South American species of *Galaxias* ranges between 52 and 64; Scott (1936) describes *Saxilaga anguilliformis* with 73 myomeres. In the opposite direction *Paragalaxias* (Scott, 1935, Pap. and Proc. Roy. Soc. Tasman. for 1934, p. 41) has only 44 vertebrae. The South African representative has even fewer, viz. 40 (occasionally 39 or 41).

In conjunction with the character of 6 ventral rays, this low number of vertebrae might be considered to justify generic rank. It seems, however, a pity to refrain from using the classical and euphonious name in order to adopt the (with all respect to Mr. Scott) less euphonious anagram.

Moreover, Stokell has recently shown (1940, Trans. Proc. Roy. Soc. N. Zeal., lxix, p. 422) that variation in the number of ventral rays occurs not only in a species but even in an individual, and therefore that the subgeneric divisions proposed by Scott cannot be maintained.

The dentition of typical *Galaxias* comprises (Regan, 1906) a single row on the lower jaw, on the premaxilla, and on the entopterygoid, and a double row on the tongue. An exactly similar dentition is found in the South African species. That is, on the assumption that, when a dentition is said to be uniserial, it means that only a single row of teeth is operative at a time; it does not exclude the presence of an inner, decumbent, row of replacing teeth.

When the head of a South African *Galaxias* is rendered transparent in a clearing reagent (*e.g.* parachlorophenol + chloralhydrate) all the rows of teeth, which ordinarily appear to be uniserial, are seen to have a series of replacers adjacent to them: on the inner side of the mandibular and premaxillary rows, on the outer side of the entopterygoid row, and on the outer side of each lingual row. A similar appearance as regards the mandibular and premaxillary series has been figured by Scott (*l.c.*, 1935, fig. 1) for *Paragalaxias*. Scott regards the dentition of *Paragalaxias* as biserial. I believe that this is an erroneous description, because if the process of clearing be watched under a lens, the row of replacer teeth only becomes visible as the flesh becomes transparent, whereas the operative row is visible without any clearing.

Scott (1935, *l.c.*, p. 43, fig. 2) in a brief mention of the mucus-pits or pores in *Paragalaxias*, says there are 6 on the dorsal surface of the head. The figure shows 2 interorbital pairs and a single postorbital pore behind each eye. In case the number and arrangement of the pores varies in different genera or species, the arrangement in the South African species may be given. In addition to the 6 in the same position as in *Paragalaxias*, there is one on the inner side of each posterior nostril, and one on the inner side of each anterior nostril. On the side of the head there is one behind each anterior nostril, 2 preorbital, 1 suborbital, and 5 around the edge of the preopercle. Below, and slightly in front of the suborbital pore,

[Late Tertiary coast-line - - - - - - -, corresponding approximately with the 900-foot contour, and Tertiary terrace shaded.]

For details of Cape Peninsula, see fig. 28.

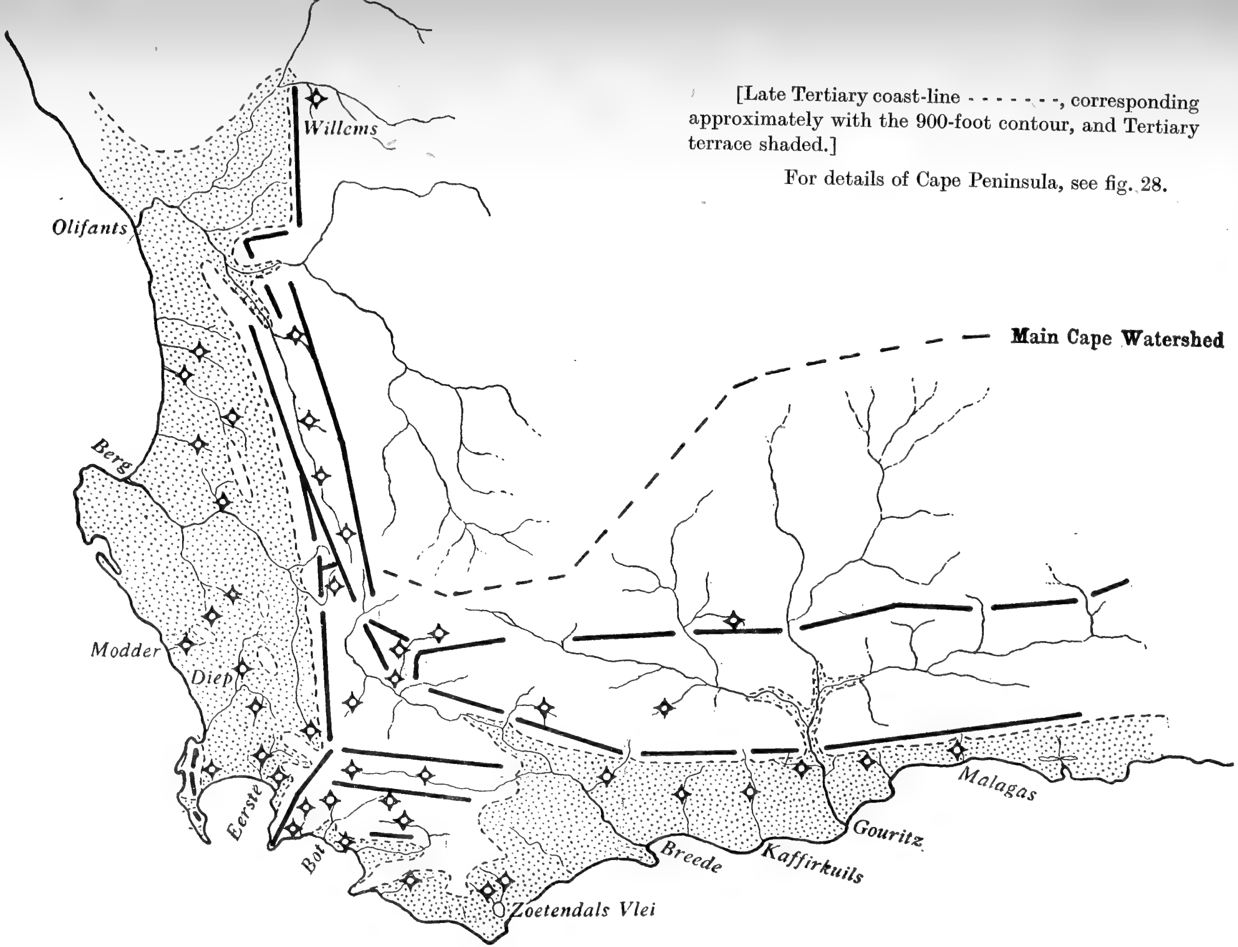


Fig. 24.—Distribution of *Galaxias*.

there may be another, small and indistinct, but often absent (fig. 25).

The lateral line pores are somewhat irregular, there being sometimes two, though usually only one, to a myomere. The number of pores is therefore not an indication of the number of myomeres (vertebrae).

The arrangement in both forms, *zebratus* and *punctifer*, is the same.

The following would appear to be characteristic of the South African species: vertebrae (39) 40 (41); teeth on jaws and entopterygoid uniserial, a double row (larger and recurved) on the tongue; branchiostegals (6) 7; gill-rakers on anterior arch 2 or 3 + 9 or 10; D 3–4, 8–9; A 3–4, 8–10 (total in both cases 11–13).

As regards the species in South Africa, Gilchrist and Thompson admitted three in their monograph, but suggested (p. 473) that the examination of extensive material might show that the three species should be regarded as varieties of one. Such examination does indeed lead to the conclusion that *dubius* G. and T. cannot be maintained as separate from *zebratus*, and furthermore that Castelnau's original two species are variable to such an extent that only their extreme forms can be separated.

Both of Castelnau's species were found together on the Cape Flats, near Cape Town, *punctifer* being stated to be "beaucoup plus rare" than *zebratus*.

Steindachner's species *capensis* has been regarded as synonymous with *zebratus* (Regan, Boulenger, Gilchrist and Thompson), and specimens from the same locality, Lourens (Lorenz) River, Somerset West, in the South African Museum confirm this synonymy.

The examination and tabulation of the characters of some 4700 specimens of all sizes (9 mm. upwards), mostly long series from each of several localities, discloses the extreme difficulty of finding clear-cut and constant characters of specific value.

Ratios of head-length to body-length, depth to length of caudal peduncle, length of the latter in relation to head-length, etc., are quite inconclusive in a long series. The positions of the dorsal, anal, and ventral fins, and even the most outstanding difference, namely, the shape of the caudal fin, are found to be variable, and the extreme forms, *zebratus* and *punctifer*, are connected by transitional forms (fig. 26). Young and half-grown examples often have a squarish tail and approximate closely to typical *punctifer* in this respect. See also Steindachner's description of *capensis* (SB. Ak. Wiss. Wien, ciii, p. 460, 1894), where variation in the position of the dorsal fin and shape of the tail is noted.

Castelnau's statement that *punctifer* was much rarer than *zebratus* is certainly true, taking the S.W. Cape as a whole. The only recorded localities for *punctifer* are: "Cape Flats" (Castelnau), Liesbeek River, at Durban Road (Regan), and Diep River, Lakeside (Gilchrist and Thompson). Recently, however, typical examples have been collected

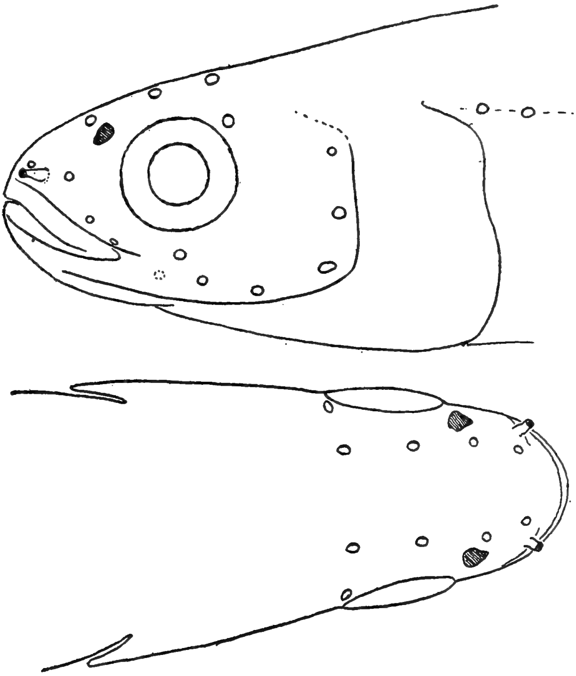


FIG. 25.—*Galaxias.* Lateral and dorsal views of head, showing mucus pores; only two in lateral line in upper figure shown. Openings of nostrils shaded.

in the Mosselbank and Diep * rivers (Klipheuvel–Philadelphia–Kalabas Kraal, Malmesbury area); in the headwaters of the Zout River, a tributary of the Gt. Berg River, near Mamre Road Siding; in Zeekoe Vlei on the Cape Flats; and near the mouth of Verloren Vlei, Piquetberg Division.

All these examples are (after preservation in alcohol) cream-coloured, with scarcely any trace of pigmentation. When alive they were transparent, the backbone, the red gills and heart, and the

* Not to be confused with the previously mentioned Diep River. See p. 119.

silvery lining of the body cavity showing through. The water in the Mosselbank and Diep rivers at the time was muddy and opaque; that in Zeekoe Vlei clear, with a pale sandy bottom; in the latter habitat the fishes whenever possible sought shelter under the landing-stage, boats, or clumps of weed growing on the bottom.

Other series collected in the Nieuwejaars River, Elim, and in a small stream at Strandfontein (S.E. of Zeekoe Vlei on the False Bay coast) approach very closely to typical *punctifer*, but tend to be more pigmented, and the caudal fin can be described as emarginate *only when not completely expanded.*

The only factor which appears to be common to these localities is a slight alkalinity of the water: pH 8–9.

Passing to the other extreme, the *zebratus* form, with a more or less rounded tail, and (usually) a heavier, often a much heavier, pigmentation, we find this in the smaller streams, nearer the foot of the mountains, where there is usually an abundance of decaying vegetable debris, and the water is more or less brownish ("peat"-stained) and on the acid side: pH 5–6·5.*

But variation occurs in each and every locality. Some of the Mosselbank River, Mamre Road Siding, and Zeekoe Vlei specimens have very feebly emarginate or square tails, with the tips of the lobes very slightly rounded. Amongst the Strandfontein lot was one with a very definitely and conspicuously rounded tail. Young and half-grown specimens, as already remarked, are often impossible to place in the one or the other form, judging by the shape of the tail.

Therefore, as a series showing complete transition from the *zebratus* form to the *punctifer* form could be picked out, though not from a single community in any one locality, only one species (*zebratus*) should be recognized. But the extreme forms, if placed side by side, are so distinct that this course would probably not meet with general approval. We may therefore recognize two forms, thus:

zebratus.—Caudal fin rounded-truncate, the tips of the lobes usually distinctly rounded, but sometimes somewhat squarish; distance between end of middle caudal rays and 1st dorsal spine (not the adipose extension in front of it) not exceeding the distance between latter and hind margin of eye, *i.e.* the 1st dorsal spine arises slightly behind the middle of the *total* length, and approximately opposite the vent; usually more or less heavily pigmented, with or

* Colour of the water and acidity are not necessarily correlated. In the lower reaches of the Nieuwjaar River near Zoetendals Vlei the water is alkaline but retains its brown-stained coloration (A. C. H.).

without cross-bars, the silvery lining of the belly mostly obscured; usually in slightly acid waters.

punctifer.—Caudal fin emarginate, the tips of the lobes square or slightly acute; distance between end of middle caudal rays and 1st dorsal spine subequal to (or even slightly greater than) distance

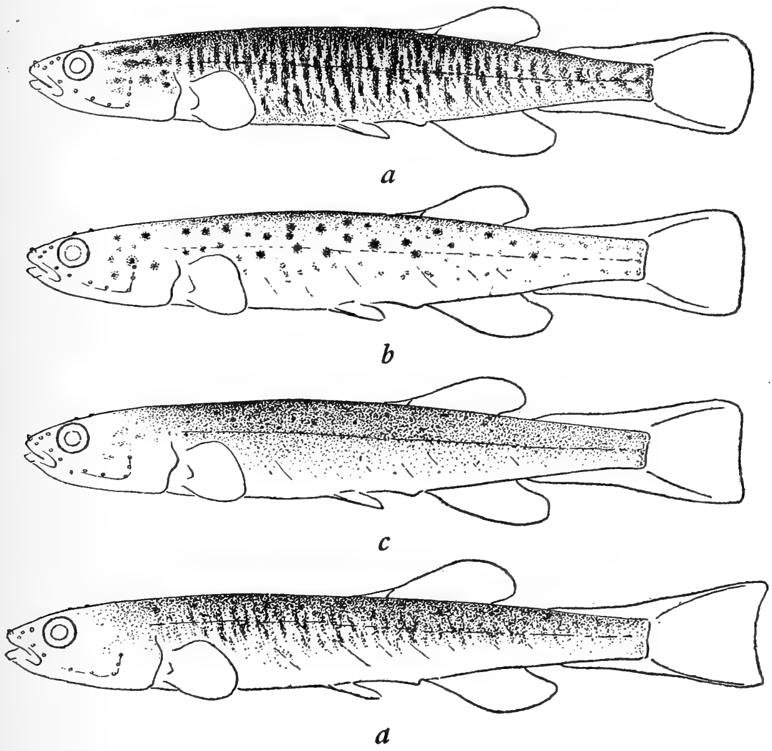


FIG. 26.—*Galaxias.* Semidiagrammatic, to show variation in caudal fin in *zebratus* (*a–c*) and *punctifer* (*d*). The letters *a–d* are each exactly at the middle of the total length. Varieties of coloration also shown, but there is no correlation between coloration and morphology.

between latter and tip of snout, *i.e.* 1st dorsal spine arises in middle of total length, and slightly in advance of vent; body often a little more slender, especially the caudal peduncle; usually scarcely or not at all pigmented; the silvery lining of the belly usually very distinct; usually in slightly alkaline waters.

Fig. 26 shows typical *zebratus* and *punctifer* and two transitional forms. It may be noted that Boulenger's fig. 8 of *zebratus* is rather too deep in the body, and that the outline of the dorsal fin in Regan's fig. 3 of *punctifer* is not quite accurate (both figures copied in Gilchrist and Thompson's work).

Coloration.—Fig. 26 also shows some of the varieties of coloration, but is not intended to indicate any correlation between coloration and morphology. There is no such correlation. Typical *zebratus* is more or less strongly barred (*a*). The most heavily barred specimens are found in the Silvermine Stream, Kalk Bay, Cape Peninsula, many of them being even more heavily barred than the one figured, the dark bars extending almost to the ventral profile.

In other examples, and in other localities, a mild barring (*d*) or a shadowy mottling is found, or the whole body is tinted with minute specks with here and there a larger dot (*c*).

Both the *c* and *d* coloration, but mostly the former, is found in *punctifer*.

Adult males of the *zebratus* form are usually darker in colour than females, either the cross-bars being more intense, or the pigmentation (*c*) becoming so dark and uniform that all markings are obliterated.

The character of the stream-bed and the colour of the water may perhaps influence the coloration. Most of the habitats are small streams (not the main rivers) with muddy (fine, dark, vegetable debris) bottoms, or containing pools with muddy bottoms, with more or less brown-coloured water. But in one such stream, the Jan Niemands, a tributary of the Palmiet River, all the *Galaxias* were noticeably pale. In some clear streams with gravelly or stony bottoms, the gravel and stones being various shades of grey, buff, or orange-brown, specimens of a pale buff or grey body-colour were found, with either a uniform and faint pigmentation (*c*) or irregularly arranged dark spots (*b*). The figured specimen of *b* is by no means the most heavily spotted; these spotted specimens are very striking, especially after preservation, as the body-colour fades to white while the spots remain (in alcohol) for a considerable time. The colour of typical *punctifer* has been noted above.

Whether colour changes could be induced in captivity would be an interesting experiment; as would also experiments to show whether the extreme forms of *zebratus* and *punctifer* will interbreed.

Breeding.—Except that they are not sea-going, little is known about the breeding of South African *Galaxias*. They are hardy in captivity, but in spite of continual observation (examples in glass tanks) (A. C. H.) the actual pairing and deposition of the eggs has not been seen.

The ripe eggs are demersal, relatively large, numbering about 30–40; the number probably seldom if ever exceeds 50.

The fishes become sexually mature at about 38–40 mm. in length. The maximum length seems to vary in different localities: on the Cape Peninsula both the *zebratus* and *punctifer* forms reach a length of 65 mm. The largest specimen of *zebratus* hitherto caught is one of 68 mm. (Slanghoek stream, Worcester district), and the largest *punctifer* one of 75 mm. (Malmesbury). The specimens collected by Dr. Holub in 1884 at Somerset West and described by Steindachner (1894) as *capensis* were "nearly 7 cm." in length.

Very young fry have been observed in captivity in garden ponds during March (A. C. H.), and have been collected in the free state in June, July, August, and September (Cape Peninsula), late September and October (Clanwilliam and Villiersdorp), November (Citrusdal and Hermanus), January (Genadendal), February (Drakenstein, Cape Peninsula, and George), April (Hermanus). In most cases mature specimens (the ♀♀ with ripe eggs) were taken at the same time. Probably breeding occurs throughout the greater part of the year.

Individuals have been kept in captivity for three years (A. C. H.).

Postembryonal Stages.—The earliest stage yet obtained is one 9 mm. in length (fig. 27, *a*) showing the straight tail, and no indications of the fins (except the pectorals). At 10·5–11 mm. there appear the indications of the dorsal fin, and, at a slightly later stage, of the anal fin; and the tail has an upward bend (heterocercal). At 12·5–13 mm. in this series, corresponding with a stage slightly later than the 11-mm. stage in the George series (fig. 27, *b*), the dorsal fin is nearly free of the median adipose flange or lamina of skin, and the ventral fins are just visible as two minute knobs. At 15 mm. the ventral fins are free, but the anal is still embraced within the median flange. At 16–17 mm., corresponding with the 15-mm. stage in the George series (fig. 27, *c*), both the medio-dorsal and medio-ventral flanges have disappeared except for a short extent on the belly and on the caudal peduncle. The belly flange persists until the fish is about 18–19 mm. in length. On the caudal peduncle the flange is gradually reduced to a greater or lesser extent (fig. 26).

Distribution (figs. 24 and 28).—The known limits of distribution to the north and east have not been extended since Gilchrist and Thompson wrote, but *Galaxias* has been shown to occur in many intervening localities. The northward limit is the Willems River (Gilchrist and Thompson) about 6 miles north of Nieuwoudtville (Calvinia Division), which flows northwards into the Klein Doorn

River, Zout River, and thence into the Olifants River. In the same river-system *Galaxias* occurs in the Boontjes River (Citrusdal) and Jan Diesels River (Clanwilliam), and in the headwaters and upper reaches of the Olifants itself.

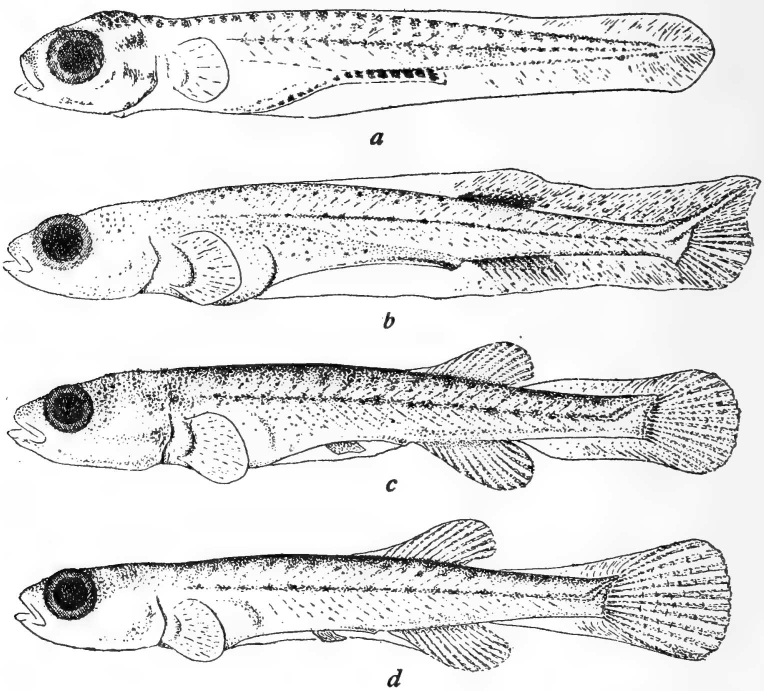


FIG. 27.—*Galaxias*, juveniles. *a*. 9 mm. (Villiersdorp). *b*. 11 mm. (George). *c*. 15 mm. (George). *d*. 13 mm. (Lourens River, Somerset West).

Galaxias is probably to be found in all streams near the bases of the mountains (not in torrential mountain streams), and side channels of the rivers in the following systems, and in the neighbouring vleis (lakes) if permanent. The following are actual localities (where no author is added, collected by S. African Museum or A. C. Harrison):—

zebratus (mountain form)

Olifants River, Clanwilliam: headwaters of main river (so-called Malangs River) between Witzenberg and Schurfteberg Ranges; main river at Keerom (P.O. Groot Kuil); Boontjes River, Citrusdal; Jan Diesels River in Bosch Kloof, Clanwilliam; Willems River, north of Nieuwoudtville (Gilchrist and Thompson).

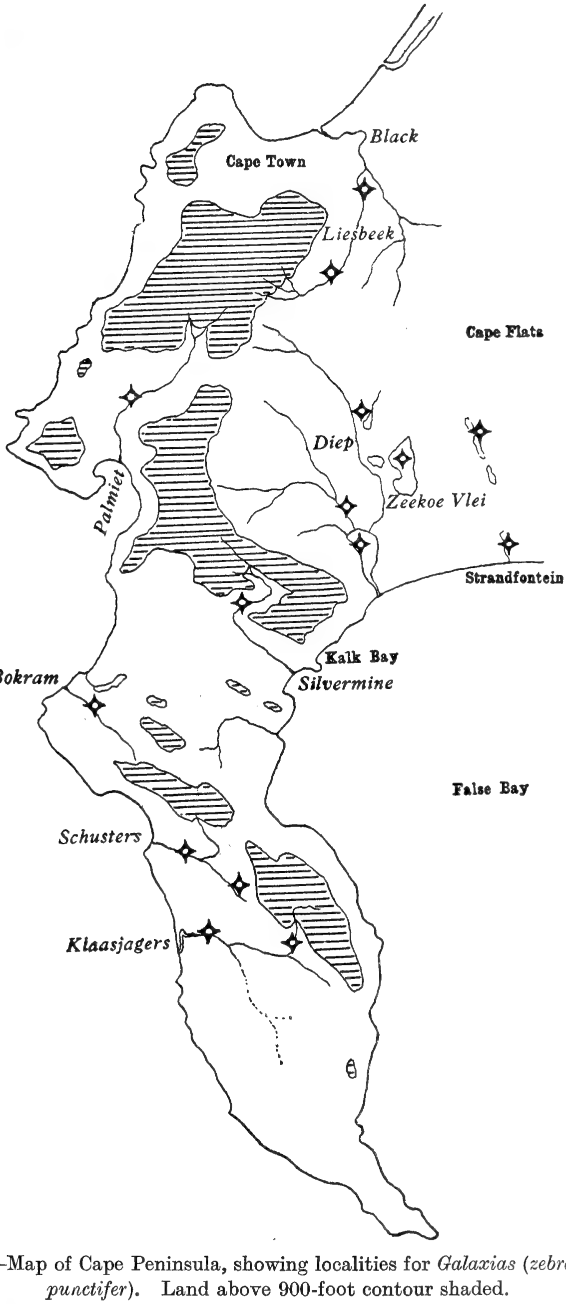


FIG. 28.—Map of Cape Peninsula, showing localities for *Galaxias* (*zebratus* and *punctifer*). Land above 900-foot contour shaded.

Langevlei, Leipoldtville (Clanwilliam Division).

Het Kruis, upper reaches of Verloren Vlei.

Zoutkloofs River, north-west of Aurora.

Berg River: headwaters of Little Berg River at Tulbagh; of the Berg River at French Hoek (Weber), Wemmershoek, and Drakenstein; Bushmans River at Sauer (transition to *punctifer*).

Modder River, west of Mamre (Malmesbury Division).

Cape Peninsula: Liesbeek River at Newlands (Weber), at Kirstenbosch and Rondebosch; Little Princess Vlei (Weber); Silvermine stream, Kalk Bay; Palmiet River flowing into Hout Bay; Bokram stream, Kommetje; Schusters and Klaasjagers rivers. "Cape Flats" (Castelnau).

Eerste River: Jonkershoek, Stellenbosch.

Lourens River, Somerset West (Steindachner, Gilchrist and Thompson).

Steenbras and Palmiet rivers; and Malkop Vlei on west side of Palmiet River mouth (property of Hangklip Estates) (A. C. H.).

Bot River: a small tributary at Eerste Hoop (Post Office) on Bot River to Viliersdorp road; Zwart River at Caledon.

Onrust River, and small streams on coastal terrace near Hermanus.

Hartebeest River, being the upper reaches of the Klein River.

Zontagskloof stream.

Nieuwejaars River, Elim (transition to *punctifer*); Grashoek and Kars rivers, Bredasdorp district.

Breede River tributaries: Montagu; Zanddrift and Buffelshoek streams, Hex River; headwaters of Zanddrift stream north of Matroosberg (farm "Lakenvlei," Ceres district); du Toit's Kloof, Rawsonville; Slanghoek, Goudini; Zonder End River, headwaters near French Hoek Pass (east side) and Villiersdorp, and Genadendal; Buffelsjagt River, east of Swellendam.

Gouritz River system: Klein Zwartberg stream, tributary of the Buffels River, north of the Zwartberg Range (near farm "Koudebergs Berg"); Seven Weeks Poort stream east of Ladismith; Weyders River, south of the Langeberg Range, Albertinia Division; Doorn River, Barrydale.

Little Brak River (Mossel Bay district); upper reaches at Haalkraal.

Malagas River, George district (Gilchrist and Thompson, also recent collecting); Wit Els River, George district.

punctifer (lake or vlei form).

Verloren Vlei, near mouth.

Berg River: stream crossing Malmesbury to Hopefield Road; Zout River at Mamre Road Siding; Bushmans River at Sauer (transition to *zebratus*).

Diep River and its tributary Mosselbank River, Klipheuvel, Kalabas Kraal, and Malmesbury districts.

Cape Peninsula: Liesbeek River at Durban Road (Regan); Diep River at Lakeside (Gilchrist and Thompson); "Cape Flats" (Castelnau); Princess Vlei; Zeekoe Vlei; Oleboom Vlei (A. C. H.); Strandfontein.

Eerste River: below junction with Kuils River, Faure (Sheik Joseph's Tomb).

Nieuwejaars River, Elim (transition to *zebratus*).

All these localities lie on the Tertiary marine-cut terrace, or on the present-day headwaters of rivers flowing across it. This terrace follows approximately the 900-foot contour (fig. 24).

In the map of the Cape Peninsula the land above the present 900-foot contour is shaded (fig. 28). Only in these areas is the water-table apparently high enough to maintain a perennial stream. Towards the end of summer the Bokram, Schusters, and Klaasjagers streams run very low, becoming often merely a series of disconnected pools or bog-holes; and the water becomes brackish. At such times, near the mouth of the Klaasjagers River, *Galaxias* occurs in water as salt as the sea. This fact is not surprising when we remember that *G. attenuatus*, the Australasian and S. American species, migrates downstream to the coast for spawning.

Although it is not intended to draw any conclusions here, the distribution of *Galaxias* in the S.W. Cape is certainly very suggestive of a marine ancestry during the Tertiary epoch, followed by the adoption of a fluviatile habitat, and gradual penetration inland with the cutting-back of the streams.

Some experiments on the duration of survival out of water were made by Mr. A. C. Harrison, on lines similar to those of Scott (1938, Pap. Proc. Roy. Soc. Tasmania for 1937, p. 138). Using *G. zebratus*, it was found that the fishes when placed in a dry enamel bowl became very adhesive as they dried, and this probably acted against their survival, especially in the case of small and weak fishes. In this experiment the fishes survived only 3–6 hours. Others were then placed on very slightly damp moss, and in these conditions survived 10 hours (the experiment was not completed owing to an accident).

Family ANABANTIDAE.

1909. Regan, Proc. Zool. Soc. Lond., ii, p. 770.

Up to the present no species of this family has been recorded from any of the Cape rivers north of the main Cape watershed, nor from the Orange Free State, Transvaal, Natal, and southern part of Portuguese East Africa. Hey makes no mention of Kurper from the Transkei, Pondoland, or Natal.*

From Lake Ngami and the Zambezi basin northwards occur several species with more or less multispinose opercle and denticulate subopercle (*Ctenopoma*), allied to the Indian and S.E. Asiatic species (*Anabas*).

The two Cape species have a non-denticulate subopercle, and the opercular spines either entire or feebly bifid or trifid.

Both the morphology and the remarkable discontinuity in distribution therefore uphold the justice of Regan's classification, which regards the Asiatic *Anabas*, the tropical African *Ctenopoma*, and the Cape *Sandelia* (*olim Spirobranchus*) as three separate genera.

In addition to the character of the opercle, there are the following differences between *Ctenopoma multispinis* and *Sandelia capensis*.

All the scales in *multispinis* (except those forming the sheaths of the dorsal and anal fins, those on top of head and on throat) are ctenoid; in *capensis* all or very nearly all of them are cycloid.

In *multispinis* the anterior prolongations of the air-bladder are relatively short, ending close behind the rather deep posterior cavity of the supra-branchial chamber (fig. 30, *a*); in *capensis* they are very long, extending up towards the nape, where they are separated one from the other by the vertical septum of the supra-occipital bone at the back of the skull (fig. 30, *b*). In neither species is there any apparent connection between these anterior prolongations of the air-bladder and the supra-branchial chamber. In juvenile *capensis*, 13 mm. total length, the anterior prolongations are already developed to their full extent, whereas the posterior prolongations extend only half-way along the anal fin (in the adult they extend to midway on the caudal peduncle).

The labyrinthine organ is very simple in *capensis* (fig. 30, *b*; and *cf.* Cuv. and Val., Hist. Nat. Poiss., pl. 205), but complexly foliate

* See p. 120. "Kurper" in the Transvaal refers to species of *Tilapia*.

in *multispinis* (fig. 30, *a*). In adult *capensis* there is a more or less horizontal lamina arising from the upper part of the rachis of the 1st gill-arch, fused with the hind wall and forming the lining of the upper posterior half of the chamber, and extending across to the inner (median) wall of the chamber; thus incompletely dividing the

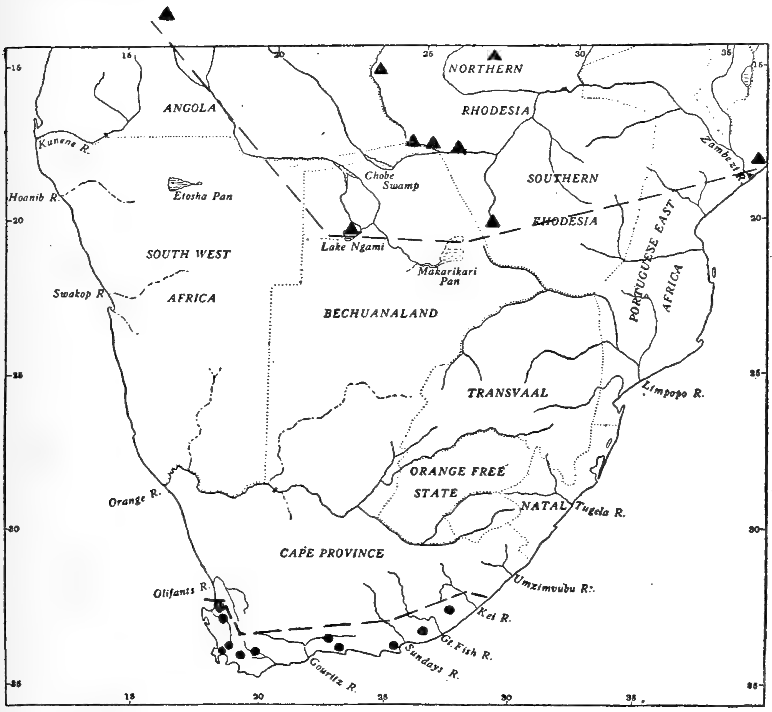


FIG. 29.—Distribution of *Anabantidae*. ▲ Tropical forms with denticulate subopercle and more or less multispinose opercle (*Ctenopoma*). ● Southern forms with non-denticulate subopercle, and only two entire (or feebly bifid) opercular spines (*Sandelia*).

chamber into an upper and a lower cavity. The free margin of this lamina is sinuous, more or less thickened, and often develops a small ear-like lobe (usually not so large as that represented in the figure). In juveniles of 17 mm. total length the lamina is relatively small, and arises on the rachis between the inner and outer rows of gill-rakers. At 25 mm. total length the base of the lamina seems to have spread outwards so as to absorb the 2 uppermost outer gill-rakers, all trace of which has vanished.

In *multispinis* there is a similar lamina continuous with the upper

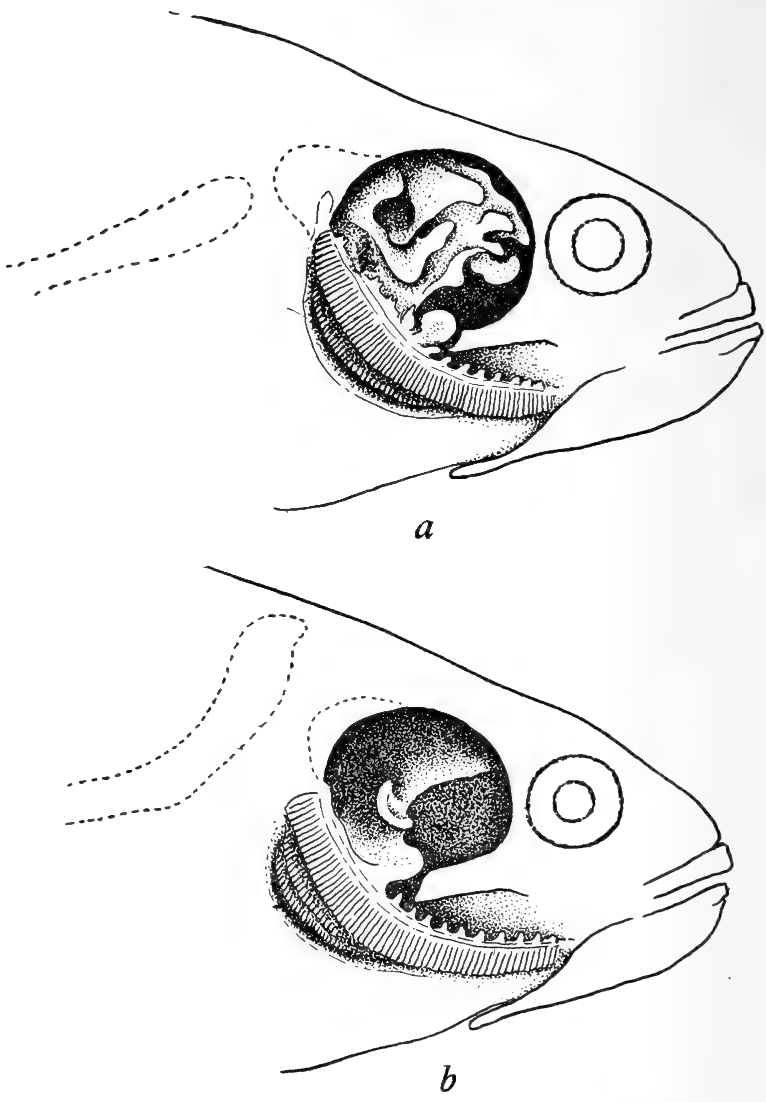


FIG. 30.—Dissected head to show 1st gill arch with labyrinthine organ (adults). Posterior cavity of the branchial chamber, and position of anterior prolongation of the air-bladder indicated by dotted lines.
a. Ctenopoma multispinis. *b. Sandelia capensis.*

part of the gill-arch and extending across the branchial chamber as in *capensis*, but additional lobes and foliations are developed from its free margin and outer surface. There are traces of 4 (or 5) upper outer gill-rakers. Further, there is a small ear-like lobe anterior to the main foliate lamina, and seemingly formed by expansion of one of the outer gill-rakers.

In *Anabas* (*sensu stricto*) the supra-branchial chambers extend upwards into the cavity behind the head and are separated by the supra-occipital septum, but Regan (*l.c.*, p. 770) does not mention the extent of the anterior processes of the air-bladder.

In some MSS. notes made by the late W. W. Thompson in preparation for Gilchrist and Thompson's Monograph, I find that Thompson had observed these differences and wanted to use them as a reason for separating the three genera. Apparently he was overruled in deference to Boulenger.

Breeding.—I have not seen Boulenger's paper on oral gestation in *A. multispinis* (The Field, cxviii, p. 968, 1911), nor a paper on the breeding of *Anabas* by Lönnberg (Fauna och Flora, Upsala, vi, p. 224, 1911).

Gen. SANDELIA Cast.

1829. Cuvier, Règne Anim., ed. 2, ii, p. 229 (*Spirobranchus*, preocc. Oken, 1818, Vermes).

1831. Cuvier and Valenciennes, Hist. Nat. Poiss., vii, p. 392 (*Spirobranchus*).

1861. Castelnau, Mem. Poiss. l'Afr. austr., p. 36.

1909. Regan, *l.c.*, p. 770 (*Spirobranchus*).

1916. Boulenger, *l.c.*, iv, p. 48 (*Anabas*, part.).

1917. Gilchrist and Thompson, *l.c.*, p. 542 (*Anabas*, part.).

Sandelia capensis (C. and V.)

Cape Kurper.

Figs. 30, *b*, 31, 32.

1916. Boulenger, *l.c.*, iv, p. 50, fig. 27.

1916. *Id.*, *ibid.*, p. 51, fig. 28 (*vicinus*).

1917. Gilchrist and Thompson, *l.c.*, p. 543, fig. 157.

1917. *Id.*, *ibid.*, p. 545, fig. 158 (*vicinus*).

Examination of a large amount of material, including series of specimens of all sizes caught at one and the same time and place, convinces me that *vicinus* cannot be maintained as a separate species; but it may well rank as a colour variety.

In specimens from the S.W. Cape the dorsal spines vary from 12 to 14, the anal spines from 6 to 8, the usual numbers being 13 and 7 respectively. In specimens from localities farther east, George to Port Elizabeth, the anal spines number 8, only occasionally 7, and the dorsal spines vary from 13–14, mostly 14 (one specimen with 15).

The slight difference in size between the scales on the upper part of the body and those in the middle of the side is often a little more noticeable in *vicinus* than in typical *capensis.*

The number of scales around the caudal peduncle (at its base) is normally 18, but there may be only 16, especially in younger specimens (30–60 mm.), or 14 (15–25 mm.).

The opercular spines are more or less obtuse; when the covering skin is removed, they are seen to be frequently feebly bifid or sometimes trifid, the points being separated merely by a slit or very narrow cleft; often the composite nature of the spine is shown only by surface striae or slight ridges.

The coloration and markings are not always stronger or more distinct in the *vicinus* form than in the *capensis* form; as Castelnau remarked, there is considerable variation in colour. Specimens from muddy and opaque water in the Diep and Mosselbank rivers (Malmesbury–Kalabas Kraal–Klipheuvel district) were silvery with a very pale greenish tinge, even the opercular spot being inconspicuous. Sometimes there is a pinkish tinge around the axil of the pectoral fin. Hence the name "Rooivlerk Kurper" applied in some localities (see pp. 107, 120).

The largest specimen I have seen is one 215 mm. in length from Princess Vlei, Cape Flats; this specimen contained 2 full-sized *Gilchristella,* and pieces of water-weed (the latter possibly accidental). Juveniles from 8 mm. upwards have been examined.

These juveniles were taken in November, December, and January, but it is not known how long the spawning season lasts. Males appear to begin breeding at 70 mm., females at 80 mm.

Some rather noticeable differences in body-shape have come under observation.

The original figure by Cuvier and Valenciennes (reproduced in Boulenger and G. and T.) is a fair representation of the normal shape of a small or medium-sized specimen, though the body is usually a little deeper. In most cases the depth of the body is about equal to length of head, $2\frac{3}{5}$–$2\frac{4}{5}$ in length (to end of *large* scales on caudal peduncle); the depth between anal spines and dorsal fin is less than length of head. The front profile is very slightly convex, and the snout is moderately sharply pointed (fig. 31, *a*).

Large specimens from Aurora (Piquetberg Division) and Cape Flats tend to become "bull-nosed," with bluntly rounded snout (fig. 31, *e*).

Specimens from the Diep River in the Malmesbury district are unusually shallow: the depth less than length of head, and $3\frac{1}{2}$ times in length of body (fig. 31, *d*).

In the opposite direction there are specimens, *e.g.* from Goukama River near Knysna, showing an increase in the depth of the body, the depth being greater than length of head, and $2\frac{1}{2}$ times in length of body (fig. 31, *b*).

The most remarkable specimen observed is one from the Palmiet River, Elgin, which was forwarded to Mr. A. C. Harrison (Inland Fisheries Advisory Officer) as a "Black-bass" (which has been introduced into this river). The body is very deep, the depth being only $2\frac{1}{3}$ times in body-length, and considerably greater than length of head. The dorsal-anal depth also is greater than length of head. The profile is slightly but distinctly concave, and the snout is abnormally sharp (fig. 31, *c*). The colour was also abnormally dark.

A thoroughly intensive study of large numbers of specimens from all rivers and localities has not been carried out, but the following points may be noted, not as demonstrated facts but as indicating lines of investigation.

There seems to be a tendency in large specimens to become "bull-nosed," and this may be found to be more noticeable in specimens from alkaline waters (pH 7·5–8·5) and to be correlated with a lesser body-depth. On the other hand, in the specimens from acid waters (pH 4·5–5·5) the depth seems to be greater and the snout more pointed. As examples of this are 2 from Goukama River near Knysna, and the extreme form from the Palmiet River.

The extremes of the shallow and deep forms placed side by side, and apart from the intermediates, appear to be utterly different species.

In addition to the localities given in Weber, Boulenger, Gilchrist and Thompson, recent collecting has supplied specimens from the following localities (arranged from north to south and then eastwards):—

Langevlei River, Leipoldtville (Clanwilliam Division).
Het Kruis and Verloren Vlei (Piquetberg Division).
Zoutkloofs River, N.W. of Aurora (Piquetberg Division).

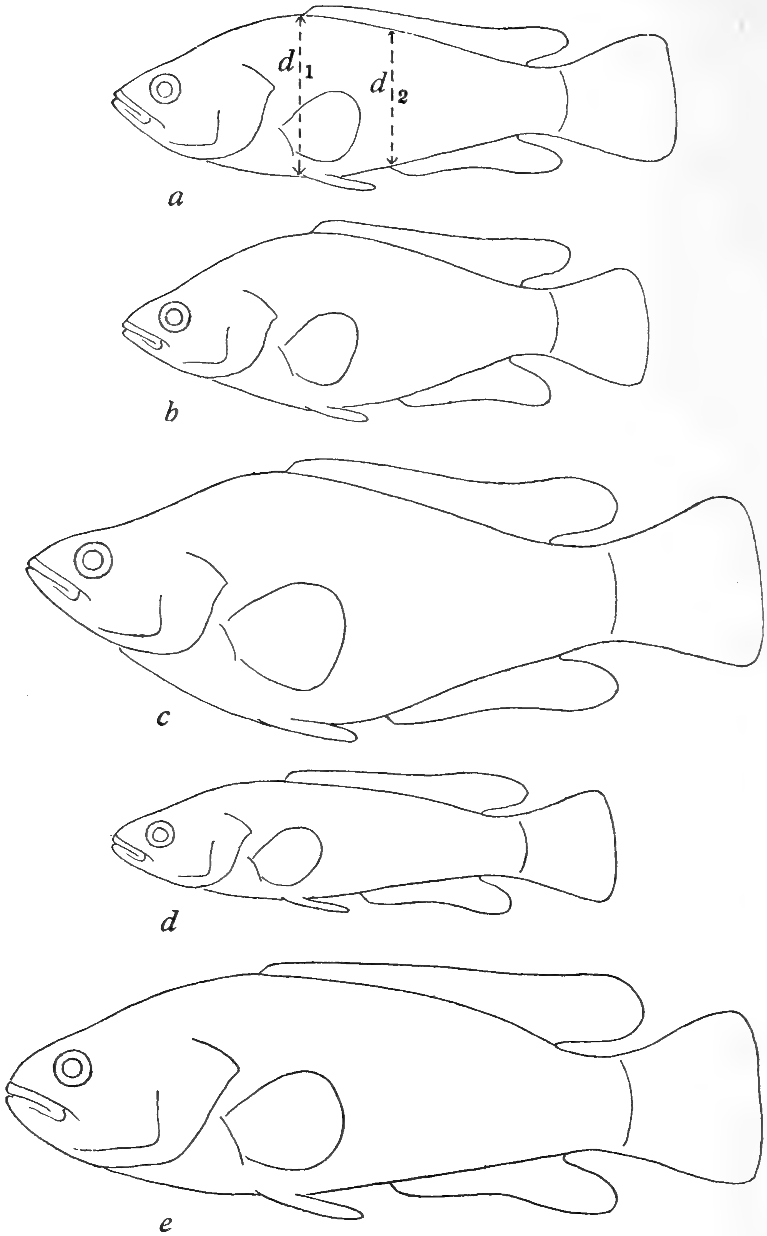


Fig. 31.—*Sandelia capensis*, variation in shape.

Berg River: Twenty-four Rivers (south of Porterville); Drakenstein.

Diep and Mosselbank rivers near Philadelphia, Kalabas Kraal, Klipheuvel, and Malmesbury.

Cape Peninsula: Liesbeek stream, and Diep River, Lakeside.

Eerste River.*

Steenbras and Palmiet rivers.

Bot River: at Eerste Hoop and Houw Hoek Pass.

Onrust River, Hartebeest, and Klein River (Hermanus–Stanford district).

Zonntagskloof and Uilenkraal rivers.

Nieuwejaar River, Elim; Grashoek and Kars River, Bredasdorp district. Also Zoetendals Vlei (coll. V. Fitzsimons, Transvaal Mus.).

Breede River and tributaries: Witte River (Bain's Kloof); Robertson; Hex River, Worcester; headwaters of River Zonder End (east side of French Hoek Pass); Villiersdorp; Genadendal; Buffelsjagt River (east of Swellendam).

Duivenhoks River, Heidelberg (Cape), and Kaffirkuils River, Riversdale.

Gouritz River: Touws River between Ladismith and Montagu; Buffels River west of Ladismith; Seven Weeks Poort, Amalienstein; Langtouw River, Herbertsdale; Weyders River, Albertina district.

Ruigte Vlei, between George and Knysna.

Goukama River, near Knysna.

Keurbooms River at Edmonton.

Kromme River, Assegai Bush.

* Hey (*l.c.*, Rep. i, p. 36, 1926) stated that the Kurper had been exterminated in the Eerste River, but that is incorrect.

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a. Palmiet River. pH 4·5–5, 100 mm., typical, $\frac{l}{d_1}$ $2\frac{4}{5}$, $d_1 = h$, $d_2 < h$.

b. Goukama River. pH 5, 95 mm., rather deep, $\frac{l}{d_1}$ $2\frac{1}{2}$, $d_1 > h$, $d_2 = h$.

c. Palmiet River. pH 4·5–5, 130 mm., very deep, $\frac{l}{d_1}$ $2\frac{1}{3}$, d_1 and d_2 both $> h$.

d. Diep River, Malmesbury district. pH 8–8·5, 90 mm., very shallow, $\frac{l}{d_1}$ $3\frac{1}{2}$, d_1 and d_2 both $< h$.

e. Aurora, Piquetberg Division. pH 7·5, 135 mm., shallow, bull-nosed, $\frac{l}{d_1}$ $2\frac{3}{4}$, $d_1 = h$, $d_2 < h$.

Zeekoe River, Humansdorp.

Gamtoos River (lower portion) at Loerie and Patentie. In the Groote River at Fullarton and Steytlerville, *i.e.* the upper portion of the Gamtoos River, no specimens were obtained.

Van Stadens River.

Zwartkops River, Uitenhage.

The distribution, though extending farther eastwards, is thus the same as that of *Galaxias*, viz. all along the old Tertiary terrace and

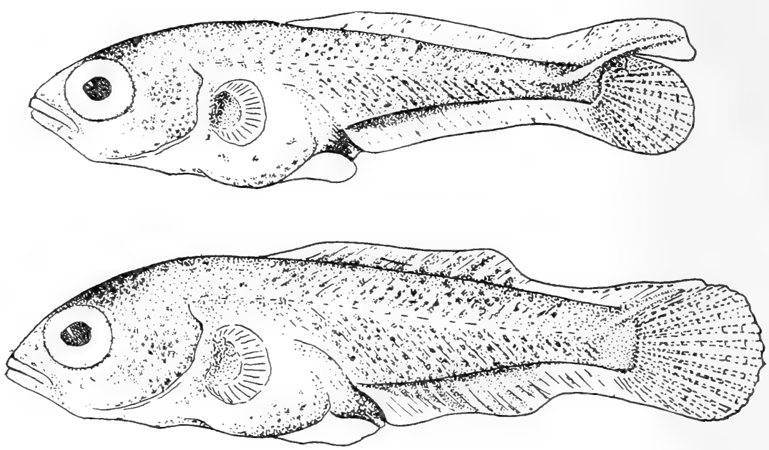

Fig. 32.—*Sandelia capensis.* Juveniles, 8 mm. and 10 mm. in length.

the headwaters of the rivers flowing across it, except in two particulars: *Sandelia* appears to be absent from the whole of the Clanwilliam Olifants system; and (at least at the present day) from all streams on the Cape Peninsula except the Liesbeek and the Diep (Lakeside) rivers.

If the assumption be granted that the Kurper never was present in the Palmiet, Silvermine, Schusters, and Klaasjagers rivers on the Cape Peninsula, the fact that there is no means by which a purely *freshwater* fish could get to these rivers from the Cape Flats, seems to point to the Kurper having arrived after the land had begun to rise. On the other hand, at the time of maximum elevation of the land the whole of False Bay would have been dry land, and the Silvermine and Diep rivers were probably connected. Did the Kurper formerly live in the Silvermine stream, and has it for some reason been unable to maintain itself? This does not seem likely, as it is a very hardy fish; but, as we shall never know whether the

Kurper did actually live in the Silvermine, the problem must remain unsolved.

We can, however, say that *Sandelia* was present in the Breede River system either before or during the period of maximum elevation, because it is present in the Nieuwejaars, Grashoek, and Kars rivers, which are now cut off from communication with the Breede River.

The finding of the Kurper as far north as Leipoldtville on the west coast belt intensifies the question as to why it has not (apparently) penetrated into the Olifants River (Clanwilliam) system. The Jackals River, flowing through Graafwater to Lambert's Bay, seems to be mostly dry and to have no fish-fauna at the present day.

In some specimens from Zoetendals Vlei, Bredasdorp district, Dr. V. Fitzsimons of the Transvaal Museum has found specimens of the Fish-louse *Argulus*.

Sandelia bainsii Cast.

Bain's or Eastern Province Kurper, Rockey.

1916. Boulenger, *l.c.*, p. 52, fig. 29.

1917. Gilchrist and Thompson, *l.c.*, p. 546, fig. 159.

This species is distinguished by the more pointed snout and the slightly smaller scales. The scales on the upper part of the body are distinctly smaller than those in the middle of the side, 6–7 between lateral line and origin of dorsal fin.

There are 22 scales around the caudal peduncle in the larger specimens and 20 in young specimens up to 60 mm. in length.

The opercular spines are distinctly more acute than in *capensis*. Either the upper or lower spine, or both, and either on one side only or on both sides, may be bifid. Bifurcation might be due to injury, but probably occurs as a normal concomitant of growth. In young specimens both spines are acute and entire, but with traces of incipient bifurcation.

The two groups of opercular spines is one of the characters on which Castelnau based his genus *Sandelia* in contradistinction to *Spirobranchus*. As shown above, however, there is no essential difference between these spines in *capensis* and *bainsii* which would warrant generic separation. But both *capensis* and *bainsii* are sharply distinguished in this respect from the typical species of *Anabas* (s.s.) and *Ctenopoma*.

Castelnau's type came from the Kowie River near Grahamstown. Boulenger's record, "Buffalo River, Port Elizabeth," should, it seems, be corrected to Buffalo River, East London.

According to Mr. Harrison's investigations, the Rockey occurs in the Nahoon River, but is unknown to local fishermen in the Kubusie River at Stutterheim (a tributary of the Great Kei River).

The largest specimen I have seen is that recorded by Gilchrist and Thompson from King William's Town (its total length is 115 mm.). I have also examined two small ones from the Pirie Trout Hatchery near King William's Town, and a series, 45 mm. to 110 mm., collected by Mr. A. C. Harrison (Oct. 1941) from the Tyusha stream near Pirie (a tributary of the Buffalo River).

The colour when freshly caught is dull olive-green, with very few and indistinct markings (A. C. H.).

Family CLUPEIDAE.

Gen. Gilchristella Fowler.

1935. Fowler, Proc. Ac. Nat. Sci. Philad., lxxxvii, p. 365.

Gilchristella aestuarius (Gilch.)

Whitebait.

1913. Gilchrist, Mar. Biol. Rep., i, p. 55, fig. (*Spratelloides a.*).

1925. Barnard, Ann. S. Afr. Mus., xxi, p. 109 (*Spratelloides a.*).

1935. Fowler, *l.c.*, p. 365, fig. 4.

1934. Harrison, Fish. Mar. Biol. Surv., Investigat. Rep. 4, pp. 22, 63, 64, 80 (*Spratelloides*, localities).

1936. *Id.*, *ibid.*, Investigat. Rep. 7, pp. 94 ("Gillieminkies, a small *Barbus*, probably *burchelli*") and 96 (*Spratelloides*).

1937. J. L. B. Smith, *l.c.*, p. 139.

In addition to Princess Vlei, Cape Flats, and the Zwartkops River, Port Elizabeth, this little fish has been caught at the following localities:—

Verloren Vlei, near mouth (Piquetberg Division).
Lakeside, Cape Flats.
Brand Vlei and Breede River, Worcester (permanently fresh, 100 miles, as crow flies, from mouth of Breede River).
Zonder End River, at Genadendal.
Klein River, Stanford.
Nieuwejaars River, Elim; Grashoek and Kars River, Bredasdorp.
Groen Vlei, Knysna.
Blue Lagoon, Umgeni, Natal (Fowler).

Family MUGILIDAE.

1935. J. L. B. Smith, Ann. S. Afr. Mus., xxx, p. 587 (revision of S. African species).

Although the majority of the South African Harders or Springers enter estuaries and rivers, only the three mentioned below appear to be actually recorded from fresh water.

Mugil cephalus (with well-developed adipose eye-lids, pointed scale in axil of pectoral, and no scales on soft dorsal fin) was recorded by Cuvier and Valenciennes (as *constantiae*) from one of the vleis near Constantia, Cape Peninsula; and by Weber (1897) from Little Princess Vlei.

The South African Museum has specimens from Lakeside and Zeekoe Vlei (Cape Flats): Wilde Vogel Vlei, Kommetje; Klaasjagers Lagoon (Cape Peninsula).

Mugil capito (with feebly developed or no adipose eye-lids, soft dorsal scaly only at base, pointed scale in axil of pectoral) is recorded from the Berg River (Boulenger, 1916), probably from near the mouth in St. Helena Bay. The South African Museum has collected specimens at the mouth of the Olifants River (Van Rhynsdorp Division), and Verloren Vlei (Piquetberg Division).

Mugil euronotus (with feebly developed or no adipose eye-lids, soft dorsal completely scaly, no pointed scale in axil of pectoral). Specimens of this species have been caught in the Valsch River, a tributary of the Gouritz River, Albertinia Division.

Family ANGUILLIDAE.

Anguilla mossambica (Peters)

Freshwater Eel; Paling.

1897. Weber, Zool. Jahrb. Abt. Syst., x, p. 155 (*delalandii*).

1917. Gilchrist and Thompson, *l.c.*, p. 466, figs. 111*a*, 112.

1925. Barnard, Ann. S. Afr. Mus., xxi, p. 175, and 1927, *ibid.*, p. 1018.

1935. *Id.*, Rep. S. Afr. Mus. for 1934, p. 10 (elver).

1937. *Id.*, Ann. S. Afr. Mus., xxxii, p. 49 (elver).

As mentioned in the appendix to the Monograph of Marine Fishes (1927, p. 1018), the researches of the late Dr. J. Schmidt showed that only this one species of Freshwater Eel occurs in South Africa.

Although it is generally known that eels are found in all or most of the southward and eastward flowing rivers in the Cape area under discussion, the only definite recent records are those given by Weber, viz. Kammanassie River at Oudtshoorn; Kafferkuil River at Riversdale; and Duivenhoeks River at Heidelberg (Cape). At the last-mentioned locality Ensign Schrijver caught some on 17th January 1689.*

The South African Museum has a specimen caught by Mr. F. G. Chaplin at Jonkershoek in the Eerste River near Stellenbosch. Mr. A. C. Harrison caught one in a stream on the south side of Potteberg near the mouth of the Breede River, and below the dam on the Steenbras River; one was caught in Ruigte Vlei, between George and Knysna (C. W. T., Oct. 1938), and another in a tributary of the Kruis River, 5 miles north of Knysna (Nov. 1938). According to several verbal reports eels are common all along the River Zonder End.†

In addition to Dr. Kannemeyer's Orange River specimen,‡ Gilchrist informed Schmidt (*in litt.* 29/xii/08) that one large specimen was caught in a stream which ultimately joins the Orange River, but near the watershed of the Crocodile and Orange rivers in the Pretoria district.§ Both these records would seem to be satisfactorily explained by overland migration. The intensification of the main Cape watershed would seem to have cut off all possibility of migration from the southeast-flowing rivers into the Orange River system, except in rare instances.

In the case of the record from the Liesbeek River, overland migration was certainly possible.|| Although this stream rises on the eastern slopes of Table Mt. and flows northwards into Table Bay, it is joined not far from the coast by the Kromboom stream, which rises on the Cape Flats (*cf.* fig. 28). Between the source of the latter and one of the sources of the southward-flowing Diep River there was (in 1891, when this eel was caught) a stretch of some two miles of low-lying marsh and meadow-land: by no means an insuperable barrier.

An earlier record occurs in van Riebeeck's Journal ¶ of an eel in the "Fresh River," *i.e.* the stream flowing through the settlement where Cape Town now stands, in opposition to the "Salt River."

* Van Riebeeck Society Publ., xii, p. 215, 1931, Cape Town. W. W. Thompson, Sea Fisheries of the Cape Colony, p. 134, Cape Town, 1913.

† See Hey, *l.c.*, Reports, i–iii.

‡ Kannemeyer, Proc. 26/vi/95 in Trans. S. Afr. Philos. Soc., viii, p. xcvii, 1896. Barnard, *l.c.*, *supra*, 1925, p. 176.

§ Schmidt, K. Dansk. Vid. Selsk. Skr., ser. 8, vol. x, p. 334, 1925.

|| Barnard, *l.c.*, p. 176, 1925.

¶ W. W. Thompson, *l.c.*, p. 134, 1913.

It is possible that this record refers to the Liesbeek, the old name of which was *Vers Rivier* (= *Vars* = Fresh).*

Apart from the possible unsuitableness of the rivers on the west coast of South Africa owing to their being mainly periodical, the absence of Freshwater Eels from these westward-flowing rivers seems to be due to past oceanographical factors in the South Atlantic Ocean. Eels are in fact absent from the whole of the *west* coast of Africa as far north as about 15° N. lat., and from the *east* coast of South America as far as about 5° N. lat.† It is just these parts of these two continents which, on the Taylor-Wegener Displacement Hypothesis, were formerly much closer together than they are to-day. In other words, there was no South Atlantic Ocean in which these eels could breed.‡

Freshwater Eels breed in the deep waters of the ocean; and the spawning-grounds of the South African eel lie in the region of the Madagascan Deep. Schmidt says: " . . . in the western part of the Indian Ocean the larvae of three species were found, viz. *Anguilla bicolor, Anguilla mossambica, Anguilla mauritiana*" [*i.e.* the East African, South African, and Madagascan species].§

Up to the present only one specimen of the elver of *A. mossambica* has been recorded, although verbal reports indicate that the arrival of the elvers and their ascent of the rivers is well known to many people in Natal.||

The correlation of the *Leptocephalus* larva and the elver with the adult is based on the number of myotomes (muscle-bands) and vertebrae. Each species has a definite and characteristic number of vertebrae, within certain rather narrow limits; that of *A. mossambica* being 100–105.

In view of Schmidt's discovery of the *Leptocephalus* larva of *A. mossambica*, and the record of the elver, it is a little difficult to understand the unorthodox and rather startling suggestion made by Dr. J. L. B. Smith. It would be interesting to know the nature of the evidence which is said to be accumulating to show that the South African Freshwater Eel may have a life-history entirely different from that of any other species.¶

* C. Graham Botha, Place Names in the Cape Province, Cape Town (Preface dated Dec. 1926), p. 79.

† Schmidt, *l.c.*, p. 367 and pl. 1, 1925.

‡ A. L. du Toit, Our Wandering Continents, 1937.

§ Schmidt, ed. Tånning, Danish Eel Investigations during Twenty-five Years, p. 8, footnote, Copenhagen, 1932.

|| Barnard, *l.c.*, *supra*, 1935 and 1937.

¶ J. L. B. Smith, Albany Mus. Guide to Vertebrates, pt. 2, p. 132, 1937.

Family GOBIIDAE.

Gobies (freshwater).

Only the Cape species are discussed, but a synopsis of the fluviatile species is given. In estuaries several of the marine species are likely to be found, and for the identification of these the key in Barnard, Marine Fishes S. Afr. (Ann. S. Afr. Mus., xxi, p. 813, 1927), may be used.

Synopsis of Fluviatile Species.

I. Gill-membranes free from isthmus, gill-opening very wide (fig. 33, *a*). Dorsal and anal rays (branched) 9–10. Scales in lateral series 29–31. An irregular patch of scales on throat . . *Psammogobius knysnaensis.*

II. Gill-membranes united to isthmus, gill-opening restricted (fig. 33, *b*) . *Gobius.*

- A. Lower jaw projecting beyond upper jaw.
    1. Dorsal and anal (branched) rays 7. Scales in lat. series 20 *silvanus.*
    2. Dorsal and anal rays 8–9.
        - *a.* Scales in lat. series 28–36. Mouth extending to below front margin of eye. Scales on throat present or absent . *giuris.*
        - *b.* Scales in lat. series 26. Mouth wide, extending to below hind margin of eye . . . . . *dewaali* (Natal).
- B. Upper jaw overhanging lower jaw. Dorsal and anal rays 10. Scales in lat. series 58–64. No scales on throat *aeneofuscus* (Natal, Transvaal, Rhodesia, East Africa).

Psammogobius knysnaensis J. L. B. Smith

Fig. 33, *a*.

1935. J. L. B. Smith, Rec. Albany Mus., iv, p. 215.

Recorded from the tidal portions of the Breede, Knysna, Keurbooms, Bushmans, and Kowie rivers.

Gobius silvanus n. sp.

Head $3\frac{1}{2}$ in length (excluding caudal), eye 3 in length of head. Lower jaw projecting, mouth extending to below front margin of eye (or very slightly farther back). Snout scarcely $\frac{1}{2}$ length of eye. Tongue free, rounded. Teeth in 2–3 rows in both jaws, no canines. Gill-rakers 6–8 feeble knobs on lower part of anterior arch. Mucus pores (difficult to trace) a row along lower margin of orbit, one horizontal row across cheek, a row along lower margin of preopercle.

D vi. + i. 7. A i. 7. Caudal shorter than head. Rays of each ventral fin very flimsily connected, and apparently no membrane connecting the two fins posteriorly.

Scales in lat. series 20, transv. series 7, around caudal peduncle 12. Head naked; a triangular naked patch extending back almost to origin of dorsal fin, only 1–2 predorsal scales in middle line.

Colour (as preserved) pale with minute grey speckling, chiefly on upper parts; some of the scales brownish, or outlined in brown,

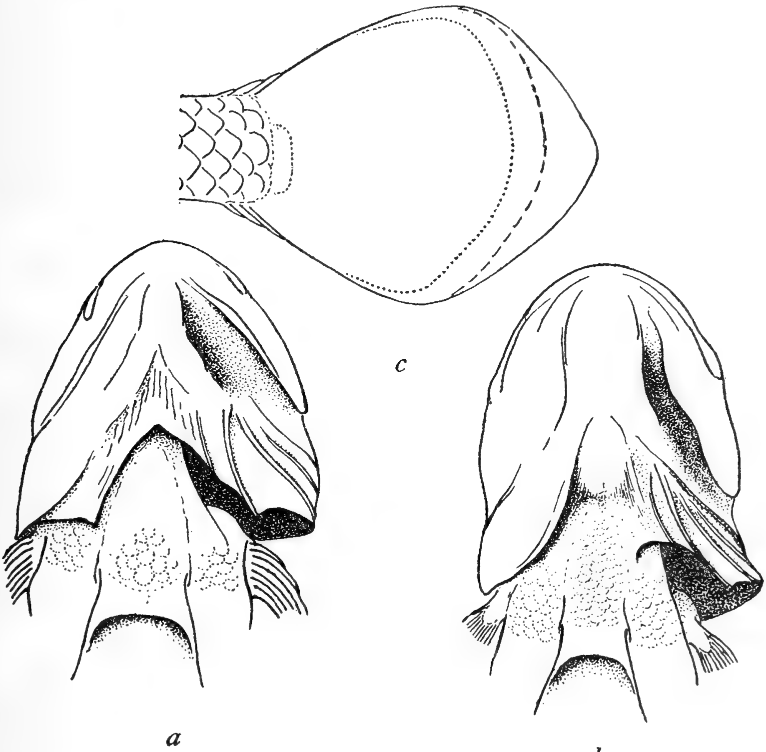

FIG. 33.—Ventral views of head, showing extent of gill membranc, and scaling on throat, in (*a*) *Psammogobius*, and (*b*) *Gobius*. (Pectoral and ventral fins not completely shown.) (*c*) Caudal fin of *Gobius giuris*: shorter than (dotted), equal to (broken line), and longer than length of head (full line).

producing an irregular and variable dappled appearance; 3–4 darker (blackish) spots on hinder part of mid-ventral line, the foremost being at, and divided by, the anal fin, and one spot at base of middle caudal rays; spinous dorsal with a black blotch. Ova showing through body wall as yellowish-orange patch.

Length: 20–22 mm. (including ovigerous ♀♀).

Locality.—Knysna Lagoon (C. W. Thorne and H. G. Wood, Oct. 1938).

Remarks.—This little Goby has fewer scales in the lateral series than any other South African species. The specific name in allusion to the two collectors, and the appearance of sylvan light and shade on the body.

Gobius giuris Ham. Buch.

Flat-head Goby.

Fig. 33, *b*, *c*.

1916. Boulenger, *l.c.*, iv, p. 24, fig. 15.

1927. Barnard, Ann. S. Afr. Mus., xxi, p. 814.

1936. J. L. B. Smith, Trans. Roy. Soc. S. Afr., xxiv, p. 49, fig. 2 (*gulosus*).

1937. *Id.*, Guide Vert. Fauna East. Cape Prov., pt. 2, p. 137, fig. 4 (*callidus*).

This species grows to a length of about 300 mm. in Natal and the Transvaal, but the South African Museum has no specimens over 100 mm. from localities in the Cape Province. Nor is there a series of young or half-grown from Natal or the Transvaal, so that I am unable to say at what size breeding starts in those regions.

Recent collecting of series of specimens in the Zwartkops River (Uitenhage), Gamtoos River, and Kromme River (Assegai Bush) shows that in this part of the Cape Province breeding starts at a length of about 43 mm. No specimens over 100 mm. were obtained, so that I cannot say to what size this fish may grow in Cape rivers.

Examination of the material shows the following points. In my 1927 description of the species, the gill-rakers were said to be obsolete. That is more or less true of large specimens, merely 7 or 8 very short knobs being present. But a series seems to show that after an initial increase from 7 or 8 to 10 or 11 there is a subsequent reduction in the number and in the length of the rakers (see table, p. 262).

The scales on the throat (the triangular area between the ventral fins and the isthmus) are variable. In the large specimens the area is completely scaled, and likewise in a series of small specimens (23–100 mm.) from the Buffalo River (King William's Town and East London). On the other hand the Gamtoos River series shows absence of scales in the young up to about 30 mm., and their gradual development in specimens over that length. In the Kromme River series the scales seem tardy in developing, first appearing in some specimens of 75 mm., but being absent in others 80–90 mm. None of the Zwartkops River series (up to 85 mm.) have throat scales. This character therefore cannot be used for specific differentiation.

The scaling on the occipital region is subject to growth, but appears to follow a more regular development. In the smallest specimens the whole occipital region is naked, extending back almost to the origin of the dorsal fin, in front of which only 1 to 2 or 3 scales are traceable. With the development of 4–5 predorsal scales the scaling extends forwards to about the level of the hind margin of opercle, and with 6–7 or 8 scales to about midway between the opercle and preopercle. When fully developed there are 14–16 scales together with some 4 or 5 small irregular, often indistinct, ones in front (*ca.* 20 in all), extending to or almost to the level of the hind margin of the eyes. The Buffalo River specimens are well-scaled for their size, in comparison with the other series (*cf.* throat-scaling, *supra*).

The number of scales in a transverse series (between bases of soft dorsal and anal) may increase with age, but a longer series should be examined from localities where the fishes are known to reach a size of 250 or 300 mm.

The dorsal and anal branched fin-rays number usually 9 and 8 respectively; but in the Zwartkops River specimens the normal formula is 10/9, only occasionally 9/8, and in one instance 9/9 (a second case of this latter in one specimen from Van Stadens River). I have seen no specimen with 8/7 (as in *gulosus*), but there are 2 from Assegai Bush with 9/7.

The caudal fin, *when fully expanded* (which cannot be done in specimens much hardened in strong preservative), forms a broad fan with rounded margin. Neither Peters' figure (reproduced in Boulenger, fig. 15) nor J. L. B. Smith's figure (1936 and 1937) are correct, both being based on incompletely expanded caudal fins. The roundness or pointedness of the caudal fin is not a character, but the length of the middle caudal rays is a feature which deserves consideration, together with the length of the pectoral, in relation to the head-length (fig. 33, *c*).

Like other features, the lengths of these two fins seem to be dependent on growth, and to be variable at that. They seem to increase in length with growth up to 100 mm., and may equal the length of the head, or in the case of the caudal fin may exceed it. But the increase is not regular or constant in a series of specimens, especially in series from different localities. Further, when the largest specimens are measured there seems to be a retrogression (*cf.* the 3 Umkomas specimens); but unfortunately I have no long series from the very young upwards from any locality in Natal or the Transvaal.

The tables, however, give sufficient indication of the truth of Day's remark (1878–1888, Fish. India, p. 295): "The fins are subject to very great variations as to the length of the spines and rays"; and of the necessity of a detailed investigation of long series from many localities.

Even on the basis of the very small amount of material available, I am unable to admit the validity of *gulosus*, based on a single specimen, whose *only* unusual feature is the fin formula 8/7. This is surely an individual abnormality (*cf.* the Assegai Bush specimens). It would be inadvisable to claim specific rank for any of the present series until we know the growth-changes, and the size when breeding starts, in communities in Natal and the Transvaal.

The eggs are of the characteristic oval shape; and the nearly ripe gonads can be seen as a yellowish patch through the body-wall at a length of 38 mm. (Kromme River). The fully ripe ♂♂ and ♀♀ from 43 mm. upwards were taken in late October.

Addendum and Corrigendum to p. 153.

Barbus aeneus (Burchell)

syn. *B. holubi* Stndr.

Burchell (1822, Travels Int. S. Afr., vol. i, p. 280, fig. on p. 284) described "*Cyprinus*" *aeneus*, and (*ibid.*, p. 425, fig. on p. 445) "*Silurus*" *gariepinus*. The latter was accepted by Günther and Boulenger, but, for no apparent reason, not the former.

As regards *gariepinus*, Burchell gave no characters by which this species can be distinguished from, e.g., *mossambicus*. Burchell's species is not recognisable except on a geographical basis; it is typical of the Orange River and apparently the only species found in that river.

On this basis *aeneus* is also recognisable, although the description does not fulfil modern requirements. But is the description entirely inadequate? The description states that the head is small (cf. *supra*, p. 157, and fig. 8); the figure shows an elongate anal fin, and was made from a fish $19\frac{1}{2}$ inches in length; the locality was the Zak River.

As *B. holubi* is known from the Zak River, and the main Orange River, and is the only large species of Barbus in this system, Burchell's species is clearly recognisable. Therefore his earlier name should be accepted in place of Steindachner's.

The colloquial name (pp. 121, 153) should be changed to Orange River Yellow-fish.

Remarks.
s not as far as opercle. asionally 9/8; one specimen 9/9. 43 mm.
only one of 68 mm. s not quite to opercle. mature.
55 mm.
s not quite to opercle. ith 9/7 rays. hable from 38 mm. 45 mm.
om East London. Villiams Town.
Exact locality ?.

To face page 262.

Gobius giuris.

Locality.	Length.	Gill-rakers.	Pectoral: Head.	Caudal: Head.	Lateral Series.	Transverse Series.	Predorsal.	Throat Scales.	Dorsal Rays.	Anal Rays.	Sex.	Remarks.
Zwartkops R. (Groendal Valley), Uitenhage	18 25 35 45 55 65 75 85	From 8 ($\frac{3}{4}$ length of the filaments) to 10–11 ($\frac{1}{2}$ length of filaments)	$\frac{1}{2}$ length of head $\frac{2}{3}$,, ,, $\frac{2}{3}$,, ,, $\frac{3}{4}$,, ,, $\frac{4}{5}$,, ,, $\frac{5}{6}$ to almost equal	$\frac{2}{3}$ length of head $\frac{3}{4}$,, ,, $\frac{3}{4}$,, ,, $\frac{3}{4}$,, ,, $\frac{4}{5}$–$\frac{5}{6}$,, ,, $\frac{5}{6}$ to equal	26 28 28–29 29–31	6 7	0 1 1 1–2 2 2 2 2–3	None	10	9		114 specimens. Predorsal scales not as far as opercle. Rays 10/9, occasionally 9/8; one specimen 9/9. Ripe ♀♀ from 43 mm.
Gamtoos R., tributary at Loerie	25 30 35 40 45 50 60 68	7(–8) ($\frac{3}{4}$ filaments) 9(–10) 10 ($\frac{3}{4}$) 10–11 10–11 ($\frac{1}{2}$ length of filaments)	$\frac{2}{3}$–$\frac{3}{4}$ head $\frac{3}{4}$,, $\frac{4}{5}$,, $\frac{5}{6}$ to almost equal	$\frac{3}{4}$–$\frac{5}{6}$ head $\frac{5}{6}$,, Equal $1\frac{1}{5}$ times the head	28 28–31	7	1 2 2–3 3–4 4	None ,, A small patch	9	8		25 specimens, only one of 68 mm. Predorsal scales not quite to opercle. None sexually mature.
Gamtoos R., tributary at Patentie	40 60 70	As in Loerie series	$\frac{3}{4}$ $\frac{5}{6}$ $\frac{5}{6}$	$\frac{5}{6}$ Equal ,,	29–31	7	2–3 3	A small patch	9	8		12 specimens. Ripe ♀♀ from 55 mm.
Kromme R., Assegai Bush	30 40 50 60 70 80 90	As in Loerie series	$\frac{3}{4}$ $\frac{5}{6}$ $\frac{5}{6}$ to equal	$\frac{3}{4}$ $\frac{5}{6}$ Equal	28–31	7	1–2 2 2–3 3 3	None, or sometimes a small patch	9	8 (7)		21 specimens. Predorsal scales not quite to opercle. 2 specimens with 9/7 rays. Ova distinguishable from 38 mm. Ripe ♀♀ from 45 mm.
Van Stadens R.	80	10	=	$1\frac{1}{5}$ times head	31	7	1	Small patch	9	9	♂	One specimen.
Buffalo R. East London K.W.T.	23 30 35 55 65 75 70	7–8 ($\frac{3}{4}$) 8–9 10 10–11 ($\frac{1}{2}$ length of filaments)	$\frac{2}{3}$ $\frac{3}{4}$ $\frac{4}{5}$	$\frac{2}{3}$–$\frac{3}{4}$ $\frac{4}{5}$	27 28 29–32 28	7 7–8 7	5–6 8–9 9–10	Present	9	8		6 specimens from East London. 1 from King Williams Town.
East London	100	10 ($\frac{1}{2}$)	$\frac{2}{3}$	$\frac{2}{3}$	..	..	10	Present	9	8	?	1 specimen.
Port Elizabeth	65 70	10 ($\frac{1}{2}$)	$\frac{3}{4}$ $\frac{4}{5}$	$\frac{3}{4}$ $\frac{4}{5}$	28–29	7	9–10	Present	9 10	8 9		2 specimens. Exact locality ?.
Loc. ?	105	9 ($\frac{1}{2}$)	$\frac{3}{4}$	$\frac{3}{4}$	31	9	4–5	None	9	8	..	1 specimen.
Umkomaas	80 100 200	10 ($\frac{1}{2}$) 10 ($\frac{1}{2}$) 7 ($\frac{1}{4}$)	$\frac{4}{5}$ $\frac{2}{3}$	$\frac{4}{5}$ = $\frac{2}{3}$	29 31 31	7 8 9–10	4 5–7 *ca.* 20	None ,, Complete	9	8	♂	3 specimens.
Sabi R.	150	9 ($\frac{1}{2}$)	$\frac{3}{5}$	$\frac{2}{3}$	32	9	*ca.* 20	Complete	9	8	♂	1 specimen.
Natal	255	7–8 ($\frac{1}{4}$)	$\frac{2}{3}$	$\frac{2}{3}$	30	9	*ca.* 20	Complete	9	8	♂	1 specimen.
Umgeni R.	275 300	7–8 ($\frac{1}{4}$)	$\frac{2}{3}$	$\frac{2}{3}$	31–32	9	*ca.* 20	Complete	9	8	♂ ♂ ripe	2 specimens.

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ANNALS

OF THE

SOUTH AFRICAN MUSEUM

VOLUME XXXVI.

PART III, *containing*:—

4. *Contributions to our Knowledge of the Genus Latrodectus (Araneae) in South Africa.*—By REAY H. N. SMITHERS, B.Sc. (With Plate VIII, 20 Text-figures, and 2 maps.)

SEMPER ALIQUID NOVI AFRICA AFFERT

ISSUED MAY 1944. PRICE 5s.

PRINTED FOR THE

TRUSTEES OF THE SOUTH AFRICAN MUSEUM, CAPE TOWN

BY NEILL AND CO., LTD.,

212 CAUSEWAYSIDE, EDINBURGH.

4. *Contributions to our Knowledge of the Genus Latrodectus (Araneae) in South Africa.*—By Reay H. N. Smithers, B.Sc.

(With Plate VIII, 20 Text-figures, and 2 Maps.)

The deadly nature of the venom of spiders of the genus *Latrodectus* has long been known, and, as a result, considerable attention has been paid to the systematics and bionomics of the genus in various parts of the world.

Until the early part of the present century, however, relatively little mention had been made of specimens from South Africa. In 1902 Frederick Pickard-Cambridge, in his paper (8), recorded several specimens from widely separated localities in this region; this being followed in 1904 by a paper (12) by Octavius Pickard-Cambridge in which he described two species of *Latrodectus*—*L. indistinctus* and *L. concinnus*—from material in the collection of the South African Museum lent to him by the late Dr. W. F. Purcell. In this publication (12) there appeared to be some misunderstanding regarding the local name "Knopiespinnekop," for Octavius Pickard-Cambridge applied this to another Theridiid spider *Teutana lepida* with the remarks: "An abundant species known as the 'Knopie-spider' and its bite is dreaded by the natives, Cape Peninsula, under stones everywhere." The application of the name "Knopiespinnekop" to this spider is wrong; the true "Knopiespinnekop or Button-spider" is *Latrodectus indistinctus.*

During the years 1934–36 increasing numbers of cases of serious illness and death were attributed to spider bite, the majority of these occurring in the coastal belt of the Western Province. While it was impossible to arrive at any definite conclusion from the reports of sufferers as to the type of spider causing these illnesses, suspicion centred on a black spider common at some seasons of the year in the wheat fields and locally known as the "Knopiespinnekop." Investigation of the properties of the venom of this spider by Finlayson (17) threw further light on the problem, and subsequently it was proved beyond doubt that the females of the "Knopiespinnekop or Button-spider," *Latrodectus indistinctus*, were the culprits (18).

As a result of these reports and accounts published from time to time in the Press, numbers of supposed Button-spiders were received by the South African Museum for identification. It soon became apparent that, as far as South Africa was concerned, our knowledge of the systematics and bionomics of the genus was meagre in the extreme and that, owing to its economic importance, an investigation of these might prove interesting.

While full details of the properties of the venom, records of clinical cases, Arachnolysin, and the Antivenene now prepared by the Union Health Department, are available in the papers by Finlayson (17, 18), the following observations may be of general interest.

Owing to the difficulty of obtaining adequate numbers of males their venomous properties have not up to the present been investigated. It seems probable, however, that only the bite of the female *L. indistinctus* can cause serious symptoms in man; since, owing to the small size of the males and the consequent minute size of their fangs, it is unlikely that these could penetrate the human skin.

Under normal circumstances the danger of being bitten by the Button-spider has been greatly exaggerated for, except under exceptional circumstances, chances of contact with the spider are small. Unlike *L. mactans*, better known as the "Black Widow Spider" of America, *L. indistinctus* does not build its nest in houses or outbuildings. To workers in the grain fields at harvest time, however, its presence constitutes a very real danger.

The majority of clinical cases of Button-spider bite occur during the harvest season; in the Western Province the greatest number being recorded in the grain lands of the western coastal belt. During this season the spiders, which are then particularly numerous, are disturbed by the reaping operations. Owing to the disruption of their nests or exposure to the sun, through the removal of the shade afforded them by the standing grain, they become restless and seek more substantial shelter. This is provided for them by the sheaves which are left lying on the stubble for a few days to dry. Under these they rebuild their nests. The workmen who come to stack these in "shooks" are in the habit of collecting several sheaves under their arms, and in doing so may come into contact with a spider, which, being irritated by friction with the clothing or skin, are induced to inflict a bite.

During the 1936 harvest a count over a considerable area in the districts of St. Helena Bay, Philadelphia, and Bellville showed that one out of every six sheaves turned over had a "Knopiespinnekop" nest on the underside. In the St. Helena Bay district during the same season as many as twelve were collected on or around a wagon bringing grain from the fields to the thresher.

As far as the systematics of the genus is concerned, owing to the confusion which has arisen through the description in 1904 by O. Pickard-Cambridge (12) of the species *L. concinnus*, which will be shown in this paper to be a synonym of *L. geometricus* C. L. Koch, this opportunity is taken to give a short redescription of a typical South African specimen of *L. geometricus*. As Octavius Pickard-Cambridge's description of *L. indistinctus* is lacking in the mention of several important characters, this species is redescribed and at the same time the characters of the previously undescribed male are given.

Owing to the scarcity of material from districts of South Africa outside the Western Province no finality is claimed for the distribution records. Judging from the results so far obtained, however, it seems likely that both *L. indistinctus* and *L. geometricus* will in time be shown to occur throughout South Africa. It is hoped, when further material becomes available from Southern Rhodesia and South West Africa, to deal at greater length with the forms occurring in these regions.

Immature forms of *Latrodectus* differ noticeably in pattern and coloration from the adults, and in order to understand the various forms occurring in South Africa a departure from the normal examination of preserved specimens was necessary. A series of specimens was reared from emergence from the egg-sac till the adult state had been reached, and the examination of these was augmented by comparison with similar stages collected in the field. The results obtained demonstrate clearly the danger of attempting to describe new species from immature forms, an error into which many of the earlier students of the genus fell. At the same time they facilitate the correlation of the brightly coloured immature forms with the jet-black adults.

I take this opportunity of expressing my thanks to the following gentlemen for specimens and information: Dr. K. H. Barnard, Dr. M. H. Finlayson, Dr. S. H. Skaife, Dr. J. Hewitt, Mr. R. Attwell, Mr. C. H. Colson, Mr. J. F. Cloete, and Mr. C. H. Major. I have also to thank Mr. C. W. Thorne of the South African Museum, who accompanied me on most of my local collecting expeditions and whose enthusiastic co-operation was invaluable throughout the course of this investigation; Dr. R. F. Lawrence for helpful advice and the loan of specimens from the collection of the Natal Museum; and to Dr. A. J. Hesse of the South African Museum, who kindly consented

to identify the insects which form the food supply of *Latrodectus indistinctus* from material incorporated in a series of nests and webs. A list of these insects is given in a separate paper by Dr. Hesse in which at the same time he describes the Hymenopterous parasites infesting the egg-sacs of this spider (22).

The major part of the collecting for distribution records was made possible by grants during 1937–39 from the National Research Council and Board, to whom my thanks are due; and the whole of the laboratory work was carried out while I was a member of the staff of the South African Museum.

Genus Latrodectus Walckenaer.

Tabl. Arach., p. 81, 1805.

Key to the South African species.

Adult Females.

(1) Ventral surface of abdomen with a distinct hour-glass-shaped yellow or reddish-yellow marking. Dorsal surface of abdomen without coarse bristles . . . . *geometricus* C. L. Koch.
Ventral surface without a distinct hour-glass-shaped marking, but with one or two indistinct whitish transverse bands or jet black. Dorsal surface of abdomen with coarse bristles . . . . 2.

(2) Dorsal surface of abdomen jet black or with a series of small white spots; a red spot or subtriangular patch on the posterior apex *indistinctus* O. Pickard-Cambridge.
Dorsal surface of abdomen jet black with a distinct red median longitudinal band the anterior end of which is sometimes produced into two arms laterally forming a T-shaped marking . . . . *indistinctus* var. *karrooensis.*

Adult Males.

(1) Dorsal surface of abdomen predominantly pale cream or white with an irregular brownish pattern. . . . . 2.
Dorsal surface of abdomen predominantly black with a distinct red median dorsal longitudinal band the anterior end of which is produced laterally into two arms forming a T-shaped marking and on either side of the shaft of this T-shaped marking two lateral red patches *indistinctus* var. *karrooensis.*

(2) Dorsal surface of abdomen with two parallel longitudinal rows of three or four black spots on an irregular brownish pattern. Leg I subequal to twice length of cephalothorax + abdomen . . *geometricus* C. L. Koch.
Dorsal surface without black spots. Leg I subequal to four times length of cephalothorax + abdomen . . *indistinctus* O. Pickard-Cambridge.

Notes on the Type of *Latrodectus indistinctus* O. Pickard-Cambridge.

Unfortunately O. Pickard-Cambridge did not designate his types. In the collection of the Hope Museum, Oxford, however, there is a jar containing a series of spiders left to this Museum by him. This is labelled "From Dr. W. F. Purcell, South African Museum," the specimens bearing registered South African Museum numbers and corresponding through the series with the spiders described by O. Pickard-Cambridge in his paper published in the Annals of the South African Museum (12). As O. Pickard-Cambridge's description of *L. indistinctus* is given in this paper, it seems reasonable to suppose that the two specimens included in this series from Mamre, C.P., are the syntypes of this species.

Through the good offices of Professor G. Hale Carpenter I had the opportunity of examining these two specimens.

While they agree in their general morphology they exhibit small but noteworthy differences in certain characters.

No. 1 specimen has a small light yellow spot on the posterior apex of the abdomen immediately above the superior spinerettes, while in No. 2 specimen this marking is subtriangular. This variation was found to be fairly common in specimens from Mamre, in some cases the marking being very faint. As a period of some years had elapsed from the time that the specimens were collected (1896) till they were received by O. Pickard-Cambridge (1899) the original colour of these markings had ample time to fade. No mention is made in his paper of differences in colour between these markings and the other markings on the dorsal surface of the abdomen. From extensive collecting in the Mamre area there is little doubt that in the fresh specimens this

Anterior.
No. 1 Specimen.

Anterior.
No. 2 Specimen.

FIG. 1.—*L. indistinctus* O. Pickard-Cambridge. Diagrams of the eyes of the syntypes.

spot or subtriangular marking was bright red, whereas the other markings on the dorsal surface were white.

No. 2 specimen has, on the ventral surface of the abdomen, two distinct light yellow transverse bands, one immediately posterior to the epigastric furrow, the other immediately anterior to the thoracic groove. In No. 1 specimen the ventral surface is of a uniform black colour. In both cases the two rows of eyes are divergent, the anterior median being the smallest (fig. 1). In No. 2 specimen the eyes of the posterior row are homogeneous, while in No. 1 they are heterogeneous, the median pair being slightly smaller than the laterals.

The weight of the legs as compared by Petrunkevitch's Tibial Index Formula, $\frac{\text{Width of patella} \times 100}{\text{Length of patella} + \text{tibia}}$, shows that the fourth pair of legs of No. 2 specimen are thicker than those of No. 1.

Specimen.	No. 1.	No. 2.
Leg I . .	10·8	10·7
Leg IV . .	10·7	11·4

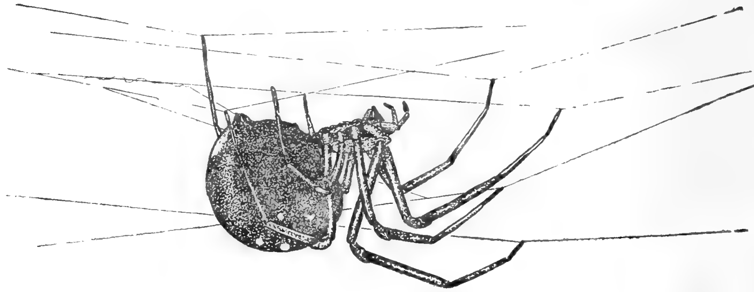


FIG. 2.—*L. indistinctus*, adult ♀.

This variation in the weight of the legs is met with in series of specimens from the same locality, but, as it does not seem to be related to other morphological differences, deserves but passing mention.

In both specimens the sternum is slightly longer than broad in the proportions 10 : 9, and the dorsal abdominal setae, which are stout and bristle-like, are of three types: long curved, medium curved, and short straight in the proportions of length 8 : 3 : 2.

Latrodectus indistinctus, O. Pickard-Cambridge.

Ann. S. Afr. Mus., vol. iii, part v, p. 154, and pl. xi, fig. 1, 1904.

Female. Fig. 2.

Cephalothorax: fig. 3 (*c*).—Slightly longer than broad, covered with short stout setae, these more numerous towards the lateral margins where they are interspersed with a few long setae. Posterior area of raised cephalic region covered with long fine setae. Median fovea a deep recurved depression the ends of which are deeper than the median portion. Clypeus anteriorly rounded.

Eyes.—Anterior median pair the smallest, raised on a common low tubercle, about one and a half diameters apart and nearer together than either is to the anterior lateral on its side. Posterior medians slightly larger than the anterior medians and nearer together than either is to the posterior lateral on its side. Laterals homogeneous or the anterior lateral slightly larger than the posterior, and slightly larger than the posterior medians. Median ocular quadrangle longer

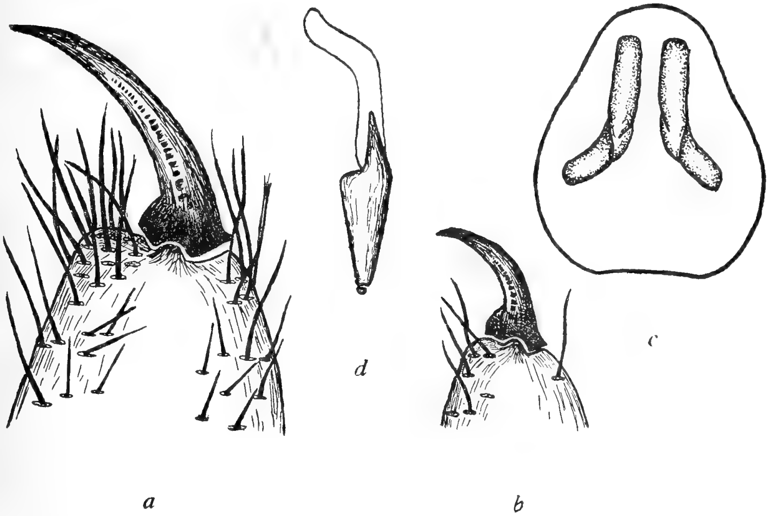


FIG. 3.—*L. indistinctus.* *a*, chelicera of ♀. *b*, chelicera of ♂. *c*, cephalothorax of ♀, with poison sacs. *d*, lateral view of chelicera with poison sac.

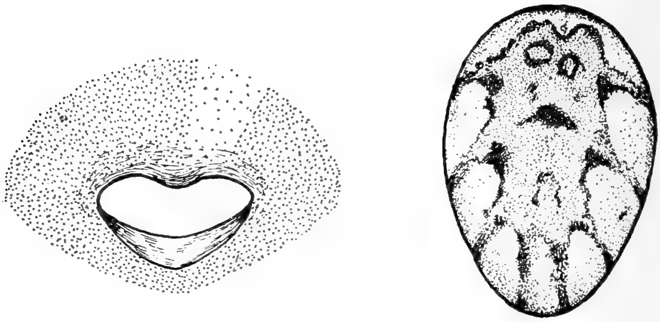
than broad, in front narrower than behind. Clypeus subequal to twice length of median ocular quadrangle.

Chelicerae: figs. 3 (*a*) and 3 (*d*).—Subequal to one and a quarter times length of clypeus, unarmed, with a brush of long fine setae on the distal apex of the inner margin.

Sternum.—Longer than broad in the proportions 10 : 9, brownish black covered with long fine setae. The posterior apex ending acutely beyond coxae of fourth legs. Labium twice as broad as long, apically rounded.

Abdomen.—Subglobular, jet black, dorsally with a few indistinct white spots. The posterior apex with a red spot or subtriangular red marking. Covered with three types of bristle-like setae, long stout curved, medium curved, and short straight in the proportions of length 8 : 3 : 2, fig. 20 (*f*). Ventrally black with two indistinct transverse white or light yellow narrow bands, one immediately anterior to the thoracic groove, the other immediately posterior to the epigastric furrow, one or other of these bands frequently absent.

Legs: I, IV, II, III.—Jet black, tarsi and metatarsi lighter than the remainder of the legs, femora, patellae, and tibiae with setae of



a *b*

Fig. 4.—*L. indistinctus.* *a*, epigyne ♀. *b*, abdomen ♂.

the same type as the abdomen, the setae on the tarsi and metatarsi longer and finer. Femora, patellae, and tibiae with two glabrous dorsal longitudinal bands on either side of a median band of setae.

Epigyne: fig. 4 (*a*).

Dimensions.—Cephalothorax, 5 mm.; abdomen, 12 mm.; leg I, 21 mm.; leg IV, 19 mm.

Male. Fig. 5.

Taken from nest with adult female, Klapmuts, C.P., Nov. 1937. S.A.M. 9185.

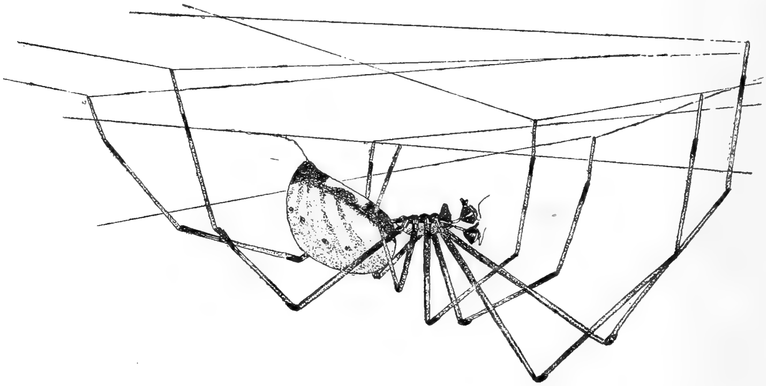
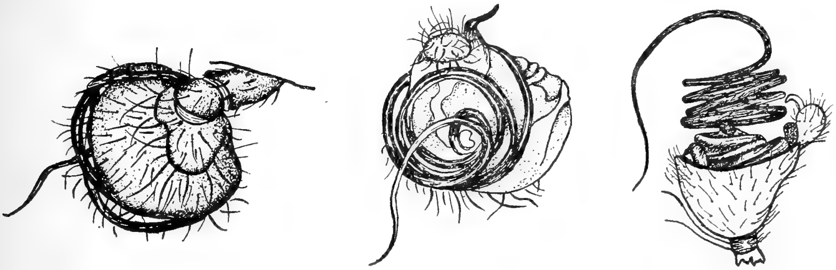


Fig. 5.—*L. indistinctus*, adult ♂.

Cephalothorax.—Dull yellow-brown, longer than broad in the proportions 7·5 : 6, lateral margins infuscated, sparsely covered with short fine setae, these more numerous on the anterior face of the clypeus and in the region of the eyes.

Eyes.—In two distinctly converging rows, the anterior strongly, the posterior weakly recurved. Anterior medians the smallest, the posterior median smaller than the laterals, which are of uniform size. Median ocular quadrangle longer than broad, the anterior side shorter than the posterior. Lateral eyes on either side separated by three-quarters their diameter. Clypeus subequal to length of median ocular quadrangle.



a b c

FIG. 6.—*L. indistinctus*, ♂ palp. *a*, dorsal view. *b*, anterior view. *L. geometricus*—*c*, ♂ palp.

Chelicerae: fig. 3 (*b*).—Unarmed, subequal to one and a half times length of clypeus.

Sternum.—Dark brown, as broad as long, longitudinally bisected by an indistinct pale yellow band, lateral margins lightly infuscated. Covered with medium length fine setae. Posterior apex ending acutely beyond coxae of fourth legs.

Abdomen: fig. 4 (*b*).—Longer than broad in the proportions 10 : 7. Dorsally predominantly white or pale cream with an irregular pattern of dark brown lines and spots as in fig. 4 (*b*). Ventrally dark brown with a distinct diabilo or hour-glass-shaped light yellow marking between the epigastric furrow and the thoracic groove, and a series of four white spots surrounding the spinerettes. Sparsely covered with short fine setae.

Legs: I, IV, II, III.—Femora, patellae, and tibiae dark brown, the tibiae lighter towards their apices, metatarsi and tarsi light brown.

Palpi.—See section devoted to these organs. Figs. 6, 7, and 8.

Dimensions.—Cephalothorax, 1·75 mm.; abdomen, 2·25 mm.; leg I, 15 mm.; IV, 11 mm.; II, 8 mm.; III, 5 mm.

The very long slender legs are particularly characteristic of the males of this species. In males of *L. geometricus,* in which the over-

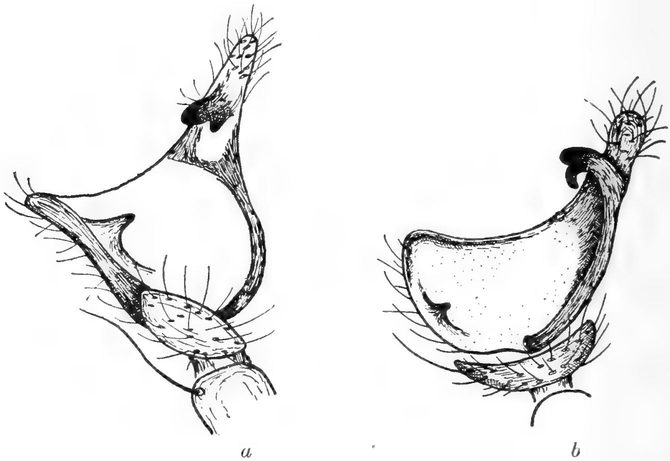


Fig. 7.—Modified tarsus of ♂ palp with the embolus and other organs removed. *a, L. indistinctus. b, L. geometricus.*

all length of the cephalothorax + abdomen is the same as in this specimen, *i.e.* about 4 mm., leg I is 9 mm. as against 15 mm. in *L. indistinctus.*

The Male Palp of Latrodectus.

The sexual organs of the male palp are borne in the modified tarsus, which is subtriangular and curved, the apex covered with a brush of setae situated in an inner and ventral position, the broader portion serving as a roof over these organs.

Internally near the apex of the tarsus there is an inwardly directed two-lobed process the structure of which differs in the species *L. indistinctus* and *L. geometricus.* In *L. indistinctus* the lobes are straight and truncate, one being noticeably larger than the other, whereas in *L. geometricus* while the larger lobe is similar to the corresponding one in *L. indistinctus,* the other is much finer and distinctly hooked (fig. 7).

The embolus which resembles a stiff coiled tape, through the centre of which runs the sperm duct to open near the point, lies in an open coil on the anterior side of the tarsus and is clearly visible in live specimens as a small jet-black ring. The basal portion of the embolus is enclosed in the tarsus and is held there by membranous fibres (fig. 8 (*a*)).

On the inner side of the tarsus lies the hematodocha, a semi-transparent fibro-elastic bag, connected at its innermost edge by a

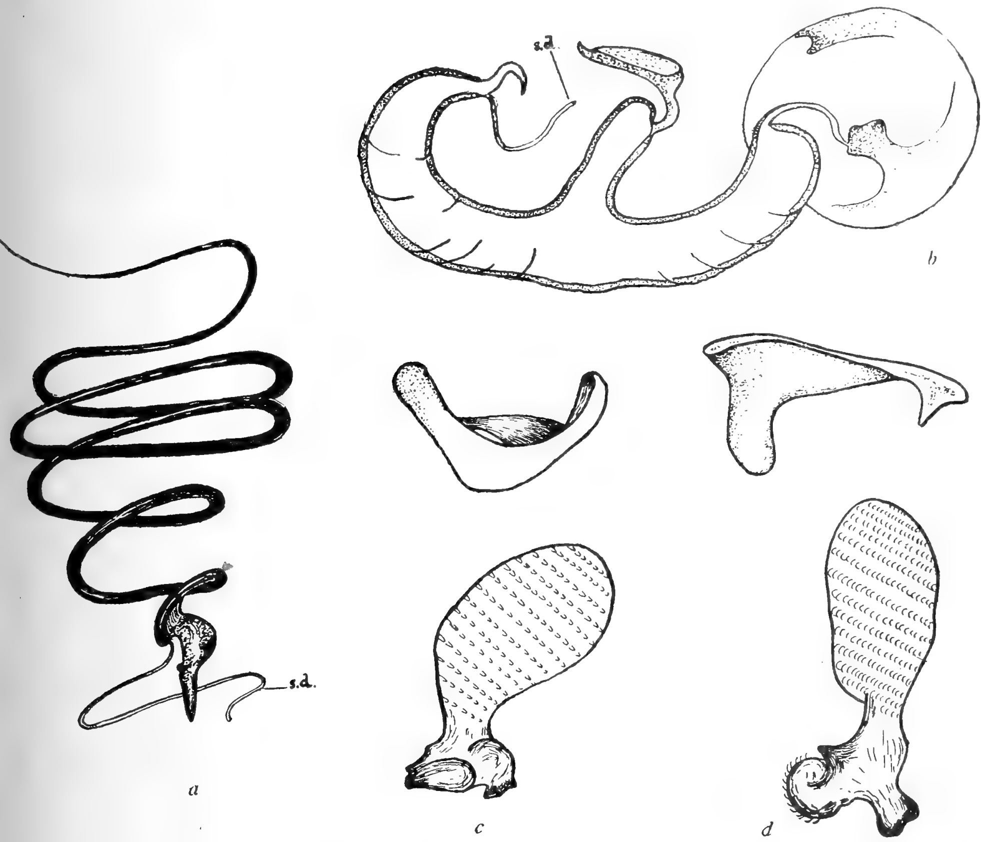


FIG. 8.—*L. indistinctus*, portions of the ♂ palp. *a*, embolus. *b*, receptaculum seminis and hematodocha. *c*, accessory organs. *L. geometricus*—*d*, accessory organs from ♂ palp.

short fine duct leading to the receptaculum seminis, a three-lobed pouch lying curled round the base of the tarsus (fig. 8 (*b*)). From the lobe of the receptaculum seminis farthest from the hematodocha arises the sperm duct which leads to the base of the embolus and connects with the duct running through this organ.

The median lobe of the receptaculum seminis has at its distal end a funnel-shaped structure attached by means of a small duct. Two other smaller structures are found near the base of the embolus (figs. 8 (*c*) and 8 (*d*)).

Notes on the Bionomics of *L. indistinctus*.

Female.—The females of this species are sedentary by nature, and having constructed a nest and web seldom, save under exceptional circumstances, leave this during their lifetime.

The web consists of three distinct portions; the nest, the tunnel, and the delaying threads.

The nest is constructed at the base of small bushes, tufts of grass or stubble, or among heaps of loose debris, being situated low down often on the ground and usually in the centre of such cover or at least well concealed. Nests have been found under the overhanging edges of stones and in rock crevices as well as among occasional rubbish such as old tins, but sites such as these are the exception. Unlike the species *L. geometricus* or the American *L. mactans*, no nest of *L. indistinctus* has yet been recorded from the immediate precincts of a building.

The nest consists of a dense pocket of closely woven webbing, a corner of which is fashioned into a small pouch which just accommodates the spider with its legs drawn close to its body. To this portion of the nest it retires on being disturbed. In the case of nests of this species taken from the scrub bush near Mamre, C.P., the nest measured from 4 to 6 inches in length. Nests of these dimensions are seldom found in grain lands, as here they are disturbed during the course of the season. An outstanding characteristic of the nests of *L. indistinctus* is that the carcasses of the spiders' victims are woven into the walls of the nest (Plate VIII).

From the opening of the nest runs a more open web mass, attached to twigs or small stones on the ground on either side and raised in the centre, forming a tunnel with the ground as a floor. Small pieces of stick, leaves, and other debris are woven into the walls of this tunnel by the spider often in such quantity that from above it is difficult to distinguish it from the surroundings. Much of this debris originates from the floor of the tunnel, and this is usually singularly free of loose material, the remainder is added by being blown there by the wind or falling from above. Very large pieces of stick and even stones have been found in the walls of the tunnel, some of them many times the weight of the spider. From the roof of this tunnel numbers of vertical strands are dropped attached at their basal ends to vantage-points on the ground below, these strands being coated over a distance of one or two centimetres at their basal ends with globules of a viscid fluid. These appear to be the only portions of the web with the exception of the points of attachment where this viscid fluid is used, and they form the main trapping apparatus of the web. The tunnels vary in length from a few inches up to 2 feet. The delaying threads radiate irregularly from the mouth of the tunnel and may often be detected 3 feet from the nest.

The great strength of individual strands is a distinctive feature of webs of *Latrodectus* and, after a little practice, one can determine, when the nest and spider are hidden, whether the web belongs to a specimen of this genus by passing a finger through one or two of the delaying strands. This is of some assistance in collecting as the nest is often well hidden at the base of dense vegetation, its presence being revealed solely by a glint of sunlight on a solitary strand of web among the surrounding vegetation.

As a consequence of the great strength of the individual strand the walls of the nest are of the strength of a light fabric which is, moreover, waterproof. Frequently the tunnel was easily capable of supporting the weight of a 15-inch pair of metal forceps (5–6 oz.).

The greater part of the work involved in the construction of the web is performed at night; during the day the spider seldom leaves the nest except for the purpose of effecting a capture or of carrying out minor repairs.

Nests are seldom found in damp places or in wooded country.

In an open sclerophyll association such as in the Mamre district where extensive examination and collecting has been carried out, *L. indistinctus* nests are found mainly in the thicker clumps of low-growing Proteaceous shrubs such as *Leucospermum hypophyllum* or patches of *Restio* grass, especially when these are surrounded by an accumulation of dry debris. The more open bushes or grass patches harbour but few individuals. As this type of locality shelters many different types of insects, the spiders are assured of a plentiful food supply. In this locality several webs of *Latrodectus* were found under the spreading sheet webs of another spider, *Euprosthenops* sp., the webs, however, being quite independent.

In the more arid parts of the country such as the Great Karroo, Namaqualand, and Bushmanland, *L. indistinctus* is, in comparison with the coastal belt of the Western Province, relatively scarce. Here greater use of disused rat holes, depressions in the ground, overhanging banks and stones is made for the construction of the web. In the Victoria West and Williston districts all the specimens collected were taken from nests among stones on the sides of rocky kopjes almost devoid of vegetation. In Namaqualand many specimens were taken from disused meercat (*Suricata*) holes and several from crevices in rocks and under stones.

Far larger numbers of *L. indistinctus*, however, have been collected in stubble, but the apparently great numerical concentration here is to some extent due to the fact that they are easier to find in such an environment than in the indigenous scrub. It is probable that owing to the plentiful food supply and the shelter afforded by the grain, greater numbers of the young survive in these fields than in the veld. In the St. Helena Bay, Aurora, and Piquetberg areas at least the concentration in the grain fields is far greater than in the scrub bush between the fields. In collecting for distribution records a search was invariably instituted in stubble before the bush was searched, special attention being paid to heaps of dry debris and small indigenous bushes in the stubble which proved to be fruitful sources of specimens.

While rather sluggish and awkward in her movements on the ground, the spider moves freely and at times with great speed on her web. On the web her normal position is upside down, hanging from the roof of the nest or tunnel.

In securing the victim the eyes are put to the minimum of use, the spider relying mainly on its sense of touch to locate and secure its prey. On an insect coming into contact with one of the delaying threads or one of the sticky vertical strands hanging from the roof of the tunnel, the spider advances towards the site of the disturbance in a series of short rushes, pausing from time to time to orient herself in the right direction. Advancing close to the disturbing insect the spider turns round and applies short strands of web heavily covered with viscid fluid by means of the fourth pair of legs to the body of the victim. This initial application has the effect in most cases of immobilising the victim, which is then securely bound up with further lengths of plain web applied in like manner. In the case of the larger insects such as *Psammodes* sp. and the larger *Acridiidae*, a bite may be inflicted which soon quietens the struggles, after which the securely tied victim is cut from the web and carried between the fourth pair of legs to the entrance of the nest to be devoured. Smaller insects are often carried still struggling in this manner. When the victim is too large to be carried, the bound-up carcass may be sucked dry *in situ* or slung by a careful attachment and cutting of lines to the entrance of the nest. Very large amounts of the viscid fluid can be applied by the spider at a time, and often when it is picked up with a pair of forceps the points of these get covered in the sticky mass.

Victims are similarly treated when they become arrested in the vertical snaring strands in the tunnel; here contact with that portion of the web strand carrying the globules of sticky substance holds the victim until the spider has time to catch it. Such is the strength of these strands that even some of the large *Anthiades* are held, as if on the end of a fishing line. When smaller prey gets caught in this manner, the spider has been observed to lift the still struggling victim at the end of the strand and without entangling it further to carry it to the nest.

In the case of the delaying threads situated at some distance from the nest which carry no viscid fluid, the spider relies on the mechanical entanglement of these to hold the victim until it can approach.

When insects walk over the outside of the tunnel the spider applies viscid fluid from the inside, which serves to arrest the victim until the spider can cut its way through and complete the capture. While applying the tangling threads in this case the spider has to do so in an unnatural position, *i.e.* dorsal side uppermost, but this is carried out with as much facility as when she is hanging in her natural attitude inside the tunnel.

The egg-sacs are as a rule hung from the roof of the nest, but in some cases they are situated outside the nest near the entrance of the nest in the tunnel. When this is done the roof of the tunnel is reinforced with additional web forming a watertight roof over them.

Males.—Adult males of *L. indistinctus* have been taken only during the months of November to January, during which period they may be found on the female web near the entrance to the nest, often two or three to each female.

After hatching and dispersal they construct a web similar to that of the female but much smaller, which they occupy until the final ecdysis. After this the male, probably actuated by sexual desire, develops a wandering habit and leaves his nest to seek a mate. Having found one he must exercise great caution in moving about her web, for when adult males are artificially introduced to the webs of females, unless this is done with great caution, she will rush out and seize him before he has had a chance to drop out of harm's way. The male appears at all times to have great fear of the female, for even when he has been in attendance on the female for some days he exercises great caution in his approach to her and will immediately drop from the web and remain motionless on the slightest sign of aggression from her. It frequently happens when males are on the female web that they all drop and lie motionless when she rushes out of the nest to secure a passing victim.

Having found a mate the male takes no part in the construction or repairing of the female web or in the capture of food. In the majority of cases he makes no attempt to feed while on the female web, although in a few cases he was observed to suck at the carcass of an insect which the female had discarded.

If adult males are introduced on to the webs of immature females they are almost invariably driven off, the female making vigorous attempts to catch them. On the other hand, on two occasions in the laboratory when the female was underfed and sickly the male turned the tables on her, tied her up, and proceeded to suck her carcass.

The Mating of *L. indistinctus*.

The mating of pairs of *L. indistinctus* under laboratory conditions was observed on several occasions, the following details of two cases being recorded.

No. 9384, an immature female collected on 29th September 1938 at St. Helena Bay. On 21st November the final ecdysis took place. On 1st October an immature male and on 6th November a mature male had been introduced to this female, but in both cases she had immediately attacked and killed them. After her final ecdysis, however, her behaviour towards a mature male introduced to her on 6th December was entirely different. This male was collected near Mamre, C.P., on this day and introduced to her web at 3.29 p.m.

On first contact with her web he remained motionless for a few moments, then proceeded to move cautiously around with a peculiar jerky movement. At first several brief excursions were made to outlying parts of the web as if a survey were being made of roads of escape should the female prove hostile. Then certain adjustments were made to the web, threads being cut, new attachments made and loose strands of web being pulled to one side and carefully attached. At 3.40 p.m. a somewhat lengthier excursion brought one of his first pair of legs into contact with the first pair of legs of the female which were protruding from the nest. On this contact the male remained motionless for a few moments, then a rapid trembling of his abdomen began which continued for the remainder of the mating.

After a few moments the female suddenly dropped from the nest and hung below it upside down. The male in the meantime had hastily withdrawn, but almost immediately re-established contact with the female and proceeded with the same jerky movements which had characterised his movements since the beginning to walk over and around the abdomen of the female, at the same time lightly tying up her legs with threads. As will be seen later these threads, owing to their extreme fineness, do not in any way hinder the movements of

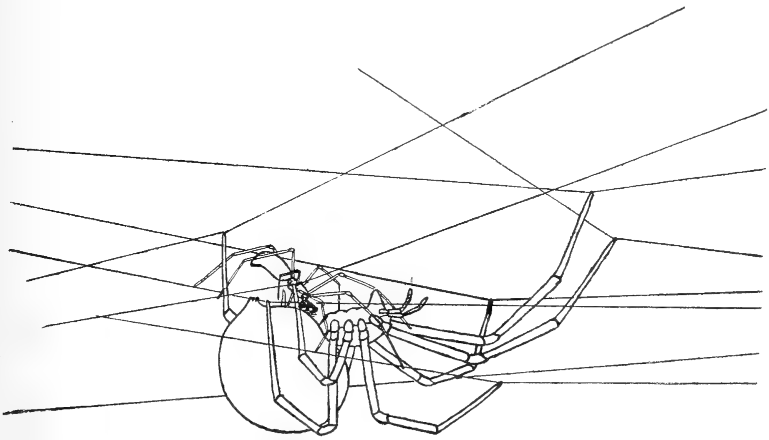


FIG. 9.—Positions taken up by ♂ and ♀ *L. indistinctus* at mating.

the female when she later makes up her mind to break loose, but they probably serve to give the male confidence or to remind the female that her partner is in attendance.

At 3.46 p.m. the first contact of the male palp with the female epigyne was observed, but no insertion of the embolus took place, instead the male tapped the raised portion of the epigyne for some moments, then suddenly withdrew to recommence tying up her legs and to resume his excursions round her body. At this stage the female shook her abdomen with a trembling movement for a few seconds, this being the only time during the mating that the female showed any sign of life. At 3.50 p.m. the male climbed on top of the female, head to head, and appeared to make the first definite insertion of his right palp (fig. 9). He remained on top of the female for about three minutes, the trembling of his abdomen being most pronounced during this period. At the end of this time, on attempting to resume his excursions, it was evident that he was caught, his right palp remaining attached to the female epigyne. For some ten minutes he struggled frenziedly to free himself. At the end of this time he at last broke free and retired a short distance, where he proceeded to pull out the embolus of his right palp with one of his forelegs as if it was causing him irritation. It was observed that the tip of this embolus was missing, this later being found in the female epigyne.

At 4.12 p.m. the male recommenced his advances, and after several excursions about the body of the female and having made adjustments to the web again proceeded to tap the epigyne of the female, this time with his left palp, now and then withdrawing a short distance then rushing in again to resume the tapping with almost feverish haste.

This continued until 4.38 p.m., when the insertion of the left palp took place. Contact was established until 4.42 p.m., when he again attempted to withdraw but again found himself firmly attached to the female. At this moment the female, who until now had shown no signs of movement, suddenly sprung into action and proceeded to rid herself of her attached mate. With the aid of her second and third legs the body of the male was pulled in towards her and several attempts were made to bite the apex of his abdomen which, however, was too short to reach her chelicerae, so instead she proceeded to wind him up in a mass of web. In the meantime the male frantically attempted to dislodge himself, but without avail. In the course of these struggles his fourth pair of legs were torn off, these being followed by his first pair, then by one of the third, but this did not serve to distract the attention of the female, who continued to apply webbing to his body. The female finding that she was not freeing herself by this method moved slowly and uneasily about the web, stopping now and then to apply more webbing to the body of her mate or to try and force him away with her fourth and second legs. Eventually by a process of turning and twisting, the remains of the male, now totally enclosed by a mass of webbing, broke free and dropped to the ground. The female, as if to rid herself of all memory of her erstwhile loving partner, carefully cut the legs which remained in the web and dropped them after his body.

The whole process occupied one hour and twenty minutes.

In the case of female No. 9388, who had likewise killed several immature males introduced to her nest, the mating took 40 minutes. In this case the process was observed through a high-power dissecting microscope and, while the whole process proceeded in much the same manner as in the case of No. 9384, this time the male was destroyed after the insertion of one palp only, in this case the left palp. On the insertion of the embolus at the act of copulation a sac-like protuberance was noticed at the base of the embolus, this gradually filling out like a small balloon. This was apparently the hematodocha or fibro-elastic bag, normally lying undistended in the modified tarsus of the palp, filling with body fluid and so forcing the sperm from the palp into the female epigyne. This swelling of the hematodocha has been observed by Gerhardt in the *Eresidae* (19), Bonnet in the *Pisauridae* (5), and more recently by Locket in the *Attidae* (31).

Portions of the embolus of the male palp are frequently observed in microscope slides of the female epigyne of *L. indistinctus*, the tip of this organ entering the anterior lobe of the female spermatheca by a duct on its inner side, the remainder of the embolus lying in the coiled tube leading from the opening of the epigyne to spermatheca. Epigynes have been examined in which portions of the embolus were observed in both spermatheca, in one only, and in some exceptional cases two emboli were observed in one spermatheca.

I have repeatedly tried to mate females of *L. indistinctus* with males of *L. geometricus* and *vice versa*, but without success.

The Egg Sac.—The egg sacs of *L. indistinctus* are globular or pear-shaped and are normally suspended inside the nest. A well-fed female under laboratory conditions constructed nine during its life-time, but in the field eight is the maximum number observed in any one nest, three or four being more usual. In contrast to the egg sacs of *L. geometricus*, which are covered on the outside with short spikelets of web, those of *L. indistinctus* are smooth (fig. 10).

During the height of the warmer season, *i.e.* December to February, an average of 180 eggs are deposited in each egg sac, but in the laboratory fewer eggs were found, the average number being 130. Occasionally in the field much larger egg sacs were found containing 250–300 eggs.

The size and number of the egg sacs and the number of eggs laid in these depends mainly on the food supply. From a series of deliberately poorly fed females under laboratory conditions very small egg sacs were produced from which as few as twelve spiders emerged, whereas from well-fed females larger egg sacs were obtained with up to 200 eggs in each.

The normal size of the egg sacs of *L. indistinctus* is approximately 12–15 mm. in diameter.

The construction of the egg sac takes place at night or in the late evening, the lower portion of the globular sac being woven and the eggs dropped into this. On the egg-laying being completed the sac is closed and then the whole rotated between the fourth legs, while a final layer of webbing is laid over the outside surface with a dabbing motion of the abdomen. When first laid the eggs are covered with a

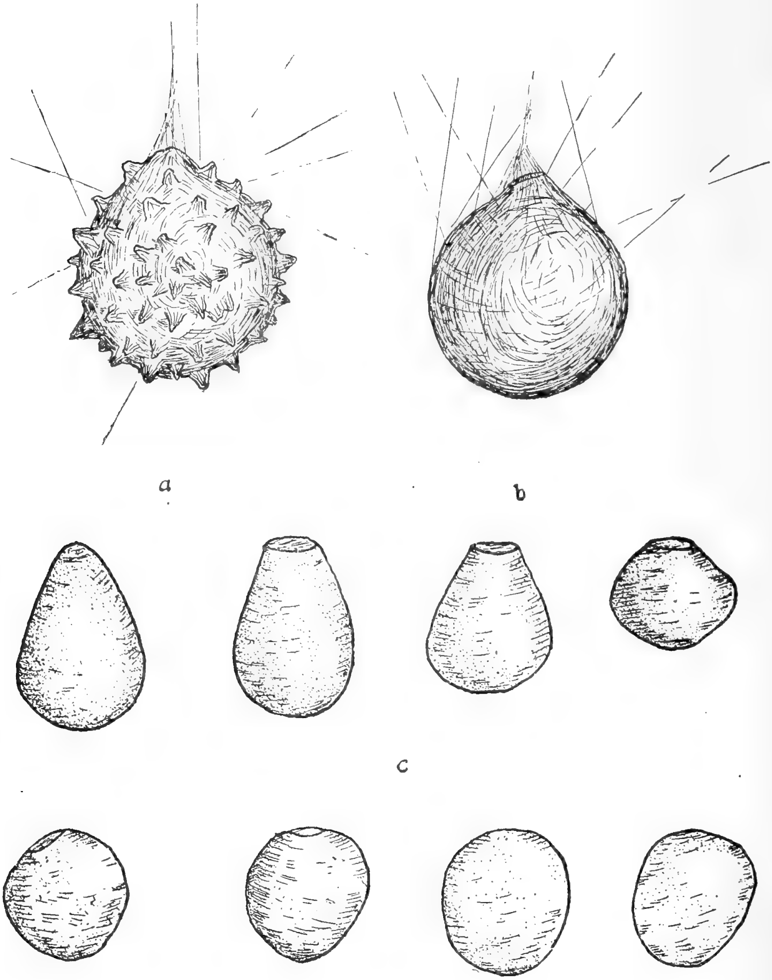


Fig. 10.—Egg sacs of *a*, *L. geometricus*. *b*, *L. indistinctus*. *c*, a series of eight egg sacs of *L. indistinctus* (Eendekuil, Cape Province) to illustrate variability in shape.

layer of viscid fluid which binds the mass of eggs together, this later dries allowing the individuals to lie free in the sac. The newly constructed egg sacs are pure white, becoming yellowish after a few days. Once the spiderlings inside have undergone their first ecdysis, the sacs darken in colour and assume a greyish colour owing to the dark mass of spiderlings being seen through them.

The Life-history of *L. indistinctus* prior to Emergence from the Egg Sac.

From egg sacs constructed during the warmer season of the year, say in December, the spiderlings emerge at regular 28–32-day intervals from the time that these are constructed. Towards the end of this season, however, the incubation period lengthens and the young when they do hatch from the egg remain in the sac until the arrival of the warmer weather in the following spring, the time spent in the sac in some instances being as long as 212 days.

To quote from the records of a spider from Agter Paarl collected on 22nd November 1937, in which case it will be noticed that the emergence time during December and January is longer than was found in the much larger series kept under observation during the following year, a difference which was probably seasonal:—

S.A.M. 9728.

Date of Construction of Egg Sac.	Young Emerged.	Number of Young.	Emergence Time in Days.
25.12.37	2.2.38	175	39
6.1.38	14.2.38	161	39
26.1.38	6.3.38	182	39
10.2.38	24.3.38	165	42
18.2.38	18.9.38	170	212
3.3.38	26.9.38	192	207
12.3.38	6.10.38	205	208
21.3.38	10.10.38	125	203
1.4.38	Alive 5.10.38	160	At least 188

Note.—The last record is based on a sac in which the spiderlings were seen to be alive on 5.10.38, but in which the young were inadvertently destroyed.

This to a large extent explains why far greater numbers of spiders are found during the harvest season in January and February, for a great proportion of these emerged from egg sacs which were constructed during the latter part of the previous season and from which the young only emerged with the coming of the warm weather in August to October.

Further information on the time taken for the young to emerge from the egg sacs is given in the table on next page.

S.A.M. No.	Date of Construction of Egg Sac.	Young Emerged.	Number of Young.	Time in Days.
9465	30.9.37	18.11.37	198	49
9275	12.12.37	22.1.38	185	42
..	21.3.38	13.8.38	..	145
9276	26.7.38	17.8.38	..	53
9276	25.7.38	17.9.38	..	54
9376	17.10.38	5.12.38	178	49
9465	21.10.38	8.12.38	180	48
9465	2.11.38	8.12.38	153	36
9465	21.11.38	29.12.38	176	38
9515	28.11.38	3.1.39	130	36
9518	5.12.38	11.1.39	110	37
9515	7.12.38	10.1.39	118	34
9384	12.12.38	17.1.39	196	36
9515	13.12.38	16.1.39	208	34
9388	14.12.38	23.1.39	..	40
9518	18.12.38	23.1.39	96	36
9515	19.12.38	23.1.39	48	35
9384	21.12.38	21.1.39	87	31
9388	29.12.38	28.1.39	..	30
9518	7.1.39	6.2.39	45	30
9515	16.1.39	11.2.39	36	33
9623	16.1.39	15.2.39	..	30
9518	17.1.39	15.2.39	12	29
9408	19.1.39	20.2.39	220	32
9515	21.1.39	20.2.39	75	30
9515	21.1.39	18.2.39	88	28
9405	23.1.39	21.2.39	196	29
9388	23.1.39	24.2.39	110	32
9407	24.1.39	23.2.39	82	30
9583	1.2.39	18.3.39	171	46
9417	2.2.39	14.3.39	98	41
9388	4.2.39	19.3.39	215	43
9633	6.2.39	18.3.39	86	40
9583	6.2.39	27.3.39	69	48
9384	7.2.39	24.3.39	..	43
9413	7.2.39	21.3.39	130	42
9409	7.2.39	21.3.39	..	42
9405	8.2.39	23.3.39	..	43
9518	13.2.39	23.3.39	71	38
9584	9.2.39	1.4.39	72	51
9406	9.2.39	29.3.39	37	48
9581	10.2.39	29.3.39	33	47
9583	13.2.39	8.4.39	43	54
9416	13.2.39	29.3.39	93	44
9587	13.2.39	1.9.39	15	171
9417	14.2.39	18.4.39	15	63
9585	14.2.39	21.4.39	12	65
9515	20.2.39	29.3.39	18	37
9584	20.2.39	12.9.39	25	204
9408	23.2.39	10.8.39	92	168
9585	21.2.39	18.8.39	14	178
9413	1.3.39	4.9.39	110	190
9587	4.3.39	30.8.39	86	151

It must be emphasised that in the foregoing tables the emergence time, that is the time taken from the construction of the egg sac till the young emerge, has been tabulated rather than the hatching times. To remove the eggs from their sacs and observe their hatching times may, by exposing the eggs to conditions from which they are protected while inside the sac, distort the natural sequence of events.

This emergence time is dependent on several stages in the development, each of which appears to be influenced by certain factors, especially temperature. It is dependent not only on the time taken for the young to hatch, but also on the time which elapses from hatching till the first ecdysis, before which the young are incapable of cutting their way out of the sac owing to their mouth-parts not having hardened. Again when this ecdysis has taken place the spiderlings are much more active during warm weather and sooner feel the urge to cut their way out than during colder periods.

That the hatching times are shorter during the warmer seasons of the year is shown by the results obtained by removing the eggs from their protecting sacs and allowing them to develop between beds of sterile cotton-wool in test-tubes. From eggs treated in this manner and laid in August the young hatched in 41 days, while from those laid in July the period was 54 days. Eggs treated in this manner seemed particularly prone to attack from a fungus which killed many batches before they hatched; they were also inclined to dry out without hatching unless care was taken to keep the air in the tubes moist with small pieces of damp blotting-paper.

The graph (fig. 11) is compiled from a short series of readings of the emergence times of egg sacs under laboratory conditions. It has not been possible to plot all the results obtained, but it shows clearly the sudden increase in the emergence time about the middle of February. The average mean monthly temperature is given as a rough measure of the temperatures experienced by the developing eggs and young at different times of the year.

It would of course be more satisfactory to keep the developing eggs and young under controlled conditions, but a study of this kind is outside the scope of the present inquiry.

It is interesting to note that the sudden increase in the emergence time took place at approximately the same time for both years under review. It is probable, however, that this time will vary according to conditions ruling at this period from year to year.

Regarding the four results plotted for June 1938, it must be borne in mind that no record is available of the time of the construction of these sacs, but it is noted that their minimum emergence time is what might be expected for live egg sacs found around this time of the year,

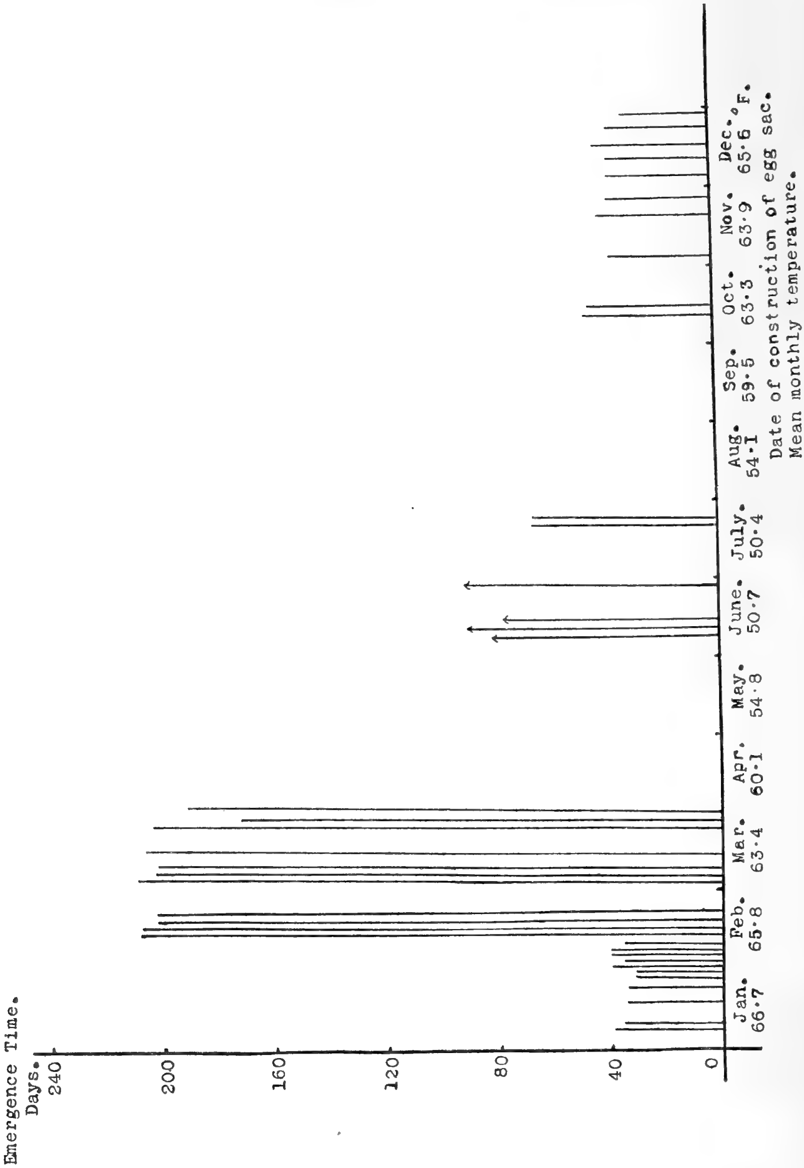


Fig. 11.—Graph to show increase in emergence time of young *L. indistinctus*, from data collected during 1938 and the first three months of 1939. With mean monthly temperature.

i.e. 69–84 days, much longer than the normal time for those developing during the warmer sea on.

To sum up our knowledge of the pre-emergence history, it appears that from egg sacs which are constructed and in which development proceeds during the warmer months of the year the young emerge in periods from a minimum of 28 days to a maximum of about 40 days. From those egg sacs which are constructed at the end of the warmer season the young do not emerge until a much longer period has elapsed, up to about 200 days, *i.e.* the young remain in the shelter of the egg sac and emerge with the onset of the warmer weather in the spring. This ensures that the young spiders emerging from the former sacs get settled before the arrival of the colder weather, while those emerging from the latter are assured of favourable weather conditions and a plentiful food supply when they do emerge.

The Life-history of *L. indistinctus*.

Female.—Adult female specimens of *L. indistinctus* are found throughout the year, but the numerical concentration varies with locality, season, and from year to year. They are most numerous from about November till the end of February. From this time onwards increasing numbers of empty nests or nests with the dried-up remains of spiders are found. They appear to be most numerous in grain lands, especially the grain lands of the Western Province.

Female specimens have been kept alive in captivity for periods up to fifteen months and have been watched in the field over periods of eleven to thirteen months. In the latter cases the spiders had had at least one moult before being found. It seems probable, therefore, that the normal life-span is from a year to eighteen months, in some cases up to two years.

To consider a typical life-history take, for example, an adult fertile female during December when the spiders are numerous.

The construction of the egg sacs and the laying of eggs takes place, the eggs hatching and from the sacs the young spiderlings emerging at regular 39–40-day intervals from all egg sacs constructed from December till about the end of January. From the end of January onwards, however, although the eggs hatch, the spiderlings do not emerge from the sac until the early spring in, say, August and September, with the onset of the warmer weather. As egg-laying continues from the end of January till about the beginning of April, in some cases even further into the year, the onset of the warmer weather in August finds large numbers of egg sacs containing spiderlings which have lain throughout the winter and which are ready to emerge. These young spiderlings by the end of the year have reached maturity, are fertilised, and the cycle repeats itself.

Rearing experiments carried out in the field have shown that maturity can be reached under approximately normal conditions in three to four months.

In the laboratory spiders were reared to maturity in periods from 107 to 135 days, the very young spiderlings being fed on Argentine ants, *Iridomyrmex humilis*, followed as they grew up by black beetles, *Chlaenius* sp., and later by *Acridiidae* and Tok-tokkie beetles, *Psammodes* sp. In some cases the growth in the laboratory was much slower, and young from an egg sac collected at Malmesbury, from which they emerged on 1st September, the majority had only reached a size of 5 mm. by 14th December, two of the specimens only reaching maturity after a period of 176 days.

If the weather is warm and sunny the spiderlings, on emergence from the egg sac, climb to the tips of the surrounding vegetation and scatter by "ballooning" off on the end of lengths of fine web. If the conditions are unfavourable they remain bunched together on the web until better conditions prevail. On settling they seek the shade of a bush under which to settle and build their nests. In the first stages moisture is essential, and they dry out very quickly if exposed for any length of time to the direct rays of the sun. This is probably the most important factor in the numerical control of the species in any locality: a spell of hot dry weather at the time of emergence will cause a high mortality rate, while cooler or overcast weather conditions following the scattering will allow them to get settled in a shady corner where they are less likely to be effected by such adverse conditions.

Female spiderlings which emerge from the sacs late in the season, *i.e.* say in March, may live through the winter and mate during November to January when the males appear. Immature females have been found throughout the year, and many adult specimens taken during the early part of the spring were found to be infertile, which points to their having hatched from eggs laid late in the season.

Both in the laboratory and in the field it was observed that females which were fertilised one season and which laid fertile eggs during that season can survive the winter and recommence egg-laying the following season. During the winter these females are very sluggish, and with one or two exceptions made no attempt to capture insects presented to them. With the advent of the warm weather, however, they regained their liveliness and fed normally. In the high-lying parts of the Karroo such as the Victoria West district, mature and immature females in the second and third instars were collected during June when the nightly temperatures fell as low as several degrees below freezing-point. Although occupying nests on the exposed sides of kopjes where there was little protection from the bitter conditions, they seemed to suffer no ill effects, and during midday hours when the temperature rose to 60° or 70° F. in the shade they fed readily on insects presented to them.

Females of *L. indistinctus* undergo eight ecdyses before the adult stage is reached, one of which takes place before the spiderling emerges from the egg sac. The time between the ecdyses varies greatly and seems to depend to a large extent on the food supply. The history of a typical female from an egg sac constructed in captivity may be tabulated as follows:—

Egg sac constructed 21.3.38.
First ecdysis in sac date undeterminable.
Emerged 1.9.38.

			Time in Days between Ecdyses.
2nd ecdysis . .	12.10.38		
3rd ,, . .	17.10.38		5
4th ,, . .	11.11.38		25
5th ,, . .	9.12.38		28
6th ,, . .	24.12.38		15
7th ,, . .	12.1.39		19
8th ,, . .	27.1.39	Now adult	15

Until the first ecdysis in the sac the spiderlings are white or pale cream in colour, semi-transparent and incapable of feeding or spinning. After this ecdysis they gradually become darker in colour and are now capable of feeding, spinning, and of chewing their way out of the sac. They emerge through one or two minute holes chewed in the fabric of the sac. For some two or three days prior to each ecdysis they eat nothing.

As males have up to the present only been found during the months of November to January, it appears that those that hatch from egg sacs constructed after the end of January till the beginning of the spring die with the onset of the cold weather, otherwise we might expect to find them before November. That males do hatch from these late sacs has been shown by rearing spiderlings from these in the laboratory and from clutches of newly hatched spiderlings collected in the field. Unfortunately it was not found possible to sex the young spiderlings until the third instar when the swelling of the palp in the males becomes noticeable. The methods employed by Montgomery for sexing newly hatched *L. mactans* are not applicable to *L. indistinctus*.

The males moult 4–6 times, the time taken to reach maturity from emergence from the egg sac being 38–42 days. As in the case of the female the first moult takes place inside the egg sac.

During the early stages the males behave in much the same way as the females, a small web being constructed on which they remain until the final moult, when they leave it to seek a mate. While on this web the young males catch small insects and feed like the immature females.

Abdominal Pattern and Coloration of Immature *L. indistinctus*.

Examination of a large series of immature specimens of *L. indistinctus* in Museum collections showed that a wide variety of abdominal patterns and colorations is exhibited by these specimens. In cases where immature specimens and adults were available from the same locality the immature specimens were in every case much more brightly coloured than the adults, the difference being so great that at times it was difficult to believe that they belonged to the same species. At the same time the abdominal pattern and coloration of these immature specimens differed from specimens from other localities of approximately the same instar.

In order to understand the changes taking place in the abdominal pattern and coloration during growth, series of spiders were reared in the laboratory from egg sacs collected or constructed by specimens from various localities throughout the country.

This showed that, while the adults from, *e.g.*, the Little Karroo and Port Elizabeth were identical, this stage was reached by a progressive series of changes in the abdominal pattern and coloration of the immature specimens which was different in the two groups. When spiders were reared from egg sacs collected in the type locality, Mamre, C.P., the progressive changes were different from either of the series of changes observed in the series from the Little Karroo or Port Elizabeth.

Unfortunately it has only been possible to obtain egg sacs from a limited number of localities, but the results obtained demonstrate what may be expected in immature specimens from other parts and the danger of describing new species from immature forms.

I have examined the specimen in the collection of the British Museum mentioned by F. Pickard-Cambridge in his paper to the Zool. Soc. Lond. from Jansenville, C.P. (9), which he ascribes to the species *L. hasseltii* Thorell owing to its distinctive abdominal marking. This can now be shown to be a brightly coloured immature specimen of *L. indistinctus*.

Details of the progressive changes in the abdominal pattern and coloration during the growth of spiders from three districts are as follows:—

Mamre, C.P. Dorsal (fig. 12).

Instar I.—The first ecdysis occurs in the egg sac, and during the latter part of instar I the young spiderling cuts its way out of the sac. During this instar the dorsal surface of the abdomen is pearly white.

Instar II.—At instar II, two, four, or six black spots appear on the pearly white surface, and sometimes a pair of indistinct black lines one on either side near the apex.

Instar III.—Similar to instar II, but with three black lines, a median and two lateral, at the apex. The pearly white ground colour becomes broken up by a network of fine black lines, and in some cases a faint red colour is noticeable at the apex.

Instar IV.—By this stage the spiderling has attained a size of about 5 mm. overall, the ground colour is greyish white with two transverse reddish bands basally and a median and two lateral reddish bands apically, these apical bands converging on the apex where they meet, forming a **W**-shaped pattern.

Instar V.—The ground colour is now dark grey and the basal bands and apical pattern bright red, the former narrowly margined with white. In some cases the posterior of the basal bands is broken up into a transverse series of red spots margined with white.

Instar VI.—The spider is now approximately 8 mm., the ground colour is jet black, the apical pattern and the anterior basal band remain, and only a few small red, white, or red margined with white spots remain to mark the position of the posterior basal band. In some cases the anterior basal band is broken up in a similar manner.

Instar VII.—The ground colour is jet black, the basal bands having disappeared altogether, their place being taken by a few scattered white or red spots. The lateral arms of the apical pattern are much shorter and narrower.

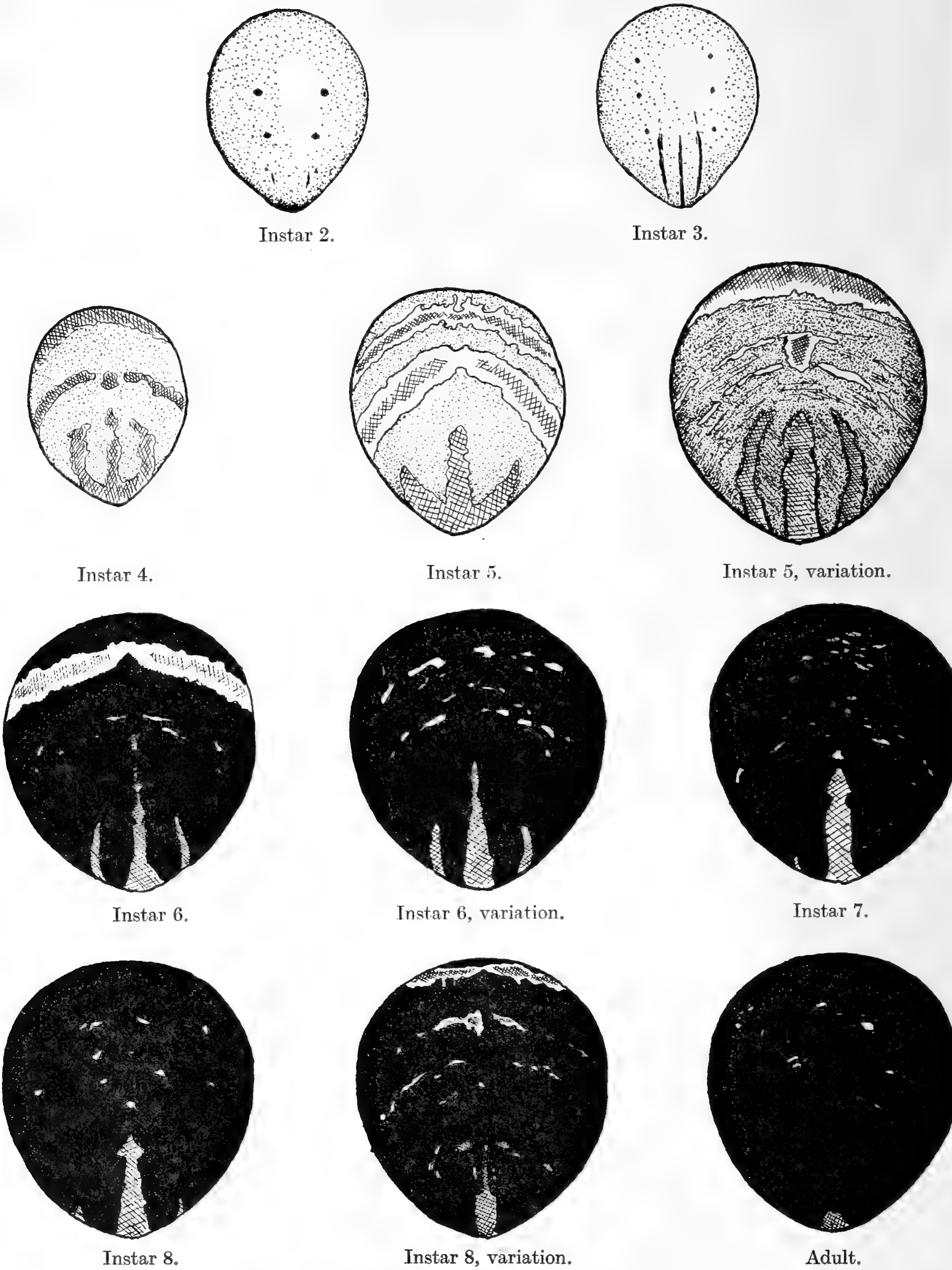


Fig. 12.—Progressive phases, with variations, of the dorsal abdominal pattern of *L. indistinctus* from emergence from the egg sac to the adult stage. Cross-hatching denotes a red colour. (Mamre, Malmesbury Div., Cape.)

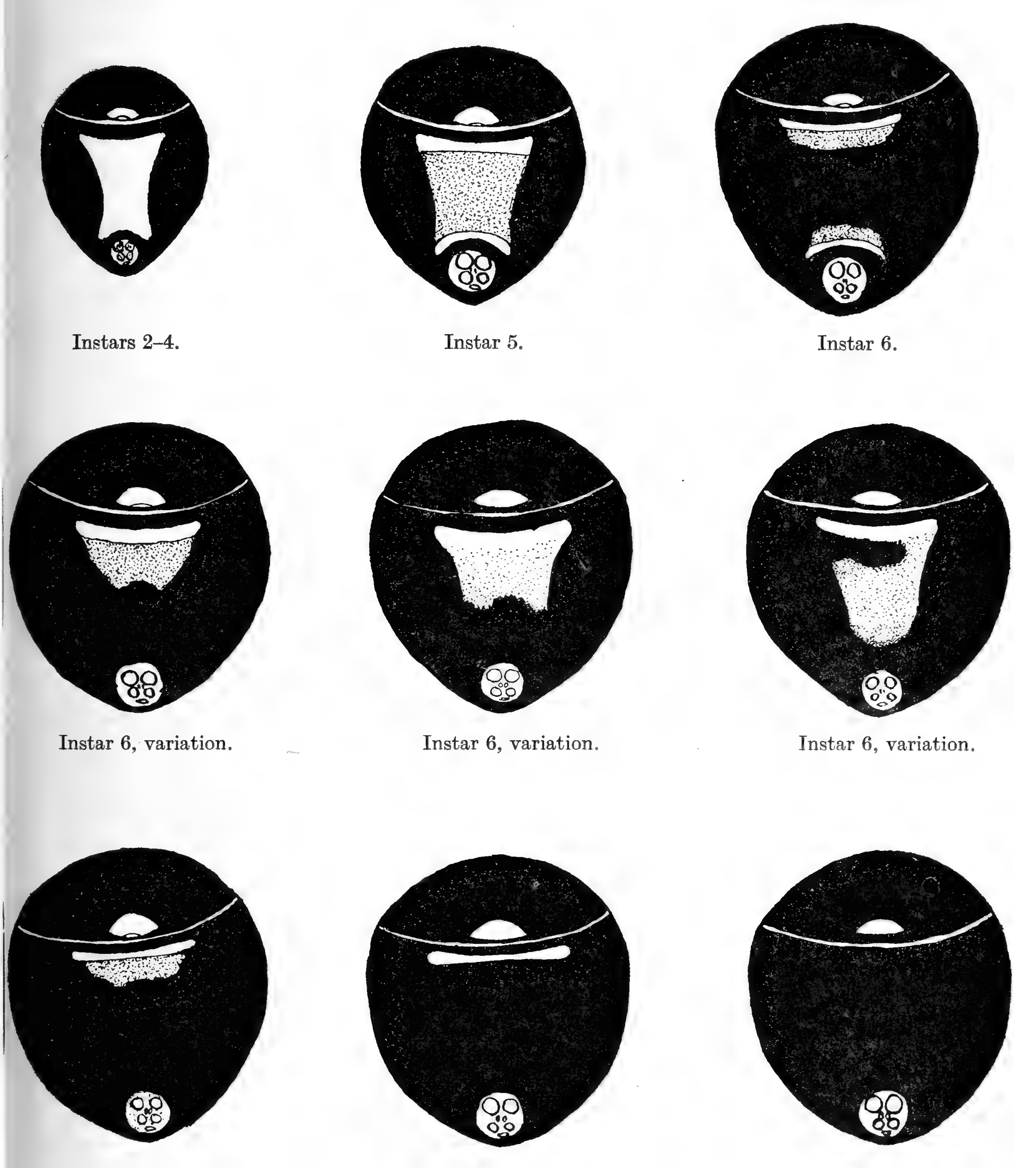


FIG. 13.—Progressive phases, with variations, of the ventral abdominal pattern of *L. indistinctus* from emergence from the egg sac to the adult stage, showing disappearance of the hour-glass-shaped marking. (Mamre, Malmesbury Div., Cape.)

Instar VIII.—Similar to instar VII, but the lateral arms of the apical pattern shorter still and with but a few minute white spots basally. In some cases the basal bands do not entirely disappear at instar VII, but are narrow and broken up and the median band of the apical pattern begins to disappear.

Adult.—The adults from Mamre, C.P., have a jet-black abdomen, with a few white spots basally and a small apical red spot or sub-triangular marking.

Ventral (fig. 13).

The ventral surface of the abdomen on hatching is jet black, with a distinct hour-glass-shaped red or yellowish-red marking between the epigastric furrow and the thoracic groove, similar to the marking found in the adults of *L. geometricus.* Up to the time that the young reach the fourth instar, or about 5 mm., this marking persists, but from this stage onwards gradually disappears, the median portion of the marking darkening and blending with the ground colour and in the adults being represented by one or two transverse whitish bands in the position of the anterior and posterior side of the original hour-glass-shaped marking. Great variation exists in the manner and stage at which this pattern disappears, the final result, however, being constant.

Port Elizabeth, C.P. (fig. 14).

In tracing the dorsal abdominal pattern and colour changes in a series of developing spiders from the Port Elizabeth district (Patentie, Humansdorp Division, S.A.M. 9473, 9474) an even more drastic change is found.

Instars I, II, and III.—During these instars the abdomen of the young spiderlings is marked with a series of white bands and an apical white pattern on a light grey ground as in fig. 17.

Instar IV.—The ground colour immediately posterior to the transverse lines is dark grey.

Instar V.—The ground colour is an even dark grey, and a reddish tinge is seen in the apical half of the median band of the apical marking.

Instar VI.—The ground colour is jet black and the lateral arms of the apical marking have joined medially, and two inwardly directed lobes have appeared pointing towards the apex of the median band of this marking. Both the basal bands and the apical marking are bright red.

Instar VII.—Similar to Instar VI, but the inwardly directed lobes of the apical marking have joined with the median band.

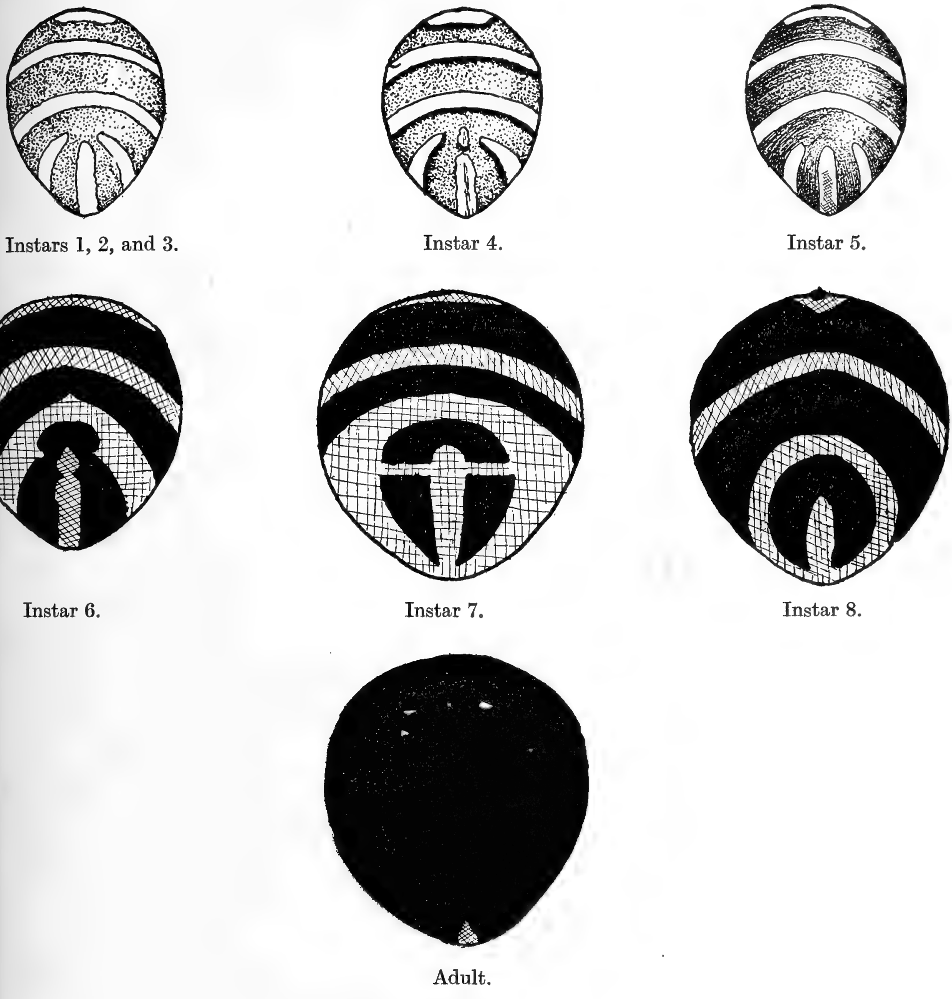


Fig. 14.—Progressive phases in the dorsal abdominal pattern of *L. indistinctus* from emergence from the egg sac to the adult stage. Cross-hatching denotes a red colour. (Patentie, Humansdorp Div., Cape.)

Instar VIII.—The red markings have become distinctly narrower and the apex of the median band of the apical marking is again free.

Adult.—The abdomen is jet black, with a few white spots basally and a small red spot or subtriangular marking at the apex. Ventrally the changes are similar to the changes taking place in specimens from Mamre, C.P.

The colour of the cephalothorax and legs of the spiderlings from Patentie is much redder than the corresponding stages from Mamre, and one has no difficulty in distinguishing between batches of spiderlings from the two districts. This reddish tinge disappears in the Patentie specimens about the seventh instar, and the adults from the two localities are indistinguishable one from another.

Amalienstein (*Ladismith District, Little Karroo*) (fig. 15).

While it has not been possible up to the present to examine a complete series from the Amalienstein district, the examination of

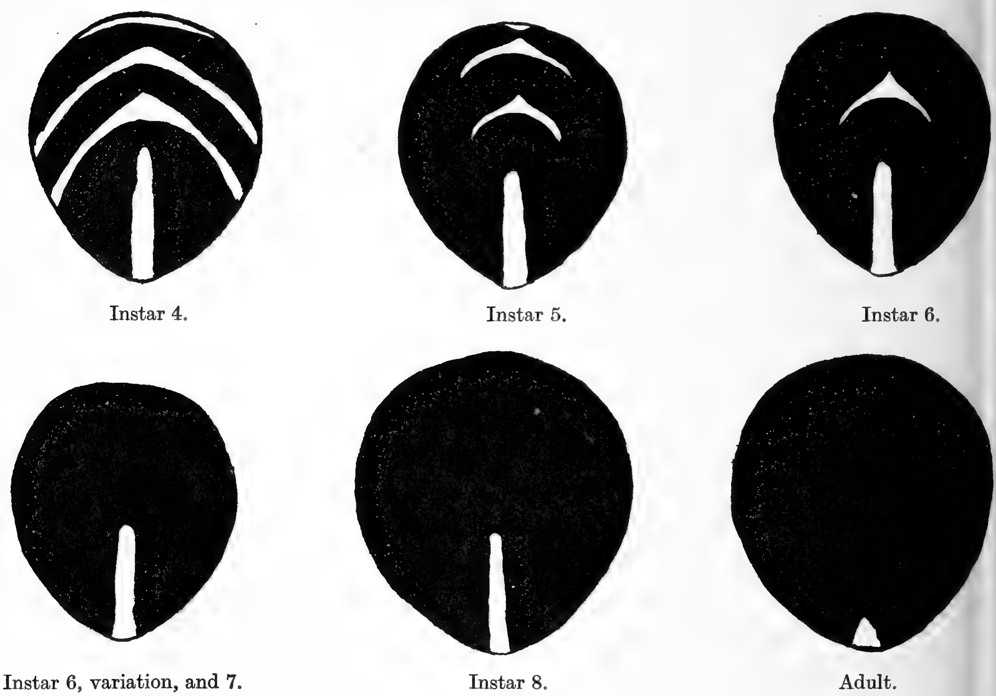


FIG. 15.—Progressive phases in the dorsal abdominal pattern in an incomplete series of *L. indistinctus* from instar IV to the adult stage. All markings red. (Amalienstein, near Ladismith, Cape.)

several specimens during four or five instars each gives a good indication of the changes taking place.

Instar IV.—At this stage the abdomen is jet black, with three bright red transverse bands and a longitudinal apical band of the same colour.

Instar V.—The lateral portions of the transverse bands are lost, only the median portion remaining, and the apical longitudinal band is shorter than in the last instar.

Instar VI.—Only the median portion of the posterior transverse band is now left, the apical band persisting. In some cases only the longitudinal apical band remains.

Instar VII and VIII.—The apical band only persists during these two instars.

Adult.—At the final ecdysis the apical band is lost, only a red spot of subtriangular marking being left at the apex, the remainder of the abdomen being jet black, sometimes with a few white spots basally.

It appears from specimens in the Transvaal Museum, T.M. 5891, the S. African Museum, S.A.M. B3705, the British Museum, 03–7–14–62–5 and 15–10–27–1, that in the Northern Transvaal and Southern Rhodesia the adult stage is reached by a series of colour and pattern changes very similar to those recorded for the specimens from Patentie. The series in the British Museum, 03–7–14–62–5, gives us the clue to this, as the series includes several immature forms as well as adults, these adults having jet-black abdomens with a small red spot on the apex of the abdomen, while the immature forms are brightly coloured, some having a longitudinal apical red band and three transverse red bands basally, while others have only the longitudinal apical band. The specimen from Zoutpansberg, T.M. 5891, S.A.M. B3705, from the Marico Rover, and B.M. 15–10–27–1 from S. Rhodesia have the three transverse bands and the apical band similar to an immature specimen in the series, B.M. 03–7–14–62–5.

It will be necessary, however, to obtain egg sacs from these localities before the whole series of changes can be fully understood.

Disposition of the Eyes in Immature Specimens of *L. indistinctus*.

In another portion of this paper it is observed that characters drawn from the eye formula are unreliable, in support of which evidence is given of South African specimens in which the two rows of eyes are not divergent as in the characterisation of the genus *Latrodectus* by authors. In newly hatched specimens of $1\frac{1}{2}$ mm. the two rows of eyes are convergent, but between this stage and approximately 7 mm. they gradually, in the majority of cases at least, become divergent. In male specimens the two rows of eyes remain convergent to the adult stage, no exceptions to this rule being met with.

Latrodectus indistinctus var. *karrooensis* (fig. 16).

In the South African Museum collection there are eighteen specimens similar in every respect with *L. indistinctus* except that the adult females have a bright red median longitudinal band on the dorsal surface of the abdomen (fig. 16). The males too differ in abdominal pattern and coloration from the males of *L. indistinctus*, having a bright red median longitudinal band on the dorsal surface of the

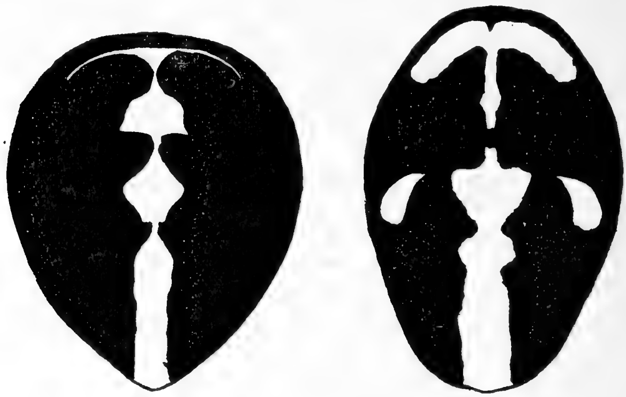


Fig. 16.—Dorsal abdominal pattern of *L. indistinctus* var. *karrooensis*, ♀ (left) and ♂ (right). All markings red.

abdomen with two red spots one on either side about the middle, the anterior end of the dorsal band produced laterally into two arms, forming a T-shaped marking (fig. 16). Ventrally in the females there is an indistinct light yellow patch between the epigastric furrow and the thoracic groove, and the sternum is bisected longitudinally by a light yellow band broadening anteriorly.

From records at present available it appears that these brightly coloured specimens are found only on the high-lying parts of the Karroo, and in order to distinguish them from the normal specimens of *L. indistinctus* I propose to designate them as a colour variety of this species *L. indistinctus* var. *karrooensis*.

As well as this striking difference in abdominal pattern and coloration, the nests and webs of this colour variety are different in certain respects from those of *L. indistinctus*. In this case the nest, an inverted cup-shaped structure, is suspended in mid-air at a height of about

18 inches from the ground in the middle of a small bush or, as in the case of a specimen from Laingsburg, S.A.M. 9101, among the upright stems of a species of *Euphorbia*. The uppermost or convex side of the nest is densely covered with stone chips, many of them as large as the abdomen of the spider. From the mouth of this nest radiates an irregular web attached at vantage-points on the *Euphorbia* stems and the ground below. Most of the specimens listed below from the Hanover district were collected by the late S. C. Cronwright Schreiner who, in the Popular Science Monthly (54), gives a detailed description of the nest built by these spiders in this district, which shows that they are of exactly the same type as those found in the western parts of the Karroo: "She builds a bell-like nest, about three inches long, in a small bush. At the bottom of the bell, which hangs mouth downwards, the web is very fine and open and from the mouth radiate web strands. As the webbing approaches the top of the bell it becomes closer woven until, for the last inch or so, it is quite opaque and often covered with small stone chips, some of them astonishingly large for the size of the spider, which she has carried up one by one from the ground."

In the Calvinia district nests of *L. indistinctus* and the colour variety var. *karrooensis* are found close to one another. The following records of *L. indistinctus* var. *karrooensis* are at present available:—

S.A.M. 13192 ♀, 11952 ♀, 11801 ♂ and ♀, B234 ♀, 11867 ♀, 11801 ♀, 11869 ♀, 11814 ♀, 11932 ♀, 10058 ♀ and ♂, 11801 2 jnr. ♀♀, 5809 ♀, district Hanover.

S.A.M. 13239 ♀ and 2 ♀♀, N/N Calvinia.

S.A.M. 14673 ♀, De Aar.

S.A.M. 9101 ♀, Laingsburg.

Lawrence, in his paper "Contributions to a knowledge of the fauna of South West Africa" (29), describes a species of *Latrodectus* from Ongandjera, Ovampoland, *L. incertus*, which, in its adult form, has a very brightly coloured abdomen somewhat similar to fig. 14, instar VI. It seems that this is another colour variety of *L. indistinctus*, but until further specimens are available I do not propose to deal with it.

The occurrence of these colour varieties of *Latrodectus indistinctus* is interesting in that it may be possible to show, when a wide range of specimens becomes available from localities from the Northern parts of the Union of South Africa to Southern Europe, that this species is itself but a colour variety of the Southern European *L. tredecimguttatus*.

Distribution of *L. indistinctus* and *L. indistinctus* var. *karrooensis*.

Since the publication of the preliminary investigation of the distribution of *L. indistinctus* in the S.A. Medical Journal (69), which was based on specimens examined up to September 1938, large numbers of specimens were received by the South African Museum from widely scattered localities. I have also been able to carry out a very intensive search in the coastal districts from Namaqualand to Port Elizabeth with the aid of a grant from the National Research Council.

This has shown that the species is much more widely distributed than was previously thought, and it is reasonable to suppose from the results obtained that, when further exploration is possible, it will be shown to be distributed throughout the whole of South Africa.

The results of these investigations to date are shown pictorially in the distribution map (Map 1).

Outside the Union our information is scanty. In Southern Rhodesia our knowledge is based on a series of specimens in the collection of the South African Museum from Salisbury, B3201, B3240, 3286, Bulawayo, 3307, 9102, and from the Matopos, 6249. In the collection of the British Museum there is a series from Lonely Mine, 15-10-27-1.

The South African Museum has specimens from South West Africa: Walfish Bay, B2302, 2301, Namutoni, B5883, Aminuis, 9021, Ovamполand, B6236; and the Transvaal Museum from Windhoek, 7852.

No specimens have up to the present been recorded from the Basutoland Protectorate, and there is but one record from Swaziland, Henwoods Halt, near Piet Retief, S.A.M. 9843.

L. indistinctus var. *karrooensis*.

As but few records of this variety of *L. indistinctus* are at present available, we can only state that it has been found in the districts of Calvinia, Prince Albert, De Aar, and Hanover. It seems likely that, as further records become available, it will be shown to be present in the intermediate districts of the Great Karroo.

Latrodectus geometricus, C. L. Koch.
= *L. concinnus*, O. Pickard-Cambridge.
Ann. S. Afr. Mus., vol. iii, p. 152, 1904.

As in the case of many of the descriptions given by early workers, C. L. Koch's original description of this species published in 1839 (25)

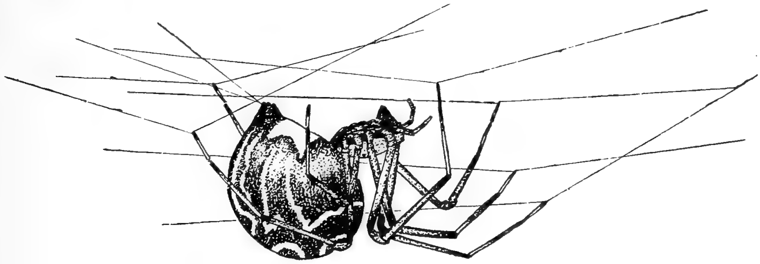


FIG. 17.—*L. geometricus*, adult ♀.

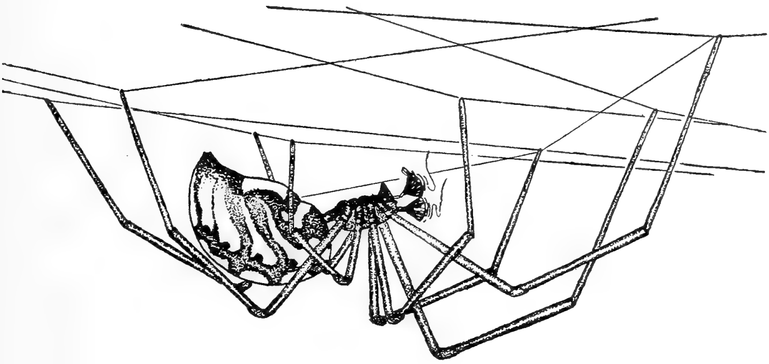


FIG. 18.—*L. geometricus*, adult ♂.

is not comprehensive enough for the requirements of modern systematics. His description deals entirely with the abdominal pattern and colour, and while an excellent figure accompanies the description no details are given of such important characters as the epigyne.

In 1875 Dr. T. Thorell (75) described a spider from Madagascar as *L. geometricus*, figuring the abdomen. This agrees in every respect with Koch's original description. Dr. Thorell at the same time gave a description of the epigyne which reads as follows: "Cujus in apice adest vulva sub specie foveae vel rimae transversae sat parvae magno ejus posticus elevatus aequaliter procurvus est intiger (non in medio incursus) margo vero anticus in medio rectus ad utramque extremitatem in lobum brevem retro directum productus his lobis tuberculata duo assimulantibus."

In 1884 Count Keyserling in his "Spinnen Amerikas" (24) described a spider from South America as *L. geometricus* C. L. Koch, the epigyne of which differs entirely from the description given by Dr. Thorell and yet the abdominal pattern and colour of which agrees with both Dr. Thorell's and C. L. Koch's descriptions.

Fortunately C. L. Koch's type is still in existence as a dried specimen in the collection of the Zoologisches Museum der Universität in Berlin, and Professor Dr. E. Hesse was good enough to supply me with details and a drawing of the epigyne of this type.

This shows quite clearly that the specimen which Count Keyserling described as *L. geometricus* does not belong to this species or that some typographical error has been made, for the epigyne of the specimen which he figured and the epigyne of the type differ in certain notable respects.

When O. Pickard-Cambridge examined specimens of *L. geometricus* from the Cape he used Count Keyserling's description as a basis for his knowledge of *L. geometricus* and consequently he was forced to create a new species, *L. concinnus,* for these Cape specimens, saying that while the markings were very like those of *L. geometricus* the epigyne was different from that described by Count Keyserling.

Through the good offices of Professor Hale Carpenter of the Hope Museum I have had the opportunity of examining O. Pickard-Cambridge's types of *L. concinnus* and have found them to agree with C. L. Koch's type *L. geometricus* in every respect save that they are much darker in colour.

Regarding this colour difference, attention was first drawn to variation in colour in this species by F. Pickard-Cambridge in his paper to the Zoological Society of London (9) in which he says that "in numerous examples of *L. geometricus* from the Amazons, Table Mountain, Karachi, and Jansenville one finds every variation in coloration from pale whitey grey to almost jet black." Extensive collecting in South Africa has produced further evidence in support of this assertion. Within the area of a one-acre garden on the slopes of Table Mountain it was possible to collect a series of specimens whose individual coloration varied from pale yellowish white to almost jet black. The abdominal pattern of the lighter coloured specimens agrees in detail with the original description of *L. geometricus,* while in the case of the darker specimens the conspicuous pattern of lines and spots is almost obliterated by the dark ground colour. In the intermediate stages what pattern is present corresponds in the main to the outline of the patterns found on the brightly coloured specimens. Careful examination has not revealed any morphological differences between the various stages, nor does the mode of construction of the nest or web, the formation of the egg sacs or the position in which the nests are found show any differences of habit. It seems therefore that O. Pickard-Cambridge's *L. concinnus* is a synonym of *L. geometricus* C. L. Koch.

Embrick Strand (72) suggests that *L. indistinctus* is a synonym of *L. concinnus*, but this is not the case, for the two species differ in such important features as the morphology of the epigyne, the types of abdominal setae, and the fact that the ventral hour-glass-shaped marking so characteristic of the adults of *L. geometricus* is invariably absent in the adults of *L. indistinctus*.

When E. Simon surveyed the genus *Latrodectus* (58) he recognised three species, *L. tredecim-guttatus*, *hystrix*, and *geometricus*, the latter differentiated by the fact that the anterior median eyes were a little larger than the remainder. F. Pickard-Cambridge noted (9) that characters drawn from the eye formula were unreliable, and during this investigation this was borne out in the examination of a series of *L. geometricus* from the Cape area in which, out of one hundred and ten specimens, in three the eyes were homogeneous. Although Walckenaer's original description of the genus makes no mention of the disposition of the eyes, at a later date (78) he enlarges on this and says that the eyes are "sur deux lignes ecartes et legerment divergent." O. Pickard-Cambridge mentions in his original description of *L. concinnus* that the eyes are not divergent as in the characterisation of the genus by authors, and suggests that if a uniform persistence of this character be noted it might be sufficient to warrant the creation of a new genus. Out of one hundred and ten South African specimens examined, six had convergent rows of eyes, while in seven others the rows were parallel. Out of the six with convergent rows three were from Eendekuil, C.P., but twenty others from this district showed the more usual character of divergence, and two of the specimens with parallel rows were taken in Wynberg, C.P., where a large series were collected with normal divergent rows. In immature specimens the rows of eyes are convergent until about the third or fourth instars, and in males the rows are always convergent even in adult specimens. From these considerations we must treat the disposition of the eyes as a variable character.

F. Pickard-Cambridge described the abdomen of *L. geometricus* as having a "clothing of fine silky hairs." In all specimens of *L. geometricus* examined, not only from South Africa but from many other parts of the world, the abdominal setae were found to be of

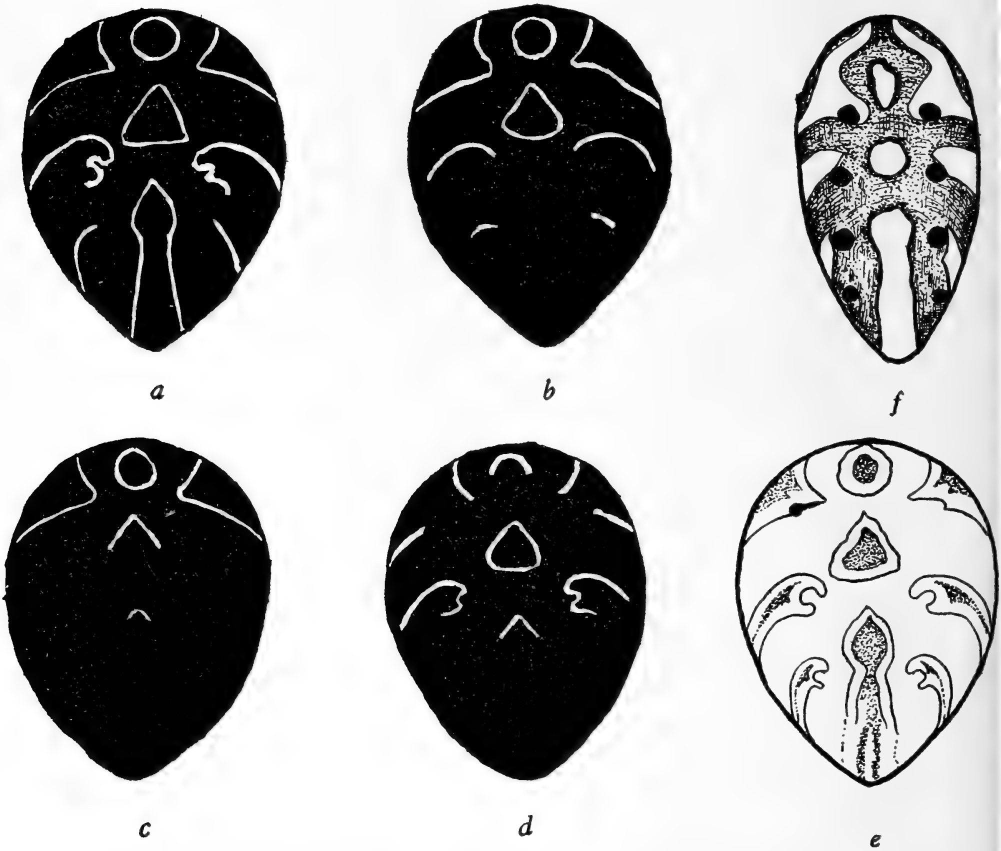


Fig. 19.—*L. geometricus.* *a–d*, variation in the dorsal abdominal pattern in a series of dark-coloured specimens from the Cape. *e*, abdomen of a light-coloured specimen. *f*, abdomen of ♂.
(S.A.M. Nos. *a*, 8997 ; *b*, 9004 ; *c*, 9882 ; *d*, 8968.)

two types, the longer about half a millimetre, the shorter about half this length and finer.

The diabolo or hour-glass-shaped marking on the ventral surface of the abdomen was present in all specimens examined and forms the easiest means of distinguishing adult *L. geometricus* from adult *L. indistinctus*.

I have been unable to trace the specimen referred to by Count Keyserling in his "Spinnen Amerikas" (24), for unless a typographical error has been made it might form the basis for a new species. On the other hand it seems more probable that an error has been made, for the figure of the epigyne marked *L. geometricus* corresponds very well with the epigyne of the species *L. mactans* which Count Keyserling figures and describes immediately prior to *L. geometricus.*

Illness resulting from the bite of *L. geometricus* has been recorded (18, Mar.), but it appears from the investigations by Finlayson (17, Jan.) that the potency of the venom is much less than in the case of *L. indistinctus,* the minimum lethal dose of *L. geometricus* venom for rabbits being 12 mg. as against 3 mg. of *L. indistinctus* venom.

Latrodectus geometricus C. L. Koch.

Die Arach., vol. 8, p. 117, 1839.

Female. Fig. 17.

Cephalothorax.—Longer than broad in the proportions 6 : 5, light or yellowish brown, covered with short fine setae, the posterior portion of the raised cephalic region with a few long fine setae. The median fovea a deep recurved depression. Clypeus anteriorly rounded with a shallow median indentation.

Eyes.—In two recurved, usually divergent but on rare occasions convergent rows. Anterior medians usually larger than the remainder, which are homogeneous. Distance between anterior medians subequal to three-quarters the diameter of an eye, and the anterior medians nearer together than either is to the anterior lateral on its side. Eyes of the posterior row equidistant, the laterals raised on divergent tubercles. Median ocular quadrangle longer than broad, in front narrower than behind. Clypeus subequal to length of median ocular quadrangle.

Chelicerae (fig. 20 (*a*)).—Subequal to two and a half times length of clypeus, armed with a single minute denticle and a brush of long fine setae, subequal to three-quarters the length of the unguis, on the distal end of the inner margin.

Sternum.—Longer than broad in the proportions 8 : 6, dark brown covered with long fine setae. Posterior apex ending acutely beyond coxae of fourth legs. Labium twice as broad as high, apically rounded.

Abdomen (fig. 19).—Subglobular, covered with long fine and short fine setae, the latter about half the length of the former and more numerous. Ground colour varying from pale yellow to jet black

If the former, then with a conspicuous pattern of lines and spots as in fig. 19 (*e*); if the latter, then with a few narrow white lines and spots

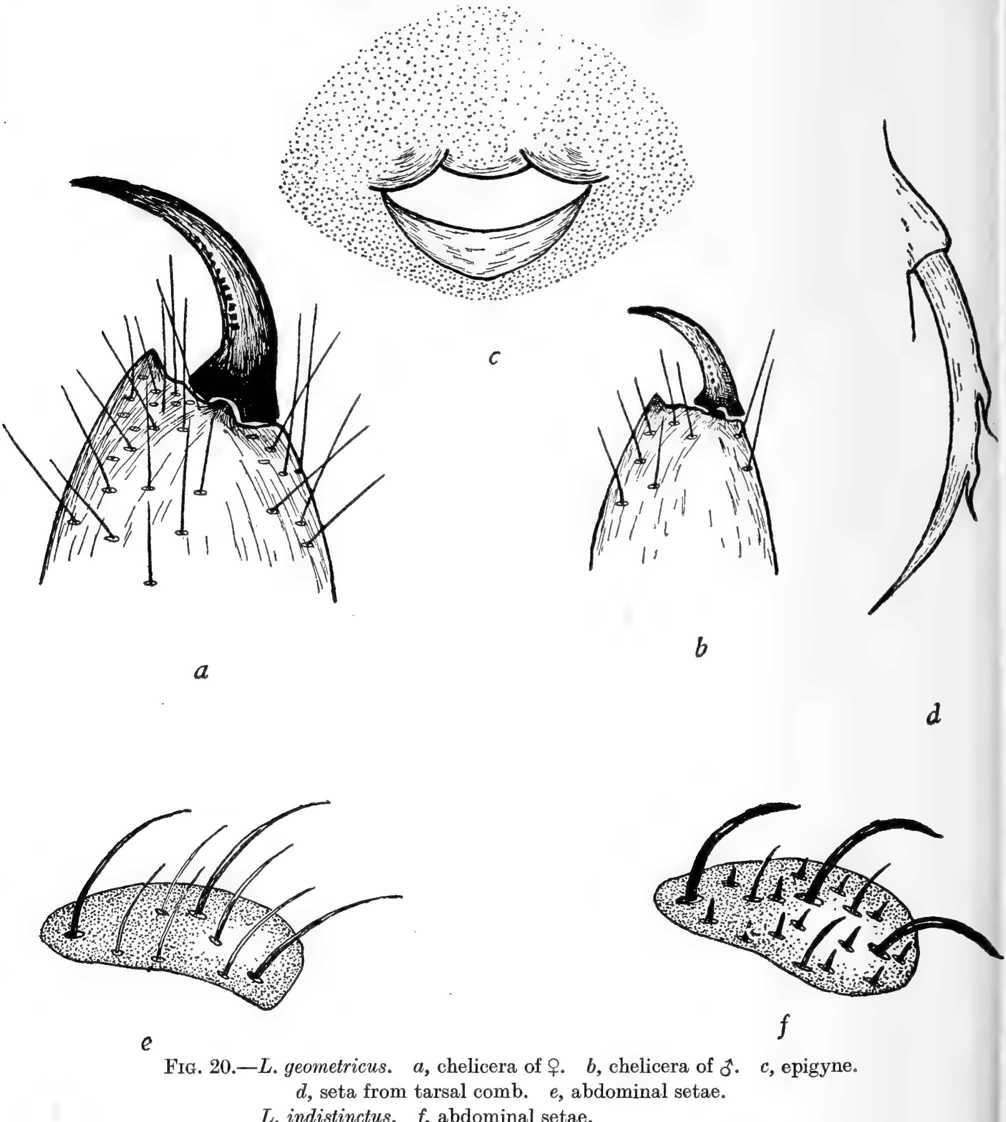


FIG. 20.—*L. geometricus.* *a*, chelicera of ♀. *b*, chelicera of ♂. *c*, epigyne. *d*, seta from tarsal comb. *e*, abdominal setae. *L. indistinctus.* *f*, abdominal setae.

corresponding to the outline of the pattern of the lighter coloured specimens (fig. 19 (*a–d*)). Ventrally with a characteristic hour-glass-shaped yellow, ochre, red or, in the case of the very light coloured specimens, almost white marking between the epigastric furrow and the thoracic groove. Spinerettes surrounded by six white spots, these sometimes absent in the dark specimens.

Legs: I, IV, II, III.—In the light coloured specimens with dark brown encircling bands at the joints; in the dark ones, uniform dark brown. In both cases the tarsi and metatarsi lighter than the remainder. The patella and apical quarter of the femur of the legs dorsally with a glabrous band on either side of a median band of setae. Setae on the femora, patellae, and tibiae the same as on the abdomen setae, on the tarsi and metatarsi longer and of even length.

Epigyne.—As in fig. 20 (*c*).

Dimensions.—Cephalothorax, 3·5 mm.; abdomen, 7 mm.; leg I, 21 mm.; IV, 19 mm.; II, 13 mm.; III, 9 mm.

Male. Fig. 18. Museum grounds, Cape Town, Feb. 1937, S.A.M. 9071.

Cephalothorax.—Light yellow, margins narrowly infuscated, a black band from the median fovea to the posterior pair of eyes. Sparsely covered with short fine setae. Median fovea a transverse recurved depression.

Eyes.—In two converging rows, anterior medians a diameter apart and nearer together than either is to the anterior lateral on its side. Anterior medians the largest, the remainder homogeneous. Median posteriors a diameter apart and nearer to the posterior laterals than from each other. Laterals three-quarters their diameter apart, raised on divergent tubercles. Clypeus subequal to half length of median ocular quadrangle.

Chelicerae (fig. 20 (*b*)).—Subequal to three times length of clypeus, armed with a minute denticle on the distal end of their inner margin.

Sternum.—Longer than broad in the proportions 3 : 2·5, dark brown, with a longitudinal median light yellow band. Posterior apex ending acutely beyond coxae of fourth legs.

Abdomen (fig. 19 (*f*)).—Subglobular, dorsally dark brownish grey with three white spots in a median longitudinal line, the hindermost spot produced into a broad white band reaching the spinerettes. On either side of this line a further line of four black spots each situated at the end of vertical lateral tapering white band, these converging on the spinerettes. Covered with long fine setae of even length. Ventrally light yellow with an hour-glass-shaped white or light yellow marking as in the female.

Legs: I, IV, II, III.—Even light yellow.

Palpi.—See figs. 6, 7, and 8.

Dimensions.—Over-all, 4 mm.; leg I, 9 mm.; IV, 6 mm.; II, 5 mm.; III, 3 mm.

Notes on the Bionomics of *Latrodectus geometricus.*

Unlike *L. indistinctus* the nests and webs of *L. geometricus* are most often found in and around buildings, the nest being hidden in a ventilator, behind pipes, under the eaves, in fact in any odd corner which affords substantial shelter for the nest and where a plentiful supply of insects is to be found. They are particularly numerous round barns, stables, garden buildings and rubbish pits, and are also found under the bark of trees, in holes in the ground, under bridges, in rock crevices, under stones, and occasionally in thick tufts of grass or bushes. Owing to the position of the nest, contact with this spider is more likely than with *L. indistinctus*, but, up to the present, no fatality and only one case of illness resulting from the bite of this species has been recorded (18, Mar.). A comparison of the relative strengths of *L. indistinctus* and *L. geometricus* venom is given in the introduction to the latter species.

The web of *L. geometricus* is similar to that of *L. indistinctus*, consisting of three parts—namely the nest, the tunnel, and the delaying threads, but in this case the tunnel is never so well developed and is at times absent altogether. Again sometimes the delaying threads are woven together, forming a stout cable which may lead for a foot or more from the main mass of web, where it breaks up into an auxiliary series of delaying threads.

The individual threads are of great strength and the web is as a rule easily differentiated from the webs of other spiders such as *Agelenidae* and *Teutana* spp., which build in similar positions, by the accummulation of leaves, twigs, feathers, and other debris held by the web.

The egg sacs are of characteristic spherical shape covered with little protuberances (fig. 10 (*a*)), and are suspended either just inside or at the entrance of the nest, each containing 80–100 eggs. Under laboratory conditions with ample feeding up to ten egg sacs have been constructed by one female, eight being the maximum number recorded in the field. These egg sacs, when first constructed, are pure white, but darken after a few days and become yellowish. When the young hatch inside they become dark grey owing to the mass of young being visible through the fabric of the sac.

The time taken for the young to emerge from the sac is about the same as that of *L. indistinctus* taking similar seasons of the year, a typical record being as follows:—

Date on which Egg Sac was Constructed.	Young Emerged.	Number of Young.	Emergence Time in Days.
12.10.38	20.11.38	82	40
31.10.38	8.12.38	96	38
14.11.38	19.12.38	98	36
22.11.38	28.12.38	68	36
3.12.38	6.1.39	53	36
28.12.38	26.1.39	75	29
7.1.39	4.2.39	26	28
21.1.39	16.2.39	58	26

Males.—Males of *L. geometricus* are found throughout the year. When on the female web they usually occupy a position in the vicinity of the entrance to the nest, where as many as four are found to each female. Round the Museum outbuildings in Cape Town males were systematically removed from the webs of a series of females; in practically every case new males had arrived within three or four days, in one case eight males being removed in 32 days, in another five in 14 days. Immature males have never been found on female webs, although they are frequently found occupying a web of their own. This web is much smaller than that of the female. It appears that, like *L. indistinctus*, the males do not seek a mate until they have become adult.

The mating of this species has not been observed, but judging from the number of bound-up and dead specimens found at the bottom of breeding-cages in the laboratory it appears that, as in the case of *L. indistinctus*, the males are usually killed after the act of copulation.

In numerous microscope slides of the female epigyne the tip of the male embolus was seen, and adult males have been found in which the tip of one embolus was missing, which points to their being held prisoner for a time during the act of copulation.

Distribution of *Latrodectus geometricus*.

L. geometricus is a very widely distributed species, being recorded by Simon (58) "dans presque toutes les régions tropicales du globe," and by Petrunkevitch (43) as a "cosmotropical species." As far as South Africa is concerned it is probably an introduced species.

Petrunkevitch in his "Spiders of Porto Rico" (43) notes that the first record of this spider on the island was a specimen which he collected from a packing-case from some other tropical country, "there being scarcely a doubt as to the accidental importation of the specimen in question." Spiders of this type which construct their nests in sheltered crannies readily make use of the corners of packing-cases, and as they are quite capable of living for long periods without food may be artificially distributed over long distances. Nests of *L. geometricus* are common in the region of Cape Town docks and railway sheds, and it is highly probable that they attach themselves from time to time to merchandise destined for other localities. Webs have also been found under rolling-stock, and during 1938 one constructed its web under the chassis of my motor van and, notwithstanding the fact that the van was in daily use, it lived there for four months in apparent perfect harmony with its surroundings, in due course producing one egg sac which unfortunately was destroyed in a washing operation. In 1939 a web was seen under the saddle of a bicycle, the spider being immature.

In South Africa *L. geometricus* is found in a wide range of localities from Cape Town to Pretoria, from Port Nolloth on the west coast to Durban and in localities as far inland as Upington. Further details of the districts from which it is recorded are given in the distribution map (Map 2). It seems probable that as further records become available it will be found to be present throughout the country.

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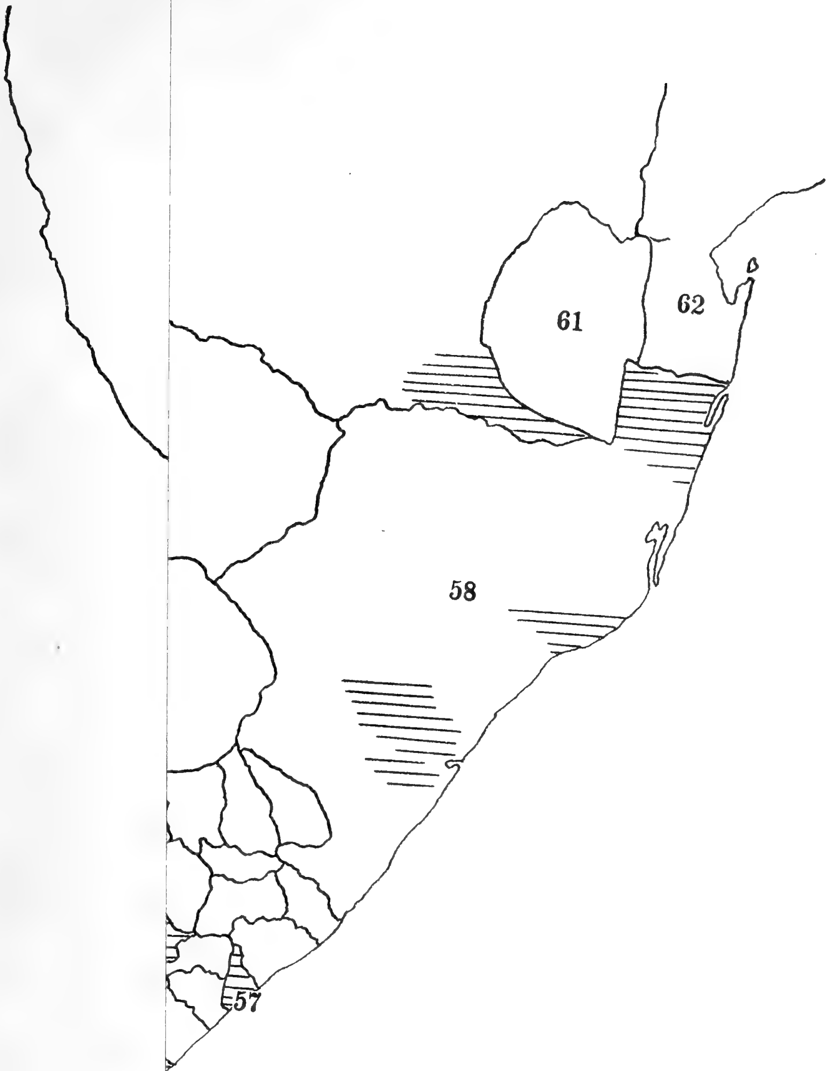
EXPLANATION OF PLATE VIII.

Adult ♀: *L. indistinctus* with nest in a clump of stubble, egg sac and victim (*Psammodes* sp.).

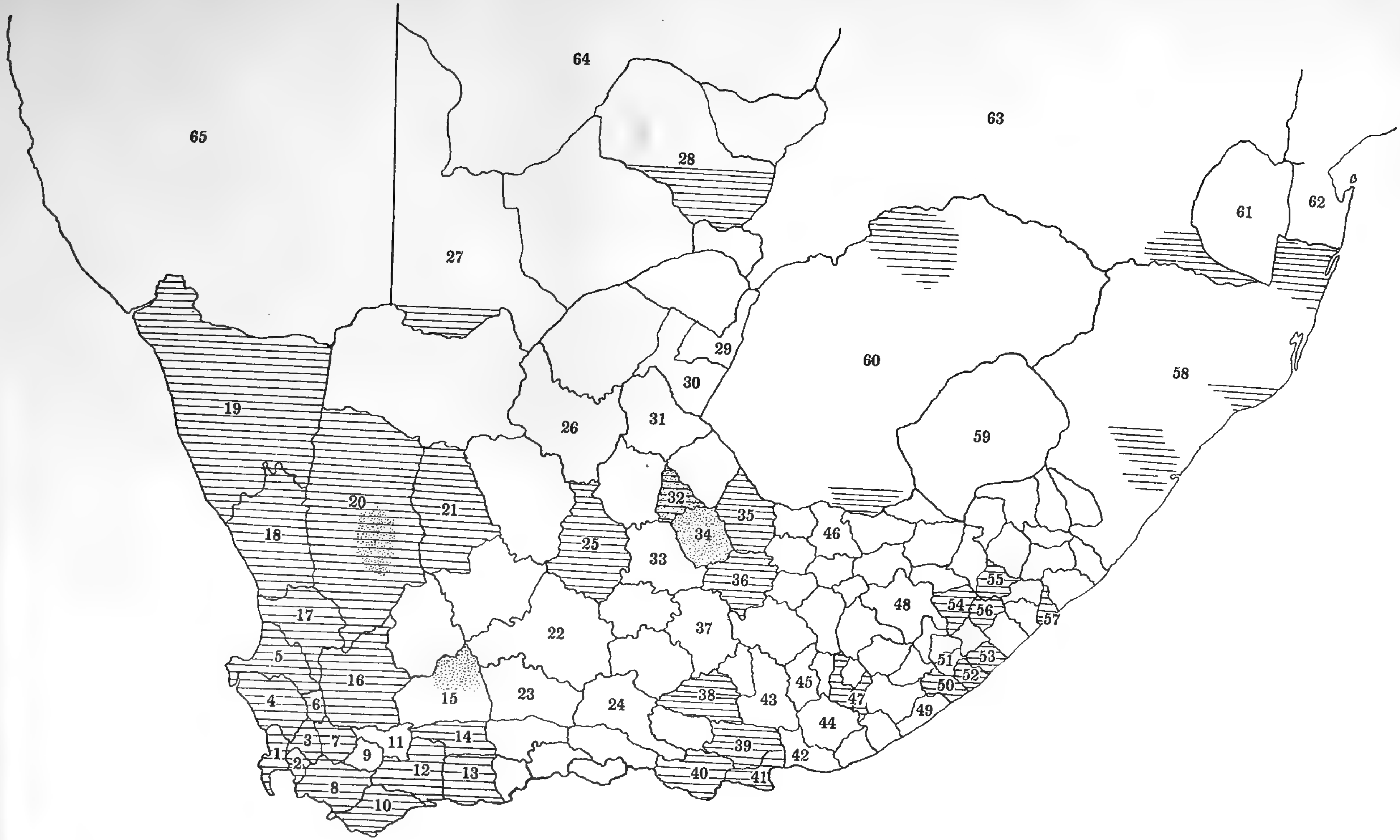
Note the loose debris on the right woven into the web. The tunnel of the nest which runs into the centre of the stubble is concealed. (Mamre, Malmesbury Division, Cape Province.)

Photo— R. H. N. S.



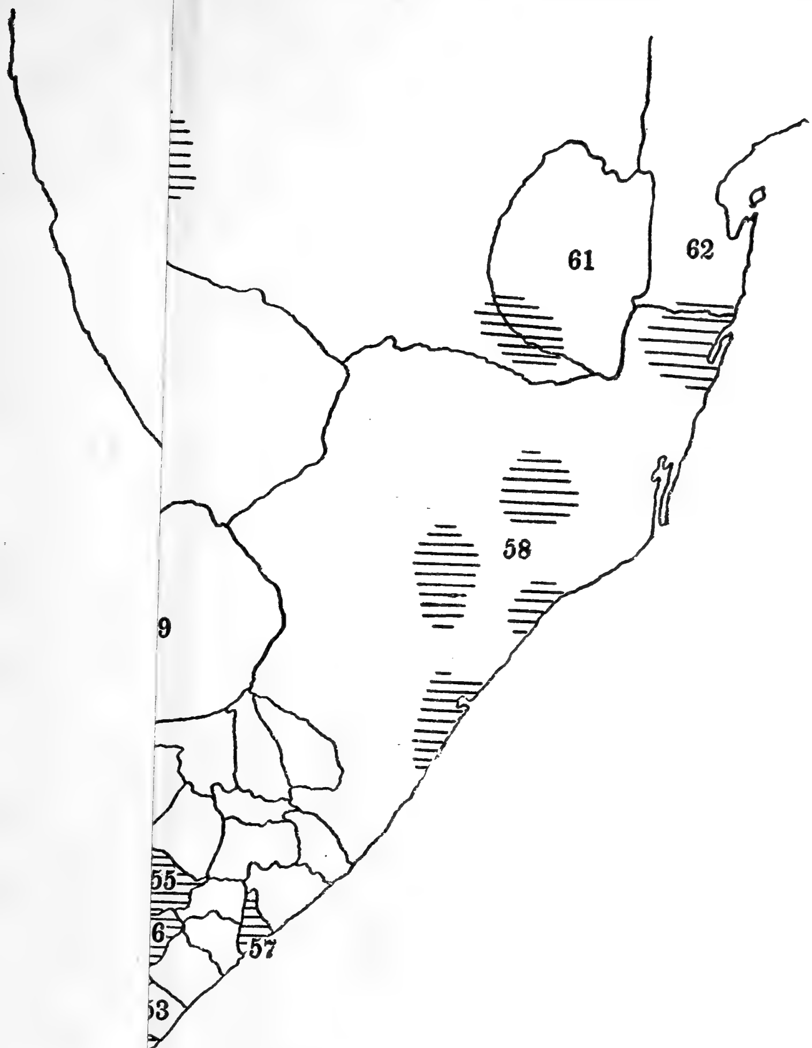
ensis (stippled).

R. H. N.



MAP I.—South Africa south of lat. 25° S. to show distribution of *Latrodectus indistinctus* (lined) and *indistinctus* var. *karrooensis* (stippled).

R. H. N. Smithers.



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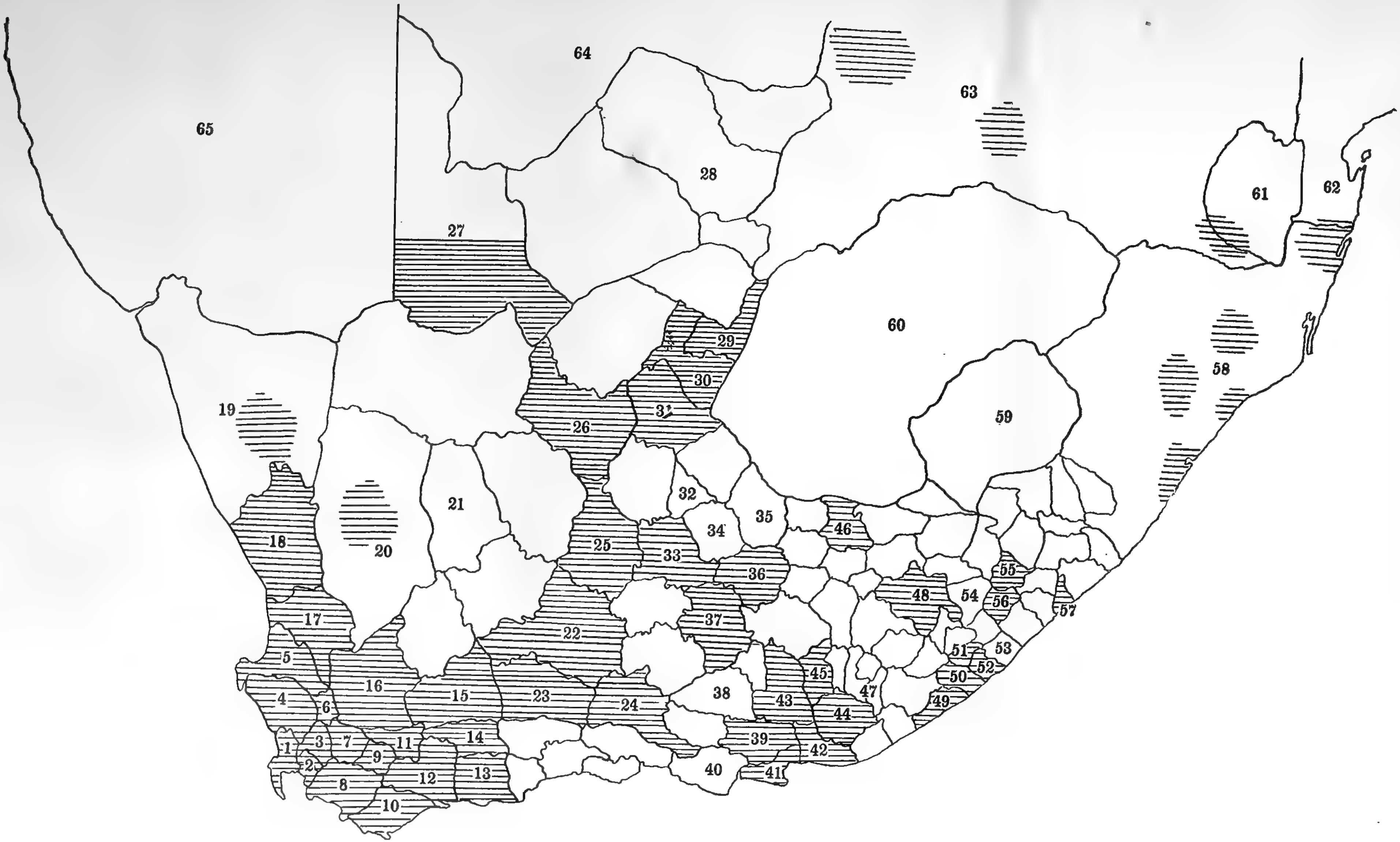

MAP 2.—South Africa south of lat. 25° S. to show distribution of *Latrodectus geometricus*.

R. H. N. Smithers.

Key to Administrative Divisions of the Cape Province (1–57), and to Political Areas of South Africa (58–65).

1. Cape.
2. Stellenbosch and Somerset West.
3. Paarl and Wellington.
4. Malmesbury.
5. Piquetberg.
6. Tulbagh.
7. Worcester.
8. Caledon.
9. Robertson.
10. Bredasdorp.
11. Montagu.
12. Swellendam.
13. Riversdale.
14. Ladismith.
15. Laingsburg.
16. Ceres.
17. Clanwilliam.
18. Van Rhynsdorp.
19. Namaqualand.
20. Calvinia.
21. Williston.
22. Beaufort West.
23. Prince Albert.
24. Willowmore.
25. Victoria West.
26. Prieska.
27. Gordonia.
28. Vryburg.
29. Kimberley.
30. Herbert.
31. Hopetown.
32. De Aar.
33. Richmond.
34. Hanover.
35. Colesberg.
36. Middelburg.
37. Graaf Reinet.
38. Jansenville.
39. Uitenhage.
40. Humansdorp.
41. Port Elizabeth.
42. Alexandria.
43. Somerset East.
44. Albany.
45. Bedford.
46. Albert.
47. Fort Beaufort and Victoria East.
48. Glen Grey, Xalanga, and St. Marks.
49. East London.
50. Komgha.
51. Butterworth.
52. Kentani.
53. Willowvale.
54. Engcobo.
55. Tsolo.
56. Umtata.
57. Port St. Johns.
58. Natal.
59. Basutoland.
60. Orange Free State.
61. Swaziland.
62. Portuguese East Africa.
63. Transvaal.
64. British Bechuanaland.
65. South West Africa.

ANNALS

OF THE

SOUTH AFRICAN MUSEUM

VOLUME XXXVI.

PART IV, *containing:—*

5. *Observations on the Food-Cycle of the South African Stockfish,* Merluccius capensis *Cast. off the West Coast of South Africa; with a Note on the Food of the King-Klip* Genypterus capensis (*Smith*). By J. M. RATTRAY, M.Sc., Low Temperature Research Laboratory, Cape Town. (With 2 Text-figures.)

SEMPER ALIQUID NOVI AFRICA AFFERT

ISSUED JUNE 1947. PRICE 3s.

PRINTED FOR THE
TRUSTEES OF THE SOUTH AFRICAN MUSEUM, CAPE TOWN
BY NEILL AND CO., LTD.,
212 CAUSEWAYSIDE, EDINBURGH.

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(With 2 Text-figures.)

(MS. received 1945.)

The observations recorded in this paper were made during a bacteriological investigation of a serious outbreak of spoilage in various canned stockfish products. The bacteria which were ultimately found to be responsible for the spoilage were traced back to the fish on the trawler, and eventually the evidence suggested that the fish actually left the water in an infected condition. As a result of this it was thought that a study of the food-cycle of the stockfish might throw some light on the primary source of infection.

The South African stockfish *Merluccius capensis* Cast. is apparently very similar morphologically to the Northern Atlantic form *M. vulgaris*, commonly known as hake, and may even be identical with it. The question, however, has not yet been satisfactorily settled, and at present *M. capensis* is regarded as a distinct species. Although it is one of the most important commercial fishes of South Africa and forms the bulk of the fish trawled round the coast of this country and half of the total fish harvest, no information has been published regarding its life-history, feeding habits, etc. Barnard (1) says of the stockfish: "It is very abundant at times, but seems to be uncertain in appearance. Like the Northern form, they probably migrate considerable distances, both for purposes of spawning and also from one food-ground to another." According to Gilchrist (2) their chief food seems to be one particular species of Macrurid, viz., *Macrurus fasciatus*. This appears to be the only first-hand reference there is on the subject.

It must be stressed again that the data presented here were obtained during the course of a *bacteriological* examination of the foodstuffs in the stomach of the stockfish and that it was not intended to make a comprehensive and independent study of this aspect of

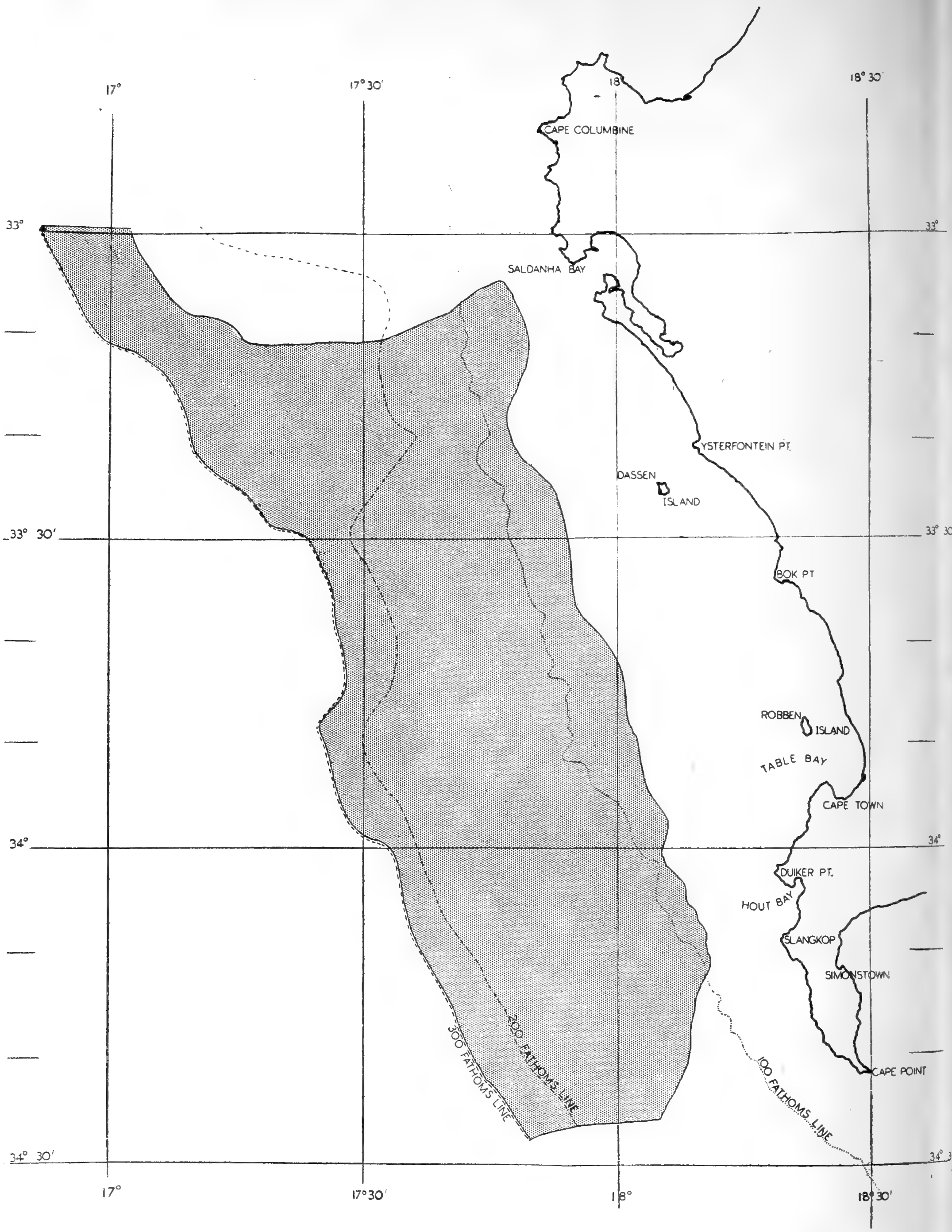

Fig. 1.—Showing the trawling grounds (shaded area) from which the stockfish were obtained. (Taken from Division of Fisheries Analytical Chart, No. 1, 1931.)

ERENT SIZE GROUPS.

Organisms Found.

Sebastosemus (Jacopever).	Fish remains (unidentifiable).	*Solenocera* or *Funchalia* (Prawns).	Prawn-like crustacean remains (unidentifiable).	*Parapagurus dimorphus* (Hermit Crabs).	Starfish or Polychaeta.	Sea-anemones.
..	..	1				
..	..	..	1			
1	..	1				
..	2	2	1			
1	1	1	1	..	1	
..	3	1	2			
..	2	..	..	1		
..	1	..	1	..	1	
..	3	1				
..	4	1				
..	3					
..	4	..	..	1		
..	..	..	..	..	..	1
..	1	..	..	..	1	
..	3					
..	..	..	..	..	1	
..	1					
..	..	..	..	..	..	1
..	1					
..	1	..	..	1	..	2
..	..	..	..	1	..	1
..	..	..	..	..	..	2
..	1					
2	31	8	6	4	4	7

ng the table especially where organisms

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the natural history of the fish. The observations were made over a period of about 18 months and involved the examination of some 1450 stomachs of fish trawled from the main Atlantic fishing grounds. No fish from the Indian Ocean were examined.

The fish, which were obtained through the courtesy of Messrs. Irvin and Johnson, were trawled from what are known as the North fishing grounds that lie roughly between lat. 33° S. and 30° 30′ S. and long. 17° E. and 18° 10′ E., and the depth of this area varies between 100 and 300 fathoms (see fig. 1). Depending on circumstances, the trawlers usually stay on the grounds three or four days, returning to port twice a week to land the fish. When conditions permitted, a small sample of between 12 and 18 fish in the round state and selected as being representative of the usual commercial sizes was sent to this laboratory for examination.

According to existing legislation (3) it is not permissible to catch or offer for sale stockfish under 20 inches in length, and the size of the trawl mesh is presumably laid down so as to ensure this. In practice, however, it is apparent that a considerable number of fish below 20 inches are caught, and there is evidence to show that only fish under 12 inches escape, while fish from 12 to 19 inches are caught in ever-increasing quantities (4). The few fish under 12–13 inches which were examined were obtained from the stomachs of larger fish.

The Main Food of the Stockfish.

At least 19 different organisms were removed from the stomachs at various times throughout the 18 months, but it soon became apparent which of these constituted the main food of the fish and which were mere casual items of diet. Undigested organisms found in the mouth have been disregarded, as the stockfish presumably behaves like the hake and snatches at anything which may be present in the trawl while being pulled to the surface.

Table 1 shows the different types of organisms which were found in the stomachs of fish of different size groups.

The number of stomachs examined includes those that were found empty. When several different organisms were present in the same stomach, each organism is recorded as having been found once. The frequency of occurrence is given as the actual number of times the organism was found and not as a percentage, as this is misleading in the size groups where only a few stomachs were examined.

Table 2 shows the monthly distribution of the various types of organisms recovered.

TABLE 1.—SHOWING FOOD PRESENT IN STOMACHS OF FISH OF DIFFERENT SIZE GROUPS.

Size Group of Fish (in inches).	No. of Stomachs Examined.	Frequency of Occurrence. Main Food of Stockfish. Mysids and/or Euphausiids.	*Myctophum* and/or *Maurolicus*.	*Merluccius capensis* (Stockfish).	Macrurids (mostly *Coelorhynchus fasciatus*).	Cephalopods (mostly *Loligo* sp.).	*Trachurus trachurus* (Masbankers).	Other Organisms Found. *Scomber colias* (Mackerel).	*Photichthys argenteus*.	*Helicolenus maculatus* (Sancord).	*Tripterophycis gilchristi* (Gilchrist's Triplefin).	*Sebastosemus* (Jacopever).	Fish remains (unidentifiable).	*Solenocera* or *Funchalia* (Prawns).	Prawn-like crustacean remains (unidentifiable).	*Parapagurus dimorphus* (Hermit Crabs).	Starfish or Polychaeta.	Sea-anemones.
9¾ and under . .																		
10–10¾ . .	3	3	2															
11–11¾ . .	2	2																
12–12¾ . .	3	..	1															
13–13¾ . .	9	7	3															
14–14¾ . .	11	4	6	..	..	1												
15–15¾ . .	22	8	5	..	..	..	..	..	..	..	..	..	..	1				
16–16¾ . .	43	19	5															
17–17¾ . .	64	25	8	..	1	1	..	..	..	..	..	..	..	..	1			
18–18¾ . .	95	42	20	1	1	7	..	..	..	..	..	1	..	1				
19–19¾ . .	138	56	36	..	4	6	..	..	..	..	..	..	2	2	1			
20–20¾ . .	171	68	35	1	3	12	..	1	..	..	..	1	1	1	1	..	1	
21–21¾ . .	125	42	28	3	4	5	..	..	2	..	..	..	3	1	2			
22–22¾ . .	74	22	18	..	1	2	..	..	..	..	..	..	2	..	..	1		
23–23¾ . .	82	21	17	2	4	3	..	..	..	..	..	..	1	..	1	..	1	
24–24¾ . .	65	18	8	3	2	2	..	1	..	..	..	..	3	1				
25–25¾ . .	54	10	6	2	5	3	..	..	..	..	..	..	4	1				
26–26¾ . .	61	8	8	10	2	2	2	..	..	..	..	..	3					
27–27¾ . .	57	3	2	5	4	4	..	1	1	..	..	..	4	..	..	1		
28–28¾ . .	49	1	6	5	4	1	..	..	..	..	..	..	..	..	..	..	..	1
29–29¾ . .	53	5	3	7	..	3	1	..	..	1	..	..	1	..	..	..	1	
30–30¾ . .	53	..	3	7	2	..	1	..	..	..	..	..	3					
31–31¾ . .	30	3	1	4	1	..	..	..	..	..	..	..	..	..	..	..	1	
32–32¾ . .	33	..	..	6	5	..	2	..	..	..	..	..	1					
33–33¾ . .	29	1	..	4	3	..	3	1	..	..	..	..	..	..	..	..	..	1
34–34¾ . .	37	..	..	8	3	..	4	..	..	..	1	..	1					
35–35¾ . .	25	..	..	5	..	..	2	..	..	..	..	..	1	..	..	1	..	2
36–36¾ . .	15	1	..	3	2	..	2	..	..	1	..	..	..	..	..	1	..	1
37–37¾ . .	20	..	..	5	4	..	1	..	..	..	..	..	..	..	..	..	..	2
38–38¾ . .	8	1	..	1	3	..	..	..	1									
39–39¾ . .	6	..	..	2	1													
40 and over .	4	..	..	1	..	..	..	..	..	..	..	..	1					
		370	221	85	59	52	18	4	4	2	1	2	31	8	6	4	4	7

Where no figures are given, "0" is intended. It has been omitted in order to facilitate reading the table especially where organisms only occurred once or twice.

J. M. Rattray.

To face page 317.

TABLE 2.—SHOWING THE MONTHLY DISTRIBUTION OF THE VARIOUS TYPES OF ORGANISMS RECOVERED.

Month.	Frequency of Occurrence.																
	Main Food of Stockfish.						Other Organisms Found.										
	Mysids and/or Euphausiids.	*Myctophum* and/or *Maurolicus*.	*Merluccius capensis* (Stockfish).	Macrurids (mostly *Coelorhynchus fasciatus*).	Cephalopods (mostly *Loligo* sp.).	*Trachurus trachurus* (Masbankers).	*Scomber colias* (Mackerel).	*Photichthys argenteus*.	*Helicolenus maculatus* (Sancord).	*Tripterophycis gilchristi* (Gilchrist's Triple-fin).	*Sebastosemus* (Jacopever).	Fish remains (unidentifiable).	*Solenocera* or *Funchalia* (Prawns).	Prawn-like crustacean remains (unidentifiable).	*Paragurus dimorphus* (Hermit Crabs).	Starfish or Polychaeta.	Sea-anemones.
1942 August . .	5	1	3	1	..	2	..	..	..	..		5	..	..	1		
September .	32	15	6	5	2	1	..	..	..	..		2	..	..	..	..	1
October . .	8	8	4	2	2	4	..	1	..	..	..	3					
November .	29	21	7	6	7	2	..	1	..	..	..	2	1 F* 1 S*	2	..	..	1
December .	59	14	4	4	2	..	..	..	..	..	2	4	1 S	..	..	..	1
1943 January . .	26	18	2	2	8	..	..	..	..	..	..	1	1 S 1 F				
February .	48	40	1	5	10	..	..	..	..	1	..	1	..	..	1	..	1
March . .	24	16	3	2	10	..	1	1	..	..	..	3	2 F	1	1		
April . .	12	9	4	..	..	..	..	..	..	..	..	..	..	1			
May . .	29	16	7	4	3	..	1	..	1	..	..	1					
June . .	18	13	7	1	..	..	1	..	..	..	..	1					
July . .	14	16	6	2	2	1	..	..	..	..	..	1	..	..	..	2	
August . .	16	11	6	10	4	1	..	..	..	..	..	3	1 F	..	..	1	
September .	6	0	5	4	..	2	..	..	1	..	..	3	..	..	..	..	1
October . .	32	16	7	4	..	2	1	1	..	..	..	..	1 S	..	1	1	
November .	4	5	7	5	2	..	..	..	..	..	..	1	..	1	..	..	1
December .	7	1	5	1	1	1	..	..	..	..	..	..	..	..	..	..	1
1944 January . .	..	1	1	1	1												

* F=*Funchalia* ; S=*Solenocera*.

As will be seen from Table 1 the type of food found in the stomachs varied to a large extent with the size of fish. For convenience, therefore, fish from 10 to $17\frac{3}{4}$ inches in length were ranked as small, those between 18 and $30\frac{3}{4}$ inches as medium, and fish 31 inches and over as large. Fish below 10 inches in length were rarely encountered so that it was not possible to ascertain to any great extent what constituted the main food of these very small fish.

Before discussing each item of food separately it should be pointed out that the South African stockfish appears to be very similar in its habits to the European hake in that it feeds by night, presumably some distance from the bottom, and is only caught by the trawl during the day when it goes back to the bottom again. The fish from which the data for this paper were obtained were usually brought up in the last trawl of the day before returning to port, *i.e.*, between 2 p.m. and 3 p.m. To what extent the types of food found in the stomachs of these fish would have varied had they been caught in the early morning has not been ascertained.

The principal food constituents of the stockfish in order of importance are: small crustacea belonging to the *Mysidacea* and *Euphausiacea*, small deep-sea fish belonging to the *Myctophidae* and *Stomiatidae*, small specimens of *Merluccius* (stockfish), *Macrurids*, *Cephalopods*, and to a lesser extent *Trachurus* (masbanker or horse mackerel). Of the other organisms listed in the table only the prawn-like crustacea, represented chiefly by the two genera *Solenocera* and *Funchalia*, may possibly form a minor constituent of the diet, the rest occurred far too spasmodically to be regarded as important.

Mysidacea and Euphausiacea.—These small pink crustacea formed a very large part of the food of fish up to about 30 inches in length but fish larger than this do not appear to feed on them at all, only single specimens being found when they did occur in the stomachs. The mysids were usually species of *Thysanopoda* and the euphausiids species of *Euphausia*, but identification was often difficult on account of the mutilation which had taken place and no attempt was made to determine the species.

According to Smith (5) the *Mysidacea*, although pelagic, are not very frequently found on the surface but generally swim some distance below it, going down in many cases to the abysses, while the euphausiids, on the other hand, are frequently met with in the surface plankton, one species *E. pellucida* being taken at the surface as well as at considerable depths. Hickling (6) says that the euphausiids, which form the main part of the food of small hake, have a very definite habit of swimming up to the surface at night and sinking to the bottom or to considerable depths by day. There is no available information regarding this vertical migration as far as the South African euphausiids and mysids are concerned, but in view of the fact that the stockfish leave the bottom at night to feed in the higher strata it is possible that these crustacea also rise from the bottom to the middle depths at this period, unless of course they frequent them all the time. That they are present in midwater at the time of feeding is obvious, but how far they extend towards the surface is a matter of conjecture. Hickling says that small hake feed directly on these euphausiids and must clearly follow them to the surface. The small stockfish, *i.e.*, those between 10 and 18 inches in length, also feed heavily on them, but if the crustacea rise right to the surface at night and the small fish follow them, then the medium, and particularly the large, stockfish will be found at the surface as well, in order to obtain the small stockfish which in turn form such an important item in their diet. It is unlikely that stockfish of all sizes feed at the surface in this manner, and it seems more probable that only the very small stockfish, *i.e.*, those under 10 inches, will be found there, and thus account to a certain extent for the extreme rarity with which fish of this size are found in the stomachs of the larger fish. It therefore appears that the small- and medium-sized fish remain in the middle waters where the crustacea abound freely and that the large fish either remain in still deeper waters where few crustacea occur, or if they do come up to midwater they show great discrimination in their selection of food. Other deep-sea fish such as *Coelorhynchus*, *Maurolicus* and *Myctophum* as well as the pelagic species *Trachurus* also feed heavily on these crustacea.

Several attempts were made to ascertain the food of these mysids and euphausiids, but apart from a few diatoms of the *Coscinodiscus* type nothing recognisable was recovered from their alimentary tract.

Myctophidae and Stomiatidae.—These two families were represented by the genera *Myctophum* and *Maurolicus* respectively and are classed together, as in the majority of cases they were found in a semi-digested condition making identification difficult. The presence of photophores characteristically arranged on pieces of skin, and also the otoliths, assisted materially in recognising these two genera when the bodies were often considerably digested. They are small deep-sea fish usually about $1\frac{1}{4}$–$1\frac{3}{4}$ inches long, and were nearly always found together with the small crustacea. They form a large part of the food of fish up to about 30 inches in length throughout the year, but fish above this length do not feed on them at all. When these small fish are in abundance as food, as many as 77 have been found in one stomach. It is interesting to note that it was on this occasion when the stockfish had been feeding more heavily than usual on the small fish, that the latter in turn were found to have been feeding on copepods (*Calanus* sp.). This occurred towards the end of February 1943 and was the only time that copepods were found as food—the mysids and possibly euphausiids being the only other food encountered in the stomachs of these small fish.

Myctophum cocci (Cocco) and *Maurolicus pennanti* (Walb.) were the two species commonly encountered, but *Myctophum humboldti* (Risso) was also found on a few occasions and it is possible that other species may have been present but were too badly mutilated to allow of identification. Barnard (1) has described a new species of *Myctophum* (*M. aeolochrus*) as having been found in the stomach of a stockfish.

Merluccius capensis Cast. (Stockfish).—These were found in the stomachs all the year round and form the main diet of the large fish. They were recovered from fish 18 inches in length and upwards but were more common in fish above 24 inches. They were not found in the stomachs of any fish below 18 inches in length. The size of the stockfish found as food varied between 4 and 21 inches. Of those still measurable 3 were below 10 inches, 45 between 10 and 15 inches, and 14 between 16 and 21 inches. The rarity with which fish below 10 inches were found in the stomachs has been mentioned in a previous section of this paper and is interesting in that it indicates that the South African stockfish apparently follows to some extent the same habits as the hake during the first two years of its life. The available data (4) on the rate of growth of the stockfish during the first few years of its life indicate that it grows about 4–4½ inches a year. Thus at the end of the second year the fish ought to be 8–9 inches long. If these very young fish are similar in their habits to the hake, which according to Hickling (6) remain pelagic for the first two years and only go down to the bottom when they are about 8 inches long, then they will obviously only be found at the surface and therefore not be available as food for the larger fish until they are about two years old or approximately 9 inches in length. On the other hand, even if these very small stockfish do live at the surface during this period, it has still not been established whether they are to be found in the same areas as the larger fish. The hake moves to deeper waters at the commencement of spawning and gradually migrates to shallower waters as spawning progresses, but the eggs and newly hatched fish, being pelagic, drift considerable distances away from the spawning grounds and it is usually quite a long time before they get back to their usual localities. There is a certain amount of evidence (4) to show that the stockfish also migrates to deeper waters during spawning, but whether the eggs and small fry are carried away by currents and wind and are completely absent from the spawning area until they can fend for themselves has not yet been ascertained.

An interesting point which has arisen in connection with the cannibalism of stockfish is the fact that more males are eaten as food than females. That this is almost inevitable is shown by the greater proportion of males to females in the size group which is eaten by the larger fish. The following table (Table 3) shows the percentage of males which were found among fish under 23 inches in length.

Table 3.—Showing the Percentage of Males among Fish under 23 Inches in Length.

No. of Fish under 23 Inches Examined.	Per cent. Males.
755	61
* 970	63
* 533	61

* From data supplied by Dr. Roux (4).

Only a small number of stockfish actually taken from the stomachs were examined for sex, but 71 per cent. were males. The male stockfish is obviously a smaller fish than the female and very few of them reach lengths over 23 inches. This is very strikingly shown by the fact that of 683 fish which were over this length only 8 per cent. were males. Fig. 2 shows graphically on a percentage basis the proportion of males to females which were found in the total number of fish examined. As was pointed out earlier, the fish were selected for size and do not therefore constitute a random sample. The fact that they are selected fish may account for the apparently very great preponderance of males over females in the smaller size groups up to about 18 inches. In a random sample this difference is not so marked although the general shape of the curve is the same, particularly in the biggest size groups.

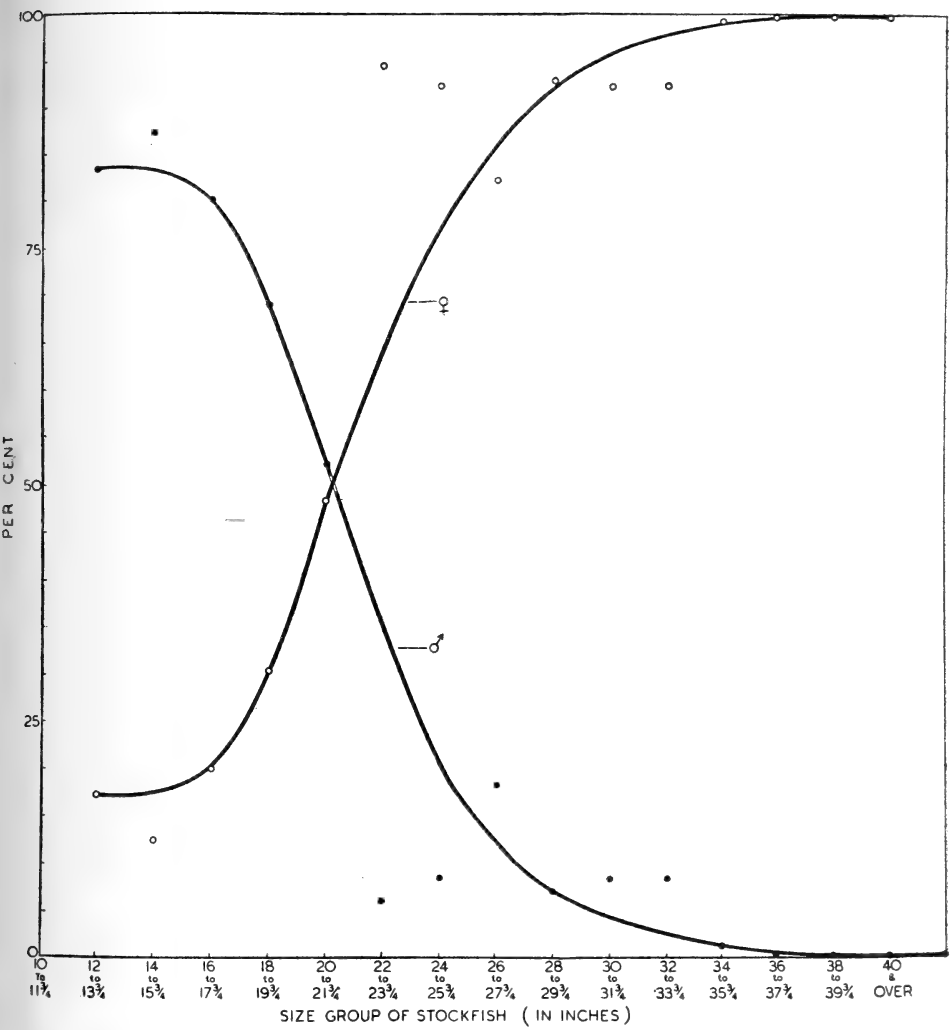


Fig. 2.—Showing the proportion of males to females in the total number of fish examined.

It is difficult to account satisfactorily for the predominance of males in the smaller size groups caught by the trawl or eaten by other fish, but a possible explanation may be that the males congregate sooner than the females.

Macrurids.—It is interesting to note that Hickling (6) states it to be unusual to find bottom-living fish such as the Macrurids in the real food of the hake. Gilchrist (2) however, in reference to the stockfish, says that it was

"... found by the 'Pickle' in great abundance in the deeper waters up to 300 fathoms, and, occasionally, even in 500 fathoms. Its presence in deeper water is explained by the fact that it seems to feed almost exclusively on *Macrurus fasciatus*, which is so abundant in these regions, and a glance at the list of fishes, etc., procured, published in the first Report of the Survey, will show how constant is the association of the two fish in the catches."

During the present investigation Macrurids were certainly found to form part of the diet of stockfish, but were by no means the chief constituent. The stockfish examined, however, were trawled at depths of about 150–200 fathoms and their food may of course be different from that of the stockfish frequenting the very deep waters up to 500 fathoms. *Coelorhynchus fasciatus* (Gnthr.) was the commonest Macrurid encountered. It occurred all the year round and was eaten by fish from 17 inches and upwards in length, but not by the smaller fish, although the rat-tail itself was sometimes only $2\frac{1}{4}$ to 6 inches long, the longest being $18\frac{1}{2}$ inches.

As the Macrurids are essentially bottom dwellers—a study of their food (Table 4) shows that they feed mostly on or near the bottom—it is of course possible that they mainly frequent the depths in which the larger stockfish occur and thus are more likely to become the prey of these fish. On the other hand the fact that copepods (*Calanus* sp.) were eaten in quantity by small rat-tails at one stage shows that they do feed near the surface on occasions.

Cephalopods.—In a large number of cases only the eyes and horny mandibles were found in stockfish stomachs, but when specimens in an identifiable state were recovered they were almost invariably a species of the decapod *Loligo*. These varied in size from 4 to 18 inches and were present practically throughout the year, being in greatest abundance in 1943 during January to March. They formed an important constituent of the food of the medium-sized fish, only two being found in fish below 18 inches in length and none in fish over 30 inches. *Loligo* is pelagic and moves about in large shoals so that it would appear to be available as food for all sizes of stockfish. It is therefore curious that only the fish of the medium-sized group seem to favour it as food. Whether such a fact has any biological significance in South African waters is a matter of conjecture, as

TABLE 4.—FOOD OF MACRURIDS (MOSTLY OF *COELORHYNCHUS FASCIATUS*).

Month.	Contents.
August 1942	4 specimens of *Squilla armata,* and crustacean remains, some probably of *Squilla*; 1 sponge crab (*Exodromidia spinosa*); 2 *Polychaeta*; 2 dragonets (*Paracallionymus* sp.); unrecognisable fish remains.
September 1942	Remains of a fish (probably stockfish).
October 1942	Numerous *Thysanopoda*, several specimens of *Eunice aphroditois.*
November 1942	..
December 1942	Several specimens of *Eunice aphroditois* and prawns (*Squilla* sp.)?
January 1943	1 Isopod; 1 *Polychaete*; 1 mysid; 1 starfish.
February 1943	Very numerous mysids; 1 *Maurolicus*; 1 euphausiid; 1 *Polychaete*; 1 hermit crab, probably *Eupagurus* sp., and remains of several small fish.
March 1943	Numerous hermit crabs (*Eupagurus*); several mysids; 3 specimens of *Eunice aphroditois*; 1 *Pandalina brevirostris*; and crustacean remains probably *Squilla*; 1 *Polychaete.*
April 1943	..
May 1943	1 sponge crab (probably *Exodromidia*); several hermit crabs; 2 *Polychaeta*; crustacean remains and fish remains, both unidentifiable.
June 1943	Remains of cephalopod; remains of stockfish.
July 1943	2 Dragonets; 4 mysids; several hermit crabs; 7 *Polychaeta*; remains of 4 cephalopods; 3 specimens of *Squilla* and remains of crustacean, probably *Squilla*; remains of several small fish (1 of which probably stockfish; 2 of which probably *Maurolicus*); remains of 2 small crabs (probably sponge crabs).
August 1943	Numerous copepods (*Calanus* sp.); 3 *Polychaeta,* several hermit crabs (*Eupagurus* sp.); 3 specimens of *Eunice aphroditois*; 1 *Loligo,* and remains of several small cephalopods; very numerous portions of red starfish; 3 *Maurolicus*; several *Thysanopoda*; 9 *Leontocaris paulsoni*; 1 stockfish.
September 1943	..
October 1943	Gorged with *Thysanopoda.*
November 1943	..
December 1943	..
January 1944	Several *Squilla*; 3 cephalopods; 1 *Eunice aphroditois*; remains of *Maurolicus* or *Myctophum.*

cephalopods apparently form an important part of the food of all sizes of the European hake, except of course the very young fish. No recognisable food remains were recovered from the alimentary tract of the cephalopods.

Trachurus trachurus Linn. (Masbankers, Horse-mackerel).—Masbankers, although not found very frequently, were recovered mostly from the stomachs of the large stockfish, *i.e.*, those over 30 inches in length, none being found in fish below 26 inches. From the present data masbankers do not appear to be available as food from January to June but further observations are required to confirm this. In this connection, however, it is interesting to record that Kallir, Rapson and Schwartz (7), during a study of the variations in oil content of the masbanker, found difficulty in obtaining trek-net fish during the latter half of the year, and they suggest that a migration may take place at this time, away from the coastal waters in which they are usually caught, possibly for spawning purposes. If the masbanker migrates to deeper waters, then it could become available as food for the stockfish during the latter half of the year and be absent from their feeding grounds during the first half.

Two masbankers 13 inches and 14 inches long, taken from a stockfish in July, were examined and their stomachs found to contain numerous mysids and a few specimens of *Maurolicus* as well, while masbankers examined from other sources were found to feed fairly frequently on Mysidacea (*Thysanopoda* sp.) and on one occasion the stomachs were gorged with *Mesopodopsis slabberi* van Beneden.

Other Organisms Found in the Stomach of the Stockfish.

Several other organisms were found in the stomachs from time to time, which, although not forming part of the regular diet, are listed here mainly for purposes of distribution records.

(*a*) Prawn-like Crustacea. The badly mutilated remains of red prawn-like crustaceans were found several times in the stomachs, and when whole specimens were recovered they were identified as *Solenocera* sp. (probably *S. siphonoceras*) and *Funchalia woodwardi* Johnson. On one occasion 18 of the latter were found in one stomach and 12 in another. It is interesting to note that several adult males of *F. woodwardi* were present among these specimens and are the first to be recorded from South African waters.

(*b*) *Photichthys argenteus* Hutton, a deep-sea fish, which, like *Maurolicus,* belongs to the family *Stomiatidae,* was found on four occasions but the presence (at other times) of pieces of skin with photophores similar to *Photichthys* suggest that it may have been eaten more frequently.

(*c*) *Scomber colias* Gmel. (Mackerel). These fish were recovered from the stomachs of stockfish only four times throughout the year, which is surprising as they are said to occur in large shoals together with masbankers.

(*d*) Jacopever. Five small (about 1–1½ inches long) and very young specimens of either the ordinary Jacopever (*Sebastichthys*) or the Spiny Jacopever (*Sebastosemus*), probably the latter, were found in a good state of preservation and were obviously freshly swallowed. They were taken from two stockfish stomachs in December. The stomachs of these young fish were gorged with Mysidacea.

(*e*) *Helicolenus maculatus* (C. and V.) (Sancord). Two obviously freshly swallowed specimens were recovered in May and September. One of them had been feeding heavily on Mysidacea.

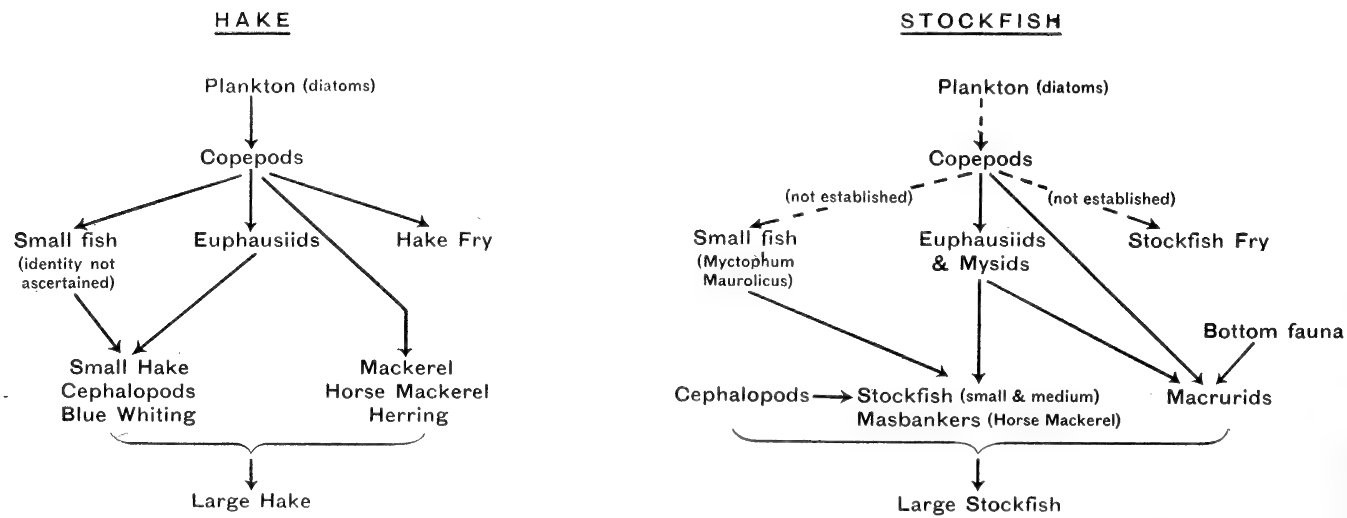
(*f*) *Tripterophycis gilchristi* Blgr. (Gilchrist's Triple-fin) was found once in February.

(*g*) *Parapagurus dimorphus* (Studer) (Hermit crabs), large red Sea-anemones, and Starfish were found several times and on one occasion a *Polychaete*; most of these were obviously freshly swallowed.

Comparison of the Food-Cycle of the South African Stockfish with that of the Hake of European Waters.

Unfortunately the Fisheries Investigations Reports (Nos. 1 and 2 of vol. x, Series II) of the British Ministry of Agriculture and Fisheries, wherein Hickling describes in detail the food of the hake, are not available in this country, and all the references to the hake throughout this paper have been taken from "The Hake and the Hake Fishery" which are his Buckland Lectures for 1934 published in book form. However, for purposes of a general comparison sufficient data are available and the following charts (see page 328) of the food-cycles of the two fish show the essential features fairly clearly.

In the case of the stockfish the initial links in the food chain have not yet been established, but it is reasonable to assume that, following the cycle of the hake, copepods feed on some plankton organisms such as diatoms, and that very young stockfish, mysids and euphausiids feed on copepods. The identity of the small fish mentioned by Hickling which form an important part of the food of small hake,



Comparison of Food-Cycles of European Hake and South African Stockfish.

blue whiting, horse mackerel, etc., has not been ascertained, but they feed on copepods and euphausiids, and have their counterparts in the stockfish cycle in *Maurolicus* and *Myctophum*. These small fish feed on copepods, mysids and euphausiids, and are in turn fed upon by small- and medium-sized stockfish, masbankers and macrurids, which also feed on the small crustacea. Small hake and small- and medium-sized stockfish are important items of the food of the larger fish. Hickling states that actually 21 per cent. of the food of the hake consists of smaller hake. In the case of the hake cycle, cephalopods feed on euphausiids and small fish, and in turn form one of the principal constituents of the food of the hake generally. The food of the South African cephalopods has not been ascertained, but they themselves are fed upon largely by the medium-sized stockfish.

According to Hickling, most of the hake live in deep water at depths of from 90 to 300 fathoms in the winter and spring, and during this time they feed almost exclusively on blue whiting, smaller hake and fantails (cephalopods). They then migrate to shallower waters during summer and autumn and their food then consists chiefly of mackerel, horse-mackerel and herring. The stockfish migrates, apparently to deeper waters, during the spawning season which is usually about the end of winter and the beginning of spring, but the types of food present in the stomach, except for variations in quantity, remain essentially the same throughout the year.

To what extent the hake exhibits the same peculiar discriminatory powers as those apparently shown by the stockfish in their selection of food is not known, as the data are not available, but the size of the stockfish seems to play an important part in the type of food which will be eaten.

Note on the Food of the King-Klip, *Genypterus capensis* (A. Smith).

A number of king-klip were obtained during the above investigations and it is of interest to record the contents of the stomachs, as these fish are trawled in the same waters as the stockfish. The specimens ranged in length from $17\frac{1}{2}$ to $44\frac{1}{2}$ inches and were examined throughout the 18 months.

In view of the fact that the king-klip is found on the same fishing grounds as the stockfish it is not surprising that the latter should form part of the food of the king-klip, but it is interesting to note that no specimens of king-klip were ever found in the food of the stockfish.

TABLE 5.—SHOWING ORGANISMS FOUND IN THE STOMACHS OF THE KING-KLIP.

Organism Present.	Frequency of Occurrence.
Paracallionymus costatus (Blgr.), Cape Dragonet	15
Macrurids	14
**Merluccius capensis*	8
Maurolicus sp.	6
Prawns (mostly *Squilla armata*)	8
Cephalopods	5
Small crustacea (mostly mysids)	8
Remains of small fish, unidentifiable	19
Remains of large fish, unidentifiable	12

The writer wishes to acknowledge with many thanks the assistance given by Dr. K. H. Barnard of the South African Museum, who identified all the marine organisms mentioned in the paper, and for many helpful suggestions. The writer is also indebted to Dr. E. R. Roux of Vitamin Oils Ltd. for the use of much unpublished data, and to Dr. C. von Bonde, Director of Fisheries, for access to the Fisheries Library and for allowing reproduction in part of the Department of Fisheries chart of the fishing grounds.

SUMMARY.

1. The observations recorded in this paper were made during the course of a bacteriological investigation of spoiled canned stockfish. The stomachs of about 1450 stockfish trawled from the main Atlantic fishing grounds were examined in an attempt to find the primary source of the bacterial infection causing the spoilage.

2. The principal types of food were found to be species of *Mysidacea* and *Euphausiacea*, small deep-sea fish *Myctophum* sp. and *Maurolicus* sp., small stockfish, Macrurids, cephalopods, and to a lesser extent masbankers (*Trachurus trachurus*).

3. Several other organisms were found as well, but of these only the prawns (*Solenocera* and *Funchalia*) may possibly form a minor constituent of the stockfish diet.

* The smallest stockfish seen by the writer was recorded from the stomach of the king-klip on 10th June 1943. It was complete except for the rays of the tail and measured $1\frac{3}{4}$ inches in length.

4. The stockfish appears to show a certain amount of selectivity in its food, and the size of the fish seems to have an important bearing on the type of food eaten. Thus fish from 10 inches up to about 25 inches eat mainly small crustacea and the small deep-sea fishes, *Myctophum* and *Maurolicus*, while fish above 30 inches length feed chiefly on other stockfish, macrurids and masbankers. Fish between 25 and 30 inches appear to feed fairly evenly on all the major constituents of the food of fish below and above these lengths. Cephalopods were only recorded from the stomachs of fish between 18 and 30 inches.

5. (*a*) The main food of *Mysidacea* and *Euphausiacea* was not ascertained although a few diatoms were recovered.

(*b*) *Maurolicus* and *Myctophum* feed on small crustaceans, chiefly *Mysidacea* and *Euphausiacea*, and occasionally on copepods.

(*c*) *Macrurids* are mainly bottom feeders, and such organisms as *Chaetopoda*, hermit crabs, sponge crabs and starfish were often recovered from their stomachs, but other organisms such as *Squilla armata*, *Mysidacea*, *Euphausiacea*, *Cephalopoda*, small stockfish, dragonets and *Maurolicus* were also found as food.

(*d*) Masbankers appear to feed chiefly on small crustacea such as *Thysanopoda* and *Mesopodopsis*, but include the small deep-sea fish *Maurolicus* as well.

6. The food-cycle of the stockfish is very similar in its main features to that of the European hake. The cycle can be represented generally thus: Plankton→Copepods→Small fish, Mysids and Euphausiids→Small- and medium-sized stockfish, Masbankers, Macrurids (Cephalopods)→Large Stockfish.

7. A note is given of the food of the king-klip (*Genypterus capensis*).

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ANNALS

OF THE

SOUTH AFRICAN MUSEUM

VOLUME XXXVI.

PART V, *containing*:—

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7. *Further Notes on South African Marine Fishes.*—By K. H. Barnard, D.Sc., F.L.S., Assistant Director. (With Plates IX–XIII and 17 Text-figures.)

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ISSUED JUNE 1948. PRICE £1, 3s. 6d.

PRINTED FOR THE
TRUSTEES OF THE SOUTH AFRICAN MUSEUM, CAPE TOWN
BY NEILL AND CO. LTD.
212 CAUSEWAYSIDE, EDINBURGH

6. *Reports on the Marine Mollusca in the Collections of the South African Museum.*—By J. R. LE B. TOMLIN, M.A.

XI. FAMILY BUCCINIDAE.

Gen. NASSARIA Link, 1807

THIS name is inconveniently similar to *Nassarius* Dumeril, 1806, but is not to be rejected on that account. In 1853 H. and A. Adams called the genus HINDSIA.

Nassaria acuminata (Reeve)

Triton acuminatus Reeve, Conch. Icon., ii, pl. 14, fig. 54, *a*, *b*, June 1844. China.
Durban (Brit. Mus.). Mörch, Yoldi Cat., i, p. 107, gives it doubtfully from the Cape.

Nassaria gracilis Sowerby III.

Marine Investigations in S. Africa, ii, p. 94, pl. 2, fig. 10, Sept. 1902. Tugela R. mouth, N. by W$\frac{3}{4}$W., distant 15$\frac{1}{2}$ miles: depth 40 fathoms.

Gen. PHOS Montfort, 1810

Phos cyanostoma A. Adams

P.Z.S. Lond., 1850, p. 155, Feb. 1851. Philippine Islands.
Durban Bay (Falcon).

Phos laevigatus A. Adams

P.Z.S. Lond., 1850, p. 155, Feb. 1851. Cape of Good Hope.

Phos nodicostatus A. Adams

Ibid., p. 154. Negros Is.
Scottburgh (Burnup), a small example.

Phos roseatus Hinds

Voy. "Sulphur," ii, p. 38, pl. 10, figs. 9, 10, 1844. Sumatra.
Durban (Brit. Mus.).

Gen. Engina Gray, 1839

Engina mendicaria (Linn.)

Voluta mendicaria Linn., Syst. Nat., ed. 10, p. 731, 1758. Asia.
Durban (Brit. Mus.); Natal (Krauss).

Engina perlata (Küster)

Buccinum perlatum Küster, Conch. Cab. (2), Lief. 163, pl. 12, fig. 56, 1858. Natal.

Engina natalensis Melvill, Proc. Mal. Soc. London, i, p. 226, pl. 14, fig. 12, 1895.

I have seen specimens from as far west as East London and Port Alfred. It occurs up the E. coast as far as Mombasa.

Engina astricta (Reeve)

Ricinula astricta Reeve, Conch. Icon., iii, pl. 4, fig. 30, Oct. 1846. Hab.?

Umkomaas (Burnup); Durban (McClelland).

Charitodoron Tomlin, 1932

Charitodoron euphrosyne Tomlin

Ann. S. Afr. Mus., xxx, p. 167, fig. 8, 1932. Off Cape Point in 660–700 fathoms, 26 miles E. in 218 fathoms, and 18 miles N. 50° E. in 180 fathoms.

Charitodoron aglaia Tomlin

Ibid., p. 169, fig. 9, 1932. S. Africa.

Charitodoron thalia Tomlin

Ibid., p. 169, fig. 10, 1932. Off Cape Point in 131 fathoms and in 800–900 fathoms.

Charitodoron pasithea Tomlin

Tomlin, J. Conch., xxii, p. 50, text-fig., 1943.
Off Cape Point in 430–630 fathoms.

Gen. Euthria Gray 1850

Euthria filmerae Sowerby III

Proc. Mal. Soc. London, iv, p. 1, pl. 1, fig. 3, April 1900. Pondoland.

Euthria ponsonbyi Sowerby III.

Journ. of Conch., vi, p. 149, pl. 3, fig. 3, Oct. 1889. S. Africa. Taken subsequently not rarely *ex piscibus.*

Euthria pura Martens

Deutsch. Tief-See Exp., vii, Lief, i, p. 25, pl. 2, fig. 14, 1903. Agulhas Current, 273 fathoms.

Euthria queketti Smith

Journ. of Conch., x, p. 110, pl. i, fig. 1, 1901. In a fish caught 10 miles off Durban in 40 fathoms.

Gen. Pisania Bivona, 1832

Pisania tritonoides (Reeve)

Buccinum tritonoides Reeve, Conch. Icon., iii, pl. 10, fig. 77, Dec. 1846. Ticao Is.
Durban (Brit. Mus.).

Pisania marmorata (Reeve)

Buccinum marmoratum Reeve, Conch. Icon., iii, pl. 12, fig. 95, Dec. 1846. Capul Is.
Isipingo (B.M.); Durban (McClelland and Casey); Port Elizabeth (Sowerby).

Pisania crenilabrum A. Adams

P.Z.S. London, 1854, p. 138, April 1855. W. Indies (by error).
Pisania montrouzieri Crosse, J. de C., x, p. 251, pl. 10, fig. 7, 1862, New Caledonia.
Pondoland (Sowerby); Umkomaas (Burnup); Natal (Brit. Mus.); Coffee Bay (Tyson in Albany Mus., several).

Gen. Pollia Gray in Sowerby, 1834

Pollia subcostata (Krauss)

Buccinum rubiginosum Reeve var. *subcostata* Krauss, Südafr. Moll., p. 120, 1848. Natal.
Buccinum cariniferum Küster, Conch. Cab. (2), Lief. 163, p. 63, pl. 12, figs. 9, 10, 1858. Natal.
Tritonidea natalensis Smith, J. of C., x, p. 111, pl. 1, fig. 23, 1901. Durban.
Durban (Burnup and McClelland); Izotoka (coll. Tomlin).

Krauss' above name is evidently intended for this species. Sowerby (J. of C., vii, p. 368, and Mar. Invest., ii, p. 229) wrongly identified it with *T. subrubiginosa* Smith.

Martens wrongly identified it with *Buccinum porcatum* Gmelin (J. B. Mal. Ges., I, p. 136).

Pollia insculpta (Sowerby III)

Tritonidea insculpta Sow., Pr. Mal. Soc. London, iv, p. 2, pl. 1, fig. 4, April 1900. The Kowie.

Pollia shepstonensis Tomlin

Ann. Natal Mus., v, p. 291, pl. 16, fig. 4, May 1926. Beach End, near Port Shepstone.

Pollia undosa (Linn.)

Buccinum undosum Linn., Syst. Nat., ed. 10, p. 740, 1758. Asia.

A very common Indo-Pacific shell, recorded from Durban and Port Elizabeth; Cape, not uncommon (Sow.). Falcon has one 35 mm. long from Durban Bay. Sowerby (J. of C., vi, p. 148, 1889) unnecessarily introduces a var. *minor*—fortunately a *nomen nudum*.

It is always a variable shell in point of size.

Gen. METULA H. and A. Adams

Metula clathrata (A. Adams and Reeve)

Buccinum clathratum A. Adams and Reeve, Zool. Voy. Samarang, p. 32, pl. ii, fig. 12, 1850. Cape of Good Hope, 136 fathoms.

Gen. BURNUPENA Iredale, 1918

Burnupena cincta (Röding)

Buccinum mexicanum Bruguière, Enc. Méth. Vers., I, p. 260, 1789. Mexico.

Buccinum cinctum Röding, Mus. Bolt., p. 113, 1798.

Buccinum porcatum Gmelin, Syst. Nat., p. 3494, 1791. Anglia. (*non* da Costa 1778.)

Purpura ligata Lamarck, An. s. Vert., vii, p. 244, 1822. Hab.?

Buccinum crassum Mörch, Cat. Yoldi, i, p. 94, 1852. Cape.

Buccinum pubescens Küster, Conch. Cab. (2), Lief. 162 and 164, p. 73, pl. 13, figs. 8, 9, 1858. Hab. unknown, probably S. Africa.

Common and generally distributed. The earliest name is undoubtedly *Buccinum mexicanum* Brug., but I have hesitated to make use of this, in view of its incorrectness.

Tryon says that *Buccinum biseriale* Küster from Cape Elim is this species.

Burnupena limbosa (Lamarck)

Purpura limbosa Lamarck, An. s. Vert., vii, p. 243, Aug. 1822. Hab.?

Cominella porcata multilirata Bartsch, U.S. Nat. Mus. Bull. 91, p. 47, pl. 4, fig. 6, July 1915. Cape of Good Hope.

St. James and Lambert's Bay (Stephenson); Camps Bay (Connolly); Port Alfred (Turton); Natal (Krauss); Dyer Is. (Odhner); False Bay and Algoa Bay (Martens).

Burnupena prolongata (Smith)

Cominella (?) *prolongata* Smith, J. of C., ix, p. 248, pl. 5, fig. 3, 1899. Cape Colony.

Until other and better specimens turn up it is doubtful where this should be placed.

Burnupena delalandii (Kiener)

Buccinum delalandii Kiener, Coq. Viv., p. 15, pl. 5, fig. 14, 1834. Cape of Good Hope.

Port Nolloth and Lambert's Bay (Stephenson); Saldanha Bay (Kimberley Mus.); Port Alfred (Turton); Dyer Is. (Odhner); Lüderitzbucht.

Burnupena lagenaria (Lamarck)

Purpura lagenaria Lam., An. s. Vert., vii, p. 245, Aug. 1822. Hab.?

Purpura cucurbita Duclos, Ann. Sci. Nat., xxvi, p. 112, pl. 2, fig. 12, May 1832. Hab. Inconnu.

Buccinum violaceum Quoy and Gaimard, Voy. Astrolabe, ii, p. 456, pl. 30, figs. 32–34, 1832. Table Bay.

Common in the Cape Province. Quoy and Gaimard's *Buccinum violaceum* (Voy. Astrolabe, Zool., ii, p. 456, pl. 30, figs. 32–4, 1832) may possibly be this species.

Burnupena papyracea (Bruguière)

Buccinum papyraceum Brug., Enc. Méth., Vers, I, p. 260, 1789. Norway (error).

Buccinum anglicum Gmelin, Syst. Nat., p. 3494, 1791. England (error).

Buccinum anglicanum Reeve, Conch. Icon., iii, pl. 4, fig. 23, Dec. 1846. England and Norway.

Buccinum intinctum Reeve, *l.c.*, pl. 5, fig. 32, Dec. 1846. Hab.?

Buccinum robustum Küster, Conch. Cab. (2), Lief. 164 and 165, p. 81, pl. 14, fig. 13, pl. 15, fig. 5, 1858. Cape and Natal.

Port Nolloth (Stephenson); Lüderitzbucht.

Burnupena semisulcata (Sowerby III)

Cominella semisulcata Sow., Marine Shells S.A., p. 10, pl. 1, fig. 7, 1892. Port Elizabeth.

Turton does not seem to have come across this, but Becker sent me several from Port Alfred many years ago.

Burnupena tigrina (Kiener)

Buccinum tigrinum Kiener, Coq. Viv., p. 27, pl. 10, fig. 32, 1834. Hab.? Common in the Cape Province.

Burnupena dunkeri (Küster)

Buccinum dunkeri Küster, Conch. Cab. (2), Lief 164 and 165, p. 86, pl. 15, figs. 9–11, 1858. Cape.

Fusus lineolatus (Dunker) Philippi, Abbild., i, p. 110, pl. 1, fig. 10, March 1844. Cape. [non *F. lineolatus* Costa 1840.]

Burnupena capensis (Philippi)

Fusus capensis (Dunker) Philippi, Abbild., i, p. 110, pl. 1, fig. 7. March 1844. Cape of Good Hope.

Euthria turtoni Bartsch, U.S. Nat. Mus. Bull. 91, p. 50, pl. 3, fig. 6, July 1915. Port Alfred.

Port Alfred and East London. This is probably the shell that Sowerby (M. Shells, App. 2) lists as *Euthria magellani* Vélain: *cf.* Smith in Pr. Mal. Soc. London, V, p. 371.

Sowerby (M. Shells S.A. p. 10) gives the New Zealand *Cominella glandiformis* (Reeve) as South African with a query. It certainly does not occur here.

Gen. AFROCOMINELLA Iredale, 1918

Afrocominella simoniana (Petit)

Fusus simonianus Petit, J. de C., iii, p. 164, pl. 7, fig. 7, 1852. Cape Agulhas.

Cominella elongata Dunker, Pr. Z.S. London, 1856, p. 356, May 1857. Hab.?.

Cominella alfredensis Bartsch, U.S. Nat. Mus. Bull. 91, p. 48, pl. 3, fig. 7, July 1915. Port Alfred.

Petit's name for this common shell has been overlooked. The figure is unmistakable.

Afrocominella lacertina (Gould).

Euthrya lacertina Gould, Pr. Boston Soc. N.H., vii, p. 327, Sept. 1860. Simons Bay.

I have what I take to be this species from Jeffreys Bay and False Bay and specimens which Stephenson took at Lambert's Bay.

Afrocominella angusta (Sowerby III)

Cominella angusta Sow., J. of C., v, p. 4, Jan. 1886, and vi, pl. 1, fig. 8. Port Elizabeth and Port Alfred.

Afrocominella puncturata (Sowerby III)

Cominella puncturata Sow., J. of C., v, p. 2, Jan. 1886, vi, pl. 1, fig. 9. Common on the Cape coast.

Gen. GLYPTEUTHRIA Strebel, 1905

Glypteuthria capensis Tomlin

Ann. S.A. Mus., xxx, p. 165, fig. 6, 1932. Cape Point, N. 41° E., 38 miles, 318–400 fathoms.

Glypteuthria solidissima Tomlin

Ibid., p. 166, fig. 7. Cape Point, 11 miles, 45 fathoms.

7. *Further Notes on South African Marine Fishes.*

By K. H. Barnard, D.Sc., F.L.S., Assistant Director.

(With Plates IX–XIII and 17 Text-figures.)

This paper contains notes on the material which has been received at the South African Museum since the publication of my last paper (Ann. S. Afr. Mus., xxxii, 1937). Interim notes and photographs of some of the recent acquisitions have appeared in the Museum Reports for 1937, 1938, 1939 (published respectively 1938–1940).

Several donors have contributed the specimens on which these notes are based. The Museum is greatly indebted to the firm of Messrs. Irvin & Johnson, Cape Town. The skippers and crews of the trawlers of this firm have kept a sharp look-out for rare and unusual fishes; in particular the names of Captains Gibson, McGill, and Pace should be mentioned with gratitude. Thanks are also due to the National Trawling and Fishing Co. Ltd., Cape Town, one of whose trawlers obtained the remarkable new Hand-brush Fish (*Ateleopid*).

The literature published on South African Marine Fishes since 1936 need not be specified here, but one paper was omitted in the list given in my 1937 paper: 1930. Pauca. Ann. Nat. Hist. Mus. Wien, xliv, pp. 33–37 (Walfish Bay records). Also, the reference to Smith's paper on the *Aluteridae* should *follow* the reference to his paper in Rec. Alb. Mus., iv.

In Mr. J. R. Norman's paper on the John Murray Expedition Fishes (John Murray Exp. Rep., vii, 1939) there are records which extend the distribution of several fishes of the South African fauna-list up the east coast of Africa to Zanzibar and the Arabian Sea region.

I wish to express my thanks to Mr. Norman of the British Museum for lending me pamphlets (unobtainable here) from his personal library, and giving me his opinion on several matters concerning morphology and synonymy.

Observations on the oesophageal sacs and teeth of Stromateids, and finally, some notes on hyperostosis of the supra-occipital bone are here given.

Family BRANCHIOSTOMIDAE.

Branchiostoma capense Gilch.

1884. Report S. African Museum for 1883, p. 8 ("*Amphioxus lanceolatus*").

1925. Barnard. Ann. S. Afr. Mus., xxi, p. 12.

The first record of an *Amphioxus* from South Africa is that contained in the above Report. The specimen was dredged in 40 fathoms in Simons Bay (False Bay) by Mr. H. W. Oakley, Assistant Curator, and was identified at the time as the European species.

It was mentioned by Gilchrist, 1902, p. 112, together with the other specimens on which *capense* was founded. Unfortunately Oakley's historic specimen was not returned to the Museum.

Family SCYLLIORHINIDAE.

Scylliorhinus africanus (Gmel.).

1925. Barnard, Ann. S. Afr. Mus., xxi, p. 39.

1939. *Id.*, Rep. S. Afr. Mus. for 1938, p. 12 (albino).

An albino specimen, 450 mm. in length, was caught at Kalk Bay (False Bay) in November 1938 and presented to the Museum by Mr. Fleck.

It was uniform creamy-white all over; the extremities of the fins, especially the caudal, were pinkish, but this may have been due to extravasation of blood after capture. The colour of the iris was cream; the pupil was colourless when the specimen was brought to the Museum, but may have been emerald green in life, like that of *Squalus acanthias*. After preservation in alcohol an extremely faint indication of one of the normal dark lateral stripes appeared.

Family ISURIDAE.

Gen. Isurus Raf.

Isurus bideni Phillips.

Blue Porpoise Shark.

1925. Barnard, *l.c.*, p. 33 (*Isurus glauca*, non M. and H.).

1931. Whitley, Rec. Austral. Mus., xviii, p. 140, pl. 20, figs. 1, 2 (*Isuropsis* sp.).

1932. Phillips, W. J., New Zeal. J. Sci. Techn., xiii, p. 227, fig. 2.

1941. Fowler, Bull. U.S. Nat. Mus., no. 100, vol. 13, p. 104.

The South African form of Porbeagle has been described as a distinct species with the above name, after Mr. C. L. Biden. Whether it is distinguished by really constant characters from *Isurus glaucus*, and other species, remains to be tested on a large series of specimens of all sizes.

In Fowler's key, *bideni* is said to have the anal base wholly behind 2nd dorsal fin, in contrast with *glaucus* which has it partly beneath the 2nd dorsal. Two specimens are in the South African Museum: one is a ♂ and corresponds with *glaucus*, the other is a ♀ and corresponds with *bideni*.

Family GONORHYNCHIDAE.

Gonorhynchus gonorhynchus (Linn.).

1766. Linnaeus, Syst. Nat., ed. 12, i, p. 528.

1925. Barnard, Ann. S. Afr. Mus., xxi, p. 125, pl. 6, fig. 4.

1931. Chabanaud, Bull. Soc. geol. Fr., (5), i, pp. 497 sqq. (figs. scale, skeleton, chart of distribution of recent species).

1937. Barnard, Ann. S. Afr. Mus., xxxii, p. 46 (*gronovii*).

At the time of my last note I had not actually seen Chabanaud's paper. Linnaeus' name is accepted: *gronovii* C. and V., 1846, and *brevis* Kner, 1867, being synonyms.

The distribution is from Port Nolloth to Natal, and the islands of Bourbon and St. Paul (southern Indian Ocean).

All the species of the genus are very closely allied and are separated on slight differences in the position of the dorsal fin (see Ogilby, Ann. Queensland Mus., x. pp. 30 sqq.).

Family ARGENTINIDAE.

Gen. Nansenia Jord. and Everm.

1896. Jordan and Evermann, Bull. U.S. Nat. Mus., xlvii, p. 528.

1922. Gilchrist, Rep. Fish. Mar. Biol. Surv., Rep. 2, Spec. Rep. 3, p. 53 (*Bathymacrops*).

1939. Norman, Rep. John Murray Exp., vii., p. 16.

The genus is provisionally placed in the *Argentinidae* by Norman.

Nansenia groenlandica (Reinhdt.).

1922. Gilchrist, *l.c.*, p. 53, pl. 9, fig. 2 (*B. macrolepis*).

1925. Barnard, Ann. S. Afr. Mus., xxi, p. 129, pl. 7, fig. 3 (*B. macrolepis*).

1939. Norman, *l.c.*, p. 16, fig. 4 (synonyms).
Distribution.—N. Atlantic, near Zanzibar, Maldives.

Family STOMIATIDAE.

1925. Barnard, Ann. S. Afr. Mus., xxi, p. 131.
1930. Regan and Trewavas, Rep. "Dana" Exp., No. 6, p. 53.

The remarkable fish described below was brought up in the trawl about 40 miles W.N.W. of Cape Town from 220 fathoms, September 1937. The skipper of the trawler, Capt. J. T. R. Gibson, who has on several previous occasions brought interesting fish to the Museum, reported that the fish was alive when the trawl came on board, with its head bent downwards almost at right angles to the body. It was photographed in this position ("Cape Times," 16/10/1937). Before placing the fish in alcohol, however, Mr. Drury, of the Museum, found that the flesh of the ventral surface was pulled forwards and hooked over one of the teeth of the lower jaw; he unhooked it and more or less straightened out the head.

I did not see this fish until after preservation. I found then that the head could be eased into the normal position, and that the skin of the chest formed an angular projection below the pectoral fins. On the right side there was a fold of skin into which the opercle would fit when the head was bent down; on the left side there were only a few creases in the flesh. Fig. 1, *a*, shows the fish with head straightened out and the ventral flap extended.

In July 1939 a larger and nearly perfect specimen was captured by Capt. Pace, skipper of one of the same Company's (Irvin & Johnson) trawlers, in approximately the same locality.

This specimen shows that the peculiar convex profile of the upper surface of the head in the first specimen is abnormal; and that the size of the eye in proportion to the head is probably also abnormal. In the second specimen the dentition is asymmetrical.

Gen. Opostomias Gnthr.

1887. Günther, "Challenger" Rep., vol. xxii, p. 208.
1930. Regan and Trewavas, *l.c.*, p. 55.
1941. Imai, Jap. J. Zool., ix, p. 239.

Although there are slight differences in the numbers of dorsal, anal, and pectoral rays, these two specimens are very close to the Australian *micripnus*, the only species included in this genus. Günther stated that maxillary teeth were absent, but Regan and Trewavas say "maxillary teeth minute, not piercing skin." The present specimens are in agreement with Günther's statement.

A more important feature is the presence (in both specimens) of the post-temporal bone (fig. 2, *a*, *c*), in consequence of which the present specimens cannot be fitted into any of the genera in the key given by Regan and Trewavas (*l.c.*, p. 53). Possibly the post-temporal was overlooked in the type specimen of *Opostomias*; if not, too much taxonomic importance appears to have been attached to the presence or absence of this bone. The Australian and South African species are so much alike that two separate genera are unnecessary.

Opostomias gibsonpacei n.sp.

Figs. 1, 2.

Description of first specimen (Capt. Gibson's).

Parietal and post-temporal bones present (figs. 1, *e*; 2, *a*, *c*). Depth

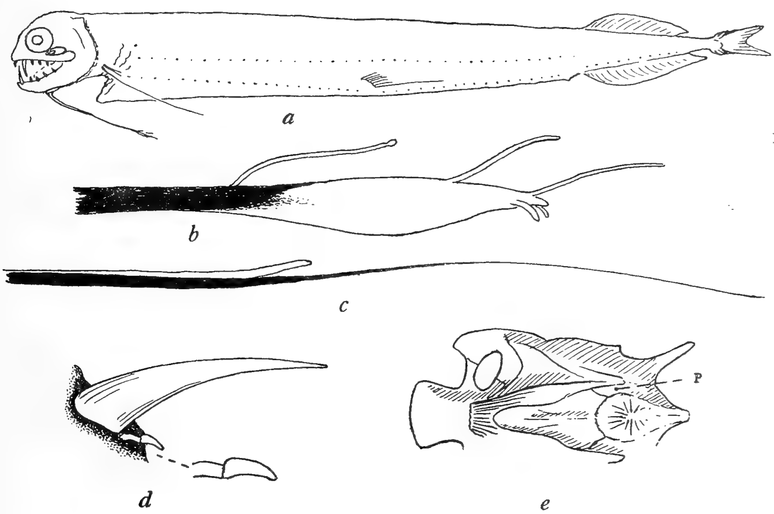


Fig. 1.—*Opostomias gibsonpacei* n.sp. *a*, first specimen, lateral series of photophores diagrammatic, not the exact number. *b*, end of barbel. *c*, end of pectoral ray. *d*, tooth with its denticle. *e*, dorsal view of centre and right side of skull, *p* = parietal bone.

(at ventral fins) 8, length of head (to symphysis of lower jaw, which does not extend beyond tip of snout) 9 in length (excl. caudal fin). Eye 3 in length of head, $1\frac{1}{4}$ in interorbital width. Pupil round, about $\frac{1}{2}$ eye diameter. Snout $1\frac{1}{3}$ in eye, $4\frac{1}{2}$ in head. Thickness of body (at ventral fin) about 3 in depth.

All teeth simple, not apically bifid or barbed; 5 in each jaw, the 2nd upper and 1st lower fang-like, the latter perforating the premaxillae when mouth closed; all fixed except the 2nd in lower jaw, which is depressible; a small denticle, consisting of a soft base with enamel tip and with dermal attachment only, on the inside of each tooth (fig. 1, *d*); a pair of vomerine teeth, the left one depressible, the right fixed; no palatine or lingual teeth.

Symphysis of lower jaw knob-like. Gill-rakers short, spiniform, mostly in pairs, 2 on upper + 8 on lower portion of anterior arch (each pair counted as one raker). Branchiostegal rays 10 (? 11).

Barbel $1\frac{2}{3}$ as long as head (about 58 mm.), black, ending in a slight expansion, which is white, 3 white filaments of fair length and 2 short subapical ones (fig. 1, *b*).

Dorsal and anal arising opposite one another; D 23, 1st ray very short and more or less concealed in skin (last ray double but counted as one). A 26 (the last ray single). C 17, with 3–4 short curved basal rays on upper and lower margins. V 7, midway between tip of snout and base of caudal fin, lateral, but not high up, the outermost ray very slender, filamentous, the other rays broken. P 1 + 5, the lowermost ray about 50 mm. in length, separate, black, with a white margin at about 30–32 mm., which ends freely as a short digitiform process, beyond this the ray continues (about 18 mm.) as an exceedingly fine filament (fig. 1, *c*); the 5 short rays so close together as to appear like only 2 or 3, until dissected out. Lateral surfaces of dorsal, anal, caudal, and ventral fins with minute scabrosities.

Post-ocular luminous organ rather large, longitudinally oval. Lateral photophores present but impossible to count; ventral series: 4 symphysial, 13 branchiostegal, 7 below right pectoral fin as far as the fold of skin (skin on left side injured), 20 to ventral fin, 17 from ventrals to vent, 10–11 long base of anal.

Total length 355 mm. Dark blackish-brown, skin when closely examined, with minute black dots arranged more or less in vertical lines, photophores whitish, those on the branchiostegal membranes amethystine. Innumerable minute white dots which may be photophores (*cf.* Günther, p. 209).

Description of second specimen (Capt. Pace's). Agrees with the first specimen in the presence of parietal and post-temporal bones, and in other features except as follows.

Depth (at ventral fins) $6\frac{1}{5}$, length of head (to symphysis of lower jaw, which projects beyond tip of snout) 8 in length (excl. caudal fin). Eye $5\frac{1}{2}$ in length of head (to tip of snout), $1\frac{1}{3}$ in snout, 2 in interorbital width. Snout 4 in length of head (to tip of snout). Thickness (at ventral fins) $2\frac{3}{4}$ in depth. Pupil round, approximately $\frac{1}{2}$ eye diameter.

Dentition similar to first specimen except: in lower jaw 2 large fangs on left side, none on right, the socket being covered over with skin (fig. 2, *b*); the peculiar denticles on dermal pedicels are absent,

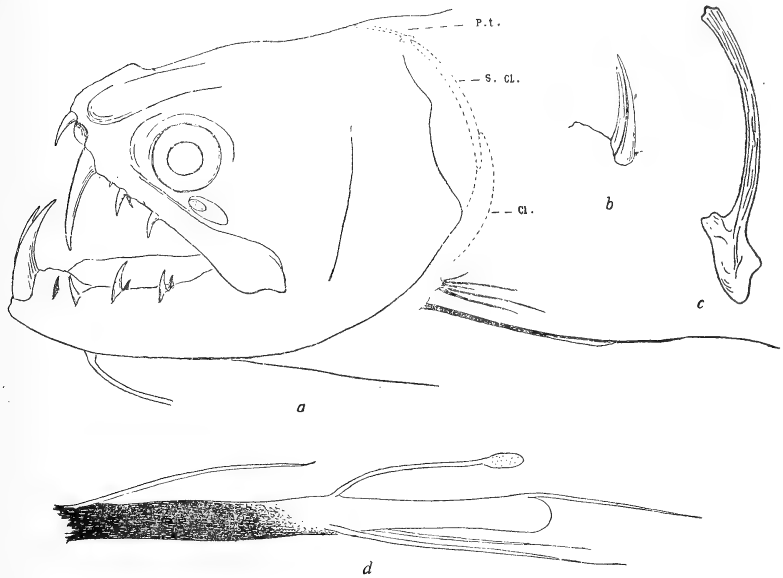


FIG. 2.—*Opostomias gibsonpacei* n.sp. *a*, head of second specimen, with shoulder girdle indicated. *b*, front view of 1st lower left tooth. *c*, post-temporal bone. *d*, end of barbel.

there is a depressible tooth behind the 4th and the 5th teeth in lower jaw on left side (fig. 2, *a*), on right side 2 depressible teeth (between which the upper fang closes), then 4 fixed teeth, the 2nd of which is the largest, corresponding with the normal 4th tooth on left side, and the hindmost 2 adnate at their bases; teeth in upper jaw symmetrical, the 3rd tooth is the smallest, more or less concealed in skin, and close in front of the 4th, behind the latter a depressible tooth; left tooth on vomer fixed, the right depressible.

Barbel about $1\frac{2}{3}$ as long as head (about 90 mm.), with 3 filaments above, the middle one with a pinkish knob at end, and 2 elongate subapical filaments below (fig. 2, *d*).

D 23, 6th or 7th ray longest, about equal to post-ocular part of head. A 25, 7th or 8th ray longest, slightly longer than longest dorsal rays, last ray arising at level posterior to origin of last dorsal ray. C 19, with 4 or 5 curved rays on upper and lower basal margins; lower lobe stronger than upper. V 7, length about 46 mm., 1st ray slender but not longer than the others. P 1+5, the lowermost (isolated) ray about 47 mm. in length, the white margin not ending in a free projection (fig. 2, *a*).

Post- (or sub-) ocular luminous organ oval, whitish, with a red spot in it anteriorly. Lateral photophores not counted; ventral series approximately as in first specimen.

Total length 515 mm. Colour as in first specimen; but all lateral and ventral photophores amethystine. Ventrals grey, all rays pale, membrane between 3rd and 7th rays black in its distal $\frac{2}{3}$ (as in *micripnus*).

Remarks.—It would not be surprising if a re-examination of the types of *micripnus* showed that a few of the dorsal, anal, or pectoral rays were overlooked in the original description (Günther: D 21, A 23, P 1+3). Günther counted 15 branchiostegals; I cannot find more than 11 in either of my specimens. Perhaps the most noticeable difference in the descriptions is the shape of the pupil, which Günther said was vertical; the figure shows it vertically oval, and proportionately much smaller than the round pupil of the present specimens.

There appears also to be a great similarity in the skin of the Australian and South African specimens, with its vertical lines of dark dots, faint pale nebulous banding, and the innumerable scattered minute dots which may be luminous (*cf.* Günther, p. 209).

Although this fish appears to be normally of compressed shape, the first specimen was certainly in an emaciated condition. The gonads were in an early stage of development, too early for sexing. The second specimen was in good condition, and the whole of the body cavity was filled up with the two ovaries, containing an enormous number of eggs, apparently nearly ripe.

In both specimens the stomach and intestine were completely empty. The structure is as described by Regan and Trewavas (*l.c.*, p. 37) for Stomiatids in general. The caecal stomach is very long, extending almost to the vent, black with whitish vascular network on its surface; in the smaller specimen there are two subsidiary diverticula on the stomach. The connection between stomach and intestine is very similar to that of *Idiacanthus* (Regan and Trewavas, *l.c.*, fig. 8, E), with two well-developed pyloric caeca.

Family MYCTOPHIDAE.

The expectation (Ann. S. Afr. Mus., xxi, p. 1021, 1927) that *Lampadena* would eventually be found in South African waters has at last been fulfilled.

Lampadena chavesi Collett.

1905. Collett, Zool. Anz., xxviii, p. 728.

1906. Brauer, Wiss. Erg. D. Tiefsee Exp., xv, p. 210, fig. 129.

1911. Zugmayer, Res. Sci. Camp. Monaco, fasc. 35, p. 29.

1914. Pappenheim, D. Südpol. Exp., xv, p. 194.

1916. Regan, Brit. Antarct. ("Terra Nova") Exp., i, p. 140, pl. 6, fig. 8 (post larva).

1928. Taning, Vid. Medd. Dansk. Naturf. For., lxxxvi.

1928. Parr, Bull. Bingham Ocean. Coll., iii, 3, p. 149.

1936. Fowler, Bull. Amer. Mus. Nat. Hist., lxx, 1, p. 399, fig. 198 (after Brauer).

A fine specimen of this species was caught in December 1943 by one of Irvin & Johnson's trawlers (Skipper Warren) in about 200 fathoms on the Stock-fish grounds N.W. of Table Bay. At the same time a specimen of *Echiostoma tanneri* (Barnard, Ann. S. Afr. Mus., xxxii, p. 48, 1937) was taken from the stomach of a stock-fish.

The present specimen is considerably larger than any of those previously recorded, but appears to agree in all respects with the specific diagnosis given by Parr.

Brauer redescribed Collett's example, which was 70 mm. in length.

Length.—155 mm. (to end of middle caudal rays).

Distribution.—Azores (Collett); off Moroccan coast, 3660 m. (Zugmayer); west of Cape Verde Islands, 3000 m. (Pappenheim).

Family ATELEOPODIDAE.

1925. Barnard, Ann. S. Afr. Mus., xxi, p. 250 (*Ateleopidae*).

1929. Roule, Bull. Inst. ocean. Monaco, no. 546, p. 13.

1935. Rivero, Mem. Soc. Cubana Hist. Nat., ix, p. 91 (p. 1 in reprint).*

The family diagnosis as given in 1925 has to be slightly altered. Body more or less elongate. Mouth more or less inferior, protractile, small or large. Teeth present or absent; when present, small, villiform, in bands in upper or in both jaws. Pupil not always very

* My thanks are due to Mr. Norman for lending me his personal copy of Rivero's paper.

small. Perforated scales present on inner wall of the lateral mucus canal which lies below the surface of the skin. Ventral fins jugular or thoracic; each consisting of a more or less elongate anterior ray, followed by 2 or 3 rudimentary or well-developed rays, and also in one genus by a well-developed membrane-bearing fin. Vent and genital opening separate or opening into a common cloaca. No pseudobranchiae.

Rivero found a difference in the pelvic arch between *Ateleopus* and *Parateleopus* on the one hand, and *Ijimaia* on the other hand. The former (*Ateleopinae*) have two foramina and two feeble ossifications; the latter (*Ijimaiinae*) has only a single median foramen and no ossifications.

To these three genera is now added a fourth, remarkable for several features, which might quite reasonably be made the type of a third subfamily. The well-developed ventral fin and the short tail seem to indicate a lesser degree of specialization, whereas the scales in the lateral mucus canal are more highly specialized.

In the South African Museum the name "Handbrush Fish" has been adopted for these fishes, the body being likened to the handle, and the tail with its long anal fin to the brush.

Key to the Genera (adapted from Rivero).

1. Pelvic arch wide, with 2 foramina and 2 ossifications. Head as long as trunk. Ventral ray elongate (no proper fin).
   - *a.* 8–10 dorsal rays . . . . *Ateleopus*
   - *b.* 3 dorsal rays . . . . *Parateleopus.*
2. Pelvic arch narrow, with one median foramen and no ossifications. Head approximately equal to or shorter than trunk.
   - *a.* Ventral ray short, followed by 3 rudimentary rays (no proper fin). Dorsal rays 9–10 . . . . . *Ljimaia.*
   - *b.* Ventral consisting of 3 separate rays and a proper fin. Dorsal rays 12 . . . . *Melanogloea.*

Gen. Ateleopus Schlegel.

Ateleopus natalensis Regan.

Fig. 3.

1925. Barnard, *l.c.*, p. 251.

1935. Rivero, *l.c.*, p. 7 (in reprint).

1939. Norman, John Murray Exp. Rep., vii, p. 31.

Rivero expresses the opinion that this is probably a synonym of *japonicus* Blkr.; Norman is inclined to agree, but points out certain differences.

Where the skin is not abraded, the course of the lateral mucus canal can be traced by a series of shallow depressions. As in the case of *Ijimaia* (*infra*) these depressions do not communicate with the canal. On cutting open the canal, perforated scales at intervals are seen lying on the internal (body side) wall of the canal. These scales are broadly oval, with lines of growth, but without any little projection on the internal surface near the foramen.

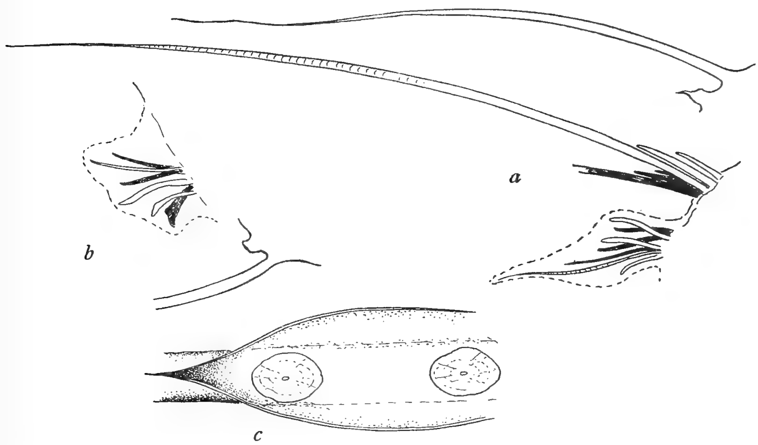


FIG. 3.—*Ateleopus natalensis* Regan. Ventral fins: *a*, left fin, slightly enlarged, prior to dissection, and further enlarged showing the components separated after dissection; *b*, right fin of same individual, showing variation. *c*, portion of lateral mucus canal cut open to show perforated scales on inner wall.

Each ventral fin consists of one long ray, segmented distally, and a separate small skinny projection behind it. When dissected the long ray is found to consist of 2 short spines and a long segmented ray, each one paired. In the enlarged figure (3, *a*) these 6 components are drawn separated. The cutaneous membrane enclosing the whole "ray" extends as an unsupported filament well beyond the end of the segmented ray. The rudimentary detached portion also consists of paired elements, but not so closely bound together as in the long "ray." There are 3 pairs of spines (sometimes an extra single one), and the hindmost pair, or one of its halves, may be segmented. This rudimentary fin varies in different individuals, and even on the two sides of the same individual, as shown in fig. 3, *a*, *b*.

The stomach contents of specimens in the South African Museum consist of Crustacea, both Macrura and Brachyura, but none of the fragments is specifically identifiable.

Distribution.—Off Zanzibar, 640–658 metres (John Murray Exp.).

An interesting juvenile specimen, presented to the South African Museum by Dr. Roux (Vitamin Oils Ltd., Cape Town), was caught during daylight in a surface tow-net about 40 miles N.W. of Table Bay.

Total length 223 mm., depth just in front of dorsal fin 15 mm., at vent 14 mm., and midway between these two points 18 mm. D 10. P 13. A 108 or 109. C 9 (A + C *ca.* 118). Gill-rakers on first arch 8, lower ones not well developed. Eye $2\frac{1}{2}$ in snout, 7 in length of head, 3 in interorbital width. Top of head flat, in side view the eye almost touching dorsal profile. Dorsal and pectoral fins subequal, about $1\frac{1}{4}$ as long as head. Ventral fin consisting of 3 long simple rays a trifle longer than length of head, and 2 short rays. Pelvic arch with the posterior projections distally expanded, but not as strongly as in adult; the presence of foramina (one or two) not determined with certainty owing to the extreme tenuity of the arch in the centre line. From the vertical of the fore part of dorsal fin a fleshy midventral ridge extends to the vent. A few indications of the formation of scales on the inner wall of the lateral mucus canal were visible, but no actually formed scales could be isolated.

The whole body, pale, semi-transparent (similar to a *Leptocephalus* after preservation), the hind end of the gut near vent greyish showing through the skin; upper part of eyeball blackish, the rest pale, pupil black; front margin and tip of dorsal grey, front margin and tip of pectoral black, anal with a narrow black margin.

This specimen is referable certainly to the genus *Ateleopus*, and possibly to *natalensis*, though *natalensis* has not been found outside the Natal area, and no species of this genus is known from either the north or the south Atlantic.

Gen. Ijimaia Sauter.

1905. Sauter, Annot. Zool. Japon, v, p. 235.
1929. Roule, *l.c.*, p. 13.
1935. Rivero, *l.c.*, p. 7 (in reprint).

The external differential features of this genus are the head shorter than trunk, and the short ventral ray, followed by 3 rudimentary rays.

Ijimaia loppei Roule.

Fig. 4.

1929. Roule, *l.c.*, p. 14, text-fig.
1935. Rivero, *l.c.*, p. 8 (in reprint).

Owing to the flabbiness of the whole fish and the soft and gelatinous

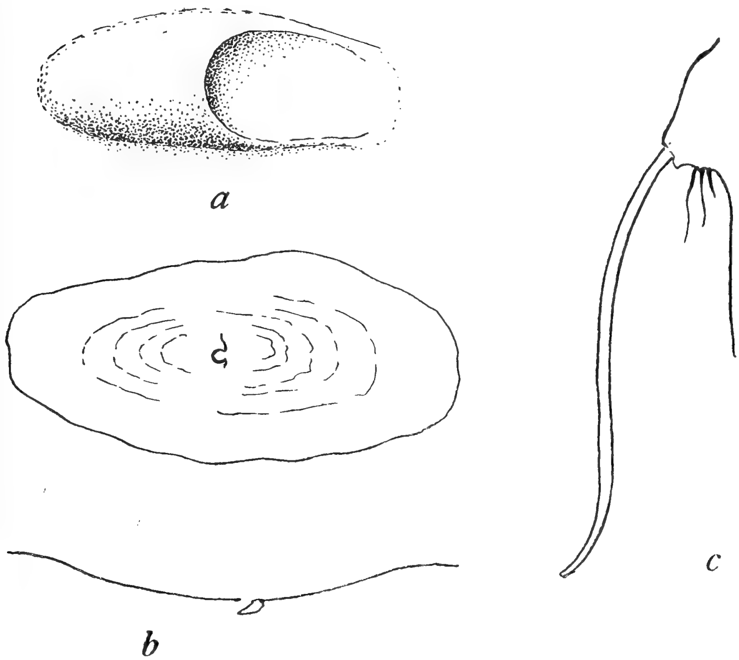


Fig. 4.—*Ijimaia loppei* Roule. *a*, external view of slipper-like pocket in skin over lateral mucus canal. *b*, scale from lateral mucus canal with longitudinal section (in *a*. and *b*. anterior end to left). *c*, ventral fin.

nature of the snout, the usual "exact" measurements cannot be given.

Skin gelatinous and naked; a moderate number of scales embedded in the lateral mucus canal. Vent very prominent. From about the vertical from the vent there is a low mid-dorsal fleshy ridge extending to base of caudal fin (*cf*. Sauter's figure of *I. dofleini*, 1905).

Head shorter than trunk; head plus trunk $\frac{1}{3}$ length from snout to base of caudal rays. A conical knob behind eye, its tip projecting through the skin (? due to abrasion in trawl). Eye 7–8 in post-ocular part of head; 2 in distance from anterior margin of eye to anterior nostril. Distance from eye to anterior nostril $3\frac{1}{2}$ in post-ocular part of head. Pupil round.

Upper jaw with short band of villiform teeth. Gill-rakers 10 on 1st arch, the lowest one feeble. Branchiostegals 7. Gill membranes free from isthmus.

D 10. P 14. V 1+3. A 79. C 11 (A+C 90). Distance between verticals from base of 1st dorsal ray and end of opercle $2\frac{1}{2}$ in post-ocular part of head. Height of dorsal approximately equal to the longest pectoral rays, and also to distance from anterior nostril to end of opercle; length of base of dorsal $2\frac{1}{2}$ in height of dorsal, 2 in post-ocular part of head. The spine of the ventral fin is about 30 mm. long, stiff, somewhat sinuous, apically acute; the 3 rudimentary rays are 5–7 mm. long, very slender and inconspicuous (fig. 4, *c*).

Lateral line not so near dorsal profile as in Roule's figure: it lies approximately midway between base of dorsal and upper base of pectoral. In the anterior two-thirds the lateral line has at intervals a series of scales, 38–40 in number, which were not visible before the specimen was skinned and mounted. During the process of skinning, Mr. Drury, the taxidermist, found little hard lumps in the skin in the position of the lateral line. After mounting, these scales showed clearly in the dried skin, especially anteriorly above the pectoral fin. They appear externally as slipper-like depressions (fig. 4, *a*); but apparently the opening of the "slipper" is a blind pocket, as no tube could be traced leading to the internal mucus canal, although one would expect some such connection. When cleaned the scales are boat-shaped, concave externally, with a tiny foramen at the bottom of the concavity. On the internal surface there is a small cup or spoon-like projection posterior to the foramen (fig. 4, *b*). No other scales, embedded or superficial, were found either on the tail or the belly (contrast *I. dofleini* Sauter, 1905, though Roule, *l.c.*, p. 15, queries their presence). It is probable that the lateral line scales would be found in Roule's specimens if the mucus canal were dissected out.

Ovaries well developed, but ova not ripe. Genital duct and vent opening into a common cloaca.

Lengths (approximate): snout to base of caudal rays 1025 mm., snout to beginning of anal fin 370 mm., beginning of anal fin to base of caudal rays 655 mm.

Dark brown, very slightly lighter on belly, the dorsal fleshy ridge blackish, dorsal and pectoral fins black, anal and caudal blackish brown. Lining of mouth dark, fold of skin at angle of mouth pale.

Tip of knob behind eye and the spines of ventral fins pale; rays of ventral fins black. Pupil black, iris greyish brown.

Locality.—Off Slangkop Lighthouse (west coast of Cape Peninsula, north of Cape Point), 200 fathoms. Capt. Gibson, June 1939.

Distribution.—Off Agadir, Morocco, 350–400 metres. Two specimens 1845 and 1990 mm. (the latter incomplete).

Remarks.—The specimen seems so like Roule's species (total number of anal plus caudal rays exactly the same) that it may be regarded as conspecific. So few specimens of Ateleopids are known, and their consistency so flabby, that specific characters are hard to find.

Unfortunately the pelvic arch of the specimen was cut up and destroyed in the course of mounting the specimen.

Like the two Moroccan specimens, this specimen is a female. The sex of Sauter's Japanese specimen is not given. Both Rivero's specimens (*I. antillarum*, W. Indies, and *fowleri*, Japan) were females, measuring respectively 1636 mm. and 1534 mm. It may sound a fantastic suggestion, but is it possible that *Ijimaia* is the female of *Ateleopus*? The five specimens of *A. natalensis* in the South African Museum, 350–480 mm., are immature, but so far as they can be sexed appear to be males.

The contents of the stomach and intestines of the present specimen consisted of a large quantity of fragments of the Brittle-star *Ophiura trimeni* Bell (cf. *Ateleopus plicatellus* Gilbert, 1905, Bull. U.S. Fish. Comm. for 1903, pt. 2, p. 654). Together with these fragments were fish-scales belonging apparently to *Photichthys argenteus.* I have compared them with the scales from a *Photichthys* 8 inches in length, and they agree exactly both in size and characteristics. A slim fish such as a *Photichthys* of this size could be just conveniently taken into the mouth by the *Ijimaia.* Sauter (*l.c.*, p. 238) doubts whether the practically toothless mouth could catch or hold quickly moving prey. In the present case there is no means of knowing whether the *Photichthys* was caught alive, or whether the *Ijimaia* was merely scavengering.

These scales have also been compared with those of *Merluccius*, to which they bear some resemblance. But even a fish 16 inches long has scales smaller than those from the *Ijimaia* intestines. So unless *Ijimaia* is a scavenger, the size excludes *Merluccius.*

Melanogloea Brnrd.

1941. Barnard, Ann. Rep. S. Afr. Mus. for 1940, p. 10.

Body not greatly elongate. Head about equal to trunk, tail shorter than head plus trunk. Skin, especially on head and trunk, very gelatinous. Mouth subinferior, very large. No teeth on either jaws, palate, or tongue. Branchiostegals 7. No pseudobranchiae. Dorsal rays 12. Pelvic arch narrow, raised into a median boss dorsally, concealing the foramen which opens posteriorly between the bases of the long curved posterior cornua; ventral fins thoracic, below the pectorals, each consisting of 3 separate rays and a well-developed membrane-bearing fin. Perforate scales in lateral mucus canal tubular in shape. Vent and genital opening separate.

Melanogloea ventralis Brnrd.

Fig. 5.

1941. Barnard, *l.c.*, p. 10, fig. on plate.

Length of head $3\frac{1}{2}$ in length of body, approximately equal to or a little shorter than trunk (depends on how much allowance is made for the gelatinous nature of the snout), and a little greater than depth of body. Eye (approx.) 3 times in snout, which is (approx.) $1\frac{3}{4}$ in post-ocular part of head. Pupil $\frac{1}{2}$ eye-diameter. Mouth very large, when pulled open vertically the gape is about 90 mm., when pulled open laterally about 130 mm. Lips fleshy. Maxilla extending back to below hind margin of eye. Gill-rakers 5 + 17 or 18 on anterior arch, the anterior one or two mere knobs.

D 12, all segmented rays, 3rd longest, the first 3 and the last one simple, the others once bifurcate. A 80. P 13. C 6.

V 1 + 1 + 1 + 7, 1st ray 100 mm. long, flattened basally and slightly grooved above and below, appearing as if composed of 2 rays, but really only a single ray, distally segmented, unbranched, supporting apically a fleshy, club-shaped flap of skin; 2nd ray 30 mm. long, simple, segmented, without fleshy apical enlargement; 3rd ray 75 mm. long, resembling the 1st ray; fin composed of 7 segmented rays, the first simple, the others once bifurcate.

Scales in the embedded lateral mucus canal traceable nearly to end of tail (where not abraded), boat-shaped, tubular. No scales elsewhere on body.

Vent large. Genital opening smaller, behind the latter and quite separate. No pyloric caeca. Gonads not fully developed, but apparently female.

No recognisable substances or fragments in stomach or intestine.

680 mm. Black, including the exposed parts of the lips, and a marginal border $\frac{1}{2}$–1 inch wide around the inner surface of the gill-cover; whole cavity of the mouth, and the concealed parts of the

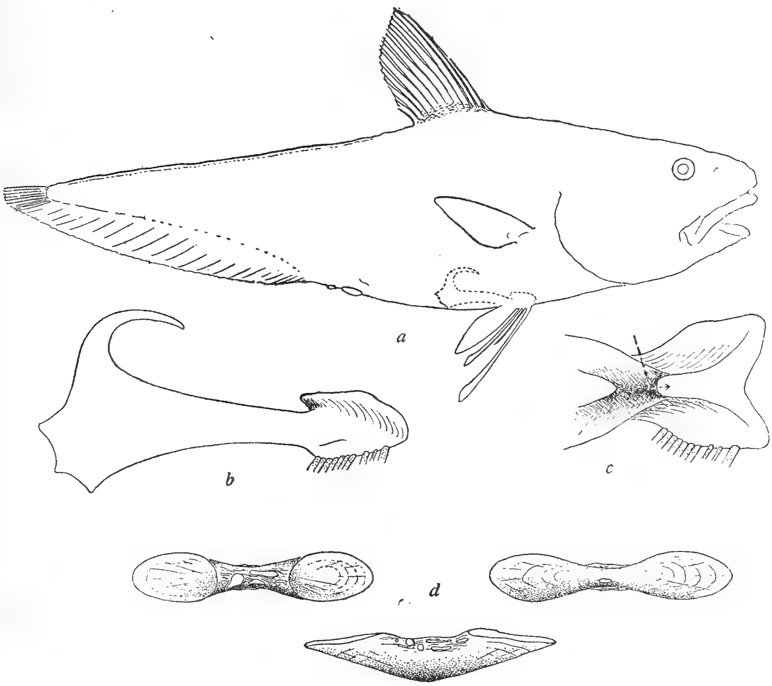


FIG. 5.—*Melanogloea ventralis* Brnrd. *a*, whole fish, with one of the posterior cornua of the pelvic arch dotted. *b*, lateral view of right side of pelvic arch. *c*, dorsal (internal) view of arch, posterior cornua not completely drawn, bases of ventral rays shown on one side, arrow indicating median foramen. *d*, external, internal, and side views of one of the tubular scales from the lateral mucus canal.

maxilla white; all fins black; the basal parts of the detached ventral rays greyish, but the fleshy apices of the 1st and 3rd rays jet black; iris dark greyish, pupil transparent.

Locality.—On the Stock-fish grounds north-west of Table Bay and west of Saldanha Bay, 300 fathoms.

Remarks.—This very interesting specimen was caught early in August 1940 by one of the trawlers belonging to the National Trawling and Fishing Co. Ltd., Cape Town. It was in very good condition, except that the head was somewhat abraded and the eyeballs rather loose in their sockets. The head and body were extraordinarily gelatinous. This was greatly reduced, however, by preservation in alcohol.

Whereas in *Ateleopus* the scales in the lateral mucus canal are broadly oval in shape, and in *Ijimaia* elongate oval (with a small remnant of the tubular portion found in normal external lateral line scales), in *Melanogloea* these scales have become boat-shaped and the lateral margins curled over until they meet and fuse. The whole scale thus becomes a more or less complete tube. The fusion of the margins is not perfect, as several little gaps, variable in number, shape, and size, remain. As increase in the size of the scale is not possible at this fused area, the lines of accretion are seen crowded together between and around these gaps, and sometimes partly obliterating them.

Family MACRORHAMPHOSIDAE.

1925. Barnard, Ann. S. Afr. Mus., xxi, p. 275.

Gen. Centriscops Gill.

1914. Regan, Ann. Mag. Nat. Hist. (8), xiii, p. 20 (Jan. 1914).

Centriscops humerosus (Rich.).

Red and White banded Bellows-fish.

1911. Waite, Rec. Canterbury Mus., i, p. 170, pl. 26 (var. *obliquus*).
1914. Regan, *l.c.*, p. 21 (*humerosus* and *obliquus*).
1914. McCulloch, Biol. Res. "Endeavour," ii, p. 90 (synonymy) (July 1914).
1938. Barnard, Report S. Afr. Mus. for 1937, p. 12, plate (*obliquus*).

A specimen caught in the trawl (together with *Notopogon macrosolen*) W.N.W. of Table Bay, 270 fathoms, by Capt. Gibson (1937) agrees with Waite's figure.

Total length 230 mm. Tip of snout to anterior margin of eye 55 mm. Depth, from bony knob in front of ventral fins vertically to the dorsal profile, approx. 110 mm. Dorsal profile bristly from occiput almost to where the profile rises to the dorsal spine. Skin very rough to the touch. Eye equal to post-ocular part of head, and to its distance from lower profile of snout, but a little greater than the depth of the cheek. D vii, 16. A 19. C 12 (9 strong main rays).

McCulloch maintains that *obliquus* is the adult of *humerosus*, the difference in body-shape being accounted for by growth changes. All McCulloch's specimens were banded ("rose-pink" and "yellowish").

The present specimen, after preservation, has the same pink and yellowish banding; but when fresh the yellow bands were almost white. By a slip, in the above-quoted Museum Report the fish was described as "black-banded," the red bands showing black in the photograph.

Family TRACHYPTERIDAE.

Trachypterus arcticus (Brünn.).

Fig. 17 (see p. 406).

1925. Barnard, *l.c.*, p. 353, pl. 14, fig. 3.

On 8th August 1945 Capt. Gibson, skipper of one of Irvin & Johnson's trawlers, captured a very fine ovigerous female of this species. It arrived at the Museum very little damaged, and a cast was made for exhibition.

From base of caudal fin to front margin of eye the length was 2125 mm.; length of snout closed 100 mm.; total 2225 mm. (7 ft. 5 in.).

Snout fully protruded 210 mm. Diameter of eye 87 mm. Depth at pectoral fin 305 mm.; greatest depth (at 400 mm. behind eye) 320 mm.; at 1000 mm. behind eye, 210 mm.; at 1400 mm. behind eye, 85 mm.; at end of tail 10–12 mm.

D 176, rays smooth, no anterior dorsal crest. P 9, 1st ray stronger than the others, longest ray 75–80 mm. C 8, rays about 130 mm. in length. Ventral fins obsolete.

Eggs 3–3·5 mm. in diameter.

Dark spots or blotches (two) scarcely visible.

If the position of the greatest depth of the body is to be regarded as a differential character between *arcticus* and *iris*, the specific identity of the present specimen seems a little doubtful. The greatest depth is in fact posterior to the occipital region, but there is not a great difference between the measurements at the two positions.

Locality.—N.W. of Table Bay, 300 fathoms (Stock-fish grounds).

Regalecus glesne (Ascan.).

1925. Barnard, Ann. S. Afr. Mus., xxi, pp. 354 and 1025.

From perusal of the Museum Reports and old correspondence files the following additional records have come to light:

1876. Simonstown, reported to S. African Museum.

1879. Table Bay, S. African Museum Report for 1879. 8 ft. 6 in., tail mutilated.

1886. February/March. Knysna, reported to S. African Museum.

Since 1927 the following specimens have been reported to the South African Museum:—

1929 May. Kei River mouth.

1930 April. Kentani.

1930 April. Knysna.

1935 March. Gordon's Bay, False Bay.

1936 July. Port St. Johns.

1939 March. Kommetje, west coast of Cape Peninsula.

1939 October. Port St. Johns.

1941 February. Port St. Johns.

Together with those in the 1925 monograph the total is 23 records.

The 1879 specimen is no longer in existence, having probably been discarded when a better specimen came to hand in 1906.

Family MONOCENTRIDAE.

Monocentris japonicus (Hout.).

Fig. 6.

1914. Yoshizawa, Dobutsu-Gaku-Zashi, xxviii, p. 411, figs. (luminous organ).

1925. Barnard, Ann. S. Afr. Mus., xxi, p. 360, pl. 14, fig. 6.

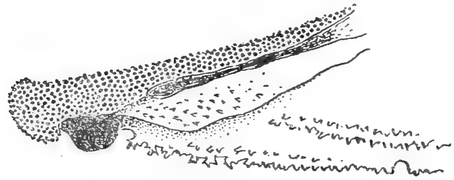


Fig. 6.—*Monocentris japonicus* (Hout.). External view of left ramus of lower jaw, showing luminous pad.

1926. Okada, Woods Hole Biol. Bull., 50, p. 365, figs. 1–7 (photogenic organ).

1928. Yasaki, J. Exp. Zool. Philad., 50, p. 495, pls. (luminescence).

In January 1939 Dr. Nanni, Curator of the East London Aquarium, wrote to me stating he had in his aquarium a Pine-cone Fish with a pair of luminous organs on its chin, and wanting to know whether his specimen could possibly be the Australian *Cleidopus*, in which luminous organs have been recorded. From diagrams of the essential differences between *Monocentris* and *Cleidopus* Dr. Nanni concluded that his fish was a *Monocentris*. In January the fish had been about four months in the aquarium; in March it died and was forwarded to the South African Museum. I can confirm the identification as *M. japonicus*.

The luminous organs consist of two pads, black in colour (as preserved), below the chin, one on either side of the symphysis, and are glandular in structure. According to Okada the light can be produced both by day and by night. It is spontaneous, though controlled to some extent by the fish; it can be evoked by agitating the water or by chemical stimuli.

Family DIRETMIDAE.

Diretmus argenteus Johnson.

1863. Johnson, Proc. Zool. Soc. Lond., p. 403, pl. 36, fig. 1.
1879. Campbell, Tr. New Zeal. Inst., xi, p. 298, fig. (*Discus aureus*).
1895. Goode and Bean, Ocean. Ichthyol., p. 211, fig. 234.
1939. Norman, John Murray Exp., vii, p. 54.
1944. Barnard and von Bonde, Ann. Mag. Nat. Hist., (11) xi, p. 237, fig. (references).

The last-mentioned paper gives a description and figure of the first-known adult of this species. It was caught in 170–200 fathoms off the west coast of the Cape Peninsula in December 1943. Total length 405 mm.

Family GRAMMICOLEPIDAE.

1937. Myers, Proc. U.S. Nat. Mus., lxxxiv, pp. 145–156.

From an examination of several specimens of *Grammicolepis* and *Xenolepidichthys*, and also the type specimen of *Vesposus*, Myers has shown that *Vesposus* is a synonym of *Grammicolepis*, and that the latter genus and *Xenolepidichthys* are closely allied but separable by certain characters which he sets out in tabular form.

Prionolepis J. L. B. Smith (1931, Rec. Albany Mus., iv, p. 145) (non Egerton 1850) has been withdrawn by Smith himself (1935, *ibid.*, p. 209) as not being *Grammicolepid* at all, but based on a post-larval stage of *Monoceros*.

Thus only two monotypic genera are now included in this peculiar family.

Myers has examined half-grown and "subadult" specimens of

G. brachiusculus Poey, 73–182 mm. (standard length, *i.e.* excl. caudal fin), and the 230 mm. type of *Vesposus egregius* Jordan, which seem to indicate that certain growth-changes occur.

The depth of the body relatively to length decreases with age, the high-arched lateral line becomes flattened into a low curve, and the end of the base of the dorsal fin moves forward relatively to that of the anal fin.

These three features are included in Myers' table as generic features separating *Grammicolepis* from *Xenolepidichthys*. He has, however, seen no specimens of the latter over 90 mm. (standard length), and seems to have assumed that the largest was fully grown; the figure of a 71 mm. specimen is labelled "subadult." No indication was given as to the degree of development of the gonads. In the largest specimen I have seen, 120 mm. total (=105 mm. standard), the gonads are in a very early stage of development. Three specimens in the British Museum, up to 110 mm. standard length, have been examined by Mr. J. R. Norman at my request. Mr. Norman finds that in all these the gonads are insufficiently well developed to enable the sex to be determined (*in litt.* 11/iv/39). It is true that Gilchrist in his original description (p. 74) mentioned a "mature ♀ of 116 mm."; but while one does not doubt that statement, it is unfortunate that the specimen is not available for confirmation.

Recently (March 1939), however, a specimen was received by the South African Museum which appeared as if it might be the real adult of *X. dalgleishi*. Its gonads are well enough developed to enable its sex to be determined with fair certainty as a ♂. And it exhibits exactly the three changes in external anatomy mentioned above as occurring during the growth of *Grammicolepis*. Since in other respects the specimen is a *Xenolepidichthys*, these three characters (nos. 8–10 in Myers' table) cannot be used to differentiate the two genera.

I am able to confirm Myer's statements that the pseudobranchiae are present, and that there are 7 branchiostegals.

The description of this remarkable specimen follows. As quite a fair number of specimens of *dalgleishi* were known or recorded from South African waters (Gilchrist, von Bonde, Barnard, Smith: see Myers, 1937, *l.c.*, p. 153),* all of a comparatively small size, and the largest not sexually mature, it seemed eminently reasonable to assume that the large sexually developed individual was merely the adult

* The distribution of *X. dalgleishi* is now known to extend to the Phillippine Is., Japan, and off the coast of British Honduras.

of the former, and not the representative of a distinct species. The description and the remarks were written before I had received Nichols and Firth's paper, and are left as written; with the addition of a comparison between the American and South African specimens of *americanus*.

Xenolepidichthys americanus Nichols and Firth.

Plate IX and text-fig. 7.

1939. Nichols and Firth, Proc. Biol. Soc. Wash., lii, p. 85, fig. 1.

1940. Barnard, Rep. S. Afr. Mus. for 1939, p. 11, plate.

Body ovate, greatest depth below 2nd–3rd dorsal spines, $1\frac{9}{10}$ in length (excl. caudal fin), length of head $4\frac{1}{5}$ in length of body. Eye $2\frac{1}{2}$ in length of head. Maxilla rugulose, reaching to midway between tip of snout and front margin of eye. Preopercle with double serrulate edge. Supra-orbital ridge with its upper surface (forming an elongate triangular area in dorsal view) spinulose. Interorbital ridges spinulose and denticulate [as in *dalgleishi*]. Papillose mucus pores between supra- and inter-orbital ridges, on median side of nostrils, on preorbital, a row in front of the scales on nape, 2 longitudinal rows on chin, each continued along lower margin of preopercle [as in *dalgleishi*]. 12–13 gill rakers on anterior arch (incl. one or two feeble ones) [in *dalgleishi* the number varies from 13 to 15, also incl. feeble ones at both ends of the series].

D vii, 32. 1st spine minute and hidden under skin in a pocket between the predorsal scales, 2nd spine not quite equal to eye, closely serrate on its front edge except the apical sixth, only 4–5 serrations in basal quarter on each postero-lateral edge; 3rd–7th spines thin, filiform, 3rd a trifle longer than 2nd, 4th shorter than 3rd, 5th a little longer than eye, 6th between 3rd and 4th in length but broken, 7th equal to 4th. The 5th and 7th taper to very fine tips, but the 6th is broken and the 3rd and 4th also may be incomplete. 1st articulated ray about $\frac{1}{2}$ eye, longest rays in posterior quarter, subequal to eye. 35 bony scutes along base of dorsal, all except the hinder 3 with a hooked spine, and additional spinules or serrations in front of the spine, more numerous on the anterior than on the posterior scutes. [*dalgleishi* for comparison: 1st spine minute but exposed, 2nd spine serrated for nearly its whole length (where tip not broken off) on all three edges, 3rd spine serrated at base on both postero-lateral edges, preserved in its entirety only in the smallest specimen (65 mm.

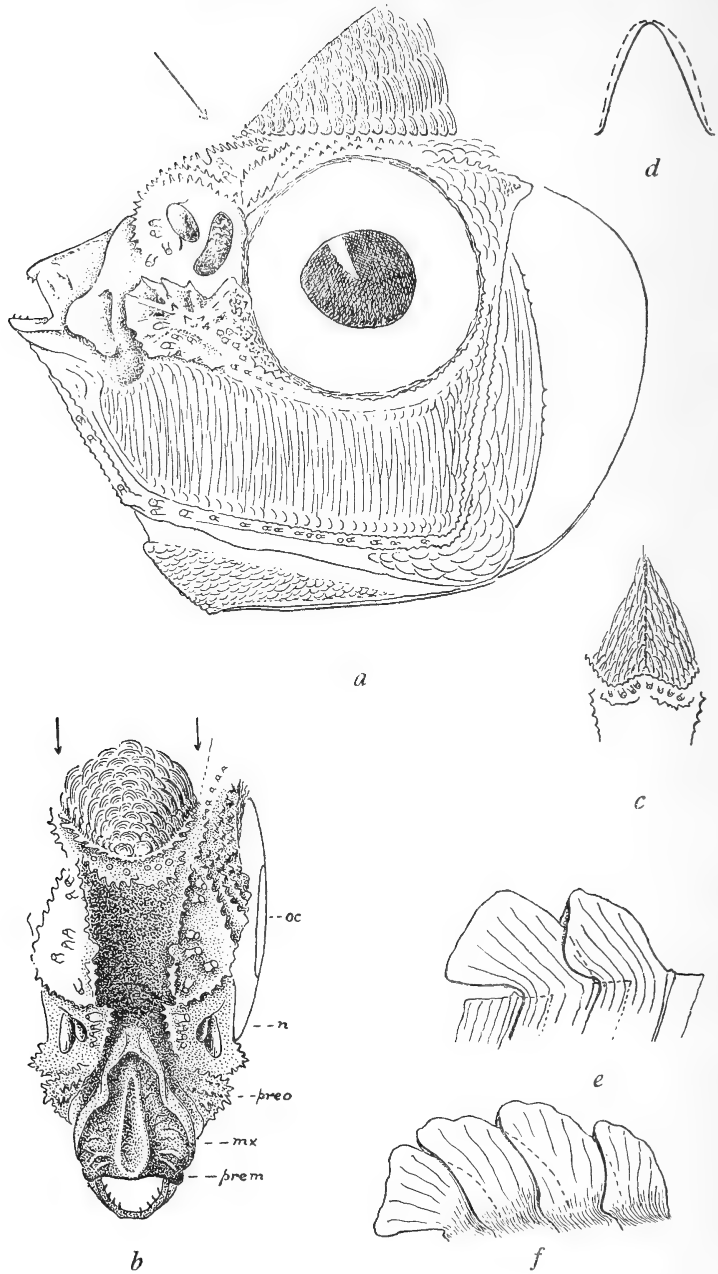


FIG. 7.—*Xenolepidichthys americanus* N. and F. *a*, head, arrow indicates view-point of *b*. *b*, dorsal view of head, width between arrows 14 mm. *c*, dorsal view of nape of *X. dalgleishi* Gilch. for comparison, showing different arrangement and shape of scales. *d*, diagrammatic cross-section of nape at vertical from centre of eye in *X. dalgleishi* (full line) and *americanus* (broken line). *e*, *f*, lateral projections of scales, *f*, from the caudal peduncle (anterior end to right).

total length) where it ends in a fine tip and is twice as long as eye. About 31 bony scutes along base of fin.]

A ii—33. 1st spine very long (Pl. IX), extending back to end of caudal peduncle, triquetral at base (about $\frac{1}{2}$ inch), then quadrangular for about half its length, then again triquetral, serrulate on all 3, resp. 4, edges, but mainly on the front edge (edges) for about half its length, the distal half smooth. 2nd spine $\frac{1}{3}$ eye, triquetral with one or two serrations at base only on each postero-lateral edge, connected by a low membrane (represented by the hyphen in the above formula) in the groove between the basal scutes to the 1st ray which is distant about $\frac{3}{4}$ eye diameter. 1st ray subequal to 2nd spine, longest rays in hinder quarter, subequal to eye, 36 scutes along base of fin, similar to those along dorsal fin. [*dalgleishi*: 1st spine triquetral at base, then more or less quadrangular, then triquetral at tip (where preserved), 2nd spine serrate on both postero-lateral edges, a gap between 2nd spine and first definitely articulated ray, containing 1 (sometimes 2) feeble non-articulated ray.]

A narrow naked groove in front of 1st anal spine extending to vent. [*dalgleishi*: a similar groove but the scales on the two sides of the belly usually meet for a short distance between it and the vent.]

V i. 6. Spine slightly longer than eye, serrated on front edge, 2nd ray $\frac{2}{3}$ length of head, a few spinules on basal portion of 1st–4th rays, on ventral and dorsal surfaces (chiefly dorsal). [*dalgleishi*: these spinules on the rays are inconspicuous.]

P 14, longest rays subequal to eye.

Caudal subtruncate, or rounded if fully expanded. 15 rays, the outermost one, dorsal and ventral, spiniform, subequal to eye and serrated on its outer edge; in addition there is a very short serrated spine dorsally and ventrally in front of the above-mentioned spines, *i.e.* there are 17 in all; longest rays subequal to length of head. [*dalgleishi*: 17 rays, the outermost dorsally and ventrally short but relatively longer than the very short ones mentioned above, neither this nor the next one serrated.]

All the dorsal, anal, and pectoral rays are simple, though articulated; the ventral rays and some of the caudal rays, however, are branched.

Scales.—As in *Grammicolepis* where the high arch of the lateral line of the young becomes a low curve in the adult, so in this specimen the lateral line forms a low, somewhat wavy, curve. There are 97 lateral line scales to the end of the lateral process on caudal peduncle, beyond this some 3–4 obscurely perforated scales, and several small ones extending to base of caudal rays. There appear to be 5 transverse rows (excl. small scales near ventral margin), but these are not so easy to count except by removing a piece of skin [as was done in the case of a *dalgleishi*]. Gular region fully scaled. 12 scales around caudal peduncle.

The scales, both of the normal subcircular or transversely oval shape, and of the excessively elongate shape, all have a central (in the long axis of the scale) ridge, with numerous but irregular prickles in the case of the elongate scales. The posterior (exposed) field has a few concentric, or in the case of the elongate scales sub-parallel, striae (*cf.* fig. 8, *X. dalgleishi*).

The lateral projections seen in the photograph (Pl. IX) are outgrowths of the scales. They occur in eleven places on each side, and are almost symmetrically arranged on the two sides. In some places only one scale has this outgrowth, in others 2, 3, or 4 successive scales have them (fig. 7, *e*, *f*). These outgrowths are developed on the posterior (exposed) field of the scale, and have an appearance similar to what one would expect by a pinching-up of the scale membrane, and the ordinary scale striae can be more or less clearly traced across them; the anterior field of the scale takes no part in the formation of the outgrowth (cf. *Trachurus* and other Carangids).

When two or more successive scales produce outgrowths, the anterior margin of one is received into the slot-like hind margin of the one in front.

Viewed in profile (*i.e.* from the dorsal or ventral margin of the fish) the posterior outgrowths project slightly more than the anterior, the greatest "height" (that of the hindmost one on caudal peduncle) being 5 mm.

The number of scales participating in each projection is not quite the same in the corresponding outgrowths of the two sides: the upper one on caudal peduncle and the lower anterior one on belly are each formed by one scale on left side, 2 scales on right; the one in centre of the body and the central one just before beginning of caudal peduncle are each formed by 2 scales on left, 3 on right side; the upper anterior one by 2 scales on left, one on right side.

Dimensions: total length (to end of mid caudal rays) 300 mm. (=245 mm. standard length). Thickness greatest at upper hind margin of opercle, 30 mm. Thickness at base of scales on nape in vertical from centre of eye 14 mm.

Colour (after being on ice for a few days) silvery with faint indications of blackish spots or blotches, chiefly towards the belly; upper part of head (interorbital, preorbital) and the snout and lower jaw blackish, the interorbital and premaxillary groove intensely black; inside of mouth whitish; fins whitish, the anal spine with black rings, some of the rays and intervening membrane of anal with black marks, apices of rays of the ventral fin and a spot at the base of the rays black, caudal rays apically blackish, and some irregular dark spots

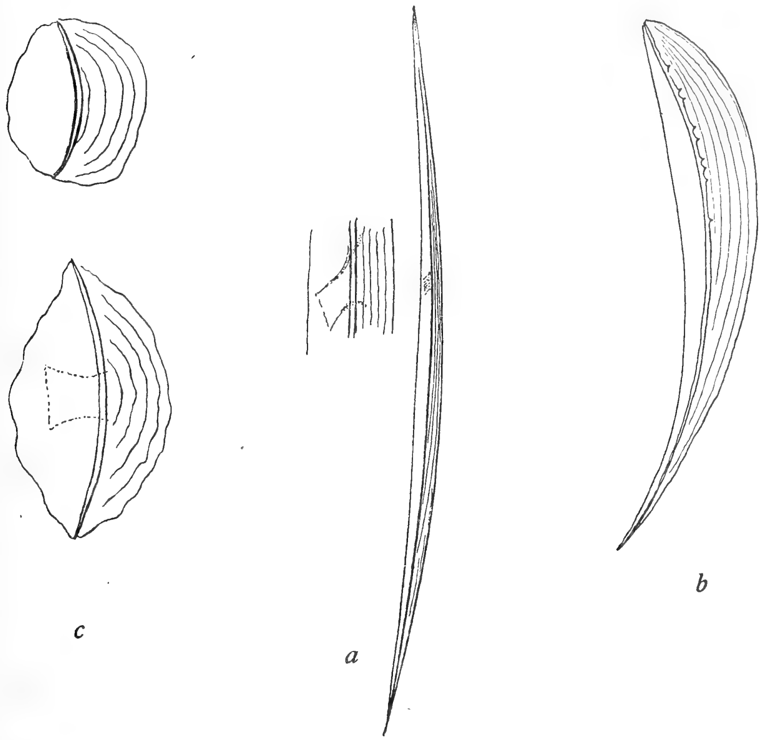


FIG. 8.—*Xenolepidichthys dalgleishi* Gilch. Scales from a specimen 120 mm. in length. *a,* from lateral line behind shoulder, 30 mm. × 1 mm., with area of lateral line pore further enlarged. *b,* from nape, dorso-ventral length 13 mm. *c,* from caudal peduncle, 1·3 mm. and 2·5 mm.

across the middle of the caudal; the filiform dorsal spines appear to be blackish.

Locality.—Off Table Bay, approximately 250 fathoms. Capt. Pace, March 1939.

Distribution.—Off east coast of N. America (220 miles E.S.E. of Boston Lightships at outer edge of Georges Bank).

Remarks.—In comparing this specimen with *dalgleishi,* there are three features which may be left out of account. These have already been referred to, and may be regarded as being normal growth changes by analogy with the closely allied genus *Grammicolepis*.

The very long 1st anal spine is paralleled only in the smallest *dalgleishi* hitherto described, viz.: Smith's 43 mm. specimen (*l.c.*, 1935). Normally one finds that a spine (or ray) which is elongate in the juvenile becomes shortened with age. Four specimens of *dalgleishi* in the South African Museum conform with this, but in none of them can one be absolutely certain whether the spine has been broken off in the process of capture or has become shortened by normal wear and tear during the life of the fish.

One noticeable difference between the specimen of *americanus* and *dalgleishi* is the shape of the scales on the nape (fig. 7, *b* and *c*): in the former, scales of an oval or moderately elongate shape are more numerous; whereas in the latter, scales of elongate or considerably elongate shape are more numerous. In the latter also there is a more or less distinct line of demarcation between the scales of the two sides. This difference may be explained by the change in the *transverse* curvature of the nape. The thickness of the nape measured at the base of the scales above the orbit and in the vertical from centre of eye is approximately the same in relation to length of head in the specimen of *americanus* as well as in *dalgleishi*; and the height from base of scales to dorsal profile in the same vertical is relatively the same, being in fact the same as the thickness; so that a cross-section of the nape at the vertical from centre of eye is nearly an equilateral triangle (fig. 7, *d*). But whereas in *dalgleishi* the sides are only slightly convex and meet dorsally in a sharp curve, in *americanus* the sides are more strongly convex and meet in a broad curve.

There remains the difference in the dorsal and anal fin formulae. For *dalgleishi* Gilchrist * gave: D iv. 28, A ii. 28; Barnard (4 specimens): D v. 27–29, A ii. 28; Smith: D v. 27, A ii. 27; Myers (4 specimens): D vi. 28–29, A ii. 27–29. The total number of spines plus rays thus ranges in the dorsal fin: 32–35; in the anal: 29–31.

The specimen of *americanus* on the other hand has D vii. 32, A ii. 33, total D 39, A 35; being an increase of 4 over the highest total for the smaller specimens.

It is clearly better to take the total number on account of the difficulty sometimes of deciding whether a particular fin-support should be called a spine or a ray, the latter being all unbranched.

With only the one specimen one cannot be sure that it has the

* Gilchrist overlooked the minute true 1st spine.

normal fin formulae, but it is reasonable to assume that with the gradual increase in the length of the body another 4 rays might be developed. I have no information on this point, but from my experience with some hundreds of young of the Cape species of fresh-water *Barbus,* the full complement of spines and rays characteristic of each species is developed right at the start; in the case of *Barbus,* however, the length of the fin-base is very short, and no lengthening of the body takes place. In *Xenolepidichthys* the presumed lengthening of the body affects exactly the part subtending the fin-bases.

When we compare *Grammicolepis,* and assuming that Myers' correlation of small and large specimens is correct, we find a very pleasing confirmation that the total number of fin-supports does increase with age. Setting out the lengths of the specimens and the respective dorsal and anal formulae (total numbers), which Myers has most fortunately given, we find:

73 mm.	D 34, A 30.
82 mm.	D 35, A 31.
85 mm.	D 36, A 30.
182 mm.	D 39, A 36.
230 mm.	D 41, A 38.

On the available evidence, therefore, there were good reasons for claiming Capt. Pace's remarkable specimen as the adult of *Xenolepidichthys dalgleishi.* The discovery of the small example described as *X. americanus,* however, puts this assumption out of court.

Comparison of the present specimen (245 mm. standard length) with the type (100 mm. standard) of *americanus.*

The two specimens exemplify the growth-changes which Myers has traced in *Grammicolepis* (*v. supra*), and are thus an additional proof that the three characters (nos. 8–10 in Myers' table) are not generic.

The American and South African specimens are clearly conspecific, and distinct from *dalgleishi.*

The reduction of gill-rakers in the adult (in this case from about 20 in the young to 12–13 in the adult) is not unknown in other fishes.

An increase in the total number (spines + rays) of dorsal and anal "fin-supports," such as suggested above takes place in *Grammicolepis,* is not found (type: D 38, A 36. S. African specimen D 39, A 35).

The change from a forked tail (young) to a subtruncate or rounded one (adult) is not surprising.

The change in the course of the lateral line is not so marked as in *Grammicolepis.*

Nichols and Firth do not state the actual number of groups of lateral outgrowths of the scales ("horizontally flattened spines"), but judging by their figure there seem to be 9, as against 11 in the present specimen.

Family SOLEIDAE.

Zebrias regani (Gilch.)

1925. Barnard, Ann. S. Afr. Mus., xxi, p. 408 (*Aesopia r.*).

1937. *Id., ibid.*, xxxii, p. 54.

Chabanaud (1936, Bull. Soc. zool. Fr., lxi, p. 401) withdraws his proposed subgenus *Pseudaesopia,* and regards Gilchrist's species as a true *Zebrias,* distinguished from *zebra* Bloch, *altopinnis* Alcock, and *fasciatus* Macleay by the contiguity of its eyes.

Family ACANTHOPLESIOPIDAE.

In accordance with Regan's (*l.c., infra*) suggestion, Jordan (Classif. Fishes, 1923) places this family after the *Plesiopidae.* It contains only *Acanthoclinus* Jenyns, 1841,* New Zealand, with 3 (and a partial 4th) lateral lines, and *Acanthoplesiops* Regan, 1912, India, with one lateral line. See also Weber and de Beaufort, Fish. Indo-Austral. Archipel., v, p. 372, 1929.

Gen. Acanthoplesiops Regan.

1912. Regan, Ann. Mag. Nat. Hist. (8), x, p. 266.

Day described the lateral line as absent, and the ventral fin as having 3 soft rays; Regan corrected these statements. There are only 2 ventral rays, the 1st being bifid.

Acanthoplesiops indicus (Day).

Fig. 9.

1888. Day, Proc. Zool. Soc. London, p. 264 (May) (*Acanthoclinus i.*).

1888. *Id.*, Fish. India. Suppl., p. 798, fig. (Oct.) (*Acanthoclinus i.*).

1889. *Id.*, Fauna India. Fishes, ii, p. 325, fig. 105 (*Acanthoclinus i.*).

1912. Regan, *l.c.*, p. 266.

Depth 4 (or just over), length of head 3, in length of body (excl.

* Not 1842. See Neave, Nomencl. Zool., i, 1939.

caudal). Eye subequal to snout, 4 in head. Maxilla extending to below centre of eye, lower jaw projecting. 2 opercular spines (in the smaller specimen only the upper one developed).

D xviii. (smaller specimen) to xix. (larger) 4. Beginning above hind margin of opercle, 1st ray projecting slightly beyond last spine.

A viii. 4. Dorsal and anal connected with base of caudal.

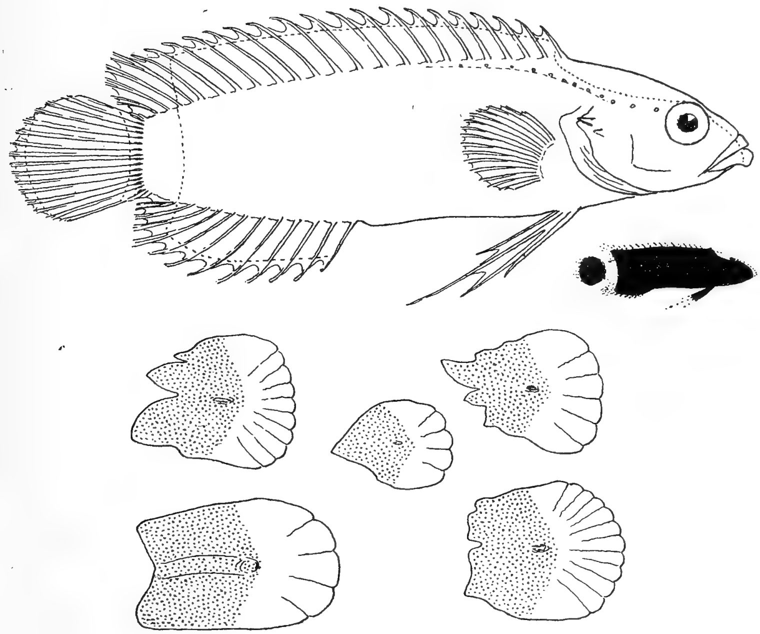


FIG. 9.—*Acanthoplesiops indicus* (Day).

C 16. P 16. V i. 2, 1st ray bifid, its inner branch elongate, extending almost to vent, 2nd ray shorter than outer branch of 1st ray.

Scales of somewhat unusual shape (fig. 9), more or less pyriform, the exposed area ending in a point, or 2–3 points like a cockscomb, or if on the middle of the hinder part of the body (where the lateral line usually is) often more or less symmetrically bilobed. About 36–38 in a lateral series. The whole of the head is naked right up to the origin of dorsal fin, and this bare patch is continued backwards on either side of the dorsal as a narrowing strip until about the 8th–10th spine. A series of mucus pores from behind the eye follows the margin of the naked area until the scaling begins; apparently these pores constitute all that remains of the lateral line tubules, although two or three at irregular intervals can be traced piercing the scales adjoining the bases of the dorsal spines, but apparently not descending to the middle of the side or on to the almost non-existent caudal peduncle. (Possibly by removing each successive scale separately more exact details would be obtained, but there are only 2 specimens available and they do not belong to the South African Museum.)

Length 26 and 30 mm. Body and fins very dark, almost blackish brown except as follows: a medio-dorsal white stripe from base of dorsal to snout and upper lip, and extending on to lower lip (in dorsal view the stripe is lenticular in shape between dorsal fin and eye); a white cross-band through caudal peduncle and the dorsal and anal soft rays; hind margin of caudal, tips of dorsal and anal spines, and distal half of ventral fin white; pectoral transparent. In the larger specimen the first 2 dorsal spines are included in the medio-dorsal white stripe, in the smaller specimen only the base of the 1st spine. Eye dark.

Locality.—Delagoa Bay. Prof. C. J. van der Horst, 1939.

Distribution.—Madras, India.

Remarks.—Day described the species from one specimen an inch long. Regan seems to have examined a specimen, as he corrected certain of Day's statements, but he was concerned only with its systematic position, and gave no locality. I cannot find any later reference to the occurrence of this little fish.

At first glance the fish looks like the letter A or N in the Morse code according as seen from the right or the left side, thus: · — or — · (fig. 9).

Family APOGONIDAE.

Epigonus telescopus (Risso).

1927. Barnard, *l.c.*, p. 523.

1935. Fowler, Proc. Ac. Nat. Sci. Philad., lxxxvii, p. 383.

I have examined a specimen, 460 mm. in length, caught in 1940 by a local trawler and submitted to the Zoology Department, University of Cape Town. It corresponds with my description of the specimen in the South African Museum, but the dorsal spines are longer; apparently I did not make enough allowance for the length of the broken tips. In the present specimen the 4th spine is broken at the tip, but was probably the longest since; it is now, as is likewise the complete 3rd spine, $1\frac{1}{3}$ times the eye, the 5th is $1\frac{1}{4}$ times the eye, and the 6th about $\frac{7}{8}$ the eye.

Although externally in good condition, the initial preservation was not penetrating enough to preserve the internal organs in a good enough condition to enable the pyloric caeca to be accurately counted; but the number does not seem to be as high as 22. Two specimens submitted by the Fisheries Survey, caught in December 1943, were in too poor a condition for an accurate count, but there were certainly not as many as 22 caeca. Fowler records it from off the Natal coast.

Family CARANGIDAE.

Trachurus capensis Cast.

1861. Castelnau, Mem. Poiss. Afr. austr., p. 43.
1927. Barnard, *l.c.*, p. 531, pl. 23, fig. 1 (*trachurus*).
1934. Fowler, Proc. Ac. Nat. Sci. Philad., lxxxvi, p. 443 (*trachurus*).
1935. Nichols, Copeia, no. 2, 16th July.

Nichols, on the basis of 10 specimens from "south-west Africa (probably Walfisch Bay)," finds that the South African specimens are deeper in the body than the Mediterranean *trachurus*, and more slender than the northern European *semispinosus*; and they have a greater number of dorsal and anal rays than either of these species.

The accessory lateral line extends back under the second dorsal fin.

Nichols is inclined to regard the forms occurring in various geographical regions as subspecies.

Elagatis bipinnulatus (O. and G.).

1927. Barnard, *l.c.*, p. 562.

Specimens of this species have been caught in False Bay in February, March, and December 1928 (C. L. Biden), and in December 1941 (Fleck).

Family BRAMIDAE.

Gen. Taractes Lowe.

1843. Lowe, Proc. Zool. Soc. Lond., p. 82.
1929. Bigelow and Schroeder, Bull. Mus. Comp. Zool. Harv., lxix, pp. 41 sqq.

The joint authors have discussed the genus and the several species. They regard *longipinnis* and *asper* as separate species on account of the rounded caudal fin of the latter. They do not agree with Smitt's union of *princeps* with *longipinnis*, apparently considering Smitt's *princeps* is the same as Johnson's *princeps*.

Taractes longipinnis (Lowe).

Plate X.

1927. Barnard, Ann. S. Afr. Mus., xxi, p. 594.

1929. Bigelow and Schroeder, *l.c.*, p. 45, pl. (*princeps*).

1939. Barnard, Rep. S. Afr. Mus. for 1938, p. 12, pl. 2.

[Not: Fowler, Bull. Amer. Mus. Nat. Hist., lxx, p. 653, fig. 293,* 1936.]

Description of the large mounted example (Camps Bay, 1938) (Pl. X, lower figure). The specimen was mounted while I was out of town, and none of the internal parts (gill arches, gonads, pyloric caeca) were preserved.

Depth 2 in length (reckoned to end of scaling on caudal peduncle), length of head $4\frac{1}{2}$. Thickness $5\frac{1}{4}$ inches between eye and edge of opercle, $5\frac{3}{4}$ inches in middle of flank at vertical from origin of dorsal fin (*i.e.* greater than in *princeps* Johnson). Eye vertically oval, its minor (horizontal) diameter 4 in length of head and 1 in snout (if measured flat as in the photo, but $4\frac{1}{2}$ and $1\frac{1}{2}$ if measured on the curve); major diameter about $1\frac{1}{2}$ in distance from its upper margin to the high rounded profile of head. Preorbital $\frac{1}{3}$ minor diameter of eye. Maxilla extending to below first $\frac{1}{4}$ of eye.

Gill opening extending upwards to level of middle of eye, distance of its upper limit to upper base of pectoral being twice the length of pectoral base. The photograph gives a false impression that the gill opening ends lower than it actually does; the upper margin of the opercle is formed by projecting scales which fit very closely against the scales on the body; 3 depressed scales on the body (seen in photograph as a slightly darker spot) opposite the hind rounded angle of the opercle mark the *apparent* upper extent of the gill opening (*cf.* Bigelow and Schroeder's figure).

A distinct transverse groove dorsally and ventrally on caudal peduncle at base of caudal lobes.

D 34, 4th longest (possibly actually the 5th, but if there is a very short ray in front it is not counted here), about equal to length of head. A 25, 3rd longest (maybe actually the 4th), about $1\frac{1}{3}$ in length of head. Length of head $1\frac{1}{3}$ in length of pectoral. Ventral about

* The legend to the figure says "after Lowe," instead of after Smitt. Lowe published no figure of his species, his pl. 7, quoted by Fowler, illustrates an entirely different fish. Smitt's figure seems to refer to *raschii* Esmark.

equal to major diameter of eye. In the low part of both dorsal and anal fins the rays project beyond the membrane.

Scales.—Lat. series 20 with pores, 26 without pores, to level of grooves on caudal peduncle, plus 9–10 posteriorly, total 55–56. The first 20 scales show more or less clearly a single or a bifurcate mucus channel. About 4 rows of scales along the flanks have a slight median horizontal ridge; and some of the scales on the belly (laterally) have a small median point, apparently the remains of a spine. Around the caudal peduncle there are 22 scales, and though the lateral scales are slightly ridged, none bear spines. Head, except the interorbital and snout, scaly; dorsal and anal fins scaly.

Teeth in bands on jaws anteriorly, posteriorly a single row; this single row, continued anteriorly as the inner row of the band, contains slightly larger teeth than do the bands. A single row of incurved teeth on palatines; no teeth distinguishable on vomer.

Length.—From end of middle caudal rays to tip of snout 765 mm., to tip of lower jaw when closed 775 mm.

Colour.—Brownish or bronzy above, many of the scales with dark vertical marks, silvery laterally and ventrally; dorsal and anal fins silvery, with blackish margin anteriorly and at tips of the prolonged portions, continued submarginally along the short rays, the tips of which are white and project beyond the black stripe; pectoral blackish above, greyish below; ventrals black with white tip and white internal edge; caudal with black upper and lower margin, the concave portion with white margin, and black submarginal band; iris brownish, pupil bluish black.

Description of half-grown specimen (Simonstown, 1876), taken from the dried and mounted half-skin (Pl. X, upper figure).

Depth $1\frac{2}{3}$ in length, length of head $3\frac{1}{2}$. Eye approximately (a circular glass eye has been inserted in the skin) $3\frac{1}{2}$ in length of head, slightly greater than snout. Preorbital approximately $\frac{1}{3}$ eye diameter. Maxilla extending to below middle of eye. Gill opening extending upwards to level of middle of eye, distance between its upper limit and upper base of pectoral twice length of pectoral base.

Teeth as described for the larger specimen. The vomer has been cut through, but the row of teeth on the palatine is distinct.

Dorsal and ventral transverse groove on caudal peduncle.

D 33 or 34, 3rd (maybe the 4th) $1\frac{1}{3}$ in length of body, almost 3 times length of head. A 26 or 27, 3rd nearly as long as longest dorsal ray. Rays of both dorsal and anal projecting beyond membrane in low part. Pectoral and ventral broken.

Scales.—Lat. series 45 (not counting the very small ones on base of middle caudal rays), the posterior 10 with antrorse spines, the 7 or 8 in front of these with spines directed backwards; 6 or 7 rows on the flanks with slight ridges, those on the hinder part of the flank with backwardly directed spines; 20 around the caudal peduncle, the row above and below the mid lateral row of scales bearing antrorse spines. Head, except interorbital and snout, scaly; dorsal and anal scaly.

Length.—From end of middle caudal rays to tip of snout 300 mm.; the 350 mm. given in my 1927 description included the caudal lobes.

Remarks.—Photographs of the two specimens here described were submitted to Mr. J. R. Norman of the British Museum for comparison with British Museum specimens and figures in works not accessible here (Lütken, etc.).

Mr. Norman very kindly informed me (*in litt.* 30/xii/38) that a specimen in the British Museum, 540 mm. in length, thus intermediate in size between our two specimens, has the fins proportionately intermediate in length. Thus the lobe of the anal fin is about equal to the length of the fin. In our smaller specimen the lobe of the anal is $1\frac{1}{2}$ *times the length* of the fin, in Bigelow and Schroeder's specimen it is $1\frac{1}{2}$ *in the length* of the fin, and in our large specimen twice in the length of the fin. These four specimens therefore constitute a series in which the relative lengths of the lobe of the anal fin and of the body are correlated.

The length of the lobe of the dorsal fin seems also to be correlated with the length of the body (not given for B.M. specimen), except that Johnson's figure does not fit.

The following table includes data so far as they are available.

	Length mm.	D.	A.	Height of Lobe of D in Length of Base and in Length of Fish.	Height of Lobe of A in Length of Base and in Length of Fish.	Scales.	$\frac{L}{D.}$
asper . . .		33	23			43	
1876 specimen . (S. Afr. Mus.)	300	33–34	26–27	$1\frac{1}{3}$ times base $1\frac{3}{7}$ in length body	$1\frac{1}{2}$ times base	45	$1\frac{2}{3}$
longipinnis Lowe .	460	35	28			41–45	$2\frac{3}{11}$ approx.
princeps . . (Br. Mus., Norman)	540				height of lobe = length of base	45	
princeps . . (Big. and Schr.)	670	35	28	$1\frac{2}{3}$ in base $3\frac{1}{2}$ in body	$1\frac{1}{2}$ in base	43	1·9
1938 specimen . (S. Afr. Mus.)	765	34	26	$2\frac{1}{4}$ in base $4\frac{1}{3}$ in body	2 in base	45	2
princeps Johnson .	825	5 + 27–33	29	1 : $2\frac{1}{7}$ length of fish		45	$2\frac{1}{2}$

The conclusion that the two South African fishes are young and adult of the same species seems not unreasonable; but, as Mr. Norman says, a lot more material is required to put the taxonomy of these fishes on a sound basis.

Bigelow and Schroeder's specimen was caught 50 miles S.W. of Cape Sable, Nova Scotia, on a hook at a depth not exceeding 50 fathoms.

Family HISTIOPTERIDAE.

Histiopterus spinifer Gilch.

Plate XI.

1927. Barnard, Ann. S. Afr. Mus., xxi, p. 620, pl. 31, fig. 2 (adult).

1939. Norman, Rep. John Murray Exp., vii, p. 65.

A photograph of a young specimen, 72 mm. in total length, is reproduced to show that the coloration is not always uniform. In juveniles there are black spots on a silvery-white ground-colour, the fins also being spotted.

The specimen was caught off Cape Infanta by Capt. McGill, April 1938. Another specimen of approximately the same length was caught on the Agulhas Bank in May 1941.

Distribution.—Gulf of Aden (Norman).

Family AMPHIPRIONIDAE.

Amphiprion polymnus (Linn.).

1893. Saville-Kent, Gt. Barrier Reef Austral., p. 308, chromo pl. 16, fig. 7 (*A. clarkii* Benn.).

1927. Barnard, *l.c.*, p. 729.

1928. Fowler, Fishes Oceania. Mem. Bishop Mus., x, p. 303.

1928. *Id.*, Bull. U.S. Nat. Mus., no. 100, vol. vii, p. 6.

Specimens collected at Delagoa Bay exactly resemble the figure in Saville-Kent's work: white (in life most of the white is yellow) with a black stripe through eye, another through spinous dorsal, another through hinder part of soft dorsal, caudal and pectoral each with a round black spot, margins white, ventral fins blackish in front.

Family SCOMBRIDAE.

Gen. Neothunnus Kish.

1923. Kishinouye, Scombroid Fishes, pp. 45, 445.

1926. Jordan and Evermann, Occ. Papers Calif. Ac. Sci., xii, pp. 8, 18.

1933. Fowler, Proc. Ac. Nat. Sci. Philad., lxxxv, p. 163.

Fowler includes in his genus *Semathunnus* the genotype *S. guildi* from Tahiti, and the "imperfectly known" *itosibi* and *allisoni*, and possibly the unidentifiable *albacores*.

The reference to Fowler is given above without implying that I agree that certain species should be taken out of *Neothunnus* and included under *Semathunnus*. The pectoral ridge, and the completeness or otherwise of the corselet, are features which may prove to be available as generic distinctions.

Neothunnus albacora (Lowe).

Plate XI.

1788. Bonnaterre, Encycl. Meth., p. 140. Based on a rough drawing by Sloane. (See Jordan and Evermann, *infra.*) (*Scomber albacores.*)

1831. Cuvier and Valenciennes, Hist. Nat. Poiss., viii, p. 148. Based on Sloane's figure. (*Scomber sloanei.*)

1839. Lowe, Proc. Zool. Soc. Lond., p. 77. (*Thynnus albacora.*)

1910. Cunningham, *ibid.*, p. 110, fig. 4, juv. (*Thynnus a.*)

1926. Jordan and Evermann, *l.c.*, p. 23. (*N. albacores.*)

1929. Frade, Bull. Soc. Port. Sci. Nat., x, p. 235, pl. 5, fig. 2.

1935. J. L. B. Smith, Rec. Albany Mus., iv, p. 207, fig. 4. (*N. itosibi.*)

1936. Fowler, Bull. Amer. Mus. Nat. Hist., lxx, pt. 2, p. 623, fig. 282. (*Germo a.*)

1939. Barnard, Ann. Rep. S. Afr. Mus. for 1938, p. 12, pl. (photo of mounted specimen). (*N. itosibi.*)

Depth of body 4, length of head 4, in length of body. Greatest thickness (at bases of pectoral fins and in middle of body) $5\frac{1}{2}$ in length of body. Eye 7 in head, $3\frac{1}{2}$ in interorbital width, $2\frac{1}{2}$ in snout. Maxilla extending to below anterior margin of eye. Width across lateral caudal keel slightly greater than length of snout. Behind the lateral keel are two smaller keels slightly oblique at the start, and continuing to the two small lobes in the centre of the caudal fin. A horizontal lateral ridge from base of pectoral, against which upper margin of fin fits when laid back. Gill-rakers $9+21=30$.

D xiii. 13 (or 14). 1st spine 3, 2nd $2\frac{3}{4}$ in length of head. 9 detached finlets and 1 semi-detached at hind base of soft dorsal. A ii. 9 (or 10), 9 detached and 1 semi-detached finlets. Pectoral not quite as long as head.

Corselet deeply excavate behind. The lateral line runs nearly horizontal from upper end of opercle to below 1st dorsal spine, then rising rather abruptly and following a gently curved course, sinking gradually to below soft dorsal, where there is another, smaller, rather abrupt bend down to the middle of the flank, thence horizontal to the lateral keel on caudal peduncle.

Length (to end of middle caudal rays) 5 ft. 6 in.

Colour.—Bluish black above, shading to bluish on sides, silvery white below, with more or less conspicuous silvery spots from the level of the soft anal backwards, lower jaw white, grooves around end of maxilla black, inside of mouth black, spinous dorsal blackish brown, soft dorsal and anal dark on front edge, yellowish behind, finlets bright yellow with black margins, caudal greyish with pale yellowish tinge, pectoral bluish on upper margin, white below.

Locality.—Off Cape Infanta, Agulhas Bank, April 1938. The Museum is indebted to Capt. McGill, skipper of the trawler "Bluff," for taking care of this specimen when it came up in the trawl, and delivering it at the Museum in excellent condition.

Remarks.—The specimen had been gutted when brought to the Museum, so the liver could not be examined. Dissection during the course of skinning seemed to show the cutaneous blood-vessels passing through the myotome of the 5th vertebra (as in *Thunnus*), whereas in *Neothunnus* they are said to pass through that of the 7th vertebra.

There are several differences between this specimen and the description of the stuffed specimen given by Smith. The unsatisfactoriness of the specific diagnosis of this species is shown by the following table. Jordan and Evermann examined more than one specimen, but did not record the number of dorsal and anal spines and soft rays. There is much to be said for Smith's surmise that probably only one, circumtropical, species should be recognised. The manufacture of species based on photographs, and *a fortiori* on old drawings, surely cannot advance our knowledge of these fishes (*cf.* Fowler's remarks).

In the table I have included *S. guildi*, because there are several resemblances to our specimen. On the other hand Fowler notes the absence of the ridge (or groove) from the pectoral base in his specimen, whereas it is present in Jordan and Evermann's photograph and in our specimen. Fowler's figure also shows the pectoral arising very much higher up, opposite the upper end of opercle; and his specimen was completely scaled.

A second specimen, caught off Simonstown in January 1946, has also been examined. It measured 5 ft. in length and was stated to weigh 125 lb.

Body completely scaled. Liver not striated, trilobed, right lobe the longest. Spleen large (*cf.* Godsil and Byers, Div. Fish and Game, Californ. Fish Bull. No. 60, 1944). Gill-rakers 20 + 8 on 1st arch. Other characters as in table.

Fowler (1936) regards the Pacific *macropterus* (Temm. and Schleg.) and *allisoni* (Mowbray) from Florida as synonymous. In 1933 he regarded *itosibi* as insufficiently known.

I think there can be little doubt that the Cape specimens should be referred to *albacora*, which has been recorded in the eastern Atlantic down to St. Helena.

	Length (inches).	l/d.	l/h.	h/e.	s/e.	D.	A.	Finlets D/A.
N. itosibi type text	...	4½	4	...	...	...	...	9/8
N. itosibi type photo	...	...	4	7½	2½			
,, another spec.	75	3	4	9				
,, Smith text	66	5	4	12	4½	xv. 14	ii. 12	9/9
,, Smith fig.	...	4½	4½	8½	3			
S.A.M. specimen, 1946	60	4½	4½	7¾	3	xiv. 12	ii. 10	9 (10)/9 (10)
,, 1938	66	4	4	7	2½	xiii. 13	ii. 9	9 (10)/9 (10)
S. guildi Fowler	73	4	4	7	2½	xiii. 13	v. 8	10/9

Scomberomorus commersoni (Lacep.).

1927. Barnard, *l.c.*, p. 802.

A very fine specimen, one of a large shoal, was caught off Kalk Bay, in False Bay, in March 1944; length 49 inches, weight 24 lb.

Family BLENNIIDAE.

1927. Barnard, *l.c.*, p. 831.

1943. Norman, Ann. Mag. Nat. Hist. (xi), 10, p. 793 (synopsis of genera).

The present time is not opportune for a revision of the South African species, but the list of recorded species may be set out with their equivalents in Norman's arrangement; and also a key simplified and adapted from those given by Norman.

Barnard 1927.	Norman's nomenclature.
Blennius bifilum Gnthr.	*Rhabdoblennius* (*Antennablennius*) *b.*
,, *cornutus* (Linn.)	*Blennius c.*
,, *fascigula* Brnrd.	*Blennius f.*
,, *punctifer* Regan	Not specified by Norman.
,, *cristatus* Linn.	*Blennius c.*
,, *scullyi* G. and T.	[Syn. of *cornutus*, fide Smith 1935.]
,, *ocellatus* G. and T.	Not specified.
,, *hypenetes* Klunz.	*Rhabdoblennius* (*Antennablennius*) *h.*
,, *capito* C. and V.	*Chalaroderma c.*
Petroscirtes woodi (G. and T.)	*Omobranchus w.* [syn. of *striatus* fide Fowler 1931].
,, *rhinorhynchus* Blkr.	*Aspidontus r.*
,, *elongatus* Peters	*Omobranchus e.*
,, *variabilis* Cant.	*Dasson v.*
,, *mitratus* Rüpp.	*Petroscirtes m.*
Aspidontus taeniatus Q. and G.	*Aspidontus t.*
Salarias sexfasciatus von B.	[Syn. of *Blennius bifilum*, fide Smith 1935.]
,, *rivulatus* Rüpp.	Not specified.
,, *dussumieri* C. and V.	*Istiblennius d.*
,, *meleagris* C. and V.	*Istiblennius m.*
,, *unicolor* Rüpp.	*Istiblennius u.*
,, *kosiensis* Regan	*Cirripectus k.*
,, *periophthalmus* C. and V.	*Istiblennius p.*
,, *oortii* Blkr.	*Istiblennius o.*
Xiphasia setifer Swains.	*Xiphasia s.*

Later additions to fauna list:

Blennius steindachneri Day	*Blennius s.*
,, *trifascigula* Fowler	Not specified.
Petroscirtes striatus J. and L.	*Omobranchus s.*
,, *tapeinosoma* Blkr.	*Aspidontus t.*
Salarias edentulus (Schn.)	*Istiblennius e.*
,, *frenatus* Val.	Not specified.

I. Caudal free.

A. No bony crest on premaxilla. Teeth large or moderate, more or less attached to bone and usually immovable.

1. Interorbital less than eye. Canines, if any, well developed in both jaws, the lower ones not enormous compared with the upper.

a. Gill membranes forming a fold across throat. Gill openings wide . . *Blennius.*

b. Gill membranes united to isthmus, no fold across throat. Gill openings restricted.

i. Gill openings extending downwards in front of pectoral base. Skin loose and flabby *Chalaroderma.*

ii. Gill openings entirely above pectoral base, usually smaller than eye . . *Omobranchus.*

2. Interorbital equal to or greater than eye (except *Petroscirtes*). Canines small in upper jaw, relatively enormous in lower jaw.

a. Gill opening entirely above pectoral base.

i. Dorsal rays 13–15 . . *Petroscirtes.*

ii. Dorsal rays 28–31 . . *Dasson.*

b. Gill opening extending down in front of pectoral base. Dorsal rays 26–38 . . . . *Aspidontus.*

B. A bony crest on premaxilla forming a groove for reception of upper lip. Teeth (except *Rhabdoblennius*) small, implanted in lips, movable.

1. Crest on premaxilla covering roots of teeth, which are moderate, more or less attached to bone, and somewhat movable . . *Rhabdoblennius.*

2. Crest not covering roots of teeth, which are very small, implanted in lips, and freely movable.

a. Anal spines in ♂ modified to form fleshy dendritic masses. Two or more tentacles on each side of nape *Cirripectus.*

b. Anal spines in ♂ not or only slightly modified, not dendritic. A single tentacle on each side of nape . *Istiblennius.*

II. Caudal united with vertical fins. Body eel-like . . . *Xiphasia.*

Family CLINIDAE.

Gen. Clinus Cuv.

1927. Barnard, *l.c.*, p. 850.

1931. Smith, J. L. B., Rec. Albany Mus., iv, p. 154.

1937 (March). Barnard, Ann. S. Afr. Mus., xxxii, p. 63.

1937 (May). Smith, J. L. B., Ann. Natal Mus., viii, p. 194 (distribution).

In any future revision of the South African species, I would suggest the possibility of *agilis* Smith, 1931, being the young of *taurus*, which according to Smith, 1937, extends as far as Plettenberg Bay.*

In order to indicate the possible variations or aberrations which may be found, descriptions are given of two specimens both from Port St. Johns, one found several years ago, the other in 1944. The first might be a *superciliosus* with reduced number of dorsal fin spines and anal rays. The second may also be a *superciliosus* without supraorbital tentacles. The shape of the head and snout is quite different from that of *pavo*, the only species with a dorsal crest and no supraorbital tentacles.

♀. 160 mm. Depth of body 4, length of head $3\frac{1}{2}$, in length of body. Eye equal to snout, $4\frac{1}{2}$ in length of head. Interorbital $1\frac{1}{3}$ in eye. Maxilla extending to below posterior third of eye. Nasal (anterior) tentacle fringed; supraorbital tentacle flattened and fringed. No occipital groove. Front row of teeth stronger than inner rows. D iii. + xxviii. 5, beginning in vertical from between preopercle and hind margin of eye, 2nd spine in crest $\frac{1}{2}$ length of head, membrane of 3rd spine reaching to base of 4th; the 3 spines of the crest each with a tuft of cirri, all the other spines each with a single apical cirrus. A ii. 22 (= 24). V i. 2. Lateral line a single row of pores.

♂. 130 mm. Body not strongly compressed. Depth of body subequal to length of head, $4\frac{1}{2}$ in length of body. Eye slightly greater than snout, 4 in length of head. Interorbital 2 in eye. Maxilla extending to below centre of eye. Nasal (anterior) tentacle fringed. No supraorbital tentacle. No occipital groove. Front row of teeth stronger than inner rows. D iii. + xxvii. 5, beginning in vertical of hind margin of preopercle (or slightly in front), 1st and 2nd spines of crest about $\frac{1}{2}$ length of head, membrane of 3rd spine reaching to

* Smith (1945, Ann. Mag. Nat. Hist. (xi), 12, pp. 535–546) not only retains *agilis* as a distinct species, but places *taurus* and *agilis* in different genera.

base of 4th, a gap between the 14th and 15th spines (the 11th and 12th excluding the crest) filled with membrane without the spine, cirri apparently absent. A ii. 22 (=24). V i. 3, 3rd ray very small. Lateral line a single row of tubules. Red-brown, mottled, 8 dark patches on dorsal fin, 6 on anal fin, caudal and pectoral with narrow bars on the membrane "staggered" and not always forming continuous unbroken lines across the fin. Indications of two dark bars from eye, one horizontal to hind margin of opercle, the other passing obliquely behind end of maxilla.

Family STROMATEIDAE.

1902. Regan, Ann. Mag. Nat. Hist. (7), x, pp. 115 and 194 (classification).

1922. Gilchrist, *ibid.* (9), ix, p. 249 (oesophageal teeth).

1923. Gilchrist and von Bonde, Fish. Mar. Surv., Rep. 3. Special Rep. 4 (S. African species).

1927. Barnard, *l.c.*, p. 889.

Having occasion to examine a fresh specimen of the rare *Cubiceps capensis*, it seemed worth while to repeat, in general, Gilchrist's observations on the oesophageal teeth. This has been done for all the genera occurring in South Africa.

No comment is made on the homologies of the oesophageal sacs suggested by Gilchrist; I have merely examined the structure of the toothed processes within the sacs.

Gilchrist's figures of these processes in *Stromateus* and "Psenes natalensis" are confirmed except for minor differences. The provisional name "Psenes natalensis" is a *nomen nudum* for a species which was called in 1923 *Psenes africanus*, and which I am inclined to regard as synonymous with *P. indicus*.

On p. 253 Gilchrist describes the oesophageal sacs, upper pharyngeals, and papillae of "Psenes (*Atimostoma* Smith, *Cubiceps* Günther) capensis." This is remarkable because in the following year (1923, p. 7) Gilchrist and von Bonde state that Smith's stuffed type in the British Museum is the only known specimen, and quote Regan's taxonomic description.

But Gilchrist was in possession of the specimen (caught in 1919) which he afterwards made the type of *Centrolophodes irvini* (1923) (which in 1927 I regarded as synonymous with *Centrolophus niger*), and his description of the pharyngeals and oesophageal sacs agrees with these structures in *Centrolophus niger*. It is true that the description would in fact also fit *Cubiceps capensis*, but one must conclude that Gilchrist described these structures from a fish which he

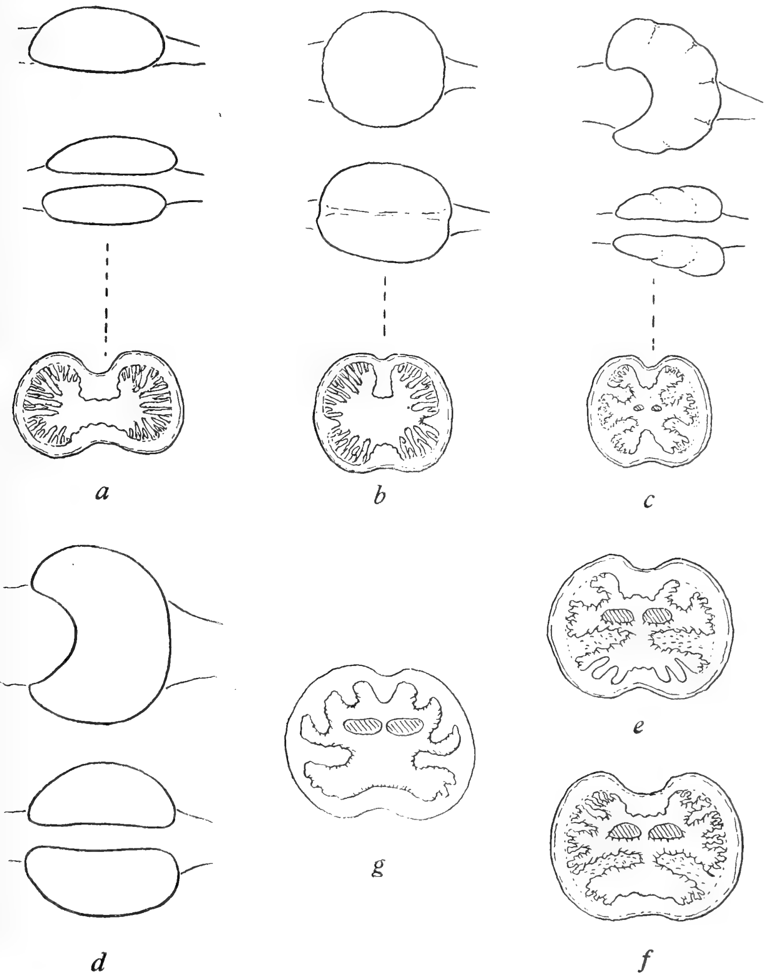


FIG. 10.—*Stromateidae*, oesophageal sacs. Lateral and dorsal views, and cross-section of: *a*, *Psenes indicus*. *b*, *Stromateus fiatola*. *c*, *Nomeus grovonii*. *d*, lateral and dorsal views in *Centrolophus niger* and *Cubiceps capensis*. *e*, *f*, *g*, cross-sections in *Centrolophus niger*, *Cubiceps capensis*, and *Schedophilus ovalis* respectively. In the lateral and dorsal views the branchial arches are situated on the left, the oesophagus on right. In the cross-sections the obliquely shaded oval structures are the 4th upper pharyngeal teeth; they are not shown in the figure of *Stromateus* because they only just enter the anterior part of the sac.

had actually before him; and that the name in an *anatomical* paper was a temporary *pis aller* (*cf.* "P. natalensis," *supra*) or a *lapsus* *calami.* In accordance with this conclusion, corrected references for the two species are given below.

Fig. 10 shows the differences in form and situation of the oesophageal sacs in the genera examined. In *Psenes indicus* the two sacs are longitudinally ovoid and lie parallel with the course of the oesophagus (10, *a*); in *Stromateus fiatola* the two sacs together form a nearly globular mass, in side view nearly circular and extending both above and below the oesophagus (10, *b*). In *Nomeus, Centrolophus niger, Cubiceps capensis*, and *Schedophilus ovalis* each sac is kidney-shaped and lies athwart the oesophagus, as Gilchrist says, "following the general contour of the branchial arches" (10, *c, d*). Their appearance certainly suggests that they are a specialised development of the closed-up gill-slit behind the 5th branchial arch.

Gilchrist came to the conclusion that the spiniferous lining of the sacs was derived from two different sources; in the one case being homologous with the spiniferous lining of the upper pharyngeals ("Psenes capensis" = *Centrolophus*, and *Nomeus*), in the other case homologous with the gill-rakers (*Psenes* "natalensis," and *Stromateus*). It seems rather doubtful to me whether detailed studies of the structures in question would confirm this view. In the case of *Psenes* "natalensis" Gilchrist examined the gill-rakers and found that they "showed the same structure" (p. 252). If this statement implies that the gill-rakers have a circular or oval base, my observations do not confirm Gilchrist's.

In *Psenes indicus* and *Stromateus* the sacs are lined with numerous spiniferous papillae, of all sizes, projecting inwards more or less radially (fig. 10, *a, b*). Each of these papillae (Gilchrist: "long horny processes resembling gill-rakers") has its own base for attachment to the muscular wall of the sac. This base is round and scale-like in *Psenes*, stellate in *Stromateus* (*cf.* Gilchrist, figs. 1 and 2).

I find that in *Psenes* the base is not always circular, but is very often irregularly oval, and the papilla seems to arise normally at one side of it, not centrally (fig. 11, *a*). In *Stromateus* the basal root-like processes are not always curved at their extremities as Gilchrist shows them.

In *Nomeus*, and especially in *Centrolophus niger* and *Cubiceps capensis*, the inner wall of the sac is lobed and plicate; in the two latter species there is a particularly strong digitiform process anteriorly in the lower half of each sac *vis-à-vis* the 4th upper pharyngeals (fig. 10, *c, e, f*). The whole lining is beset with spiniferous papillae (fig. 11, *b, c, d*). None of these, however, attains the size, relatively to the lumen of the sac, that the papillae do in *Psenes* and *Stromateus.*

In *Schedophilus ovalis* there is a rather broad spiniferous area projecting into the anterior part of the lumen between the sacs (? an extension of the lower pharyngeals) but not extending to the hinder part of the lumen which is strongly plicate (fig. 10, *g*).

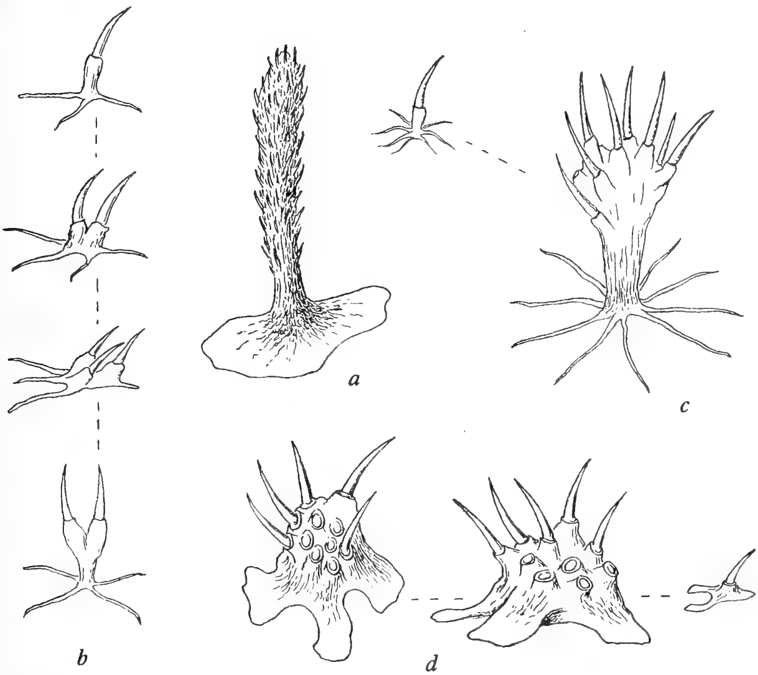


FIG. 11.—*Stromateidae,* papillae from lining of oesophageal sacs. *a, Psenes indicus. b, Cubiceps capensis. c, Nomeus gronovii,* a small and a large papilla. *d, Centrolophus niger,* on right a small papilla, or one at an early stage of growth.

In *Cubiceps capensis* and *Nomeus* the papillae have stellate bases (fig. 11, *b, c*). In *Centrolophus niger* they are of heavier build, somewhat like a humped-up starfish, and when closely packed they form quite a firm "horny" layer, which has a Polyzoan-like appearance when the spines are rubbed off (fig. 11, *d*).

It seems therefore that there is no essential difference between the *Psenes-Stromateus* type and the *Nomeus-Cubiceps* type. In the former the *individual* papillae grow to an enormous size relatively to the lumen of the sac, which they nearly fill; in the latter, outgrowths of the wall, covered with relatively small papillae, occupy most of the lumen.

Also, it would seem that the words used in Regan's key (1902, *l.c.*, pp. 120, 121), "oesophagus with (*per contra*: without) longitudinal plications" are not very happily chosen to form the antithesis required in the key. *Psenes* and *Centrolophus* both fall within his first category.

Centrolophus niger (Gmel.).

Figs. 10, *d*, *e*; 11, *d*.

1902. Regan, *l.c.*, p. 195.

1922. Gilchrist, *l.c.*, p. 253 (oesophageal teeth, quoted as "Psenes (Atimostoma Smth., Cubiceps Gnthr.) capensis") (non *Cubiceps capensis* (A. Smith)).

1923. Gilchrist and von Bonde, *l.c.*, p. 3, pl. 17, fig. 1 (*Centrolophodes irvini*).

1927. Barnard, *l.c.*, p. 895, pl. 33, fig. 1.

1935. Fraser-Brunner, Proc. Roy. Irish Ac., xlii, B, p. 323.

Since my 1927 paper I have seen two more specimens. One is half-grown, 450 mm. to end of middle caudal rays, and was caught by a trawler off Table Bay, approx. 200 fathoms, in 1937. The other is a large specimen, 1165 mm., caught in the same locality in November 1941.

Beyond recording these specimens, the only point that need be mentioned is that the upper pharyngeals on the 2nd arch form an oval patch (in contrast with the linear patch in *Cubiceps capensis*, v. *infra*). Fraser-Brunner notes the difference in coloration of the sexes.

Gen. Cubiceps Lowe.

1927. Barnard, *l.c.*, p. 891.

1930. Chabanaud, Bull. Mus. Nat. Hist. Paris, (2), ii, p. 519.

1938. Fowler, Monogr. Ac. Nat. Sci. Philad., 2 (key to species).

The diagnosis has to be altered in regard to the palatine teeth, which may be present or absent. Regan's 1902 diagnosis gave "palatine teeth absent." McCulloch (1923) described a 79 mm. *caeruleus* Regan, and a 371 mm. *baxteri* n. sp., both with palatine teeth. Chabanaud says his *dollfusi* n. sp. (up to 145 mm.) differs from all other species of this genus in the absence of teeth "au palais" (vomer and palatines).

Fowler (1934, Proc. Ac. Nat. Sci. Philad., lxxxvi, p. 442, fig. 23) describes *longimanus* n. sp. from a juvenile 55 mm. long, from Natal, with D viii. i. 15 and A i. 14, pectoral slightly shorter than head.

I have not seen Fowler's 1938 paper.

Cubiceps capensis (A. Smith).

Figs. 10, *d, f*; 11, *b*; 12.

1845. A. Smith, Illustr. Zool. S. Afr. Fishes, pl. 24.
1902. Regan, *l.c.*, p. 123.
1923. Gilchrist and von Bonde, *l.c.*, p. 7.
1927. Barnard, *l.c.*, p. 891.
[Not *Psenes capensis* Gilchrist, 1922, *l.c.*, p. 253 = *Centrolophus niger*.]

Description of a male specimen, 460 mm. in length (to end of middle caudal rays).

Depth equal to length of head, $3\frac{3}{4}$ in length of body (excl. caudal fin); thickness at bases of pectorals a little greater than half length of head. Caudal peduncle just over $1\frac{1}{2}$ times as long as deep (scarcely $1\frac{2}{3}$ as in stuffed type). Eye equal to snout, $3\frac{3}{4}$ in length of head, $3\frac{4}{5}$ in interorbital width (measured point to point, not round the strongly convex curve). Maxilla extending to vertical from a point midway between eye and posterior nostril; without supplemental bone, and entirely concealed under preorbital when mouth closed. Preorbital depth (at end of maxilla, narrower posteriorly) $\frac{1}{2}$ eye diameter. Snout rounded. Lips thin. Nostrils far forward, internarial distance $1\frac{1}{2}$ times in distance from posterior nostril to anterior margin of eye.

Branchiostegals 6. Gill membranes free from isthmus. Gill-rakers 10 + 18 on 1st arch, longest rakers subequal to filaments, $\frac{1}{2}$ diameter of eye. Pseudobranchiae well developed.

A single row of setiform teeth in both upper and lower jaws, regular and close-set but not adjacent to one another. A single longitudinal row on vomer, and on each palatine (fig. 12).

Tongue slightly concave in its free portion (to receive the vomerine teeth) with a small number of scattered setiform teeth; behind the tongue there is a roof-like ridge between the gill-arches, with a single median row of setiform teeth, fitting into the V-shaped groove of roof of mouth (fig. 12). Upper pharyngeals: no teeth on 1st arch, a linear patch on 2nd, a rhomboidal patch on 3rd, 4th projecting into lumen of oesophageal sac. Oesophageal sacs, see *supra*. Pyloric caeca numerous but uncountable on account of surrounding fatty tissues.

D xi. 23. 1st spine arising in vertical from middle of pectoral base; 3rd spine longest, subequal to or a trifle longer than spine at beginning of soft dorsal; 9th and 10th spines concealed in groove between spinous and soft dorsals; an unusually wide gap between the 6th and 7th spines suggests that one spine is here undeveloped, though the membrane between the 6th and 7th spines is unbroken. A iii. 20,

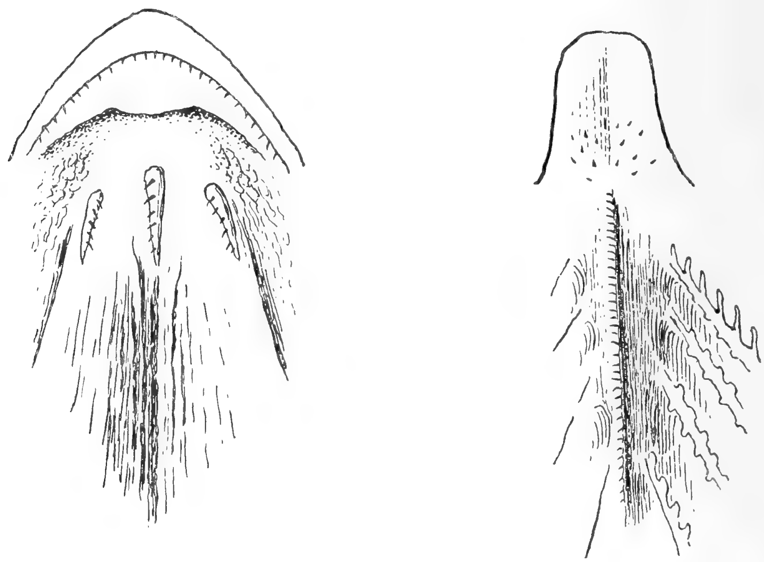


FIG. 12.—*Cubiceps capensis* (A. Smith). Left: view of roof of mouth. Right: tongue and ridge between gill arches.

3rd spine $3\frac{1}{4}$ in length of head, subequal to 3rd dorsal spine. P 24, $1\frac{1}{3}$ times length of head; direction of insertion of base nearly horizontal. Ventral $2\frac{1}{2}$ in length of head, spine arising below base of last pectoral ray. Caudal from base of middle rays to end of lobes $\frac{3}{4}$ length of head. The fin has been split in the middle apparently as a result of injury in early life, and the two lobes can be easily folded, the one completely over the other.

Most of the scales are lost; a few remain near the pectorals and along the bases of soft dorsal and anal. One to 3, sometimes 4 or even 5, pores in each scale pocket. Scaling on head extending almost to tip of snout (to vertical from anterior nostril), and to the margin of orbit except the anterior portion, continued on preorbital to vertical from nostrils; on cheek and subopercle, extending to symphysis of lower jaw; on gular membrane and on throat, extending to isthmus. Soft dorsal and anal scaly at base, and also pectoral for a short distance.

Scales large, cycloid, exposed surface with rather inconspicuous crinkly subparallel longitudinal striae. Lateral line: 66 to base of caudal, 52 or 53 to vertical from base of last dorsal ray. Approximately 46 from beginning of scaling on snout to origin of dorsal fin. L. tr. 6 between lat. line and spinous dorsal, and between l.l. and spine at beginning of soft dorsal, the uppermost scale being the narrow one next to the scaly fin-base; 5 between l.l. and 1st–3rd rays, and 4 between l.l. and remainder of soft dorsal; 22 between l.l. and middle line of belly; 12 from l.l. to level of base of hindmost pectoral rays, and 6 from this point to base of spine of ventral fin; 18 between l.l. and anterior part of anal fin; 12 between l.l. and last anal ray; 28 around caudal peduncle; 6 (7) rows of small scales on cheek next to orbit, followed by 2 rows of large scales; 10 between orbit and upper limit of gill opening, the hinder 3 being large scales.

Colour.—Purplish brown, the snout paler, tongue and lining of mouth intense blue-black, dorsals, anal, caudal, and ventrals blackish grey, pectorals lighter.

Locality.—Off Table Bay, approximately 200 fathoms, June 1939.

Remarks.—This specimen was caught by Capt. Pace, skipper of one of Irvin & Johnson's trawlers. It agrees very well with Regan's description of Andrew Smith's stuffed type, which is approximately $2\frac{1}{3}$ times larger.

The specimen is interesting as being the second * of this species to be obtained in a century (Andrew Smith left the Cape in 1837). No young specimens seem to have been caught either by the Fisheries Survey or the trawlers, or, if so, they have not been recognised as of sufficient importance to be saved; on commercial trawlers small fish are dumped overboard, except those of strikingly bizarre appearance.

The Cape species may be retained under Andrew Smith's name, though very possibly it will eventually have to be included in *gracilis* Lowe 1843, when more material is available.

Andrew Smith stated that the head was without scales except behind the posterior edge of orbit; but in the figure there are distinct indications of scales on the interorbital as far at least as

* Mr Norman, however, informed me (*in litt.* 10/vii/39) that he received four rather small specimens in October 1925 which he identified as this species. They were taken from the stomach of a Sei Whale caught 70 miles W.N.W. of Saldanha Bay and were presented to the British Museum by Hans Ellefsen Ltd.

above centre of eye, and the artist has carried the purplish colour forward almost to above the nostrils, which is approximately where the scaling begins in the present specimen. In fact Smith's figure is a very good one, except that the scaling on the caudal peduncle has been continued too far backwards, making the middle caudal rays absurdly short.

Gen. Schedophilus Cocco.

1829. Cocco, Giorn. Gab. Messina, i, p. 30, and Innom. Messina Ann., iii, p. 57.

1833. Cocco, Giorn. Sci. Lett. Sicil., xiii, p. 20 (*Mupus*).

1834. Lowe, Proc. Zool. Soc. London, p. 143 (*Leirus*, nom. preocc. Meg. in Dahl., 1823, Coleopt.).

1843/4. Valenciennes in Webb and Berthelot, Ichthyol. Iles Canaries, p. 43 (1843, *fide* Sherborne; 1844, *fide* Prussian Acad. Nomenclator). (*Crius.*)

1846. Agassiz, Nomencl. Zool., p. 213 (*Lirus* emend. for *Leirus* Meg. and *Leirus* Lowe).

1902. Regan, *l.c.*, p. 195 (*Lirus*).

1927. Barnard, *l.c.*, p. 896 (*Lirus*).

1937. Norman, Discovery Rep., xvi, pp. 117, 118 (comments on subdivision of genus).

Mr. J. R. Norman recommends the use of this name, which is in conformity with American usage. *Leirus* is admittedly preoccupied; Agassiz' emendation may be valid for the Coleopterous genus, but cannot be valid also for Lowe's genus.

Agassiz gave the etymology of *Leirus* as λειρος = subtilis; but Valenciennes claimed that it was the latinised form of "leiro," the Portuguese name of the fish at Madeira.

Schedophilus ovalis (C. & V.).

Figs. 10, *g*; 13.

1833. Cuvier and Valenciennes, Hist. Nat. Poiss., ix, p. 346 (*Centrolophus o.*) and p. 348 (*C. crassus*).

1843/4. Valenciennes, *l.c.*, p. 43 (*Crius bennettii*).

1843/4. *Id.*, *ibid.*, p. 45, pl. 9, fig. 1 (*Crius bertholotii*).

1896. Collett, Res. Sci. Camp. Monaco., x, p. 27 (*L. bennetti*).

1902. Regan, *l.c.*, p. 198 (*Lirus o.*).

1919. Roule, Res. Sci. Camp. Monaco, lii, p. 42 (*Centrolophus crassus*).

1933. Roule and Angel, *ibid.*, lxxxvi, p. 83 (*Centrolophus o.*).

1937. Pellegrin, Bull. Soc. centr. Aqu. Pêche., xliv, pp. 33–36, 2 figs. (bionomics and fishery).

Depth (reckoned as 155 mm.) 3 in total length (to end of middle caudal rays), $2\frac{2}{3}$ to end of lat. line tubules; length of head $4\frac{1}{5}$ and $3\frac{2}{3}$ in the above lengths respectively. Eye slightly less than snout (in true profile), $4\frac{1}{2}$ in length of head, not quite twice in interorbital width (point to point, not around the strongly convex curve), which is $2\frac{2}{3}$ in length of head. Maxilla extending scarcely beyond vertical from anterior margin of eye. Narrowest (posterior) width of preorbital $\frac{1}{2}$ eye diameter.

Preopercle denticulate, subopercle less conspicuously so. A single row of setiform teeth in both upper and lower jaws; no teeth on vomer, palatines, or tongue. Gill rakers $6+16$ on 1st arch, the longest not quite as long as longest filaments, which are about $\frac{1}{2}$ eye. Branchiostegals 7. Pseudobranchiae well developed. An oval patch of upper pharyngeal teeth on 2nd arch; 4th pharyngeals extending into oesophageal sacs.

D viii. 27, arising above upper limit of gill opening; 1st spine short, $\frac{1}{3}$ eye, 2nd close behind 1st, $\frac{1}{2}$ eye, following spines graduated to the rays, 9th about $1\frac{1}{2}$ times the eye, 9th or 10th ray the longest. A iii. (17, middle portion of fin missing). P 22. Ventrals about $\frac{1}{2}$ length of head, folding into a slight groove, innermost ray connected with body by membrane.

Scaling on back beginning only a short distance in front of dorsal fin, 5–6 (not more) predorsal scales. 2–3 rows on lower part of cheek, *i.e.* across middle of preopercle. Opercle and subopercle scaly; rest of head, lower jaw and gular region naked, with numerous pores, the top of the head somewhat spongy.

Lat. line *ca.* 95; about 18 between 1st dorsal spine and origin of lat. line; about 42 around caudal peduncle; base of dorsal and anal, and pectoral for a short distance, scaly.

Oesophageal sacs kidney-shaped, lying athwart the oesophagus (fig. 10, *g*, cross-section). Six large and bulky, digitiform pyloric caeca.

Length 470 mm. to end of middle caudal rays, 430 mm. to end of scaling on caudal; depth of body 150–160 mm. (difficult to measure exactly on account of scaly base of dorsal fin); length of head 110 mm.; snout 25 mm. in true profile (30 mm. if measured from middle point of tip of snout to eye); eye 24 mm.; pectoral 95 mm.

Colour.—Grey with a purplish tinge, probably more silvery when the scales are in position, top of head and all the fins darker; roof of mouth purplish grey, but tongue and floor of mouth pale; gall-bladder very distinctly green.

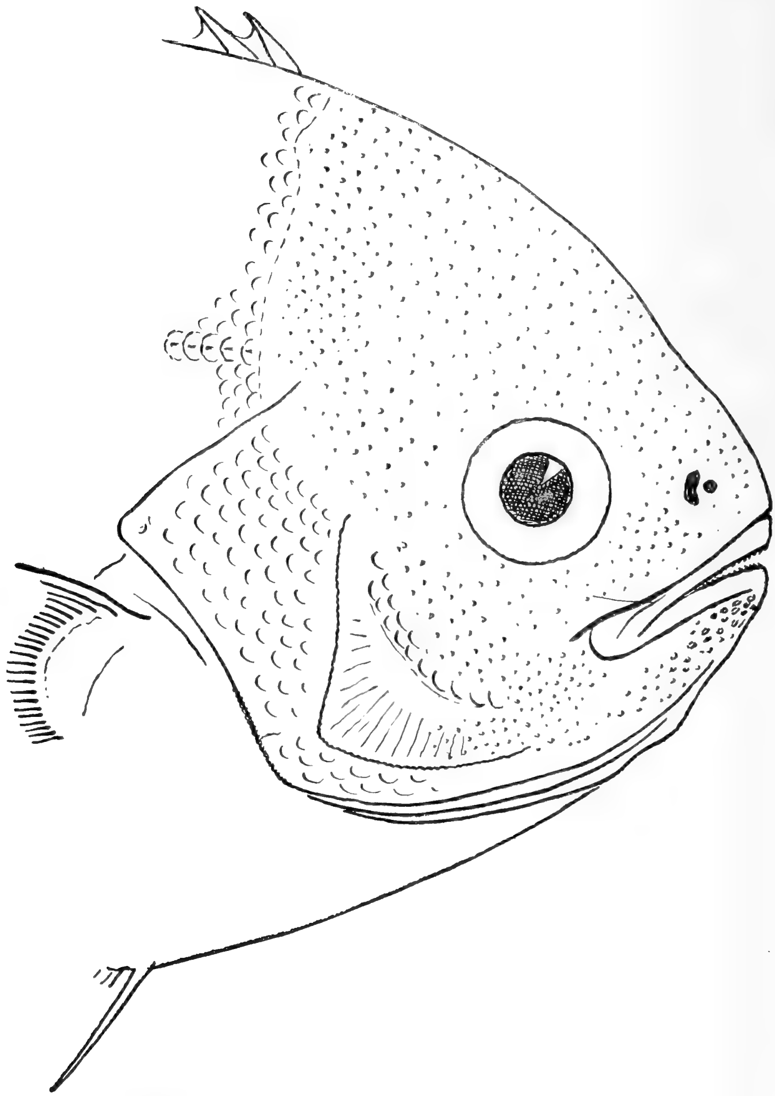


FIG. 13.—*Schedophilus ovalis* (C. and V.). Head to show scaling and pores (diagrammatic, the scales are not numerically correct).

Locality.—Off west coast of Cape Peninsula, approx. 150 fathoms. Capt. Pace, June 1939.

Distribution.—Madeira, Canary Is., Azores, Moroccan coast, Mediterranean.

Remarks.—The specimen is a male. A large hemispherical hole, about $1\frac{1}{2}$ inches across, has been scooped out (? eaten by a Hag-fish) on the lower part of the right-hand side at the middle of the anal fin and injuring also the fin itself; the exposed flesh has been covered over by a layer of thick skin, but no new scales have been developed.

For the purpose of proportional measurements the above lengths have been chosen because I am not certain what actual points Regan in his table of measurements of British Museum specimens (*l.c.*, p. 199) has taken as the junction of the trunk with the "caudal". For the larger specimens he gives the "caudal" as approximately one-fifth of the total length. One-fifth of the total length of the present fish reaches from the end of the middle caudal rays to the narrowest part of the caudal peduncle; but there are many scales, including lat. line tubules behind this point. A more exact measurement is: tip of snout to end of hypural 415 mm., end of hypural to end of middle caudal rays 55 mm.

Gen. Palinurichthys Blkr.

1859. Bleeker, Acta Soc. Indo-Neerl., vi, p. xxii.
1859. Günther, Cat. Fish. Brit. Mus., i, pp. 273, 337 (*Hyperoglyphe*).
1937. Norman, Discovery Rep., xvi, pp. 117, 118.

Palinurichthys (*Hyperoglyphe*) *porosa* (Rich.).

Fig. 14.

1845. Richardson, Voy. "Erebus and Terror", Fish, p. 26, pl. 16, figs. 5, 6. (*Diagramma p.*).
1889. Günther, Challenger Rep., xxxi, p. 11, pl. 2, fig. F (*Lirus p.*).
1902. Regan, Ann. Mag. Nat. Hist. (7), x. p. 202 (*Lirus p.*).
1929. McCulloch, Mem. Austr. Mus., v, p. 125 (*Hyperoglyphe p.*).
1937. Norman, *l.c.*, p. 118 (*Hyperoglyphe o.*).

Description of two specimens 520 and 530 mm. in length (to end of middle caudal rays); immature, with feebly developed gonads.

Depth not quite 3, head 3 times, in length (excl. caudal fin); thickness at base of pectorals about $\frac{1}{2}$ length of head. Caudal peduncle twice as long as its least depth. Eye $4\frac{3}{4}$ in head, $1\frac{1}{4}$ in snout (slightly less as figured), 2 in interorbital width (over the curve). Snout rounded, lips thin. Mouth slightly oblique, lower jaw projecting slightly beyond upper (when closed). Maxillary extending to below centre of eye, not concealed under preorbital, with supplementary bone. Edge of preopercle denticulate, edges of opercle and subopercle very finely denticulate where they meet, edge of preorbital

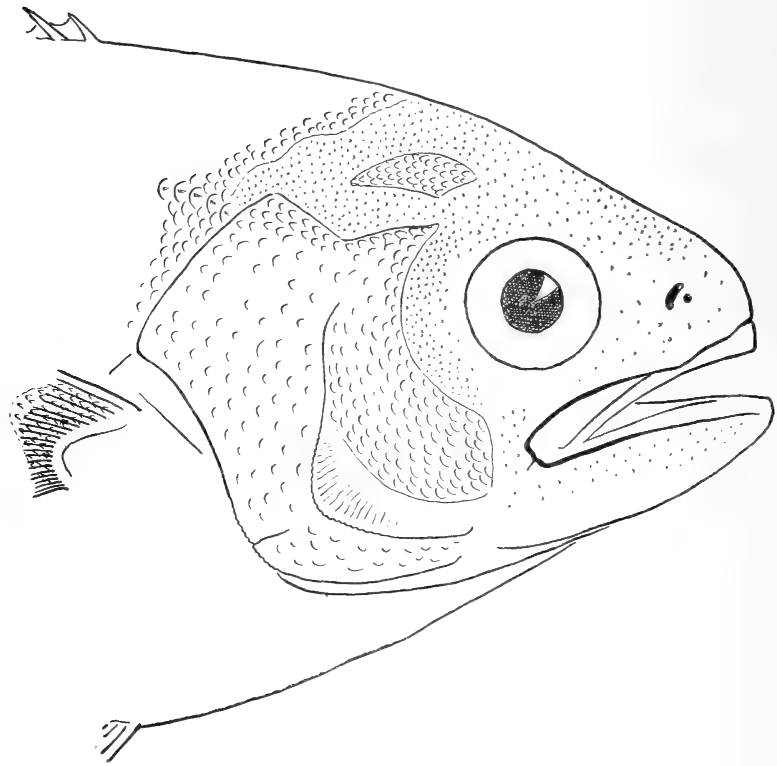


FIG. 14.—*Palinurichthys porosa* (Rich.). Head to show scaling and pores (diagrammatic, the scales are not numerically correct).

smooth. Nostrils about midway between tip of snout and anterior margin of eye.

Teeth in jaws small, numerous, conical, in a single row in each jaw; no teeth on palate or tongue. Upper pharyngeals, none on 1st arch, an elongate patch on 2nd, an oval patch on 3rd arch, 4th projecting into lumen of oesophagus.

Gill-rakers 7 + 16 or 17 on 1st arch; longest rakers about $\frac{1}{2}$ eye diameter, not as long as longest filaments. Pseudobranchiae well developed. Branchiostegals 7. Gill membranes free from isthmus.

Oesophageal sacs feebly developed. Lining of oesophagus plicate.

Pyloric caeca numerous, but impossible to count owing to surrounding fatty tissue.

D viii. i. 19 or 18, 1st spine arising in vertical from axil of pectoral, 4th and 5th spines longest, $\frac{3}{4}$ eye diameter, 6th–8th decreasing, 8th longer than 1st but shorter than 2nd, the spine at beginning of soft dorsal slightly shorter than 4th or 5th spines, not quite $\frac{1}{2}$ length of longest rays which are $\frac{2}{5}$ length of head, rays decreasing to last which is $\frac{3}{4}$ eye diamenter.

A iii. 14, 3rd spine subequal to 3rd dorsal spine, longest rays not quite as long as longest dorsal rays. P 21, falcate, $1\frac{4}{5}$ in length of head. V not quite $\frac{1}{2}$ length of head, spine arising in vertical from middle of pectoral base and from 1st dorsal spine, inner ray joined to belly by membrane.

Scales mostly lost, a few remaining beneath pectoral fins, along lat. line, and at bases of dorsal and anal, thin, cycloid. No pores in scale pockets. Head and snout naked, with numerous pores which extend on to preorbital and the postorbital crescent; an isolated patch of scales on the supra-scapular region. Preopercle (except lower corner) scaly, about 9 rows; opercle and subopercle also scaly. Soft dorsal and anal scaly at base, also pectoral for a short distance.

Lateral line becoming straight about opposite beginning of anal or middle of soft dorsal, approx. 72 (but scale pockets difficult to count accurately), 10 to vertical from 1st dorsal spine, 56 to vertical from last dorsal ray; l. tr. approx. 11 between l.l. and 1st dorsal spine, approx. 18 between l.l. and beginning of soft dorsal; approx. 30 around caudal peduncle.

520 and 530 mm. (to end of middle caudal rays), end of hypural to end of middle caudal rays 60 and 65 mm. resp. Purplish-grey, tongue and lining of mouth grey, dorsal fin blackish-grey, anal pectorals and ventrals grey; iris dark, pupil as preserved pale (probably translucent when alive).

Locality.—Stock-fish ground N.W. of Table Bay, approximately 250 fathoms: (larger specimen) Nov. 1941 (Dr. Molteno, Vitamin Oils Ltd.), (smaller specimen) March 1943 (National Trawling and Fishing Co. Ltd.).

Remarks.—Specimens of *porosa* up to 140 mm. in length have been described from the coast of Australia (Richardson) and the Kermadec Islands (Günther). Richardson's type is the largest known specimen, and there is a close agreement between his description and figure and the present specimens. The points of agreement include the relative lengths of the dorsal spines, and the isolated patch of scales on the supra-scapular region. The anterior rays, however, of the soft dorsal and anal fins, especially of the former, are considerably longer than the hinder rays, whereas in Richardson's specimen there is much less difference in length. The pectoral is distinctly falcate instead of broadly rounded as shown in Richardson's figure. There are 1 or 2 rays less in the dorsal and 1 less in the anal than in the type.

These differences, and the diminution in the denticulation of the edges of the preorbital, opercle and subopercle, may very likely be due to the greater size of the present specimens.

The North Atlantic species *P. perciformis* (Mitchell), according to Regan (*l.c.*, 1902, p. 202), has the dorsal spines behind the 4th subequal instead of decreasing in length. I have not seen Morton's description of the Tasmanian *H. johnstonii* (1888, Pap. Proc. Roy. Soc. Tasman. for 1887, pp. xlvii and 77, plate).

For the present, therefore, the Cape specimens are referred to Richardson's species.

Family SCORPAENIDAE.

Scorpaena kowiensis J. L. B. Smith.

1935. Smith, J. L. B., Rec. Albany Mus., iv, p. 224.

Port St. Johns, one specimen, 1944. 112 mm. Well-developed supraorbital tentacles. Four skinny flaps along the lateral line, the last at base of caudal peduncle.

Red-brown, obscurely mottled; dorsal fin dark brown, mottled, with an oblique pale band on soft dorsal from top of 1st ray to base of posterior rays; anal with 3 oblique dark bars, ground colour buff between basal and middle bars, crimson between latter and marginal bar; pectoral with dark spots forming bars; pelvics bright orange-red in axils, rest dull salmon, with a dark bar across middle and another along margin; caudal irregularly barred.

This second specimen with fin formula similar to that of the type, seems to confirm the validity of the species, though the additional differences formerly supposed to distinguish it from *haplodactylus* prove to be fallacious. The type was 59 mm. long, and possibly the supraorbital tentacles and skinny flaps had not been developed, or they had been rubbed off when the specimen was "beach-rolled". The present specimen was also picked up on the beach after a cold snap, but fortunately is in excellent condition.

Gen. Scorpaenodes Blkr.

1857. Bleeker, Nat. Tijdschr. Ned. Ind., xiii, p. 371 (pro *Scorpaenichthys* Blkr. 1856, non Girard 1854).

Resembles *Scorpaenopsis* in the absence of palatine teeth, but has D xiii, and ctenoid scales on the head.

Scorpaenodes guamensis (Q. and G.).

1824. Quoy and Gaimard, Voy. Uranie & Phys. Zool., p. 326 (*Scorpaena g.*).

1878–88. Day, Fish. Ind., p. 150, and Supplem., p. 788 (*Scorpaenopsis g.*).

1885. Ramsay and Ogilby, Proc. Linn. Soc. N.S.W., x, p. 577 (*Sebastes scabra*).

1913. McCulloch, Rec. Austral. Mus., ix, p. 387, pl. 13, fig. 2 (*Sebastopsis scabra*).

1928. Fowler, Fishes of Oceania. Mem. B. P. Bishop Mus., x, p. 289, and p. 290 (*scabra*).

1931. *Id.*, Supplement 1, *Ibid.*, xi, p. 349.

1943. Schultz, Bull. U.S. Nat. Mus., no. 180, pp. 170 (in key), 173.

A specimen, 93 mm. in length, from the neighbourhood of Port St. Johns, agrees closely with Fowler's description of *scabra*, except as regards the suborbital stay which agrees better with Garman's figure (Bull. Mus. Comp. Zool. Harv., xxxix, no. 8, pl. 1, fig. 2) of *erinacea* (=*guamensis fide* Fowler *l.c.*). A smooth keel ends below the anterior third of eye, followed by two keels each ending in a spine, the 1st below middle of posterior third of eye, the 2nd near edge of preopercle which bears a double spine.

D xiii. 10. A iii. 5. 2nd anal spine nearly as long as the depressed anal fin.

McCulloch's figure differs in showing the middle keel (*i.e.* the 1st keel ending in a spine) considerably shorter than the posterior one, whereas in Garman's figure and the present specimen the difference in length is not so great, though the posterior keel is the longest.

S. guamensis is recorded from the Red Sea, Malaya, East Indies, Australia, and Southern Pacific, *scabra* from the last two areas. Though both McCulloch and Fowler maintain the two species, one wonders whether they may not really be conspecific. The present specimen appears to be a male. Possibly the length of the 2nd anal spine is a sexual character. Schultz finds that it is very variable, and is inclined to regard *scabra* as a synonym.

Family MONACANTHIDAE.

1927. Barnard, *l.c.*, p. 949 (*Balistidae*: part).

Gen. Stephanolepis Gill.

1861. Gill, Proc. Ac. Nat. Sc. Philad., p. 78.

1940. Fraser-Brunner, Ann. Mag. Nat. Hist. (xi), v, 518 (key to species).

Distinguished from *Monacanthus* by the pedunculate dermal scales.

Fraser-Brunner has revised the genus, redefined the true *setifer* of Bennett (a Caribbean species), and resurrected Castelnau's South African species *auratus*.

Key to the South African species.

1. Profile of snout concave. Length of caudal peduncle 3 in length of head. D and A rays 32–33. P. 14 . . . . *auratus.*
2. Profile of snout straight. Length of caudal peduncle 4 in head. D and A rays 30–31. P. 13 . . . . *rectifrons.*

Stephanolepis auratus (Cast.)

1861. Castelnau, Mem. Poiss. Afr. Austr., p. 77 (*Monacanthus a.*).

1927. Barnard, *l.c.*, p. 955 (*setifer*, non Bennett).

1935. Smith, Rec. Albany Mus., iv, p. 228, pl. 19, fig. B (*setifer*, non Bennett).

1940. Fraser-Brunner, *l.c.*, pp. 522 (in key), 532.

Brownish with indistinct dark or blackish spots, mostly transverse, but some of them usually more or less confluent to form a longitudinal stripe on hinder part of body and caudal peduncle; caudal fin obscurely barred. Castelnau's 60 mm. specimen was golden brown, soft dorsal and anal fins yellow. Length of largest specimen in South African Museum 170 mm.

Localities.—Knysna to Zululand.

Stephanolepis rectifrons F–B.

1940. Fraser-Brunner, *l.c.*, pp. 522 (in key), 531, fig. 6.

Dark brown with more or less distinct black blotches tending to form transverse bands; caudal fin with 2 dark bars. 125 mm.

Localities.—Delagoa Bay and Zanzibar.

Family OSTRACIONTIDAE.

1935. Fraser-Brunner, Ann. Mag. Nat. Hist. (x), xvi, p. 313 (synopsis of genera).

1940. *Id.*, *ibid.* (xi.), vi, p. 390 (sexual dimorphism).

Ostracion lentiginosus Bl. Schn.

1851. Bleeker, Verh. Bat. Gen., xxiv, p. 32, pl. 6, fig. 13 (*sebae* = ♂).
1865. *Id.*, Atlas Ichthyol., v, p. 41, pl. 204, fig. 1 (*sebae*).
1927. Barnard, *l.c.*, p. 962 (*punctatus*).
1934. Fowler, Proc. Ac. Nat. Sc. Philad., lxxxvi, p. 510.
1940. Fraser-Brunner, *l.c.*, p. 391.

Two specimens have been washed up on the beach at Strandfontein, in False Bay (Cape) (Jan. and March 1938).

One, 28 mm. in length (incl. caudal), agrees with the Natal specimen described in 1927. The smaller one, 10 mm. in length (incl. caudal), has the ventro-lateral keel more pronounced, and a low blunt ridge (or longitudinally compressed tubercle) immediately in front of the dorsal fin, but not extending forwards beyond the vertical from base of pectoral fin. The hinder part of the carapace is therefore 5-angled. No indication of any spines.

Family MOLIDAE.

Mola mola and *lanceolata*.

1861. Castelnau, Mem. Poiss. l'Afr. Austr., p. 75 (*Pedalion, Aledon, capensis*).

1935. Barnard, Ann. S. Afr. Mus., xxx, p. 653, figs. 5–7.

1937. Gudger, Proc. Zool. Soc. Lond., cvii, A, p. 353, figs. 1–24 and pls. 1–5 (natural history and distribution of *lanceolata*) (references).

In the list of records (1927) I omitted Castelnau's record of *mola*; and in the files of the South African Museum I have found two other records both presumably referring to *mola*.

(*mola*) 5th November 1856. Castelnau. Length 1000 mm. Height 600 mm.
(? *mola*) April 1878.
(? *mola*) 21st December 1881. $\Big\}$ reported to S. Afr. Mus.

Since 1934 the following are the records of these two Ocean Sunfishes from the neighbourhood of Table Bay, which have been reported to the South African Museum:—

(*mola*) June 1935. 36 inches in length.
(*mola*) July 1935. $17\frac{1}{2}$ inches in length (cast of this in S. Afr. Mus.).
(*mola*) 1st October 1935. 24 inches in length.
(*mola*) 18th November 1935.
(*mola*) 11th January 1936.
(*mola*) 25th January 1938.
(*mola*) 20th March 1938.
(*mola*) 10th October 1939.
(*mola*) 2nd October 1940.
(*lanceolata*) 15th January 1942.

Amongst some papers of the late Dr. J. D. F. Gilchrist, I have found photographs of two specimens which seem worth figuring here.

The small specimen (Plate XII), Table Bay, 1900, was approximately 23–24 inches in length, judging by the size of a man's head alongside the fish in the original photograph. The profile of the tail has a perfectly even curve. The $17\frac{1}{2}$ in. and 24 in. specimens recorded above were of the same shape.

The large specimen (Plate XIII), Kalk Bay (False Bay), 1901, was approximately 6 feet in length, judging by the man alongside in the original photograph. Both dorsal and anal fins and the lower part of the caudal fin appear to have suffered injury while the fish was alive. The frontal view shows unusually heavy supra-orbital ridges.

Mola alexandrini (Ranz.).

1839. Ranzani, Nov. Comm. Ac. Sci. Inst. Bonon., iii.
1935. Barnard, *l.c.*, p. 655, fig. 5, *a*, *b*, and p. 658 (*mola*).

In 1935 I recorded a remarkable Sun-fish stranded in 1934 at Kommetje (west coast of Cape Peninsula), which I regarded as a freak specimen of *mola*. This opinion I am now inclined to revise in view of a very similar specimen which was caught near the shore at Sea Point (Cape Town) in January 1942.

Its length was 5 ft. 10 in. In side view the shape was similar to that of the Kommetje specimen (*l.c.*, fig. 5, *a*), but not quite so prominently protuberant on the throat; and the profile of the dorsal ridge began farther forward, above or slightly in advance of the vertical from the eye. In fact, if one assumes a certain crudity in Ranzani's drawing, the present specimen is intermediate between his and my figures.

The coloration of both the Kommetje and Sea Point specimens was considerably paler than is usually the case in typical *mola*. The upper part of the back, and the dorsal and anal fins, are blackish, but the dark colour shades off, in an irregular and blotchy pattern, into grey on the flanks behind the pectoral fin, and the lower parts are more or less silvery.

Both the Kommetje and Sea Point specimens appeared to be males; at least they were not definitely females. The former specimen was somewhat decomposed when I examined it, and the latter had the abdominal cavity cut open by curious sightseers and the organs were partially dried in consequence.

I am indebted to Mr. J. R. Norman for the tracing of Ranzani's figure; I do not know what description Ranzani gave. But the presence at the Cape of two examples of such extraordinary shape certainly seems to warrant the use of a distinctive specific name, and Ranzani's name seems suitable.*

Hyperostosis.

Figs. 15, 16.

Swelling and thickening of the supraoccipital bone is well-known in a number of fishes: *Platax, Sparidae, Sciaenidae,* etc. (Köstler, Zeitschr. wiss. Zool., xxxvii, p. 429, 1882; Pellegrin, Mem. Soc. zool. France, xvi, 1903, p. 118, 1904). Ebina (J.Imp. Fish. Inst. Tokyo, xxxi, p. 69, 1936) has given photographs of the enlarged supraoccipital bone in the ♂ and ♀ of *Evynnis cardinalis*, showing that the bone tends to become thicker and more elevated in the former.

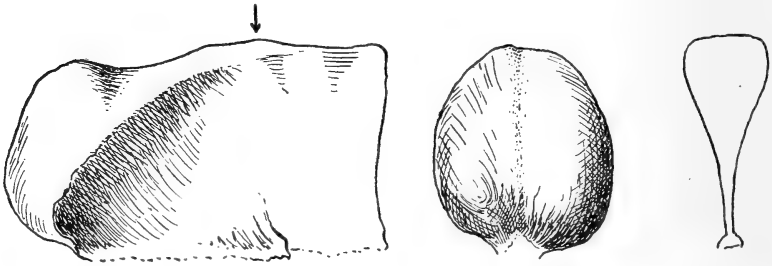
A figure is given here (fig. 15, *a*) of the supraoccipital of a Red Stumpnose, *Chrysoblephus gibbiceps*, from a skeleton, sex unknown, in the South African Museum.

In the course of mounting for exhibition a large specimen of *Caranx equula* (total length 580 mm., sex not determinable), Mr. Drury, the Museum taxidermist, discovered a relatively enormous bony mass on the top of the skull. This proved to be the enlarged supraoccipital (fig. 16, *c, d*). Two other specimens were then examined. One 285 mm. in length (sex not determinable), showed an early stage of hyperostosis (fig. 16, *b*). The other, 185 mm. in length, showed no sign of hyperostosis, the supraoccipital forming a thin vertical keel (fig. 16, *a*).

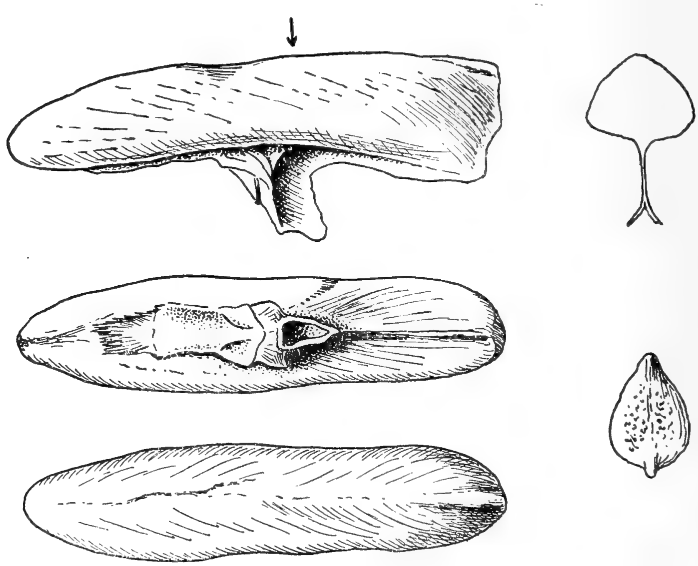
At the same time Mr. Drury found the two suprascapulars. These also are subject to hyperostosis. In the smallest specimen, with the

* See note p. 406.

thin keel-like supraoccipital, they are elongate-oval in shape and quite thin (dorso-ventrally) (fig. 16, *a*). In the 285 mm. specimen they are subcylindrical, with a groove and a curved ridge on the



a

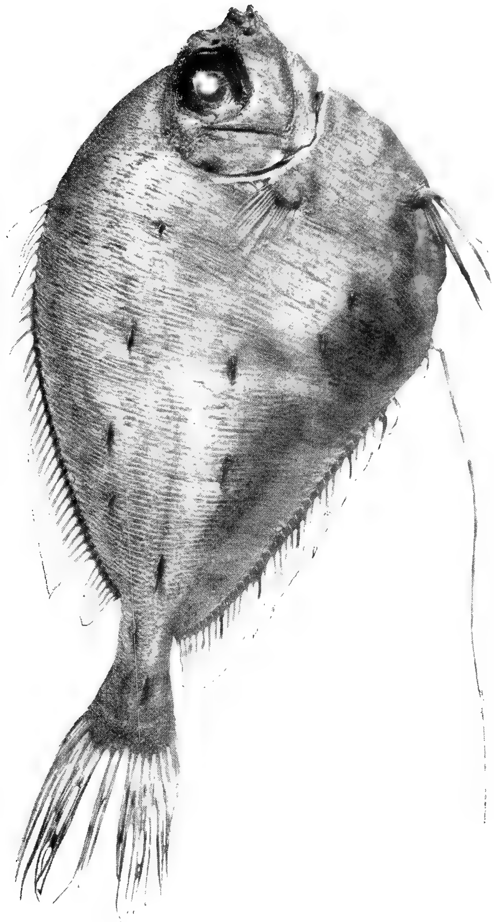


b

Fig. 15.—Hyperostosis of supra-occipital bone. *a*, *Chrysoblephus gibbiceps*, lateral and frontal views, and section at arrow; length 70 mm., height at arrow 37 mm. *b*, lateral, ventral, dorsal, and posterior views, and section at arrow, of a supra-occipital bone from Strandlooper kitchen-midden deposits at Hermanus, Cape Province; length 90 mm.

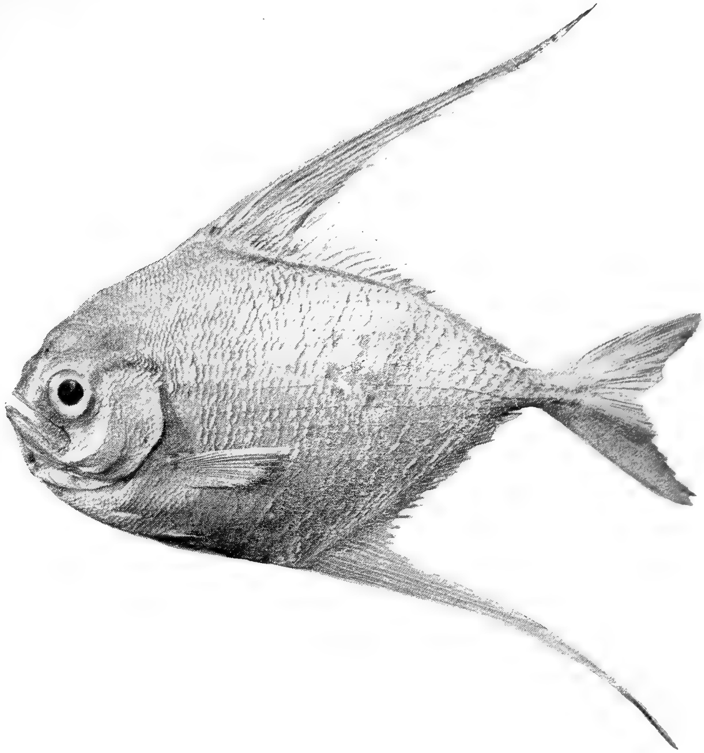
external surface (fig. 16, *b*). In the largest specimen they are very massive; the ridge has been obliterated by the excessive growth of bone, and only a faint trace of the groove remains (fig. 16, *e*, *f*).

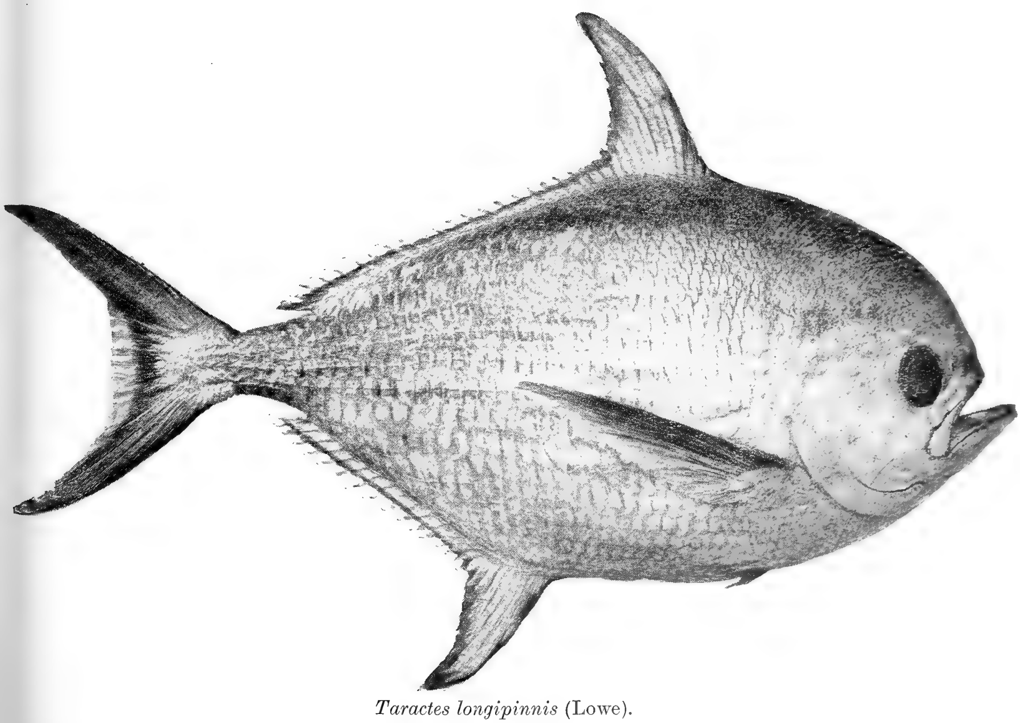
The real reason, however, for introducing this subject of hyperostosis



Xenolepidichthys americanus N. and F.

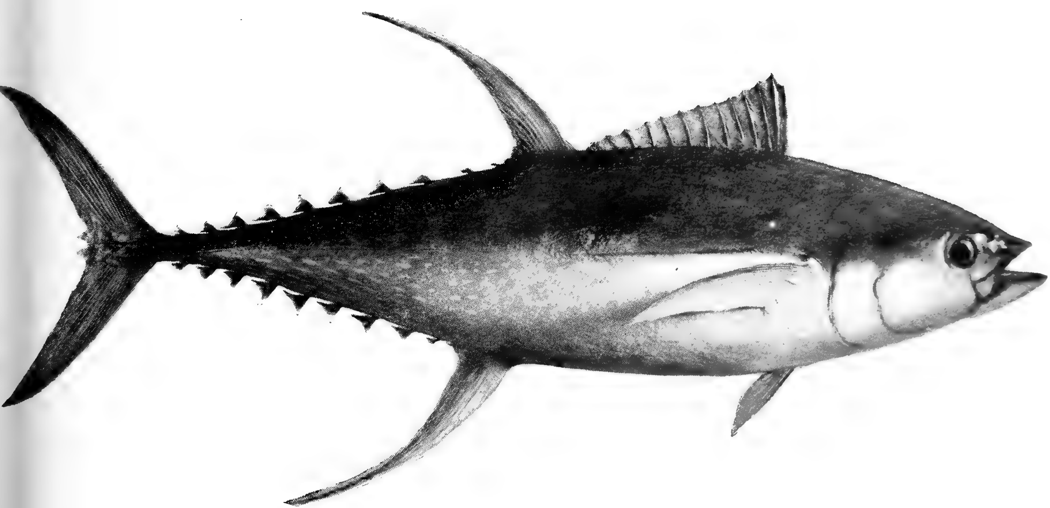
K. H. Barnard. *Neill & Co., Ltd.*





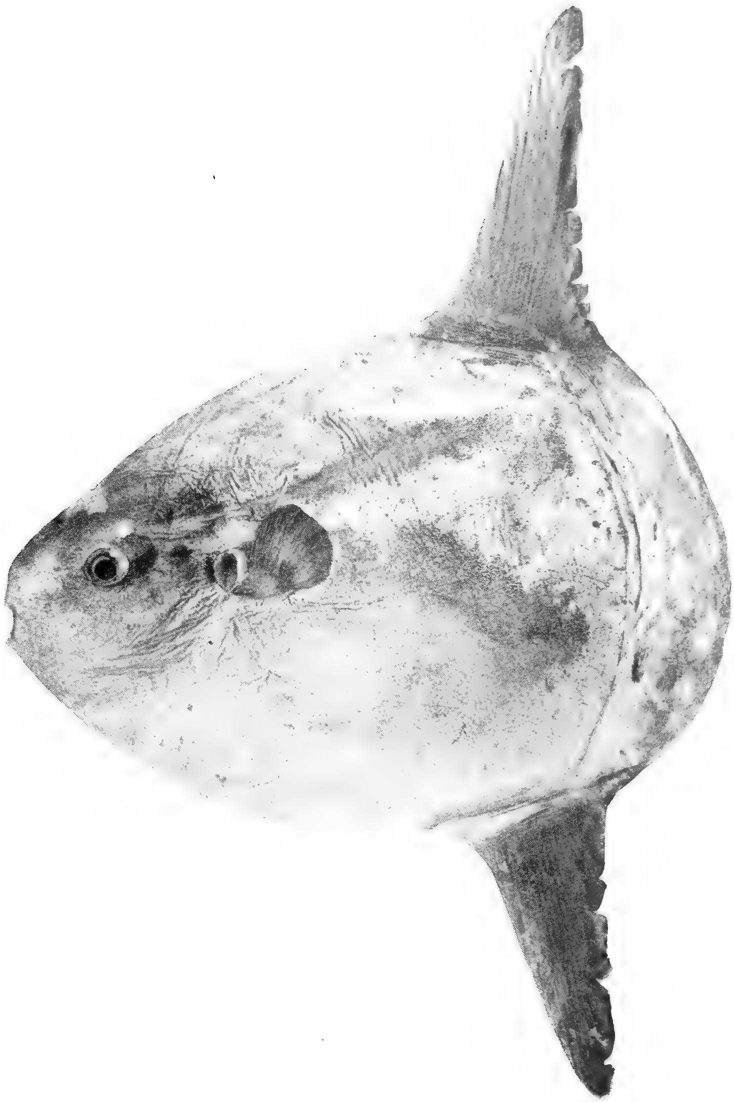
Taractes longipinnis (Lowe).
Upper figure 300 mm., lower figure 765 mm. in length.

K. H. Barnard. *Neill & Co., Ltd.*



Upper figure, *Histiopterus spinifer* Gilch., 72 mm.
Lower figure, *Neothunnus albacora* (Lowe) 5 ft. 6 in.

K. H. Barnard, Neill & Co., Ltd.



Mola mola, young, approximately 23 inches in length.

Photo: By the late Dr Gilchrist. *Neill & Co., Ltd.*

Mola mola, lateral view of mutilated specimen, and front view of head.

Photo: By the late Dr Gilchrist.

Neill & Co., Ltd.

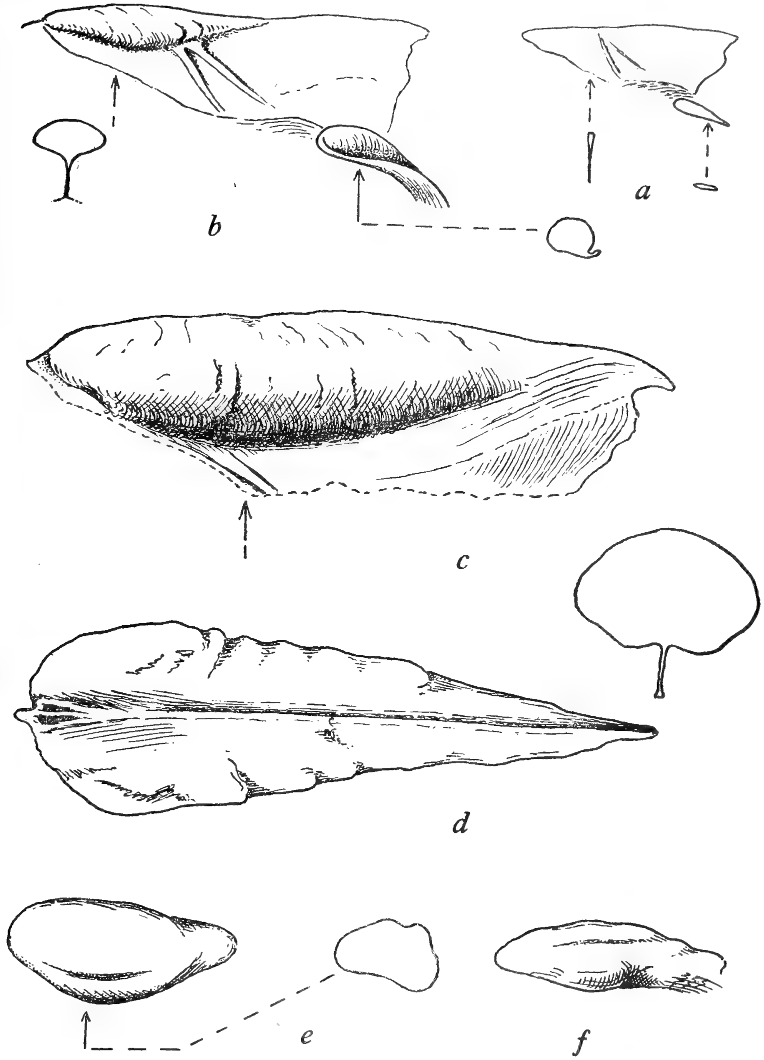


FIG. 16.—Hyperostosis of supra-occipital and supra-scapula bones in *Caranx equula*. *a*, specimen 185 mm. in length, lateral view with sections, length of supra-occipital 40 mm. *b*, specimen 285 mm. in length, lateral view with sections, length of supra-occipital 71 mm. *c*, specimen 580 mm. in length, lateral view of supra-occipital with section, length 115 mm. *d*, the same, dorsal view, width 33 mm. *e f*, the same specimen, dorsal and external lateral views of left supra-scapula, with section, length 42 mm.

In all cases anterior end to the left; in section attached to *e* the external surface is to the right; in *f* the zigzag lines at right-hand end indicate broken surface of bone.

is to give a figure (15, *b*) of a remarkable bone which has been found occasionally in kitchen-midden deposits at Hermanus (see Goodwin, Ann. S. Afr. Mus., xxiv, p. 211, 1938). The bone has caused considerable speculation. It seems to be undoubtedly the supra-occipital of a fish; and Mr. Norman of the British Museum agrees with this identification. But the question is to what fish it belongs.

Mr. Norman was unable to match it with any of the skeletons in the British Museum. It corresponds in a general way with the supraoccipital of one of the ♀♀ illustrated by Ebina (fig. 9, B), being low and subcylindrical. But the primitive peoples who left the kitchen-middens would not catch ♀♀ only, and no specimens of high and gibbous ones like that of the ♂ *Evynnis*, or the Red Stumpnose here figured, were found in the deposits.

It also resembles the supraoccipital of the *Caranx* mentioned above in being elongate and subcylindrical; quite different from the Sparid type illustrated by the Red Stumpnose. With this general resemblance as a hint, examples of the following local fishes allied to *Caranx* were examined. *Lichia amia* (Leer-fish or Garrick), *Trachurus trachurus* (Maasbanker), *Seriola* (Yellow-tail), *Trachinotus baillonii* (=*russellii*). Only young examples of *Seriola* were available (not exceeding 300 mm.). All these examples had the thin keel-like supraoccipital without any thickening.

Specimens (not exceeding 450 mm.) of *Sciaena* (Kabeljouw) and *Atractoscion* (Cape Salmon or Geelbeck) have also been examined.

It would seem that the fish, to which the bone belongs, must be some fish which is (or was) plentiful inshore along the southern coast and easily either caught on primitive hooks or trapped in the stone fish-kraals.

The specimen figured is 90 mm. in length. I have seen smaller specimens (50 mm.), but none larger.

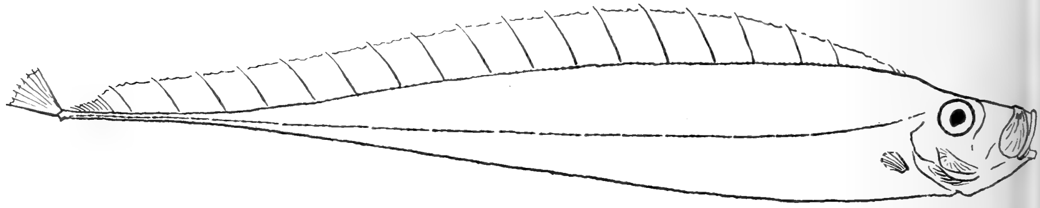


FIG. 17.—*Trachypterus arcticus* (Brünn).

NOTE.—The Peace Memorial Museum, Zanzibar, has sent me a photograph of a specimen of Ranzani's or Alexandrine Sunfish which was washed ashore at Wete Harbour, Pemba, in September 1947, length 6 feet.

A specimen 5 ft. 7 in. in length was washed ashore on Mouille Point beach (Cape Town) on 7th April 1948, constituting the third Cape record.

8. *Report on a Collection of Fishes from the Okovango River, with Notes on Zambesi Fishes.*

By K. H. Barnard, D.Sc., F.L.S., Assistant Director.

(With 9 Text-figures.)

In 1939 Mr. Eedes, Native Commissioner stationed at Runtu on the Okovango River, South West Africa, sent to the South African Museum a collection of Fresh-water Fishes. The specimens were excellently preserved, and in spite of transport difficulties, arrived in perfect condition. Mr. Eedes is to be congratulated on his energy and enthusiasm in making the collection. Very little collecting has been done in the Okovango River, and the collection thus forms a very important addition to the South African Museum collections.

The specimens were identified and a preliminary report sent to Mr. Eedes. Publication of the present fuller report has been delayed by world conditions. In preparing it I have utilised Gilchrist and Thompson's material and the material received by the South African Museum from various collectors since the publication of their monograph in 1917.

Of these collections special mention should be made of those presented by the Rev. Ellenberger from Lealui (Lialui) and the Rev. Jalla from Sesheki (Shesheki) (see map, fig. 1). These have been of great value for comparison with Mr. Eedes' collection.

It may be noted that the Rev. Ellenberger also sent specimens to Dr. Pellegrin at the Paris Museum; and that Pellegrin and Gilchrist and Thompson do not always agree on the identity of their respective specimens which one suspects are really conspecific, having been caught not only at the same locality but very likely also at the same time (see *Synodontis jallae, infra*).

In this paper I have commented on some cases of synonymy, which, on the basis of the material examined, seem moderately certain. To be really useful, however, criticism and discussion of synonyms should be based on extensive fresh material; "arm-chair" criticism based on a few odd specimens collected casually here and there often produces ill-considered results. I have tested Regan's suggestions as to the synonyms of Gilchrist and Thompson's species of Cichlids by examination of the types in the South African Museum.

We are very far from being able to discuss the geographical distribution of the fresh-water fishes of this region in relation to the fish-fauna of other African and South African regions. There are still too many doubtful identifications of recorded species. For example, Pellegrin (1936) records *Barbus burgi* Blgr. from the Cubango River in Angola. I do not for a moment doubt that Pellegrin's material agreed with Boulenger's description, and that the only alternative would have been the institution of a *n.sp.* whose diagnosis would have disclosed no apparent differences from *burgi*.* But I find it impossible to believe that *burgi*, which is a synonym of *burchelli*, a *Red-fin* species inhabiting only a single river system in the S.W. Cape, should also occur in the Angolan highlands. The life-history and the specific characters at every stage of growth must be worked out before we can claim to have a true knowledge of the actual species constituting the fish-fauna of a region†

Historical.—Castelnau recorded from Lake Ngami thirteen species obtained for him by one of his "préparateurs" (1861, Mem. Poiss. de l'Afr. Australe), and of these nine have maintained their status as valid species as the outcome of later researches.‡

Boulenger (1911, Trans. Zool. Soc. London, xviii, p. 399) described a collection made by Mr. R. B. Woosnam and was able to identify the majority of Castelnau's species, which up to that time had been really *species inquirendae* owing to inadequate descriptions. He recorded twenty-five species, which included all of Castlenau's species except two (*Mormyrus lacerda* and *Hydrocyon vittatus*).

These species were incorporated in Boulenger's classic Catalogue of Fresh-water Fishes of Africa (vols. 1–4, 1909–1916).

Gilchrist and Thompson (1913 and 1917, Ann. S. Afr. Mus., xi, pts. 5 and 6) based their work on Boulenger's Catalogue. They had in addition a collection of Ngami fishes made by Mr. H. F. Kirkham and presented to the South African Museum. Five species were added to the list, two of them being described as new.

* Cf. Trewavas, 1936, Novit. Zool., xl, p. 69. *B. mocoensis* Trew. from Angola compared with *B. burgi*.

† *Cf.* Barnard, Ann. S. Afr. Mus., xxxvi, p. 188, 1943.

‡ Including *Chromis levaillantii*, which Boulenger claimed to have recognised as *P. angusticeps*. On the ground that a good description of the latter had been given in 1907, Boulenger in 1911 declined to accept Castelnau's name as he was not *quite* certain of the identity.

Regan's revision of the *Cichlidae* (1922, Ann. Mag. Nat. Hist (9), x, p. 249), however, removed *Tilapia woosnami* Blgr., T. *kirkhami* G. & T., and *Pelmatochromis ngamensis* G. & T. from the list as synonyms. *Paratilapia longimanus* Blgr. was regarded as a synonym of *Serranochromis macrocephalus* (Blgr.), but remained on the list of Ngamiland species. Regan also regarded *T. sheshekensis* G. and T. as a synonym of *T. andersonii.*

In 1923 the South African Museum received a collection from Captain Stigand which contained, however, only species already known from Ngamiland.

With the exception of *Barbus poechii* Stndnr. (1930, Lohberger, Zool. Anz., lxxxviii, p. 246), which is a synonym of *B. trimaculatus,* no more records appear to have been published until Fowler described the results of the de Schauensee Expedition (1931, Proc. Ac. Nat. Sci. Philad., lxxxiii, p. 233) and the Vernay-Lang Kalahari Expedition (1935, Ann. Transvaal Mus., xvi, p. 251). These expeditions added respectively five species, of which three were new, and fifteen species, of which eleven were new.

In the following report, however, I have shown that some of Fowler's species are definitely synonyms, and others probably so. Fowler completely ignores Regan's classification of the *Cichlidae,* and consequently as no anatomical details are given for Fowler's n. spp. (*Tilapia alleni, deschauenseei, Paratilapia deschauenseeae*) one can only guess where they should be placed in Regan's system, or with what species they should be compared.

In 1936 Pellegrin published an important contribution to the ichthyology of Angola (Arq. Mus. Bocage Lisbon, vii, pp. 45–62). Part of Pellegrin's material was collected in the Cubango River, which is the upper portion of the Okovango River. His results are therefore particularly useful for comparison with the collection made by Mr. Eedes.

This is the list of species recorded by Pellegrin, together with those collected by Mr. Eedes (see p. 410).

According to the Zoological Record (lxxvi, 1939, Pisces, p. 60), Tortonese published a paper on Zambesi fishes (Boll. Mus. Zool. Torino, xlvi, 1939, p. 73). I have not seen the paper.

Geographical.—Mr. Woosnam stated in his report (in Boulenger, 1911, p. 400) that "although the fish were labelled 'Lake Ngami' for convenience of reference to maps, they come in reality from the Okovango River and vast extent of marshes (of which Lake Ngami is a part) into which the river opens out before it continues its way

	Pellegrin, 1936.	Eedes coll.	Remarks.
Marcusenius cubangoensis Pelleg.	×		
Petrocephalus stuhlmanni Blgr.		×	
Gnathonemus macrolepidotus (Peters)	×		
Mormyrus anchietae Guim.	×		
Hepsetus odoë (Bl.)	×		
Hydrocyon vittatus (Cast.)		×	
Alestes lateralis Blgr.	×		
Micralestes acutidens (Peters)		×	
Petersius woosnami Blgr.	×		
Nannocharax multifasciatus Blgr.		×	
Hemigrammocharax monardi Pelleg.	×		
Labeo cylindricus Peters	×		
greeni Blgr.	×		
forskalii Rüppell		×	
parvulus G. and T.		×	
Barbus hypostomatus Pelleg.	×		
rhodesianus Blgr.	×		
trimaculatus Peters	×	×	
paludinosus Peters	×	×	
eutaenia Blgr.	×		
viviparus Weber	×	×	Recorded by Pellegrin as *bifrenatus* Fowl., see p. 426.
burgi Blgr.	×		See p. 408.
unitaeniatus Gnthr.	×		
barotseensis Pelleg.		×	
lineomaculatus Blgr.	×		
macrurus G. and T.		×	
lujae Blgr.	×		
barilioides Blgr.	×		
sp. juv.		×	
(*Beirabarbus*) *okavangoensis* Brnrd.		×	
Barilius neavei Blgr.	×		
Clarias gariepinis Burch.	×	×	
ngamensis Cast.	×		
dumerili Stndr.	×		
Schilbe mystus Linn.	×		
Amphilius platychir Gnthr. var. *cubangoensis* Pelleg.	×		
Auchenoglanis ngamensis Blgr.	×	×	
Synodontis nigromaculatus Blgr.	×		
woosnami Blgr.	×		
macrostigma Blgr.	×		
melanostictus Blgr.		×	
jallae G. and T.		×	
Chiloglanis fasciatus Pelleg.	×		
Haplochilus cabindae Blgr.	×		
Hemichromis fasciatus Peters	×		
Pelmatochromis thumbergi (Cast.)	×	×	Now *Serranochromis t.*
genisquamulatus Pelleg.	×		? = *S. thumbergi*, see p. 447.
welwitschi Blgr.	×		

	Pellegrin, 1936.	Eedes coll.	Remarks.
Tilapia galilaea Art.	×		? = *macrochir.*
melanopleura Dum.	×	×	
macrochir Blgr.		×	
ovalis Stndr.	×	×	= *Haplochromis moffatii.*
sparrmanii A. Smith	×	×	
Sargochromis codringtoni		×	
Serranochromis sp.?		×	
Anabas multispinis Peters	×		Now *Ctenopoma m.*
Mastacembelus mutombotombo Pelleg.	×		

as a single great river known as the Botletle or Zouga." Except that he travelled from Lehutitu to Okwa, Woosnam did not give his itinerary, so that the actual locality or localities are not known. It is clear, however, that "Okovango River" refers to that portion of the river within the political boundaries of Bechuanaland (map, fig. 1).

He refers (p. 401, footnote) to the likelihood of the Okovango marshes being connected with the Chobe marshes in times of flood; and concludes his report with his opinion that: "There are not and never have been any fish in Lake Ngami which are not also in the Okovango and marshes. . . . But that there are fish in the upper waters of the Okovango which are not found in the marshes is highly probable" (p. 402).

The de Schauensee collection was made at Maun on the Thamalakani River (upper or northern reaches of the Botletle). The Vernay-Lang Expedition collected at the same locality, at Tsotsoroga Pan between the Okovango marshes and the Chobe, and in the Chobe River; and also in the Nata River flowing from the east into the Makari-kari Salt Pan.

From the list of recorded species prior to 1930, and taking into account the collections in the South African Museum from the Upper Zambesi River (those received after the publication of Gilchrist and Thompson's work will be included in this report), the fish-fauna of "Ngamiland" appeared to be essentially the same as that of the Zambesi. Fowler's reports, however, seemed to show that there are a certain number of endemic species. This element will very likely be reduced or wholly cancelled when more intensive collecting has been carried out in the Zambesi River, especially in the case of small species of *Barbus*.

The importance of the present collection is that it was made in the

Okovango River far above the area where it branches and loses itself in the marshes of Ngamiland, but below that portion of the selfsame river known as the Cubango River in Angola, whence Pellegrin (1936) obtained his material. The actual locality is Runtu, S. lat. 17° 55′ E. long. 19° 43′, between Andara and Kuringkuru (88 miles east of the latter place) (see map, fig. 1).

Family MORMYRIDAE.

Marcusenius castelnaui Blgr.

1913. Gilchrist and Thompson, Ann. S. Afr. Mus., xi, p. 328, and 1917, pp. 578, 579.

1913. *Id. ibid.*, p. 327 (*isidori*, non C. & V.).

1916. Boulenger, Cat. F. W. Fish. Afr., iv, p. 159, fig. 106.

1916. *Id. ibid.*, p. 161 (quotes G. and T's record of *isidori* without comment).

The three specimens from the Kafue River recorded by Gilchrist and Thompson are not in good condition, but are certainly not *isidori*. This latter species should be expunged from the South African fauna-list.

As a matter of fact the specimens agree quite well with *castelnaui*. Gilchrist and Thompson's diagnosis seems to be composite. The teeth number respectively from the smallest to the largest $\frac{7}{7}$, $\frac{7}{8}$, $\frac{7}{9}$; in the last case the 3 on the right side of the jaw appear to be replacers and are not pushed up to the level of the other teeth.

There are also in the South African Museum six specimens from Lialui and fifty-four from Sesheki, both localities on the Zambesi, the latter opposite the Linyanti and Chobe swamps. The Sesheki specimens range from 28 to 75 mm. The normal number of teeth seems to be $\frac{7}{8}$. The larger specimens frequently have fourteen scales around the caudal peduncle.

M. discorhynchus Peters, from the Lower Zambesi (Tete), has been recorded by Pellegrin (1920) from Lialui on the upper Zambesi.

M. cubangoensis Pelleg. (1936) from the Cubango River (Upper Okavango River) differs from *discorhynchus* in having fewer anal rays (22–22) and a gibbosity on the chin.

Petrocephalus stuhlmanni Blgr.

1909. Boulenger, *l.c.*, i, p. 56, fig. 41.

1916. *Id., ibid.*, iv, p. 156.

1917. Gilchrist and Thompson, *l.c.*, p. 562 (Lialui specimens recorded as *catostoma*).

There is a discrepancy in the number of scales around the caudal peduncle as given by Boulenger and by Gilchrist and Thompson: *catostoma* 16, *stuhlmanni* 12 according to the former, *vice versa* according to the latter authors.

The Leydsdorp specimen identified as *stuhlmanni* by Gilchrist and Thompson has 16 scales around the caudal peduncle, the Kafue specimens have 12. In Boulenger's key the Kafue specimens do in fact run down to *stuhlmanni*, whereas the Leydsdorp specimen, which has the same curious kink in the anal fin as shown in Boulenger's figure of *stuhlmanni*, runs down to *catostoma*. Who is correct?

It seems a little curious that a half-grown specimen from the Kafue River, whence Gilchrist and Thompson identified five specimens as *catostoma*, should be identified as *stuhlmanni* by Boulenger in 1916. All six specimens were collected at the same time and place by Mr. Drury (S. African Museum taxidermist attached to the Duke of Westminster's Expedition).

The South African Museum also possesses six specimens from Lialui, Upper Zambesi, 52–58 mm., and one from Mr. Eedes' collection from the Okovango River, 73 mm. (to end of middle caudal rays).

All these specimens have 12 scales around the caudal peduncle, and agree also in other respects; but not even the largest one has any sign of the irregular anal fin base.*

The Okovango specimen, as preserved in formalin, is very dark sepia, almost black on top of head and along dorsal profile, throat and breast pale greyish-white, an indistinct blackish bar across the end of the scaling on caudal peduncle (not on the rays).

Family CHARACINIDAE.

Hydrocyon vittatus (Cast.).

1861. Castelnau, Mem. Poiss. Afr. Austr., p. 65 (*Hydrocinus v.*).

1913. Gilchrist and Thompson, *l.c.*, p. 338, fig. 12 (*lineatus*), and 1917, pp. 562, 578.

1939. Ricardo, Fish. Lake Rukwa and Bangweulu, pp. 21, 56 (*lineatus*).

This occasion is taken to note that the South African Tiger-fish should really be called by Castelnau's name: *vittatus*; and also to

* In *Gnathonemus macrolepidotus* this is a sexual character of the ♂. Ovigerous ♀♀ have a perfectly straight anal base.

draw attention to a somewhat remarkable outlying locality, Lake Sibayi in Zululand, where this fish is said to occur. The record appears in Mr. A. C. Harrison's Black-bass Report (1936, Fish. Mar. Surv. Investig., Rep. 7, p. 108) and rests on field observation only, no specimens having been submitted to Mr. Harrison.

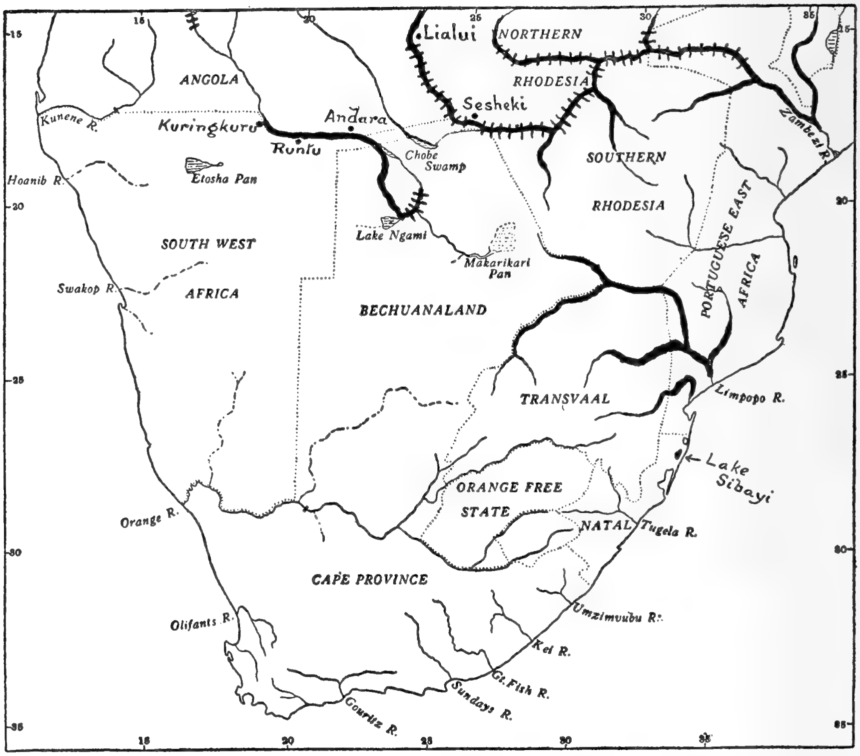


FIG. 1.—Distribution of: Tiger-fish (*Hydrocyon vittatus*), rivers thickened, also Lake Sibayi; Lesser Tiger-fish (*Hepsetus odoë*), rivers crossed.

Its absence from Lake Nyasa north of the Murchison Rapids on the Shiré River is also noteworthy (Worthington, Proc. Zool. Soc. Lond., 1933, i, pp. 286, 289; Bertram, Borley and Trewavas, Fish. Lake Nyasa, 1942, p. 18).

The map (fig. 1) shows the distribution of the Tiger-fish (*H. vittatus*) and the Lesser Tiger-fish (*Hepsetus* * *odoë*). Mr. Eedes caught the former, but not the latter, in the Okovango River. On the other

* Hubbs (Copeia, 1939, no. 3, p. 168) has resurrected Swainson's name *Hepsetus*, 1838, to take the place of *Hydrocyonoides* Castelnau.

hand, Pellegrin records the latter but not the former from the Cubango River.

Gen. ALESTES and MICRALESTES.

In the descriptions of the species of *Alestes* and *Micralestes* in his Catalogue, Boulenger did not refer to the sexual difference in the shape of the anal fin, although he figured the ♂ and ♀ of *M. acutidens.* In his Fishes of the Nile (1907), however, he specially mentions this feature in three species of *Alestes* (pp. 113, 118, 123) and in *M. acutidens* (p. 133). Gilchrist and Thompson also made no reference to sexual differences, but copied Boulenger's figures of *M. acutidens* without explanation, leaving the reader to guess that the two figures portrayed the two sexes.

No doubt the absence of a definite statement in Boulenger's Catalogue is responsible for Fowler instituting (1935) two "species" for the ♂♂ and ♀♀ of a lot of *Alestes* all caught together at the same place on the same day.

Whether sexual differences in the anal fin occur in all the species of these two genera is a point to investigate (see Trewavas, 1936, Novit. Zool., xl, p. 65). It occurs in *Alestes imberi*, as I have been able to determine from specimens in the South African Museum. In some species there is sexual difference also in the dorsal fin.

Alestes lateralis Blgr.

1913. Gilchrist and Thompson, *l.c.*, p. 341, fig. 14.
1916. Boulenger, *l.c.*, iv, p. 179.
? 1925. Fowler, Proc. Ac. Nat. Sci. Philad., lxxvii, p. 197.
1935. *Id.*, Ann. Transvaal Mus., xvi, p. 257, fig. 3 (*thamalakanensis* = ♀).
1935. *Id.*, *ibid.*, p. 258, fig. 4 (*langi* = ♂).
1936. Pellegrin, Arq. Mus. Bocage Lisbon, vii, p. 49.

In the South African Museum there are 11 specimens (3 ♂♂, 8 ♀♀, 75–90 mm.) from Sesheki, Zambesi River. The depth of the body, especially in ♀♀, is frequently a little greater than the length of the head, as in Boulenger's figure.

Micralestes acutidens (Peters).

1913. Gilchrist and Thompson, *l.c.*, p. 342, fig. 15.
1913. *Id.*, *ibid.*, p. 343 (*humilis* non Blgr.).

The specimens from Maromba River, a tributary of the Zambesi

River, recorded by Gilchrist and Thompson (and quoted later by Boulenger, *l.c.*, iv, p. 184) as *humilis* are really *acutidens*.

M. humilis should be struck off the South African fauna-list.

In addition to Gilchrist and Thompson's material, there are in the South African Museum six specimens (three ♂♂, three ♀♀, 60–75 mm.) from the Victoria Falls (*ex* Rhodesian Mus.), and a series of thirty-two (3 ♂♂, the rest ♀♀ and juv., 27–60 mm.) from the Okovango River.

Gen. Petersius Hilg.

1909. Boulenger, *l.c.*, i, p. 231, and 1916, *l.c.*, iv, p. 185.

1936. Trewavas, Novit. Zool., xl, p. 66, footnote.

Pellegrin (1936) has recorded the Upper Congo species *woosnami* Blgr. from Kukulakaze (Cunene system) and the Cubango River.

Herre (1936) described *P. barnardi* from near Beira. The latter constitutes the most southerly record of this genus.

Nannocharax multifasciatus Blgr.

1923. Boulenger, Ann. S. Afr. Mus., xiii, p. 437.

? 1933. Worthington, Ann. Mag. Nat. Hist. (10); xii, p. 40 (*minutus*).

1935. Fowler, Ann. Transvaal Mus. xvi, p. 260, figs. 6, 7 (*Distichodina stigmaturus*).

? 1938. Poll. Rev. Zool. Bot. Afr., xxx, p. 415, fig. 14 (*minutus* Worth).

A misprint in Boulenger's description may have been responsible for Fowler regarding this little fish as an undescribed species.

As printed the fin formula was given as D iii. 10; A. iii. 6; re-examination of the type shows that it is really D iii. 11, A ii. 9. I fail to find more than two anal spines, either in the type or in the new material from the Okovango River; except in the case of the 36 mm. specimen where either ii. 9 or iii. 8 can be reckoned.

The material shows the following features:—

Number of Specimens.	Length, mm.	D rays.	A rays.	l.l.	c.ped.	l/h.	h/e.	Interorb.	Snout.	
1 . .	19	11	8	37	12	$3\frac{1}{3}$	$2\frac{2}{3}$	< e	< e	No adipose fin.
2 . .	23	11	8	38–39	12	$3\frac{1}{3}$	$2\frac{2}{3}$	< e	< e	,,
5 . .	26	11	8	39	12	$3\frac{1}{2}$	$2\frac{3}{4}$	< e	< e	,,
1 . .	30	13	8	40	16	$3\frac{1}{2}$	$2\frac{4}{5}$	< e	< e	With adipose fin.
1 . .	36	12	9*	41	16	$3\frac{1}{2}$	3	i=e	< e	,,
Type .	48	11	9	41	16	$3\frac{3}{4}$	$3\frac{1}{2}$	=	=	,,
Fowler .	22–36	12	9–10	39–42	14 (in figure of 31 mm. specimen).	$3\frac{1}{3}$–$3\frac{1}{2}$	$2\frac{2}{3}$–$2\frac{3}{5}$	< e or = e	< e	

* Might equally well be counted as iii. 8, instead of ii. 9.

Boulenger's type came from Sesheki, Zambesi River, Fowler's fourteen specimens from the Chobe River, 3 miles from Kasane. There are in the South African Museum nine specimens 23–36 mm., from the Okovango River, one, 19 mm., from the Linyanti River, and Boulenger's type.

Coloration as described by Fowler, the number of bars being variable. The black spot on the tail, however, is on the caudal rays, and there are no scales extending beyond it, contrary to Fowler's fig. 6; there may be one or two dark bars on the caudal behind the spot. There is a strong superficial likeness to a *Barilius*.

The most interesting feature of this series is the absence of the adipose fin in specimens up to 26 mm. in length. The adipose fin would appear to develop rather suddenly between the 26 and 30 mm. stages, and seems to be correlated with an increase in the number of scales around the caudal peduncle. The absence of the intermediate stage is very unfortunate. Although Fowler had specimens of 22 mm. upwards he makes no mention of this. Juveniles without the adipose fin bear an even closer resemblance to a *Barilius* than do the adults, but the shape of the mouth at once distinguishes them.

N. minutus Worth, from Lake Bangweolo, is closely related, if not actually synonymous.

Hemigrammocharax monardi Pelle, 1935 (see also 1936), from the Cubango River, is easily distinguished by its incomplete lateral line and predorsal scales 13 (instead of 15–16), although the coloration is very similar.

Family CYPRINIDAE.

Labeo parvulus G. and T.

1913. Gilchrist and Thompson, *l.c.*, p. 353, fig. 22.

1916. Boulenger, *l.c.*, iv, p. 205, fig. 129.

1937. David and Poll, Ann. Mus. Congo Belge, zool. ser. i, T. iii, fasc. 5, p. 215 (Elisabethville).

One specimen, 60 mm. in length, from the Okovango River.

Head 4 in length of body, eye $1\frac{1}{2}$ in snout, 4 in head, $1\frac{2}{3}$ in interorbital width. Lat. line 34, predorsal 11, tr. $\frac{5}{6}$, 4 between lat. line and root of ventral, 14 around caudal peduncle. D iii. 10, 1st ray a little shorter than head.

Sharp horny tubercles on snout, some of them bifid. Gonads undeveloped.

For the time being this specimen must be identified as *parvulus*, although I suspect that *parvulus* itself is really the same as *cylindricus*.

The life-history of *cylindricus* should be worked out in one and the same locality.* As showing the reasonableness of the suggested synonymy, the following table has been drawn up from specimens from several localities:—

Total Length, mm.	L/H.	H/E.	S/E.	I/E.	l.l.	c.ped.	D rays.	Tubercles, sex.
Okovango River, 60	4	4	1½	1⅔	34	14	10	Conical tubercles, gonads immature
Crocodile River,† 72 Type of *parvulus*	4	4¼	1¾	1¾	35	14	9	Conical tubercles gonads immature
Sabi River E. Transvaal 87	4	4	1⅔	1¾	34	14	9	Scars. Immature.
120	4	4½	2	2	35	14–16	9–10	Scars. Immature.
130	4	4¾	2¼	2	35	14–16	9	Scars few and feeble. ♂.
150	4	5	2½	2½	35	14–16	9–10	Scars numerous. Immature. ?♀.
190	4¼	6	3	2¾	35	16	10	Scars and rounded warts numerous. Ovig. ♀
Manzemtoti River, 220 E. Transvaal	4¼	6¼	3	3	36	18	10	Scars and rounded warts numerous. Ovig. ♀.

† Eastern Transvaal, not the Crocodile River west of Pretoria.

In all these specimens the shape of the body agrees with Peters' figure, and both the depth of the body and the length of the 1st dorsal ray do not exceed the length of the head, or, in the case of the dorsal ray, only very slightly. The pectoral is longer than either the ventral or the anal.

In contrast to Boulenger's statement (1909, p. 330) that the tubercles on the snout are more developed in ♂ than in ♀ in *forskalii*, in the above specimens of *cylindricus* they are more numerous in the ♀♀.

There are, further, three specimens (245, 260, 275 mm., recorded by Gilchrist and Thompson as *cylindricus*) in the South African Museum from the western Transvaal and Zoutpansberg in the Limpopo River system, which agree except that the depth is greater (1¼) than the head. Consequently the dorsal profile is steeper, and the characteristic *cylindrical* appearance is lost.

Probably these should be identified as *darlingi* Bilgr., which is recorded from the Letaba River, also in the Limpopo system. (The

* In Bertram, Borley and Trewavas, Fish. Lake Nyasa (1942, p. 43), some notes on the biology of *cylindricus* are given, but not from the taxonomic point of view.

localities for the type of *parvulus* and the specimens of *cylindricus* in the above table are in the Komati River system.)

Labeo forskalii Rüppell.

1913. Gilchrist and Thompson, *l.c.*, p. 348, fig. 19.

1917. Nicholls and Griscom, Bull. Amer. Mus. Nat. Hist., xxxvii, p. 693 (Stanleyville).

Boulenger (1916, p. 205) considers that the Victoria Falls specimen, referred by Gilchrist and Thompson to *forskalii*, is probably *cylindricus*. With this opinion I cannot agree, that is if the South African Museum specimens of *cylindricus* are correctly identified. Both Peters and Boulenger refer to the close resemblance of these two species. There is, however, a great difference in the shape of the body between Peters' figure of a Zambesi *cylindricus* and Boulenger's figure of a Nile *forskalii*.

There are a number of specimens in the South African Museum from Transvaal localities which agree in body shape with Peters' *cylindricus*, and some of their main characters are set out below.

The Victoria Falls specimen, however, is quite different, with a steeper dorsal profile. It may not be the true *forskalii*, but it is certainly not the *cylindricus* of Peters. As there is a short series in the South African Museum I give a table of characters for comparison with those of *cylindricus*, including the two very fine and well-preserved specimens from the Okovango River.

In all of them from the youngest upwards both the depth of the body and the length of the 1st dorsal ray are greater than the length of the head, the 1st dorsal ray being in larger specimens considerably longer than head. Length of head $1\frac{1}{5}$ juv.–$1\frac{1}{3}$ adult in depth of body. In younger specimens the pectoral fin is subequal to the ventral fin and to the anal fin; it does not reach the ventral fin, and the ventral fin reaches only as far as the vent. In some of the larger ones the pectoral is slightly longer than the ventral and anal fins. In the two Okovango specimens they are subequal, but the pectoral reaches the ventral, and the ventral reaches to or almost to the anal (midway between vent and anal). The large Sesheki specimen is remarkable for having the pectoral $1\frac{1}{3}$ times as long as head, and extending beyond base of ventral; the latter is $1\frac{1}{5}$ times as long as head and extends beyond a knob-like excrescence which represents the absent anal fin.

All specimens with scales tr. $\frac{6}{7}$, and 4 between lat. line and root of ventral (5 if the scale covering the axillary scale be counted), predorsal 11–12.

Comparison of a long series from the very smallest upwards of the Zambesi form with a similar series of *forskalii* from the Nile might disclose differences; but for the time being there is no other course open but to identify all the above specimens as *forskalii*.

Total Length, mm.	L/H.	H/E.	S/E.	I/E.	l.l.	c.ped.	1st D ray/H.	Warts, Sex.
Lialui Zambesi River 112 .	4	5	2	$2\frac{1}{3}$	37	16	$1\frac{1}{5}$	Scars on snout feeble. Immature.
Lialui Zambesi River 120 .	4	5	2	$2\frac{1}{3}$	37–38	18	$1\frac{1}{4}$	
Victoria Falls 135 .	4	5	2	$2\frac{1}{3}$	38	18	$1\frac{1}{4}$	Scars numerous (gutted).
Sesheki Zambesi River 150 .	$4\frac{1}{4}$	5	2	$2\frac{1}{2}$	38	18	$1\frac{1}{3}$	Scars moderate. Immature.
Victoria Falls 200 .	$4\frac{1}{4}$	$5\frac{1}{2}$	$2\frac{2}{3}$	$2\frac{3}{4}$	39	16	$1\frac{1}{2}$	Rounded warts and scars. ?♂.
Sawmills (N. of Bulawayo) southern tributary of Zambesi River 250	$4\frac{1}{4}$	$6\frac{4}{5}$	3	$3\frac{1}{2}$	38	16	$1\frac{1}{4}$	Numerous sharp conical, bifid, or multifid tubercles spent ♀.
Sawmills (N. of Bulawayo) southern tributary of Zambesi River 285	$4\frac{1}{4}$	7	3	$3\frac{1}{2}$	37	16	$1\frac{1}{4}$	
Sesheki 310 . .	$4\frac{1}{4}$	7	3	$3\frac{2}{3}$	37	18	$1\frac{3}{4}$	Scars not numerous, rather feeble. ?♂.
Okovango River 300	$4\frac{1}{4}$	7	3	4	38	18	$1\frac{3}{4}$	Scars not numerous, rather feeble. ?♂ spent.
Okovango River 335	$4\frac{1}{4}$	7	3	4	38	20	$1\frac{3}{4}$	

Gen. Barbus Cuv.

The genus is divided according as the scales are longitudinally or radiately striate.

Of the first group, species with longitudinally striate scales, there are no specimens in Mr. Eedes' Okovango collection. Nevertheless it is interesting to set out the species which have been recorded from the Zambesi system, together with certain comments.

A. Last dorsal spine more or less enlarged . . . . *brucii* Blgr.
    D iv. 9–10. Scales 28–30. $\frac{4-5}{4}$. 12 . (syn. *sector* and *cookei*)

B. Last dorsal spine not enlarged.
  1. Dorsal high.
    D iv. 9. 32–34. $\frac{5}{3}$. 12 "rubber-lip." 130 mm. *zambesensis* Peters
    D iv. 9. 30–32. $\frac{4}{2}$. 12. "rubber-lip." 235 mm. *chilotes* Blgr.
    D iv. 9. 29. $\frac{4}{2}$. (?12). "rubber-lip." 215 mm. *hypostomatus* Pellegr.
    D iv. 8. 30–31. $\frac{5}{3}$. 12. 320 mm. . . *victoriae* Blgr.
    D iii. 9. 32. $\frac{3}{2}$. 12. 390 mm. . . . *codringtonii* Blgr.
    D iii. 9. 28. $\frac{4}{2}$. 12. 360 mm. . . . *altidorsalis* Blgr.

2. Dorsal moderate.
   D iii. 8–9. 30–32. $\frac{4}{2}$. 12. 280 mm. . . *rhodesianus* Blgr.
3. Dorsal low.
   D iii. 8. 33. $\frac{5}{3}$. 14. 420 mm. . . . *fairbairnii* Blgr.
   D iv. 9. 30. $\frac{4}{3}$. 12. 482 mm. . . . *nasutus* G. and T.

Even at a first glance the list has a suspicious look. How many of these are really natural species, and how many merely "Museum species?" Three (*victoriae*, *fairbairnii*, *codringtonii*) came from the Victoria Falls (above and below), and one (*chilotes*) from two miles above the Falls. It seems rather a remarkable circumstance that the collector caught, or picked out from his catch, only a single specimen of each of the first three "species", and two of the last-mentioned. That is to say, four species were based on five specimens, and not one of them apparently identifiable with the already known *zambesensis* Peters. A fifth species (*altidorsalis*) was also based on a single specimen, from the Kafue River.

B. hypostomatus Pellegr., 1936, was described from a single specimen from the Cubango River (Upper Okovango), very like *chilotes*.

A further question: have no young specimens of any of these ever been caught and described? See p. 431: *inermis*.

B. brucii. I have elsewhere suggested,* that as fleshy lobelike lips ("rubber-lips") are not a specific character,† *sector* is probably a synonym of *brucii* (which latter has line precedence). Here again two species were founded on two specimens from the same locality. *B. cookei* G. and T. (one specimen) is in my opinion also synonymous.

I have examined a specimen from the Mazoe River, Mashonaland. This, in spite of its longitudinally striate scales, was first identified by Boulenger as *gurneyi* and returned to the South African Museum, then recorded by Gilchrist and Thompson as *bowkeri* (1913, p. 387). Actually it is a specimen of *brucii*. *B. dwaarsensis* G. and T., 1913, is probably also synonymous.

Of the second group, species with radiately striate scales, there are several representatives in Mr. Eedes' Okovango collection.

A synopsis of the relevant species is given, embodying the synonymy suggested below under the respective species.

I. No sensory ridges on head.
   A. Last dorsal spine enlarged, not serrate. Two barbels. D rays
      (7) 8. l.l. 30–34. tr. $\frac{5}{3}$. c.ped. 14–16 . . *trimaculatus* Peters

* Barnard, Revision of F. W. Fishes S.W. Cape, Ann. S. Afr. Mus., xxxvi, p. 167, 1943.

† Worthington, 1929, Proc. Zool. Soc. Lond., p. 431.

B. Last dorsal spine more or less enlarged, serrate.
  1. Two barbels. D rays 7.
    Scales 33–36. $\frac{6\text{–}7}{3\text{–}4}$. 16–18. Ventral in front of dorsal, scales with few striae . . *paludinosus* Peters
    35–37. $\frac{6}{3}$. 14. Ventral partly below dorsal, scales with numerous striae . . . . . *longicauda* Blgr.
    24–26. $\frac{4}{4}$. 12. Ventral arising in front of dorsal . *eutaenia* Blgr (Zambesi)
    24–26. $\frac{4}{4}$. 12. Ventral arising below 3rd dorsal spine. . . . . . *manicensis* Pellegr. (near Beira)
  2. One barbel. D rays 8 . . . . . *serrula* G. and T.

C. Last dorsal spine not enlarged, not serrate.
  1. Two barbels. Dorsal rays 8.
    a. Black spot at base of anal.
      26–29. $\frac{3}{2-3}$. 12. 3–7 black spots on sides . *barotseensis* Pellegr.
      27–29 (31). $\frac{4}{3}$. 12. l.l. curved, distant from dark pigment stripe . . . . *viviparus* Weber
      25–28. $\frac{4}{2}$. 12. l.l. straight, almost coincident with dark stripe . . *thamalakanensis* Fowler
      21–24 (Fowler) 28–30 (Blgr.). $\frac{4}{2}$. 10. Vertical bars on sides . . . . . *barilioides* Blgr.
    b. No black spot at base of anal.
      i. Scales with more than 10 striae.
        29–31. $\frac{4}{2}$. 12 (sometimes 9 or 10 D rays) *inermis* Peters
        30–36. $\frac{5}{2}$. 14–16 . . . . *macrurus* G. and T.
      ii. Scales with less than 10 striae.
        26–27. $\frac{3}{2}$. 10. Posterior barbel $\frac{2}{3}$ eye . *radiatus* Peters
        26–27 (? c.ped. and striae). 3–4 black spots on side. l.l. incomplete . . *lujae* Blgr.
        30. $\frac{4}{2}$. 12. Both barbels longer than eye *lineomaculatus* Blgr.
        30–33. $\frac{5}{3}$. 12. Dark lateral stripe, with or without spots. Depth of body greater than length of head . . *unitaeniatus* Gnthr.
  2. One barbel . . "*afer*" (Pellegrin 1920 name only) *
  3. No barbels, or very minute ones. D 8.
    Lat. line and dark pigment stripe coincident. No black spot at base of anal . . . . . . *rogersi* Blgr.
    Lat. line curved, distant from dark stripe. A black spot at base of anal . . . . juv. sp.? (Okovango)

II. Sensory ridges or lines or pores on head (*Beirabarbus*) . . *okavangoensis*

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* Possibly a juvenile in the "single barbel" stage.

Barbus trimaculatus Peters.

1852. Peters, MB. Ak. Wiss. Berlin, p. 683.

1861. Castelnau, Mem. Poiss. Afr. Austr., p. 59 (*kurumanni*, original spelling).

1913. Gilchrist and Thompson, *l.c.*, p. 401, fig. 60.

1917. *Id.*, *ibid.*, p. 563.

1930. Lohberger, Zool. Anz., lxxxviii, p. 246, fig. (*poechii* Stndr.).

1930. Fowler, Proc. Ac. Nat. Sci. Philad., lxxxii, p. 34 (Lake Victoria).

1933. Worthington, Proc. Zool. Soc., i, p. 304.

1935. Fowler, Ann. Transvaal Mus., xvi, p. 262.

1936. Pellegrin, Arq. Mus. Bocage Lisbon, vii, p. 53.

From the examination of forty-two specimens (forty with 8, two with 7 dorsal rays) recently collected at Kuruman by Drs. Hesse and Boonstra and Mr. Thorne (of the South African Museum) it is obvious that Castlenau's species should be put into synonymy here. Castelnau said "la lèvre supérieure porte deux petits barbillons"; Boulenger (*l.c.*, ii, p. 144) has interpreted this as *one* barbel *on each side*, and has suggested that the species is allied to *trevelyani*. The strong dorsal spine and the locality (Orange River system) might have suggested *aeneus*, but the black spot at base of caudal would have excluded this latter species.

Kuruman was the only known locality for this species in the Orange River system, until the above-mentioned collectors captured four specimens in the Dry Hartz River, at Taungs in October 1939.

In the South African Museum there are the four specimens from the Kafue River recorded by Gilchrist and Thompson, one of them with 7 dorsal rays; one is an ovigerous ♀ 90 mm. in length. Also the faded Kuruman specimen (G. and T., 1917, p. 563) 70 mm. in length with 7 dorsal rays. Also two immature specimens from Lialui (one of them with 7 dorsal rays) and one from Sesheki, both on the Zambesi River.

Fifteen immature specimens, 50–63 mm. from the Okovango River. All of them with 8 dorsal rays, and 14 scales around caudal peduncle (except one which has only 12). The oval black spot at base of caudal is very distinct; a faint lateral stripe, with indications of the two spots (fore and aft the dorsal fin) in some specimens; the scales on upper half of body with darker edges; the lateral line below the lateral stripe is sometimes faintly indicated by pigmentation above and below the tubule on each scale.

Pellegrin records it from the Kunene River and the Cubango River, the latter being the upper (Angolan) portion of the Okovango River.

Peters described the fins as greenish, the lower ones more yellowish.

Fowler (1930) mentions a dark spot at base of anal in specimens from near Lake Victoria.

Barbus paludinosus Peters.

1913. Gilchrist and Thompson, *l.c.*, p. 404, fig. 62.

1913. *Id.*, *ibid.*, p. 408 (specimen from Wonderfontein, Transvaal, as *longicauda*).

1916. Boulenger, *l.c.*, iv, p. 251.

1917. Gilchrist and Thompson, *l.c.*, p. 563.

1930. Fowler, Proc. Ac. Nat. Sci. Philad., lxxxii, p. 34.

1933. Worthington, Proc. Zool. Soc., i, p. 304.

1935. Fowler, Ann. Transvaal Mus., xvi, p. 263.

1935. *Id.*, *ibid.*, p. 265, fig. 9 (*tsotsorogensis*).

1936. Pellegrin, Arq. Mus. Bocage Lisbon, vii, p. 53.

1936. Trewavas, Novit. Zool., xl, p. 66.

1939. Ricardo, Fish. Lake Rukwa and Bangweulu, p. 23.

1943. Barnard, Ann. S. Afr. Mus., xxxvi, p. 171, fig. 14 *a*, *b*, (growth-changes).

The dusky coloration, composed of minute dots and specks which are often (especially along the middle of the sides) vertically oval in shape, is characteristic of specimens preserved in formalin. In specimens preserved in alcohol the silvery coloration often renders the pigmentation less conspicuous.

Two specimens from the Okovango River, preserved in formalin, were on arrival at the Museum olivaceous above, dorsal and caudal fins faintly pinkish, pectoral, ventral, and anal slightly yellowish.

Specimens from the Orange River, preserved in alcohol, were silvery, more or less greyish above and along middle of sides, the fins very faintly yellowish.

Peters gave the colour as green, silvery on sides, fins red. Probably rosy or salmon would have been a better term than "red."

I have personally examined specimens of *tsotsorogensis*, kindly loaned by the Transvaal Museum. The identity is obvious on direct comparison.

B. longicauda Blgr. (*gibbosus* Peters, non C. and V.) differs in having rather numerous striae on the scales instead of comparatively few (*cf.* Peters, Reise Mossamb., pl. xi, figs. 1, *paludinosus* and 2, *gibbosus*), and the ventral fins are not wholly in advance of the dorsal fin. The Transvaal specimen recorded by Gilchrist and Thompson is *paludinosus*, not *longicauda*.

Barbus barotseensis Pellegr.

Fig. 2.

1920. Pellegrin. Bull. Soc. zool. Fr., xlv, p. 149 (*radiatus* var. *barotseensis*).

Differs from *radiatus* Peters (Tete, Lower Zambesi) in having three spots along the sides, and one at base of anal fin; and in having a

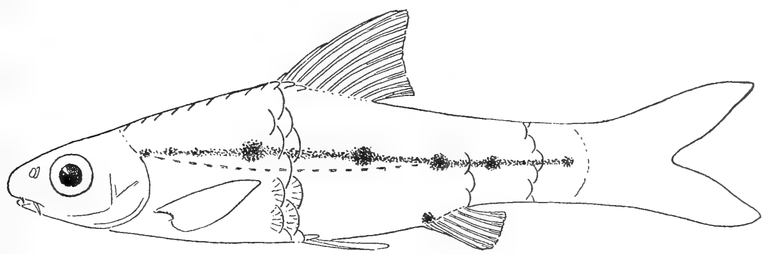


FIG. 2.—*Barbus barotseensis* Pellegr. 10th, 20th, and 25th scales in lat. line indicated.

shorter pectoral. Pellegrin does not suggest it, but the latter feature may be merely sexual.

	L/H.	H/E.	S/E.	I/E.	l.l.	c.ped.	Striae.	g.r.	Barbels.
32 mm.	$3\frac{1}{4}$	$2\frac{3}{4}$	e > s	e > i	27	12	3–4	1 + 5	Anterior $\frac{1}{6}$ eye. Posterior $\frac{1}{4}$ eye.
35 ,,	$3\frac{1}{3}$	$2\frac{3}{4}$	,,	,,	28	12			
40 ,,	$3\frac{1}{2}$	$2\frac{3}{4}$	,,	,,	28	12			
45 ,,	$3\frac{2}{3}$	3	,,	e = i	28	12	5–6		Anterior $\frac{1}{4}$ eye. Posterior $\frac{1}{3}$ eye.
57 ,,	$3\frac{3}{4}$	3	,,	,,	28	12	6–7 (8)	1 + 6 (7)	Anterior $\frac{1}{4}$ eye. Posterior $\frac{2}{5}$ eye.

A series of thirteen specimens, 32–57 mm. in length, from the Okovango River seem to be referable in this species. They have 3 or 4 to 6 or 7 black spots more or less connected by a faint lateral stripe. Unlike *lineomaculatus*, where only the spot at base of caudal is on the lateral line, in these specimens the last 2 or 3, *i.e.* one or two situate above the anal fin and on caudal peduncle, as well as the one at base of caudal are on the lateral line; *cf.* figure of *atromaculatus* N. and G., 1917, and Fowler, 1930, fig. 6 ("*lujae*" *). Moreover, there is a conspicuous black spot at base of anal fin, which is not present in *lineomaculatus*.

On arrival at the Museum (in formalin) the fins were colourless.

The scales show 4 radiating striae in the smallest, and not more than 8 in the largest specimen. Both barbels are very short, in the largest specimen the posterior barbel not quite $\frac{1}{2}$ eye-diameter, the anterior one about $\frac{1}{4}$ eye. By this feature these specimens are distinguished from *atromaculatus, lineomaculatus, lujae, tetrastigma.*

The eye is distinctly larger than in equal-sized specimens of *lineomaculatus*. Pupil $\frac{1}{2}$ eye-diameter.

D iii. 8. Ventral spine below 3rd dorsal spine. Lat. line 27–28; 3 above l.l., 2 below; predorsal 8–9; around caudal peduncle 12. Pellegrin does not give the caudal peduncle and predorsal scale counts.

Gill-rakers about 6 short blunt knobs on lower part of 1st arch. Snout rounded, shorter than eye, mouth sub-inferior.

These specimens are distinguished from *lujae* by the very short barbels, the sub-inferior mouth, and the complete lateral line.

B. barotseensis was first described (as a variety of *radiatus*) from Lialui, Upper Zambesi River. It was not reported by Pellegrin from the Cubango (Upper Okovango River) in 1936.

Barbus viviparus Weber.

Fig. 3.

1913. Gilchrist and Thompson, *l.c.*, p. 421, fig. 79.†

cf. 1935. Fowler, Ann. Transvaal Mus., xvi, p. 266, fig. 10 (*bifrenatus*).

1936. Pellegrin. Arq. Mus. Bocage Lisbon, vii, p. 55 (*bifrenatus*).

1943. Barnard, Ann. S. Afr. Mus., xxxvi, p. 218 (notes on alleged viviparity).

Fowler mentioned differences in coloration between *bifrenatus* and *rogersi*, but did not specially mention that the latter has no barbels or only a minute one on each side.

Pellegrin records *bifrenatus* from the Cubango River, Angola (upper reaches of the Okovango River).

* David and Poll (1937) consider that Fowler's 1930 figures represent *lineomaculatus*; one must assume that they consider the black spot at base of anal (present in *lujae* but not in *lineomaculatus*) as of no specific importance. They also do not agree that *lujae* and *lineomaculatus* are synonymous.

† P. 421, line 6 from bottom, *for* "but" *read* "not".

As a matter of fact *bifrenatus* is so extraordinarily like *viviparus* that I think the two should be united.

I have compared paratypes of *bifrenatus* with cotypes of *viviparus*; I have also examined the Livingstone specimen (referred by G. and T. to *viviparus*) and three specimens from the Saib River, eastern Transvaal.

From the descriptions it is not easy to reconcile the differences in the numbers of scales transversely, unless the points between

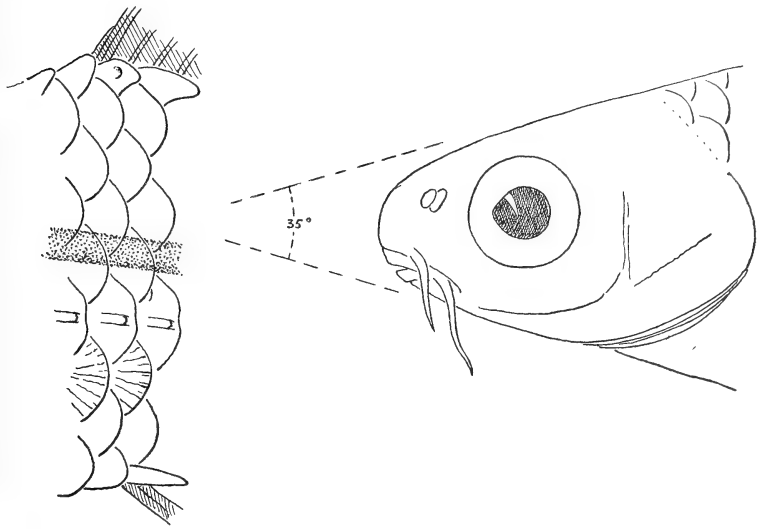


FIG. 3.—*Barbus viviparus-bifrenatus.* Scaling between dorsal and ventral fins to illustrate method of counting, and position of the dark lateral stripe in relation to the lateral line. Head to illustrate features mentioned in text.

which the count is taken are definitely stated. Weber gave: "1. tr. 5.1.4 (V)"; Boulenger: "$\frac{4\frac{1}{2}}{4\frac{1}{2}}$, 3 between l.l. and ventral"; Gilchrist and Thompson: "$\frac{4\frac{1}{2}}{4\frac{1}{2}}$, $2\frac{1}{2}$ between l.l. and ventral"; Fowler: "6 above 3 below"; Pellegrin: $\frac{4\frac{1}{2}}{4\frac{1}{2}}$." Boulenger's figure shows 4 between l.l. and dorsal, 3 between l.l. and ventral; Fowler's figure of the young agrees with this, but his figure of the type shows 3 above and 3 below the lat. line.

As frequently happens, such discrepancies, evident enough "on paper", disappear when the actual specimens are compared.

In all the above mentioned specimens there are 4 scales between the l.l. and the base of the dorsal, *not* counting the pre-dorsal scale in front of the dorsal spine, or the elongate scales along the base of dorsal; and 3 between the l.l. and ventral spine, including the scale which lies immediately above base of spine and from behind which the axillary scale projects, or 2 if this and the axillary scale be excluded (fig. 3).

Weber mentioned the lateral stripe, but not the double line of dots along the lateral line tubules; nor do his specimens (collected 1894–5) show any trace of the latter marking. It is, however, mentioned and figured by Boulenger (whose figure was copied by G. and T.); described but not well figured by Fowler; and mentioned by Pellegrin. It is present also in the Livingstone and Sabi River specimens.

The dark lateral stripe, in the middle of the side, passes through the upper half of the series of scales immediately above the l.l. scales (fig. 3); posteriorly descending to the middle and the lower half of this series of scales, and eventually passing on to the l.l. series at about the 8th (7th–9th) scale from caudal fin.

The dark stripe on the snout passes round in front very distinctly in *bifrenatus* and the Livingstone and Sabi River specimens, but can scarcely be traced even on the sides of snout (though distinct behind eye) in *viviparus*.

There are some dark specks along base of dorsal fin, usually concentrated into a spot at base of spines and another at base of last rays, sometimes a third in the middle.

In the Okovango specimen a black medio-ventral streak between anal and caudal on the caudal peduncle, and a fainter medio-dorsal stripe.

There are 12 scales around the caudal peduncle: in 18 mm. *bifrenatus* and 20 mm. *viviparus*, and larger specimens.

The position of the base of the ventral spine is in the vertical from the dorsal spines; Fowler's figure of the type of *bifrenatus* shows it distinctly in advance; but it is not in advance in the five paratypes I have seen.

After thorough comparison, the only differences I can find are: a very slightly larger eye and a few more straie on the scales in the Sabi and Zambesi specimens than in *viviparus* from Natal (specimens of equal size compared, see table). In *viviparus* there are 5–7 striae (on the exposed field), in *bifrenatus* 8–10 (not counting incomplete intercalaries). These differences are scarcely enough to justify two species, especially when other small species of *Barbus* (e.g. *trimaculatus*, *paludinosus*) seem to have an equally wide range in the *tropical* and (eastern) *subtropical* areas.

In the largest paratype of *bifrenatus* seen, 30 mm., the eye is greater than length of snout (as seen in profile); Fowler's statement that it is subequal to the snout would be correct if measurement is taken on the curve to tip of snout.

As I have elsewhere pointed out, there are strong reasons for suspecting that the alleged viviparity of this species was based on erroneous observations.

Diagnostic characters, in addition to the more usually given specific characters, of *viviparus-bifrenatus*:—

(*a*) Depth of body at least equal to length of head, usually (in larger specimens) slightly greater, not more than $3\frac{2}{3}$ in length of body (G. and T.'s measurement wrong).

(*b*) Distance from top of gill opening to the dorsal profile at 1st predorsal scale subequal to eye.

(*c*) Pupil of eye not exceeding $\frac{1}{2}$-eye diameter.

(*d*) Upper and lower profiles of head if continued in straight lines meeting at an angle of approximately 35°.

(*e*) Lateral line curved downwards and meeting dark lateral stripe only in vertical from end of anal base.

(*f*) Dark stripe passes through the upper halves of the scales above the lat. line (*i.e.* where the l.l. and the dark stripe are separate).

			L/H.	H/E.	S/E.	L/E.	Barbels.
bifrenatus paratypes		(2 spec.) 18 mm.	$3\frac{1}{2}$	$2\frac{3}{4}$	s < e	subequal	Anterior a mere point. Posterior $\frac{1}{2}$ eye.
		21 ,,	$3\frac{1}{2}$	$2\frac{4}{5}$	s < e	,,	Anterior $\frac{1}{4}$ eye. Posterior $\frac{2}{3}$ eye.
		(2 spec.) 30 ,,	$3\frac{1}{2}$	3	s < e	,,	Anterior $\frac{2}{3}$ eye. Posterior = eye.
Sabi River		35 ,,	$3\frac{1}{2}$	3	s < e	,,	Anterior $\frac{2}{3}$ eye. Posterior = eye.
		36 ,,	$3\frac{1}{2}$	3	s < e	,,	(Mutilated).
		43 ,,	4	3	s < e	,,	Anterior $\frac{1}{2}$ eye. Posterior $\frac{3}{4}$ eye (whole specimen shrunken).
Okovango River		37 ,,	$3\frac{2}{3}$	3	s < e	,,	Anterior $\frac{2}{3}$ eye. Posterior = eye.
Livingstone		40 ,,	4	3	s < e	,,	Anterior $\frac{3}{4}$ eye. Posterior slightly > eye.
Cotypes *viviparus*	Verulam	20 ,,	$3\frac{1}{2}$	$2\frac{1}{2}$	·		Anterior a mere point. Posterior $\frac{1}{2}$ eye.
		25 ,,	$3\frac{3}{4}$	3	s < e	,,	Anterior $\frac{1}{4}$ eye. Posterior $\frac{2}{3}$ eye.
		35 ,,	4	$3\frac{1}{5}$	s < e	,,	Anterior $\frac{1}{3}$ eye. Posterior $\frac{4}{5}$ eye.
		40 ,,	4	$3\frac{1}{4}$	s < e	$1\frac{1}{4}$	Anterior $\frac{1}{2}$ eye. Posterior = eye.
		45 ,,	4	$3\frac{1}{2}$	s < e	$1\frac{1}{2}$	Anterior $\frac{2}{3}$ eye. Posterior > eye.
		50 ,,	4	$3\frac{3}{4}$	s = e	$1\frac{1}{2}$	Anterior $\frac{4}{5}$ eye. Posterior > eye.
	Isipingo	59 ,,	4	$3\frac{3}{4}$	s = e	$1\frac{1}{2}$	Anterior = eye. Posterior > eye.

Barbus thamalakanensis Fowler.

1935. Fowler, Ann. Transvaal Mus., xvi, p. 263, fig. 8.

1935. *Id., ibid.*, p. 267, fig. 11 (*fitzsimonsi*).

I have seen the type of the former, and nine paratypes (Transv. Mus. No. 15251, Kasane, 12–20 mm.) of the latter. The former is in poor condition, as Fowler noted (tip of dorsal spine broken off), and many of the scales are rubbed off. There are several discrepancies between the descriptions and figures of these two "species"; *fitzsimonsi* is said to have "one pair of barbels at maxillary end", the figure indicates that there are two barbels on each side (and only 6 rays in the dorsal fin).

I have therefore carefully examined these specimens.

As regards *thamalakanensis*: the anterior barbel is longer, $\frac{1}{3}$ the posterior; l.l. with 27 on left, 25 on right side, all told, pre-dorsal 11 (in figure about 30 and 13 respectively), 12 around caudal peduncle; ventral axillary scale present; the l.l. nearly straight, the tubules in the middle of the side touching the lower margin of the lateral stripe. Pupil $\frac{1}{2}$ eye-diameter. Distance from top of gill opening to dorsal profile at 1st pre-dorsal scale less than eye-diameter. Dorsal and ventral profiles of head, if continued, subtending an angle greater than 30°.

The specimen is a ♂, but not fully ripe, 36 mm. in length to end of middle caudal rays.

The specimens of *fitzsimonsi* are obviously juveniles. They display all the features of *thamalakanensis*: where the full scaling remains the number of l.l. tubules is 27–28 (in one case only 26), pre-dorsal 10–11, 12 around caudal peduncle; l.l. nearly straight, and touching (in middle of side) the lower margin of lateral stripe; both anterior and posterior barbels present in specimens from about 16 mm. upwards. Four clear rows of scales above l.l. and 2 clear rows below, but if the small scales at base of dorsal and ventral spines be counted, the numbers are 5 and 3. In this respect the figure of *thamalakanensis* is correct, that of *fitzsimonsi* incorrect.

I have no doubts on the above synonymy, but the question remains whether *thamalakanensis* itself is a valid species.

	L/H.	H/E.	S/E.	I/E.	l.l.	c.ped.	Striae.	g.r.	Barbels.
fitzsimonsi									
Kasane paratypes 13 mm.	$3\frac{1}{4}$	3	e > s	e > i	Scaled, but many lost. Count uncertain.			0 + 3	Posterior $\frac{1}{4}$ eye. Anterior a mere point.
14 ,,	$3\frac{1}{4}$	3	,,	,,					Posterior $\frac{1}{4}$ eye. Anterior a mere point.
16 ,,	$3\frac{1}{3}$	3	,,	,,					Posterior $\frac{1}{3}$ eye.
18 ,,	$3\frac{2}{5}$	3	,,	e = i	27	12	4–5		Anterior $\frac{1}{5}$ eye. Posterior $\frac{2}{3}$ eye.
19 ,,	$3\frac{1}{2}$	3	,,	,,	27	12		0 + 3	Anterior $\frac{1}{4}$ eye. Posterior $\frac{2}{3}$ eye.
20 ,,	$3\frac{1}{2}$	3	,,	,,	27	12		1 + 3	Anterior $\frac{1}{4}$ eye. Posterior $\frac{3}{4}$ eye.
22 ,,	$3\frac{1}{2}$	3	,,	,,	27–28	12	5	1 + 4	Anterior $\frac{1}{4}$ eye. Posterior = eye.
thamalakanensis type 36 ,,	$3\frac{3}{4}$	3	,,	,,	27 left 25 right	12	7	1 + 4	Anterior $\frac{1}{3}$ eye. Posterior = eye.

Barbus inermis Peters.

1911. Boulenger, *l.c.*, ii, p. 153, fig. 129 (copy from Peters) (Limpopo system).

1913. Gilchrist and Thompson, *l.c.*, p. 426, fig. 84 (copy from Peters).

1937. David and Poll, Ann. Mus. Congo Belge, zool. ser., 1, T. iii, fasc. 5, p. 218 (Elizabethville).

Boulenger (p. 153, footnote) says the scales of this species may be regarded as a link between those with longitudinal striae and those with radiate striae. Peter's figure (1862, pl. xi, fig. 3) of the scale shows fourteen feebly radiating striae (largest specimen 80 mm.). Boulenger records "ad. and hgr." up to 100 mm., but one does not know whether he actually examined the gonads.

The point of these remarks is that the scales of *inermis* bear a strong resemblance to those found in juveniles of species with longitudinally striate scales. A further noteworthy feature is the shape of the anal fin. This elongate shape, as I have mentioned in another paper,* seems to be found mostly in species with longitudinally striate scales.

It is, moreover, a remarkable fact that no young specimens of any of the big Zambesi *Barbus* (with longitudinally striate scales) seem to have been recorded. It is therefore urgently desirable that the *life-histories* of the fishes of this river be investigated.

* Ann. S. Afr. Mus., xxxvi, p. 143, 1943.

I do not actually claim *inermis* as the young of a larger species.

There is a 55 mm. specimen from the Victoria Falls in the South African Museum. It is not in very good condition, but agrees well with Peters's description. The anal fin is of the same rather elongate shape, but the dorsal fin has only 3 spines and 8 rays. Lat. line 28; 4 clear scales above l.l., and 2 below; pre-dorsal 10; caudal peduncle 12. Striae numerous and feebly radiating.

The barbels are longer than in Peters's figure and Boulenger's description: the anterior one is almost equal to the eye, and the posterior one a little longer than eye. Gonads immature.

Out of four specimens Peters found three with D iv. 9 and 4 scales between lat. lin. and dorsal, and one specimen with D iv. 8 and 5 scales above l.l. The question may be asked whether examples of two species have not been mixed together. David and Poll's specimens had 9–10 dorsal rays, which increases the suspicion that they may be the young of a large species with longitudinally striate scales.

The anomalous specimen mentioned by Peters may be the same as the Okovango specimens assigned to *macrurus* (*infra*).

But much more material is required. It is useless to consider single or only a few specimens.

Barbus cf. *inermis* Peters, and *macrurus* G. and T.

Fig. 4.

1913. Gilchrist and Thompson, *l.c.*, p. 425, fig. 83.

1916. Boulenger, *l.c.*, iv, p. 263, fig. 161.

Twenty-seven specimens, 38–75 mm. in length, from the Okovango River appear at first sight somewhat like *unitaeniatus* (Angola and Cubango River), but are much more slender and have more scales around the caudal peduncle.

It is always risky to identify specimens from one river system with species described from another system without actual comparison. In the present instance a direct comparison with the type material of *macrurus* (Dwars River, Transvaal, Limpopo system) is possible.

This type material now comprises (in South African Museum) only five specimens from the Dwars River, 66–80 mm. in length (Thompson gave the standard length 60–74 mm., *i.e.* excluding caudal fin). The shape of the snout in Gilchrist and Thompson's figure is due to shrinkage.

Okovango specimens: depth of body less than length of head, $4\frac{1}{3}$–$4\frac{1}{2}$ (largest) in length of body (excl. caudal). Mouth sub-inferior.

D iii. 8. A. iii. 5. Predorsal scales 10–11, 5 clear rows above lat. line, 2 below. See also table, and following features:—

(*a*) Depth of body less than length of head.

(*b*) Distance from top of gill opening to dorsal profile at 1st predorsal scale less than eye-diameter.

(*c*) Pupil of eye (slightly) exceeding $\frac{1}{2}$ eye-diameter.

(*d*) Upper and lower profiles of head, if produced straight, subtending an angle of about 30° (juv. somewhat less than 30°, adult scarcely exceeding 30°).

(*e*) Lat. line curved, meeting dark lateral stripe above middle or end of anal base.

(*f*) Dark lateral stripe along middle of row of scales immediately above lat. line (where latter and the stripe are separate).

Except that the caudal peduncle tends to be a very little longer in *macrurus* than in the Okovango specimens, the lat. line scales in the larger *macrurus* slightly more numerous, and the striae on the scales slightly fewer, I find no differences. For the present the Okovango specimens may be assigned to *macrurus*, with the proviso that when full series of all stages from both localities are available, differences in the earlier growth-stages may possibly be found.

As in several other species, there are actually four dorsal spines, but the first is so minute, and not visible externally, that it may be ignored in practice (*cf.* my remarks in Ann. S. Afr. Mus., xxxvi, p. 142). On the other hand the small 1st spine in *inermis* is clearly illustrated in Peter's figure.

Boulenger (*l.c.*, p. 264) considered that this species might be the same as *labialis*. Unfortunately the type of the latter is not in the South African Museum, so I am unable to check G. and T.'s description.

		L/H.	H/E.	S/E.	I/E.	l.l.	c.ped.	Striae	g.r.	Barbels, and Sex.
Okovango River	38 mm.	$3\frac{1}{2}$	3	e > s	e = i	29–30	14	5–6	1 + 3	Both well developed. Anterior $\frac{2}{3}$ eye.
	45 ,,	$3\frac{1}{2}$	3	,,	,,	29–30	14	8		
	65 ,,	$3\frac{3}{4}$	$3\frac{1}{2}$	e = s	$1\frac{1}{4}$	31–32	16	10–12	2 + 4 or 5	Anterior $\frac{3}{4}$ eye. Posterior = eye.
	75 ,,	4	$3\frac{1}{2}$	,,	$1\frac{1}{4}$	32–33	16	14		Anterior $\frac{3}{4}$ eye. Posterior = eye.
macrurus type material, Dwars River	66 ,,	$3\frac{4}{5}$	$3\frac{1}{2}$	,,	$1\frac{1}{4}$	33	16	8	2 + 5	Anterior $\frac{3}{4}$ eye. Posterior = eye.
	68 ,,	$3\frac{4}{5}$	$3\frac{1}{2}$	,,	$1\frac{1}{4}$	33	16			♂.
	(2) 75 ,,	4	$3\frac{2}{3}$	,,	$1\frac{1}{3}$	33–35	16	8–10		
	80 ,,	4	$3\frac{2}{3}$	,,	$1\frac{1}{3}$	36	16	10–12	2 + 5	Spent ♀. Anterior = eye. Posterior $1\frac{1}{4}$ eye.

In the Okovango specimens the dark lateral stripe varies in width and intensity; sometimes continuous, sometimes appearing as if broken up into longitudinal streaks, varying in length. Usually a dark spot at base of caudal, but not wider than the lateral stripe. The lateral line tubules anteriorly where the lat. line is separate from the dark stripe indicated more or less distinctly by pairs of dark marks.

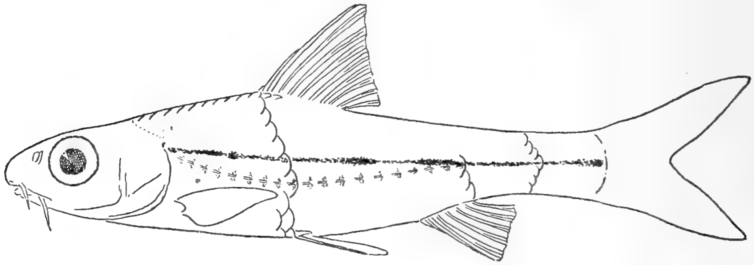


FIG. 4.—*Barbus* cf. *inermis* Peters and *macrurus* G. and T. Okovango specimen, 10th, 20th, and 25th scales in lat. line indicated.

No black spot at base of anal fin. Coloration in *macrurus* similar (so far as it remains; the dark stripe in G. and T.'s figure is wider than in the five specimens at hand.

Barbus lineomaculatus Blgr.

1913. Gilchrist and Thompson, *l.c.*, p. 420, fig. 78, and 1917, p. 563.
1916. Boulenger, *l.c.*, iv, p. 266.
1936. Pellegrin, Arq. Mus. Bocage Lisbon, vii, p. 55.
1936. Trewavas, Novit. Zoolog., xl. p. 69.
1937. David and Poll, Ann. Mus. Congo Belge, zool. ser., 1, T. iii, fasc. 5, p. 219, fig. 13*a*.

The specimens recorded by Gilchrist and Thompson conform with Boulenger's description; also one from Spring Vale, Matoppos, Rhodesia (? whether the latter, and also Insiza, are in the Zambesi or the Limpopo system). Boulenger's 1916 locality is Solwezi on the head-waters of the Kafue River.*

Both barbels at least as long as eye-diameter. All but the last of the lateral spots are above the lateral line tubules; no dark spot at base of anal fin. About 12 radiating striae on exposed surface of scale in a specimen 50 mm. long.

* Boulenger in Gilchrist and Thompson (*l.c.* 1917, p. 578) says Solwezi is on the "Congo watershed". Actually it is on the *south* side of the watershed, in the Kafue-Zambesi drainage system.

Fowler (1930, *l.c.*, p. 36, and 1935, *l.c.*, p. 266) unites *lineomaculatus* Blgr., 1903, with *lujae* Blgr., 1913; if they *are* synonymous surely the 1903 name must be accepted.

Neither David and Poll nor myself consider that these two are synonymous. Nor am I altogether satisfied that the Rhodesian *lineomaculatus* is the same as the East African (type locality), but as Boulenger has compared actual specimens, his opinion is accepted here. In addition to the lat. line (complete or incomplete respectively) another difference between *lineomaculatus* and *lujae* is the position of the mouth; although one wonders whether, in some cases at least, this may not be due to different methods of preservation (*cf.* the figure of *atromaculatus* N. and G., 1917, with those of "*lujae*" given by Fowler, 1930).

Pellegrin records it from the Cubango (Kubango) River, Angola; and Trewavas from the upper reaches of the Kunene River.

Barbus juv. sp.?

Fig. 5.

Twenty specimens, 22–45 mm. in length, from the Okovango River.

Colour (as preserved in formalin): dusky above, a black lateral stripe around front of snout and continued through eye to caudal, rather sharply defined, sometimes with slight enlargement (but scarcely forming a spot) at end of caudal peduncle; lateral line where it is separate from the stripe marked by a double row of black specks; a black spot at base of anal, and usually one at base of dorsal spines; a thin medio-ventral stripe on caudal peduncle, also a less conspicuous medio-dorsal one, also sometimes a predorsal stripe with or without one or two spots on it.

D iii. 8 (one specimen with 7 rays). A iii. 5. Predorsal 10–11; 4 clear rows between dorsal spine and l.l., and 2 clear rows between l.l. and ventral spine (*i.e.* excluding the smaller scales at bases of the spines).

Other features are given in the following table, and the diagnostic features, which indicate the differences between this species and *viviparus*.

(*a*) Depth of body less than length of head, or in larger specimens nearly equal, but *not greater than* (4–$4\frac{1}{3}$ in length of body).

(*b*) Distance from top of gill opening to dorsal profile at 1st predorsal scale less than eye-diameter.

(*c*) Pupil of eye exceeding $\frac{1}{2}$ eye-diameter.

(*d*) Upper and lower profiles of head, if continued straight, meeting at an angle less than 30°.

(*e*) Lateral line nearly straight, meeting the dark lateral stripe at vertical from anterior end or middle of anal base.

(*f*) The dark lateral stripe more diffuse or broader than in *viviparus,* passing through centre and lower half of scales immediately above the l.l., and sometimes embracing the top portions of the l.l. scales (*i.e.* where the stripe and the l.l. are separate).

	L/H.	H/E.	S/E.	I/E.	l.l.	c.ped.	Striae.	g.r.	Barbels.
22 mm.	$3\frac{1}{2}$	$2\frac{2}{3}$	e > s	e > i	28	12		0 + 4	None.
23 ,,	$3\frac{1}{2}$	$2\frac{2}{3}$	,,	,,	29	12	4–5		Posterior a mere point.
28 ,,	$3\frac{1}{2}$	$2\frac{3}{4}$	,,	,,	29	12			,,
30 ,,	$3\frac{1}{2}$	$2\frac{3}{4}$	,,	,,	29–30	12	4–6	0 or 1 + 4	,,
37 ,,	$3\frac{3}{4}$	$2\frac{3}{4}$	,,	,,	29–31	12			,,
40 ,,	$3\frac{4}{5}$	3	,,	e = i	29–30	12	4–6		Posterior $\frac{1}{8}$–$\frac{1}{6}$ eye.
45 ,,	4	3	,,	,,	29	12		1 = 4 or 5	Anterior a mere point. Posterior $\frac{1}{5}$ eye.

These specimens cannot be assigned to *viviparus-bifrenatus* because, in addition to the above reasons, the barbels do not develop at all

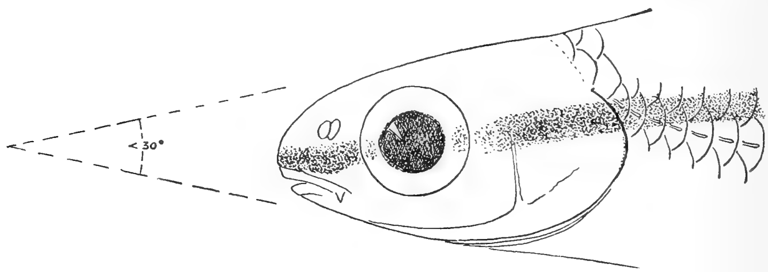


FIG. 5.—*Barbus* sp. juv. Okovango.

until a later stage (size), and even in the longest the anterior one is a mere point (easily overlooked), whereas in an equal sized *viviparus-bifrenatus* it is at least $\frac{1}{2}$ the eye-diameter.

They might have been assigned to *thamalakanensis,* but I have shown above, by re-examination of the type, that the figure of that species is incorrect.

They are the juveniles (gonads in the larger specimens undeveloped) of some larger species, but much more material is required before they can be correctly identified.

Barbus (*Beirabarbus*) *okavangoensis* Brnrd.

Figs. 6*a*, 7.

1941. Barnard, Ann. Mag. Nat. Hist. (xi), 8, p. 470.

Seventy-five specimens, 27–65 mm. in length, from the Okovango River.

Depth of body *not exceeding* length of head *at any stage*, less than head in young, equal to in adults. Predorsal profile behind head not strongly elevated. Snout rounded, shorter than eye, but in some of the largest specimens subequal to it. Mouth inferior. Barbels very small, even in the largest specimens, not exceeding $\frac{1}{5}$ eye, the posterior one only very little longer than the anterior one (*i.e.* shorter than in typical *palustris*). Gill-rakers 2 + 5 or 6 on 1st arch, short, knob-like, the lower ones very feeble.

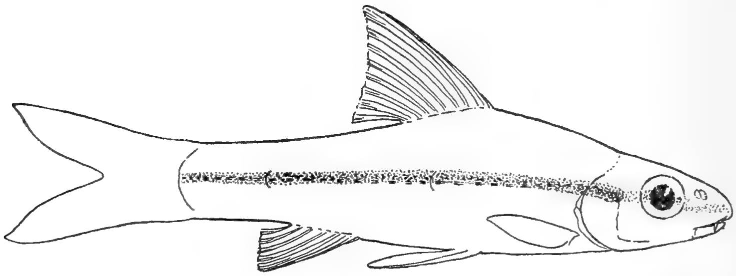
D iii. 8. A iii. 5. Pectoral reaching to or almost to ventrals in both sexes. Scales: l.l. 26–28, predorsal (8–)9, 3 between dorsal and l.l., 2 between l.l. and ventral spine (as in *palustris*), 12 around caudal peduncle. Lateral line *straight* from beginning to end. Scales with 4–6 striae on exposed field in smaller specimens, 6–8 in largest.

Colour of the Okovango specimens after preservation in formalin: each scale above lat. line, and, less conspicuously, the two series below it, with a greyish lunate or arrow-head shaped spot; a blackish line from tip of snout to base of caudal rays, straight and *exactly following* the course of the lat. line tubules; dorsal and caudal fins salmon, anal fin also usually tinged with pink (cf. *aurantiacus*), front edge and tip of dorsal, and sometimes hind margin (cf. *rogersi*), more or less greyish.

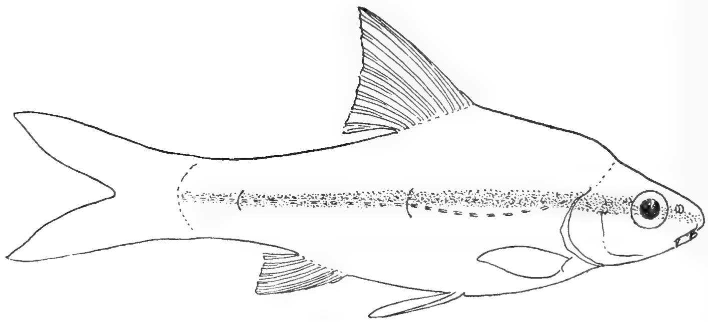
A peculiarity of this species is the straightness of the lateral line, in consequence of which the series of tubules and the dark lateral streak coincide throughout their entire length. As a rule in the species of *Barbus* the lateral line is curved and runs below the dark streak anteriorly, though joining it on the hinder part of the body and caudal peduncle. According to illustrations, two other closely allied species have this peculiarity: *aurantiacus* Blgr., 1910 (figured 1916); and (very conspicuous) *rogersi* Blgr., 1911.

Both these species have very short or minute barbels; if they also possess the sensory ridges (which may easily be overlooked if the skin is shrivelled or contracted) the question will arise whether this species is a synonym of *rogersi,* or perhaps both of them synonyms of *aurantiacus.*

In addition to the Okovango specimens, there are three, 33–55 mm. in length, from Insiza, S. Rhodesia. This locality is between Bulawayo and Gwelo, but whether the specimens are from the Zambesi system



a



b

Fig. 6.—*Barbus* (*Beirabarbus*). *a. okavangoensis* Brnrd. 63 mm. *b. palustris* Herre. Paratype 59 mm. 10th and 20th scales in lat. line indicated.

or the Nuanetsi (Wanetsi) River, which flows into the Limpopo, is not recorded.

The specimens are not in very good condition, but from their body-depth, head-length, eye-diameter, profile, and straight lateral line appear to belong to the Okovango, rather than to the Beira, form.

	L/H.	H/E.	S/E.	I/E.	l.l.	c.ped.	Barbels.
27 mm.	$3\frac{1}{4}$	$2\frac{2}{3}$	s < e	i < e	26	12	None.
30 ,,	$3\frac{1}{4}$	$2\frac{2}{3}$	,,	,,	26	12	None.
33 ,,	$3\frac{1}{4}$	$2\frac{3}{4}$	,,	i=e	26	12	Anterior and posterior mere points.
40 ,,	$3\frac{1}{4}$	3	,,	,,	26–27	12	Minute.
50 ,,	$3\frac{1}{2}$	3	,,	,,	26–27	12	Minute.
55 ,,	$3\frac{2}{3}$	3	,,	,,	26–27	12	Minute.
65 ,,	$3\frac{2}{3}$	$3\frac{1}{4}$	s=e	,, or i slightly > e	26–28	12	Not exceeding $\frac{1}{5}$ eye.

Barbus (*Beirabarbus*) *palustris* Herre.

(Fig. 6, *b*.)

1936. Herre, Proc. Biol. Soc. Wash., xlix, p. 100 (Beira district, P.E.A.).

Thanks to the kindness of Dr. G. S. Myers of Stanford University, I have been able to examine 4 of Herre's paratypes (32–34 mm. and 59 mm.). I do not quite agree with Herre's statement, "maxillary barbel more than twice in eye, about equal to diameter of pupil"; the diameter of the pupil is a little *more than half* the eye-diameter in all four paratypes, as well as in the Okovango specimens.

The lateral line shows a slight but distinct *downward bend* from its beginning to about the 12th scale. The dark lateral stripe, however, is straight as in the Okovango specimens, consequently it runs across the *upper* part of the 1st or 2nd to the 11th or 12th tubuliferous scales.

The depth of body *exceeds* the length of head in specimens of 30 and 60 mm. length; the eye is relatively smaller than in the Okovango form; and the predorsal profile is elevated.

The remarkable feature of these two forms is the development of more or less parallel lines of minute mucus pores (Herre: sensory ridges) on the head. Without sectioning a piece of the skin it cannot be stated that they are definitely pores. In the interorbital and internarial area these structures appear as pale lines, more or less curved and intersecting, on the dark ground-colour. Neither on the top of the head nor on the cheeks or opercle are the lines constant or exactly alike in any two individuals.

In addition to these pores on the head, there are similar lines of minute pores on the lateral line scales and some of the neighbouring scales, chiefly on the shoulders and anterior part of body. These

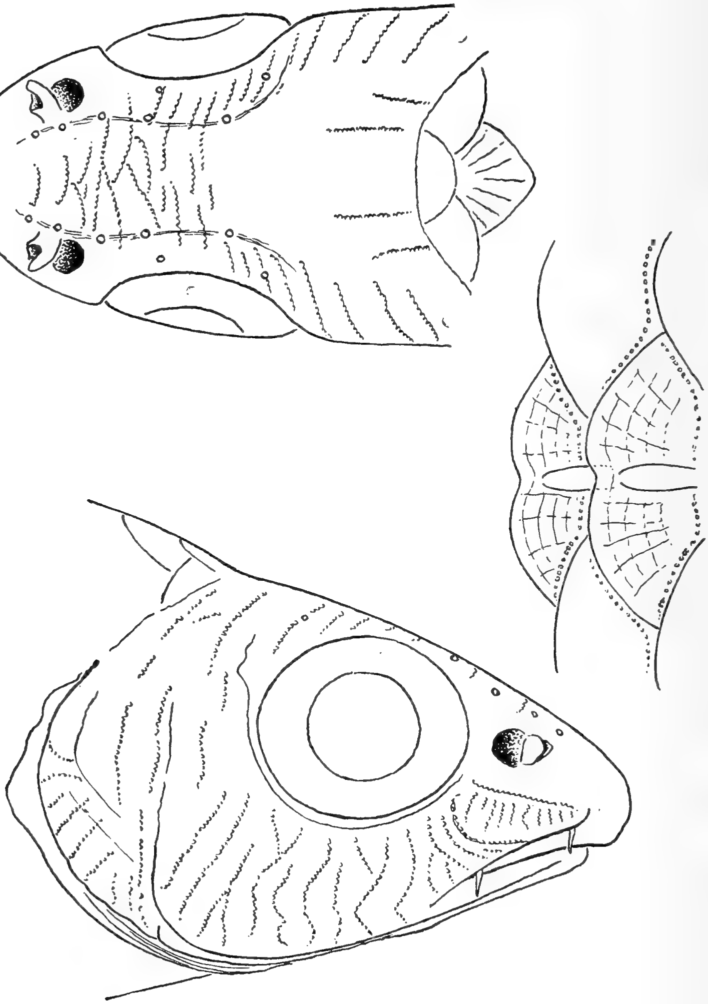


FIG. 7.—*Barbus* (*Beirabarbus*) *okavangoensis* Brnrd., mucus pores on head and scales.

pores are in a single transverse and somewhat arcuate line on the exposed field of each scale, just behind the free margins of the scales in front. These scale pores are even less visible than the head pores when the specimen is submerged in liquid; to be properly seen the specimen must be removed from liquid and partially dried.

Some taxonomic distinction, either subgeneric or full generic, should be given to indicate this exceptional feature, which differentiates these two species from all other South African (? African) species. But I am not competent to judge the merits of Herre's proposed generic diagnosis.

Family MOCHOKIDAE.

Gen. Synodontis Cuv.

Excluding *colyeri* Blgr., 1923, from N. Rhodesia, and taking the triangular area between the points Lake Ngami, Lialui, and the Victoria Falls (with a linear extension to Tete on the Lower Zambesi) we find that seven species of this genus have been described and one other recorded:

nebulosus Peters, 1852	founded on	one specimen.
zambesensis Peters, 1852	,,	? several specimens.
woosnami Blgr., 1909	,,	one specimen.
macrostigma Blgr., 1909	,,	two specimens.
leopardinus Pelleg., 1914	,,	one specimen.
jallae G. and T., 1917	,,	one specimen.
thamalakanensis Fowl., 1935	,,	two specimens.
melanostictus Blgr.	one specimen recorded by Boulenger, 1911, and nine by Fowler, 1935.	

It may seem a little remarkable that so many species should be found within such a comparatively small area and within only one present-day river system. Moreover, it cannot be said that the validity of the species has been well confirmed by later collecting. According to published records there are three specimens of *zambesensis* (from the area in question) and eleven of *melanostictus*. The South African Museum has eighteen specimens, including Gilchrist and Thompson's material and material received since 1917, and also eleven specimens from the Okovango River. The latter are in a perfect state of preservation.

It is obvious that this small collection is quite inadequate for a revision of the Zambesi species, but such as it is, it seems to show that some of the characters hitherto relied upon as specific should be carefully tested.

The number of movable mandibular teeth varies with age: one specimen of *zambesensis* of 37 mm. has 11, two of 50 and 60 mm. have 16–18, one of 100 mm. has 20–22 teeth (see also *melanostictus*, *infra*). Young *zambesensis* have indications of a nodose front margin on the maxillary barbel (method of preservation may have some effect in concealing or accentuating this feature), and the outer margin of the pectoral spine may be strongly serrate as in *melanostictus.* In fact it may be asked what is the morphological difference between *zambesensis* and *melanostictus,* especially in juveniles?

The shape of the humeral process seems to be a good character, and secondarily the length of the maxillary barbel (excluding of course minor individual variations such as "reaching to first $\frac{1}{4}$ or first $\frac{1}{3}$ of pectoral spine).

The following key may be useful as a preliminary aid to identification. *S. nigromaculatus* recorded from the Cubango River by Pellegrin (1936) is included.

I. Humeral process narrow, longer than broad, acutely pointed, upper margin concave or straight. Mandibular teeth in adult up to 40.
   - A. Maxillary barbel long, reaching to middle of pectoral spine (the latter closed against body).
     - 1. Usually unspotted. Outer edge of pectoral spine usually smooth or feebly serrate, at least in adult . . . *zambesensis*
     - 2. With very numerous small spots. Outer edge of pectoral spine usually strongly serrate.
       - *a.* Small spots . . . . . . *nigromaculatus*
       - *b.* Very small spots or dots . . . *melanostictus*
   - B. Maxillary barbel short, reaching only to anterior $\frac{1}{4}$ of pectoral spine. Moderately small spots . . . *colyeri*

II. Humeral process broad, little if at all longer than broad, obtusely pointed, upper margin convex. Mandibular teeth in adult not exceeding 26.
   - A. Maxillary barbel short and usually smooth on anterior margin. Small spots . . . . . *woosnami, ?leopardinus*
   - B. Maxillary barbel short and usually nodose on front margin.
     - 1. Large spots . . . . *macrostigma*
     - 2. Small spots, more or less elongate, and arranged more or less in longitudinal lines . . . . *jallae*

One suspects that *nebulosus* is merely an aberrant specimen of *zambesensis* (humeral process rather short and broad, intermediate between I and II in above key). If this were so, the name *zambesensis* must give place to *nebulosus* as having page precedence.

According to the character of the maxillary barbel (described by Pellegrin as "simple") *leopardinus* may prove to be a synonym of *woosnami*; or, on the other hand, it may be a valid species, in which case *jallae* is probably a synonym of it. However that may be, *thamalakanensis* is a synonym of *jallae.*

The type of *colyeri* is an ovigerous ♀. As Boulenger said, it is closely allied to *zambesensis*.

Synodontis melanostictus Blgr.

1917. Gilchrist and Thomson, *l.c.*, pp. 560 and 579.
1935. Fowler, Ann. Transvaal Mus. xvi, p. 273.
1936. Pellegrin, Arq. Mus. Bocage Lisbon, vii, p. 58.
1939. Ricardo, Fish. Lake Rukwa and Bangweulu, p. 61.

In the South African Museum: seven specimens from Lialui, Lake Ngami, Victoria Falls, and Sesheki. The three from Lialui all have very small spots or dots, 1–1·5 mm. in diameter, whereas in the others they are 2 mm. (in specimens 150–200 mm. in length); this difference does not seem very great *on paper*, but is immediately perceptible to the eye. In both cases the spots are *round*, and *in general* their diameter is less than the distance between any two of them.

There is a series of nine specimens from the Okovango River, 50–210 mm. in length. The two largest, 170 and 210 mm., have conspicuous white or whitish barbels, a feature not apparent in the preserved specimens from other localities; nor is it so conspicuous in the younger Okovango specimens.

The spots are approximately 2 mm. in diameter in all the specimens irrespective of length, except in two (65 and 70 mm.) in which they are 2·5–3 mm., giving a somewhat *macrostigma*-like appearance. In the smallest specimen the minute, nearly uniformly spread, speckling is beginning to become aggregated into spots; the specimen looks "patchy".

In the three smallest specimens the front margin of the maxillary barbel is nodulose (all the specimens have been preserved in formalin, probably put alive into the liquid, and the skin is *plump*, not shrivelled) but in the larger ones it is merely villous.

The following table gives the increase in number of mandibular teeth, and the length of the maxillary barbel:—

50 mm. . .	26 teeth . .	10 mm.,	reaches to base of pectoral spine.
60 ,, . .	26 ,, . .	12 ,,	,, ,, ,,
65 ,, . .	26 ,, . .	12 ,,	,, ,, ,,
70 ,, . .	28 ,, . .	14 ,,	,, ,, ,,
75 ,, . .	28 ,, . .	20 ,,	reaches $\frac{1}{3}$ along pectoral spine.
80 ,, . .	28 ,, . .	20 ,,	,, ,, ,,
100 ,, . .	26 ,, . .	28 ,,	,, ,, ,,
170 ,, . .	33 ,, . .	60 ,,	reaches $\frac{2}{3}$ along pectoral spine.
210 ,, . .	36 ,, . .	65 ,,	reaches just over half-way.

On two of the smaller specimens from the Okovango River (80 and 100 mm.) parasitic Copepods (*Chonopeltis* sp. Fam. *Argulidae*) were found, mainly at the bases of the barbels on the chin, and the folds of the lower lip, but also in the axils of the pectoral fins.

Pellegrin's record is from Humbe on the Kunene River.

Synondontis jallae G. and T.

1917. Gilchrist and Thompson, *l.c.*, p. 561.

1931. Fowler, Proc. Ac. Nat. Sci. Philad., lxxxiii, p. 236 (*woosnami* non Blgr.).

1935. *Id.*, Ann. Transvaal Mus., xvi, p. 274, fig. 12 (*thamalakanensis*)

In the South African Museum, besides the type, there is an additional specimen from Sesheki, and one from Lialui. The latter was collected by the Rev. Ellenberger in the same locality as the specimen he sent to Pellegrin, on which *leopardinus* was founded. Like localities do not necessarily imply synonymy, but they are suggestive. In fact it is only the size of the spots, which are larger in *leopardinus* (judging by Pellegrin's description "atteignant à peine les dimensions de l'œil"), which makes one hesitate to put *jallae* into synonymy (cf. *melanostictus* for variation in size of spots, *supra*; and Pellegrin, 1936, *l.c.*, *supra*).

The type of *jallae* has round spots 1–1·5 mm. in diameter (eye 9 mm.) numerous and evenly distributed. A second specimen (topo-type) has larger spots, 2 mm., most of them distinctly elongate oval or even linear, and showing a linear arrangement on the hinder part of body. The Lialui specimen has small spots like the type, but those on anterior part of body are mostly round, while those on the hinder part are more or less elongate. Lastly, there are two specimens from the Okovango River which have spots of the larger size (the intervening ground colour forming a pale network), more or less oval in shape and arranged in lines. The paratype of *thamalakanensis* figured by Fowler seems to represent the extreme development of this linear arrangement of elongate oval spots. *Cf.* also Pellegrin, 1936, *l.c.*, for linear arrangement of spots in *nigromaculatus* Blgr. from the Cubango River.

An immaculate lower surface (*cf.* Fowler, 1935, p. 275) is merely an individual character; one of the Okovango specimens is spotted from chin to vent, the other immaculate (except for microscopic pigment specks) as far as base of ventrals.

The following table gives the number of mandibular teeth, and the length of the maximillary barbel; in the case of the latter some allowance must be made for shrivel in the Sesheki and Lialui specimens:—

	Okovango	110 mm.	40 teeth	30 mm., reaches $\frac{2}{5}$ along pectoral spine.
	Lialui	130 ,,	18 ,,	30 ,, reaches $\frac{1}{7}$ along pectoral spine.
ovig. ♀—	Sesheki	150 ,,	23 ,,	35 ,, reaches $\frac{1}{7}$ along pectoral spine.
	Okovango	165 ,,	14 ,,	35 ,, reaches $\frac{1}{10}$ along pectoral spine.
Type *jallae*—	Sesheki	190 ,,	16 ,,	32 ,, scarcely reaches spine (falls short by $\frac{1}{6}$ length of spine).
	leopardinus	160 ,,	21 ,,	does not reach pectoral spine.
	thamalakanensis	184–194 mm.	17–18 teeth	reaches $\frac{1}{10}$–$\frac{1}{8}$ along spine.

The low number of teeth on one of the Okovango specimens and the remarkably high number in the other (and smaller) are points worth noting.

The front edge of the maxillary barbel is nodulose in the Sesheki, Lialui, and Okovango specimens, especially so in the Lialui one; it is also nodulose in Fowler's figures, of *thamalakanensis*; in *leopardinus* the barbel is described as "simple", presumably the front edge is smooth (or not conspicuously nodulose).

A certain amount of variability in the posterior processes of the occipito-nuchal shield is noticeable in the series of *melanostictus* from the Okovango, but it is much more noticeable in these specimens of *jallae*. Maybe it is a sexual difference, but that is not possible to determine with so few specimens at hand.

Pellegrin described the process in *leopardinus* as "pointu"; in *jallae* (type) it is narrowly rounded as in the figure of *thamalakanensis*; in the larger Okovango specimen rounded but obliquely bevelled off below; in the smaller Okovango specimen it would probably be described as pointed; in the smaller Sesheki specimen (ovig. ♀) and the Lialui specimen it is broadly rounded.

The humeral process does not seem to vary.

Family BAGRIDAE.

Auchenoglanis ngamensis Blgr.

1913. Gilchrist and Thompson, *l.c.*, p. 454, fig. 105.
1917. *Id.*, *ibid.*, pp. 578, 579.
1936. Pellegrin, Arq. Mus. Bocage Lisbon, vii, p. 58.

Recorded from Sesheki on the Zambesi River, in the appendix to Gilchrist and Thompson's work, and from the Cubango River, and the Chiumbe River, N.E. Angola (a tributary of the Kasai, Congo system) by Pellegrin.

There are two specimens: 64 and 180 mm. in length, from the Okovango River.

Length of head 3 in body (excl. caudal); eye $3\frac{1}{2}$ and $4\frac{1}{2}$ in snout, 7 and 9 in head, $2\frac{1}{3}$ and $2\frac{1}{2}$ in interorbital width (in the smaller and larger specimens respectively). Gill-rakers $4+9$ on anterior arch, decreasing in length below, the lowermost (anterior) 2 or 3 being short and knob-like.

Boulenger's figure shows the 3rd ray of ventral fin abruptly longer than, and projecting beyond, the others. In these two specimens the 2nd ray is the longest, but not abruptly so, merely giving the fin an ovate shape, especially in the larger specimen.

The larger specimen with few spots, mostly forming vertical bars; smaller specimen with numerous spots, with narrow intervening pale reticulation.

Family CICHLIDAE.

1920. Regan, Ann. Mag. Nat. Hist. (9), v, p. 33 (Tanganyika genera).
1920. *Id.*, *ibid.* (9), v, p. 422 (Madagascan genera).
1921. *Id.*, *ibid.* (9), viii, p. 632 (Lakes Edward and Kivu).
1921. *Id.*, Proc. Zool. Soc. London, p. 675 (Lake Nyassa).
1922. *Id.*, *ibid.*, p. 157 (Lake Victoria).
1922. *Id.*, Ann. Mag. Nat. Hist. (9), x, p. 249 (African and Syrian genera).

These papers have done much to clarify the classification of this difficult family. In the last-mentioned paper Regan has suggested a reduction in the number of South African species in the genus *Tilapia*. It is probable that several more so-called "species," based on single specimens or very limited material, will also fall into synonymy when a proper investigation of the rivers is undertaken.

The number of species recorded from the Zambesi area is considerable; some of them certainly merely "museum species."

In addition to Regan's suggestions with some but not all of which I agree (he did not see the actual types of Gilchrist and Thompson's species), I would suggest the following synonymy:—

Tilapia sheshekensis G. and T., 1917 = *macrochir* juv.

Tilapia alleni Fowler, 1931 = *macrochir.*

Tilapia deschauenseei Fowler, 1931 = *sparrmanii,* as already suggested by Trewavas (1936).

Tilapia ellenbergeri G. and T., 1917, apparently accepted by Regan as a valid species, proves on examination of the type to be *Haplochromis moffatii* (Cast.).

Pelmatochromis genisquamulatus Pelleg., 1914 = *Serranochromis thumbergi* (Cast.) as already suggested by Gilchrist and Thompson.

Paratilapia carlottae Blgr. is considered by Regan to be a synonym of *giardi* Pellegr., a species with 6 scales between pectoral and ventral fins; the type of *carlottae,* however, has only 3 or 4 scales like *gibbiceps* Blgr., 1911. The latter should therefore become a synonym of *carlottae,* 1905.

Chromys moffatii Cast. is not a synonym of *T. sparrmanii,* as suggested by Trewavas (1936), but a valid species as maintained by Regan.

Astatotilapia ellenbergeri Pelleg., 1920, agrees with *giardi* in having 12 gill-rakers, and with *darlingi* in having 4 cheek scales; but the description does not allow it to be run down in Regan's key.

Paratilapia arnoldi G. and T., 1917 = *Haplochromis darlingi.* Regan's synonymy confirmed by examination of the type.

Tilapia rumsayi G. and T., 1917, regarded by Regan as synonymous with *Haplochromis acuticeps,* but does not agree with his 1922 description as the middle teeth of the lower pharyngeal are stout and blunt, as in *darlingi.* Six anal rays is probably an individual feature.

The following synopses only contain the species recorded from the Zambesi and Okovango systems.

KEY TO GENERA.

1. Teeth usually not conical. Scales cycloid. Caudal truncate (at least in Zambesi species) . . . . *Tilapia*
2. Teeth usually conical. Scales usually denticulate, but often very finely or obscurely so.

a. 3rd vertebra with inferior apophyses.
i. Teeth nearly uniform in size. Caudal usually rounded *Haplochromis*
ii. Middle pairs of teeth more or less enlarged, in both jaws. Caudal subtruncate . . . . *Hemichromis*
b. 4th vertebra with inferior apophyses.
i. Pharyngeal teeth stout, blunt. Caudal subtruncate *Sargochromis*
ii. Pharyngeal teeth slender. Caudal rounded or rounded subtruncate . . . . *Serranochromis*

Gen. Tilapia A. Smith.

1920. Regan, *l.c.*, p. 37.
1922. *Id.*, Ann. Mag. Nat. Hist. (9), x, p. 250.
1922. *Id.*, Proc. Zool. Soc. London, p. 676.

Teeth usually not conical, but bi- or tri-cuspid. Lower pharyngeal subtriangular. Cheek scales in 2–4 (rarely 5) series. Caudal truncate (in the under-mentioned species). Gill-rakers slender, pointed.

A. Anal spines III. Lower pharyngeal with short anterior blade (*Tilapia*).
1. Gill-rakers 8–12 on lower part of 1st arch. Pectoral not reaching beyond vent.
a. D xiii–xv. 9–11. A (rays) 8–10. Cheek scales 2–3 *sparrmanii* (syn. *deschauenseei*)
b. D xiv–xvi. 10–12. A 9–10. Cheek scales 3–4 (5) . . . . *melanopleura* (syn. *swierstrae* *mackeani* *sykesii* *druryi* *kirkhami*)
2. Gill-rakers 15–20. Pectoral reaching to origin of anal (sometimes slightly beyond).
a. D xv–xvii. 10–12. A 9–10. Cheek scales 2–4 *mossambica* (syn. *vorax* *natalensis* *T. arnoldi*)
b. D xvi. 10–11. A 8–9. Cheek scales 2. Caudal covered with small scales . . *squamipinnis* (Shiré R.)
3. Gill-rakers 20–25. Pectoral reaching at least to origin of anal, usually beyond.
a. D xvi–xvii. 13. A 11–12. Cheek scales 3–4. Depth more than twice in length . . . *kafuensis*
b. D xv–xvi. 11–12. A 10. Cheek scales 2–3. Depth about twice in length . . *macrochir* (syn. *alleni* *sheshekensis*)
c. D xvi–xvii. 11–13. A 9–11. Cheek scales 2–3. Depth more than twice in length *andersonii* (syn. *intermedia*)

B. Anal spines IV. Lower pharyngeal with long anterior blade (*Sarotherodon*).
D xvi–xvii. 10–13. A 9–10. Cheek scales 2–3. Gill-rakers 15–19. Depth 2–2½ in length . . . . . *shirana* (Shiré R.)

Tilapia sparrmanii A. Smith.

Fig. 8, *a*.

1835. A. Smith, MSS. Diary of Exped., 23rd Jan., "Fish No. 76". Description of colour. Locality: Bootscap, Hartz River, Becuanaland.

1840. *Id.*, Ill. Zool. S. Afr. Pisces, pl. 5 (coloured): "North of Orange River".

1917. Gilchrist and Thompson, *l.c.*, p. 502 (*sparrmani* [sic]), and p. 509 (Kuruman specimen as *calliptera*, non Gnthr.)

1935. Fowler, Ann. Transvaal Mus., xvi, 285 (*sparrmani*) Ngami and Chobe area.

1936. Pellegrin, Arq. Mus. Bocage Lisbon, vii, p. 60 (*sparrmani*), Cubango River.

1936. Trewavas, Novit. Zool., xl, p. 72, footnote 1, and p. 73, footnotes 1, 2.

1939. A. Smith's Diary, ed. P. R. Kirby, van Riebeeck Soc. Publ., Cape Town, no. 20, vol. 1, p. 227. Locality "Bootscap" = Boetsap., p. 228, "Fish No. 76".

1939. Ricardo, Fish. Lake Rukwa and Bangweulu, p. 63 (*sparrmani*).

1942. Bertram, Borley and Trewavas, Fish. Lake Nyasa, pp. 23, 40 (*sparrmani*).

1943. Barnard, Ann. S. Afr. Mus., xxxvi, pp. 111, footnote, 117.

Boulenger seems to have added the word "Namaqualand" to Andrew Smith's locality "north of Orange River"; and Trewavas (1936) quotes Boulenger. From Andrew Smith's Diary we now know the exact type locality for this species; north of the Orange River, it is true, but a long way from Namaqualand.

Gilchrist and Thomspon's Kuruman specimen is not *calliptera* but *sparrmanii*.

On a recent (1939) South African Museum expedition to Kuruman specimens of both *T. sparrmanii* and *H. moffatii* were collected. Thus Trewavas's suggestion that *Chromys moffatii* Cast. is "probably a *Tilapia*" is disproved. Nor can I accept Trewavas's statement that *C. ovalis* Stndr. is a synonym of *sparrmanii*, as Steindachner's original material had a rounded tail. Regan (1922) regarded *ovalis* as a synonym of *moffatii*.

T. sparrmanii has been recorded from the Zambesi system and Ngamiland (and other localities). The South African Museum has material from Bulawayo, Kafue River, Sesheki and Lialui, Lake Ngami, and the Okovango River. But I confess I am unable to

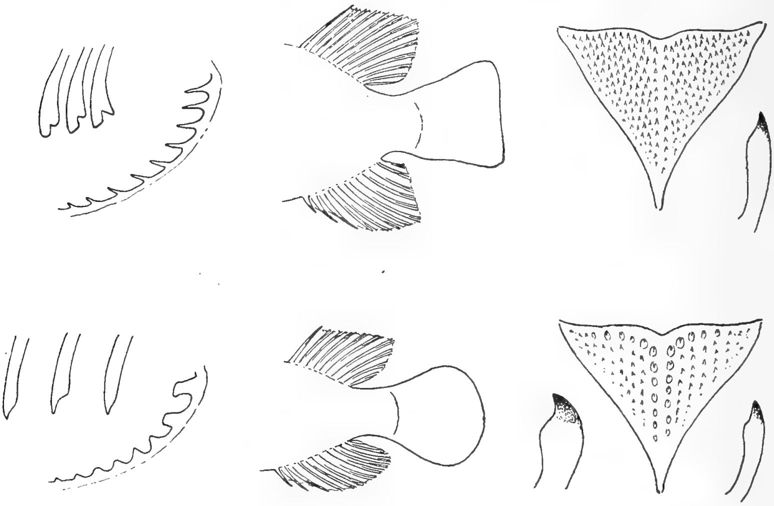


FIG. 8.—Cichlids from Kuruman. Above *Tilapia sparrmanii* A. Smith; below *Haplochromis moffatii* (Cast.). Three teeth from upper jaw, consecutive, spacing natural; lower part of 1st gill arch; hind part of body showing shape of soft dorsal, caudal, and anal; lower pharyngeals, with individual teeth further enlarged.

find in the material at hand any constant characters by which a preserved specimen may be identified as *sparrmanii* or young *melanopleura*.

Trewavas (1936, p. 72, footnote 1) considers *deschauenseei* Fowler, 1931, as probably synonymous with *sparrmanii*.

Tilapia melanopleura Dum.

1917. Gilchrist and Thompson, *l.c.*, p. 495, fig. 127.

1917. *Id.*, *ibid.*, p. 498, fig. 128 (*swierstrae*), p. 499 (*mackeani*), p. 500 (*sykesii*), p. 500 (*druryi*), p. 510 (*kirkhami*).

1922. Regan, Ann. Mag. Nat. Hist. (9), x, p. 251, synonymy.

1935. Fowler, Ann. Transvaal, Mus., xvi, p. 281, fig. 16.

1936. Pellegrin, Arq. Mus. Bocage Lisbon, vii, p. 60.

1939. Ricardo, Fish. Lakes Rukwa and Bangweulu, p. 63.

1942. Bertram, Borley and Trewavas, Fish. Lake Nyasa, pp. 23, 39, fig. 3, *a* (gillrakers).

I have examined the type specimens of Gilchrist and Thompson's species, which Regan suggested were synonyms of *melanopleura*, and I see no reason for disagreeing with Regan. All these "species" were founded on single specimens and are nothing more nor less than "museum species".

Tilapia macrochir Blgr.

1915. Boulenger, *l.c.*, iii, p. 160, fig. 105.

1917. Gilchrist and Thompson, *l.c.*, p. 488, fig. 123, and p. 579.

1917. *Id.*, *ibid.*, p. 489 (*sheshekensis* = juv.), p. 495 (three specimens from Kafue River as *squamipinnis*, non Gnthr.).

1917. *Id.*, *ibid.*, p. 492 (Victoria Falls specimen as *galilaea*, non Art.).

1931. Fowler, Proc. Ac. Nat. Sci. Philad., lxxxiii, p. 238, fig. 1 (*alleni*).

1935. *Id.*, Ann. Transvaal Mus., xvi, p. 280 (also *sheshekensis* and *alleni* as separate species).

? 1936. Pellegrin, Arq. Mus. Bocage Lisbon, vii, p. 60 (*galilaea* ? non Art.).

1939. Ricardo, Fish. Lakes Rukwa and Bangweulu, p. 63.

The Victoria Falls specimen (95 mm. standard, 120 mm. total length), identified by Gilchrist and Thompson as *galilaea*, belongs here, as also the three Kafue River specimens doubtfully assigned to *squamipinnis*.

There are eight specimens, 150–320 mm., in the South African Museum from Lake Ngami, Victoria Falls, Sesheki, Lialui, Mazuli River, Rhodesia; also eight specimens, 180–280 mm., from the Okovango River.

All the Okovango specimens, on arrival at the Museum after a short period in formalin, have a pale border, varying in width, on the longest rays of the dorsal and anal fins, and on the hind margin of the caudal fin (somewhat similar to the figure of *Paratilapia longimanus*, see Gilchrist and Thompson, *l.c.*, fig. 140). No definite bars across the chin (as in *alleni*), but the throat often appears somewhat clouded or blotchy.

Regan thought *sheshekensis* might be a synonym of *andersonii*, but the type and several other specimens from the type locality appear to be merely the juveniles of *macrochir*.

Gen. Haplochromis Hilg.

1921. Regan, Proc. Zool. Soc. London, pp. 676, 685.

1922. *Id.*, Ann. Mag, Nat. Hist. (9), x, pp. 250, 253 (key to species).

Teeth conical or compressed, with or without cusps (but not incisor-like), in 2 or more series. Third vertebra with inferior apophyses. Cheek-scales in 3–7 series. Caudal fin usually rounded.

South African (Zambesi and southwards) species belong to subgen. *Ctenochromis* Pfeffer, with outer series of bicuspid or conical teeth, and one or more inner series of tricuspid or conical teeth (Regan).

Gill-rakers usually stout, blunt, sometimes T-shaped.

In 1921 Regan accepts *Astatotilapia* Pelleg. as well as *Haplochromis*. In the former the teeth in outer series of upper jaw increase in size posteriorly, in the latter they decrease. In *Astatotilapia* were included (*inter alia*) *swynnertoni*, *calliptera*, and *moffatii*. In 1922, however, he withdrew *Astatotilapia* after examining Lake Victoria species (Proc. Zool. Soc., p. 158, footnote).

In the Kuruman specimens, which it is reasonable to regard as *moffatii* (see *infra*), the outer upper teeth may project a little more from the gum, but cannot be said to increase in size posteriorly.

Boulenger (*l.c.*, iii, p. 302) admits that he was unable to separate some specimens of *strigigena* from young *moffatii*. Pellegrin (1920, Bull. Soc. zool. Fr., xlv, p. 150) describes *Astatotilapia ellenbergeri* as near to *strigigena* and *moffatii* (but with more gill-rakers). This serves to show the great difficulty of defining some of the species, and the small progress, if any, which can be expected from discussions on affinities and synonymy. What is really wanted is the investigation *in the field* of the full life-histories and range of variation of the species in any particular locality.

I. Dorsal rays 12–15. Pharyngeal teeth obtusely conical. Gill-rakers 9–12. Caudal rounded.

  A. Depth of preorbital not greater than eye.

    1. Chest scales small, 6 between pectoral and ventral fins. Pectoral a little shorter than head . . *giardi*

    2. Chest scales large, 3–4 between pectoral and ventral. Pectoral as long as head . . . . . *carlottae* * / ? *gibbiceps*

  B. Preorbital a little greater than eye . . . *smithii* (syn. *T. woosnami* / *P. robustus*)

  C. Preorbital much greater than eye . . . . . . *frederici*

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* See above, p. 447.

II. Dorsal rays 8–12.
- A. Cheek-scales 6–7.
  - 1. Caudal truncate. Gill-rakers 9 . . . . . *jallae*
  - 2. Caudal rounded . . . . *humilis*
- B. Cheek-scales 3–5. Gill-rakers 7–10.
  - 1. Maxillary to between nostril and eye. Caudal peduncle longer than deep. Lower pharyngeal teeth small, hooked. Chest scales small *acuticeps* (syn. ? *T. rumsayi*) *
  - 2. Maxillary to front margin of eye.
    - *a*. Lat. series of scales 29–32. Middle teeth of lower pharyngeal stout, blunt. Chest scales small. D xiv–xvi. 8–12. A 7–9.
      - i. Caudal subtruncate . . { *darlingi* (syn. *P. arnoldi*) ? *A. ellenbergeri* † ? *T. rumsayi* }
      - ii. Caudal rounded . . . . . *calliptera*
    - *b*. Lat. series of scales 26–30. Lower pharyngeal teeth all small, conical.
      - i. Chest scales small, 5–6 between pectoral and ventral. Caudal subtruncate *swynnertoni*
      - ii. Chest scales large, 3–4 between pectoral and ventral. Caudal rounded { *moffatii* (syn. *T. ellenbergeri* G. and T. *philander*) }

Haplochromis moffatii (Cast.).

Fig. 8 *b*.

1861. Castelnau, Mem. Poiss. Afr. Austr., p. 16 (*moffatii*, original spelling) Kuruman River.

1922. Regan, Ann. Mag, Nat. Hist. (9), x, p. 257 (*moffati*).

As mentioned above only two Cichlids were collected by the South African Museum Expedition (1939) at Kuruman, the type locality for Castelnau's species. The largest *moffatii* is 87 mm. in length; Regan gives 120 mm. as maximum length, Castelnau's was 140 mm. We can ignore as an *obiter dictum* Castelnau's statement that the Cape Museum possessed one double that length.

Although Castelnau's description is quite inadequate for modern requirements, it contains the one character necessary to identify a Cichlid fish from Kuruman, granting that actually only two species

* See above, p. 447.

† Not to be confused with *Tilapia ellenbergeri* G. and T., 1917. Pellegrin's species has 12 gill-rakers, as also has *giardi* Pelleg.

are present in that river, viz. the *rounded* caudal. The fin formulas given by Castelnau fit both *T. sparrmanii* and *H. moffatti,* but the former has a square tail.

These two are the only Cichlids recorded, not only from the Kuruman River, but from the whole of the Orange River system (Gilchrist and Thompson's Potchefstroom specimens identified as *H. desfontainesii* are really *moffatii*).

Twelve specimens, 30–58 mm., from the Okovango River. A dark lateral stripe broken up into darker spots where the faint vertical cross-bars meet it; a black opercular spot, and a dark bar from eye to mouth; soft dorsal and anal yellowish with pale (transparent) spots, and pink edge, spinous dorsal with faint red margin; caudal pale yellowish with wavy or zigzag cross-bands.

Gen. Hemichromis Peters.

1922. Regan, Ann. Mag. Nat. Hist. (9), x, pp. 250, 253.

Teeth conical, middle pairs more or less enlarged (see fig. 156, Gilchrist and Thompson). Cheek-scales in 5 series. Gill-rakers 9, blunt, more or less T-shaped. Caudal subtruncate.

Hemichromis fasciatus Peters.

1917. Gilchrist and Thompson, *l.c.*, p. 540, fig. 156.

Specimens in the South African Museum from Victoria Falls, Sesheki, and Lake Ngami.

Gen. Sargochromis Regan.

1920. Regan, Ann. Mag. Nat. Hist. (9), v, p. 45, footnote.

1922. *Id., ibid.*, (9), x, pp. 250, 263.

Teeth conical in adult, sometimes cuspidate in young. Pharyngeal teeth massive, the teeth stout, blunt. 4th vertebra with a pair of apophyses united below. Cheek scales in 4–7 series. Gill-rakers 10–12, blunt, more or less T-shaped. Caudal subtruncate.

1. Cheek-scales in 4–5 series	*codringtoni* (syn. *P. marginata*)
2. Cheek-scales in 6–7 series	*angolensis*

Sargochromis codringtoni (Blgr.).

1917. Gilchrist and Thompson, *l.c.*, p. 527, fig. 146 (*Paratilapia c.*).
1917. *Id.*, *ibid.*, p. 531 (*Paratilapia marginata*).
1917. *Id.*, *ibid.*, p. 535 (Kafue specimens as *P. mellandi*, non Blgr.).
1922. Regan, Ann. Mag. Nat. Hist. (9), x, p. 263.

Regan makes *codringtoni* the genotype, and in the key gives the difference between *codringtoni* and *mellandi* as respectively: depth twice, and depth $2\frac{1}{3}$–$2\frac{2}{3}$, in length. *S. mellandi* was described from Lake Bangweolo specimens, 150–200 mm., but Boulenger (*l.c.*, p. 359, footnote) identified a specimen (length not stated) from the Kafue River as this species.

S. codringtoni was described from Zambesi specimens 300 mm. in length.

In the South African Museum there are: types of *marginata* G. and T., 120 and 295 mm. (95 and 232 mm. standard length) from Lialui and Victoria Falls, three others from Lialui, three from Sesheki, and three of the Kafue specimens recorded as *mellandi* by Gilchrist and Thompson. Also nine specimens, 75–245 mm., from the Okovango River.

The latter series is not a long one, even when supplemented by the specimens from the other localities, but it appears to average out to the result that the younger stages are less deep in the body, *i.e.* more *mellandi*-like, than the adults. There is, however, one possible objection. Some or all of the younger specimens may be *Haplochromis*, and apparently there is no means of distinguishing the *Haplochromis* species with blunt pharyngeals except by dissection or radiograph of every specimen to see on which vertebra the apophyses are situated.

	L/D.	L/H.	H/E.	S/E.	Snout in relation to postorbital part of Head.
Okovango 75 mm.	$2\frac{4}{5}$	$2\frac{4}{5}$	3	1	Subequal.
Okovango 115 ,,	$2\frac{3}{4}$	$2\frac{3}{4}$	4	$1\frac{1}{2}$	,,
Okovango 140 ,,	$2\frac{1}{2}$	$2\frac{3}{4}$	4	$1\frac{1}{2}$	,,
Sesheki, 190 ,,	$2\frac{1}{3}$	$2\frac{3}{4}$	$4\frac{1}{2}$	$1\frac{2}{3}$	,,
Okovango, 245 ,,	$2\frac{1}{4}$	$2\frac{3}{4}$	$4\frac{3}{4}$	$1\frac{3}{4}$	Snout slightly $<$ p.
Lialui, 300 ,,	2	3	$4\frac{4}{5}$	2	s $<$ p.
Sesheke, 235 ,,	a little less than 2	3	5	2	s $<$ p.

All the Okovango specimens have the soft dorsal, anal, caudal, and ventrals with a broad pale border (*cf.* G. and T.'s description of *marginata*).

Possibly Fowler's *Paratilapia deschauenseei* (1931) and specimens identified as *P. mellandi* (1935, Ann. Transv. Mus., xvi, p. 292) belong here.

Gen. Serranochromis Regan.

1920. Regan, Ann. Mag. Nat. Hist. (9), v, p. 45, footnote.

1922. *Id.*, *ibid.* (9), x, pp. 250, 263.

Teeth conical. Pharyngeal teeth slender. 4th vertebra with a pair of small inferior apophyses. Cheek scales in 5–10 series. Gill-rakers 10–12, blunt, more or less T-shaped.

1. Cheek scales in 5–6 series. Premaxilla extending to between orbits . . . . *macrocephalus* (syn. *longimanus*)
2. Cheek scales in 7–10 series.
   - *a.* Premaxilla not extending beyond front margin of orbits. Head 2–$2\frac{1}{4}$ as long as broad. . *thumbergi* (syn. *P. ellenbergeri*, *P. zambesensis*, *P. ngamensis*, *genisquamulatus*)
   - *b.* Premaxilla extending to between orbits. Head $2\frac{1}{2}$–3 as long as broad . . . . *angusticeps*

In Miss Ricardo's Report on Fish. . . . Lakes Rukwa and Bangweulu (1939, p. 64) Boulenger's *Paratilapia kafuensis* (1908) is recorded without any reason being given for resuscitating as a distinct species a form which Boulenger later (1915) regarded as the female sex of *angusticeps*.

Serranochromis thumbergi (Cast.).

1861. Castelnau, Mem. Poiss. Afr. Austr., p. 13 (*Chromys thumbergi* original spelling).

1914. Pellegrin, Bull. Soc. zool. Fr., xxxix, p. 27 (*Pelmatochromis genisquamulatus*).

1917. Gilchrist and Thompson, *l.c.*, p. 526, fig. 145 (*Paratilapia t.*).

1917. *Id.*, *ibid.*, p. 521, fig. 141 (*Paratilapia ellenbergeri*).

1917. *Id.*, *ibid.*, p. 522, fig. 142 (*Paratilapia zambesensis*).

1917. *Id.*, *ibid.*, p. 539, fig. 155 (*Pelmatochromis ngamensis*).

1922. Regan, Ann. Mag. Nat. Hist. (9), x, p. 264.

1939. Ricardo., Fish. Lakes Rukwa and Bangweulu, p. 64 (*thumbergii*).

1942. Bertram, Borley, and Trewavas, Fish. Lake Nyasa, p. 55 (err. inserted among *Cyprinidae*), fig. 7, *c*.

The types of the three species described by Gilchrist and Thompson and placed in synonymy by Regan, have been examined and Regan's suggestions confirmed.

A good series has been received from the Okovango River, the smallest measuring 55 mm. in length. It is the smallest specimen in the Museum collections and its proportions are given here for comparison with a rather remarkable specimen described below.

Depth $3\frac{1}{2}$ in length, very slightly greater than distance from tip of snout to preopercle. Head $2\frac{2}{3}$ in length. Eye very slightly greater than snout, 3 in length of head, nearly twice the interorbital width. Width of head (at preopercle) $2\frac{1}{4}$ in length of head.

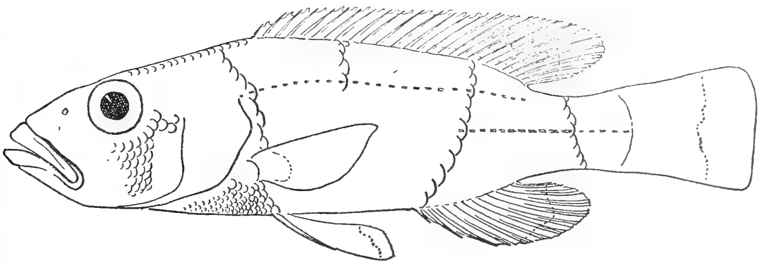

FIG. 9.—*Serranochromis* sp. 99 mm. Okovango River. Possibly an abnormally slender young *thumbergi*.

Coloration of juveniles (about 90 mm.) from the Okovango River: pale brownish with scattered orange spots on hinder part of body and caudal peduncle; a dark lateral stripe, with indications of another between it and the dorsal fin, more or less well-marked vertical cross-bars; a black opercular spot, lateral stripe continued across gill-cover to eye, a dark bar from eye to mouth; dorsal pale buff or greenish, edged with scarlet, the soft portion with dark spots more or less forming wavy longitudinal bands, anal yellow with a few deep red spots, and a reddish-orange border, caudal yellowish shading into red on lower lobe, with reddish-brown spots, ventrals pale, but somewhat suffused near the spine.

Serranochromis sp. ? *thumbergi* aberr.

Fig. 9.

Depth of body equal to distance from tip of snout to preopercle, $3\frac{1}{2}$ in length. Head $2\frac{2}{3}$ in length of body. Eye 4 in head, $1\frac{1}{3}$ in snout. Interorbital $1\frac{1}{3}$ in eye, nearly 2 in snout. Maxilla exposed. Premaxilla extending to vertical from front border of eye. Teeth conical, 3 rows in upper jaw, very few teeth in the two inner rows, a single row in lower jaw. Gill-rakers 9–10, pointed. Lower pharyngeal teeth few and conical, not enlarged or blunt. D xv. 13–14. A iii. 10. Pectoral short, equal to distance between tip of snout and hind margin of eye. Caudal subtruncate. Scales denticulate; lat. series 34; lat. lines 25 and 16; cheek with 7–8 series, chest scales small.

99 mm. Blackish, with black lateral stripe expanded into half a dozen diamond-shaped marks where the faint cross-bars meet it (*cf.* G. and T.'s fig. 141, of *P. ellenbergeri* = juv. *thumbergi*); dorsal and anal blackish, soft dorsal with a few pale spots basally, apical portion of soft dorsal and of anal pale; posterior half of caudal pale, basal part obscurely spotted; pectoral greyish, ventrals blackish with pale border (cf. *codringtoni*).

This single specimen resembles *Sargochromis codringtoni* in having pale borders to the vertical fins and ventrals; but the lower pharyngeal teeth are of the *Serranochromis* type. The depth and head proportions are like those of the young *S. thumbergi* given above; the eye, however, is proportionately smaller, as it is also in normal *thumbergi*; $4\frac{1}{2}$ times at 90 mm., and 5 times at 110 mm.

The suggestion is made that this specimen is possibly an abormally slender *thumbergi, i.e.* abnormally so for a specimen of its length. Its elongate shape somewhat resembles a *Lamprologus* or *Champsochromis.*

Whether that be so or not, it would obviously be bad zoology to regard it as an undescribed species, especially as there is already a surfeit of synonyms among the Cichlids. A figure is given in case more specimens are collected in the future.

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